The Role of Positive Psychology in the Treatment of Overweight and Obesity, and its Effects on Molecular Genetic Pathways Involved

Jana Rozehnalova, BSc (Hons)

A thesis submitted to the University of Bolton for the degree of Doctor of Philosophy

University of Bolton
September, 2018
# Table of Contents

List of Abbreviations .............................................................................................................. 7  
List of Tables ........................................................................................................................... 12  
List of Figures .......................................................................................................................... 14  
Acknowledgements ................................................................................................................ 15  
Abstract .................................................................................................................................. 16  
**CHAPTER 1: Introduction and Overview of the Thesis** ......................................................... 18  
1.1. Background ....................................................................................................................... 19  
    1.1.1. Positive psychology ................................................................................................. 19  
    1.1.2. Obesity overview ................................................................................................... 22  
    1.1.3. Genotype-environment interaction ....................................................................... 25  
1.2. Overview of the Thesis ..................................................................................................... 27  
    1.2.1. Gaps in research ...................................................................................................... 28  
    1.2.2. Aims and objectives ............................................................................................... 29  
    1.2.3. Contribution to knowledge .................................................................................... 29  
    1.2.4. Overview of the remaining chapters ..................................................................... 30  
1.3. Chapter Summary ........................................................................................................... 32  
**CHAPTER 2: Literature Review** .......................................................................................... 34  
2.1. Introduction ....................................................................................................................... 34  
    2.1.1. Case for obesity ...................................................................................................... 35  
    2.1.2. Case for positive psychology ............................................................................... 45  
2.2. Obesity ............................................................................................................................ 48  
    2.2.1. Treatment approaches in adult obesity ................................................................. 48  
2.3. Positive Psychology ......................................................................................................... 67  
    2.3.1. History and origins of positive psychology ........................................................... 67  
    2.3.2. Advances in positive psychology ......................................................................... 74  
    2.3.3. Criticisms of positive psychology ........................................................................ 85  
    2.3.4. Applications of positive psychology ...................................................................... 87  
2.4. Obesity and OMICS: Human Genome Responses to Positive Psychology ................. 107  
    2.4.1. Food intake, emotional responses and signal transduction pathways .................. 107  
    2.4.2. “-Omis” and the study of obesity and psychological well-being ............................ 111  
    2.4.3. Combining molecular genetics with psychological approaches to obesity treatment 114
TABLE OF CONTENTS

6.5. Conclusion .................................................................................................................. 259

CHAPTER 7: Randomised Controlled Trial ........................................................................ 261

7.1. Introduction ................................................................................................................ 261

7.2. Material and Methods ............................................................................................... 265

7.2.1. Design and randomisation .................................................................................. 265

7.2.2. Participants ........................................................................................................... 266

7.2.3. Measures ............................................................................................................. 267

7.2.4. Procedure ............................................................................................................ 268

7.3. Results ...................................................................................................................... 268

7.3.1. Analysis of covariance (ANCOVA) .................................................................... 268

7.3.2. Paired-samples t-test ......................................................................................... 275

7.3.3. Determination to change ..................................................................................... 281

7.4. Discussion ................................................................................................................ 282

7.4.1. Happiness and well-being .................................................................................. 282

7.4.2. Symptoms of depression and anxiety .................................................................. 283

7.4.3. Readiness to change (RTC) ................................................................................ 285

7.4.4. Weight loss ......................................................................................................... 286

7.5. Conclusions and Limitations .................................................................................... 287

CHAPTER 8: Protocols Adopted for the RT-qPCR, Results of the OXTR Gene Expression
Analyses Combining Samples from All Studies, and Combined Results from the
Psychological Analyses for Comparison ............................................................................. 289

8.1. OXTR Gene Expression Analysis ............................................................................. 290

8.1.1. Sample collection and RNA isolation ................................................................. 290

8.1.2. DNA marker and primers sequences ................................................................ 291

8.1.3. RNA quality ...................................................................................................... 292

8.1.4. cDNA synthesis ............................................................................................... 292

8.1.5. Quantitative PCR ............................................................................................. 292

8.1.6. Normalization strategy and considerations in relation to the reference genes ....294

8.1.7. Statistical analysis ............................................................................................. 294

8.1.8. Results .............................................................................................................. 295

8.2. Psychological Outcomes of the PPI Combining Data from All Studies ...................... 298

8.2.1. Material and methods ......................................................................................... 298

8.2.2. Results ............................................................................................................... 300

8.3. Discussion and Conclusions .................................................................................... 308

CHAPTER 9: Discussion ................................................................................................... 310
# TABLE OF CONTENTS

9.1. Effectiveness of the PPI on Overall Well-being ................................................................. 311  
9.1.1. Well-being .................................................................................................................. 312  
9.1.2. Symptoms of depression and anxiety ........................................................................ 318  
9.1.3. Body image flexibility .............................................................................................. 322  
9.2. Effectiveness of the PPI on Weight Loss ........................................................................ 324  
9.3. Readiness to Change (RTC) and the Intervention Outcome ........................................... 329  
9.4. Identifying Potential Molecular Genetic Pathways through which the PPI Functions ........................................................................................................... 332  
9.4.1. OXTR and co-expressed genes ................................................................................. 336  
9.4.2. OXTR and protein similarity..................................................................................... 337  
9.4.3. OXTR and co-localized genes ................................................................................. 338  
9.5. OXTR Gene Expression as a Model System for Validation of PPIs ............................. 338  
9.6. Limitations .................................................................................................................. 340  
9.7. Implications of the Main Findings and Suggestions for Future Research .................... 346  

## CHAPTER 10: Conclusions ........................................................................................................ 351  
10.1. General Conclusions ................................................................................................. 352  
10.1.1. Development of PPI for individuals with weight problems .................................... 352  
10.1.2. Effectiveness of the PPI on well-being and weight loss ........................................ 353  
10.1.3. Identification of potential molecular genetic pathways through which PPIs function ........................................................................................................... 354  
10.1.4. Using OXTR gene expression as a model system to validate PPIs ....................... 356  
10.2. Contributions to Knowledge ....................................................................................... 357  

References .................................................................................................................................. 358  

## Appendix A.  
Assessment of an Obese Patient Seeking Weight Loss Intervention .......................................... 491  

## Appendix B.  
The Selection Process of Appropriate Obesity Treatment Based on a Comprehensive Assessment of the Obese Patient ........................................................................................................... 497  

## Appendix C.  
Dietary Interventions and Exercise Recommendations – The Most Commonly Applied Obesity Treatments ........................................................................................................... 500  

## Appendix D.  
Drug and Surgical Treatment Approaches for More Severe Cases of Obesity – A Brief Overview ....................................................................................................................... 517  

## Appendix E.  
Reflective Reviews from Each Session of the Pilot Studies and the RCT ................................ 520
TABLE OF CONTENTS

Pilot Study I. – Group Session Reflections ................................................................. 520
Pilot Study II. – Group Session Reflections ............................................................... 534
Main Study (RCT) – Group Session Reflections ......................................................... 550

Appendix F. ................................................................................................................. 572
Gene Expression Analyses – Brief Overview .............................................................. 572

Appendix G. .................................................................................................................. 580
Study Information Sheet and Consent Form Given to Participants Prior Initial Assessment 580

Appendix H. .................................................................................................................. 584
Self-report Measures Used to Conduct Psychological Assessment Before and After the Intervention in the First Pilot Study: The Change Questionnaire, BI-AAQ, and PERMA ...584

Appendix I. .................................................................................................................... 590
A Scanned Copy of the Original Ethical Approval to Conduct the First Pilot Study, and Additional Approval of Changes/Additions for the Second Pilot Study and the RCT Granted by the University of Bolton Ethics Committee ........................................................................... 590

Appendix J. .................................................................................................................... 623
Additional Self-report Measures Used to Conduct Psychological Assessment Before and After the Intervention in the Second Pilot Study and the RCT: GAD7 and PHQ9 .......... 623

Appendix K. .................................................................................................................... 625
PPI Email Notifications Sent to the Participants in Pilot Study II., and the RCT .......... 625

Appendix L. .................................................................................................................... 637
Risk Assessment for Nucleic Acid Extraction – Polymerase Chain Reaction: Real-Time qPCR .................................................................................................................................. 637
LIST OF ABBREVIATIONS

List of Abbreviations

ACT : Acceptance and Commitment Therapy .......................................................... 93
ACTH : Adrenocorticotropic Hormone .................................................................. 211
ACTβ : Actin β ........................................................................................................ 142
ADHD : Attention Deficit Hyperactivity Disorder ............................................... 183
ALSPAC : Avon Longitudinal Study of Parents and Children ............................ 210
AN : Anorexia Nervosa ....................................................................................... 91
ANCOVA : Analysis of Covariance ..................................................................... 267
ARFID : Avoidant/Restrictive Food Intake Disorder ......................................... 91
AVP : Vasopressin (also known as VP; ADH; ARVP; AVR; AVP-NPI) ............... 211
AVPR1A : Arginine Vasopressin Receptor 1A (also known as V1aR; AVPR1; AVPR V1a) ................................................................. 178
AVPR1B : Arginine Vasopressin Receptor 1B (also known as V1bR; AVPR 3) ... 183
AVPR2 : Arginine Vasopressin Receptor 2 (also known as DI1; DIR; NDI; V2R; ADHR; DIR3) ............................................................................................................. 183
BDD : Balanced-deficit-diet ................................................................................ 509
BDNF : Brain Derived Neurotrophic Factor (also known as ANON2; BULN2) ... 180
BED : Binge Eating Disorder .............................................................................. 91
BI-AAQ : Body Image Acceptance and Action Questionnaire ............................ 232
BIND : Biomolecular Interaction Network Database .......................................... 175
BioGRID : General Repository for Interaction Datasets .................................... 175
BMI : Body Mass Index ....................................................................................... 21
BN : Bulimia Nervosa ......................................................................................... 91
BPS : British Psychological Society .................................................................. 233
BT : Behavioural Therapy .................................................................................. 57
CART : Cocaine-and-Amphetamine-Regulated-Transcript .................................. 178
CBT : Cognitive Behavioural Therapy ................................................................. 60
CBT-BN : Cognitive Behavioural Therapy particularly designed for treatment of Bulimia Nervosa .................................................................................................................. 61
cDNA : Complementary DNA .......................................................................... 136
CMS : Centres for Medicare and Medicaid Services ........................................ 22
CNS : Central Nervous System .......................................................................... 107
COMT : Catechol-O-Methyltransferase (also known as HEL-S-98n) ............... 178
CSF3 : Colony Stimulating Factor 3 (also known as GCSF; CSF3; C17orf33) ... 184
Ct : Threshold cycle .............................................................................................. 142
DAT1 : Dicarboxylate/amino Acid Cation Sodium Transporter ......................... 332
DBT : Dialectical Behaviour Therapy ................................................................. 93
DIP : Database of Interacting Proteins ............................................................... 175
DNA : Deoxyribonucleic Acid ........................................................................... 112
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRD1</td>
<td>Dopamine Receptor D1 (also known as DADR; DRD1A)</td>
<td>183</td>
</tr>
<tr>
<td>DRD2</td>
<td>Dopamine Receptor D2 (also known as D2R; D2DR)</td>
<td>108</td>
</tr>
<tr>
<td>DRD3</td>
<td>Dopamine Receptor D3 (also known as D3DR; ETM1; FET1)</td>
<td>179</td>
</tr>
<tr>
<td>DRD4</td>
<td>Dopamine Receptor D4 (also known as D4DR)</td>
<td>179</td>
</tr>
<tr>
<td>DRD5</td>
<td>Dopamine Receptor D5 (also known as DBDR; DRD1B; DRD1L2)</td>
<td>183</td>
</tr>
<tr>
<td>dsDNA</td>
<td>Double-stranded DNA</td>
<td>138</td>
</tr>
<tr>
<td>ED</td>
<td>Eating Disorder</td>
<td>91</td>
</tr>
<tr>
<td>EDI-2</td>
<td>Eating Disorder Inventory-2</td>
<td>201</td>
</tr>
<tr>
<td>EST</td>
<td>Expressed Sequence Tag</td>
<td>133</td>
</tr>
<tr>
<td>FCE</td>
<td>Finished Consultant Episode</td>
<td>37</td>
</tr>
<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
<td>516</td>
</tr>
<tr>
<td>FTO</td>
<td>Alpha-ketoglutarate Dependent Dioxygenase (also known as GDFD; ALKBH; BMIQ14)</td>
<td>286</td>
</tr>
<tr>
<td>GAD7</td>
<td>Generalized Anxiety Disorder 7-Item Measure</td>
<td>127</td>
</tr>
<tr>
<td>GHRL</td>
<td>Ghrelin/Obestatin Prepropeptide</td>
<td>106</td>
</tr>
<tr>
<td>GI</td>
<td>Glycaemic Index</td>
<td>512</td>
</tr>
<tr>
<td>GOI</td>
<td>Gene of Interest</td>
<td>142</td>
</tr>
<tr>
<td>GPR31</td>
<td>G Protein-Coupled Receptor 31 (also known as HETER; HETER1; 12-HETER)</td>
<td>182</td>
</tr>
<tr>
<td>GWEI</td>
<td>Genome Wide Environment Interaction</td>
<td>24</td>
</tr>
<tr>
<td>HDL</td>
<td>High Density Lipoprotein</td>
<td>110</td>
</tr>
<tr>
<td>HGNC</td>
<td>8529 : Alternative coding for the OXTR gene</td>
<td>27</td>
</tr>
<tr>
<td>HGP</td>
<td>Human Genome Project</td>
<td>110</td>
</tr>
<tr>
<td>HHS</td>
<td>Health and Human Services</td>
<td>22</td>
</tr>
<tr>
<td>HM Government</td>
<td>Her Majesty's Government</td>
<td>40</td>
</tr>
<tr>
<td>HMR</td>
<td>Health Management Resources</td>
<td>54</td>
</tr>
<tr>
<td>HP</td>
<td>High Protein</td>
<td>510</td>
</tr>
<tr>
<td>HPRD</td>
<td>Human Protein Reference Database</td>
<td>175</td>
</tr>
<tr>
<td>HSCIC</td>
<td>Health and Social Care Information Centre</td>
<td>21</td>
</tr>
<tr>
<td>HTR2A</td>
<td>5-Hydroxytryptamine Receptor 2A (also known as HTR2; 5-HT2A)</td>
<td>179</td>
</tr>
<tr>
<td>IEP</td>
<td>Internet Encyclopedia of Philosophy</td>
<td>67</td>
</tr>
<tr>
<td>IHD</td>
<td>Ischemic Heart Disease</td>
<td>508</td>
</tr>
<tr>
<td>IL18BP</td>
<td>Interleukin 18 Binding Protein</td>
<td>185</td>
</tr>
<tr>
<td>IL1F10</td>
<td>Interleukin 1 Family Member 10 (also known as IL-38; FKSG75; IL1HY2; IL-1HY2; IL1-Theta; FIL1-Theta)</td>
<td>185</td>
</tr>
<tr>
<td>IL1F6</td>
<td>Interleukin 1 Family Member 6 (also known as Fil1; Il1f9; Il36a; Il-1H1; Il1RP2)</td>
<td>185</td>
</tr>
<tr>
<td>IL1RN</td>
<td>Interleukin 1 Receptor Antagonist (also known as DIRA; IRAP; IL1F3; IL1RA; MVCD4; IL-1RN; IL-1ra; IL-1ra3; ICIL-IRA)</td>
<td>179</td>
</tr>
<tr>
<td>IL-1α</td>
<td>Interleukin 1 Alpha</td>
<td>215</td>
</tr>
<tr>
<td>IL-1β</td>
<td>Interleukin 1 Beta</td>
<td>215</td>
</tr>
<tr>
<td>IL36B</td>
<td>Interleukin 36 Beta (also known as FIL1; FIL1H; IL1F8; IL1H2; IL-1F8; IL-1H2; IL1-ETA)</td>
<td>184</td>
</tr>
</tbody>
</table>
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL36G</td>
<td>Interleukin 36 Gamma (also known as IL1E; IL1F9; IL1H1; IL-1F9; IL-1H1; IL1RP2; IL-1RP2)</td>
</tr>
<tr>
<td>IL36RN</td>
<td>Interleukin 36 Receptor Antagonist (also known as FIL1; FIL1D; IL1F5; IL1L1; PSORP; IL1HY1; IL1RP3; IL36RA; IL-36Ra; PSORS1; FIL1(Delta))</td>
</tr>
<tr>
<td>IL37</td>
<td>Interleukin 37 (also known as FIL1; FIL1Z; IL-1H; IL-37; IL1F7; IL1H4; IL-1F7; IL-1H4; IL1RP1; IL-1RP1; FIL1(ZETA))</td>
</tr>
<tr>
<td>IL-6</td>
<td>Interleukin 6 (also known as CDF; HGF; HSF; BSF2; IL-6; BSF-2; IFNB2; IFN-beta-2)</td>
</tr>
<tr>
<td>IntAct</td>
<td>Molecular Interaction Database</td>
</tr>
<tr>
<td>IQ</td>
<td>Intelligence Quotient</td>
</tr>
<tr>
<td>ITT</td>
<td>Intention-to-treat</td>
</tr>
<tr>
<td>LCD</td>
<td>Low-calorie-diet</td>
</tr>
<tr>
<td>LDL</td>
<td>Low Density Lipoprotein</td>
</tr>
<tr>
<td>LEPR</td>
<td>Leptin Receptor (also known as OBR; OB-R; CD295; LEP-R; LEPRD)</td>
</tr>
<tr>
<td>MAOA</td>
<td>Monoamine Oxidase A (also known as BRNRS; MAO-A)</td>
</tr>
<tr>
<td>MBCT</td>
<td>Mindfulness-Based Cognitive Therapy</td>
</tr>
<tr>
<td>MB-EAT</td>
<td>Mindfulness-Based Eating Awareness Training</td>
</tr>
<tr>
<td>MBI</td>
<td>Mindfulness-Based Intervention</td>
</tr>
<tr>
<td>MDD</td>
<td>Major Depressive Disorder</td>
</tr>
<tr>
<td>MDT program</td>
<td>Multidisciplinary teamed program</td>
</tr>
<tr>
<td>MGI</td>
<td>McKinsey Global Institute</td>
</tr>
<tr>
<td>MI</td>
<td>Motivational Interviewing</td>
</tr>
<tr>
<td>MIn</td>
<td>Myocardial Infarction</td>
</tr>
<tr>
<td>mITT</td>
<td>Modified Intention-to-treat</td>
</tr>
<tr>
<td>MPSS</td>
<td>Massively Parallel Signature Sequencing</td>
</tr>
<tr>
<td>mRNA</td>
<td>Messenger Ribonucleic Acid</td>
</tr>
<tr>
<td>NAASO</td>
<td>North American Association for the Study of Obesity</td>
</tr>
<tr>
<td>NAO</td>
<td>National Audit Office</td>
</tr>
<tr>
<td>NGF</td>
<td>Nerve Growth Factor (also known as NGFB; HSAN5; Beta-NGF)</td>
</tr>
<tr>
<td>NHLBI</td>
<td>The National Heart, Blood and Lung Institute</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Services</td>
</tr>
<tr>
<td>NICE</td>
<td>National Institute for Health and Care Excellence</td>
</tr>
<tr>
<td>NOO</td>
<td>National Obesity Observatory</td>
</tr>
<tr>
<td>NPSR1</td>
<td>Neuropeptide S Receptor 1 (also known as GPRA; NPSR; VRR1; ASRT2; PGR14; GPR154)</td>
</tr>
<tr>
<td>NPY</td>
<td>Neuropeptide Y (also known as PYY4)</td>
</tr>
<tr>
<td>NTF3</td>
<td>Neurotrophin 3 (also known as NT3; HDNF; NGF2; NT-3; NGF-2)</td>
</tr>
<tr>
<td>NTF4</td>
<td>Neurotrophin 4 (also known as NT4; NT5; NT-4; NT-5; NTF5; GLC10; GLC1O; NT-4/5)</td>
</tr>
<tr>
<td>OECD</td>
<td>The Organisation for Economic Co-operation and Development</td>
</tr>
</tbody>
</table>
LIST OF ABBREVIATIONS

-OMICS: Refers to a field of study ending in the neo-suffix “-omics” [from Greek -ομα (-ōma)], such as genomics, transcriptomics, epigenomics, proteomics, metabolomics or interactomics .............................................................. 29
OPRD1: Opioid Receptor Delta 1 (also known as OPRD) .......................................................... 181
OPRK1 : Opioid Receptor Kappa 1(also known as KOR; OPRK; KOR-1; K-OR-1) .......... 182
OPRL1: Opioid Related Nociceptin Receptor 1(also known as NOP; OOR; NOPr; ORL1; KOR-3; NOCIR) ........................................................................................................ 181
OPRM1 : Opioid Receptor Mu 1 (also known as MOP; MOR; LMOR; MOR1; OPRM; M-OR-1) ........................................................................ 178
OXT : Oxytocin/Neurophysin I prepropeptide (also known as OT; OT-NPI; OXT-NPI) ...... 17
OXTR : Oxytocin Receptor (also known as OT-R) .................................................................. 17
PA : Physical Activity ............................................................................................................. 513
PCR : Polymerase Chain Reaction ...................................................................................... 113
PERMA : Positive emotions, Engagement, Relationships, Meaning, and Accomplishment 76
PHQ9 : Patient Health Questionnaire 9-Item Measure ..................................................... 127
PPI : Positive Psychological Intervention ........................................................................ 17
PPT : Positive Psychotherapy ............................................................................................ 81
PPY : Pancreatic Polypeptide Y (also known as PP; PNP) .................................................. 181
PYY : Peptide YY (also known as PYY-1; PYY-I) ................................................................. 181
QOL : Quality of Life ........................................................................................................... 174
qPCR : Quantitative Polymerase Chain Reaction ............................................................. 114
RCT : Randomised Controlled Trial .................................................................................. 30
RMR : Resting Metabolic Rate ............................................................................................ 508
RNA : Ribonucleic Acid ...................................................................................................... 112
RNA Seq : RNA Sequencing ............................................................................................... 133
RTC : Readiness to Change .............................................................................................. 284
RT-PCR : Real-time Polymerase Chain Reaction; also Reverse-transcriptase Polymerase 114
Chain Reaction ................................................................................................................... 114
RT-qPCR : Reverse Transcriptase Quantitative Polymerase Chain Reaction (also referred to as qRT-PCR) ........................................................................................................ 29
SAGE : Serial Analysis of Gene Expression ........................................................................ 133
SLC6A4 : Solute Carrier Family 6 Member 4 (also known as 5-HTTLPR; 5-HTT) ......... 178
SNP : Single Nucleotide Polymorphism ............................................................................. 23
TNF-α : Tumor Necrosis Factor Alpha ............................................................................ 178
TPH1 : Tryptophan Hydroxylase 1 (also known as TPRH; TRPH) ................................. 332
TrkB : Tyrosine Kinase Receptor B ................................................................................... 186
TUBα : Tubulin Alpha ........................................................................................................ 142
UK : United Kingdom ....................................................................................................... 21
US : United States ............................................................................................................. 21
USDA : U. S. Department of Agriculture ........................................................................ 509
USDHHS : U. S. Department of Health and Human Services ........................................ 509
USPSTF : U.S. Preventive Services Task Force ................................................................. 49
LIST OF ABBREVIATIONS

VLCD : Very-low-calorie-diet .................................................................................. 505
VLCKD : Very-low-carbohydrate-ketogenic-diet ..................................................... 511
VNTR : Variable Number Tandem Repeat ............................................................... 215
WHO : The World Health Organization .................................................................. 34
ΔΔCt : Double-delta (relative) Quantification .......................................................... 142
List of Tables

Table 2.5. Changes in weight/BMI in the mindfulness intervention groups................................. 99
Table 2.6. Changes in weight after mindfulness meditation intervention................................. 103
Table 3.1. Advantages and disadvantages of the methods used for global analysis of gene expression. ........................................................................................................................................................................ 136
Table 5.1. Biological pathways and candidate molecular genetic markers in the QOL domains addressed in the current study. ............................................................................................................... 179
Table 5.2. Additional genes identified as functionally similar, or as having shared properties with the target QOL genes. ............................................................................................................... 182
Table 5.3. Positive emotional functioning candidate genes and their role in obesity and obesity-related eating psychopathology................................................................. 189
Table 5.4. Interactions between genes involved in the target QOL domains and obesity-related genes................................................................................................................................. 193
Table 5.5. Interactions with and between additional genes identified as functionally similar, or as having shared properties with the target QOL genes .................................................. 194
Table 5.6. Social functioning candidate genes and their role in obesity and obesity-related eating psychopathology.................................................................................................................... 196
Table 6.1. Paired-samples T-test analysis of the effect of the PPI on well-being and body-image flexibility (pilot study I.). ............................................................................................................................ 237
Table 6.2. Pearson product-moment correlations between measures of readiness to change and well-being and body-image flexibility before and after the intervention (pilot study I.). .................................................................................................................................................. 238
Table 6.3. Participant characteristics and weight data before and after the PPI (pilot study I.). .......................................................................................................................................................... 240
Table 6.4. Paired-samples T-test analysis of the effect of the PPI on well-being, body-image flexibility, anxiety and depression (pilot study II.). ........................................................................................................ 248
Table 6.5. Pearson product-moment correlations between measures of readiness to change and well-being and body-image flexibility and anxiety and depression before and after the intervention (pilot study II.). .................................................................................................................................. 251
Table 6.6. Participant characteristics and weight data before and after the PPI (pilot study II.). .......................................................................................................................................................... 253
Table 7.1. Between subjects-effects showing the effects of the condition (“Intervention”/”Control” group) on the post-intervention total scores on all measures taken at Time B.............................................................................................................................................. 270
Table 7.2. Between subjects-effects showing the effects of the condition (“Intervention”/”Control” group) on the post-intervention scores on all PERMA subscales taken at Time B ........................................................................................................................................ 271
Table 7.3. Between subjects effects showing the effects of the covariate on the post-intervention scores on all PERMA subscales after controlling for the condition (“Intervention”/”Control” group)..............................................................................................................272
Table 7.4. Means and standard deviations at Time A and Time B for both groups and all variables, including all PERMA subscales. ..........................................................................................................................273
Table 7.5. Paired-samples T-test analysis of the effect of the PPI on anxiety, depression, body-image flexibility, and well-being of the participants in the intervention group. ..............277
Table 7.6. Paired-samples T-test analysis of the effect of the PPI on anxiety, depression, body-image flexibility, and well-being of the participants in the control group. .................278
Table 7.7. Participant characteristics and weight data at Time A and Time B (both groups). ........................................................................................................................................................................279
Table 7.8. Pearson product-moment correlations between measures of readiness to change and well-being, body-image flexibility, anxiety and depression after the intervention........281
Table 2.1. The International Classification of adult underweight, overweight and obesity according to BMI. ..................................................................................................................................................493
Table 2.2. Seven essential criteria for healthy weight control plans........................................501
Table 2.3. Guidelines for composition of healthy weight control plans .......................................503
Table 2.4. Indications and contraindications for VLCDs.................................................................509
List of Figures

Figure 1.1. Illustration of a case of genotype-environment interaction. Hypothetical response of three genotypes to increase in energy or fat intake in the absence of genotype-environment interaction (left panel) and in the presence of genotype-environment interaction (right panel).

Figure 2.1. The world’s overweight and obesity statistics in 1975 and 2014.

Figure 2.2. Obesity among adults in 2015 according to the OECD Health Statistics.

Figure 2.3. Trends in overweight and obesity among adults aged 15 – 74: OECD countries with available data since 1990s.

Figure 2.4. Trends in overweight including obese among adults aged 16 and over: United Kingdom, 1993 – 2014.

Figure 2.5. Adult obesity trends in the United Kingdom, 1993 – 2014.

Figure 2.6. Prevalence of severe/class III obesity among adults aged 16 and over: United Kingdom, 1993 – 2014.

Figure 2.8. The PERMA model of well-being (Seligman, 2011).

Figure 3.1. Summary of the essential features in a simple experimental design.

Figure 3.2. The randomised controlled trial.

Figure 3.3. Features of a well-designed RCT.

Figure 3.4. Relative fluorescence vs. cycle number in RT-qPCR.

Figure 3.5. Comparison of TaqMan-based and SYBR Green–based detection workflows.

Figure 3.6. Melting curve analysis can detect the presence of non-specific products, such as primer-dimer, as shown by the additional peaks to the left of the peak for the amplified product in the melt curve.

Figure 4.1. Conceptual model outlining the proposed mediators between positive affect and improved health behaviours.

Figure 4.2. Conceptual model of the present intervention outlining the proposed mediators between positive affect and improved health behaviours reinforced by individual readiness to change.

Figure 5.1. Interactions between the OXTR and components that might be involved in Obesity-Related Eating Disorders. The main components of these interactions are depicted in the diagram, but additional elements have been omitted for clarity. Comprehensive reviews are available, and should be referred to for additional pieces of information.

Figure 2.7. Obesity treatment algorithm: A conceptual scheme showing a three-stage process for selecting treatment.
Acknowledgements

I would like to express my sincere thanks to Professor Jerome Carson who was the Director of Studies on this project for the full three years (between 2015 and 2018). His continued support throughout the time was invaluable.

I would like to extend my thanks to Dr Ianis Matsoukas who supervised the molecular genetic part of this project throughout the three years. It would be impossible to combine three distinctive scientific fields into one project without his expertise and continued support.

Within this project I worked with the University of Bolton students and staff who participated in my studies. I am extremely grateful for the great contribution of these participants and the support I received from the University to conduct and disseminate my research. I would like to thank the Dean of the Faculty of Professional Studies, Dr Gill Waugh, for giving me the approval to deliver my intervention within the teaching of first year Psychology, Psychotherapy and Counselling students. I would also like to thank the University President and Vice-Chancellor, Professor George E. Holmes, DL for funding this research though a full-time bursary.

Last, but not least, I would also like to thank my dear family for their endless support and encouragement which were much needed at times. My special thanks goes to my husband to whom I am forever grateful for giving me the personal time and space to complete this work.
Abstract

**Background:** Obesity represents a world-wide health problem. As yet, there is no gold standard treatment. Positive psychology (PP) has been successfully applied to psychological disorders and disturbances related to obesity. Research applying PP to address overweight and obesity is lacking.

**Aims:** This research aimed to develop a positive psychological intervention (PPI) for individuals with weight problems and assess its effectiveness on well-being and weight loss in non-clinical populations. Further aims were to identify potential molecular genetic pathways through which the PPI functions, and validate the intervention using *OXTR* gene expression as a model system.

**Method:** A 6-week PPI for weight management was delivered in two pilot studies (*n*=38) and a randomised controlled trial (RCT; *n*=20) to students and staff at an English University. Saliva samples were collected in weekly basis during the intervention sessions and qRT-PCR was used to analyse relative *OXTR* expression in the samples.

**Results:** Quantitative analyses of the pilot studies revealed significant increases in well-being and decreases in depression and anxiety. RCT findings revealed significant increases in well-being and decreases in anxiety in the intervention group. Differential gene expression analysis using a real time RT-PCR approach revealed significant increases in the *OXTR* gene expression levels in response to the intervention. Bioinformatic approaches revealed a number of genexgene interactions, elucidating potential novel molecular genetic pathways that may affect psychological wellbeing.
Conclusions: The current PPI made an effective contribution to mental health and overall well-being of participants in all three studies. The PPI may be able to modulate expression of genes related to positive psychological functioning, leading to increased well-being. Finally, it is proposed that the *OXTR* expression levels could be used as an experimental assay in validation of PPIs, promoting the practical legacy of PP.

Keywords: obesity, positive psychology, gene-environment interaction, *OXTR* gene expression, gene network interaction
INTRODUCTION

CHAPTER 1: Introduction and Overview of the Thesis

The present PhD focuses on the application of positive psychology to overweight and obesity as an alternative method of treatment. It is a novel approach incorporating molecular genetics; using OXYTOCIN RECEPTOR (OXTR) gene expression as a model system it aims to validate a positive psychological intervention (PPI) for weight management.

NOMENCLATURE: With reference to the molecular approaches employed in this research the following nomenclature will be used throughout the thesis:

Names of genes are written in italicized upper-case letters, e.g., OXTR.
Names of proteins are written in non-italicized upper-case letters, e.g., OXTR.

The purpose of this chapter is to introduce the main research areas this thesis covers. It will briefly discuss the background on positive psychology and obesity, and describe the basic principles of genotype-environment interaction, which form the basis for the assumption that gene expression may be affected by an environmental (positive psychological) stimuli. This chapter gives a background and synopsis of the PhD thesis and it provides an overview of the content of the remaining chapters.
INTRODUCTION

1.1. Background

1.1.1. Positive psychology

Since World War II, psychology has been focusing mainly on healing, paying almost exclusive attention to illness and pathology neglecting the fulfilled individuals who have achieved their full potential (Seligman & Csikszentmihalyi, 2000). Over the years researchers and practitioners have mastered different ways of assessment, understanding and treatment of mental illnesses (Carr, 2012). A wide range of empirically based treatment strategies has been developed for clinical practice (Hibbs & Jensen, 1996) and detailed research in molecular genetics has been able to elucidate different genetic pathways, correlations and interactions contributing to the development and maintenance of various mental health disorders and disturbances (Berrettini, 2004; DiMaio, Grizenko & Joober, 2003; Haeffel, Getchell, Koposov, et al., 2008; Hayden, Klein, Dougherty et al., 2010; Munafò, 2012; Serretti, Lilli, Lorenzi et al., 2002; Steiger, 2004; Talkowski, Bamne, Mansour & Nimgaonkar, 2007; Vercammen, Weickert, Skilleter et al., 2014). There is a large amount of evidence providing support for the efficacy of the traditional psychological approaches to the treatment of a wide range of psychiatric disorders (Butler, Chapman, Forman & Beck, 2006; Eysenck & Keane, 2000; Gould, Safren, O’Neill Washington & Otto, 2004; Gournay, 1998; Wells, 2000). However, increasing amount of research evidence (e.g. Curran, Darling, Rogers & Gournay, 2012; Hayes, 2004; Öst, 2008) also suggests that a shift in focus towards the more positive and accepting one may be necessary in the treatment of these disorders. It is possible that “a ‘build-what’s strong’ approach to therapy may usefully supplement the traditional ‘fix-what’s wrong’ approach” (Duckworth, Steen & Seligman, 2005, p. 361).
INTRODUCTION

Positive psychology is relatively new but rapidly developing field in the world of science, which emphasizes the importance of building positive qualities, enhancing the development of positive experiences and positive individual traits (Duckworth et al., 2005). Scientists have always endeavoured to answer the so-called simple question raised by ancient philosophers thousands of years ago: What is a good life? The term “good life” itself dates back to Plato and Aristotle and refers to their interpretation of “eudaimonia,” or pleasure, which was the central aim of the stoic philosophy (Riel, 2000). Since then, a large number of philosophers, religious leaders and scientists have studied the “good life” and themes thought to be associated with it, such as good character, human strengths, happiness and a good striving society (Lopez & Snyder, 2009). Even though all these scholars were studying the same problems, only from different perspectives, no one has ever attempted to bring all their work together. It has only been a matter of the last two decades, that Martin Seligman initiated the positive psychology network with a group of academics, who already focused their work on positive aspects of life, as opposed to just seeing the problems in life. This was the first step towards building the field of positive psychology and studying the “good life” from a scientific perspective. According to Seligman (2011) “the topic of positive psychology is well-being, the gold-standard for measuring well-being is flourishing, and the goal of positive psychology is to increase flourishing” (p.13). From this perspective, an individual is no longer seen as a “passive vessel responding to stimuli”, but rather as a master of their own choices, decisions and actions who has achieved their potential in life (Seligman & Csikszentmihalyi, 2000, p.8). Positive psychology is based on building strengths, and increasing positive feelings, behaviours, and cognitions (Sin & Lyubomirsky, 2009). It helps an individual to understand that strengths can become weaknesses if they are underused or overused. Therefore, maintaining balance in using strengths may help facilitate happiness, well-being, positive traits,
INTRODUCTION

and the development of meaningful positive relationships, social systems and institutions (Carr, 2011).

A common misinterpretation of positive psychology is that it focuses only on the positives ignoring real problems in life and underestimating clients’ negative experiences, which leads to a failure to provide understanding and appropriate amount of support for them (Magyar-Moe, Owens & Conoley, 2015; Magyar-Moe, Owens, & Scheel, 2015). However, positive psychology practitioners certainly do not ignore suffering of their clients, but they do promote well-being and quality of life in addition to helping their clients alleviate the suffering (Seligman & Csikszentmihalyi, 2000; Slade 2010). As stated by Seligman (1999), psychology is not just the “study of weakness and damage; it is also the study of strength and virtue. Treatment is not just fixing what is broken; it is nurturing what is best within ourselves” (p. 1; in Smith, 2006). Positive psychologists respect and understand the importance of the study of pathology and they build on the findings of this research. Their aim is to find out what factors may buffer people from pathology and how they could be supported in developing their character strengths and virtues in order to achieve their full potential.

It ought to be mentioned that notions such as full and optimal human functioning (Rogers, 1961) individuation, self-realisation, and self-actualisation (Jung, 1939; Maslow, 1971), maturity (Allport, 1961), and positive mental health (Jahoda, 1958) are not new concepts. However, they have been studied mainly from the perspective of clinical application. Psychological growth and well-being were viewed as some sort of by-products of symptom relief, rather than a primary focus of psychology and an original aim of all human beings. Historically, only a very few therapies (e.g. Fordyce, 1977; 1983) concentrated directly on the positives in clients. Therefore, the dramatic shift from the study of “illness” towards the study of “health” observed in the last few decades, represents an important turning point in
INTRODUCTION

psychology research today (Yi-Frazier, Hilliard, Cochrane & Hood, 2012), and will be the main focus of this thesis.

1.1.2. Obesity overview

Obesity represents a global health problem with substantial medical, social, and economic consequences (Arterburn, Maciejewski & Tsevat, 2005; Yach, Suckler & Brownel, 2006; Runge, 2007), which has now reached epidemic proportions. Particularly in developed countries, obesity is regarded as a major contributor to the global burden of chronic disease and disability (Greenhalgh & Carney, 2014; Karasu, 2012; World Health Organisation, WHO, 2004a). The health problems associated with obesity (e.g. coronary heart diseases, hypertension, stroke, diabetes, cancer) are a leading cause of mortality in the US (Mokdad, Marks, Stroup & Gerberding, 2005) with the annual death rates ranging from 111,909 (Flegal, Graubard, Williamson & Gail, 2005) to 365,000 (Mokdad, Marks, Stroup & Gerberding, 2004; Mokdad et al., 2005; see Greenberg, 2013 for overview). England has seen a marked increase in the proportion of adults who were obese between 1993 and 2012 from 13.2% to 24.4% among men and from 16.4% to 25.1% among women (Health and Social Care Information Centre, HSCIC, 2014). In the same years, the proportion of adults with a normal Body Mass Index (BMI) has decreased from 41.0% to 32.1% among men and from 49.5% to 40.6% among women. (HSCIC, 2014). Despite public health warnings of the dangers of increased body weight, record rates of dieting, and the availability of a wide range of interventions, and drug and hospital treatments, obesity is still on the rise and it is only expected to worsen (Messina, Dalia, Tafuri et al., 2014). It is proposed that by 2020, there will be potentially as many as 75% of Americans and Europeans suffering with overweight issues (Wang & Beydoun, 2007) and by 2030, the treatment costs for obesity-related health problems in the US will reach
INTRODUCTION

between $195 and $276 billion (Voelker, 2012). In the UK, obesity currently presents a greater burden on the country’s economy than armed violence, war and terrorism, costing nearly £47 billion a year (The Guardian, 2014).

The rapid increase in obesity prevalence has been so dramatic that it has even led Medicare¹ to alter its policy on covering obesity treatments. The statement that “obesity is not considered an illness” has been removed from the Centers for Medicare and Medicaid Services (CMS) manual (Mann, Tomiyama, Westling et al., 2007) giving Medicare the opportunity to develop treatment approaches for obesity itself, rather than just treatments for various medical conditions associated with it. Over the past few decades, there has been an incredible expansion of different weight management programs, self-help approaches, and behavioural and pharmacological treatments; all developed to tackle the obesity epidemic. In 1998, a panel of experts assembled by the National Heart, Lung and Blood Institute (NHLBI, 1998) conducted an incredibly comprehensive review of currently applied obesity treatments including their safety and efficacy (Wadden & Osei, 2002). In the majority of cases, strategies for weight loss and weight maintenance require adjustment of diet and increase in physical activity from overweight or obese patients. Even though this usually leads to a successful weight loss, it tends to only be short-term progress. Evidence shows that individuals often struggle to comply with their diets and exercise plans after achieving their target weight-loss, resulting in high rates of relapse (Jeffrey, Drewnowski, Epstein et al., 2000; Marcus, Dubbert, Forsyth et al., 2000). Some research even shows that dieting and restrained eating can lead to a significant weight gain in the future (Lowe, Doshi, Katterman & Feig, 2013).

¹ The Centers for Medicare & Medicaid Services, CMS, is part of the Department of Health and Human Services (HHS), USA. Medicare makes policy decisions to grant coverage for specific treatments, basing the coverage determinations on descriptive information, and scientific and clinical evidence (“Medicare program,” 2003).
INTRODUCTION

Indeed, long-term weight management can be challenging. Therefore, there has been a constant search for new and better strategies to enhance the efficacy of the traditional weight loss approaches, particularly in terms of relapse prevention. Comprehensive behavioural treatment approaches are being enriched by additional methods and techniques, such as motivational interviewing (DiLillo, Siegfried & Smith West, 2003; DiMarco, Klein, Clark & Wilson, 2009; Van Dorsten, 2007), or a stepped-care approach (Carels, Darby, Cacciapaglia et al., 2005). However, evidence for the effectiveness of incorporating these approaches into behavioural weight-loss programs, is somewhat inconsistent (Moss, Tobin, Campbell & von Ranson, 2017).

In order to further enhance the development and application of obesity treatment strategies, a large amount of research has been devoted to studying the genetic factors related to obesity. From the first studies, which focused on candidate genes with a suspected role in the regulation of metabolism and food intake, there has been a revolutionary progress in the ways genetic studies are performed (Day & Loos, 2011). Being able to sequence and analyse the human genome (Chakravarti, 2001; International Human Genome Sequencing Consortium, 2001) and use databases of single nucleotide polymorphisms (SNPs), such as dbSNP (Sherry, Ward, Kholodov et al., 2001) and the International HapMap (The International HapMap Consortium, 2003), the majority of common variants in the human genome can be now studied. Geneticists are able to search for loci associated with a particular trait or disease, and even identify new loci of different genes found in individuals susceptible to obesity (Day & Loos, 2011). The progress that science has made in terms of the understanding of the biology underlying obesity has aided the development of obesity treatment approaches significantly. Unfortunately, everything that has been discovered until this point, still seems to be just a part of the tip of the iceberg, and new questions arise with every single answer.
1.1.3. Genotype-environment interaction

The environment plays an important role in individual differences in human behaviour (Plomin, DeFries, Knopik & Neiderhiser, 2013). Increasing amount of evidence from genetic research suggests that human behaviour is nurtured, rather than natured. Environmental influences seem to explain a surprisingly large number of differences between individuals (Turkheimer & Waldron, 2000) and many environmental measures used in the behavioural sciences show genetic influence (Riemann, Angleitner & Strelau, 1997). Also, different human experiences have been found to correlate with genetic predispositions (Plomin & Caspi, 1999). In other words, it seems that people create their own experiences, in part for genetic reasons. However, one of the biggest topics in the nature and nurture debate is that the effects of the environment can depend on genetics and the effects of genetics can depend on the environment. The question is, as noted by Theodosius Dobzhansky (1964), “to what extend are the differences observed among people conditioned by the differences of their genotypes and by the differences between the environments in which people were born, grew and were brought up?” (p. 55). A number of genetic epidemiology studies (e.g. Bouchard, 1994; Bouchard, Pérusse, Rice et al., 1998) demonstrated the importance of genetic factors in the aetiology of human obesity but most have not considered the effects of genotype-environment interaction until only recent years with the development of approaches assessing genome-wide environment interaction (GWEI) (Huang & Hu, 2015).

Genotype-environment interaction occurs when the response of a phenotype (e.g. fat mass) to environmental changes (e.g. diet change) is modulated by an individual’s genotype (Pérusse & Bouchard, 1999). If genotype-environment interactions are not considered, any changes in body fat in response to dietary adjustments will be similar across genotypes. In other
words, if two different individuals followed the same diet, their adiposity levels would become the same in response to the dietary change. If this was true, obesity would not be so prevalent. People do not react the same way to specific diets (Newman, 2016). “Obesity is a chronic medical disorder that is the result of a complex interaction of genetic, environmental, neuro-endocrinological, psychosocial and behavioural factors.” (Karasu, 2013, p. 3). Therefore, in order to understand the complex problem of obesity, genotype-environment interaction has to be considered. As shown in Figure 1.1., the response to dietary changes varies across phenotypes, in the presence of genotype-environment interaction.

Figure 1.1. Illustration of a case of genotype-environment interaction. Hypothetical response of three genotypes to increase in energy or fat intake in the absence of genotype-environment interaction (left panel) and in the presence of genotype-environment interaction (right panel). Retrieved from Pérusse and Bouchard (1999).

In epidemiology, interaction is defined by estimating whether the degree of risk attributable to the joint effects of a genotype and an environmental factor on an outcome is greater or less than would be expected if these joint effects were additive (Thomas, 2010). Alternatively, genotype-environment interaction exists where the risk conveyed by a specific genotype depends on one or more environmental exposure levels. This definition is quite helpful in the context of intervention studies where the environmental exposures can be altered,
such as by diet and physical activity, to offset genetic risk (Ahmad, Varga, Franks, 2013; Franks & Nettleton, 2010; Manolio, Bailey-Wilson & Collins, 2006).

In summary, the effects of genotype-environment interaction are thought to be relevant to obesity in two ways (Pérusse & Bouchard, 1999). First, susceptibility to weight gain in response to environmental risk factors (e.g. high-fat diet, low level of physical activity) may be determined by the level of genotype-environment interaction. Second, the effects of genotype-environment interaction could be involved in the tendency of obese individuals to develop the various comorbidities associated with obesity (e.g. diabetes, coronary heart disease, hypertension etc.) or, more importantly, in individual responsiveness to a particular type of treatment.

1.2. Overview of the Thesis

The current PhD presents a novel approach to overweight and obesity treatment using positive psychology in combination with molecular genetic approaches.

Over the past few decades, research has noted a significant progress in understanding the differences in human development depending on the interaction between environmental exposures and individual genotypes and phenotypes (Ellis, Boyce, Belsky, Bakermans-Kranenburg & van IJzendoorn, 2011). While it is known that psychological well-being is partly heritable, it is only recently that positive health has started to investigate the specific factors that influence obesity in response to happiness and well-being.

In the past few years, a number of PPIs have been developed and applied to some psychological disorders and disturbances related to obesity, such as depression (Layous & Lyubomirsky, 2014; Sin & Lyubomirsky, 2009), substance use and addictions (Krentzman,
INTRODUCTION

2013), alcohol dependence (Akhtar & Boniwell, 2010), use of nicotine and drugs (Peltzer & Pengpid, 2013), problem gambling (Loo, Tsai, Raylu & Oei, 2014), overeating (Bardone-Cone, Brownstone, Higgins, Harney & Fitzsimmons-Craft, 2012) and binge eating disorder (Pinto-Gouveia, Carvalho, Palmeira et al., 2017). Interestingly, none of these interventions has been tested on a molecular genetic level, even though positive psychological stimuli have been shown to produce changes on a molecular genetic level with differences in responsiveness to the stimuli depending on individual genotype (Beevers, Marti, Lee et al., 2011).

1.2.1. Gaps in research

Up to date, quite a few studies have used mindfulness-based approaches to aid weight loss (see Chapter 2 for a review). However, research applying comprehensive PPIs to address overweight and obesity is lacking.

The purpose of the present research is to assess the effectiveness of a comprehensive PPI for weight management developed within the scope of this PhD. Considering the common limitations of self-report measures used in positive psychology (see Chapter 2, section 2.3.3.), further aims of this research are to validate the intervention though differential gene expression analysis exploiting the OXYTOCIN RECEPTOR (OXTR; HGNC: 8529) gene as a model system, and identify potential molecular genetic pathways through which the PPI function. The purpose of this is to assess whether the PPI could act as a potential trigger of change in obesity-related gene expression, and thus, lead to weight loss as a result of this genotype-environment interaction. This is a completely novel approach.
1.2.2. Aims and objectives

Considering the gaps in research, this PhD has four main aims:

1. Develop a PPI for individuals with weight problems.
3. Identify potential molecular genetic pathways through which the PPI functions.
4. Validate the intervention by using $OXTR$ gene expression as a model system.

1.2.3. Contribution to knowledge

Achieving the above research aims, the present project is expected to bring four main contributions to knowledge that will be original in this PhD:

1. This thesis represents the first empirical research applying a comprehensive PPI as a holistic approach to the treatment of overweight and obesity.
2. It is one of the first studies to supplement experiential group work with online learning.
3. It is the first study to incorporate molecular genetics into a positive psychological approach to overweight and obesity treatment bringing the fields of positive psychology, obesity and molecular genetics together.
4. Similarly, it is the first study to attempt to validate a PPI by using $OXTR$ expression as a model system.
INTRODUCTION

1.2.4. Overview of the remaining chapters

The first four chapters of the thesis provide supporting information for the development of the PPI for weight management, and justification of its structure, design and application. The remaining six chapters focus on addressing the four main aims of this research through different studies that were conducted over the past three years, and discussing the main findings and overall implications of this research.

Chapter 2 has three main parts. The first one will review the literature on different approaches currently used to treat obesity discussing their effectiveness. Looking through the history of positive psychology and its applications, part two will discuss the effects of positive psychology on physical and mental health problems related to obesity and/or leading towards its development. Part three will explore the principles of genotype-environment interactions in greater detail highlighting the significance of the role of the environment in gene expression. It will discuss how the application of “-OMICS” approaches to the study of treatment methodologies in medical and biomedical sciences can aid understanding of the dynamic interactions between genetic variants associated with well-being and genetic variants related to obesity, and how these can be affected by the environment.

Chapter 3 focuses on reviewing the general methodologies used in psychological and biological sciences, which are directly relevant to the current research. The chapter has two main parts: (1) describes quantitative methodology used within psychology to assess effectiveness of novel treatments, (2) describes methodologies of gene-expression analysis

---

2 “-OMICS” refers to a field of study ending in the neo-suffix “-omics” [from Greek -όμα (-ōma)], such as genomics, transcriptomics, epigenomics, proteomics, metabolomics or interactomics.
used within the field of molecular genetics with particular focus on the real-time reverse-transcriptase quantitative polymerase chain reaction (real-time RT-qPCR) used in this research.

*Chapter 4* provides information on the theoretical background justifying the structure, design, and development of the PPI for weight management created within the scope of this PhD. It discusses each of the positive psychological themes intentionally selected as the most suitable for use in addressing overweight and obesity, and it provides justification for all exercises used throughout the intervention.

*Chapter 5* describes the use and application of bioinformatics approaches used to identify gene networks, which offer functional basics of the complexity of gene and protein, and their interacting partners. Using the network study on genes and proteins, researchers are able to find novel candidate genes based on the assumption that neighbours of a disease-causing gene in a network are more likely to cause either the same or a similar disease. For the purpose of the present research, gene networks will be used to identify whether and how genes involved in positive psychological functioning can be implicated in obesity. That will serve as a basis for creating a model describing potential molecular genetic pathways through which the PPI functions/affects weight loss.

*Chapter 6* discusses the first two studies conducted to pilot the present PPI. It reports the results of the two pilot studies, and discusses the major implications of the pilot findings leading to the development of a full randomised controlled trial (RCT). The chapter also provides an overview of the main differences between the two studies, and a detailed explanation and justification of the changes and alterations made for the purpose of the main trial.
INTRODUCTION

Chapter 7 reports the results obtained in the RCT which was conducted with an immediate intervention group and a wait list control group. Implications of these findings are discussed in terms of well-being, body-image flexibility, depression, anxiety, and weight loss.

Chapter 8 provides a detailed review of the protocols adopted for the RT-qPCR, and results of the OXTR gene expression analyses combining samples from all conducted studies. It also reports results from psychological analyses that have been conducted after merging all data from all the studies together to enable comparison with the OXTR expression findings.

Chapter 9 provides a detailed summary of all the findings discussing their major implications for both fields, positive psychology and molecular genetics, in terms of addressing overweight and obesity. It addresses limitations of this research, and presents suggestions for future studies.

Chapter 10 is devoted to concluding remarks. Re-visiting the four main aims of this research, the chapter finishes with highlighting the original contributions to knowledge brought by this PhD research.

1.3. Chapter Summary

Until now, there seems to be inconsistent evidence for long-lasting effects or health improvements of any currently applied obesity treatments (Fradkin, Wallander, Elliott, Cuccaro & Schuster, 2016). This suggests that there is a need for development of an alternative treatment approach, which would target the problem of obesity more comprehensively. A large amount of research evidence shows that positive psychology can be successfully applied to comorbidities associated with obesity, such as depression (Layous & Lyubomirsky, 2014; Sin
INTRODUCTION

& Lyubomirsky, 2009), addiction (Krentzman, 2013), alcohol misuse (Akhtar & Boniwell, 2010), overeating (Bardone-Cone et al., 2012), and binge eating disorder (Pinto-Gouveia et al., 2017). However the role of positive psychology in the reduction of obesity itself remains unexplored. Given the recent debate in molecular genetics on the interactions between genes and environment (Plomin et al., 2013), it may be possible that the gene-environmental interactions play a significant role in the responsiveness of obese or overweight individuals to a particular type of treatment. Some individuals may be more responsive to the treatment than others, depending on their specific genotypes and phenotypes (Beevers et al., 2011).

The aim of this PhD research is to explore whether positive psychology could be used as an alternative or complementary treatment for overweight and obesity, while also identifying potential molecular genetic pathways through which positive psychological stimuli might affect weight loss. Using OXTR expression as a model system, this PhD aims to validate a PPI for weight management, which, if successful, could subsequently serve as an objective method for the validation of other interventions in positive psychology.
CHAPTER 2: Literature Review

2.1. Introduction

The main focus of this chapter is to review the literature related to obesity and positive psychology and relate the current PhD research to gaps identified in the existing literature. Additionally, the chapter will discuss recent advances in molecular genetics with relation to obesity and positive psychology.

The chapter will open by making a case for obesity and positive psychology, by which it will introduce and justify the main focus of this project. It will then provide a comprehensive review of currently used treatment strategies for adult obesity with a main focus on psychological and self-help approaches. The second part of the review will focus on positive psychology. Giving a brief overview of its history and origins, it will then discuss recent advances in the field and challenges that need to be addressed. The main focus will be on the applications of positive psychology to enhance well-being and address the psychopathology of disordered eating and other obesity related disorders. The final part of this chapter will give a brief overview of the theoretical background of genetic factors underlying the mechanisms of food intake, emotional responses and brain signalling, that are relevant to obesity. It will then conclude with discussing the application of “-OMICS” approaches to the study of treatment methodologies in medical and biomedical sciences. Application of the “-OMICS” methodologies in psychology may greatly enhance understanding of the dynamic interactions between genetic variants associated with well-being and genetic variants related to obesity, and how these can be affected by the environment.
2.1.1. Case for obesity

Obesity can be defined as “a chronic (though sometimes a remitting and relapsing) condition that results in an accumulation of adipose (fat) tissue” (Karasu & Karasu, 2010, p. 2), which is of sufficient magnitude to impair health (WHO, 2014). The fundamental cause of obesity is an energy imbalance between energy input and output. Generally, this may be due to increased intake of calorie-dense foods and/or a decreased expenditure of energy (Jiménez, López-Ruiz, Gríñán-Lisón, Antich & Marchal, 2016). Although body weight and composition are a complex function of genetics, hormones, basal metabolic factors, diet and physical activity, the modern food environment seems to play an important role in current obesity prevalence affecting overall human health significantly (Stein & Keller, 2015).

Prevalence

The belief that obesity is only prevalent in America and developed Westernized countries is quickly becoming dated. Increasing amount of evidence are now emerging to suggest that obesity affects both developed and developing countries and that the true health consequences of increased body weight may only become fully apparent in the future (WHO, 2000). The prevalence of obesity has increased worldwide over the past three decades and it is still on the rise. Since 1980 the number of individuals suffering with obesity has nearly doubled and in 2014 more than 1.9 billion adults (aged 18 years and older) were overweight, of which 600 million were obese (WHO, 2016a). Overall, about 39% of the world’s adult population (38% of men and 40% of women) are currently overweight, and about 13% (11% of men and 15% of women) are obese. This presents an incredible rise in obesity rates since 1975 (Figure 2.1.), when only 3% of men and 6% of women were classed as obese (WHO, 2016b). In the same
time period, overweight has risen from 21% in men and 23% in women (WHO, 2016b). In the majority of countries, women are more obese than men. However, male obesity has been growing almost twice as fast as female obesity (Figure 2.1.).

![Figure 2.1. The world’s overweight and obesity statistics in 1975 and 2014 (adapted from WHO, 2016b).](image)

According to the Organisation for Economic Co-operation and Development (OECD), in 2015, 19.5% of the adult population (aged 15 years and over) were obese across the OECD countries (Figure 2.2.), with the rates ranging from less than 6% in Korea and Japan to more than 30% in Hungary, New Zealand, Mexico and the United States (OECD, 2017). More than one in four adults is obese in Australia, Canada, Chile, South Africa and the United Kingdom. Since the 1990s, the rates in overweight and obesity have grown rapidly, particularly in England, Mexico and United States, and over the past decade, it has also risen significantly in Canada, France and Switzerland (Figure 2.3.). Even though the prevalence has recently stabilised in some OECD countries (e.g. England, Italy, Korea and Spain), there is no clear sign suggesting that the obesity epidemic would be descending, in any country.

---

3 OECD member countries – Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States
Figure 2.2. Obesity among adults in 2015 according to the OECD Health Statistics (adapted from OECD, 2017).
Obesity rates in the United Kingdom are the second highest in Europe, after Hungary (OECD, 2014). Currently, about 58% of women and 65% of men are overweight or obese in England (Figure 2.4.) with the highest rates (over 75%) among women aged 45 and over. The prevalence of obesity has increased from 15% in 1993, to 26% in 2014 (Figure 2.5.), and it is considered to be the fourth largest factor (after hypertension, smoking and high cholesterol) contributing to premature deaths (HSCIC, 2016). Paradoxically, it has been estimated that individual prevention programmes could avoid up to 40 000 deaths from obesity-related chronic diseases every year (OECD, 2014). According to the Health Survey for England, the prevalence of severe, class III obesity (Figure 2.6.) is consistently higher among women (increasing from 1.4% in 1993 to 3.6% in 2014) than among men (increasing from 0.2% in 1993 to 1.8% in 2014) (HSCIC, 2013a). In 2015/16, there were 6 438 Finished Consultant Episodes (FCE’s) in NHS hospitals with a primary diagnosis of obesity and a main or

---

4 A finished consultant episode (FCE) is a continuous period of admitted patient care under one consultant within one healthcare provider. FCEs are counted against the year in which they end. Figures do not
secondary procedure of bariatric surgery (HSCIC, 2017). Over three quarters of bariatric surgery patients were aged between 35 and 54, and over three quarters of patients were female. The number of individuals receiving bariatric surgery in 2015/16 was six times higher compared to the data from 2005/06 when there were only 1 038 FCEs.

**Figure 2.4.** Trends in overweight including obese among adults aged 16 and over: United Kingdom, 1993 – 2014 (adapted from the Public Health England, 2016).

represent the number of different patients, as a person may have more than one episode of care within the same stay in hospital or in different stays in the same year.
Figure 2.5. Adult obesity trends in the United Kingdom, 1993 – 2014 (adapted from the Public Health England, 2016, and Steer, 2016).

Figure 2.6. Prevalence of severe/class III obesity among adults aged 16 and over: United Kingdom, 1993 – 2014 (adapted from the Public Health England, 2017).
The increasing tendencies in overweight and obesity are expected to continue until at least 2030 with the highest obesity rates projected for the United States (47%), Mexico (39%) and the United Kingdom (35%) (OECD, 2017).

Consequences

Increasing trends in obesity continue to threaten public health and contribute to the global burden of disease with higher morbidity impact than smoking (Jia & Lubetkin, 2010). Excessive weight significantly increases the risks for cardiovascular diseases (Manson, Colditz, Stampfer et al., 1990), stroke (Rexrode, Hennekens, Willett et al., 1997), type 2 diabetes (Colditz, Willett, Rotnitsky & Manson, 1995; Colditz, Willett, Stampfer et al., 1990), and certain cancers (Huang, Hankinson, Colditz et al., 1997) leading towards increased mortality rates (Manson, Willett, Stampfer et al, 1995, Willett, Dietz & Colditz, 1999). The risk of developing type 2 diabetes is about 20 times higher for obese people compared to lean individuals (Butland, Jebb, Kopelman et al., 2007). According to the Department of Health of the HM Government (2011) an obese woman is three times more likely to have a heart attack when compared to a non-obese woman and an obese man is three times more likely to develop colon cancer than a non-obese man. A wide amount of research also shows that obesity contributes largely to the development of various chronic diseases, such as hypertension (Huang, Willett, Manson et al., 1998; Witteman, Willett, Stampfer et al., 1989), gallbladder diseases (Maclure, Hayes, Colditz et al., 1989), osteoarthritis (Carman, Sowers, Hawthorne & Weissfeld, 1994; Davis, Ettinger, Neuhaus & Hauck, 1988; Grotle, Hagen, Natvig & Kvien, 2008) and musculoskeletal disorders (Beirman & Hirsch, 1981; Mann, 1974; Van Itallie, 1979).

Overall, most studies show that the risks of chronic illness and mortality increase as one’s BMI increases (Calle, Rodrigues, Walker-Thurmond & Thun, 2003; Patterson, Frank, Kristal & White, 2004; Yan, Daviglus, Liu et al., 2006).
In addition to the physical health problems, obesity has a serious impact on mental health, health-related quality of life and lifestyle outcomes. Excessive weight has been repeatedly associated with poorer psychological well-being (Bookwala & Boyar, 2008; Ogbeide, Neumann, Sandoval & Rudebock, 2010), including depression and anxiety (Abdus & Zuvekas, 2015; Bjerkeset, Romundstad, Evans & Gunnell, 2008; Brumpton, Langhammer, Romundstad, Chen & Mai, 2013; Dong, Sanchez & Price, 2004), low self-esteem and negative self-image (Griffiths, Parsons & Hill, 2010; Friedman & Brownell, 1995), body-image dissatisfaction (Carraça, Markland, Silva, et al., 2011; Gouveia, Frontini, Canavarro & Moreira, 2014; Pallan, Hiam, Duda & Adab, 2011), mood swings and overall life dissatisfaction (Carr, Friedman & Jaffe, 2007). A number of studies have shown that psychological disturbances related to obesity contribute to increased distress, poor perceived health status and functional impairment (Corica, Corsonello, Apolone et al., 2008; Kaplan, Huguet, Newsom, McFarland & Lindsay, 2003; Friedman, Reichmann, Costanzo & Musante, 2002; Pratt, Dey & Cohen, 2007). Moreover, obesity is perceived as one of the most persistent and continuous social stigmas (Cahnman, 1968) and obese individuals are often subjects of prejudice and discrimination (Carr & Friedman, 2005; Latner & Stunkard, 2003). They are presumed to be more impulsive and irritable, lacking willpower, motivation, and personal control (Puhl & Brownell, 2001; Puhl & Brownell, 2003; Puhl & Heuer, 2009; Teachman, Gapinski, & Brownell, 2001). In the current Westernized society that promotes thinness and fitness, obese people are less likely to be hired or promoted and they are more likely to have their performance negatively rated (Flint, Čadek, Codreanu et al., 2016). They are perceived as being less competent, having less leadership potential and are expected to be less successful (Levine & Schweitzer, 2015).
Economics

Obesity undoubtedly imposes a large economic burden not only on the individual, and their families but also on nations (Birmingham, Muller, Palepu, Spinelli & Anis, 1999; Levy, Levy, Le Pen & Basdevant, 1995; see Tremmel, Gerdtham, Nilsson & Saha, 2017 for a review). The toll obesity (on its own) takes on the global health care systems is between two and seven per cent of all health care spending in developed countries. Some estimates show that the costs of treating diseases associated with obesity account for an additional 13 to 18 per cent, bringing the overall costs up to 20 per cent (Dobbs, Sawers, Thompson et al., 2014). According to the McKinsey Global Institute (MGI) report, the impact of obesity on the world’s economy is roughly $2.0 trillion, which is about the same impact caused by smoking or armed forces (Dobbs et al., 2014). A number of studies and reviews (e.g. Andreyeva, Sturm & Ringel, 2004; Dee, Kearns, O’Neill et al., 2014; Specchia, Veneziano, Cadeddu et al., 2015) have confirmed that the health care costs attributable to obesity rise with increasing BMI. A BMI of 35 to 40 is associated with twice the increase in health care expenditure compared to the BMI of 30 to 35 (Andreyava et al., 2004), which is one of the main reasons why the economic burden is much greater in countries with a high prevalence of severe obesity (Tremmel et al., 2017). There is also a significant difference between direct costs of obesity and overall expenditures including indirect costs, such as the costs for productivity loss due to morbidity and early mortality (Weinstein, Siegel, Gold, Kamlet & Russell, 1996). Estimates of the direct costs to the NHS for treating overweight and obesity, and related morbidity in England, have ranged from £479.3 million in 1998 (National Audit Office, NAO, 2001) to £4.2 billion in 2007 (Butland et al., 2007; National Obesity Observatory, NOO, 2010). Over the same time period, the indirect costs were estimated to range between £2.6 billion (NAO, 2001) and £15.8 billion (Butland et al., 2007). Obesity rates in England have become relatively stable in the past few years (OECD,
LITERATURE REVIEW - INTRODUCTION

2017), bringing the direct costs attributable to overweight and obesity to £6.07 billion a year (Tovey, 2017). In 2014, 519,000 items were prescribed for the treatment of obesity in primary care in England, and the net ingredient cost of these prescription items was £15 million (HSCIC, 2016), which was actually half of the 2011 figure (HSCIC, 2013b). Indeed, small successes like this show that education of the population in terms of healthy eating and physical activity may help to ease the economic burden of obesity. However, education, or any kind of individual intervention on its own, is not sufficient and is unlikely to reverse the rising trends in obesity prevalence (Dobbs et al., 2014). In 2014, the MGI conducted a meta-analysis of 74 obesity interventions from around the world. Calculating their cost effectiveness, the MGI came to a conclusion that only a comprehensive, systematic program of multiple interventions (including those targeting the environment and societal norms) is likely to be effective. Combining different approaches in order to create a systematic portfolio of complex initiatives, may reverse rising obesity and increase productivity, saving around £1.2 billion a year for the NHS (Dobbs et al., 2014).

**Summary**

Obesity undoubtedly represents a world-wide health problem with substantial medical, social, and economic consequences (Arterburn et al., 2005; Yach et al., 2006; Runge, 2007), and has additional long-lasting negative effects on self-esteem, self and body image perception and overall life satisfaction (Sikorski, Luppa, Luck & Riedel-Heller, 2015). Despite public health warnings of the dangers of increased body weight, obesity is still on the rise (HSCIC, 2016) and up to date, there seems to be inconsistent evidence for long-lasting effects or health improvements of any currently applied obesity treatments (Fradkin et al., 2016). The rapid growth in obesity prevalence and seriousness of some cases suggests that there is a need for development of alternative approaches to treatment.
2.1.2. Case for positive psychology

Historically, the movement of positive psychology was born as a form of criticism of the research practices within the field of traditional psychology, which focused mainly on relieving suffering basing the discipline largely on a medical model of psychological disorders, but neglecting the positive aspects of human functioning (Ruini, 2017). Although positive psychology as a science is very young, its history and origins are deeply rooted in ancient Greek philosophies and traditional psychological approaches, some of which have been researching the concept of well-being for decades. Given this perspective, one may ask, why is positive psychology needed? In order to answer this question, it is essential to understand the concept of well-being and the ways it has been defined in the past.

All professional practices (e.g. therapy, health care, teaching, parenting, preaching etc.) have always aimed to change humans for the better. The question is, however, what “the better” truly means. From the historical point of view, psychosocial research on well-being has been dominated by two relatively distinct approaches that were different in their main characteristics, theoretical contributors, and assessment tools: (1) the hedonic or subjective approach to well-being, and (2) the eudaimonic or psychological approach (Ryan & Deci, 2001). Hedonism reflects the view that wellbeing consists of pleasure or happiness and pain avoidance (Kahneman, Diener & Schwarz, 1999). The concept of hedonic well-being could, therefore, be described as the presence of more positive emotions over negative ones, and a general positive evaluation of one’s life condition, in particular, life satisfaction (Diener, Suh, Lucas & Smith, 1999). Eudaimonism, on the other hand, is centred on the premise that well-being consists of more than just happiness. It is the ultimate actualisation of human potential in a process of self-realisation (Waterman, 1993). Eudaimonic theories describe the
psychological well-being as a multifaceted concept (Huta & Waterman, 2014) emphasizing different personality traits, such as self-esteem, meaning in life, optimism, enjoyment, and autonomy (Ryan & Deci, 2001; Ryff, 1989; Waterman, Schwartz, Zamboanga et al., 2010).

Recently, with the diffusion of the positive psychology movement, there has been an increasing awareness about the fact that positive affect is not the opposite of negative affect (Cacioppo & Berntson 1999), and that well-being is not just the absence of mental illness (Duckworth et al., 2005). The importance of integrating hedonic and eudaimonic approaches, as they complement each other in defining the overall construct of well-being (Ryan & Deci, 2001), has been recognised over the past couple of decades. The concept of optimal human functioning or optimal well-being has been defined as a combination of high subjective well-being and high psychological well-being (Ruini, 2017). In the current society, there seems to be only a very small number of people who would fall under the criteria defined by optimal human functioning, paving the way for possible psychosocial interventions.

There is no doubt that physical health and well-being are related concepts that affect each other – poor physical health has a negative impact on well-being and poor well-being is related to physical illness (McCloughen, Foster, Kerley, Delgado & Turnell, 2016). Sickness is often associated with displeasure or pain, so the presence of illness might directly increase negative affect. Additionally, since illness often presents functional limitations, it can prevent people from noticing opportunities for positive affect and life satisfaction (Ryan & Deci, 2001). The relationship between obesity and quality of life and mental well-being has been well documented in the past (Wardle & Cooke, 2005). Living with obesity impairs quality of life and increases the risk of psychiatric and affective disorders and vice versa. Patients with psychological troubles may become obese as a medication side effect and/or because they use food as a coping strategy (Avila, Holloway, Hahn et al., 2015; Polivy & Herman, 2005; Sharma, 2012; Van Der Merwe, 2007). Therefore, targeting well-being in obese populations
using positive psychology has the potential to directly improve quality of life and indirectly affect health behaviours in those populations.

Additionally, PPIs may help manage distress over obesity, which is thought to be a critical factor in successful long-term weight management (Vallis, 2016). Enhancing their experience of positive emotion, these interventions may help patients with obesity develop better coping strategies regarding their health behaviours, and become more flexible and creative in finding alternative solutions to problems (Tchanturia, Dapelo, Harrison & Hambrook, 2015). Indeed, PPIs have been successfully applied to a number of comorbidities associated with obesity, including obesity-related eating disorders.

A number of recent reviews indicated that mindfulness-based therapies may be an effective form of treatment for eating disorders and obesity-related eating pathology (Godsey, 2013; Katterman, Kleinman, Hood, Hackers & Corsica., 2014; O'Reilly, Cook, Spruit-Metz & Black, 2014), with some researchers even proposing that mindfulness is an essential component of holistic obesity treatment (Douglass, 2011; Kristeller & Wolever, 2011). Mindfulness-based approaches have been found to decrease automatic eating, as well as individuals’ tendency to eat in response to their emotions, which has been considered as one of the main contributors to obesity development and maintenance (Faith, Allison, & Geliebter, 1997). Furthermore, emotional eating underlies many of the negative moods (e. g. depression and anxiety) that have been found to be associated with overeating (Thayer, 2001), and have been effectively treated with PPIs (Sin & Lyubomirsky, 2009). Increasing well-being in individuals with weight problems by reducing distress, negative emotions, depressive moods and anxiety may, in addition, lead to decreases in their maladaptive eating behaviours. This may result in weight loss as a by-product of improved well-being. Therefore, a comprehensive PPI designed for individuals with weight problems could potentially represent an effective holistic approach to obesity treatment.
2.2. Obesity

The main purpose of this section is to review current treatment approaches used to address adult overweight and obesity. To enable an accurate assessment of individuals participating in the studies conducted within this PhD, different assessment methods were also reviewed. These are provided in Appendix A.

2.2.1. Treatment approaches in adult obesity

The decision to attempt weight-loss treatment should be based on a comprehensive assessment of the patient’s need to do so, (given their BMI and risks of health complications), as well as their behavioural readiness for weight reduction (Wadden & Osei, 2002). (See Appendix B for more details on the selection process of accurate obesity treatment.)

Obesity treatment in the primary care settings

The clinical approach to treatment of an overweight or obese person incorporates a two-step process used in the care of any patient with a multifactorial, chronic disease: (1) assessment, and (2) management (NHLBI, 1998; NHLBI & NAASO, 2000). As discussed in Appendices A and B, assessment should include determination of the degree of obesity and evaluation of the patient’s overall health status, on which basis a decision about management can be made. However, clinicians should pay attention to any potential contraindications to weight loss, if they are revealed during the assessment. Research evidence shows that there is a link between eating disorders and obesity (Stunkard, 2011) with significant similarities in risk factors and genetic predispositions (Day, Ternouth & Collier, 2009). A history of eating
disorders can present a relative contraindication for obesity treatment, and thus a referral to a specialist in this area may be more appropriate (Aronne, 2002). Alcohol and/or other substance abuse are other frequently observed comorbidities in obesity (Barry, Clarke & Petry, 2009; Sayon-Orea, Martinez-Gonzales & Bes-Rastrollo, 2011), requiring specific treatment, which should take precedence over weight reduction. Any related medical or psychiatric conditions must be stable before weight loss is undertaken (Aronne, 2002). Similarly, smoking cigarettes can complicate obesity treatment, as many individuals tend to gain weight upon attempting to quit, using food as a compensation for cigarettes (Munafò, Tilling & Ben-Shlomo, 2009). Indeed, all smokers should be encouraged to quit but smoking cessation interventions should include weight management support to help the quitting smokers avoid or minimize weight gain (Dare, Mackay & Pell, 2015). Also, faster rates of weight loss for longer periods of time have been associated with gallstone formation (Shiffmann, Sugerman, Kellum, Brewer & Moore, 1991; Weinsier & Ullmann, 1993), and increased incidence of osteoporosis (Riedt, Cifuentes, Stahl et al., 2005; Sukumar, Ambia-Sobhan, Zurfluh et al., 2011). Therefore, in case of treating obese patients with cholelithiasis and osteoporosis, practitioners should warn them that weight loss may aggravate these conditions (Erlinger, 2000). Weight reduction is not recommended during pregnancy as it may harm the health of the unborn child (NICE, 2006). However, offering an advice on healthy eating and physical activity during pregnancy may be appropriate.

Generally, all patients should be encouraged to consume a healthy balanced diet and increase their physical activity in order to manage their weight (see Appendix C for a comprehensive review of dietary interventions and exercise recommendations commonly prescribed to patients with obesity). However, individuals at increased risks of weight-related health complications should be the primary targets for treatment, which should be selected appropriately based on their BMI (NHLBI, 1998; NHLBI & NAASO, 2000; Wadden et al.,
2002). Individuals at lesser risk are usually offered some form of obesity counselling about effective lifestyle changes, which is often a combination of diet modification, increased physical activity and behaviour therapy for weight loss. Behavioural techniques can be used in conjunction with weight loss medication or surgery (see Appendix D for more detail). This approach would usually be suggested to those patients, who are at high risk of developing health complications because of their weight, and patients with existing comorbidities (NHLBI & NAASO, 2000). Primary care physicians are ideally situated to promote weight loss via obesity counselling. They have longitudinal relationships with their patients that enable rapport building and behavioural change management, and they are experts in managing chronic diseases and health conditions (Schlair, Moore, McMacken & Jay, 2012). However, research evidence about the efficacy, effectiveness and feasibility of the counselling approaches used by clinicians in primary care settings, is unclear (U.S. Preventive Services Task Force, USPSTF, 2002). In fact, several studies have suggested that primary care physicians struggle to deliver adequate obesity counselling to their patients due to lack of confidence and competence in managing obesity (Jay, Adams, Herring et al., 2009), lack of systematic counselling skills (Sciamanna, DePue, Goldstein et al., 2002), negative attitudes and prejudice (Jay, Kalet, Ark et al., 2009), and lack of time (McTigue, Conroy, Bigi, Murphy & McNeil, 2009; Tsai & Wadden, 2009). Although, the position of primary care practitioners has improved with the recent announcement of the CMS that Medicare will cover intensive behavioural counselling for obese patients (CMS, 2011). As a result of that decision, many practitioners have become more interested in gaining the necessary skills to provide high-quality weight management counselling using the 5As model\(^5\) advocated by the USPSTF and CMS (Schlair et al., 2012). This model guides the provider to: (1) assess risk and readiness to

---

\(^5\) The 5 As (Assess, Advise, Agree, Assist, Arrange) is an evidence-based behaviour-change counselling framework initially found to be effective tool to promote smoking cessation (Bentz, Bayley, Bonin et al., 2007).
change, (2) advise specific behaviour change, (3) agree on specific goals in a collaborative manner, (4) assist the patients in achieving those goals via addressing barriers (motivational interviewing), and (5) arrange to follow-up or refer the patient for further treatment. Even though the model has been found to promote obesity counselling competence in primary care providers (Jay, Gillespie, Schlair, Sherman & Kalet, 2010; Jay, Schlair, Cadwell et al., 2010), it seems that most practitioners fail to make use of the model’s full potential (Alexander, Cox, Boling Turer et al., 2011). Physicians routinely Ask and Advise patients to lose weight, but they rarely Assess, Assist or Arrange. Paradoxically, it is only Arrange that seems to be linked to actual weight loss. Patients whose physicians Arrange a follow-up visit are more likely to lose weight three months following the visit (Alexander et al., 2011).

Overall, it seems that even intensive counselling for obesity is, by itself, not sufficient to achieve clinically meaningful and sustainable weight loss, and thus, use of collaborative obesity care appears to be a better choice (Tsai & Wadden 2009).

**Self-help and commercial programs**

Nonmedical self-help and commercial weight loss programs are very popular among consumers and their use has grown markedly in recent years (IBISWorld, 2014). Even though they vary in the particular approaches they use, most of them focus on diet, exercise, and lifestyle modification in combination with some form of behavioural counselling (Womble et al., 2002), as these are believed to be the essential components of effective weight loss programs (Jensen, Ryan, Apovian et al., 2013). Many use group support as motivation for weight loss, weekly weight loss goals and awards for achievement of particular weight loss targets (Jolly, Daley, Adab et al., 2010). Medical care, however, is usually not provided by these programs. Therefore, they should not be primarily recommended to overweight or obese individuals with significant health problems. Currently, the market is dominated by three
commercial weight loss services: Weight Watchers, Jenny Craig, and NutriSystem, which are all of high intensity with two (Jenny Craig, NutriSystem) relying on low-calorie meal replacements (Gudzune, Doshi, Mehta et al., 2015).

**Weight Watchers.**

Weight Watchers International, established in 1963, is currently the largest commercial weight loss program in the world, which combines dietary intervention and physical activity with weekly group sessions, in order to achieve health improvements and weight loss (Weight Watchers International, n. d.). A number of studies comparing Weight Watchers with self-help/education approaches have been conducted over the past two decades (see Gudzune et al., 2015 for a review). However, the findings of these studies have yielded mixed results in terms of weight loss and maintenance. Some evidence suggested that participation in structured commercial weight loss program was more effective than brief counselling and self-help approaches but still produced only modest weight loss (Heshka, Anderson, Atkinson et al., 2003; Heshka, Greenway, Anderson et al., 2000). Other researchers have shown that the use of Weight Watchers results in significantly greater weight loss (between 4 and 6 kg) compared to self-help approaches (Johnson, Rost, Miller-Kovach, Moreno & Foreyt, 2013; Truby, Baic, deLooy et al., 2006). Most studies agreed that it is necessary for the participants to follow the program for a substantial period of time (usually 6 months or more) in order to achieve clinically meaningful weight loss (Jolly, Lewis, Beach et al., 2011; Truby et al., 2006). There is, however, an argument about the consumer friendliness and cost effectiveness of all these programs. Some researchers propose that commercially provided weight management services are more effective and cheaper than primary care services led by specially trained staff (Jolly et al., 2011), whereas others claim that the strategies for reducing obesity used by all these programs are not cost-effective, and their benefits for wide population health are very small (Cobiac, Vos & Veerman, 2010). Given that the average weight loss reported after 2 to 6
months of attending Weight Watchers has ranged between 2.2 kg to 4.71 kg (Jolly et al., 2011; Truby et al., 2006), and the average cost of the intervention has been estimated for $230 per person (Cobiac et al., 2010), the price for 1 kg of lost weight would fall between $48.8 and $104.5. Although these numbers may not look very optimistic, Weight Watchers is still one of the lowest cost programs providing the most cost-effective management compared to other commercial programs and non-surgical obesity treatment methods (Finkelstein & Kruger, 2014).

*Jenny Craig.*

Jenny Craig is another popular commercial program using individual counselling (as opposed to group meetings used by Weight Watchers), low-energy density diet, pre-packaged foods, and increased physical activity to promote weight loss (Rock, Pakiz, Flatt & Quintana, 2007). Only a few studies have assessed the effectiveness of this program. However, their findings seem to be much more stable compared to Weight Watchers. Jenny Craig participants have consistently achieved at least 4.9 % greater sustained weight loss (between 6.2 kg and 7.4 kg after 24 months) when compared to either control/education group (Rock et al., 2007), or groups receiving behavioural counselling (Dow, Thomson, Flatt et al., 2013; Rock, Flatt, Pakiz et al., 2014; Rock, Flatt, Sherwood et al., 2010). This was observed regardless of the program delivery method (intervention via telephone or in person) or target population (participants with type 2 diabetes mellitus). In terms of cost effectiveness, Jenny Craig seems more expensive than Weight Watchers. However, Weight Watchers estimates do not include the costs of food, whereas the meal replacements provided by Jenny Craig are included in their prices (Gudzune et al., 2015).

*Nutrisystem.*
Nutri/System, Inc., was first established in 1972 as a comprehensive weight management centre, which has used a number of weight loss methods over the years, including VLCDs, prepackaged foods, and medication (Womble, Wang & Wadden, 2002). The company in its original form was not successful and re-emerged as an entirely online weight management commercial program (nutrisystem.com) in 1999 (Key, 2000). Perhaps the greatest advantage of this commercial service is its relatively low cost compared to the other two programs mentioned above. Participants do not pay anything for the program itself, but they purchase their weekly food supplies online from the Nutrisystem store, which is then delivered to their homes. All meal plans are based on portion controlled packages containing 1200 – 1500 kcal/day, and they are individually selected by the consumers (Nutrisystem, n.d.). The effectiveness of Nutrisystem has only been assessed by three randomised controlled trials, that have compared the program to control/education approach (Foster, Bordaille, Vander Veur et al., 2009), or behavioural counselling (Figueroa, Vicil, Sanchez-Gomez et al., 2013; Foster, Wadden, Lagrotte et al., 2013). Findings from these studies were promising, as Nutrisystem resulted in at least 3.8% greater weight loss compared to both control/education approach and behavioural counselling. However, the rate of bias was moderate or high for all trials, which might have been due to their short duration (weight loss was compared at 3 months and none of them continued to 12 months) (Gudzune et al., 2015). Due to the lack of any long term studies, no definitive conclusions on the effectiveness of Nutrisystem can be made.

**Very-low-calorie and low-calorie programs:** *Health Management Resources (HMR), Medifast, Optifast.*

Medically based proprietary weight loss programs represent another sub-group in the wide range of popular weight management approaches. Traditionally, they combine the use of VLCDs or LCDs with a multidisciplinary program of lifestyle modification, and they are supervised by physicians (Womble et al., 2002). The diets can be consumed either as a solid
food with set amounts of macronutrients, or in a form of a liquid protein diet including the recommended daily allowance for vitamins and minerals. Several randomised controlled trials have reported significantly larger weight losses in patients treated with VLCDs compared to those on LCDs (Wadden et al., 1994; Wikstrand, Torgerson & Bostörm, 2010; Wing, Blair, Marcus, Epstein & Harvey, 1994). However, most patients regained up to 50% of their initial weight loss within the year following treatment.

**HMR.** HMR is a medically supervised weight loss program based on one of the three reduction diets (VLCD, LCD or BDD) with a use of protein shakes and nutrition bars. A selected dietary plan is combined with weekly behavioural group sessions, which provide the patients with lifestyle skills for weight management. A number of studies (e.g. Anderson, Brinkman & Hamilton, 1992; Anderson, Vichitbandra, Qian & Kryscio, 1999) have demonstrated the safety and efficacy of the HMR program in the past. However, only 3 randomised controlled trials have compared HMR to control/education group (Donnelly, Smith, Dunn et al., 2007; Perna, Bryner, Donley et al., 1992; Smith, Van Walleghen, Cook-Wiens et al., 2009), and one compared HMR to behavioural counselling (Anderson, Reynolds, Bush, Rinsky & Washnock, 2011). All trials reported greater weight losses in the HMR group, however, none of them continued to 12 months. At three months, participants in the HMR group achieved significantly greater weight loss than the education/control group, ranging between 8.5% (Smith et al., 2009), and 19% (Perna et al., 1992). When compared to the behavioural counselling group, HMR resulted in 13.2% (13 kg) greater weight loss at six months.

**Medifast.** Similarly to HMR, Medifast also uses portion-controlled meal replacement plans in combination with behavioural support. Up to date, only one randomised controlled trial has been conducted to assess the effectiveness of Medifast in comparison to behavioural counselling with a self-selected food-based meal plan (Davis, Coleman, Kiel et al., 2010).
Weight loss at four months was significantly better in the Medifast group (12.3%) than the food-based counselling group (6.9%). However, during the 24-week period of weight maintenance, the Medifast group also regained significantly more weight than the food-based counselling group, although it still achieved greater weight loss overall. Yet, the difference was not statistically significant at the end of the weight maintenance period.

*Optifast.* Optifast is a medically supervised weight management program, which utilizes a full meal replacement plan in combination with individual and group counselling sessions that focus on lifestyle modification (Optifast, n.d.). The program usually lasts for 26 weeks and the patients have an option to continue with a weight maintenance program. The costs depend on the clinic and the number of weeks attended, but they usually range between $2000 and $4000. The safety and efficacy of the Optifast program has been extensively researched and well established (Barrows & Snook, 1987; Doherty, Wadden, Zuk et al., 1991; Wadden, Foster, Letizia & Stunkard, 1992). Up to date, four randomised controlled trials have compared Optifast with behaviourial counselling (Doherty, et al., 1991, Wadden, Considine, Foster et al., 1998; Wadden, Foster, Sarwer et al., 2004; Wing et al., 1994). Overall, greater weight reductions (between 4.2% and 9.2%) at four to five months were observed in patients attending the Optifast program. However, only one trial continued beyond 12 months, when the differences between groups were no longer statistically significant (see Gudzune et al., 2015 for a review).

Although proprietary weight loss programs seem to offer promising weight loss outcomes, these appear to be only short term results. It is unclear, whether they can lead to sustained weight losses over long periods of time. Moreover, even the safe forms of liquid-based VLCDs can increase risks of developing some medical complications, such as gallstones, constipation and alopecia (Bischoff, Damms-Machado, Betz et al., 2012; Wadden et al., 1992).
Additionally, all of these programs are quite expensive (up to $3000 for 12 weeks), which can make them unaffordable for most people (Gudzune et al., 2015).

**Self-directed programs: Atkins, Biggest Loser Club, eDiets, Lose It!, SlimFast.**

The vast majority of self-help approaches incorporate some form or a combination of the popular diets discussed earlier. Many of them currently offer support through the Internet, and some (Biggest Loser Club, eDiets, and Lose It!) are exclusively Web-based programs. Clients usually receive customised diet plans and grocery lists to match their needs, lifestyles and preferences. Unlike the proprietary weight loss programs, there are often no standardised calorie or portion recommendations, but they are based on each individual’s weight/BMI and their weight loss targets (Womble et al., 2002). Some programs (e.g. SlimFast) provide meal replacements, which are, however, only recommended in place of one or two meals a day. For the rest of the day clients are encouraged to eat balanced meals based on advised food combinations and individually selected plans (SlimFast, n.d.).

Online programs are usually a lot cheaper than similar programs delivered in-person, which makes them generally affordable for most people. However, according to recent weight management guidelines, they are also much less effective in terms of weight loss (Jensen et al., 2013). They may lead to slightly greater short-term weight reductions than control/education (Collins, Morgan, Jones et al., 2010; Collins, Morgan, Jones et al., 2012; Hutchesson, Collins, Morgan et al., 2014), which are similar to counselling at three months (Allen, Stephens, Dennison Himmelfarb, Stewart & Hauck, 2013), but after 12 months the differences between groups are not significant (Womble, Wadden, McGuckin et al., 2004). Atkins-like programs result in greater short-term weight losses even after 6 and 12 months, when compared to both, control/education (Morgan, Griffin, Millward et al., 2009; Truby et al., 2006) and behavioural counselling groups (Foster, Wyatt, Hill et al., 2010; Gardner, Kiazand, Alhassan et al., 2007;
Moor, King, Kiernan & Gardner, 2011; Yancy, Almirall, Maciejewski et al., 2009). However, while Atkins appear more promising than other self-directed approaches, they should be interpreted with caution, as many trials relied upon registered dietitians to deliver counselling and dietary guidance on Atkins (Gudzune et al., 2015).

**Psychological interventions for obesity**

**Behavioural treatment.**

The cornerstone of successful weight management is a complex lifestyle intervention, which incorporates dietary changes and physical activity. However, as discussed previously, many individuals find it very challenging to comply with these lifestyle changes, which is why behavioural therapy has been incorporated into the overall intervention. There is a substantial amount of research evidence supporting the use of behaviour therapy in obesity treatment (Wing, 1998), and a combination of reducing diet, physical activity and behaviour therapy has been proposed as the most effective for weight loss and maintenance (NHLBI, 1998; NAASO, 2000).

Behaviour therapy (BT) as a treatment for overweight and obesity has been first applied in late 1960s (Stuart, 1967). This early approach originated in Learning Theory, on which basis it was assumed that eating and exercise behaviours included a learned component, and therefore could be re-learned or modified. Additionally, behaviourists believed that in order to change maladaptive eating patterns and exercise habits, one must strive to alter the environmental cues that control and reinforce those behaviours (Wing, 2002). Based on these premises, early behavioural programs would teach their participants to restrict their eating to one location, separate it from other activities and monitor situational and emotional cues related to eating, without prescribing any specific goals for caloric intake or exercise (Wing & Jeffery, 1979). Since then, there has been a rapid growth of BT approaches in the management of
obesity, resulting in the development of more intensive and longer interventions, which have proven to be much more effective and produced significantly greater weight losses (Wadden, Berkowitz, Womble et al., 2005).

The BT approaches currently used to treat overweight and obesity employ two main assumptions: (1) obese individuals display maladaptive eating and exercise patterns, and (2) these maladaptive behaviours can be modified with specific interventions leading to weight loss (Jacob & Isaac, 2012). Using the traditional principles of classical and operant conditioning, BT targets individual’s food consumption and exercise habits teaching them new behaviours that reduce caloric intake and increase physical activity. The major components used in behavioural weight control packages are self-monitoring, stimulus control, goal setting and behavioural contracting (Butryn, Webb, & Wadden, 2011). Studies have shown that maintaining food diaries and activity logs predicts weight loss outcomes (Guare, Wing, Marcus et al., 1989), and altering of the environmental cues related to eating helps reduce food consumption and prevent overeating (Wansink & Cheney, 2005). Setting clear and realistic goals for weight loss results in greater actual weight reductions (Bandura & Simon, 1977), as well as reinforcement of successful outcomes or good behaviour by a reward (Volpp, John, Troxel et al., 2008). A number of additional components commonly present in BT weight management approaches, have been shown to enhance weight loss (Jacob & Isaac, 2012). Slower eating, nutritional education delivered by a dietitian, and structured meal planning leads to significantly greater weight reductions compared to the absence of education (Pedersen, Kang & Kline, 2007).

Physical activity also plays an important role in successful behavioural weight management. Self-monitoring and increasing physical activity have been consistently associated with better weight loss outcomes and maintenance (Wing & Phelan, 2005). Additionally, it has been shown that including spouses and family members in BT can, not only
LITERATURE REVIEW - OBESITY

make the process of change more bearable, but also enhance the actual weight loss outcomes (Avenell, Broom, Brown et al., 2004). Interestingly, many of these components can be identified in mindfulness-based approaches to disordered eating (Dalen, Smith, Shelley et al., 2010; Katterman et al., 2014; Kristeller & Wolever, 2011; Mason, Epel, Kristeller et al., 2016). BT can be delivered in a number of settings, such as a dietary clinic, commercial and self-help weight loss programs or internet-based programs. Although it can be provided to individuals, it is usually delivered to groups of 10 – 15 participants on a weekly basis for an initial period of four to six months (Butryn et al., 2011). Previous research has found group-based BT more effective than individual care (Renjilian, Perri, Nezu et al., 2001), which may be due to aspects of empathy, social support, and healthy competition (Wadden & Foster, 2000). Each group session is typically scheduled for 60 – 90 minutes and it focuses on teaching the participants new weight management skills (e.g. healthy food choices, portion control, self-monitoring, social support) according to a structured curriculum, which is delivered by trained professionals (Butryn et al., 2011). Large amount of research evidence shows an association between a person’s weight management skills and their weight loss success. Patients who monitor their eating and weight have been consistently achieving the greatest weight losses (Baker & Kirschenbaum, 1993; Boutelle & Kirschenbaum, 1998; Butryn, Phelan, Hill & Wing, 2007).

Generally, individuals treated with a comprehensive behavioural approach including a complex lifestyle modifications, achieve an approximate weight loss of 8 – 10% of their initial body weight (Wadden, Butryn & Wilson, 2007). Based on the research evidence, there is no doubt that BT induces weight loss effectively. However, it has notable limitations in terms of weight maintenance. Individuals who initially succeed at weight loss in a BT program often find that their efforts are constantly challenged by the “obesogenic environment” (processed unhealthy food, large portion sizes, sedentary lifestyle), which remains highly influential after the intervention has come to the end (Drewnowski & Rolls, 2005; Lowe, 2003). Weight loss
maintenance is also challenged by additional biological factors, such as metabolic responses of
the organism to weight loss, genetically influenced preferences for palatable foods, and
conservation of energy (Rosenbaum, Hirsch, Gallagher & Leibel, 2008). All these aspects
suggest that the only way to achieve a long-term sustainable weight loss, is to remain vigilant
with regards to eating behaviour and physical activity (Catenacci, Ogden, Stuht et al., 2008;
Jakicic, Marcus, Gallagher, Napolitano & Lang, 2003; Jeffery, Wing, Sherwood & Tate, 2003;
Tate, Jeffery, Sherwood & Wing, 2007). In some cases, behavioural weight loss treatments can
be enhanced by pharmacologic approaches, which may improve the induction of weight loss
(Phelan & Wadden, 2002; Wadden et al., 2005), and support weight maintenance (Bray &
Ryan, 2007; Yanovski & Yanovski, 2002).

_Cognitive-behavioural therapy (CBT)._ 

In many respects, cognitive behaviour therapy (CBT) is similar to behaviour therapy. They are both problem-oriented treatments focusing on the present and future, rather than the
past. They use similar collaborative therapeutic style requiring the patients to be active
participants in the process of change, and they both seek empirical evidence to evaluate their
effectiveness (Cooper & Fairburn, 2002). Some cognitive approaches to behaviour change (e.g.
problem solving, cognitive restructuring) are sometimes used in the standard behavioural
treatment of obesity to induce changes in eating and exercise behaviour (Fabricatore, 2007).
However, there are three additional features of CBT that distinguish it from traditional
behaviour therapy: (1) it is based on a cognitive conceptualisation of the process that maintain
the problem in question (i.e. thoughts and thinking patterns), (2) it is designed to alter the
cognitive and behavioural mechanisms that maintain the problem behaviour, and (3) it
combines cognitive and behavioural techniques to help the patient identify and change the
maintaining mechanisms (Cooper, Fairburn & Hawker, 2003).
Although standard behaviour therapy does aim to target both cognitive and behavioural patterns of eating and physical activity, it sees obesity as primarily behavioural in nature, rather than a product of maladaptive thoughts and beliefs. Behavioural approaches neglect the contribution of cognitive factors to weight regain (Cooper & Fairburn, 2001), which seems to be the greatest challenge in the long-term management of obesity (Perri, 1998). Also, they are often ambiguous when defining treatment goals. Many patients identify weight loss as their main goal, but they do not consider any strategies for its maintenance, which usually leads to the patients returning to their old eating habits after completing the behavioural treatment. Therefore, the major role of CBT in obesity treatment is to address the problem of weight regain and the neglect of weight maintenance as a goal. This is achieved by following three main elements throughout a two-phase course of treatment: (1) drawing a clear distinction between weight loss and weight maintenance, (2) addressing potential obstacles to the acceptance of weight maintenance as the goal, and (3) helping patients acquire, and practice the behavioural skills and cognitive responses needed for effective weight control (Cooper & Fairburn, 2002). The treatment is usually administered on one-to-one basis with a weight loss phase (Phase One) lasting between 24 and 30 weeks, and a weight maintenance phase (Phase Two), which is recommended for a minimum of 14 weeks. However, it can be used in peer support groups, where CBT enhances the ability of relating to others, promotes self-learning and supports patients in independent self-monitoring (Liao, 2000).

CBT has been successfully applied to some forms of eating disorders (bulimia nervosa, binge eating disorder), which might be of particular relevance to the problem of weight regain in obesity, as it resulted in many of these patients making lasting changes to the way they eat (Cooper, Doll, Hawker et al., 2010). CBT particularly designed for treatment of bulimia nervosa (CBT-BN; Fairburn, 2008; Fairburn, Marcus & Wilson, 1993) has been found to substantially decrease the frequency of binge eating episodes and related behaviour, with the
treatment effects persisting in the majority of cases (Wilson & Fairburn, 2007). Research on binge eating disorder have produced similar findings (Grilo, Masheb, Wilson, Gueorguieva, & White, 2011). Additionally, CBT has been shown to effectively target a number of aspects related to binge eating disorder, such as loss of control, low self-esteem, obsessive thoughts, body-image perception (Nauta, Hospers, Jansen & Kok, 2000; Werrij, Jansen, Mulkens et al., 2009), which may be shared by patients with obesity (Folope, Chapelle, Grigioni, Coëffier & Déchelotte, 2012). The beneficial effects of CBT in eating disorders suggest that it may be able to directly target dysfunctional eating patterns, improve body-image perceptions, and promote healthy weight-control behaviours (Iacovino, Gredysa, Altman & Wilfley, 2012). Adding cognitive therapy to dietary intervention has been associated with less relapse in obesity (Werrij et al., 2009), and combining CBT with diet/exercise has led to greater weight losses than CBT alone (Shaw, O’Rpurke, Del Mar & Kenardy, 2005). However, participants included in these studies frequently displayed comorbid conditions with binge eating disorders. The effect of CBT has been rarely studied in obese patients without eating disorders and up until this point it has not proven to be superior to standard primary care (Muggia, Falchi, Michelini et al., 2014), or behavioural therapy (Cooper et al., 2010). Most people regain weight within one year following the end of treatment regardless of which type of treatment they have undergone. These findings further support previous notions that obesity is resistant to psychological methods of treatment, and currently there are no sufficiently effective strategies to help the patients achieve lasting weight loss and prevent relapse.

Motivational interviewing for weight loss.

Motivational interviewing (MI) is a person-centred, time-limited, approach to therapy that aims to address and discuss patient’s ambivalence in order to strengthen intrinsic motivation and behaviour change (Miller & Rollnick, 2013). It strives to “enhance self-efficacy and personal control for behaviour change and uses an interactive, empathic listening style to
increase motivation by highlighting the discrepancy between personal goals and current behaviour” (DiLillo et al., 2003, p. 120). Originally, MI was developed for alcohol abusing individuals to help them become more engaged in available treatments (Miller & Rollnick, 1991). However, ambivalent attitudes toward behaviour change are not unique to individuals with drinking problems. Therefore, MI can be used for all kinds of problematic behaviour to help clients/patients identify and strengthen their own motivation and commitment to change (Douaihy, Kelly & Gold, 2014). Lack of motivation and poor adherence are one of the main reasons why most people fail to achieve and maintain healthy body weight (Teixeira, Silva, Mata, Palmeira & Markland, 2012). An increasing amount of evidence suggests that incorporating MI into behavioural obesity treatment may be an effective approach to weight loss and weight-related behaviour change (Armstrong, Mottershead, Ronksley et al., 2011; Burke, Arkowitz & Menchola, 2003; DiLillo & West, 2011; Lundahl, Kunz, Brownell, Tollefson & Burke, 2010). A number of studies have reported significantly greater weight reductions in individuals who received MI intervention as part of their regularly scheduled appointments (Bennett, Herring, Puleo et al., 2010; Greaves, Middlebrooke, O’Loughlin et al., 2008; Hardcastle, Taylor, Bailey & Castle, 2008; Hardcastle, Taylor, Bailey, Harley & Hagger, 2013; Williams, Hollis, Collins & Morgan, 2014), or in addition to typical treatment in primary care settings (Martin, Dutton, Rhode et al., 2008; Martin, Rhode, Dutton et al., 2006). However, these weight reductions were only modest on average. There were only a few trials that identified weight loss greater than 5%, a parameter associated with important health-related improvements (Sjöström, Lindroos, Peltonen et al., 2004), and those were almost all individual treatments lasting typically for 6 months (see Barnes & Ivezaj, 2015 for a review). Curiously, these findings oppose the typical assumptions of many self-help and commercial programs, and behavioural therapies that work on the basis of group support. Clearly, both, group and individual approaches have their distinct place in obesity treatment, but it is possible that the
benefits of MI interventions for weight reduction may be overlooked when examining only the average weight loss.

Some studies also reported significant increases in physical activity in participants, who received MI intervention (Christian, Bessesen, Byers et al., 2008; Hardcastle et al., 2008; Hardcastle et al., 2013). However, other trials showed no differences between groups in this respect (Armit, Brown, Marshall et al., 2009; Greaves et al., 2008; Harris, Chan, Laws et al., 2013). Interestingly, no treatment-related improvement was identified in the participants’ eating behaviour, suggesting that any weight losses observed in the MI groups would not have been primarily due to a change in eating behaviour (Barnes & Ivezaj, 2015). Although MI produced only modest weight loss, it is a cost-effective approach, which can be easily disseminated and adopted by a wide range of health practitioners. MI trained professionals could help many individuals with weight problems, who do not have access to more intensive options, reduce their weight-related health complications. However, there is very limited amount of data on the effectiveness of MI for weight loss maintenance, as well as treatment fidelity. A relatively recent UK study suggested that an intensive MI intervention may facilitate long-term weight maintenance (Simpson, McNamara, Shaw et al., 2015). Yet, conclusions drawn from this trial were limited by a small sample size. Two studies have reported weight loss maintained over 12 month period, when MI was used as a part of CBT or guided self-help treatment (DiMarco et al., 2009; Rieger, Dean, Steinbeck, Caterson & Manson, 2009). Additional improvements in obesity-related quality of life, maladaptive eating patterns, body image dissatisfaction and maladaptive cognitions were also observed (see Christie & Channon, 2014 for a review). Yet, any further follow-ups have not been reported, and also other studies have shown that MI does not result in sustainable weight loss (Moss et al., 2017).

Overall, MI seems to have the potential to facilitate change and increase patient engagement in therapy, improving the efficacy of other interventions. However, there are still
many areas of uncertainty. With most studies failing to measure and report on fidelity, it is unclear what aspects of MI are actually being delivered.
2.3. Positive Psychology

2.3.1. History and origins of positive psychology

The ancient Greeks

Although positive psychology as a scientific discipline is less than a couple of decades old, the concepts studied by positive psychologists have their ancient roots in schools of great philosophers and religious leaders, who have been trying to address the concept of the “good life” for centuries (Lopez & Snyder, 2009). Stoic philosophers believed that the purpose of man was to live a “good life” achieving “eudaimonia” (pleasure⁶), but their interpretation of “eudaimonia” was not always exactly the same. Ancient Greek philosophers were divided about the nature of eudaimonia, and had they lived today, they would have had different opinions about which aspects of life should be included in assessment tools measuring happiness and flourishing (Tiberius & Mason, 2013). According to Plato pleasure was the “replenishment of a lack”, which was always identified by a relief from distress (Riel, 2000). As the lacking substance or aspect of one’s life gets replenished, it brings relief from suffering and distress. The relief, however, is not instant, rather, it occurs gradually, which leads to a conclusion that pleasure must inevitably coexist with pain unless a complete replenishment is achieved. From this perspective there ought to be different stages of “eudaimonia” with “mixed pleasures” that are identified according to the intensity of perceived lack and replenishment. In

⁶ The direct translation of eudaimonia as pleasure can be misleading from the perspective of someone who lives in the 21st century. From the context of works of Aristotle, it becomes more apparent that the alternative translation of eudaimonia as “happiness” or “flourishing” would be more appropriate (Mason & Tiberius, 2013).
other words, the state of life, the “goodness” of life and the level of happiness depends on an individual’s ability to perceive it.

Socrates, on the other hand, makes no distinction between different kinds of pleasure and although he seems to defend hedonism to certain extend, he also argues that pleasure is not always unconditionally good (Riel, 2000). According to Socrates, a “good life” can only be achieved through knowledge by constant weighing, evaluation and comparison of present pleasures and pains. Therefore, the people who fail to achieve and live a good life are those who do not have any knowledge of excess and lack, which causes them to make a wrong choice of pleasure and pain (Kahn, 1996). However, he also argues that as nobody wants to suffer willingly, the choice of wrong pleasure (or bad life) can only be made out of ignorance or wrong estimation of the pleasures and pains that are compared. Therefore, the central human value is the willingness to re-think one’s own assumptions.

Perhaps the most influential out of all of the ancient Greek philosophers was Aristotle whose works in moral psychology (Nicomachean Ethics) remain prominent in the contemporary environment. The key question Aristotle addresses is “What is the ultimate purpose of human existence?” He believes that if the goal of life is supposed to be ultimate with a final destination, it has to be self-sufficient, “that which is always desirable in itself and never for the sake of something else” (Aristotle, 350 B.C.E., Nicomachean Ethics, Book I). If people chose to do things for the sake of something else, that process would go on to infinity making all human desires vain and empty. In Aristotle’s view, happiness meets all the requirements, as it is self-sufficient and attainable by man, and therefore it must be the final destination, the ultimate purpose of life everyone should strive for. Aristotle claims that happiness cannot be found in any abstract or ideal notion, but must be based on human nature and personal experience (Internet Encyclopedia of Philosophy, IEP, n.d.), the experience of all-encompassing sense of well-being, which makes human life worthwhile (Jackson, 2007).
Happiness, the way most people understand it now, is probably quite similar to Aristotle’s version. Some aspects of his theory, however, may be argued about. It could be agreed that everybody wants to be happy, feel fulfilled or complete, and that people’s interpretations of what it means to be happy may, and do vary. However, the assumption that there is only one destination for everyone, may not be accepted by all. It would be incorrect to say that all human beings want the same happiness. Yet, according to Aristotle, “everything has an aim, therefore, there is one goal, the Good, to which every aim is directed” (Jackson, 2007, p. 3). From this perspective, the premise of one ultimate Good suggests that all potential activities performed by man should be leading towards the same end, which is a notion open to a scrutiny. For a caveman, “eudaimonia” would be a safe cave on a top of a mountain, with a fire and mammoth ready to be eaten. For a person living in the 21st century, “eudaimonia” would hardly represent the same things. Aristotle admits that different people have different opinions and perceptions of happiness. However, he insists that although there may be many things people pursue for their own sake (e.g. knowledge, pleasure, courage, honour), those things are also pursued for the sake of living well (Lacewing, 2015). “Eudaimonia” is the only self-sufficient thing and it cannot be made more desirable by adding something else to it. People do not want to live well in order to achieve some other destination, but everything they do in their lives, they do so in order to live well and flourish (Aristotle, 350 B.C.E., Nicomachean Ethics).

**Eastern philosophies**

Eastern theories of well-being and mental health are strongly associated with the concepts of harmony balance and equilibrium (Joshanloo, 2013). Similarly to the eudaimonic Greek philosophies, these theories do not believe in hedonism as a way of pursuing happiness. Pleasures and positive emotions are seen as temporary, which makes them insufficient criterion
for happiness measurement (Ruini, 2017). The main philosophical traditions of Eastern countries (e.g. Confucianism, Buddhism, Taoism, and Hinduism), indeed, share many aspects with the eudaimonic perspective on happiness. They emphasize the importance of self-cultivation, self-conquest, and self-discipline over hedonism (Lee, 2004), advocating that happiness does not depend on any external or internal pleasurable stimuli (Wallace & Shapiro, 2006). Pleasures are perceived as centred on the self, which can sometimes cause conflict with other individual’s well-being. Therefore, instead of pursuing pleasures, people should strive for mental balance and contentment (Wallace & Shapiro, 2006), and act in accordance with human virtues of gratitude, non-violence, compassion, and generosity (Shamasundar, 2008). However, they also note that happiness is not necessarily incompatible with suffering, and that happiness and unhappiness actually complement each other. Taoism, in particular, embraces the idea that “the positive is hidden in the negative and vice versa (yin and yang) and that happiness occurs as the by-product of living in accordance with Tao, the principle regulating nature, heaven, and the lives of human beings” (Littlejohn, 2007; in Ruini, 2017, p. 15).

Already the early works of ancient Greek philosophers clearly demonstrated that happiness and the “good life” are not simply the experiences of feeling good. “True happiness is found in the expression of virtue and doing what is worth doing” (Hefferon & Boniwell, 2011, p. 77). And although “eudaimonia” differs from the current understandings of happiness and well-being in that it is not believed to be the final aim or destination for all human beings but rather a process, which evolves and develops over the life span (Tiberius & Mason, 2013), it is still quite impressive how people, who lived thousands of years ago, could actually understand that human life is much more than just pleasure and satisfaction. As noted by Aristotle, “the realisation of human potential is an ultimate goal” (Hefferon & Boniwell, 2011, p. 77). Similarly, the Eastern conceptualisation of “eudaimonia” understands that pleasures are not the centre of human life, and that people should strive to achieve harmony with the universe.
by emphasizing positive qualities, such as selflessness, adjustment to the environment, social unity, and transcendence (Ruini, 2017).

The 20th century

The current understanding of the positive aspects of life has been shaped by a number of psychological traditions, including psychoanalysis or behaviourism, but the most influential field that directly identified with the study of positive human experience, was humanistic psychology (Duckworth et al., 2005). In the 1930s new approaches to psychology were developing, which introduced a completely different image of the person that highlighted “conscious experience and the potential for creative self-determination and responsible social engagement” (Wertz & Bridges, 2013, p. 492). The first American pioneers, such as William James or John Dewey, created a strong foundation for humanistic psychology with their holistic approach to human experience, which was greatly contrasting with the traditional view of the behaviourists’ determinism and orthodox psychoanalysis. Since then, humanistic theories have developed and have been applied to a wide range of subject matters, including psychotherapy, counselling, education, peace work, or industry (Wertz & Bridges, 2013). Humanistic psychologists, such as Gordon Allport, Henry Murray, Gardner Murphy, Brewster Smith, George Kelly, and Abraham Maslow have been practicing the principles of positive psychology in their fields for decades. However, it was Abraham Maslow (1954), who first used the term of positive psychology with a notion that:

The science of psychology has been far more successful on the negative than on the positive side. It has revealed to us much about man’s shortcomings, his illness, his sins but little about his potentialities, his virtues, his achievable aspirations, or his full psychological height. It is as if psychology has voluntarily restricted itself to only half its rightful jurisdiction, the darker, meaner half. (Maslow, 1954, p. 354).
The central interest of Maslow’s theory (1962) was how individuals could reach the state of self-actualization, in which they would have achieved their full potential by making a complete use of all of their talents and skills. Interestingly, the talents and skills, which, according to Maslow, would be characteristic for a self-actualised person, are very similar to the character strengths and virtues identified by the current positive psychology research (Peterson & Seligman, 2004).

Similarly, Carl Rogers (1961) described fully functioning humans as those “who are acting in accordance with an ‘organismic valuing process’ occurring within themselves” (Sheldon & Kasser, 2001, p. 34). Rogers believed that all people had the power to move themselves towards better functioning, and adapt and develop by discovering and expressing their authentic selves, which would lead to greater openness, awareness and self-acceptance over time. However, believing in one’s own abilities may not come easy for some people, which is why Rogers was of the opinion that counsellors and psychotherapists were in a good position to facilitate their clients’ growth by offering unconditional positive regard, empathy, and genuineness (Wertz & Bridges, 2013). Indeed, these growth-based assumptions characteristic for person-centred theories (Ryan, 1995) are shared by the positive psychologists today, since they both aim to understand psychological well-being in its own right, and not simply as the absence of disorder or distress (Jahoda, 1958). Although, the nature of the relationship between humanistic and positive psychology has been debated at times, with some arguing that they are more like “evil twins” or “sibling rivals” than friends with common interests (Rich, 2017). Some published remarks made earlier by leading positive psychologists argued that the humanistic approach is self-centred and lacks empirical evidence (Seligman & Csikszentmihalyi, 2000), which was undeniably a subject of concern and great controversy.

On the other hand, later remarks indicated that this early comment may not have reflected the authors’ full range of views regarding humanistic psychology (Rich, 2017).
Mihalyi Csikszentmihalyi clearly stated that the reason why positive psychology developed within just a couple of decades was because:

It brought together so much existing knowledge from Aristotle’s concepts to the work of earlier humanistic psychologists like Maslow. We had the shoulders of giants to stand on, and that’s why we could see a little bit further than perhaps they did. (Csikszentmihalyi, 2009, p. 203 - 204).

Undeniably, the works of humanistic psychologists created a strong foundation for the science of positive psychology. It is also clear, however, that there are real differences between the two disciplines in methods, and approaches they use. Whereas humanistic psychology utilizes more qualitative approaches aiming to understand the lived experiences of each individual, positive psychology prefers the use of quantitative methods believing that it is an objective way of understanding “general principles of human psychological functioning that are applicable across people, or at least across broad categories of people” (Waterman, 2013, p. 128). Of course, both approaches have their advantages and disadvantages, and there may be additional differences in terms of how psychologists view, interpret and utilize these differences.

The critical question for positive psychology is whether the dominant quantitative approach of 20th century is sufficient to measure the “uniqueness of human experience” (Resnick, Warmoth & Serlin, 2001, p. 76). Indeed, obtaining objective information is important in order to understand the science behind the functioning of psychological and social systems. However, humans are more than just objects, they are beings with “rich subjective inner experience, composed of more than thoughts” (Resnick et al., 2001, p. 76). Therefore, the challenge is to find an approach that would be able to capture and describe the full range of what it means to be a human being. Undeniably, “qualitative methods have much to offer
positive psychology, and quantitative methods, when used, applied and interpreted appropriately have much to offer humanistic psychology” (Rich, 2017, p. 14). Therefore, rather than “dismiss one approach in favour of the other” (Rich, 2009, p. 9), it may be beneficial for positive and humanistic psychologists to work together, and create stronger treatment approaches based on empirical evidence, which could be used effectively in assisting clients toward optimal human functioning (Georges & Tomlinson-Clarke, 2015).

2.3.2. Advances in positive psychology

Defining positive psychology

The concept of the “good life” has been the subject of philosophical and religious investigation for centuries, dating back to Socrates, Plato and Aristotle. But what started as a simple inquiry into happiness, has now evolved into a complex analysis of human flourishing (Seligman, 2012). Positive psychology is a scientific study of individual positive traits, experiences and institutions that help people achieve optimal functioning (Duckworth et al., 2005). It believes that in order for people to flourish, they should focus on developing their strengths, rather than just eliminating weaknesses. However, positive should not be interpreted simply as the absence of the negative, since the absence of the negative does not necessarily lead to achieving positive (Herzberg, Mausner & Snyderman, 1959). In fact, a number of studies have shown that positive emotion represents a unique psychological process with distinct neural pathways completely separate from negative emotion (Fredrickson, 1998, 2001; 2003; Davidson, Jackson & Kalin, 2000). Thus, the intention of positive psychology is not to replace, but rather supplement research findings from traditional (clinical) psychology, and offer a “complete and balanced scientific understanding of human experience” (Seligman,
Steen, Park & Peterson, 2005, p. 410), which would include both, positive and negative, suffering and happiness, as well as their interaction.

From “Authentic Happiness” to “Well-being”

Positive psychology in its current form was initiated in 1999 by Martin Seligman at the 107th Annual Convention of the American Psychological Association (Linley, 2013). Since then, the field has been evolving rapidly. Hundreds of articles have been published in the scientific and popular press, with the appearance of special journal issues (American Psychologist, Seligman & Csikszentmihalyi, 2000; Review of General Psychology, Simonton & Baumeister, 2005) and a new journal in 2006, the Journal of Positive Psychology. Different handbooks (e.g., Linley & Joseph, 2004; Ong & van Dulmen, 2007; Snyder & Lopez, 2002) and textbooks (e.g., Carr, 2004; Compton, 2005; Peterson, 2006) on the topics of positive psychology have been emerging, and a number of positive psychological interventions have been found to increase subjective well-being (Biswas-Diener, 2011; Seligman et al., 2005). However, there have been several notable contributions to positivity stemming from clinical domains (namely humanistic and existential approaches, clinical psychology and psychotherapy), and psychiatric research (see Ruini, 2017 for an overview).

The actual concept of well-being and mental health in positive terms has been defined as early as 1958, when Mary Jahoda developed criteria for defining positive well-being (Jahoda, 1958). She argued that “the absence of mental illness was not a sufficient criterion for mental health” (Jahoda, 1958, p. 15). Her model of eudaimonic well-being was later on reformulated by Carol Ryff into the model of positive functioning (Ryff & Singer, 1998). Building on the works of Rogers (1951), Maslow (1954, 1962), Jung (1947/54; in Smith 1990), Jahoda (1958), Erikson (1963, 1982), Adler (1979), Vaillant (1977), Frankl (1985), Deci and Ryan (1985), Ryff and Keyes (1995), and Ryff and Singer (1996, 1998) positive psychology
LITERATURE REVIEW – POSITIVE PSYCHOLOGY

has gradually developed into a scientific and applied approach to uncovering people’s strengths and promoting their optimal functioning (Snyder, Lopez & Pedrotti, 2011).

According to the original Theory of Authentic Happiness (Seligman, 2002), happiness could be analysed into three different elements that people choose to pursue for their own sake: positive emotions, engagement, and meaning. Each of these elements is much more clearly defined and more measurable than the concept of happiness itself. The life that is led successfully around the first element focusing on the positive aspects of one’s emotions, is called the “pleasant life”, and life lived with an aim to be fully engaged and become one with the flow is referred to as the “engaged life”. According to Seligman (2011), the pursuit of pleasure and engagement can be self-absorbing, as those are often solitary endeavours, but most people wish to live a life focusing on something they believe is bigger than the self. Therefore, a life that is lived with a higher purpose is considered a “meaningful life” (Seligman, 2011, p. 11 - 12). At the time of its publication, “Authentic Happiness” became the bestseller of the New York Times. However, after years of teaching, analysing and testing the original theory, Seligman concluded that it needed to be developed further for a number of reasons. First, in most people the concept of happiness evokes thoughts of being in a cheerful mood. Critics have noted that since neither engagement, nor meaning refer to how people feel, they cannot be part of what happiness represents. Another inadequacy in Authentic Happiness was that its main goal was to increase life satisfaction, but it seemed that people’s overall perception of life satisfaction was largely affected by their current mood. The amount of life satisfaction most people reported was determined by “how good they felt at the very moment” they were asked the question (Seligman, 2011, p. 13), but it did not take into account meaning of life or engagement in work/activities or with people. The third limitation of the Authentic Happiness Theory was that the aspects of life people choose to pursue for their own sake, could not be
limited to engagement, meaning and positive emotion. Re-evaluating his previous concepts, Seligman concluded:

I used to think that the topic of positive psychology was happiness, that the gold standard for measuring happiness was life satisfaction, and that the goal of positive psychology was to increase life satisfaction. I now think that the topic of positive psychology is well-being, that the gold standard for measuring well-being is flourishing, and that the goal of positive psychology is to increase flourishing. (Seligman, 2011, p. 13)

The new Well-being Theory (Seligman, 2011) describes well-being as a construct with a number of measurable elements, which each contribute to well-being but none of them solely defines it. It uses an analogy of weather, where weather, too, is a construct that itself cannot be measured, but it contains several elements (e.g. temperature, pressure, humidity, wind speed etc.) that contribute to it. Measuring those elements would help one create a better picture of what the weather may be like later on in the afternoon. Just like weather, well-being cannot be defined by a single measure, but as a construct it contains several elements, of which each one is a measurable aspect contributing to flourishing.

The current model of the Well-being Theory (Seligman, 2012) postulates five dimensions of holistic fulfilment labelled with the acronym PERMA: Positive emotions, Engagement, Positive relationships, Meaning, and Accomplishment (Figure 2.8.). To count as an element, each of the five aspects must contain three properties: (1) it needs to contribute to well-being, (2) it is often sought for its own sake, and not merely to pursue any of the other elements, and (3) it is defined and measured exclusively without depending on the other elements.
Positive emotions.

Positive emotions are an important aspect of well-being contributing greatly to people’s happiness and overall life satisfaction, and they are a core objective of positive psychology (Froh, 2013). Traditional approaches have often confused positive emotions with closely related affective states (i.e. positive moods or sensory pleasures) or described their function inaccurately as “generic tendencies to approach or continue” (Fredrickson, 2004, p. 1369). The Broaden-and-build theory of positive emotions (Fredrickson, 1998, 2001) developed as an alternative to the traditional model, was able to capture the unique effect of positive emotions to “broaden peoples’ momentary thought–action repertoires and build their enduring personal resources” (Fredrickson, 2004, p. 1369). Positive emotions (e.g. joy) can facilitate building of intellectual resources by triggering explorative behaviours, and subsequently engendering greater knowledge about the environment (Froh, 2013). A meta-analysis of more than 300 studies revealed that positive emotions are also closely related to success (Lyubomirsky, King...
& Diener, 2005), which may be due to the durable resources contributing to human flourishing that were gradually built over time. Happy people are able to look at the past with gratitude, see the future with hope and fully enjoy and cherish the present moment (Seligman, 2011). Positive emotions in the Well-being framework refer to the pleasant happy life, but unlike the positive emotions in the Authentic Happiness Theory, they are not considered to be the goal, but they are a “component part of a greater state, well-being” (Fulmer, 2015, p. 3).

**Engagement.**

Engagement is similar to the state of flow when one is completely absorbed by an activity often losing track of time, disregarding fatigue, and everything else but the activity itself (Csikszentmihalyi, 2013). When under the conditions of flow, experience often unfolds from moment to moment, which makes the activity intrinsically rewarding, and the end goal is often just an excuse for the process itself (Nakamura & Csikszentmihalyi, 2009). The concept of flow was first introduced in 1960s with a number of studies focusing on autotelic activities; that is, on things that are done for their own sake, rather than in order to pursue some later external goal (Csikszentmihalyi, 1997). Various groups of individuals, including rock climbers, chess players, athletes and artists were studied at that time and participants across all of these groups reported very similar levels of highly enjoyable experience while engaging in those activities. This intense involvement was eventually called the flow experience with three additional characteristics: the merging of action and awareness, a sense of control, and an altered sense of time (Csikszentmihalyi, 2013, p. 396). On that basis, engagement in the Well-being Theory is assessed subjectively by questions like “Did time stop for you?” “Were you completely absorbed by the task?” “Did you lose self-consciousness while doing something you enjoyed?” Although engagement/flow is an intense experiential involvement in an activity, when the person functions at their fullest capacity, any thoughts or feelings are usually absent during the state, which is different from the subjective state of pleasures (Seligman, 2011). The
subjective state for engagement is always retrospective, and it is only when people reflect upon it later on, they may realise “That was fun” or “That felt great” (p. 17).

**Relationships.**

The original framework for positive psychology included relationships only indirectly. However, positive relationships contribute significantly to positive life experience, which makes them crucial to health and happiness (Fulmer, 2015). Christopher Peterson summarised the purpose of positive psychology in three words: “other people matter” (Park, Oates & Schwarzer, 2013). It was in 2007 when, at the Global Well-Being Forum, Martin Seligman suggested that the original framework for positive psychology should include positive relationships directly as a major pillar of the Life Well-Lived (Positive Psychology News, n.d.). He concluded that “other people are the best antidote to the downs of life and the single most reliable up” (Seligman, 2011, p. 20). Since very little that is positive is solitary, positive relationships are a crucial element of the Well-being Theory.

**Meaning.**

Research has focused predominantly on the presence of meaning in life, which has been defined as “the extent to which people comprehend, make sense of, or see significance in their lives, accompanied by the degree to which they perceive themselves to have purpose, mission, or overarching aim in life” (Steger, 2009, p. 682). However, there are other important dimensions of meaning in life, namely, the sources from which people draw meaning, and the degree to which they search for meaning (Steger, 2013). Early consideration of life’s meaning emerged from the existential philosophers, who argued against the belief of ancient Greeks that there was a single intrinsic meaning. Instead, they claimed that each person had to search and discover their own meaning in life, which was an idea brought to psychology by Victor Frankl, who considered finding purpose in life as essential part of healthy human functioning (Frankl,
1979). He argued that searching for something greater in life was a basic human motivation (Frankl, 1965), which was an idea re-visited by Martin Seligman thirty years later. He defined meaning in a similar way, as belonging to and serving something that transcends egoism, something that is believed to be bigger than the self (Seligman, 2011, p. 17).

Recent frameworks, including PERMA, place the meaning in life within a broader context of well-being, which enables them to distinguish it from other constructs. Even though, it has been agreed that meaning in life is relevant to psychological and physical health and should, therefore, be a part of the well-being construct, many questions regarding the dimensions of meaning in life remain unanswered (Steger, 2013).

*Accomplishment.*

Accomplishment is a sense of achieving something that is often pursued for its own sake, even though it does not bring any positive emotion, meaning or enhance positive relationships (Seligman, 2011). It links goals to values and perseverance to achieve goals greatly enhances overall accomplishment leading to greater success (Duckworth, 2016). Although many people feel greater accomplishment when they achieve something that gives them joy and purpose (Duckworth 2016), “winning for the sake of winning can also be seen in the pursuit of wealth” (Seligman, 2011, p. 19). Seligman (2011) argues that there is accomplishment in its momentary form, which can be linked with positive emotions, but then there is an extended form of achievement, the “achieving life”, a life dedicated to accomplishment for the sake of accomplishment (p. 19). He admits, however, that such life is almost never seen in its pure state.

With the PERMA model, Seligman has broken positive psychology down into several building blocks, where happiness is not a goal but a process evolving in many directions, and containing many aspects, which are specific to each individual. In order to flourish, people
need to aspire to something greater and holistic, which is deemed well-being (Fulmer, 2015). Even though the Theory is relatively new, a number of studies have confirmed that positive psychological interventions addressing positive emotions, engagement, positive relationships, meaning, and accomplishment significantly improve subjective well-being and ameliorate depressive symptoms (Gander, Proyer & Ruch, 2016; Giannopoulos & Vella-Brodrick, 2011). The potential of the model to address other psychological issues, is yet to be explored.

**Positive psychotherapy**

For the past 100 years, psychotherapy has been focusing mainly on repairing negatives (symptoms, traumas, deficits, wounds, and disorders) assuming that “talking about troubles is curative” (Seligman, Rashid & Parks, 2006, p. 775). By emphasizing the pathology, psychology has been able to ameliorate a number of serious disorders. However, concentrating merely on relieving the symptoms of a disorder, it has lagged behind in enhancing human strengths and the positives. Positive psychotherapy (PPT) is a therapeutic movement within positive psychology, which seeks to broaden the scope of traditional psychotherapy by building positive emotions, strengths, and meaning, by which it aims to enhance the efficacy of traditional approaches in the treatment of psychopathology (Rashid, 2013). It encounters three major assumptions: (1) psychopathology is a result of person’s intrinsic capacity for growth, fulfilment, and happiness being obstructed, (2) positive emotions and strengths are as authentic and real as symptoms and disorders, and (3) even those clients, who seem to bring the heaviest psychopathological burden into the therapy room, care about their lives enough to be wanting to achieve more than just a relief from their suffering (Rashid, 2013, p. 749 - 750). All clients desire growth, fulfilment and happiness instead of just seeking to avoid misery, worry and anxiety. Therefore, it must be possible to build effective therapeutic relationships through the discussion and manifestation of positive resources, as opposed to just scrutinizing over person’s
weaknesses and deficits (Rashid & Seligman, 2013). Using the core values of the person-centred approach (Rogers, 1951), therapists can “draw the client’s attention to positive emotions and strengths in their lives in a gentle and careful manner” (Rashid, 2013, p. 750), which can be crucial to achieving an effective treatment, as many clients seeking therapy are biased towards remembering and focusing on the negative, and expecting the worst in general. “Drawing systematic attention towards positives and engaging clients in intentional activities which utilise their strengths, are argued to be possible mechanisms of change in PPT” (Rashid, 2013, p. 751). Therefore, focusing the therapy primarily on building positive emotions, character strengths, and meaning may not only successfully counteract negative symptoms of a disorder but also help to prevent relapse and reoccurrence of the symptoms (Seligman et al., 2006).

The nature and benefits of these positive psychological targets have been well established over the past two decades (Fredrickson & Losada, 2005; Fulmer, 2015; Haidt, 2006; Linley, Nielsen, Gillett & Biswas-Diener, 2010; Pietrowsky & Mikutta, 2012; Seligman, 2002; Seligman et al, 2005; Quick, 2013). In order to create a peaceful, fulfilling and flourishing environment, it is important for individuals to understand both, the causes of pain from trauma, as well as the potential growth from it. Through structured exercises, PPT aims to help the clients shift their focus, memory, and expectations away from the negative toward the more positive and hopeful (Rashid, 2013, p. 750). For example, instead of ruminating every day over what has gone wrong, the client can be given a task to keep a gratitude journal, which would counteract the bias induced by the rumination over the negative events. Engaging in this exercise the client would be more likely to “end the day remembering positive events and completions, rather than troubles and unfinished business” (Rashid, n.d., p. 3). From this perspective the therapist is no longer “an authority with expertise in diagnosing what is wrong with someone,” but rather “a witness of the client’s deepest and authentic psychological assets”
Individual PPT is usually scheduled for 12 to 14 weeks, whereas group intervention can be shorter (Parks & Seligman, 2007). However, they both follow exercises devised from Seligman’s Authentic Happiness Theory (Seligman, 2002), which breaks happiness into three distinguishable areas: the pleasant life, the engaged life and the meaningful life. Although people reliably differ in the type of life they pursue, it has been shown that the most satisfied people are those who orient their pursuits toward all of the three domains (Peterson, Park & Seligman, 2005). Therefore, interventions using PPT aim to address all three domains targeting the pleasant life, the engaged life, and the meaningful life in three phases. The first phase of PPT focuses on building a positive relationship with the client by encouraging them to explore their signature strengths from multiple perspectives using a balanced narrative of their life (Rashid & Ostermann, 2009). The second phase focuses on cultivating positive emotions and adaptively dealing with negative memories. The third phase encounters exercises used to foster positive relationships, meaning and purpose (Rashid, 2015, p. 27). Throughout the course of PPT the clients can learn how to look at negative experiences with a more positive mind-set and reframe and interpret those experiences in more helpful and positive ways (Rashid, n.d.).

PPT does not compete with traditional therapeutic approaches, but rather complements them (Rashid, 2013), and even though it is still developing, several studies have already demonstrated its effectiveness in addressing a number of clinical conditions, including depression, anxiety, borderline personality disorder, psychosis, and nicotine dependence (Goodwin, 2010; Kahler, Spillane, Day et al., 2014; Meyer, Johnson, Parks, Iwanski & Penn, 2012; Rashid, Uliaszek, Stevanovski, Gulamani & Kazemi, 2013; Seligman et al., 2006). Indeed, PPT has made a promising start. However, most studies applying PPT to specific psychological disorders are still at a pilot stage, and thus, its effectiveness over and beyond the traditional therapeutic approaches is yet to be established (Rashid, 2015).
2.3.3. Criticisms of positive psychology

Despite its success the field of positive psychology has received a notable amount of criticism questioning its fundamental concepts, and in some cases, even its place in science (McNulty & Fincham, 2012). One of the major criticisms was that positive psychology focused too much on the positives, completely disregarding the negatives. Undeniably positive psychology in its formative years appeared to “embrace a polarizing rhetoric, in which ostensibly negative phenomena were conceptualised as undesirable (and thus to be avoided), whereas apparently positive qualities were seen as necessarily beneficial (and thus to be sought)” (Lomas & Ivtzan, 2016, p. 1754). It has been argued that qualities that are presented as positive can sometimes lead to negative outcomes and vice versa. For example, being unrealistically optimistic may lead some people to underestimate risk factors associated with their decisions and actions, which could subsequently lead to health hazardous behaviours, such as alcohol or tobacco misuse (Weinstein, Marcus & Moser, 2005). On the other hand, some emotions that are primarily thought to be destructive, such as anger, may actually act as motivators for individuals to step up and change life situations or circumstances that have been impeding their well-being (Tavris, 1989). Although Seligman himself agreed that there are times when people must be “able to use pessimism’s keen sense of reality” in order to not to become a “slave to the tyrannies of optimism” (Seligman, 1990, p. 292), the initial assumption of positive psychology to concentrate on the positive, was undeniably challenged by the early critics.

In response to those arguments, positive psychology has reached a second wave in its development (Held, 2004), which is also sometimes referred to as positive psychology 2.0 (Wong, 2011). The concepts of well-being and flourishing remain the cornerstone in second
wave positive psychology. However, its focus is expanded by appreciation of the dialectical nature of well-being, understanding that even though two binary opposites might be diametrically different, they can still be strongly connected or even dependent on one another (Ivtzan, Lomas, Hefferon & Worth, 2016). The dialectical appreciation is centred on three key premises: (1) the principle of appraisal (referring to the challenge raised by categorizing things as either positive or negative), (2) the principle of co-valence (based on the understanding that many life experiences involve both, positive and negative elements), and (3) the principle of complementarity (the notion of harmonization between light and dark aspects of life) (Lomas & Ivtzan, 2016). The positive can exist within the negative and the negative can exist within the positive, and human flourishing is a process characterised by harmonization and constant dynamic balance between those two (Wang, n.d.).

Another major criticism of positive psychology is that it excessively uses quantitative methodology (Fernández-Ríos & Cornes, 2009), and often relies on self-report measures, or in other words, on what people say about their own happiness (Peterson, 2009). Placing excessive emphasis on mathematisation of psychological processes may paradoxically lead positive psychologists to forget about a person as a whole, with unique qualities and characteristics. One way to resolve this issue would be to apply another useful and ethical resource which would help understand the subjective well-being from a more objective perspective (Fernández-Ríos & Cornes, 2009). This may also be helpful in addressing the limitations caused by the use of self-report questionnaires, which are often subject to social desirability and reference biases (West, 2014). Additionally, it has been argued that self-report measures may be contaminated by certain psychosocial factors, especially neuroticism (Costa & McCrae, 1985; Watson & Clark, 1984), which may result in individuals reporting biases and perceptual distortions (Rasmussen, Scheiner & Greenhouse, 2009).
Research in (positive) psychology has been confronted with the need for greater synthesis of various levels of research information (Biswas-Diener, 2011). It has been well-established that biological, psychological and social factors all play an important role in human functioning, and that health and well-being are best understood when these factors are combined (Lomas, 2017). Therefore, integration of biological, neuropsychological, social, and personality sciences may greatly aid positive psychological research, and enhance validity and reliability of interventions (Rock & Page, 2009; Rothbart, Sheese & Posner, 2007).

2.3.4. Applications of positive psychology

Applied positive psychology and well-being

Since its emergence in 1998, positive psychology has flourished in many aspects. Perhaps one of the most successful developments within the field was the discipline of applied positive psychology, which has been defined as the “science and practice of improving well-being” (Lomas, Hefferon & Ivtzan, 2015, p. 1347). The core of applied positive psychology are positive psychological interventions (PPIs), some of which principles have been piloted in early 1980s (Fordyce, 1981; 1983). Since then, there has been a notable growth in different PPIs designed to promote well-being in many practical ways (Parks & Biswas-Diener, 2014), although the criteria “necessary and sufficient” for recognising interventions as PPIs are still being debated (Lomas et al., 2015, p. 1348). According to Nancy Sin and Sonja Lyubomirsky (2009), PPIs are:

Treatment methods or intentional activities that aim to cultivate positive feelings, behaviours or cognitions… Programs, interventions, or treatments aimed at fixing,
remedying, or healing something that is pathological or deficient – as opposed to building strengths – do not fit the definition of a PPI (p. 468).

However, this does not mean that PPIs could not be used to address mental health, even in clinical medical populations (Macaskill, 2016). Although most traditional treatment approaches focus on alleviating symptoms of mental illness, rather than building positive qualities and resources (Sin, Della Porta & Lyubomirsky, 2011), a number of studies have shown successful applications of PPIs to mental health disorders, such as depression (Sin & Lyubomirsky, 2009), addiction (Krentzman, 2013), alcohol misuse (Akhtar & Boniwell, 2010), eating disorders (Harrison, Al-Khairulla & Kikoler, 2016), and schizophrenia (Meyer et al., 2012).

It has been well established in mood research that positive affect and negative affect are two separate constructs (Watson & Tellegen, 1985), and thus the mere absence of negative emotions cannot be equivalent to the presence of positive ones. Indeed, there are individuals who may not suffer with any particular mental illness, yet still feel generally unhappy and incapable of effective functioning in everyday life (Keyes, 2007). Similarly, people with diagnosis of mental illness may feel generally happy and cope well with their mental health condition, altogether living a life of good quality (Bergsma, ten Have, Veenhoven & de Graaf, 2011). Well-being refers to individual’s appraisal of their life as a whole, including emotional responses, domain satisfactions, and global judgements of life satisfactions (Diener et al., 1999), leading to an “optimal psychological functioning and experience” (Ryan & Deci, 2001, p. 142).

Historically, the construct of well-being has been studied from two perspectives, the perspective of happiness or hedonic well-being, often referred to as subjective well-being; and the perspective of human potential or eudaimonic well-being, often referred to as psychological
LITERATURE REVIEW – POSITIVE PSYCHOLOGY

well-being (Keyes, Shmotkin & Ryff, 2002). However, increasing evidence suggests that although these two are “related but distinct aspects of positive psychological functioning” (Keyes et al., 2002, p. 1009), understanding of well-being may be enhanced by measuring both aspects (Green, Oades & Grant, 2006). Extensive cross-sectional and longitudinal research has identified a wide range of benefits of well-being in different life domains, including health, recovery from physical illness and longevity (Diener & Chan, 2011; Howell, Kern & Lyubomirsky, 2007; Lamers, Bolier, Westerhof, Smit & Bohlmeijer, 2012). Additionally, research has found links between subjective and psychological well-being and reduced mortality risks in individuals with physical disease (Chida & Steptoe, 2008; Lamers et al., 2012), and reduced risk of developing mental disorders or related symptoms (Keyes, Dhingra & Simoes, 2010; Wood & Joseph, 2010). (See Bolier, Haverman, Westerhof et al., 2013b for a review).

A review of research in optimism revealed that optimism, positive affect and subjective well-being are associated with better health and reduced mortality even after controlling for depression and negative affect (Rasmussen et al., 2009). Furthermore, it has been discovered that positive emotions help individuals recover faster from negative emotional experiences (Fredrickson & Levenson, 1998, Tugade & Fredrickson, 2004), and prevent relapse episodes (Fava & Ruini, 2003) by improving related coping mechanisms (Garland, Fredrickson, Kring et al., 2010) and triggering upward spirals toward greater psychological well-being (Fredrickson & Joiner, 2002). A number of evaluation studies have demonstrated the efficacy of engaging in intentional, effortful activities, such as expressing gratitude (Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011; Seligman et al., 2005; Sheldon & Lyubomirsky, 2006), counting blessings (Emmons & McCullough, 2003; Froh, Sefick, & Emmons, 2008; Lyubomirsky, Sheldon & Schkade, 2005; Seligman et al., 2005), practicing optimism (Sheldon & Lyubomirsky, 2006), performing acts of kindness (Boehm, Lyubomirsky, & Sheldon, 2011;
Lyubomirsky et al., 2005b; Otake, Shimai, Tanaka-Matsumi, Otsui & Fredrickson, 2006, setting personal goals (Green et al., 2006; Sheldon, Kasser, Smith & Share, 2002), and using one’s signature character strengths (Seligman et al., 2005) to enhance well-being, and, in some cases, to alleviate symptoms of depression (Seligman et al., 2005).

Since the main focus of positive psychology is well-being, not an illness (Park, Peterson & Seligman, 2004), it is not surprising that most research has been conducted in non-clinical populations. However, in recent years an increasing amount of evidence has been emerging to suggest that positive psychology is beginning to be applied in the health care context (Macaskill, 2016). A number of studies have examined positive psychology concepts in relation to the likelihood of a diagnosis of an illness. For example, high levels of hope and curiosity have been found to decrease the likelihood of a diagnosis of diabetes or hypertension (Richman, Kubzansky, Maselko et al., 2005). Several randomised controlled trials have shown that positive psychology related interventions lead to improved health-related behaviours in patients with heart and lung disease (Mancuso, Choi, Westermann et al., 2012; Ogedegbe, Boutin-Foster, Wells et al., 2012; Peterson, Charlson, Hoffman et al., 2012). A number of PPIs involving positive psychological concepts of optimism, and gratitude have even been developed specifically for patients with cardiovascular disease (DuBois, Millstein, Celano, Wexler & Huffman, 2016; Huffman, Mastromauro, Boehm et al., 2011), and type 2 diabetes (Huffman, DuBois, Millstein, Celano & Wexler, 2015). Most studies reviewed included optimism, featured in the Values-in-Action Classification (Peterson & Seligman, 2004), as the main character strength measured.

Interestingly, optimism seems to be related to better health outcomes, reduced symptoms and adaptation to a chronic illness in patients with a number of physical health conditions related to obesity, such as hypertension (Conway, Magai, Springer & Jones, 2008), diabetes (Brody, Kogan, Murry, Chen & Brown, 2008; De Ridder, Fournier & Bensing, 2004;
Fournier, De Ridder & Bensing, 2002a; Fournier, De Ridder & Bensing, 2002b), cardiovascular disease (Shepperd, Maroto & Pbert, 1996; Shnek, Irvine, Stewart & Abbey, 2001), and osteoarthritis (Ferreira & Sherman, 2007). Similarly, decreased optimism seems to be indicative of poorer health conditions in these patients (Motivala, Hurwitz, LaGreca et al., 1999). Additionally, when compared to individuals of a more pessimistic nature, optimistic people report less pain (Affleck, Tennen, Zautra et al., 2001; Costello, Bragdon, Light et al., 2002, Mahler & Kulik, 2000; Smith & Zautra, 2004), better physical functioning (De Ridder et al., 2004; Fournier et al., 2002a, Fournier et al., 2002b; Motivala et al., 1999), fewer physical symptoms (Fournier et al., 2002a, Glazer, Emery, Frid & Banyasz, 2002; Kurdek & Siesky, 1990; Lyons & Chamberlain, 1994; Motivala et al., 1999; Northouse, Caffey, Deichelbohrer et al., 1999), and are less likely to be rehospitalized after undergoing a coronary artery bypass surgery (Scheier, Matthews, Owens et al., 1999). (See Rasmussen et al., 2009 for a review.)

Although evidence consistently suggests that positive psychological well-being protects against cardiovascular disease, the vast majority of studies have employed cross-sectional designs, making it difficult to determine whether positive psychological well-being influences biology or vice versa (Boehm & Kubzansky, 2012). An association has been found between certain aspects of eudaimonic well-being and the amount of lipids in adults (Boehm & Kubzansky, 2012). In particular, adolescent self-sufficiency has been linked to lower levels of total cholesterol in adult men, after adjusting for lifestyle and biological factors (Twisk, Snel, Kemper & van Mechelen, 1998). Several studies have also reported inverse associations between eudaimonic well-being and adult BMI (e.g. Carr & Friedman, 2005). However, evidence from longitudinal research has been somewhat inconsistent in this respect, with some studies suggesting links between well-being and reduced risk of being overweight (Gale, Batty & Deary, 2008), but others reporting no significant associations (Roberts, Troop, Connan, Treasure, & Campbell, 2007). (See Boehm & Kubzansky, 2012 for a review.) Additionally,
certain aspects of hedonic well-being, (particularly positive affect), have been associated with lower levels of IL-6\(^7\) (Steptoe, O’Donnell, Badrick, Kumari & Marmot, 2008). Concretely trait positive affect was related to lower levels of stimulated IL-6 in adults (Prather, Marsland, Muldoon, & Manuck, 2007). It has been shown that IL-6 increases hepatic triglyceride secretion (Nonogaki, Fuller, Fuentes et al., 1995) and may therefore, contribute to the hypertriglyceridemia associated with visceral obesity (see Frühbeck, Gómez-Ambrosi, Muruzábal, & Burrell, 2001 for a review).

**Applying positive psychology to treat disordered eating**

Eating disorders (EDs), including anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED) and avoidant/restrictive food intake disorder (ARFID), present serious mental health difficulties, and are known to be one of the most challenging psychiatric disorders to treat (Halmi, Tozzi, Thornton et al., 2005). It becomes even more difficult to treat if the illness continues into adulthood (Halmi et al., 2005, Steinhausen, 2009), and 25% of patients struggle with disordered eating for the rest of their lives (Steinhausen, 2009) with at least 10% experiencing subclinical EDs (Lähteenmäki, Saarni, Suokas et al., 2014). Traditional research on EDs has focused primarily on identifying and addressing risk factors and symptoms of disordered eating. Indeed, substantial amount of evidence confirms that CBT effectively eliminates binge eating and purging in about 50% of patients with BN (Wilson & Fairburn, 2007), and there is strong empirical support for its effectiveness for BED (Apple & Agras, 1997; Fairburn, Marcus & Wilson, 1993).

Despite many successful applications of CBT to EDs, there are still high numbers of individuals with incomplete responses to treatment, and premature drop-outs from the therapy

---

\(^7\) Interleukin 6 (IL-6) is a protein secreted by adipose tissue encoded by the IL6 gene (Ferguson-Smith, Chen, Newman et al., 1988), and it is implicated in host defence and in glucose and lipid metabolism (Mohamed-Ali, Pinkney & Coppack, 1998).
(Kristeller, Baer & Wolever, 2006). Most chronic patients with EDs experience failure of traditional therapeutic approaches throughout their long history of illness, and do not improve through short-term motivational interviewing (Nagata, 2009). Therefore, it seems necessary to find interventions that would tackle disordered eating more comprehensively.

In recent years, researchers have become more interested in the application of a positive psychology framework to promote factors that protect against disordered eating (Steck, Abrams & Phelps, 2004). For example, research in the effects of positive emotions has proven to be particularly relevant to the study of EDs psychopathology (Tchanturia, et al., 2015). Evidence from theoretical and empirical studies consistently shows that individuals with EDs often struggle with emotional processing (Oldershaw, Hambrook, Stahl et al., 2011), which has negative impact on their quality of life (Tchanturia, Hambrook, Curtis et al., 2013), and contributes to high social anhedonia experienced by people with EDs (Harrison, Mountford & Tchanturia, 2014; Tchanturia, Davies, Harrison et al., 2012) and a limited number of relationships (Doris, Westwood, Mandy & Tchanturia, 2014). Experimental evidence shows that patients with EDs have difficulties with flexible thinking and being able to see the bigger picture (Lang, Lopez, Stahl, Tchanturia & Treasure, 2014), which may be one of the reasons preventing them from moving towards recovery.

According to the Broaden-and-build theory (Fredrickson, 1998, 2001) positive emotions broaden people’s thought-action repertoires, by which they can help counteract the effect of negative emotions and build resilience (Cohn, Fredrickson, Brown, Mikels & Conway, 2009; Fredrickson, 2001). Enhancing their experience of positive emotion on a regular basis, PPIs may help patients with EDs to develop better coping strategies regarding their health behaviours, and become more flexible and creative in finding alternative solutions to problems (Tchanturia et al., 2015). Indeed, higher levels of positive emotion, engagement and meaning in life have been linked with decreased ED symptomatology in female adolescents.
LITERATURE REVIEW – POSITIVE PSYCHOLOGY

(Góngora, 2014), and a number of preliminary investigations have indicated emotion-focused therapy as an efficient treatment for AN (see Sala, Heard & Black, 2016 for a review). A recent study investigating the effects of group PPI on the well-being of patients with an unspecified ED revealed significant improvements in the patients’ subjective happiness and life satisfaction after the intervention, which was also maintained six months later (Harrison et al., 2016).

A growing body of literature is emerging on the application of mindfulness-based approaches to the treatment of EDs and obesity-related eating behaviours, some of which are adaptations of previously developed therapies, such as dialectical behaviour therapy (DBT; Linehan, 1993), mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002), acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 1999), and mindfulness-based eating awareness training (MB-EAT; Kristeller & Hallett, 1999), which has been developed specifically for BED.

Mindfulness-based interventions are programs aimed at developing skills that reduce distress and improve well-being through systematic training in various mindfulness techniques and exercises (Kristeller & Wolever, 2011). It has been suggested that cultivation of these skills may play an important role in individuals’ ability to alter their maladaptive relationship with food by increasing awareness of emotional and sensory cues, and thus, enhancing self-regulatory mechanisms (Dalen et al., 2010; Kristal, Littman, Benitez & White, 2005; Kristeller & Wolever, 2011; Leahey, Crowther & Irwin, 2008; Shapiro, Carlson, Astin & Freedman, 2006). A number of recent reviews indicated that mindfulness-based therapies may be an effective form of treatment for EDs (Godsey, 2013; Wanden-Berghe, Sanz-Valero & Wanden-Berghe, 2011), and obesity-related eating pathology (Godsey, 2013; Katterman et al., 2014; O'Reilly et al., 2014), with some researchers even proposing that mindfulness is an essential component of holistic obesity treatment (Douglass, 2011; Kristeller & Wolever, 2011). Indeed, studies have demonstrated that mindfulness approaches improve or extend long term health
outcomes in individuals with EDs (Hepworth, 2011), and are also associated with reduction of overall food consumption, healthier food choices, and practices that slow the eating process among obese individuals (Daubenmier, Kristeller, Hecht et al., 2011; Field, 2011; 2016).

Several studies have reported decreases in binge eating frequency and/or severity in response to a mindfulness intervention (Baer, Fischer & Huss, 2005; Courbasson, Nishikawa & Shapira, 2011; Kristeller & Hallett, 1999; Kristeller, Wolever & Sheets 2014; Leahey et al., 2008; Smith, Shelley, Leahigh & VanLeit, 2006; Smith, Shelley, Dalen et al., 2008; Tapper, Shaw, Ilsley et al., 2009; Woolhouse, Knowles & Crafti, 2012) highlighting the importance of these findings for obesity treatment, as binge eating is the most commonly reported problematic eating behaviour among obese individuals (Tanofsky-Kraff, Wilfley, Young et al., 2007), which has been associated with an early onset of obesity (Mussell, Mitchell, De Zwaan et al., 1996), and its maintenance and greater severity (Bruce & Argas, 1992; Picot & Lilenfeld, 2003). In particular, improvements in binge eating behaviours were observed in studies that used a combination of mindfulness and cognitive behavioural therapies (Baer et al., 2005; Leahey et al., 2008; Woolhouse et al., 2012; Courbasson et al., 2011), mindful eating programs (Dalen et al., 2010; Kristeller et al., 2014), acceptance based practices (Tapper et al., 2009), and different combinations of mindfulness exercises (Kristeller & Hallett, 1999; Alberts, Mulkens, Smeets, & Thewissen, 2010). (See O’Reilly et al., 2014 for a more detailed review.) Additionally, in studies where weight data were reported, engaging in mindfulness-based interventions has led to reductions in weight, and BMI (Alberts et al., 2010; Dalen et al., 2010; Kristeller et al., 2014; Miller, Kristeller, Headings, Nagaraja & Miser, 2012; Netam, Yadav, Khadgawat, Sarvottam & Yadav 2015; Niemer et al., 2012) or stabilization of weight among obese individuals (Daubenmier et al., 2011), with some also reporting reduced levels of blood glucose and pro-inflammatory cytokines including IL-6 (Netam et al., 2015). In contrast, there have been studies which identified no positive changes in participants’ eating behaviour in
response to a mindfulness-based intervention (Kearney, Milton, Malte et al., 2012; Kidd, Graor & Murrock, 2013), with some even reporting increased body weight after the intervention (Kearney et al., 2012; Rosenzweig, Reibel, Greeson et al., 2007).

Out of all positive psychological concepts, in relation to EDs treatment, mindfulness has undoubtedly been studied the most extensively. However, the importance of other aspects of positive psychology, such as gratitude (Geraghty, Wood & Hyland, 2010; Wolfe & Patterson, 2017), compassion (Kelly & Carter, 2015; Kelly, Vimalakanthan & Carter, 2014; Pinto-Gouveia et al., 2017), hope (Boisvert & Harrell, 2013a; Irving & Cannon, 2000), spirituality (Boisvert & Harrell, 2012; Boisvert & Harrell, 2013b), meaning in life (Góngora, 2014), and forgiveness (Sesan, 2009) has also been addressed in the literature with several studies discussing the importance of positive psychology in the process of recovery from mental illness (e.g. Schrank, Brownell, Tylee & Slade, 2014; Slade, 2010). Practicing unconditional acceptance and relating to one's present life circumstances and feelings with compassion (Brach, 2003) has been proposed as central to recovery from EDs, as it opens the way to forgiveness by providing the patients with “tools that enable them to transcend the narrow focus on self and symptoms that prevent connection with others” (Sesan, 2009, p. 235). Gratitude based interventions have been found to decrease symptoms of dysfunctional eating and body dissatisfaction (Wolfe & Patterson, 2017), as well as depression (Simon, 2016). A recent review has discussed the role of self-compassion as a protective factor against poor body image and eating pathology (Braun, Park & Gorin, 2016). Self-compassion has been found to directly influence the severity of eating psychopathology in EDs (Ferreira, Matos, Duarte & Pinto-Gouveia, 2014) with the link between self-compassion and disordered eating symptomatology apparent even in non-clinical populations (Tylor, Daiss & Krietsch, 2015). Several studies have shown low levels of self-compassion and high fear of self-compassion in patients with EDs (Kelly et al., 2014; Kelly & Carter, 2015), which were predictive of treatment
outcomes (Kelly, Carter, Zuroff & Borairi, 2013). Additionally, practicing self-compassion on a daily basis has been found to reduce maladaptive eating patterns in non-clinical populations (Kelly & Stephen, 2016) suggesting the importance of targeting compassion when intervening with individuals suffering with disordered eating (Kelly et al., 2014).

Having meaning in life has been proposed as a protective factor against EDs and body image dissatisfaction (Góngora, 2014). Although research in the actual meaning in life (from the positive psychological perspective) and its relationship with disordered eating is very limited, a large amount of evidence exists to suggest that satisfaction with life is negatively related to a number of symptoms related to EDs, including vomiting, perception of being overweight, binge eating (Matthews, Zullig, Ward, Horn, & Huebner, 2012; Zullig, Pun, & Huebner, 2007), dieting and laxative use (Esch & Zullig, 2008; Valois, Zullig, Huebner, & Drane, 2003), perceived eating control (Greeno, Jackson, Williams, & Fortmann, 1998), and body dissatisfaction (Brannan & Petrie, 2011), in both, clinical and non-clinical populations.

Applying positive psychology for weight reduction and maintenance

The benefits of positive psychology, (namely mindfulness and compassion-based approaches), for the treatment of disordered eating pathology have been well documented in the literature over the last couple of decades (Baer et al., 2005; Heatherton & Baumeister, 1991; Heffner, Sperry, Eifert & Detweiler, 2002; Safer, Telch & Agras, 2001a, 2001b; Telch, Agras & Linehan, 2000; Wanden-Berghe et al., 2011). Several studies assessed the effectiveness of mindfulness-based interventions (MBIs) in eating psychopathology, reporting decreases in participants’ tendency to eat in response to their emotions, as well as decreased automatic eating (Alberts et al., 2010; Daubenmier et al., 2011; Niemeier, Leahey, Palm Reed et al., 2012; Jacobs, Cardaciotto, Block-Lerner et al., 2013). In recent years, research has been increasingly focusing on the possibility of applying MBIs to aid weight loss in individuals with obesity (Dalen et al., 2010; Daubenmier et al., 2011; Mason et al., 2016). In the past 5 years, three
systematic reviews and two meta-analyses have examined the effectiveness of MBIs on problematic eating behaviours and weight loss. Katterman and colleagues (Katterman et al., 2014) reported improvements in binge eating and emotional eating for nine out of the eleven studies reviewed. Six studies provided some kind of nutrition or energy balance education (Alberts et al., 2010; Dalen et al., 2010; Daubenmier et al., 2011; Kristeller et al., 2014; Miller et al., 2012; Timmerman & Brown, 2012), out of which one study (Timmerman & Brown, 2012) also included behavioural goal-setting and problem-solving to change eating behaviour. The observed effects on weight loss were mixed but those studies that focused on weight loss as a primary outcome (Dalen et al., 2010; Miller et al., 2012; Timmerman & Brown, 2012) found significant decreases in weight (Table 2.5.).
## Table 2.5. Changes in weight/BMI in the mindfulness intervention groups (Adapted from Katterman et al., 2014).

<table>
<thead>
<tr>
<th>Study</th>
<th>Weight loss specific components</th>
<th>Weight/BMI change at post-intervention</th>
<th>Weight/BMI change at follow-up (weeks since baseline)</th>
<th>Effect size at post-intervention (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberts et al., (2010)</td>
<td>Information on “healthy food choices”; performed 1 h of exercise after each session</td>
<td>-1.9 kg</td>
<td>n/a</td>
<td>-0.12**</td>
</tr>
<tr>
<td>Alberts, Thewissen &amp; Raes (2012)</td>
<td>None</td>
<td>-0.4 kg/m²</td>
<td>n/a</td>
<td>-0.06</td>
</tr>
<tr>
<td>Dalen et al. (2010)</td>
<td>General information on nutrition, exercise, calories; encouraged to increase levels of physical activity by 5 – 10 % each week</td>
<td>Not given</td>
<td>-4.0 kg** (12 weeks)</td>
<td></td>
</tr>
<tr>
<td>Daubenmier et al. (2011)</td>
<td>2-hour nutrition and exercise information session aimed at “moderate weight loss”</td>
<td>-0.06 kg</td>
<td>n/a</td>
<td>-0.02</td>
</tr>
<tr>
<td>Kearney et al. (2012)</td>
<td>None</td>
<td>+0.8 kg</td>
<td>+1.2 kg* (24 weeks)</td>
<td>+0.04</td>
</tr>
<tr>
<td>Kristeller &amp; Hallett (1999)</td>
<td>None</td>
<td>No change</td>
<td>No change</td>
<td>Not given</td>
</tr>
</tbody>
</table>
## LITERATURE REVIEW – POSITIVE PSYCHOLOGY

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention Content</th>
<th>Weight Change</th>
<th>BMI Change</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kristeller et al. (2014)</td>
<td>Weight management information briefly introduced in session 4 in the context of</td>
<td>-0.1 kg/m²</td>
<td>+0.4 kg/m²</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>hunger and energy balance; reinforced in session 9 but was not a primary focus of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miller et al. (2012)</td>
<td>Basic information on energy intake and nutrition; encouraged to engage in physical</td>
<td>-1.8 kg**</td>
<td>-1.5 kg/m²</td>
<td>3.29**</td>
</tr>
<tr>
<td></td>
<td>activity and mindful movement; however, no specific diet or activity goals were</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>provided</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosenzweig et al. (2007)</td>
<td>None</td>
<td>+0.9 kg</td>
<td>+1.8 kg</td>
<td>0.04</td>
</tr>
<tr>
<td>Timmerman &amp; Brown (2012)</td>
<td>General information on weight management; problem solving and behavioural goal</td>
<td>-1.7 kg*</td>
<td>n/a</td>
<td>0.09*</td>
</tr>
<tr>
<td></td>
<td>setting each session</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.05, **p<.01
Further support for the effectiveness of MBI was provided by O’Reilly and colleagues (O’Reilly et al., 2014) who documented improvements in binge-eating, emotional eating and external eating in 18 out of 21 studies reviewed. Significant weight reductions were also reported by Olson and Emery (2015) in 13 out of 19 studies reviewed. A meta-analysis of 12 studies conducted by Ruffault and colleagues (Ruffault, Czernichow, Hagger et al., 2016) revealed negative effects for mindfulness training on impulsive eating behaviours and binge-eating as well as positive effects on physical activity levels. No significant effects were, however, found for weight loss. An additional meta-analysis by Rogers and colleagues (Rogers, Ferrari, Mosely, Lang & Brennan, 2017) investigated the effects of MBIs on weight loss, eating behaviours and psychological outcomes in individuals with overweight and obesity. Findings showed large effects of MBIs on eating behaviours, medium effects on psychological variables and small effects on body mass index for the 15 included studies. However, it ought to be noted that the aforementioned reviews and meta-analyses included studies that incorporated complementary strategies such as ACT (Olson & Emery, 2015; O’Reilly et al., 2014; Ruffault et al., 2016), CBT (Olson & Emery, 2015; Katterman et al., 2014; Ruffault et al., 2016; Rogers et al., 2017) and DBT (Ruffault et al., 2016). Even though ACT and DBT fall under an umbrella of “third-wave cognitive behavioural treatments” (see Öst, 2008 for a review), they do not contain the same elements that form the basis of traditional mindfulness meditation approaches, while CBT does not contain any mindfulness-related element. Combining such strategies may therefore result in misleading interpretations.

A couple of the reviewed studies indicated that mindfulness meditation particularly aids weight loss (Mantzios & Giannou, 2014; Mantzios & Wilson, 2015a). However, there were significant differences in achieved weight loss when other therapeutic elements were applied alongside with mindfulness meditation compared to mindfulness meditation alone (Mantzios
& Wilson, 2015a). Self-compassion training, in particular, seems to add more to weight loss than mindfulness meditation alone, possibly by increasing tolerance and acceptance of self-critical thoughts commonly observed in dieters (Duarte, Matos, Stubbs et al., 2017). Furthermore, when mindfulness meditation was applied without the addition of other elements, there were significant differences between individual and group settings (Mantzios & Giannou, 2014), with those participants who practiced mindfulness meditation individually, performing poorly in losing weight (Table 2.6.). Interestingly, the difference in weight loss was not explained by the actual mindfulness scores, as the participants in the individual setting scored higher than those in the group setting. Furthermore, the difference in mindfulness was not significant, raising an important question as to what may have contributed to the actual weight loss in participants.
### LITERATURE REVIEW – POSITIVE PSYCHOLOGY

**Table 2.6.** Changes in weight after mindfulness meditation intervention.

<table>
<thead>
<tr>
<th>Study</th>
<th>Groups</th>
<th>Weight loss specific components</th>
<th>Weight/BMI change at post-intervention</th>
<th>Weight/BMI change at follow-up (6 months from post-intervention)</th>
<th>Weight/BMI change at follow-up (1 year from 6 months)</th>
<th>Effect size at post-intervention (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mantzios &amp; Giannou</td>
<td>Mindfulness within a group</td>
<td>Advertised for people who “wanted to lose weight and were about to start their diet”; no nutritional education provided during the program</td>
<td>-1.8 kg*</td>
<td>n/a</td>
<td>n/a</td>
<td>Not given</td>
</tr>
<tr>
<td></td>
<td>Mindfulness independently</td>
<td></td>
<td>-0.5 kg</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Mantzios &amp; Wilson</td>
<td>Mindfulness</td>
<td>Advertised as a weight loss program; given literature on what problems dieters usually face, how the environment affects eating behaviour and how to diet more effectively</td>
<td>-2.7 kg*</td>
<td>+0.7 kg</td>
<td>+0.5</td>
<td>Not given</td>
</tr>
<tr>
<td></td>
<td>Mindfulness + other components</td>
<td></td>
<td>-3.9 kg*</td>
<td>-2.5 kg*</td>
<td>+3.4 kg</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td>+0.8 kg</td>
<td>+1.4 kg</td>
<td>-4.0 kg</td>
<td></td>
</tr>
</tbody>
</table>

*p<.001
Compared to mindfulness, self-compassion is a relatively new concept in the context of weight loss (Mantzios & Wilson, 2015a), which has been found to play a particularly important role in weight maintenance (Mantzios, Wilson, Linnell & Morris, 2015). Self-compassion helps to buffer against the negative effects of eating psychopathology (Ferreira et al., 2014) by enabling individuals to break the negative cycle of shame, body image dissatisfaction and the drive to thinness (Ferreira, Pinto-Gouveia & Duarte, 2013) that are not only characteristic for patients with EDs but also detrimental in dieting and obese populations (Chernyak & Lowe, 2010; Conradt, Dierk, Schlumberger et al., 2008; Gavin, Simon & Ludman, 2010). It has been found that being more compassionate (Gilbert, 2005), especially with oneself (Neff, 2003), notably improves mindfulness practice and increases effectiveness of mindfulness interventions (Hollis-Walker & Colosimo, 2011; Birnie, Speca, & Carlson, 2010). (See Mantzios & Wilson, 2015b for a review.) A couple of recent studies have investigated the role of self-compassion in weight loss and management, suggesting that interventions with an added component of self-compassion aid weight loss more than interventions focusing on mindfulness alone (Mantzios & Wilson, 2015a), and that self-compassion uniquely contributes to negative prediction of weight gain (Mantzios et al., 2015). However, participants in these studies were not a typical sample that is usually seen in weight loss and management trials, as they exercised regularly and had a controlled diet, which notably restricted the authors’ ability to generalize their findings. Even though there is some research evidence to suggest that self-compassion is related to mindful eating (Webb, Jafari, Schoenfeld & Hardin, 2013), intuitive eating (Schoenfeld & Webb, 2013), overcoming disinhibition when dieting (Adams & Leary, 2007), and increasing health behaviour intentions (Sirois, 2015), the role of self-compassion in weight regulation still requires further research (Mantzios & Egan, 2017).
A few relatively recent studies investigated the role of positive psychology in weight loss and maintenance in obese Australians (Robertson, Davies & Winefield, 2013; 2015a; 2015b), addressing a previously suggested hypothesis that obese individuals may be lacking in positive emotion and psychosocial functioning (Keyes, 2002; Keyes, 2005). Taking this perspective the authors proposed that the application of more comprehensive positive psychological approaches may help enhance and balance the traditional understanding of the obesity phenomenon. Exploring the “lived” experiences of individuals suffering with obesity from the positive psychological perspective, Roberton and her colleagues found that people (Australians), who engage in weight loss attempts display a number of positive psychological assets, including life satisfaction, gratitude, strengths, optimism, and mindfulness (Robertson et al., 2013). The authors concluded that despite individuals’ failure to achieve significant and sustainable weight loss, the presence of the positive psychological aspects was encouraging, and suggestive of potential themes to be addressed within a positive psychological approach to weight loss treatment.

Further explorations of the potential positive psychological treatment targets in obese populations were supportive of previous notions that health related quality of life differs significantly across weight categories (Kolotkin & Andersen, 2017), suggesting that holistic approaches to obesity treatment should address well-being (Robertson et al., 2015b). It has been confirmed that subjective well-being differs across BMI categories, with individuals in the class two and class three obesity range displaying significantly lower levels of flourishing than overweight and normal weight subjects (Robertson et al., 2015b), indicating that cultivation of the resources and strengths associated with positive well-being would be a potentially useful obesity treatment target. Additionally, with a reference to weight loss maintenance, significant differences in some positive psychological variables have been found between successful and un-successful weight loss maintainers (Robertson et al., 2015a).
LITERATURE REVIEW – POSITIVE PSYCHOLOGY

Individuals, who successfully maintained their lost weight over 12 months reported significant differences in frequency of positive mood and the agentic thinking component of hope, which are both correlates of psychological health (Snyder, Feldman, Taylor, Schroeder & Adams, 2000; Snyder, Rand & Sigmon, 2002). They also engaged in more frequent diet, exercise and self-weighing behaviours compared to the un-successful weight loss maintainers.

Overall, these findings highlighted the importance of inclusion of positive psychological concepts in the existing obesity treatment protocols.
2.4. Obesity and OMICS: Human Genome Responses to Positive Psychology

2.4.1. Food intake, emotional responses and signal transduction pathways

Obesity is a complex, multifactorial condition. The rise of obesity can be attributed to several major societal and environmental changes (Misra & Khurana, 2008; De Henauw, Verbestel, Marild et al., 2011), encompassed by the term “obesogenic environment” (Stein & Keller, 2015). Interestingly, the obesogenic environment, depressive symptoms and emotional eating are conceptually related. Emotional eating, the tendency toward overeating in response to negative emotions (Konttinen, Mannisto, Sarlio-Lahteenkorva, Silventoinen & Haukkala, 2010; Goldschmidt, Crosby, Engel et al., 2014), is driven by emotional phenotypes like depression, anxiety, sadness, and boredom, rather than hunger. Ample lines of evidence suggest that chronic high-fat feeding promotes negative emotional states and potentiates condition for enhanced sensitivity to stress that leads to continuous repetitive cycles of overeating, weight gain, and depressed mood (Singh, 2014). Ongoing research shows that chronic exposure to highly processed foods, (filled with empty calories from added sugars and saturated fats), causes drastic changes to the reward circuitry of human brain (Avena, 2015).

Several review articles have been published recently on the biological factors and type of foods that influence appetite and mood via brain signal transduction pathways (Singh, 2014; Mansur, Brietzke & McIntyre, 2015; Schulte, Yokum, Potenza & Gearhardt, 2016). The complex nature of food intake where various biological factors link mood, food intake and brain signalling, will not be discussed in great detail here. LEPTIN (LEPR) and GHRELIN (GHRL) are two hormones that have been recognized to have a major influence on energy balance. Both hormones interact with the hypothalamus to regulate food intake, energy
homeostasis, promote satiety, and hunger (Spiegelman & Flier, 2001). Interestingly, both hormones have also been associated with the “reward pathway” suggesting the linkage between mood and food intake (Kiefer, Jahn, Kellner, Naber & Wiedemann, 2001; Opland, Leinninger & Myers, 2010; Dickson, Egecioglu, Landgren et al., 2011). Additionally, the concentration of LEPR in human plasma (Considine, Sinha, Heiman et al., 1996), and its mRNA expression in adipose tissue (Vidal, Auboeuf, De Vos et al., 1996), appear to be directly related to obesity severity. Although, some studies have shown an increased LEPR production in obese individuals who were not leptin-deficient, suggesting that they may not be responsive to leptin signalling (Imam, 2016). Several studies (Caro, Kolaczynski, Nyce et al., 1996; Bjorbaek, El-Haschimi, Frantz & Flier, 1999; Faouzi, Leshan, Bjornholm et al., 2007; Munzberg, Flier & Bjorbaek, 2004) have attempted to explain the syndrome of leptin resistance. However, apart from several discussions in mutations in the leptin resistance gene (Clément et al., 1998; Gotoda et al., 1997), the molecular basis of leptin resistance, is yet to be explored (Bakker, van Dielen, Greve, Adam & Buurman, 2004; Montez, Soukas, Asilmaz et al., 2005).

A substantial amount of evidence shows that the dysregulation of the central nervous system (CNS) significantly contributes to obesity and metabolic syndrome. Particularly the disruption of various hypothalamic pathways can be responsible for disordered feeding and energy balance resulting in the development of obesity and related health problems (Cai & Liu, 2011; 2012; Elmquist & Flier, 2004; Flier & Maratos-Flier, 1998; Schwartz & Porte, 2005). Several neurotransmitter systems have been found to play an important role in feeding behaviour. These include serotonin (Steiger, 2004; Davis et al., 2009), dopamine (Volkow, Wang & Baler, 2011), and opioids (Davis, Levitan, Reid et al., 2009). The nucleus accumbens, the brain's reward system, receives inputs of endogenous opioids, serotonin, and dopamine and sends outputs to neurons of the hypothalamus that act on appetite control. Several findings have suggested a role of β-endorphin, an opioid neuropeptide, in food intake. It has been suggested
that endogenous opioids play a significant role in appetite and metabolism regulation, and thereby control both short- and long-term energy balance (Kim, Lin, Valentino, Colon-Gonzalez & Waldman, 2011). In particular, β-endorphins in the CNS are able to modulate the activity of structures responsible for appetite control and food intake regulation (Bakkali-Kassemi, El Ouezzani, Magoul et al., 2011).

The neurotransmitter release of serotonin in the brain is controlled by food intake (Shabbir, Patel, Mattison et al., 2013). Increased levels of serotonin have been shown to suppress feeding behaviour and weight gain (Leibowitz & Alexander, 1998), and chronic dieters have often displayed symptoms of depression due to reduced levels of serotonin (Huether, Zhou, Schmidt, Wiltfang & Rüther, 1997). Interestingly, behaviour linked to serotonergic neurotransmission is influenced by the gut microbiota (O'Mahony, Clarke, Borre, Dinan & Cryan, 2015), which have also been found to play an important role in energy homeostasis and body weight regulation mechanisms (Rosenbaum, Knight & Leibel, 2015). The essential amino acid tryptophan that comes from high-quality foods (Friedman & Levin, 2012) is the precursor for serotonin synthesis (Prasad, 1998; Richard, Dawes, Mathias et al., 2009). Hence, tryptophan deficiency can lead to lower serotonin levels, although the exact relationship between the central effects of tryptophan depletion/supplementation remains unclear (Crockett, Clark, Roiser et al, 2012; Hughes, Carballedo, McLoughlin et al., 2012; Van Donkelaar, Blokland, Ferrington et al., 2011). On the other hand, consumption of sugar and fat-rich foods leads to increased dopamine turnover, which in the brain produces the same effect as some drugs of abuse, such as cocaine, heroin, methamphetamine etc. (Barry et al., 2009; Fortuna, 2010; Gluskin & Mickey, 2016).

The amino acid tyrosine is the precursor for dopamine synthesis. It has been shown that the A1 allele of the DOPAMINE 2 RECEPTOR (DRD2) has been implicated in various addictive disorders including alcohol abuse and dependence, cocaine and methamphetamine
dependence, bulimia, binge eating disorder and obesity (reviewed in Fortuna, 2010; Gluskin & Mickey, 2016). DRD2, encodes the D2 subtype of the dopamine receptor, to maintain normal craving behaviours (Del Parigi, Chen, Salbe, Reiman & Tataranni, 2003; Volkow et al., 2011; Gluskin & Mickey, 2016). The presence of the A1 allele has been suggested as a strong predictor of psychological phenotypes involving a drive for “thinness” and a belief in “ineffectiveness” (Fortuna, 2010). Compared to their lean counterparts, obese individuals seem to have significantly lower availability of striatal DRD2 in proportion to their BMI (Chen, Lin, Chao et al., 2012a). It has been suggested that dopamine and possibly oxytocin deficiency in obese individuals may perpetuate pathological eating as a means to compensate for decreased activation in motivation and reward circuits modulated by dopamine. It has also been proposed that the association between striatal dopamine and oxytocin receptors, and brain glucose metabolism in somatosensory cortices could underlie one of the mechanisms through which dopamine regulates the reinforcing properties of food (Eisenstein, Gredysa, Antenor-Dorsey et al., 2015; 2016).

The hypothalamo-neurohypophyseal neuropeptide OXYTOCIN (OXT) is classically known for its functions in reproductive physiology of mammalian females (Soloff, Alexandrova & Fernstrom, 1979). However, growing evidence indicates that many of the classical and non-classical actions of OXT are also associated with feeding changes (Arletti, Benelli & Bertolini, 1989; Douglas, Johnstone & Leng, 2007; Leng, Onaka, Caquineau et al., 2008; Ho & Blevins, 2013) with several recent studies linking OXT to the hypothalamus-brain stem circuits that work to inhibit feeding (Baskin, Kim, Gelling et al., 2010; Blevins, Schwartz & Baskin, 2004; Blouet, Jo, Li & Schwartz, 2009). Additionally, a number of recent studies revealed that obesity can be significantly attributed to OXT release defect, and OXT treatment was able to effectively correct overeating and obesity (Deblon, Veyrat-Durebex, Bourgoin et al., 2011; Maejima, Iwasaki, Yamaha et al., 2011; Zhang & Cai, 2011; Zhang, Zhang, Bai et
al., 2011; Zhang, Wu, Chen et al., 2013). (See Cai & Purkayastha, 2013 for a review). It seems that OXT plays a vital role in integrating circadian control with metabolic regulation, suggesting that OXT treatment can amend the circadian dysregulation of metabolic physiology leading to the reduction of obesity (Zhang & Cai, 2011). Furthermore, research demonstrated that when delivered systemically OXT causes reduction in fat mass and adipocyte size (Maejima et al., 2011), whereas deficiency in OXT receptor incurs an opposite effect (Takayanagi, Kasahara, Onaka et al., 2008). A recent clinical trial revealed that OXT treatment in humans not only leads to body weight reduction, but also improves the lipid profile of the patients by lowering serum LOW DENSITY LIPOPROTEIN (LDL) and cholesterol levels and a propensity for HIGH DENSITY LIPOPROTEIN (HDL) level (Zhang et al., 2013). Overall, it seems that OXT can incorporate multiple mechanisms to regulate energy and metabolic homeostasis, and represents a new-generation peptidyl drug target for the treatment of obesity and diabetes (Cai & Purkayastha, 2013).

It has been argued that eating disorders and other addictive behaviours might represent an addiction to hormones related to feeding behaviour (Schellekens, Dinan, & Cryan, 2013), rather than addiction to particular types of food and its hedonic properties. If obesity is modulated by genetic deficiency of particular types of dopamine and endorphin and oxytocin in the CNS, it would be worth investigating whether genes responsible for expression of these, can be changed, altered or transformed. Taken together, these studies imply that certain foods, apart from their effect on obesity, are strong mood regulators.

2.4.2. “-Omics” and the study of obesity and psychological well-being

The Human Genome Project (HGP) has profoundly transformed many scientific fields. After the publication of the sequence of the human genome (International Human Genome
Sequencing Consortium 2001; 2004; Venter, Adams, Myers et al., 2001), the era of “-OMICS” has emerged to revolutionize the way of studying and learning in medical and biomedical sciences. “-OMICS” refers to a field of study ending in the neo-suffix “-omics” [from Greek -\textit{ōma} (-ōma)], such as genomics, transcriptomics, epigenomics, proteomics, metabolomics or interactomics. In contrast to traditional experimental approaches, “-OMICS” are high-throughput, data-driven, holistic, and top-down methodologies, which attempt to understand the cell, tissue, organ or organism phenotype as an integrated system. These high-throughput approaches generate large amounts of data, whereas the analysis of these data often requires significant \textit{in-silico} efforts and always advanced statistical approaches.

Several reviews have been published on the “-OMIC” technologies recently (Cellerino & Ori, 2017; Mitra, Carvunis, Ramesh & Ideker, 2013; Valdes, Glass & Spector, 2013; Brookes & Robinson, 2015; Johnson, Ivanisevic & Siuzdak, 2016), so the “-OMIC” methodologies will not be described in great detail here. “-OMICS” focus on the dynamic interactions between the different entities of a biological system to analyze networks, pathways, and interactive relations that exist among them, such as genes, transcripts, proteins, metabolites, and/ or cells and cellular structures. Recently, advances in “-OMICS” research fields have come of age and are beginning to be applied in clinical practice. Genomics has, interestingly, garnered great public attention through the HGP.

Genomics, the study of the entirety of an organism’s genes, brings a deluge of data that may lead to the discovery of novel loci associated with psychological well-being and quality of life domains. Genomic variation at the level of nucleotide sequence has been shown that is associated with individual differences in personality and thus with vulnerability and resistance to a wide range of chronic illness and abnormal phenotypes (Ebstein, 2006; Meyer-Lindenberg & Weinberger, 2006; Rutter, 2007). This has a significant impact in the current understanding of mental health and in the clinical management of patients. With the next generation
LITERATURE REVIEW – OBESITY AND OMICS

sequencing technologies (Buermans & Den Dunnen, 2014), a wide range of applications are now affordable. Genomics can also be used to identify molecular networks that are deregulated in emotional and social functioning (Fredrickson, Grewen, Coffey et al., 2013; Slavich & Cole, 2013; Cole, 2014) and mental health (Schizophrenia Working Group of the Psychiatric Genomics, 2014), which will not only elucidate the underlying molecular genetic mechanisms, but may also help to determine the classes of psychological interventions that have to be used for potential treatment.

Global mRNA transcript expression profiling is a very powerful tool in modern biological psychology because it encompasses the organisms’ transcription of activated genes. Transcriptomics plays several roles in advanced management of human behaviour. Its main applications involve emotion diagnostics based on gene expression profiling of mRNA, as well as biomarker applications in studies of human behaviour. The operation of the genome and transcriptome is regulated by signal transduction pathways that are responsive to environmental experiences. The notion of epigenetics offers a putative interface between the genetic and environmental factors that interact to provide the phenotypic expression (Allis & Jenuwein, 2016). Epigenomics is the systematic analysis of the global state of gene expression not attributable to mutational changes (Stricker, Köferle & Beck, 2017). An organism has multiple, cell type-specific, epigenomes comprising epigenetic marks such as DNA methylation (Suzuki & Bird, 2008), histone modification (Papamichos-Chronakis & Peterson, 2013), acetylation (Verdin & Ott, 2015), phosphorylation (Humphrey, James & Mann, 2015), ubiquitination (Meas & Mao, 2015), sumoylation (Hendriks & Vertegaal, 2016), non-coding RNAs (Sato, Tsuchiya, Meltzer & Shimizu, 2011) and specifically positioned nucleosomes (Tsankov, Thompson, Socha, Regev & Rando, 2010).
2.4.3. Combining molecular genetics with psychological approaches to obesity treatment

Research has noted a significant progress in understanding the differences in human development depending on the interaction between environmental exposures and individual genotypes and phenotypes (Ellis et al., 2011). It has been argued that susceptibility to weight gain in response to environmental risk factors (e.g. high-fat diet, low level of physical activity) may be determined by the level of genotype-environment interaction (Pérusse & Bouchard, 1999). Additionally, the effects of genotype-environment interaction could be involved in the tendency of obese individuals to develop the various comorbidities associated with obesity (e.g. diabetes, coronary heart disease, hypertension etc.) and, more importantly, in individual responsiveness to a particular type of treatment.

Inclusion of the molecular genetic approaches in the current PhD research has two main objectives:

1. Expression analysis of OXTR gene

Gene expression is the process by which information from a gene is used in the synthesis of a functional gene product. These products are often proteins. The aim of this research is to measure OXTR gene expression levels in saliva samples in response to a PPI designed within the scope of the current PhD. Given the criticisms of positive psychological approaches and their reliance on self-report measures, the additional purpose of the OXTR expression analysis, is to validate the PPI by using OXTR expression levels as a model system. The OXTR expression levels will be determined with Real-Time PCR (polymerase chain reaction).
Real-time PCR (RT-PCR), also known as quantitative reverse transcription PCR (RT-qPCR), and quantitative PCR (qPCR), is one of the most powerful and sensitive gene analysis techniques available (Life Technologies Corporation, 2010). It is used for a broad range of applications including quantitative gene expression analysis, genotyping, copy number, biomarker discovery and pathogen detection. (See Chapter 3 for more detailed explanation of this methodology.)

Real-time PCR measures PCR amplification as it occurs, so that it is possible to determine the starting concentration of nucleic acid. In traditional PCR, which is based on endpoint detection, results are collected after the reaction is complete, making it impossible to determine the starting concentration of nucleic acid.

Every real-time PCR contains a fluorescent reporter molecule—a TaqMan® probe or SYBR® Green dye, for example—to monitor the accumulation of PCR product. As the quantity of target amplicon increases, so does the amount of fluorescence emitted from the fluorophore.

2. Exploiting the GeneMANIA database to identify potential interactions linking genes, obesity and emotional functioning: A bioinformatics approach

The GeneMANIA database (https://genemania.org) contains gene expression data, including protein and genetic interactions, pathways, co-expression, co-localization and protein domain similarity. GeneMANIA can be used to identify new members of a pathway or complex, and identify novel genes with a specific function and relationships. This bioinformatics approach will be used to identify any potential interactions linking genes, obesity and positive psychology together.
2.5. Chapter Summary and Rationale

2.5.1. Chapter summary

Obesity presents a worldwide health problem with substantial medical, social, and economic consequences (Arterburn et al., 2005; Yach et al., 2006; Runge, 2007). Severe cases of morbid obesity can be effectively treated by a form of bariatric surgery, and pharmacotherapy, which may support the process of weight loss by regulating appetite and controlling hunger, or altering metabolic and thermic functions of the body. However, “the cornerstones of weight management are always diet and physical activity, with behaviour change underpinning both” (Cook, 2014, p. 167-168).

Most self-help treatment approaches involve some kind of dietary intervention. It is generally agreed that hypo-caloric diets do lead to weight reduction. However, extremely restrictive diets are often nutritionally imbalanced and should not be used, as they are often ineffective in the long run and can be harmful to the body (NICE, 2006). On the other hand, it seems that well-balanced regimes that re-educate eating habits and that can be permanently maintained have the capacity to induce long-term weight loss (Cook, 2014), even though the composition of macronutrients in dietary regimens remains an area of great controversy (Halton & Hu, 2004). However, maintaining specific regimes can be challenging and it has been shown repeatedly that adherence to a lifestyle change presents one of the biggest barriers to the long-term weight loss maintenance (Makris & Foster, 2011). The inclusion in the patient’s care of different health care providers, such as dietitians, psychologists, nurses, or nurse practitioners may be an efficient way of providing the support needed for behaviour change and healthy lifestyle maintenance (Aronne, 2002).
Behavioural therapy is undoubtedly the most commonly used psychological approach to obesity treatment, and in combination with dietary intervention, it also produces the best weight loss outcomes (Wadden et al., 2007). Yet, having to face every day challenges of the obesogenic environment, most individuals treated with BT tend to regain weight after the intervention has come to end.

A relatively new form of cognitive behaviour therapy specifically designed for individuals with weight problems (Cooper & Fairburn, 2001), has attempted to address the relapse issue in patients with overweight and obesity. CBT is recognised for its successful applications to eating disorders, some of which (i.e. bulimia nervosa, binge eating disorder) share a number of maladaptive patterns with obesity. However, its effectiveness for relapse prevention has only been tested in recent years. Although some studies have shown beneficial effects of CBT on weight loss maintenance, especially when combined with dietary and/or exercise intervention (Shaw et al., 2005; Werrij et al., 2009), others have not found CBT approaches to be superior to either standard primary care (Muggia et al., 2014), or behavioural therapy (Cooper et al., 2010).

It is believed that one of the most common reasons why people fail to achieve and maintain healthy body weight is lack of motivation and poor adherence (Teixeira et al., 2012), which is why the use of motivational interviewing as part of, or in addition to a standard BT has recently become popular. A number of studies have reported significantly greater weight reductions in individuals who received MI intervention as part of their regularly scheduled appointments, or in addition to a typical treatment in primary care settings (see Barnes & Ivezaj, 2015 for a review). It seems that individuals who fully endorse their weight loss-related behavioural goals and feel not just competent but also autonomous about reaching them, are more likely to achieve a long-lasting behaviour change (Teixeira et al., 2012). Although the majority of studies fail to measure fidelity of delivery, it seems that MI may have the potential
LITERATURE REVIEW – SUMMARY

to facilitate change and increase patient engagement in therapy, improving the efficacy of other interventions.

Although positive psychology as a scientific discipline is less than a couple of decades old, the concept of the “good life” has been studied by ancient philosophers and religious leaders for centuries (Lopez & Snyder, 2009). The current understanding of the positive aspects of life has been greatly shaped throughout the 20th century by a number of psychological traditions, but the most influential field that directly identified with the study of positive human experience, was humanistic psychology (Duckworth et al, 2005). The reason why positive psychology developed within just a couple of decades was because “it brought together so much existing knowledge from Aristotle’s concepts to the work of earlier humanistic psychologists” (Csikszentmihalyi, 2009, p. 203), which formed a strong foundation for a field that has now evolved into a complex analysis of human flourishing (Seligman, 2012).

Since its formal beginnings in 1999, positive psychology has been developing rapidly. Hundreds of articles have been published in scientific and popular press, with the appearance of special journal issues and a new journal in 2006, the Journal of Positive Psychology. Different handbooks (e.g., Linley & Joseph, 2004; Ong & van Dulmen, 2007; Snyder & Lopez, 2002) and textbooks (e.g., Carr, 2004; Compton, 2005; Peterson, 2006) on the topics of positive psychology have been emerging, and a new therapeutic movement (positive psychotherapy) has even developed within the field of positive psychology (Biswas-Diener, 2011; Seligman et al., 2005).

Perhaps the most successful development is the discipline of applied positive psychology, which focuses on improving well-being through the application of PPIs (Lomas et al., 2015). A number of studies have shown successful applications of PPIs to mental health disorders, such as depression (Sin & Lyubomirsky, 2009), addiction (Krentzman, 2013),
alcohol misuse (Akhtar & Boniwell, 2010), eating disorders (Harrison et al., 2016), and schizophrenia (Meyer et al., 2012), some of which are known to be conditions comorbid with obesity. A number of PPIs involving positive psychological concepts of optimism, and gratitude have even been developed specifically for patients with cardiovascular disease (DuBois et al., 2016; Huffman et al., 2011), and type 2 diabetes (Huffman et al., 2015).

A growing body of literature is emerging on the application of mindfulness-based approaches to the treatment of eating disorders (Godsey, 2013; Wanden-Berghe et al., 2011) and obesity-related eating behaviours (Godsey, 2013; Katterman et al., 2014; O'Reilly et al., 2014), with some researchers even proposing that mindfulness is an essential component of holistic obesity treatment (Douglass, 2011; Kristeller & Wolever, 2011). However, the results from the application of these approaches in terms of weight loss have been somewhat inconsistent. While some studies have shown that engaging in mindfulness-based interventions leads to reductions in weight, and BMI (Alberts et al., 2010; Dalen et al., 2010; Kristeller et al., 2014; Miller et al., 2012; Netam et al., 2012; 2015), others have reported no difference or even increases in body weight after the intervention (Kearney et al., 2012; Rosenzweig et al., 2007). Furthermore, there seem to be significant differences in weight loss when other therapeutic elements, particularly self-compassion training, are applied alongside with mindfulness as opposed to mindfulness alone (Mantzios & Wilson, 2015a). Also, when mindfulness is practiced within a group setting, people seem to perform better in losing weight than when practicing it individually (Mantzios & Giannou, 2014). Although, the results from mindfulness and compassion-based interventions are promising, the application of complex PPIs to individuals with weight problems is lacking in current research. It has been shown that people who engage in weight loss attempts display a number of positive psychological assets, including life satisfaction, gratitude, strengths, optimism, and mindfulness (Robertson et al.,
2013), suggesting that holistic approaches to obesity treatment should address the concept of well-being to aid weight loss (Robertson et al., 2015b).

Although genetic predisposition has a significant role in obesity susceptibility, the current obesity epidemic does not have a purely genetic basis. Alterations to lifestyle over the past few decades have created an obesogenic environment in which the underlying molecular genetic pathways contributing to obesity have started to be elucidated. However, despite multi-disciplinary strategies including surgery, medication and psychosocial interventions, health professionals struggle to manage the complex and costly nature of obesity. The discovery of genetic polymorphisms associated with well-being and quality of life domains could pave the way for investigations into how environmental experiences and the “obesogenic environment” coordinate the levels of wellbeing by modulating specific molecular genetic pathways. Current advances in “-OMIC” technologies could provide insights not only into the identification of genetic variations related to obesity and psychological wellbeing but also to link these variations to brain function. “-OMIC” technologies could also identify the interactions between environmental experiences and “obesogenic environment” that affect mental health, and identify the neural and molecular correlates of these gene–environment interactions underlying genetically correlated phenotypes, such as depression, addiction, and obesity, for which the discovery of molecular genetic associations has proven elusive. Furthermore, by linking the “-OMIC” analysis to behaviour, it will be possible to explain, predict and possibly even alter human behaviour. Hence, it is likely that “-OMICS”-based psychology research will take a central place in the understanding, diagnosis, treatment, and monitoring of psychological wellbeing and quality of life domains in the near future.
2.5.2. Rationale for the current research

Even though short term weight loss in response to various obesity treatments has been well documented in the past literature, there seems to be inconsistent evidence for long-lasting effects or health improvements of any of those approaches. Obesity is still on the rise reaching the proportion of a global health epidemic, clearly suggesting that there is a need for development of alternative treatment approaches.

A substantial amount of research shows that positive psychology can be successfully applied to comorbidities associated with obesity, including obesity-related eating disorders. A few recent studies have applied interventions based on positive psychology to aid weight loss, highlighting particularly the importance of mindfulness and self-compassion. However, research applying a comprehensive positive psychological intervention to individuals with overweight or obesity is lacking.

Just as with any other chronic condition, obesity is a result of a complex interplay between genes and environment. While it is known that psychological well-being is partly heritable, it is only recently that positive health has started to investigate the specific factors that influence body weight in response to happiness and well-being. The discovery of genetic polymorphisms associated with well-being and quality of life domains could help elucidate how the obesity-related genes together with the obesogenic environment coordinate the levels of wellbeing by modulating specific molecular genetic pathways. By integrating the “-OMIC” technologies into psychological research, the current project could identify the interactions between environmental experiences and obesogenic environment that affect mental health, and thus facilitate improvement in therapy and treatment modalities.
LITERATURE REVIEW – SUMMARY

A number of recent studies revealed that obesity can be significantly attributed to OXT release defect, and OXT treatment was able to effectively correct overeating and obesity (see Cai & Purkayastha, 2013 for a review). It seems that OXT plays a vital role in integrating circadian control with metabolic regulation, suggesting that OXT treatment can amend the circadian dysregulation of metabolic physiology leading to reduction of obesity (Zhang & Cai, 2011).

The purpose of the present research is to assess the effectiveness of a comprehensive PPI for weight management developed within the scope of this PhD. Considering the common limitations of self-report measures used in positive psychology (see section 2.3.3.), further aims of this research are to validate the intervention though differential gene expression analysis exploiting the oxytocin (OXTR; HGNC: 8529) gene as a model system, and identify potential molecular genetic pathways through which the PPI functions. The purpose of this is to assess whether the PPI could act as a potential trigger of change in obesity-related gene expression, and thus, lead to weight loss as a by-product of this genotype-environment interaction. This is a completely novel approach.

Based on the identified gaps in previous research, this PhD has four main aims:

1. Develop a PPI for individuals with weight problems.
3. Identify the potential molecular genetic pathways through which the PPI functions.
4. Validate the intervention by using OXTR expression as a model system.
As introduced in Chapter 1, the present research has the following aims:

1. Develop a positive psychological intervention for individuals with weight problems.
3. Identify potential molecular genetic pathways through which the intervention functions.
4. Validate the intervention by using OXTR expression levels as a model system.

The purpose of this chapter is to review the methods used to address each of the aims above. The chapter is split in two major sections, where the first section discusses the methodological approaches used in psychology to pilot and test effectiveness of psychological interventions. The second section then reviews the methods of analysing gene expression used in molecular biology with the main focus on the quantitative real-time PCR used in this PhD research.
3.1. Research Methods in Psychology

Modern psychological research practice uses different approaches and methods to analyse and interpret research data. However, there are two main traditions: (1) the quantitative approach, and (2) the qualitative approach (Howitt & Cramer, 2017), which are commonly, but perhaps incorrectly, seen as alternative and incompatible approaches to psychological research. Each tradition has specific intellectual roots and distinctive features that should be carefully evaluated in order for researchers to make appropriate choices about the type of research they wish to use, which would best address their research questions. Some even argue that qualitative methods are a preliminary stage in the research process which contributes to the eventual development of adequate quantification (Howitt, 2016).

Within the present PhD research, qualitative methods were not used for data evaluation and therefore will not be further discussed here. However, some qualitative data were obtained in a form of reflective reviews (Appendix E), which were written by the researcher within 24 hours from the end of each group session (see section 3.2. for details on each session). The reason for this was for the researcher to have a written report from each session, and proven record of good clinical practice.

3.1.1. Quantitative research methods

The setting-up of the psychology laboratory at Leipzig University by Wilhelm Wundt in 1879 was a crucial moment for psychologists. Although Wundt himself did not believe that the laboratory was the place for all psychological research, laboratory experiments and statistical analyses dominate the field of psychology, and are considered as one of the most
powerful tools available to researchers. There are three essential aspects (Figure 3.1.) which need to be understood in order to design effective experiments: (1) experimental manipulation, (2) standardisation of procedures, and (3) random assignment to conditions or order (Howitt & Cramer, 2017).

<table>
<thead>
<tr>
<th>Experimental manipulation</th>
<th>Standardisation of procedures</th>
<th>Randomization</th>
</tr>
</thead>
<tbody>
<tr>
<td>- essentially “creates” the independent variable</td>
<td>- the experimental manipulation should ideally be the only difference between the experimental and control conditions</td>
<td>- primarily used to allocate participants to the experimental and control groups in unrelated designs</td>
</tr>
<tr>
<td>- is believed likely to have an effect on the dependent variable</td>
<td>- the way in which the experimenter interacts with the participants should be standardised</td>
<td>- in related designs, randomization refers to the order that the different conditions are run through</td>
</tr>
<tr>
<td>- must have at least two different levels (versions)</td>
<td>- random allocation to the sequence helps avoid inadvertently running one group sooner than the other</td>
<td>- participants can sometimes be matched in pairs and then randomly allocated to the two conditions as a pair</td>
</tr>
<tr>
<td>- manipulation of more than one thing should be avoided</td>
<td>- failure to standardise procedures increases the amount of uncontrolled variation</td>
<td>- if matching is used, then the design becomes a related one</td>
</tr>
<tr>
<td>- effectiveness of the experimental manipulation should be checked and questions asked at debriefing</td>
<td>- differences in treating the experimental and control groups can lead to erroneous conclusions</td>
<td>- matching should only be done on variables which are related to the dependent variable (otherwise it has no effect)</td>
</tr>
</tbody>
</table>

**Figure 3.1.** Summary of the essential features in a simple experimental design.
It can be a grave mistake to assume that simply because an experimental manipulation has been introduced by the researcher, the independent variable has actually been manipulated effectively. It might be argued that if the researcher finds a difference between the experimental and control groups on the dependent variable(s), the manipulation must have been effective. This is only partially true, as the experimental manipulation may have affected the participants but not quite in the expected way. Therefore, sometimes it is appropriate to pilot work trying out one’s procedures prior to the actual proper study, to establish the effectiveness of the experimental manipulation (Howitt & Cramer, 2017). From this perspective, pilot studies play an important role in research, in providing information for the planning and justification of randomised controlled trials (RCTs) (Anderson & Prentice, 1999). Essentially, there are two types of pilot studies used specifically to plan an RCT: external pilot studies that are stand-alone pieces of work planned and carried out independently to the main study; and internal pilot studies that are incorporated into the main study design of the RCT (Lancaster, Dodd & Williamson, 2004). Although there is no formal methodological guidance as to what constitutes a pilot study, and most statistical literature focuses on internal pilots, there are recommendations for good practice and examples of methodological aspects used for external pilot studies (Bauhofer, Stinner, Plaul et al., 2001; Bunn, Watling, Ashby & Smyth, 1998; Burrows, Gan, Gallus, Wallace & Burrows, 2001; Carfoot, Dickson & Williamson, 2002; Ross-McGill, Hewison, Hirst et al., 2000; Stevinson & Ernst, 2000) which were the kind of pilot studies conducted within this PhD research.

**External pilot studies**

The fundamental purpose of conducting a pilot study is to examine the feasibility of an approach that is intended to be used in a larger scale study (Porta, 2008). Prior to initiating a full scale RCT an investigator may choose to conduct a pilot study in order to evaluate the
feasibility of recruitment, randomization, retention, assessment procedures, new methods, and/or implementation of the novel intervention. A pilot study, however, is not used for hypothesis testing (Leon, Davis & Kraemer, 2011). Instead it serves as an earlier-phase developmental function that will enhance the probability of success in the larger subsequent RCTs that are anticipated. Therefore, setting clear objectives for a pilot study will not only add methodological rigour to it but it will also help with conducting a proper trial (Lancaster et al., 2004).

**Integrity of study protocol.**

In preparation for a larger trial a pilot study can be treated as a try out or a dummy run (Ross-McGill et al., 2000; Burrows et al., 2001) to test the procedures intended to be used to carry out the main study. This would include participant inclusion/exclusion criteria, drug preparation (if applicable), storage and testing of equipment and materials, training of staff in administration and assessment of the intervention (Carfoot et al., 2002). Within the present research pilot studies were used to test the participant recruitment strategies, inclusion/exclusion criteria, and assess the administration and effectiveness of the PPI for individuals with weight problems developed within the scope of this PhD.

**Testing of questionnaires for data collection.**

Piloting of data collection forms or questionnaires (Carfoot et al., 2002) is particularly important, especially when the patient/client has to self-complete the form or when several different assessors will be collecting data (Lancaster et al., 2004). This will ensure the form is comprehensible and appropriate, and that questions are well defined, clearly understood and presented in a consistent manner. Other forms such as patient information documents and consent forms could also be tested. In the first pilot study four questionnaires including a demographic information sheet were tested. After evaluation of the study findings (see Chapter
6), a decision was made to include an additional two measures (GAD7 and PHQ9) in the second pilot study giving a total of six questionnaires to be used in the main trial.

**Recruitment and consent.**

It is important to clearly specify the consent rate for participants entering the trial (Ross-McGill et al., 2000; Burrows et al., 2001; Carfoot et al., 2002), as it will have a direct impact on planning how long it will take to recruit sufficient numbers of participants. Previous research has highlighted a number of barriers in the recruitment to RCTs, with recommendations that this aspect of the trial should be carefully planned and piloted (Ross, Grant, Counsell et al., 1999), as failure to recruit sufficient numbers in a trial will reduce the statistical power, and is one of the main reasons for abandoning trials early. Within the present research recruitment strategies were carefully piloted in two separate studies (see Chapter 6 for details) on which basis it was concluded that the best recruitment strategy for the RCT would be to deliver the intervention within a module of a first year university course.

**Assessment of acceptability of intervention.**

In certain situations an intervention may not appeal to all participants, especially when working with a clinical population, in which case it would be advised to determine acceptability in a pilot sample. For example, the intervention may have known side-effects for certain populations or be difficult to administer (Ross-McGill et al., 2000), or it may be a complementary therapy (Stevinson & Ernst, 2000).

**Sample size calculation.**

There has been a tradition of using pilot studies to calculate a sample size for a larger trial on the basis of the initial data obtained from the main outcome measure (Ross-McGill et al., 2000; Stevinson & Ernst, 2000). However, despite the widespread use, it has been argued
that this tradition is insufficiently justified (Friedman, Furberg & DeMets, 1998; Kraemer, Mintz, Noda, Tinklenberg & Yesavage, 2006) and that pilot study results should not be used to determine a sample size for larger trials due to the inherent imprecision in effect size estimates from studies with small samples (Leon et al., 2011). Therefore, in order to prevent any imprecise estimates of effect sizes, the pilot studies carried out within this research were not used to calculate the sample size needed for the main trial.

From the above evidence it could be concluded that pilot studies present a necessary first step in exploring novel interventions and novel applications of interventions – whether in a new patient population or with a new delivery system. Pilot results inform feasibility, which is important in case any modifications need to be done in the planning and design of a larger trial. Despite the convention, pilot studies do not provide useful information regarding the sample size needed for a large trial (Leon et al., 2011).

**Randomised controlled trials**

RCTs are considered the gold standard ascertaining the efficacy and safety of new treatments determining whether a cause–effect relation exists between the intervention and the outcome (Figure 3.2.) (Sibbald & Roland, 1998). The basis of every RCT is the study protocol that describes the medical/scientific background, the risk: benefit assessment, the study design, the study methods, and the overall planning, conduct and analysis (Kabisch, Ruckes, Seibert-Grafe & Blettner, 2011). Figure 3.3. (adapted from Kendall, 2003) presents features of a well-designed RCT.
**Figure 3.2.** The randomised controlled trial.

**Figure 3.3.** Features of a well-designed RCT.

- **Blinding of participants and the investigator** – both groups will be treated identically.
- **Generalizable results** – the sample to be studied is sufficiently large and appropriate to the hypothesis to be tested.
- **Effective (concealed) randomization** – elimination of selection bias and minimalization of confounding variables.
- **Intention to treat analysis** – participants are analysed within the group to which they were allocated, irrespective of whether they experienced the intended intervention.
- **Testing the a priori hypothesis** – analysis focuses on testing the research question that initially led to the trial.
Objectives and rationale for the RCT carried out within the present PhD were derived from the scientific background and identified gaps in research discussed in Chapters 1 and 2.

**Study design.**

In trials with randomized and controlled design, the effects of the study treatment (intervention) are compared with those of a control treatment and the patients are randomly assigned to the two groups. The patients in the control group receive either another treatment or a placebo (Kabisch et al., 2011). The trial conducted within the present PhD project was a quasi-randomised two-armed study where participants were allocated to either immediate intervention group or a delayed intervention (wait list) control group. Although allocation of the participants was not open to a systematic bias, as usually seen in quasi-RCTs (Harris, McGregor, Perencevich & Furuno, 2006), and all participants had equal chances to be assigned to either of the two conditions, randomisation was performed by the researcher delivering the actual intervention, and thus prone to a selection bias. However, the effects of selection bias in this study were minimalised by the fact that the researcher had not met or had any knowledge about the participants prior to the randomisation process. Standardised methods of assessment, data collection, treatment delivery, communication with participants, and evaluation were in place to ensure “fair” comparison between the treatments (see Chapter 7 for details).

**Randomization.**

Randomization in RCTs is performed to ensure structural equivalence where all potential confounding factors are divided equally among the groups that will later be compared (Kabisch et al., 2011). These factors are characteristics that might affect the participants’ response to treatment/intervention, such as age, gender, weight etc. (Kendall, 2003). In the present study, the differences between these confounding variables could not be assessed with accuracy as the groups, when based on demographic information, were very uneven. However,
there were no significant differences in prior-intervention scores at the baseline when comparing the intervention group with the control group, (see Chapter 7 for details). The participants were assigned to two groups (immediate intervention or delayed intervention control) with a randomization ratio of 1:1. Since the randomisation was performed by the researcher, it was prone to a selection bias. However, this was minimalized by avoiding predictability of group allocation. Double-randomization was used to ensure that the researcher would be unaware to which treatment group the next participant would be allotted to (see Chapter 7).

**Blinding.**

Bias is avoided not only by randomization but also by blinding which can be double blind, single blind, or open. Double blinding where neither participants nor study researcher know to which treatment each participant has been assigned, is considered as the most advantageous, since knowledge of the treatment might influence the course and therefore the results of the study (Kabisch et al., 2011; Kendall, 2003). However, double blinding may not always be possible due to limited resources. Therefore it is suggested that the highest possible blinding should be chosen in order to minimise bias (Kabisch et al., 2011). In the case of the present trial, single blinding was used where only the researcher was aware of the intervention condition each participant was assigned to. The participants were only given the name of the person they were going to have a session with. They were told that they would be with that person for the first six weeks and then they would swap over.

**Analysis population.**

The data subjected to statistical analysis in RCTs are those gathered from patient/participant populations defined in the study protocol and there are a number of ways researchers can treat the data. The so-called intention-to-treat (ITT) population comprises of
all randomized participants and analysis is carried out within the groups which are then compared. Advantages of randomization such as structural equivalence, are thus retained (Kabisch et al., 2011). Because the ITT population includes all patients who were randomized, the data for analysis include some patients whose treatment was interrupted, prematurely discontinued, or did not take place at all. The analysis strategy for ITT data is therefore conservative, i.e., the treatment effect tends to be underestimated (Ellenberg, 2001), regardless of whether the primary endpoint represents an improvement or a deterioration. For this reason many studies define a modified ITT (mITT) population, which may for example comprise the participants who received at least a defined amount of study treatment/intervention. An alternative strategy is to restrict analysis to the data from the per-protocol population. Participants in whom study conduct deviated from the protocol are excluded from analysis. These protocol violations can include failure to meet the inclusion or exclusion criteria or incorrect administration of the study treatment/intervention. In the present research mITT population was used for the analyses and intervention evaluation. Similarly as in the pilot studies (see Chapter 6) data of only those participants who attended at least three sessions (50% of the PPI) were included in the RCT analyses.
3.2. Methods of Analysing Gene Expression

One of the aims of the present research was to identify the effectiveness of the PPI on a molecular genetic level attempting to validate the intervention by using $OXT_R$ gene expression levels as a model system.

Over the past three decades, global analysis of mRNA expression has emerged as a powerful strategy for biological discovery and a major advance in biomedical research (Fryer, Randall, Yoshida et al., 2002). Currently, there is a number of technologies available for analysing mRNA expression levels or differential mRNA expression (see Fryer et al., 2002; Miglani, 2015 for a review). These include Northern blots, RT-PCR, macroarrays, microarrays, differential display RT-PCR, serial analysis of gene expression (SAGE), comparative expressed sequence tag (EST) analysis, massively parallel signature sequencing (MPSS), and RNA sequencing (RNA Seq) (Bustin, Benes, Nolan & Pfaffl, 2005; Geiss, Bumgarner, Birditt et al., 2008; Heller, 2002; Josefsen & Nielsen, 2011; Lockhart & Winzeler, 2000; Ozsolak & Milos, 2011; Reinartz, Bruyns, Lin et al., 2002; Schena, Heller, Theriault et al., 1998; Wang, Gerstein & Snyder, 2009; Yamamoto, Wakatsuki, Hada & Ryo, 2001) (see Appendix F for a brief overview). All of these approaches have advantages and limitations (Table 3.1.) and it is up to each investigator to evaluate these and choose the most suitable analysis based on the nature of their research, research facilities and financial resources.

The current project used real-time RT-PCR to analyse expression levels of the $OXT_R$ in response to the PPI (see Chapter 2 for the rationale for choosing the $OXT_R$ gene in particular). This method was evaluated as the most suitable for the following reasons:
METHODOLOGY OF GENE EXPRESSION ANALYSIS

1. It is very sensitive and provides highly accurate quantification of the amount of starting material in samples.
2. It is able to monitor the progress of the PCR reaction as it occurs in real time.
3. It is inexpensive to use for a single gene expression analysis.
4. The laboratory of the University of Bolton was well equipped for this approach.
5. The requirement for a large number of samples could be met.
## Table 3.1. Advantages and disadvantages of the methods used for global analysis of gene expression.

<table>
<thead>
<tr>
<th></th>
<th>+/-</th>
<th>Micro-arrays</th>
<th>Macro-arrays</th>
<th>MPSS</th>
<th>Northern blot</th>
<th>SAGE</th>
<th>RT-PCR</th>
<th>Differential display</th>
<th>Comparative EST</th>
<th>RT-PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical difficulty</td>
<td>**</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Setup expense</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Cost of analysis</td>
<td>**</td>
<td>**</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Bioinformatics needs</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Number of genes</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Number of samples</td>
<td>**</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>Flexibility</td>
<td>**</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Gene specificity</td>
<td>**</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
</tbody>
</table>

*low; **medium; ***high
3.2.1. Real time RT-PCR

The PCR is one of the most powerful technologies in molecular biology. Using PCR, specific sequences within a DNA or cDNA template can be copied, or amplified, many thousand- to a million-fold using sequence specific oligonucleotides, heat stable DNA polymerase, and thermal cycling. In traditional RT-PCR (or endpoint PCR; Cale, Shaw, & Bird, 1998; Freeman, Walker & Vrana, 1999), detection and quantification of the amplified sequence are performed at the end of the reaction after the last PCR cycle, and involve post-PCR analysis, such as gel electrophoresis and image analysis. In the quantitative RT-PCR (RT-qPCR), PCR product is measured at each cycle, so reverse transcription is followed by real time quantitative PCR.

Reverse transcription first generates a single-stranded DNA template from the mRNA, which is called cDNA. The cDNA template is then amplified in the quantitative step, during which the fluorescence emitted by labelled hybridization probes or intercalating dyes changes as the DNA amplification process progresses (Miglani, 2015). In other words, fluorescent dyes yield increasing fluorescent signal in direct proportion to the number of PCR product molecules (amplicons) generated. The change in fluorescence over the course of the reaction is measured by an instrument that combines thermal cycling with fluorescent dye scanning capability (Life Technologies Corporation, 2012). By plotting fluorescence against the cycle number, the real-time PCR instrument generates an amplification plot that represents the accumulation of product over the duration of the entire PCR reaction (Figure 3.4.). By monitoring reactions during the exponential amplification phase of the reaction, users can determine the initial quantity of target with great precision. With a carefully constructed standard curve, qPCR can produce an absolute measurement of the number of copies of original mRNA, typically in units
METHODOLOGY OF GENE EXPRESSION ANALYSIS

of copies per nanolitre of homogenized tissue or copies per cell. RT-qPCR is very sensitive (detection of a single mRNA molecule is theoretically possible; Miglani, 2015), and with appropriate instrumentation, an investigator can measure mRNA levels in hundreds of samples each day.

Figure 3.4. Relative fluorescence vs. cycle number in RT-qPCR.

Experimental design

Successful real-time PCR assay design and development are the foundation for accurate data. It is particularly important to clearly identify what biological questions need to be answered within an experiment. There are a number of real-time PCR assay types (e.g. gene expression profiling, viral titer determination, genomic profiling assays, allelic discrimination assays) and each has a specific research purpose. The present research employed the gene expression profiling which is a methodology commonly used to assess the relative abundance of transcripts to determine gene expression patterns between samples. RNA quality, reverse transcription efficiency, real-time PCR efficiency, quantification strategy, and the choice of a
normalizer gene play particularly important roles in gene expression experiments. The protocol followed in the present experiments is detailed in Chapter 8.

Primer design

Optimal primer design is critical for successful real-time PCR based analysis of gene expression. Since first-strand cDNA contains thousands of genes, each potentially available as a PCR template, it is important to use carefully designed primers that would specifically amplify only the genes of interest. The primer pairs used in the present research were designed (Invitrogen) to span the 30-most intron to avoid amplification of DNA templates that may be present in trace amounts in the RNA samples (see Chapter 8 for more details on the primer sets used in this study and expected fragments sizes).

RT-qPCR fluorescence detection

The most widely used real-time fluorescent PCR chemistries are the 5’nuclease assay, of which the most well-known is the TaqMan® Assay and SYBR®-Green dye-based assays (Figure 3.5.). In dye-based qPCR, fluorescent labelling allows the quantification of the amplified DNA molecules by employing the use of a dsDNA binding dye. During each cycle, the fluorescence is measured. The fluorescence signal increases proportionally to the amount of replicated DNA and hence the DNA is quantified in “real time”. The present research used the SYBR®-Green dye which was chosen mainly for its lower set up costs. As the SYBR®-Green dye binds to any amplified product, target or non-target, it has lower specificity compared to the TaqMan® probes. Therefore, since amplification of non-target can vary sample to sample, it is recommended to perform at least one specificity assessment for every SYBR®-Green reaction (Life Technologies Corporation, 2012). Most commonly this assessment is the dissociation analysis using gradual melting of the PCR products after PCR
using SYBR®-Green. Melting curve analysis can detect the presence of non-specific products (Figure 3.6.), and thus improve the specificity of the SYBR®-Green dye-based assays. However, SYBR®-Green dissociation is low resolution and may not differentiate between target and non-target with similar specific melting temperature. As such, dissociation data in isolation cannot be taken as definitive. However, when combined with other information, such as data from target negative samples, sequencing or gels, dissociation data can provide more confidence in specificity. In the present research samples the specificity of the amplification was checked by melting curve analysis and electrophoresis of the products on an 8% polyacrylamide gel.
**Figure 3.5.** Comparison of TaqMan-based and SYBR Green–based detection workflows.
**Figure 3.6.** Melting curve analysis can detect the presence of non-specific products, such as primer-dimer, as shown by the additional peaks to the left of the peak for the amplified product in the melt curve.

**Internal controls and reference genes**

To achieve accurate and reproducible expression profiling of selected genes using real-time PCR, it is critical to use reliable internal control gene products for the normalization of expression levels between experiments—typically expression products from housekeeping genes are used. The target chosen to be the internal standard (or endogenous control) should be expressed at roughly the same level as the experimental gene product. By using an endogenous control as an active reference, quantification of an mRNA target can be normalized for differences in the amount of total RNA added to each reaction. In the present study, it was decided to combine two reference genes according to the geNorm program, using the pairwise comparison. To remove sampling-related differences (RNA quality and RNA quantity), a normalization strategy based upon the geNorm approach was followed (Hellemans, Mortier, De Paepe, Speleman & Vandesompele, 2007). The normalization factor was the genomic mean
of the \textit{ACTIN-\beta} (\textit{ACTβ}) and \textit{TUBULIN-\alpha} (\textit{TUBa}) genes. The absolute amount of transcript determined, was then divided by the normalization factor to obtain the normalized values.

\textbf{Data analysis}

As mentioned earlier, selecting the right quantification method depends on the goals of the experiment. Absolute quantification which is often used for determining viral titer, determines actual copy numbers of target, but is also the most labour intensive and difficult form of quantitation which requires thoughtful planning and a highly accurate standard curve. The present research has used comparative quantification for the data analysis, which is a method applicable to most gene expression studies (Life Technologies Corporation, 2012). Comparative quantification still requires careful planning, but the data generated are for relative abundance rather than exact copy number. The expression level of a gene of interest is assayed for up- or down-regulation in a calibrator (normal) sample and one or more experimental samples. Precise copy number determination is not necessary with this technique, which instead focuses on fold change compared to the calibrator sample. This method offers two main options for quantification: $\Delta\Delta C_t$ and standard curve quantification. In the current study the $\Delta\Delta C_t$ quantification technique was employed. It compares results from experimental samples with both a calibrator (e.g., untreated or wild-type sample) and a normalizer (e.g., housekeeping gene expression). With this method, $C_t$s for the gene of interest (GOI) in both the test sample(s) and calibrator sample are now adjusted in relation to a normalizer (norm) gene $C_t$ from the same two samples. The resulting $\Delta\Delta C_t$ value is incorporated to determine the fold difference in expression.
3.3. Chapter Summary

The aim of this chapter was to (1) discuss the methodological approaches used in psychology to pilot and test the effectiveness of psychological interventions, and to (2) review the methods of analysing gene expression used in molecular biology with the main focus on the quantitative real-time PCR used in this PhD research.

While the qualitative approach was briefly mentioned, the first section of this chapter focused mainly on the quantitative methods of data evaluation which were used in the present research. It discussed the purpose and importance of pilot studies in testing novel interventions for use in larger trials creating a clear link with the pilot studies conducted within this PhD. A comprehensive review of the methodology of RCTs was then provided with respect to the study protocol, design, randomisation and blinding methods, and the overall planning, conduct and analysis. Each aspect was evaluated with regards to the current RCT design.

The second section of this chapter reviewed the methodology of gene expression analysis. While global gene expression analysis is a very extensive area of research, this section was purposefully focused on discussing the real-time qPCR technique used to analyse gene expression in the samples collected for the purpose of the present experiments. After briefly introducing the RT-qPCR it considered all essential aspects/components necessary for a successful gene expression profiling which was used to determine gene expression patterns between the collected samples in the present studies. Primer design, RT-qPCR fluorescence detection, and the selection of internal controls and reference genes were evaluated with respect to the goals of the present experiment and available resources.
CHAPTER 4: Theoretical Background for the Design and Development of the PPI

The purpose of the present PhD research was to develop a positive psychological intervention for individuals with weight problems and assess its effectiveness on individual well-being, body-image flexibility and weight loss. This chapter will discuss the theoretical background for the development and design of the intervention providing supporting arguments for inclusion of each theme, self-help exercises and group work.

4.1. PPI for Weight Management: Development and Design

The PPI developed for the purpose of this research aimed to target adults with weight problems that commonly come with some form of disordered eating habits. The intervention was designed for six weeks and it combined experiential group work with online learning. Each of the six weeks was devoted to one positive psychological theme: (1) Gratitude, (2) Mindfulness, (3) Self-compassion, (4) Strengths, (5) Hope, and (6) Happiness\(^8\). There is no standard length for a PPI, although it is believed that interventions that are longer in duration (measured in hours or weeks) tend to be more effective than relatively shorter interventions (Sin & Lyubomirsky, 2009). Longer interventions may allow for more practice, greater opportunities to turn activities into long-lasting habits, and, in the case of therapies, more therapeutic guidance (Sin et al., 2011). Similarly, individuals who continue to engage in

\(^8\) The entire intervention is provided in an electronic format - a CD is attached at the back of the thesis.
positive activities after a formal intervention has come to an end experience relatively greater increases in happiness (Lyubomirsky et al., 2011; Seligman et al., 2005; Sheldon & Lyubomirsky, 2006). On the other side, some other therapies widely used to treat disordered eating, such as CBT, can be as short as 5 weeks with each weekly session lasting between 30 and 60 minutes (NHS, 2016).

While developing the present PPI it was aimed to maximise the potential effect of the intervention by combining the benefits of both, shorter and longer therapies. This was achieved by combining 6 weekly group sessions (90 minutes per session) with a complex, yet simple and practical online intervention which aimed to reinforce the effect of group sessions by encouraging the participants to partake in individual positive activities. Group interventions are well known to be the most beneficial form of therapy, right after individual interventions (Baskin & Enright, 2004; Sin & Lyubomirsky, 2009), and even though self-administered positive activities are not as effective as individual or group therapies, they still significantly enhance well-being when compared to engaging in neutral activities or no activities at all (Sin & Lyubomirsky, 2009). Furthermore, evidence is emerging to suggest that online interventions cultivating positive affect skills lead to significant improvements in well-being and reduction in depressive symptoms (Mitchell, Vella-Brodrick & Klein, 2010), even in relatively small samples (Cohn, Pietrucha, Saslow, Hult & Moskowitz, 2014).

It could be argued that if the current PPI proves to be feasible and could boost affect and motivation in overweight and obese individuals who are non-adherent to key health behaviours, it could become a cost effective tool used to improve functional and medical outcomes in the chronic condition of overweight and obesity. The question to ask is how might boosting positive affect, optimism, and psychological well-being lead to better health behaviour adherence? Broadly, positive states are thought to improve people’s social, psychological, and physical resources (Aspinwall, 1998; Aspinwall & Tedeschi, 2010;
Fredrickson, 1998). Positive affect is also linked to improved coping and problem solving skills (Aspinwall & Tedeschi, 2010; Yi-Frazier et al., 2012). Huffman and colleagues (Huffman et al., 2015) proposed a bidirectional model suggesting that positive psychological constructs, such as well-being, happiness, optimism, resilience and self-esteem, affect health behaviour through a number of mediation pathways (Figure 4.1.). They argued that positive psychological well-being leads to improvement in mediational factors linked to health behaviours, and thus increasing well-being through intentional positive activities, may result in an improvement in physical health as a by-product of those activities.

**Figure 4.1.** Conceptual model outlining the proposed mediators between positive affect and improved health behaviours. (Adapted from Huffman et al., 2015).
THEORETICAL BACKGROUND – DEVELOPMENT OF THE PPI

The model above was developed specifically for patients with type 2 diabetes which is frequently associated with obesity due to shared mechanisms of insulin resistance (Al-Goblan, Al-Alfi & Khan, 2014) and genetic factors underlying both conditions (Jafar-Mohammadi & McCarthy, 2008). Therefore, the rationale for the current PPI was derived from this model and it was then adapted to suit particularly individuals with overweight or obesity incorporating evidence from further empirical research (see below). Unlike traditional weight management programs (see Chapter 2 for a review) the present intervention did not include any nutritional education, dietary monitoring or exercise management. Improvement in health behaviours potentially leading to weight loss was proposed to be initiated by a change in similar mediational factors described above. The PPI targeted those positive psychological constructs individuals with weight problems might struggle with. Improvement in those aspects of well-being was proposed to trigger the change in the mediational factors addressed through the intervention (Figure 4.2.).

The ways positive psychological constructs affect attention and cognitive processing, active coping and resilience, self-regulation and motivation, and self-efficacy and perceived control have been previously described (see Huffman et al., 2015). The theoretical model presented here includes relationships cultivation as a mediator equivalent to the one described by Huffman and colleagues (2015) as social support. Additionally a mediating role of self-reflection and self-awareness on health behaviours has been identified together with readiness to change as an important factor contributing to the effectiveness of the positive psychological constructs.

Despite the range of available models that have inspired health-focused interventions, it seems that for many people, untapped influences persist in thwarting successful behaviour change. Based on meta-analysis of qualitative studies assessing factors related to health behaviour change, self-reflection and self-awareness seem to play an important role in
achieving sustainable change in health behaviour (Kearney & O’Sullivan, 2003). Critical reappraisal of self and situation represents the initial turning point leading to a small step towards behaviour change which, if successful, is then repeated. Self-awareness and self-confidence fuel behaviour change and reinforce development of new healthier behavioural patterns, and self-reflection is key to self-awareness (Ward, 2014). Self-monitoring is a critical health management task that requires careful attention to health stimuli and leads to improved diet and physical activity (Burke, Wang & Sevick, 2011) along with greater medication adherence (Karter, Ackerson, Darbinian et al., 2001). Such processing also results in more accurate perceptions of risk that can lead to health behaviour change (Reed & Aspinwall, 1998).

Previous research has identified a number of cognitive-behavioural mediators of changing multiple maladaptive behaviours (King, Marcus, Pinto, Emmons & Abrams, 1996). Readiness and stages of change have been widely applied in addiction treatment enabling providers to address the diverse needs of substance abusers and treatment seekers, supporting more proactive interventions, and creating a concentration on motivational enhancement (DiClemente, Schlundt, & Gemmell, 2004). Obesity research has identified readiness to change as positively related to increased physical activity (Emmons, Marcus, Linnan, Rossi & Abrams, 1994; Taylor, Hepworth, Lees et al., 2004) and motivational readiness stages as positively related to physical activity and dietary changes (Bock, Marcus, Rossi & Redding, 1998; Taylor et al., 2004).
Figure 4.2. Conceptual model of the present intervention outlining the proposed mediators between positive affect and improved health behaviours reinforced by individual readiness to change.
4.1.1. Themes of the current PPI

The present PPI incorporated six positive psychological concepts (gratitude, mindfulness, self-compassion, strengths, hope, and happiness) which were selected on the basis of previous research investigating the role of positive psychology in weight management and reduction of overweight and obesity, and related eating disorder psychopathology.

Most previous research in the field has focused primarily on mindfulness and/or self-compassion based approaches (see Chapter 2). Undoubtedly, both concepts play an important role in the treatment of eating psychopathology, and evidence is emerging to suggest that both concepts may also aid weight loss (Mantzios & Giannou, 2014; Mantzios & Wilson, 2015a; see Chapter 2 for details). However, participants in the cited studies were not typical populations that are usually investigated in weight loss and weight regulation trials. They were military civilians who exercised regularly and had a controlled diet which significantly limited generalizability of these findings. Therefore, in order to further investigate the role of mindfulness and self-compassion in weight management, inclusion of both concepts in the present PPI seemed essential.

However, mindfulness and self-compassion do not appear to be the only factors affecting weight management. It has been suggested that obese individuals may be lacking in positive emotion and psychosocial functioning (Keyes, 2002; Keyes, 2005), and thus, the application of comprehensive positive psychological approaches may help enhance and balance the traditional understanding of the obesity phenomenon. This hypothesis has been recently addressed by Australian researchers who investigated the role of different positive psychological concepts in weight loss and maintenance in obese Australians (Robertson et al., 2013; 2015a; 2015b). According to their findings, obese individuals who do engage in weight
loss attempts display a number of positive psychological assets, including *life satisfaction*, *gratitude*, *strengths*, *optimism*, and *mindfulness* (Robertson et al., 2013). Despite the fact that most of these individuals failed to achieve significant and sustainable weight loss, the presence of the positive psychological aspects was encouraging, and suggestive of potential themes to be addressed within a positive psychological approach to weight loss treatment.

When investigating the factors that actually contribute to a successful weight loss maintenance, Robertson and her colleagues found that significant differences exist in some positive psychological variables between successful and un-successful weight loss maintainers (Robertson et al., 2015a). Individuals, who successfully maintained their lost weight over 12 months reported significant differences in frequency of *positive mood* and the agentic thinking component of *hope*, which are both correlates of psychological health (Snyder et al., 2000; Snyder et al., 2002). They also engaged in more frequent diet, exercise and self-weighing behaviours compared to the un-successful weight loss maintainers. On the basis of her findings, Robertson designed a PPI for obese women in a non-clinical community sample which included three concepts over the course of 16 weeks: hope (2 modules), strengths and gratitude (Robertson, 2015). Immediately after the intervention two out of four participants lost between 1.2 and 1.6 kg. At follow-up assessment weight reduction between 0.2 and 4.0 kg was noted in three out of four participants. Although the studied sample was too small, this investigation offered a good basis for the potential applicability of a wider-focused PPI to overweight and obese populations.

The present PPI was designed as a holistic approach to weight management incorporating those positive psychological concepts that have been previously suggested as potentially aiding weight loss and/or weight maintenance. Additionally, as the importance of well-being in holistic obesity treatment has been highlighted before (Kolotkin & Andersen,
THEORETICAL BACKGROUND – THEMES OF THE PPI

2017), each concept in the present PPI was also evaluated from the perspective of its benefits on well-being.

**Gratitude**

Substantial amount of empirical research has demonstrated the positive effect of gratitude practice on well-being (Emmons & McCullough, 2003; Lai & O’Carroll, 2017). Grateful contemplation has been shown to reduce excessive worrying and levels of depression over time (Wood, Joseph & Linley, 2007). Recording grateful thoughts has been found to increase positive emotions, and altruistic behaviour leading to fewer physical complaints (Emmons & McCullough, 2003). Research has demonstrated that keeping a gratitude journal increases state gratitude (Martínez-Martí, Avia & Hernández Lloreda, 2010) and reduces negative affect (Lai & O’Carroll, 2017), and counting one’s blessings helps to reduce symptoms of depression (Simon, 2016).

The association between depression and obesity has repeatedly been established (Luppino, de Wit, Bouvy et al., 2010). Therefore the benefits of gratitude in the reduction of depressive symptoms were of particular interest here. Research has systematically yielded significant negative correlations between trait gratitude and depression (Kendler, Liu, Gardner et al., 2003; McCullough, Tsang & Emmons, 2004; Stoeckel, Weissbrod, & Ahrens, 2014), and several empirical studies have demonstrated the importance of gratitude in reduction of psychopathological symptoms, particularly depression and anxiety (Emmons & Stern, 2013). Furthermore, gratitude has been shown to uniquely predict lower levels of depression in patients with chronic illness (Sirois & Wood, 2017).

Although research in gratitude with direct links to obesity is lacking, several recent studies have demonstrated the importance of gratitude in the development of positive body
image and body image satisfaction (Dunaev, Markey & Brochu, 2018; Homan & Tylka, 2018). In particular, body-focused gratitude has been shown to effectively reduce internalized weight bias and improve body image (Dunaev et al., 2018), possibly through the mechanisms explained by the amplification model of gratitude (Watkins, 2014). Gratitude is proposed to be connected to body appreciation and intuitive eating because it amplifies the good individuals see in themselves helping them to focus on their positive internal characteristics, rather than seeking their self-worth in their appearance or the approval of other people (Homan & Tylka, 2018). Gratitude based interventions have also been found to decrease symptoms of dysfunctional eating and body dissatisfaction (Wolfe & Patterson, 2017). Since body image dissatisfaction is commonly observed in individuals with weight problems (Weinberger, Kersting, Riedel-Heller & Luck-Sikorski, 2017), inclusion of the gratitude concept in the current PPI appeared as relevant and appropriate.

**Mindfulness**

The benefits of mindfulness-based approaches for the treatment of disordered eating have been well documented in the literature over the last couple of decades (Baer et al., 2005; Heatherton & Baumeister, 1991; Heffner et al., 2002; Safer et al., 2001a, 2001b; Telch et al., 2000; Wanden-Berghe et al., 2011). A number of recent reviews indicated that mindfulness-based therapies may be an effective form of treatment for EDs (Godsey, 2013; Wanden-Berghe et al., 2011), and obesity-related eating pathology (Godsey, 2013; Katterman et al., 2014; O'Reilly et al., 2014), with some researchers even proposing that mindfulness is an essential component of holistic obesity treatment (Douglass, 2011; Kristeller & Wolever, 2011; see Chapter 2 for details). Several studies assessed the effectiveness of mindfulness-based interventions in eating psychopathology, reporting decreases in participants’ tendency to eat in response to their emotions, as well as decreased automatic eating (Alberts et al., 2010;
Daubenhimer et al., 2011; Niemeier et al., 2012; Jacobs et al., 2013). In recent years, research has been increasingly focusing on the possibility of applying mindfulness-based interventions to aid weight loss in individuals with obesity (Dalen et al., 2010; Daubenhimer et al., 2011; Mason et al., 2016). A detailed review presented in Chapter 2 shows that particularly mindfulness meditation has a good potential for weight loss treatment.

**Self-compassion**

The role of self-compassion in eating psychopathology has received much interest in the past few years. In a recent review self-compassion has been discussed as a protective factor against poor body image and eating pathology (Braun et al., 2016). Self-compassion has been found to directly influence the severity of eating psychopathology in EDs (Ferreira et al., 2014) with the link between self-compassion and disordered eating symptomatology apparent even in non-clinical populations (Tylor et al., 2015). Several studies have shown low levels of self-compassion and high fear of self-compassion in patients with EDs (Kelly et al., 2014; Kelly & Carter, 2015), which were predictive of treatment outcomes (Kelly, Carter, Zuroff & Borairi, 2013). Additionally, practicing self-compassion on a daily basis has been found to reduce maladaptive eating patterns in non-clinical populations (Kelly & Stephen, 2016) suggesting the importance of targeting compassion when intervening with individuals suffering with disordered eating (Kelly et al., 2014).

Compared to mindfulness, self-compassion is a relatively new concept in the context of weight loss (Mantzios & Wilson, 2015a), which has been found to play a particularly important role in weight maintenance (Mantziros et al., 2015). Self-compassion helps to buffer against the negative effects of eating psychopathology (Ferreira et al., 2014) by enabling individuals to break the negative cycle of shame, body image dissatisfaction and the drive for thinness (Ferreira et al., 2013) that are not only characteristic of patients with EDs but also
THEORETICAL BACKGROUND – THEMES OF THE PPI

detrimental in dieting and obese populations (Chernyak & Lowe, 2010; Conradt et al., 2008; Gavin et al., 2010). Additionally, research has indicated that being more compassionate (Gilbert, 2005), especially with oneself (Neff, 2003), notably improves mindfulness practice and increases effectiveness of mindfulness interventions (Hollis-Walker & Colosimo, 2011, Birnie et al., 2010). (See Mantzios & Wilson, 2015b for a review.)

Strengths

A substantial amount of research evidence exists to support the value of identifying and playing to one’s strengths. Benefits for the individual include elevated vitality and motivation, a greater sense of direction and higher probability of goal attainment, not to mention increased self-confidence and productivity (Clifton & Anderson, 2002; Hodges & Clifton, 2004; Peterson & Seligman, 2004) both of which are often impaired in obese individuals (Griffiths et al., 2010; Striegel, Bedrosian & Wang, 2012). Over the last two decades, there has been an increasing interest among mental health professionals in attending to both the strengths and weaknesses of their clients (McCrae, 2001). Many studies have indicated a positive relationship between positive personal traits and health (Duan, Ho, Siu, Li, & Zhang, 2015; Park et al., 2004; Peterson & Seligman, 2004; Wood, Linley, Maltby, Kashdan, & Hurling, 2011), suggesting that different strengths can be clearly identified, cultivated, used, and strengthened through regular application in daily life to increase life satisfaction and decrease depression and anxiety (Duan, Bai, Tang et al., 2012; Duan, Ho, Tang, Li, & Zhang, 2014; Park et al., 2004; Peterson & Seligman, 2004; Seligman & Csikszentmihalyi, 2000; Seligman et al., 2009; Seligman, Steen, Park, & Peterson, 2005; Wood et al., 2011).

Life satisfaction and health-related quality of life are often impaired in obese populations (Castres, Folope, Dechelotte, Tourny-Chollet & Lemaitre, 2010). The relationship between character strengths and life satisfaction has been well documented, with the specific
THEORETICAL BACKGROUND – THEMES OF THE PPI

Strengths of zest, curiosity, love, hope, and gratitude consistently among the most influential (Buschor, Proyer, & Ruch, 2013; Park et al., 2004). Interestingly, character strengths have been recently linked not only with life satisfaction, but also with physical activity and subjective health status (Kerns, 2015). An increasing number of clinical research studies support incorporating patients’ personal strengths into illness management as a way to empower and activate the patients, thus improving their health and well-being (Mirkovic, Kristjansdottir, Stenberg et al., 2016). Obesity is a chronic condition (Karasu & Karasu, 2010), and research shows that to successfully manage chronic illness, patients require support both to learn about and manage their symptoms and problems, and to activate their resources and find new ways to live the best possible life with a chronic illness (Corbin & Strauss, 1988; Lorig & Holman, 2003; Schulman-Green, Jaser, Martin et al., 2012; Zuidema, van Gaal, van Dulmen, Repping-Wuts & Schoonhoven, 2015). Therefore, incorporating strengths into the present PPI seemed relevant and appropriate given the scope of this PhD research.

Hope

There are a number of reasons why hope is likely to underpin psychological well-being. Literature suggests that people with higher hope cope better with stressful life events (Chang, 1998; Ciarrochi, Heaven & Davies, 2007; Horton & Wallander, 2001; Valle, Huebner & Suldo, 2006), and engage and gain more in therapy (Snyder, Ilardi, Cheavens et al., 2000). High hope has been shown to contribute to psychological and physical health and adaptive health outcomes (Farran, Herth, & Popovich, 1995; Farran, Wilken, & Popovich, 1992; Herth, 1989; 1990; 1993; 1996; Snyder, 1994; Snyder, Harris, Anderson et al., 1991; Snyder, Sympson, Ybasco et al., 1996; Snyder, Irving, & Anderson, 1991). Furthermore, hope has been shown to enhance personal growth and development, along with quality of life and life satisfaction by buffering psychological/emotional distress and bolstering resiliency (Farran et al., 1992; 1995;
THEORETICAL BACKGROUND – THEMES OF THE PPI

Farran & McCann, 1989; Magaletta & Oliver, 1999; Taylor, Kemeny, Reed, Bower, & Gruenwald, 2000; Snyder, 1989). As mentioned previously both, quality of life and life satisfaction are often reduced in individuals with obesity (Castres et al., 2010). High hope has also been positively correlated with positive affect and self-esteem and negatively correlated with negative affect, particularly dysphoria and depression (Lerner & Small, 2002; Snyder et al., 1991b; Vandercrew, Nye & Herth, 1994), all of which are aspects highly relevant to obese populations and individuals with weight problems.

A recent study that investigated the effects of BMI, body shame, and hope on eating disorder symptomatology revealed that women with lower hope display significantly more symptoms of disordered eating (Boisvert & Harrell, 2013a). Furthermore, in the same study, hopefulness was found as a significant moderating variable, lowering eating disorder symptomatology for women with high BMI and body shame. Supporting the relationship between hope, BMI and disordered eating, further studies have shown that morbidly obese individuals have significantly lower levels of hope compared to their overweight and normal weight counterparts (Robertson et al., 2015b). Another quite recent study, which explored the positive psychological differences between successful and unsuccessful weight loss maintainers indicated that individuals who maintain their lost weight display significantly higher levels of the agentic thinking component of hope (Robertson et al., 2015a). The evidence above suggests that incorporating hope into treatment initiatives might not only reduce the risk of developing disordered eating (Boisvert & Harrell, 2013a), but it may also play an important role in weight management.

**Happiness**

Happiness can be defined as the degree to which people positively assess their life situation (Veenhoven, 1996) and depends on a variety of individual and social characteristics. The most important ones include demographics such as age, marital status (Mastekaasa, 1994)
and religious beliefs (Gallup, 1984), socioeconomic traits such as individual income and working class (Diener, Sandvik, Seidlitz, & Diener, 1993; Warr & Payne, 1982), education and health-related characteristics (Okun, Stock, Haring & Witter, 1984). Empirical work in economics has shed light on significant determinants of individual well-being and body mass index has recently been added to the list of factors that can explain life satisfaction levels. BMI can influence happiness through deterioration in health, lower self-esteem or lower social acceptance (Katsaiti, 2012) (see Chapter 2 for a detailed review). In addition, it may affect self-confidence (Griffiths et al., 2010), personal and social relationships and attitude (Williams & Merten, 2013). Research evidence has repeatedly demonstrated that excessive weight is associated with poorer psychological well-being (Bookwala & Boyar, 2008; Ogbeide et al., 2010), including depression and anxiety (Abdus & Zuvekas, 2015; Bjerkeset et al., 2008; Brumpton et al., 2013; Dong et al., 2004), low self-esteem and negative self-image (Griffiths et al., 2010; Friedman & Brownell, 1995), body-image dissatisfaction (Carraça et al., 2011; Gouveia et al., 2014; Pallan et al., 2011), mood swings and overall life dissatisfaction (Carr et al., 2007; Oswald & Powdthavee, 2007).

Many researchers and thinkers have argued that the ability to be happy and contented with life is a central criterion of adaptation and positive mental health (e.g. Diener, 1984; Jahoda, 1958; Taylor & Brown, 1988). Compiling empirical evidence supports this notion showing that happiness has numerous by-products that appear to benefit individuals, families and communities (Lyubomirsky et al., 2005a; Fredrickson, 2001). Happiness seems to be integral to both mental and physical health. Happy people are more likely to evidence greater self-control and self-regulatory and coping abilities (e.g., Aspinwall, 1998; Fredrickson & Joiner, 2002; Keltner & Bonanno, 1997), to have a bolstered immune system (e.g., Dillon, Minchoff, & Baker, 1985; Stone, Neale, Cox et al., 1994), and even to live a longer life (e.g.,
Danner, Snowdon, & Friesen, 2001; Ostir, Markides, Black, & Goodwin, 2000), all of which are often concerns in individuals suffering with obesity.

Given the evidence above, targeting happiness in overweight and obese individuals seemed as an essential aspect of a successful PPI, and thus was included in the present intervention.
4.1.2. Design of the PPI

The whole intervention was designed in a way for the participants to first receive the online part and do some independent work for each week, which would then be concluded by the group session. The online intervention consisted of three PowerPoint presentations for each week followed by a self-help home exercise, which was explained at the end of each presentation. The purpose of the experiential groups was to conclude each theme of the week with a 90 minute session. Using self-reflection, experience sharing, group support and exercises, the sessions were designed to reinforce the effect of the online part of the intervention leading to increased self-awareness, and subsequently towards increased happiness and life satisfaction, and an improvement in overall well-being. Visual and auditory stimuli played an important role in the design on the PPI. Using a combination of warm colours and round shapes, positive messages, motivational quotes, relaxation music, beautiful pictures and inspiring videos, all intervention materials were designed to produce a positive change in the viewer’s feelings, attitudes and approach to life in general.

Visual stimuli

The study of human visual preferences and the emotions affected by various works of art and natural images has long been an active topic of research in the field of visual arts and psychology (Lu, Suryanarayan, Adams et al., 2012). Several papers (e.g. Aronoff, 2006; Reber, Schwarz & Winkielman, 2004) indicated that geometric properties of visual displays convey emotions like anger and happiness, and that curved contours lead to positive feelings whereas sharp transitions in contours trigger a negative bias (Bar & Neta, 2006). Theorizing on colour and psychological functioning has been present since Goethe (1810) penned his Theory of
THEORETICAL BACKGROUND – DESIGN OF THE PPI

Colours, in which he linked colour categories (e.g., the “plus” colours of yellow, red–yellow, yellow–red) to emotional responding (e.g., warmth, excitement). Goldstein (1942) expanded on Goethe’s intuitions, positing that certain colours (e.g., red, yellow) produce systematic physiological reactions manifest in emotional experience (e.g., negative arousal), cognitive orientation (e.g., outward focus), and overt action (e.g., forceful behaviour). Subsequent theorizing derived from Goldstein’s ideas has focused on wavelength, positing that longer wavelength colours feel arousing or warm, whereas shorter wavelength colours feel relaxing or cool (Nakashian, 1964; Crowley, 1993; in Elliot, 2015). A recent review evaluating the effects of perceiving colour on psychological functioning in humans confirmed that colour can carry important meaning and can have an important impact on people's affect, cognition, and behaviour (Elliot & Maier, 2014).

Auditory stimuli

The positive effect of music on human psychology has been noted in a number of aspects, including emotional functioning and mood regulation (Cook, 1986; Schäfer & Sedlmeier, 2010; Tarrant, 2000), social identity, functioning and interaction (Brown, 2006; Sun & Lull, 1986), coping and stress relief (Ter Bogt, Mulder, Raaijmakers & Nic Gabhainn, 2011), and many others (see Schäfer, Sedlmeier, Städtler & Huron, 2013 for a review). Furthermore, music has been shown to beneficially affect stress-related physiological (Khalfa, Bella, Roy, Peretz & Lupien, 2003; Nater, Abbruzzese, Krebs & Ehlert, 2006; Nyklíček, Thayer & Van Doornen, 1997), as well as cognitive (Burns, Labbé, Williams & McCall, 1999), and emotional processes (Blood & Zatorre, 2001). Thus, the use of listening to music as an economic, non-invasive, and highly accepted intervention tool has received special interest in the management of stress and stress-related health issues. As listening to music has the capacity to initiate a multitude of cognitive processes in the brain (Peretz & Zatorre, 2005), it might be assumed that
music also influences stress-related cognitive processes and, as a consequence, physiological responses. Several studies have reported significant positive changes in cortisol levels when listening to music before and/or during medical interventions considered stressful (Escher, Höhmann, Anthenien et al., 1993; Uedo, Ishikawa, Morimoto et al., 2004; Ventura, Gomes & Carreira, 2012), and after such interventions (Miluk-Kolasa, Obminski, Stupnicki & Golec, 1994; Nilsson, Unosson & Rawal, 2005). More recently, listening to music prior to a standardized stressor has been found to predominantly affect the autonomic nervous system (in terms of a faster recovery), and to a lesser degree the endocrine and psychological stress response (Thoma, La Marca, Brönnimann et al., 2013), providing further support for the beneficial effects of music on the human body.

**Self-help and group exercises**

All exercises included in the present PPI have been selected from a wide range of positive psychology materials used by practicing professionals in the field. Inclusion of each exercise had been carefully considered given the theme of each week and each presentation, and it has been designed in a way that would help to increase self-awareness and positive affect, and give opportunity to look at the self and the world with greater kindness and appreciation.

**Week 1 – Gratitude.**

Exercises for the Week of Gratitude included the Gratitude for Positive Events exercise (Emmons & McCullough, 2003), gratitude meditation, performing random acts of kindness, and writing a Letter of Gratitude (Seligman et al., 2005). All of these exercises have been recognised to benefit individual well-being to the extent that is highly relevant to overweight and obese populations (Doll, Petersen & Stewart-Brown, 2000; Magee, Caputi, & Iverson, 2013). Counting one’s blessings has been repeatedly shown to increase psychological well-
being, decrease physical symptoms of illness, and improve health behaviours (Emmons & McCullough, 2003). Performing random acts of kindness has been linked with greater peer acceptance (Layous, Nelson, Oberle, Schonert-Reichl & Lyubomirsky, 2012), and it has been shown to increase positive emotions (Lyubomirsky, Tkach & Sheldon, 2005), and overall well-being and life satisfaction (Buchanan & Bardi, 2010; Layous et al., 2012). An association also exists between kindness and happiness, such that happy people tend to engage in more prosocial behaviours (Lyubomirsky et al., 2005a, Otake et al., 2006) which in return results in greater perceived self-value. Writing a Letter of Gratitude (Seligman et al., 2005) expressing thanks to a significant other for an act or acts of kindness has been recognised as another important way of showing the appreciation for what is valuable and meaningful to oneself.

Overall, a large amount of empirical research has indicated that there is an association between gratitude and a sense of overall well-being (see Sansone & Sansone, 2010 for a review), and that gratitude has a unique relationship with life satisfaction (Wood, Joseph & Maltby, 2008) which may be crucial in overweight populations.

**Week 2 – Mindfulness.**

The concept of mindfulness was introduced to participants during the second week of the PPI which, perhaps slightly untraditionally, began with identifying negative self-beliefs and related emotions. Contemporary psychology considers emotion regulation a central component of mental health (Guendelman, Medeiros & Rampes, 2017), and its imbalances might underlie several mental disorders (Berenbaum, Raghavan, Le, Vernon & Gomez, 2003; Mennin & Farach, 2007), including eating disorders (Dingemans, Danner & Parks, 2017; Lavender, Wonderlich, Engel et al., 2015) and obesity (Fernandes, Ferreira-Santos, Miller, & Torres, 2018). Taking into account how individual differences in emotion regulation strategies influence mental health, and the extensive role of emotion dysregulation in many
(psycho)pathological conditions (Guendelman et al., 2017), it was believed that it might be substantially beneficial to include some exercises on emotion regulation/dysregulation in the PPI. Therefore, in one of the exercises participants were asked to work with their negative self-beliefs in four steps: (1) identify negative/unhelpful beliefs that have a significant (negative) impact on their everyday life, (2) identify where those beliefs come from, (3) write down how they would feel without those beliefs, and (4) identify how the negative impact that those beliefs have on their lives could be reduced, and how they could be transformed into more positive ones. Although the underlying psychological and neurobiological mechanisms of mindfulness based interventions are still unclear, it seems that mindfulness might act through changing attention, intention, and attitude (Shapiro et al., 2006) by acting with awareness, non-judging of inner experiences, and non-reactivity to inner experiences (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006). From this perspective, increasing awareness of one’s negative thoughts/beliefs may be a crucial aspect of mindfulness treatment.

Other exercises in the Week of Mindfulness included mindful breathing, mindfulness meditation and mindful eating. The benefits of mindful breathing on emotional regulation have been previously noted, suggesting that focused mindful breathing leads to a decrease in intensity and negativity of emotional responses (Arch & Craske, 2006), and increases one’s ability to decenter from negative thoughts and beliefs about oneself (Feldman, Greeson & Senville, 2010). Addressing negative thoughts and beliefs about oneself is central to the improvement of low self-esteem and quality of life which are both commonly observed in obese individuals (Griffiths et al., 2010). The benefits of mindfulness meditation have been well established in both clinical and non-clinical populations (Eberth & Sedlmeier, 2012) with increasing amount of evidence demonstrating the effectiveness of mindfulness meditation-based approaches to address eating-related issues (Baer et al., 2005; Dalen et al., 2010; Heffner et al., 2002). According to a recent review which focused on mindfulness meditation as the
primary intervention for binge eating, emotional eating, and/or weight change, it seems that mindfulness meditation effectively decreases binge eating and emotional eating in populations engaging in this behavior (Katterman et al., 2014). Additionally, two recent studies have indicated that particularly mindfulness meditation aids weight loss (Mantzios & Giannou, 2014; Mantzios & Wilson, 2015a). With regards to mindful eating, a number of studies have shown that it is negatively correlated with binge eating (Cohen, 2008; Jordan, Wang, Donatoni, & Meier 2014; Kristeller et al., 2014; Mauer, Hamm, Weike & Tuschen-Caffier, 2006; Rodin, 1981; Wansink, 2010; 2011) which is well-known for being associated with overweight and obesity. It has been demonstrated that people who have less awareness of their eating habits are generally more overweight, more anxious and have higher levels of negative affect, while they demonstrate less control over their eating habits (Pintado-Cucarella & Rodríguez-Salgado, 2016). Therefore, including mindful eating in the present PPI seemed essential.

Week 3 – Self-compassion.

Exercises in the Week of Self-compassion included treating oneself with kindness as opposed to engaging in self-criticism, identifying the components of one’s life in which self-compassion is lacking (e.g. physical, mental, emotional, relational), and practicing motivation based on compassion. Self-compassion and its role in individual well-being has received a notable amount of attention over the past few years. Inclusion of these exercises has been evaluated from the perspective of well-being, emotion regulation, and coping with stressful life events which are aspects highly relevant to individuals with overweight and obesity (Dallman, 2010; Leehr, Krohmer, Schag et al., 2015).

Research has noted that many people tend to be overly hard on themselves whenever they fall short of reaching a valued goal (Neely, Schallert, Mohammed, Roberts & Chen, 2009). Self-kindness, versus self-judgement is one of the three major components in the concept of
self-compassion (Neff, 2003). A healthy form of self-acceptance and the ability to treat oneself kindly in the face of perceived inadequacy has been found to significantly contribute to individual well-being (Neely et al., 2009). Kindness-based approaches have been shown to effectively reduce symptoms of depression, increase mindfulness and improve the physical health of individuals and communities through its effects on well-being and social interaction (see Galante, Galante, Bekkers & Gallacher, 2014 for a review).

An important aspect of Buddhist psychology, from which the concept of self-compassion has been derived, is the assumption that behaviour and thinking occur in light of awareness and sensitivity (Neff, 2003). Previous research has found direct effects of self-care on self-awareness and well-being (e.g., Coster & Schwebel, 1997). From this perspective awareness of those components of life in which self-compassion is lacking, could play an important role in one’s ability to become more compassionate with the self, and thus lead to improvements in individual well-being.

Practicing motivation based on compassion aids positive cognitive restructuring which involves changing one's view of a stressful situation in order to see it in a more positive light (Allen & Leary, 2010). Stress and emotional brain networks foster eating behaviours that can lead to obesity (Dallman, 2010). Research has repeatedly demonstrated that the increased amount of perceived stress experienced by individuals in modern society affects feeding behaviour (Lattimore & Maxwell, 2004; O'Connor, Jones, Conner, McMillan & Ferguson, 2008; Wallis & Hetherington, 2009). Self-compassion involves a certain degree of positive restructuring as people who are high in self-compassion construe negative events in less dire terms than people low in self-compassion (Neff, Hsieh & Dejitterat, 2005). The importance of teaching mental reappraisal techniques to restore responses to stressors from habitual to thoughtful, has been highlighted as a key aspect in battling stress-induced obesity (Dallman, 2010).
THEORETICAL BACKGROUND – DESIGN OF THE PPI

Week 4 – Strengths.

The Week of Strengths focused on identification of key character strengths, Recalling Past Success (Cuijpers, Smit, Bohlmeijer, Hollon & Andersson, 2010) and linking it to character strengths, and exploring the ways of reducing any negative impact of one’s weaknesses. Exercises where participants were asked to recall past success and link it to their strengths have been previously used in PPIs designed to treat patients with depression (Huffman, DuBois, Healy et al., 2014), cardiovascular disease (Huffman et al., 2011), and type 2 diabetes (Huffman et al., 2015) which are known to be health conditions comorbid with obesity. Reducing the impact of one’s weaknesses, and thinking of different ways these could be transformed into strengths could be perceived as a form of positive cognitive defusion, a core process of Acceptance and Commitment Therapy (ACT; Hayes, 2004) in which individuals seek to alter the function of their thoughts. The indirect effect of cognitive defusion is a philosophical shift in perspective where individuals are able to learn to distance or separate themselves metaphorically from their thoughts (Eifert & Forsyth, 2005; Gregg, Callaghan, Hayes & Glenn-Lawson, 2007; Hayes, 2004; 2005; Hayes et al., 1999; Healy, Barnes-Holmes, Barnes-Holmes et al., 2008). When individuals are fused with their thoughts, the thoughts are automatically presumed true and worthy of obedient action. In contrast, when individuals defuse from their thoughts and view these thoughts from a detached perspective they are less likely to be taken literally and to dominate behaviour (Harris, 2009; Hayes, Luoma, Bond, Masuda & Lillis, 2006; Healy et al., 2008). Cognitive evaluation of their weaknesses enables individuals to view them from a more detached perspective and evaluate how they may impact their behaviour in social situations. Exploring different ways of transforming these weaknesses into strengths may then reduce the likelihood of one’s behaviour being dominated by them. Interestingly, cognitive defusion has been identified as an effective strategy for resisting food cravings leading to improvements in self-reported eating behaviours (Moffitt, Brinkworth,
THEORETICAL BACKGROUND – DESIGN OF THE PPI

Noakes & Mohr, 2012) and it has been suggested as an effective approach to managing different behavioural contributors to obesity.

Week 5 – Hope.

In the Week of Hope participants were introduced to the Theory of Hope (Snyder, 1994) and the whole week was discussed from the perspective of goal setting, will power, and way power. Exercises in this week included identifying 3 key hopes, finding motivation (will power) to achieve these hopes, and visualization of current hopes, and sharing the Gift of Hope (Koehn, O’Neill & Sherry, 2012) with the group.

Life satisfaction and the quality of life in overweight and obese individuals have been widely discussed earlier (see Chapter 2 and section 4.1.1. of this chapter). Interestingly, even though there is a sufficient evidence to suggest that life satisfaction decreases with increasing BMI (Katsaiti, 2012), it has been argued that “sometimes the highest levels of satisfaction stem from our involvements in something larger than ourselves – a cause or goal toward which we have joined with others” (Snyder et al., 2000, p. 263). Past literature has shown that those low in hope display cognitive inflexibility sufficient to hinder goal achievement and undermine well-being (Omodei & Wearing, 1990). Low hope can have a negative effect on coping efforts and overall wellness (Cole, 1989; Johnson, Alloy, Panzarella et al., 2001; Snyder, 1998; Swindells, Mohr, Justis et al., 1999). It has been associated with negative health outcomes, self-referential thinking, dysphoria, and depression (Abramson, Alloy, & Metalsky, 1995; Abramson, Metalsky, & Alloy, 1989; Alloy, Just, & Panzarella, 1997; Chang, 2003; Kwon, 2000; Needles & Abramson, 1990) which are factors highly relevant to obese populations, as demonstrated earlier. High hope (hopefulness), on the other hand, has been shown to contribute to psychological and physical health and adaptive health outcomes (Farran et al., 1992; Farran et al., 1995; Herth, 1989, 1990, 1993, 1996; Snyder, 1994; Snyder et al., 1991a; Snyder et al.,
1996; Snyder et al., 1991b). It enhances personal growth and development, along with quality of life and life satisfaction by buffering psychological/emotional distress and bolstering resiliency (Farran et al., 1992; Farran et al., 1995; Farran & McCann, 1989; Magaletta & Oliver, 1999; Taylor et al., 2000; Snyder, 1989). High-hope individuals seem to be better at establishing clear goals, and motivating themselves to follow up on such pathways (Snyder, 1994; Snyder et al., 1991a). Writing about one’s life goals has been associated with significant increases in subjective well-being (King, 2001), and visualising one’s hopes and writing about the best possible self has been shown to decrease symptoms of physical illness (King, 2001).

With reference to obesity, research has demonstrated that obese individuals score lower on hope, especially on the agentic component of hope, compared to normal weight individuals (Robertson et al., 2015b). Similarly, obese individuals who successfully maintain their initial weight loss display significantly higher levels of the agentic thinking component of hope compared to unsuccessful weight loss maintainers (Robertson et al., 2015a). Additionally, low hope has been associated with high body dissatisfaction and higher disordered eating behaviour (Boisvert & Harrell, 2013a), indicating that level of hope may play a critical role as a “protector” or “buffer” from eating disorder symptomatology on cognitive and affective levels.

**Week 6 – Happiness.**

According to the Theory of Authentic Happiness (Seligman, 2002) an enduring level of happiness consists of three aspects: set range (the barriers to becoming happier), individual life circumstances, and factors that are under one’s voluntary control. The final week of the PPI focused on happiness as a way of life, rather than a moment in time. The purpose of this week was to target “the single most important issue in positive psychology” (Seligman, 2002, p. 45), those factors that are within person’s locus of control. Exercises in the Week of
Happiness included practicing forgiveness, spending quality time with friends and/or family and happiness reflection.

Many people often link happiness with personal life circumstances such as socioeconomic traits, education and health-related characteristics. All of these factors are undoubtedly related to individual well-being. Empirical evidence shows that people who are paid more are relatively happier (e.g., Diener et al., 1993) and that middle-class individuals are somewhat happier than working-class individuals (e.g., Warr & Payne, 1982). Married people are happier than those who are single, divorced, or widowed (e.g., Mastekaasa, 1994), even in cultures as diverse as those of Belarus and Spain (Diener, Gohm, Suh, & Oishi, 2000). Findings also reveal that religiously committed people are relatively more likely to rate themselves as “very happy” (Gallup, 1984) and that, not surprisingly, healthy people, especially older ones, declare themselves to be slightly happier than sick people (e.g., Okun et al., 1984). However, all life circumstances combined account for only 8% to 15% of the variance in happiness levels (Argyle, 1999; Diener et al., 1999). These counterintuitively small effects can be largely accounted for by hedonic adaptation and the fact that people adapt rapidly to new circumstances and life events (Lyubomirsky et al., 2005b). Intentional activities promoting well-being have been shown to increase individual happiness levels (see Lyubomirsky et al., 2005b for a review). Particularly connecting activities and fostering relationships with romantic partners, friends, and family seems to be essential for personal happiness (Diener & Seligman, 2002; Ryan & Deci, 2001). Reflecting about individual happiness and life circumstances may influence how individuals choose to spend their time. People’s priorities often shift away from professional ambitions toward more emotionally enriching human relationships when they are older (Fredrickson & Carstensen, 1990) or have a near-death experience (Loewenstein, 1999). However, it may not be necessary for individuals to be in a near-death situation or old age to become more socially inclined (Mogilner, 2010); a simple shift in focus from pounds to hours.
may be sufficient. Therefore, the purpose of the exercises in the Week of Happiness was to give the participants an opportunity to reflect on the things they believed would give them happiness and shift their focus towards more emotionally enriching human relationships.

An exercise on forgiveness was incorporated into the PPI on the basis of evidence from empirical research which has shown that there is a direct effect of forgiveness on mental health (Worthington, Berry & Parrott, 2001). This effect can be actually described in terms of unforgiveness, through rumination, and involving the emotions of resentment, bitterness, hatred, hostility, residual anger, and fear (Worthington et al., 2001). Several studies have investigated the body’s hormone response to unforgiveness revealing that unforgiveness is reflected in specific cortisol levels, adrenaline production and cytokine balance (Worthington, van Oyen Witvliet, Lerner & Scherer, 2005) with patterns that parallel those reported in people living with high stress. These hormone patterns are known to compromise the immune system (Berry & Worthington 2001; Seybold, Hill, Neumann & Chi, 2001) with the long-term consequence of leading to several identified chronic illnesses co-morbid with obesity such as diabetes or cardiovascular disease (Danese, Pariante, Caspi, Taylor & Poulton, 2007). Assessment of mental health outcomes in relation to forgiveness has focused mainly on depression, anxiety, broadly defined mental health, and broadly defined well-being. Forgiveness interventions have been shown to improve state, and trait anxiety and depression (Al-Mabuk, Enright & Cardis, 1995; Coyle & Enright, 1997; Freedman & Enright, 1996). Even though the role of forgiveness in other mental health disorders has been limited, given the co-morbidity between depression/anxiety and obesity, it seemed important to include forgiveness in the present PPI.
4.2. Chapter Summary

The rationale for the current PPI was derived from a bidirectional model suggesting that positive psychological constructs, such as well-being, happiness, optimism, resilience and self-esteem, affect health behaviour through a number of mediation pathways including active coping/resilience, self-efficacy/perceived control, attention/cognitive processing, social support, and self-regulation/motivation (Huffman et al., 2015). Authors of the original model argued that positive psychological well-being leads to improvement in mediational factors linked to health behaviours, and thus increasing well-being through intentional positive activities, may result in an improvement in physical health as a by-product of those activities. In the present research improvement in health behaviours potentially leading to weight loss was proposed to be initiated by a change in similar mediational factors described by Huffman and colleagues (Huffman et al., 2015).

The present PPI targeted those positive psychological constructs individuals with weight problems might struggle with. Six positive psychological concepts (gratitude, mindfulness, self-compassion, strengths, hope, and happiness) were selected and included in the PPI on the basis of previous research investigating the role of positive psychology in weight management and reduction of overweight and obesity, and related eating disorder psychopathology. Additionally, as the importance of well-being in holistic obesity treatment has been highlighted before (Kolotkin & Andersen, 2017), each concept in the present PPI was also evaluated and justified from the perspective of its benefits on well-being.

The unique design of the 6 week PPI combining experiential group work with online learning was selected to maximise the potential effect of the intervention evaluating the benefits
THEORETICAL BACKGROUND – SUMMARY

of both group interventions (Baskin & Enright, 2004; Sin & Lyubomirsky, 2009) and online interventions cultivating positive affect skills (Cohn et al., 2014)
CHAPTER 5: Identification of Potential Molecular Genetic Pathways through which the PPI Functions

One of the aims of the present PhD research was to identify potential molecular genetic networks through which PPIs might function. This particular aim will be addressed in this chapter, describing a bioinformatics approach exploited to identify potential interactions between genes involved in positive functioning and genes involved in obesity and eating-related disorders.

Since 2004 (Hampton, 2004), there has been compelling research evidence to suggest that there is a genetic basis to patient-reported quality of life (QOL; Sprangers, Thong, Bartels et al., 2014). A number of review articles have documented the biological pathways and several molecular markers were found to be associated with QOL domains, including the most prevalent symptoms of pain (Shi, Cleeland, Klepstad et al., 2010), fatigue (Barsevick, Frost, Zwinderman et al., 2010), and emotional (Sprangers, Bartels, Veenhoven et al., 2010) and social functioning (Ordoñana, Bartels, Boomsma et al., 2013).

The present PPI addressed a number of the identified QOL domains, including positive affect, emotional appraisal and various aspects of social functioning. Candidate genes involved in these specific domains were used to identify potential interactions with genes involved in obesity and eating-related disorders. A purposeful search through existing literature was carried out to capture empirical papers investigating the relationship between obesity and the identified candidate genes involved in the selected QOL domains.

This chapter presents findings of this search, which provides the basis for identification of the potential molecular genetic pathways through which the PPI functions.
5.1. Metabolic Pathways and Molecular Genetic Markers Associated with Quality-Of-Life Domains and Obesity: A Bioinformatics Approach

5.1.1. Introduction

Temporal and spatial network analyses offers an important tool to elucidate the functional basis of genes and proteins, and their interacting partners (Bag, Ramaiah & Anbarasu, 2015). In recent years, network interaction analyses have gained increasing interest in network biology (Hu, Chen, Huang, Cai, & Chou, 2011; Li, Huang, Liu, Cai & Chou, 2012). Molecular pathway analyses have been put-upon to find novel candidate genes based on the assumption that neighbours of a disorder-causing gene in a network are more likely to cause either the same or a similar phenotype (Bernardo, Thompson, Gardner et al., 2005; Franke, van Bakel, Fokkens et al., 2006; Segal, Friedman, Kaminski, Regev & Koller, 2005). To interpret the roles they play in complex phenotypes, genes need to be investigated in the networks they are involved in.

The interaction network represents more precise information than the lists of genes or pathways, as it describes which genes are closely connected within a given molecular pathway (Huang, Shi, Wang et al., 2010, Huang, Chen, Cai & Chou, 2011). Hence, it has the potential to detect more elusive signals, such as local disturbances within known pathways, as well as within pathways that have not yet been described. Gene networks can be constructed by ensembling previously reported interactions in the literature and various databases like the database of interacting proteins (DIP) (Xenarios, Rice, Salwinski et al., 2000), the biomolecular interaction network database (BIND) (Alfarano, Andrade, Anthony et al., 2005), a general repository for interaction datasets (BioGRID) (Chatr-Aryamontri, Breitkreutz, Heinicke et al.,
GENE NETWORK INTERACTION ANALYSIS

2013), human protein reference database (HPRD) (Keshava Prasad, Goel, Kandasamy et al., 2008) and molecular interaction database (IntAct) (Hermjakob, Montecchi-Palazzi, Lewington et al., 2004; Kerrien, Aranda, Breuza et al., 2012). Network analysis provides unified information originating from multiple studies and helps identify key components in a system (Hayasaka, Hugenschmidt & Laurienti, 2011). In the present research the GeneMANIA database (Warde-Farley, Donaldson, Comes et al., 2010) was used to generate hypotheses about potential extensive function of the selected QOL genes in obesity- and eating-related disorders and to identify potential gene and/or protein interactions.

Obesity is a global health issue, which has currently reached the proportion of worldwide epidemic (WHO, 2000; Zimmet & Alberti, 2006). It is a multifactorial abnormality which not only manifests a genetic basis but also requires environmental influences (Qi & Cho, 2008). In recent years a number of studies have investigated the role of genetic susceptibility in modern-day environments concluding that obesity interventions should target specific environmental factors (Tyrrell et al., 2017). While the role of physical inactivity (Kilpeläinen, Qi, Brage et al., 2011; Li, Zhao, Luan et al., 2010) and consumption of foods high in fat and drinks high in sugar (Qi, Chu, Kang et al., 2012; Qi, Chu, Kang et al., 2014) has been well researched, other environmental factors contributing to the obesity epidemic have been rarely considered. Several studies have shown a correlation between social deprivation and obesity (Darmon & Drewnowski, 2008; Giles-Corti & Donovan, 2002; Kinra, Nelder & Lewendon, 2000; McLaren, 2007), which has led some investigators to hypothesize that social deprivation might accentuate the genetic susceptibility to obesity. A couple of studies have found associations between obesity and positive and negative affect (Carr et al., 2007; Pasco, Williams, Jacka, Brennan & Berk, 2013) and a number of papers have been published linking emotional appraisal with obesity (Ozier, Kendrick, Leeper et al., 2008). However, the genetic basis of these associations remains unexplored.
The objective of this research was to provide an overview of the molecular genetic pathways involved in the different QOL domains and identify potential interactions of the pathways with obesity-related genes.

5.1.2. Method

The genes for the QOL domains related to the present PPI (Table 5.1.) were selected from an updated review article presenting the biological pathways, candidate genes and molecular markers involved in fatigue, pain, negative (depressed mood) and positive (well-being/happiness) emotional functioning, social functioning, and overall QOL (Sprangers et al., 2014). Empirical papers investigating the relationship between molecular genetic markers and the following QOL domains were included: positive emotional functioning (positive affect, emotional appraisal), and social functioning (social behaviour, motivational behaviour, social function, social function in response to treatment, social acceptance/rejection). Additional molecular genetic markers that are functionally similar, or have shared properties with the target QOL genes (Warde-Farley et al., 2010) were also included (Table 5.2.).

A computerised literature search on PubMed (National Library of Medicine, National Institutes of Health, USA), the most widely used online health literature search database in the world, was conducted to identify those QOL genes involved in obesity, obesity-related eating disorders, BMI and/or weight gain. Molecular genetic markers were included if there was at least one reference (either empirical paper or meta-analysis) showing significant results of its association with obesity. Articles discussing eating disorders not related to obesity, or those discussing drug-induced weight gain were excluded. Since a review on this subject had not been previously published, no limitation was set on the year of publication. The search was limited to publications in English on human subjects.
**Table 5.1.** Biological pathways and candidate molecular genetic markers in the QOL domains addressed in the current study.

<table>
<thead>
<tr>
<th>Quality-of-life domains</th>
<th>Biological pathways</th>
<th>Candidate loci</th>
<th>Biochemical markers</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emotional functioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive affect</td>
<td>Dopaminergic system (ventral tegmental area)</td>
<td>COMT, OPRM1</td>
<td>CART</td>
<td>Burgdorf &amp; Panksepp, 2006</td>
</tr>
<tr>
<td></td>
<td>Serotonergic synapse</td>
<td>SLC6A4 (5-HTTLPR), MAOA</td>
<td>NR</td>
<td>Chen et al., 2013; De Neve et al., 2011; De Neve et al., 2012</td>
</tr>
<tr>
<td></td>
<td>Adipocytokine signalling pathway</td>
<td>NPY</td>
<td>NEUROPEPTIDE Y</td>
<td>Burgdorf &amp; Panksepp, 2006</td>
</tr>
<tr>
<td></td>
<td>Cytokine-cytokine receptor interaction: Pro-inflammatory</td>
<td>TNF-α</td>
<td>TNF-α</td>
<td>Rausch et al., 2010</td>
</tr>
<tr>
<td>Emotional appraisal</td>
<td>Serotonergic synapse</td>
<td>SLC6A4 (5-HTTLPR)</td>
<td>NR</td>
<td>Szily et al., 2008</td>
</tr>
<tr>
<td><strong>Social functioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social behaviour (empathy, altruism, bonding, social skills)</td>
<td>Neuroactive ligand-receptor interaction</td>
<td>OXTR, AVPR1A</td>
<td>OXYTOCIN, ARGinine VASOPRESSIN</td>
<td>Bakermans-Kranenburg &amp; van IJzendoorn, 2008; Donaldson &amp; Young, 2008; Ebstein et al., 2010; Kim et al., 2010; Kumsta et al., 2013; Meyer-Lindenberg et al., 2009; Montag et</td>
</tr>
</tbody>
</table>
## GENE NETWORK INTERACTION ANALYSIS

<table>
<thead>
<tr>
<th>MOTIVATIONAL BEHAVIOUR (REWARD SEEKING, EXTRAVERSION)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dopaminergic synapse</td>
<td>DRD4</td>
<td>NR</td>
<td>Belsky &amp; Pluess, 2013</td>
</tr>
<tr>
<td>Serotonergic synapse</td>
<td>SLC6A4 (5-HTT)</td>
<td>NR</td>
<td>Bakermans-Kranenburg &amp; van IJzendoorn, 2008</td>
</tr>
<tr>
<td>Dopaminergic synapse</td>
<td>DRD4, DRD2, DRD3</td>
<td>NR</td>
<td>Godlewska et al., 2010; Lawford et al., 2006; Marino et al., 2004; Munafò et al., 2008</td>
</tr>
</tbody>
</table>

<p>| SOCIAL FUNCTION | | | |
| --- | --- | --- | |
| Cytokine-cytokine receptor interaction: | IL-6, TNF-α | IL-6, TNF-A | Rausch et al., 2010 |
| Pro-inflammatory | IL-1RN | IL-1RN | Rausch et al., 2010 |
| Anti-inflammatory | | | |
| Serotenic synapse | HTR2A | NR | Antypa et al., 2013 |
| Neuroactive ligand-receptor interaction | OXTR | NR | Lucas-Thompson &amp; Holman, 2013; Norman et al., 2012 |
| Dopaminergic synapse | DRD2 | NR | Lawford et al., 2003 |</p>
<table>
<thead>
<tr>
<th>Social function in response to treatment</th>
<th>Neurotrophin signalling pathway</th>
<th>BDNF</th>
<th>NR</th>
<th>Zou et al., 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social acceptance/rejection</td>
<td>Dopaminergic synapse</td>
<td>COMT</td>
<td>NR</td>
<td>Bassett et al., 2007; Waugh et al., 2009</td>
</tr>
<tr>
<td></td>
<td>Neuroactive ligand-receptor interaction</td>
<td>OPRM1</td>
<td>NR</td>
<td>Way et al., 2009</td>
</tr>
</tbody>
</table>

NR: the relevant information has not been reported.
## Table 5.2. Additional genes identified as functionally similar, or as having shared properties with the target QOL genes.

<table>
<thead>
<tr>
<th>Gene Symbol</th>
<th>Official full name</th>
<th>Allelic</th>
<th>Biological pathways</th>
<th>Function</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPY</td>
<td>PANCREATIC POLYPEPTIDE Y</td>
<td>PP, PNP</td>
<td>Adipocytokine signalling pathway.</td>
<td>Acts as a regulator of pancreatic and gastrointestinal functions and may be important in the regulation of food intake and energy balance.</td>
<td>Asakawa et al., 2003</td>
</tr>
<tr>
<td>PYY</td>
<td>PEPTIDE YY</td>
<td>PYY-1, PYY-1</td>
<td>Adipocytokine signalling pathway.</td>
<td>Binding of peptides encoded by this gene mediates regulation of pancreatic secretion, gut mobility and energy homeostasis. PPY1-36 and PYY3-36 may act as a regulator of body weight. Rare variations in this gene could increase susceptibility to obesity.</td>
<td>Batterham et al., 2007; Karra et al., 2009; Sloth et al., 2007</td>
</tr>
<tr>
<td>OPRL1</td>
<td>OPIOID RELATED NOCICEPTIN RECEPTOR 1</td>
<td>NOP; OOR; NOPr; ORL1; KOR-3; NOCIR</td>
<td>Neuroactive ligand-receptor interaction.</td>
<td>Encodes protein that functions as a receptor modulating a variety of biological functions and neurobehavior, including stress responses and anxiety behavior, learning and memory, locomotor activity, and inflammatory and immune responses.</td>
<td>Fulford, 2015; Witkin et al., 2014</td>
</tr>
<tr>
<td>OPRD1</td>
<td>OPIOID RECEPTOR DELTA 1</td>
<td>OPRD</td>
<td>Neuroactive ligand-receptor interaction.</td>
<td>Regulation of neuronal activity through neurotransmission or neuromodulation; mediation of reward, tolerance and dependence associated with opioids; some variants may increase risk of opioid addiction.</td>
<td>Bodnar, 2007; Corbett et al., 2006; Stengaard-Pedersen, 1983; Zhang et al., 2008</td>
</tr>
<tr>
<td>Gene</td>
<td>Protein Name</td>
<td>Description</td>
<td>References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPRK1</td>
<td>OPIOID RECEPTOR KAPPA 1</td>
<td><em>KOR; OPRK; KOR-1; K-OR-1</em> Neuroactive ligand-receptor interaction.</td>
<td>Inhibition of some of the rewarding properties of opiates leading to a development of opioid tolerance; some variants may increase risk of alcohol and opioid addiction. Cicciocioppo et al., 2000; Cowen &amp; Lawrence, 2006; Reinscheid, 2006; Zhang et al., 2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPSRI</td>
<td>NEUROPEPTIDE S RECEPTOR 1</td>
<td><em>GPRA; NPSR; VRR1; ASRT2; PGR14; GPR154</em> Neuroactive ligand-receptor interaction.</td>
<td>The neuropeptide S receptor is a member of the G-protein coupled receptor family which binds neuropeptide S. Reinscheid et al., 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPSRI</td>
<td>NEUROPEPTIDE S RECEPTOR 1</td>
<td><em>GPRA; NPSR; VRR1; ASRT2; PGR14; GPR154</em> Neuroactive ligand-receptor interaction.</td>
<td>The neuropeptide S receptor is a member of the G-protein coupled receptor family which binds neuropeptide S. Reinscheid et al., 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPR31</td>
<td>G PROTEIN-COUPLED RECEPTOR 31</td>
<td><em>HETER; HETER1; 12-HETER</em> Neuroactive ligand-receptor interaction.</td>
<td>GPR31 receptor activates the MEK-ERK1/2 pathway of intercellular signalling without triggering rises in the concentration of cytosolic Ca²⁺; it also activates NFκB. Guo et al., 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPR31</td>
<td>G PROTEIN-COUPLED RECEPTOR 31</td>
<td><em>HETER; HETER1; 12-HETER</em> Neuroactive ligand-receptor interaction.</td>
<td>The GPR31 receptor appears to mediate the responses of PC-3 prostate cancer cells to 12(S)-HETE in stimulating the MEK-ERK1/2 and NFκB pathways and therefore may contribute to the growth-promoting and metastasis-promoting actions that 12(S)-HETE is proposed to have in human prostate cancer. Nie et al., 2006; Porro et al., 2014; Yang et al., 2012a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### GENE NETWORK INTERACTION ANALYSIS

<table>
<thead>
<tr>
<th>Gene</th>
<th>Type</th>
<th>Interaction</th>
<th>Function/Associated Disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AVPR1B</strong></td>
<td><strong>ARGININEVASOPRESSINRECEPTOR 1B</strong></td>
<td><strong>V1bR; AVPR3</strong></td>
<td>Neuroactive ligand-receptor interaction.</td>
</tr>
<tr>
<td><strong>AVPR2</strong></td>
<td><strong>ARGININEVASOPRESSINRECEPTOR 2</strong></td>
<td><strong>D11; DIR; NDI; V2R; ADHR; DIR3</strong></td>
<td>Neuroactive ligand-receptor interaction.</td>
</tr>
<tr>
<td><strong>DRD1</strong></td>
<td><strong>DOPAMINE RECEPTOR D1</strong></td>
<td><strong>DADR; DRD1A</strong></td>
<td>Dopaminergic synapse.</td>
</tr>
<tr>
<td><strong>DRD5</strong></td>
<td><strong>DOPAMINE RECEPTOR D5</strong></td>
<td><strong>DBDR; DRD1B; DRD1L2</strong></td>
<td>Dopaminergic synapse.</td>
</tr>
<tr>
<td>Gene</td>
<td>Description</td>
<td>Function</td>
<td>Reference(s)</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>CSF3</td>
<td>COLONY STIMULATING FACTOR 3 (GCSF; CSF3OS; C17orf33)</td>
<td>The protein encoded by the CSF3 gene is a cytokine that controls the production, differentiation, and function of granulocytes.</td>
<td>Missale et al., 1998; Muir et al., 2001; Wang et al., 2001b; Wang et al., 2004; Wu et al., 2012; Zhao et al., 2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In oncology and hematology, a recombinant form of G-CSF is used with certain cancer patients to accelerate recovery and reduce mortality from neutropenia after chemotherapy.</td>
<td>Deotare et al., 2015; Thomas et al., 2002; Lyman et al., 2013</td>
</tr>
<tr>
<td>IL36B</td>
<td>INTERLEUKIN 36 BETA (FIL1; FIL1H; IL1F8; IL1H2; IL-1F8; IL-1H2; IL1-ETA; FIL1-(ETA); FIL1-(ETA))</td>
<td>Pro-inflammatory. The protein encoded by this gene is a member of the interleukin 1 cytokine family. IL-36 can stimulate the maturation and function of dendritic cells and drive T cell proliferation. As such, IL-36 cytokines actively propagate skin inflammation via the activation of keratinocytes, APC, and, indirectly, T cells.</td>
<td>Foster et al., 2014; Gabay &amp; Towne, 2015</td>
</tr>
<tr>
<td>IL36G</td>
<td>INTERLEUKIN 36 GAMMA (IL1E; IL1F9; IL1H1; IL-1F9; IL-1H1)</td>
<td>Pro-inflammatory. IL-36G is a member of the IL-1 family of cytokines that signal through a common receptor composed of IL-36R and IL-1R/AcP to activate NF-κB and MAPKs, such as p38 and JNK, and promote inflammatory responses.</td>
<td>Foster et al., 2014; Gabay &amp; Towne, 2015</td>
</tr>
</tbody>
</table>
The role of IL-36 has been demonstrated extensively in the skin, where it can act on keratinocytes and immune cells to induce a robust inflammatory response.

<table>
<thead>
<tr>
<th>Gene</th>
<th>Interleukin Family</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL36RN</td>
<td>INTERLEUKIN 36 RECEPTOR ANTAGONIST</td>
<td>Fil1; Fil1D; Fil1F; IL1L1; PSRP; IL1HY1; IL1R3; IL36RA; IL36Ra; PSORS14; FIL1(Delta)</td>
<td>Pro-inflammatory. The protein encoded by this gene is a member of the interleukin 1 cytokine family. This cytokine was shown to specifically inhibit the activation of NF-kappaB induced by INTERLEUKIN 1, FAMILY MEMBER 6 (IL1F6). Mutations in the IL-36RN gene resulting in a decrease or production of defective IL-36RA protein have been shown to cause inflammatory skin diseases. Towne et al., 2004 Navarini et al., 2013</td>
</tr>
<tr>
<td>IL1F10</td>
<td>INTERLEUKIN 1 FAMILY MEMBER 10</td>
<td>IL-38; FKSG75; IL1HY2; IL1HY2; ILI-1theta; FIL1-theta</td>
<td>Anti-inflammatory. This member of the interleukin 1 cytokine family is thought to participate in a network of interleukin 1 family members to regulate adapted and innate immune responses. Overexpression of the IL1F10 gene has been shown to decrease the production of pro-inflammatory cytokines by macrophages and synovial fibroblasts, inducing anti-inflammatory effects in humans. Boutet et al., 2017</td>
</tr>
<tr>
<td>IL37</td>
<td>INTERLEUKIN 37</td>
<td>Fil1; Fil1Z; IL-1H; IL-37; IL1F7; IL1H4; IL1F7; IL1H4; IL1RP1;</td>
<td>Anti-inflammatory. This member of the interleukin 1 cytokine family binds to INTERLEUKIN 18 BINDING PROTEIN (IL18BP), and subsequently forms a complex with IL18 receptor beta subunit, through which it inhibits the activity of IL18. Bufler et al., 2010</td>
</tr>
</tbody>
</table>
### GENE NETWORK INTERACTION ANALYSIS

**IL-1RP1; FIL1/ZETA**

IL37 has a potential to suppress inflammation; induction of IL37 has been shown to reduce the expression of pro-inflammatory cytokines and chemokines in monocyte and macrophage cell lines.  

**Bufler et al., 2010; Sharma et al., 2008**

<table>
<thead>
<tr>
<th>NTF3</th>
<th>NEUROTROPHIN 3</th>
<th>NT3; HDNF; NGF2; NT-3; NGF-2</th>
<th>Neurotrophin signalling pathway.</th>
<th>NEUROTROPHIN-3 (NT-3) is a neurotrophic factor in the nerve growth factor family of neurotrophins which induces growth and development of neurons and their survival.</th>
<th><strong>Jones &amp; Reichardt, 1990</strong></th>
</tr>
</thead>
</table>

| NTF4 | NEUROTROPHIN 4 | NT4; NT5; NT-4; NT-5; NTF5; GLC10; GLC10; NT-4/5 | Neurotrophin signalling pathway. | The NTF4 gene is a member of the neurotrophin protein family that controls survival and differentiation of mammalian neurons through phosphorylation of TYROSINE KINASE RECEPTOR B (TrkB) receptors. Mutations in the NTF4 gene cause a decreased activation of TrkB. | **Chen et al., 2012b; Pasutto et al., 2009** |

| NGF  | NERVE GROWTH FACTOR | NGFB; HSAN5; Beta-NGF | Neurotrophin signalling pathway. | The NGF gene is a member of the NGF-beta family and encodes a secreted protein which homodimerizes and is incorporated into a larger complex. This protein has nerve growth stimulating activity and the complex is involved in the regulation of growth and the differentiation of sympathetic and certain sensory neurons. | **Huang & Reichardt, 2003** |

NR - the relevant information has not been reported.
5.1.3. Results

The objective of this Chapter was to provide an overview of the different molecular genetic pathways involved in QOL domains and identify potential interactions of these pathways with obesity-related genes. With the help of GeneMANIA database (Warde-Farley et al., 2010), it was possible to identify several of these interactions. Interactions involving components of the OXTR biosynthetic pathway is of special interest.

Positive emotional functioning genes and obesity-related genes

Molecular genetic interactions between loci involved in positive emotional functioning and obesity-related loci, have been elucidated in this study. These molecular genetic interactions might have a direct or indirect involvement in obesity or obesity-related eating disorders. Interestingly, the spatial function of these genes indicate involvement of different, unrelated molecular genetic pathways. There are six main positive emotional functioning genes with a role in obesity and/or obesity-related eating psychopathology (Table 5.3.). These include COMT, OPRM1, SLC6A4, MAOA, NPY, and TNF-a.
Table 5.3. Positive emotional functioning candidate genes and their role in obesity and obesity-related eating psychopathology.

<table>
<thead>
<tr>
<th>Gene Symbol</th>
<th>Official full name</th>
<th>Domain of functioning</th>
<th>Involvement in obesity/obesity-related eating psychopathology</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMT</td>
<td>CATECHOL-O-</td>
<td>Positive affect</td>
<td>Links found between the COMT Val158Met polymorphisms and eating disorder psychopathology (binge eating, increased palatable food intake), and abdominal obesity. COMT rs4680 associated with increased body mass and waist circumference, fat-BMI and cholesterol.</td>
<td>Amorim-Barbosa et al., 2016; Annerbrink et al., 2008; Galvão et al., 2012; Hersrud &amp; Stoltenberg, 2009; Kring et al., 2009; Thaler et al., 2012</td>
</tr>
<tr>
<td>OPRM1</td>
<td>OPIOID RECEPTOR MU 1</td>
<td>Positive affect</td>
<td>Significantly lower availability of the OPRM1 in obese subjects. A118G polymorphism of the OPRM1 linked with binge eating disorder; significantly increased BMI observed in the minor OPRM1 allele carriers of rs514980 and rs7773995 allele.</td>
<td>Davis et al., 2009; Karlsson et al., 2015; Xu et al., 2009</td>
</tr>
<tr>
<td>SLC6A4 (5-HTTLPR)</td>
<td>SOLUTE CARRIER FAMILY 6 MEMBER 4</td>
<td>Positive affect, emotional appraisal</td>
<td>Stress vulnerability and stress-induced eating and related weight gain and/or disordered eating symptomatology.</td>
<td>Capello &amp; Markus, 2014;</td>
</tr>
</tbody>
</table>
Short (S) allele polymorphism in 5-HTTLPR increases risk for weight gain and/or obesity and disordered eating psychopathology.

<table>
<thead>
<tr>
<th>Gene</th>
<th>Monogram Name</th>
<th>Function</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAOA</td>
<td>Monoamine Oxidase A</td>
<td>Positive affect</td>
<td>High-activity MAOA allele is associated with lower BMI and may decrease the risk of obesity; low-activity MAOA allele is associated with higher BMI and lipid level and may increase the risk of obesity.</td>
<td>Brummett et al., 2008; Camarena et al., 2004; Ducci et al., 2006; Fuemmeler et al., 2009; Lin et al., 2015; Need et al., 2006</td>
</tr>
</tbody>
</table>

Rozenblat et al., 2017
Akkermann et al., 2010; Capello & Markus, 2014; Lan et al., 2009; Rozenblat et al., 2017; Schepers & Marcus, 2017; Sookoian et al., 2007; 2008
### NPY NEUROPEPTIDE Y

<table>
<thead>
<tr>
<th>Positive affect</th>
<th>rs16147 SNP of the <em>NPY</em> is strongly associated with obesity.</th>
</tr>
</thead>
</table>

Evidence for the rs16139 SNP being associated with increased BMI in adults, and development of obesity in young adults.

Hohmann et al., 2012; Olza et al., 2013; Zain et al., 2015

Ding et al., 2005; van Rossum et al., 2006

---

### TNF-α TUMOR NECROSIS FACTOR-α

<table>
<thead>
<tr>
<th>Positive affect</th>
<th>TNF-α affects body lipid and glucose metabolism.</th>
</tr>
</thead>
</table>

The *TNF-α* G-308A polymorphism has been associated with obesity-related insulin resistance with some evidence suggesting direct associations with obesity.

Beutler & Cerami, 1989; Grunfeld & Feingold, 1991

Brand et al., 2001; Fontaine-Bisson et al., 2007
GENE NETWORK INTERACTION ANALYSIS

**Interactions between genes of the target QOL domains and obesity-related molecular networks.**

All candidate genes involved in positive emotional functioning have been associated with obesity or obesity-related eating disorders (Table 5.4.). These include *DRD4, COMT, HTR2A, SLC6A4, OPRM1, NPY, DRD2, DRD3, AVPR1A, BDNF, OXTR, MAOA, IL-6, IL-1RN, and TNF-a.*

Interactions with and between the additional genes identified as functionally similar, or as having shared properties with the target QOL genes, were also observed (Table 5.5.). Most interactions were observed in the form of co-expression, or shared protein domains (Warde-Farley et al., 2010).

**Social functioning candidate genes and obesity**

As expected, all candidate genes involved in the target domains of social functioning have been associated with obesity or obesity-related eating disorders (Table 5.6.). This section will only address those candidate genes that have not already been discussed within the Positive Emotional Functioning Candidate Genes and Obesity section.
Table 5.4. Interactions between genes involved in the target QOL domains and obesity-related genes.

<table>
<thead>
<tr>
<th>Genes originally searched</th>
<th>Report of Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO-EXPRESSSION</td>
</tr>
<tr>
<td>DRD4</td>
<td>HTR2A, IL37, OPRL1, PPY, DRD3</td>
</tr>
<tr>
<td>COMT</td>
<td>NR</td>
</tr>
<tr>
<td>HTR2A</td>
<td>DRD4, GPR31</td>
</tr>
<tr>
<td>SLC6A4</td>
<td>PPY, DRD5, AVPR1A, AVPR2, NPY</td>
</tr>
<tr>
<td>OPRM1</td>
<td>NPY, GPR31</td>
</tr>
<tr>
<td>NPY</td>
<td>BDNF, OXTR, OPRM1, GPR31, DRD5, OPRD1, PPY, PYY</td>
</tr>
<tr>
<td>DRD2</td>
<td>OXTR, OPRL1, DRD3, IL1F10</td>
</tr>
<tr>
<td>DRD3</td>
<td>DRD2, DRD4, DRD5, OPRL1, AVPR2, GPR31</td>
</tr>
<tr>
<td>AVPR1A</td>
<td>BDNF, OPRD1, SLC6A4</td>
</tr>
<tr>
<td>BDNF</td>
<td>NTF4, DRD1, NPY, AVPR1A</td>
</tr>
<tr>
<td>OXTR</td>
<td>NPY, IL37, OPRL1, DRD2</td>
</tr>
<tr>
<td>MAOA</td>
<td>NPY, IL6</td>
</tr>
</tbody>
</table>
**GENE NETWORK INTERACTION ANALYSIS**

<table>
<thead>
<tr>
<th>Genes</th>
<th>Co-expression</th>
<th>Report of Interactions</th>
<th>Co-localization</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>IL-6</em></td>
<td><em>IL1RN, CSF3, TNF, MAOA</em></td>
<td>CSF3</td>
<td>CSF3</td>
</tr>
<tr>
<td><em>IL-1RN</em></td>
<td><em>IL6, TNF, OPRL1</em></td>
<td><em>IL37, IL1F10, IL36B, IL36RN, IL36G</em></td>
<td>OXTR</td>
</tr>
<tr>
<td><em>TNF A</em></td>
<td><em>GPR31, DRD1, IL1RN, IL6</em></td>
<td>NR</td>
<td>AVPR2</td>
</tr>
</tbody>
</table>

NR – the relevant interaction has not been reported.

**Table 5.5.** Interactions with and between additional genes identified as functionally similar, or as having shared properties with the target QOL genes.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Co-expression</th>
<th>Shared protein domains</th>
<th>Co-localization</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>PPY</em></td>
<td><em>DRD4, SLC6A4, OPRL1, OPRD1, GPR31</em></td>
<td><em>NPY, PYY</em></td>
<td>NR</td>
</tr>
<tr>
<td><em>PYY</em></td>
<td><em>DRD5, OPRD1</em></td>
<td><em>PPY, NPY</em></td>
<td>NR</td>
</tr>
<tr>
<td><em>OPRL1</em></td>
<td><em>PPY, DRD2, DRD3, DRD4, DRD5, AVPR2, CSF3, IL1RN, IL36G, OXTR</em></td>
<td><em>DRD5, OPRD1, OPRM1, OPRK1, GPR31</em></td>
<td><em>DRD3, DRD5, OPRK1, AMPR2</em></td>
</tr>
<tr>
<td><em>OPRD1</em></td>
<td><em>AVPR1A, PPY, PYY, DRD5, NPY, GPR31</em></td>
<td><em>OPRL1, OPRM1, OPRK1, GPR31</em></td>
<td>NR</td>
</tr>
<tr>
<td><em>OPRK1</em></td>
<td><em>DRD5, GPR31, AVPR2</em></td>
<td><em>OPRM1, OPRD1, OPRL1, GPR31</em></td>
<td><em>DRD3, DRD5, OPRL1</em></td>
</tr>
<tr>
<td><em>DRD1</em></td>
<td><em>DRD5, AVPR2, IL36RN, IL36G, BDNF, TNF, NTF4</em></td>
<td><em>DRD2, DRD3, DRD4, DRD5, GPR31</em></td>
<td>NR</td>
</tr>
<tr>
<td><em>DRD5</em></td>
<td><em>DRD1, DRD3, PYY, OPRD1, OPRK1, OPRL1, NPY, AVPR2, GPR31, SLC6A4, IL36RN</em></td>
<td><em>DRD1, DRD2, DRD3, DRD4, DRD5</em></td>
<td><em>DRD3, OPRL1, OPRK1</em></td>
</tr>
<tr>
<td>Gene</td>
<td>Interactions</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>AVPR1B</td>
<td>AVPR1A, AVPR2, GPR31, OXTR, NPSR1</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>AVPR2</td>
<td>AVPR1A, AVPR1B, NPSR1, OXTR, GPR31</td>
<td>OPRL1, TNF</td>
<td></td>
</tr>
<tr>
<td>GPR31</td>
<td>DRD1, DRD2, DRD3, DRD4, DRD5, OPR1, OPR2, AVPR1A, AVPR1B, AVPR2, HTR2A, OXTR, NPSR1</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>CSF3</td>
<td>IL1RN, IL1RN, IL6</td>
<td>IL6</td>
<td></td>
</tr>
<tr>
<td>IL36B</td>
<td>IL37, IL1RN, IL36G, IL36RN, IL1F10</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>IL36G</td>
<td>DRD1, OPRL1, IL36RN</td>
<td>IL1RN, IL36RN, IL36B, IL37, IL1F10</td>
<td>NR</td>
</tr>
<tr>
<td>IL37</td>
<td>IL36B, OXTR, DRD4</td>
<td>IL36B, IL36G, IL36RN, IL1RN, IL1F10</td>
<td>NR</td>
</tr>
<tr>
<td>IL36RN</td>
<td>DRD1, DRD5, CSF3, IL36G, NTF4</td>
<td>IL1RN, IL36B, IL36G, IL37, IL1F10</td>
<td>NR</td>
</tr>
<tr>
<td>IL1F10</td>
<td>DRD2, AVPR1B</td>
<td>IL36B, IL36G, IL36RN, IL37, IL1RN</td>
<td>NR</td>
</tr>
<tr>
<td>NPSR1</td>
<td>AVPR2</td>
<td>AVPR1A, AVPR1B, AVPR2, GPR31, OXTR</td>
<td>NR</td>
</tr>
<tr>
<td>NTF3</td>
<td>NR</td>
<td>NTF4, NGF, BDNF</td>
<td>NR</td>
</tr>
<tr>
<td>NTF4</td>
<td>DRD1, IL36RN, BDNF</td>
<td>NTF3, NGF, BDNF</td>
<td>NR</td>
</tr>
<tr>
<td>NGF</td>
<td>NR</td>
<td>NTF4, NTF3, BDNF</td>
<td>NR</td>
</tr>
</tbody>
</table>

NR – the relevant interaction was not reported.
Table 5.6. Social functioning candidate genes and their role in obesity and obesity-related eating psychopathology.

<table>
<thead>
<tr>
<th>Gene Symbol</th>
<th>Official full name</th>
<th>Domain of social functioning</th>
<th>Involvement in obesity/obesity-related eating psychopathology</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OXTR</strong></td>
<td>OXYTOCIN RECEPTOR</td>
<td>Social behaviour (empathy, altruism, bonding, social skills)</td>
<td>Lack of evidence for associations with obesity. However, a positive association exists between the G allele of rs53576 and bulimia nervosa; and the GG rs53576 genotype and binge eating.</td>
<td>Kim et al., 2015; Micali et al., 2017</td>
</tr>
<tr>
<td><strong>AVPR1A</strong></td>
<td>ARGININE VASOPRESSIN RECEPTOR 1A</td>
<td>Social behaviour (empathy, altruism, bonding, social skills)</td>
<td>Increased prevalence of diabetes mellitus has been found for the T-allele carriers of rs1042615 in AVPR1A with increased fat intake; increased BMI has been found for male carriers of the same polymorphism.</td>
<td>Enhörning et al., 2009; Masuki et al., 2010</td>
</tr>
<tr>
<td><strong>DRD2</strong></td>
<td>DOPAMINE RECEPTOR D2</td>
<td>Motivational behaviour (reward seeking extraversion)</td>
<td>Obese individuals have decreased dopamine DRD2/3 availability in the striatum, and blunted striatal dopamine release.</td>
<td>De Weijer et al., 2011; Van de Giessen et al., 2014; Wang et al., 2001a</td>
</tr>
<tr>
<td><strong>DRD3</strong></td>
<td>DOPAMINE RECEPTOR D3</td>
<td>Motivational behaviour (reward seeking extraversion)</td>
<td>Obese individuals have decreased dopamine DRD2/3 availability in the striatum, and blunted striatal dopamine release.</td>
<td>De Weijer et al., 2011; Van de Giessen et al., 2014; Wang et al., 2001a</td>
</tr>
<tr>
<td><strong>DRD4</strong></td>
<td><strong>DOPAMINE RECEPTOR D4</strong></td>
<td><strong>Social behaviour (empathy, altruism, bonding, social skills)</strong></td>
<td>The exon III 7-repeat allele of the <strong>DRD4</strong> has been associated with higher BMI and palatable food craving, especially in females.</td>
<td>Guo et al., 2006; Kaplan et al., 2008; Levitan et al., 2004a; 2004b; 2010; Sikora et al., 2013</td>
</tr>
<tr>
<td><strong>SLC6A4</strong></td>
<td><strong>SOLUTE CARRIER FAMILY 6 MEMBER 4</strong></td>
<td><strong>Social behaviour (empathy, altruism, bonding, social skills)</strong></td>
<td>Stress vulnerability and stress-induced eating and related weight gain and/or disordered eating symptomatology.</td>
<td>Capello &amp; Markus, 2014; Rozenblat et al., 2017</td>
</tr>
</tbody>
</table>

Short (S) allele polymorphism in **5-HTTLPR** increases risk for weight gain and/or obesity and disordered eating psychopathology.

Akkermann et al. 2010; Capello & Markus, 2014; Lan et al., 2009; Rozenblat et al., 2017; Schepers & Marcus, 2017; Sookoian et
<table>
<thead>
<tr>
<th>Gene</th>
<th>Function</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL-6</td>
<td>Social function</td>
<td>High levels of IL-6 associated with obesity and insulin resistance.</td>
<td>Abduljabbar et al., 2016; Di Renzo et al., 2008; Engeli et al., 2003; Ottobelli Chielle et al., 2016; Pang et al., 2016; Popko et al., 2010</td>
</tr>
<tr>
<td>TNF-α</td>
<td>Social function</td>
<td>TNF-α affects body lipid and glucose metabolism.</td>
<td>Beutler &amp; Cerami, 1989; Grunfeld &amp;</td>
</tr>
</tbody>
</table>
The TNF-α G-308A polymorphism has been associated with obesity-related insulin resistance with some evidence suggesting direct associations with obesity.

<table>
<thead>
<tr>
<th><strong>IL-1RN</strong></th>
<th><strong>INTERLEUKIN 1 RECEPTOR ANTAGONIST (IL-1RN).</strong></th>
<th>Social function</th>
<th>IL-1RA serum level is increased in human obesity. Carriers of the rare V allele of <strong>IL-1RA</strong> may be at an increased obesity risk.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HTR2A</strong></td>
<td><strong>5-HYDROXYTRYPTAMINE RECEPTOR 2A (HTR2A)</strong></td>
<td>Social function</td>
<td>The polymorphism -1438G&gt;A (rs6311) in <strong>HTR2A</strong> has been associated with alterations in food intake.</td>
</tr>
</tbody>
</table>

Feingold, 1991
Brand et al., 2001; Fontaine-Bisson et al., 2007; Sookoian et al., 2005; Wang et al., 2015
Juge-Aubry et al., 2003; Yang et al, 2012b
Kok et al., 2017
Collier et al., 1997; Enoch et al., 1998; Ricca et al., 2004
Carriers of the -1438G allele are at an increased risk of developing abdominal obesity and metabolic syndrome, and are likely to be responsive to multimodal treatments for binge eating.

<table>
<thead>
<tr>
<th>BDNF</th>
<th>BRAIN DERIVED NEUROTROPIC FACTOR</th>
<th>Social function in response to treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Reduced BDNF signalling is associated with obesity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obese individuals have altered or low blood BDNF levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variations in the BDNF Val66Met, rs6265 polymorphism have been associated with BMI and obesity.</td>
</tr>
</tbody>
</table>

Rosmond et al., 2002a; 2002b; Steiger et al., 2008

Schwartz & Mobbs, 2012

Araya et al., 2008; Bus et al., 2011; Gray et al., 2006; Han et al., 2008; Iughetti et al., 2011; Saito et al., 2009

Beckers et al., 2008; Friedel et al., 2005; Gunstad et al., 2006; Hong et al., 2012; Shugart et al., 2009; Skledar et al., 2012;
<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Links</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMT</td>
<td>catechol-o-methyltransferase</td>
<td>Social acceptance/rejection Links found between the COMT Val158Met polymorphisms and eating disorder psychopathology (binge eating, increased palatable food intake), and abdominal obesity.</td>
<td>Thorleifsson et al., 2009; Timpano et al., 2011; Wu et al., 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COMT rs4680 associated with increased body mass and waist circumference, fat-BMI and cholesterol.</td>
<td>Amorim-Barbosa et al., 2016; Annerbrink et al., 2008; Galvão et al., 2012; Hersrud &amp; Stoltenberg, 2009</td>
</tr>
<tr>
<td>OPRM1</td>
<td>opioid receptor mu 1</td>
<td>Social acceptance/rejection Significantly lower availability of the OPRM1 in obese subjects.</td>
<td>Karlsson et al., 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A118G polymorphism of the OPRM1 linked with binge eating disorder; significantly increased BMI observed in the minor OPRM1 allele carriers of rs514980 and rs7773995 allele.</td>
<td>Davis et al., 2009; Xu et al., 2009</td>
</tr>
</tbody>
</table>
**THE CATECHOL-O-METHYLTRANSFERASE (COMT).**

The *COMT* gene catabolizes brain catecholamine neurotransmitters such as DOPAMINE and NOREPINEPHRINE (Scherag, Hebebrand & Hinney, 2010). A substitution (472 G→A) in the mRNA creates an amino acid change (158Val→Met) leading to two alleles with different levels of enzymatic activity: the 158Val allele (G), which is about four times more active than the 158Met allele (A) (Lachman, Papolos, Saito et al., 1996). COMT has been linked to obesity (Annerbrink, Westberg, Nilsson et al., 2008; Mansego, De Marco, Ivorra et al., 2015) and obesity-related eating psychopathology (Amorim-Barbosa, Serrão, Brandão & Vieira-Coelho, 2016; Hersrud & Stoltenberg, 2009; Thaler, Groleau, Badawi et al., 2012) with an increased risk presented for the *COMT* Val158Met carriers (Amorim-Barbosa et al., 2016; Annerbrink et al., 2008; Galvão, Krüger, Campagnolo et al., 2012; Hersrud & Stoltenberg, 2009). In heterogeneous groups of individuals with an eating disorder, carriers of at least one Met allele of the *COMT* gene had significantly higher scores on the Eating Disorder Inventory-2 (EDI-2) (Frieling, Romer, Wilhelm et al., 2006), and carriers of two copies of the Val allele (Val/Val) were at increased risk for bulimia nervosa (Mikołajczyk, Grzywacz & Samochowiec, 2010). *COMT* Val158Met polymorphisms have been associated with the amount of palatable food intake with the *COMT* Val158Met*Val allele carriers consuming significantly higher amounts of lipid dense foods (Galvão et al., 2012) potentially increasing the risk of developing obesity. The genotype of rs740603 in *COMT* has been associated with waist circumference and abdominal obesity (Mansego et al., 2015). Furthermore, significant associations with obesity were found when combined genotype of 5HT2C rs3813929 and *COMT* rs4680 were examined in relation to BMI, fat-BMI, waist, and cholesterol (Kring, Werge, Holst et al., 2009).
Interestingly, despite the evidence above, the present study did not identify any interactions for the *COMT* gene and other obesity-related genes (Table 5.4.). However, several studies have previously identified an interaction between *COMT* Val158Met and *SLC6A4 5-HTTLPR* (Radua, El-Hage, Monté et al., 2014; Surguladze, Radua, El-Hage et al., 2012) in healthy individuals, which has been suggested to underlie individual differences in emotion processing or susceptibility to emotional disorders. Given the link between obesity and emotional eating, this interaction may be worth investigating in obese subjects.

It is possible that the patterns of the *COMT* gene expression in obese individuals may be regulated by epigenetic factors (Handy, Castro & Loscalzo, 2011). It has been suggested that epigenetic changes may account for the missing heritability determinants of complex diseases, such as atherosclerosis, hypertension, metabolic syndrome, and diabetes, that, to date, have not been accounted for by genetic studies of sequence variation (Haines, Guttmacher, Eichler et al., 2009; Slatkin, 2009). In a recent study (Sigurdsson, Gudjonsson, Kristinsson et al., 2009), the influence of parental origin on disease association was examined by following the inheritance of single nucleotide polymorphisms (SNPs) near known imprinted genes. These results identified 6 SNPs in which parental origin of a gene alters risk. One of these SNPs that was associated with type 2 diabetes correlated directly with methylation status, as well. Thus, these findings suggest that additional, nonsequence-dependent variations may contribute to heritable traits, including obesity.

**THE OPIOID RECEPTOR MU 1 (OPRM1).**

Obesity appears to have unique neurobiological underpinnings in the reward circuit and the *OPRM1* availability in obese subjects seems to resemble the patterns observed in addictive disorders (Carlier, Marshe, Cmorejova, Davis, & Müllor, 2015), particularly opioid addiction.
Compared to controls, morbidly obese subjects appear to have a significantly lower $\mu$-OPIOID RECEPTOR availability in brain regions relevant for reward processing, including ventral striatum, insula, and thalamus, which has been found to negatively correlate with self-reported food addiction and restrained eating patterns (Karlsson et al., 2015). The opioid system modulates motivation and reward processing, and low $\mu$-OPIOID AVAILABILITY may, therefore, promote overeating to compensate for decreased hedonic responses in this system and related hyper-reactivity to the hedonic properties of food (Davis et al., 2009). Studies identifying SNPs in $OPRM1$ have provided further evidence for the association between the $OPRM1$ gene and the obesity prevalence. Significant associations have been found between the genotypes of rs1799971 in exon 1, and rs514980 and rs7773995 in intron 1 and BMI with the BMI significantly decreasing by the copy of minor allele carriers of rs1799971, and significantly increasing by the copy of minor allele carriers of rs514980 and rs7773995 (Xu, Zhang, Zhang et al., 2009). Curiously, findings from a more recent study investigating the role of the $OPRM1$ gene in dietary and fat intake suggested that the minor $OPRM1$ allele may have a “protective” effect against obesity, as it was associated with lower fat intake and lower body-fat mass (Haghighi, Melka, Bernard et al., 2014). Individuals with the G/G genotype, on the other hand, have been shown to have significantly higher preferences for sweet and fatty foods, which correlated with measures of overeating and BMI (Carlier et al., 2015). It seems that genes associated with addictive behaviour and appetite control may markedly influence development of clinically severe obesity, especially when high risk variants of different genes are combined (Carpenter, Wong, Li, Noble & Herber, 2013). Carpenter and colleagues (Carpenter et al., 2013) found significant associations between the $DRD2$ TaqI A1 allele and BMI, but no associations with $LEPTIN RECEPTOR (LEPR)$ Lys109Arg and $OPRM1$ A118G variants. However, after stratifying $DRD2$ by $LEPR$ and $OPRM1$, they observed a significant interaction.
between *DRD2* and *LEPR*, and a marginally significant interaction between *DRD2* and *OPRM1*.

**THE SOLUTE CARRIER FAMILY 6 MEMBER 4 (SLC6A4; 5-HTTLPR).**

Brain 5-HT is well known for its role in stress coping and stress-related mood regulation (Chaouloff, 2000; Van Praag, 2004), and it has a well-confirmed role in the regulation of eating behaviour (Steiger, 2004). 5-HT is directly involved in the regulation of energy intake, body weight and macronutrient selection, including selective intake of sweet carbohydrate-rich foods (Halford, Harrold, Boyland, Lawton, & Blundell, 2007; Leibowitz & Alexander, 1998; Simansky, 1996). It seems that it is also involved in individual susceptibility to emotional eating (Capello & Markus, 2014). Disturbances in brain 5-HT function are related to negative mood and decreased stress-resilience (Firk & Markus, 2007; Jans, Riedel, Markus, & Blokland, 2007), and are often observed in disorders related to pathological overeating (Brewerton, 1995; Jimerson, Lesem, Kaye, Hegg, & Brewerton, 1990; Steiger, Bruce, Groleau, 2011). In animals and in humans, manipulations that increase 5-HT neurotransmission lead to reduced eating behaviour, whereas those that reduce 5-HT activity precipitate compulsive or binge eating (Blundell, 1986).

A number of studies have revealed associations between 5-HTTLPR and risk for overweight and obesity (Fuemmeler, Agurs-Collins, McClernon et al., 2008; Sookoian, Gemma, García et al., 2007; Sookoian, Gianotti, Gemma, Burgueño, & Pirola, 2008). Substantial amount of evidence suggests that the short (S) allele polymorphism in 5-HTTLPR may be directly linked to an increased risk for weight gain and/or obesity and obesity-related eating psychopathology (Akkermann, Nordquist, Orelan & Harro 2010; Capello & Markus, 2014; Lan, Chang, Chen et al., 2009; Rozenblat, Ong, Fuller-Tyszkiewicz et al., 2017;
STUDY OF GENE NETWORKS

Schepers & Marcus, 2017; Sookoian et al., 2007; 2008), although some earlier studies have shown increased occurrence of binge eating disorder and disordered eating patterns in individuals with the LL genotype (Matsushita, Nakamura, Nishiguchi, & Higuchi, 2002; Monteleone, Tortorella, Castaldo & Maj, 2006). The S-allele variant expresses lower transcriptional efficiency than the long (L) allelic variant resulting in decreased transporter availability (Heils, Teufel, Petri et al., 1996; Lesch, Bengel, Heils et al., 1996) and, hence, in an increased vulnerability of the 5-HTergic system (Jans et al., 2007). Studies have demonstrated that decreased peripheral SEROTONIN (5-HT) transporter (5-HTT) function is a reciprocal risk factor for the co-morbidity of depression and insulin resistance (Pomytkin, Cline, Anthony et al., 2015), which are both conditions commonly observed in obese patients (see Chapter 2 for a review).

**MONOAMINE OXIDASE A (MAOA).**

*Monoamine oxidase A (MAOA)* is a mitochondrial enzyme that degrades neurotransmitters involved with psychological and physical functioning. The gene that encodes MAOA is found on the X chromosome and contains a polymorphism (*MAOA-uVNTR*) located 1.2 kb upstream of the *MAOA* coding sequences (Sabol, Hu & Hamer, 1998). Functional studies indicating that alleles in this polymorphism differ with respect to transcriptional efficiency suggest that the 3-repeat variant conveys lower transcriptional-efficiency and the 3.5- and 4-repeat alleles covey higher efficiency (Deckert, Catalano, Syagailo et al., 1999; Denney, Koch & Craig, 1999; Sabol et al., 1998). Several studies have indicated that lower transcriptional activity *MAOA-uVNTR* alleles are associated with higher BMI (Ducci, Newman, Funt et al., 2006; Fuemmeler et al., 2008; Need, Ahmadi, Spector & Goldstein, 2006) and lipid levels (Brummett, Boyle, Siegler et al., 2008), whereas the high-activity genotype is
STUDY OF GENE NETWORKS

associated with lower BMI suggesting that MAOA may be involved in the regulation of BMI (Ducci et al., 2006). Related work from a family-based association study of the MAOA has demonstrated a preferential transmission of a low activity allele MAOA polymorphism in obese subjects (Camarena, Santiago, Aguilar et al., 2004). Interestingly, some studies have found this effect only in male subjects (Fuemmeler et al., 2008; Fuemmeler, Agurs-Collins, McClernon et al., 2009) suggesting that the relationship between MAOA alleles and obesity may vary not only as a function of genetic polymorphism but also as a function of gender.

**NEUROPEPTIDE Y (NPY).**

*Neuropeptide Y* is a 36–amino acid peptide mainly secreted by neurons (Ding, Kull, Liu et al., 2005). It plays an important role in food intake (Lin, Boey & Herzog, 2004), obesity (Dryden, Pickavance, Frankish & Williams, 1995; Kuo, Kitlinska, Tilan et al., 2007), immune function (Wheway, Mackay, Newton et al., 2005), and cardiovascular regulation (Pedrazzini, Brunner & Waeber, 1993; Zhang, Qi, Liang et al., 2012). The adipogenic and antilipolytic effects of NPY have been widely reported (Baker, Cohen, Kuo et al., 2009; Kuo et al., 2007; Rosmaninho-Salgado, Marques, Estrada et al., 2012). Evidence has indicated that the NPY is associated with obesity through stimulating food intake, decreasing energy expenditure (Flier, 2004), and increasing energy stored as adiposity (Tatemoto, 2004). Genetic variants in the NPY have been found to affect long-term weight change in prospective cohorts (Yeung, Zhang, Chen et al., 2011). A functional SNP in the promoter region of NPY, rs16147 (C-399T), was found to show allele-specific effects on NPY transcription and NPY peptide concentrations (Buckland, Hoogendoorn, Guy et al., 2004; Kim, Oh, Ko et al., 2009; Shah, Freedman, Zhang et al., 2009; Yeung et al., 2011; Zhou, Zhu, Hariri et al., 2008). A number of studies have demonstrated association of rs16147 SNP of the NPY with obesity (Hohmann, Buchmann, Witt
et al., 2012; Lin, Qi, Zheng et al., 2015; Olza, Gil-Campos, Leis et al., 2013; Zain, Mohamed, Jalaludin et al., 2015) with some suggesting that the NPY rs16147 T and rs16139 C minor alleles are associated with increased risk, whereas the minor allele T of the rs5574 is associated with a reduced risk of obesity (Hohmann et al., 2012; Zain et al., 2015). Additionally, there have been many studies examining the functional Leu7Pro polymorphism (rs16139). This SNP has been associated with a large number of conditions related to obesity and metabolic syndrome traits, including increased BMI in adults (Ding et al., 2005), development of obesity in young adults (Van Rossum, Pijl, Adan, Hoebee & Seidell, 2006), risk of hypertension (Karvonen, Valkonen, Lakka et al., 2001), high plasma low-density lipoprotein-cholesterol in children and adults (Karvonen, Koulu, Pesonen et al., 2000; Salminen, Lehtimäki, Fan, Vahlberg & Kivelä, 2008), elevated plasma triacylglycerols (Karvonen, Pesonen, Koulu et al., 1998), and the risk of type 2 diabetes mellitus in adults (Nordman, Ding, Ostenson et al., 2005; Ukkola & Kesäniemi, 2007). One study has also identified a significant association of the intronic rs16131 SNP with higher BMI, insulin, insulin resistance index, triacylglycerols, and leptin and lower high-density lipoprotein-cholesterol in children (Olza et al., 2013).

**TUMOR NECROSIS FACTOR (TNF-α).**

TNF-α is a pro-inflammatory cytokine primarily, but not exclusively, produced from macrophages (Beutler & Cerami, 1989; Old, 1985; Pennica, Nedwin, Hayflick et al., 1984). It has an important role in the whole body lipid and glucose metabolism (Beutler & Cerami, 1989; Grunfeld & Feingold, 1991). TNF-α has been shown to be correlated with adiposity and insulin resistance (Hotamisligil, Arner, Caro, Atkinson & Spiegelman, 1995; Matsushita, Yatsuya, Tamakoshi et al., 2006; Belkina & Denis, 2010). Although the exact effects of TNF-α on these conditions have not been clearly defined, four common variants in the promoter region of TNF-
STUDY OF GENE NETWORKS

α, G-308A (rs1800629), G-238A (rs361525), C-863A (rs1800630) and C-857A (rs1799724), were considered to alter TNF-α transcriptional activity (Wilson, Symons, McDowell, McDevitt & Duff, 1997; Skoog, van’t Hooft, Kallin et al., 1999; Bayley, de Rooji, van den Elsen et al., 2001).

TNF-α has been viewed as a candidate genetic risk factor for obesity and insulin resistance. In particular, the TNF-α G-308A polymorphism has been linked with elevated insulin levels indicating that it may play an important role in the pathogenesis of insulin resistance (Wang, Yang, Han et al., 2015). It has been suggested that the ways this polymorphism affects insulin levels may be modified by high BMI (Ng, Veerapen, Hon & Lim, 2014; Wang et al., 2015). However, findings on the direct associations of this polymorphism with obesity have been inconsistent (Ng et al., 2014; Sookoian, González & Pirola, 2005; Wang et al., 2015). The TNF-α −308 A allele has been associated with obesity, obesity-related insulin resistance, and altered serum lipid concentrations in some Caucasian populations (Brand, Schorr, Kunz et al., 2001; Fontaine-Bisson, Wolever, Chiasson et al., 2007; Romeo, Sentinelli, Capici et al., 2001; Um, Park & Kim, 2003). In addition, in some populations, the TNF-α −308 G>A polymorphism has been shown to change the relationship between fatty acids intake and the risk of obesity (Gómez-Uriz, Goyenechea, Campión et al., 2014; Joffe, Collins & Goedecke, 2013; Stryjecki & Mutch, 2011), but this interaction was not observed in other populations (Joffe, Van Der Merwe, Collins et al., 2011). Overall, there seems to be a relationship between some TNF-α polymorphisms and obesity but the specific role of these polymorphisms in the pathogenesis of obesity and related metabolic disorders symptomatology remains understudied.
**OXYTOCIN RECEPTOR (OXTR).**

Research evidence suggests that the disruption of various hypothalamic pathways can be responsible for disordered feeding and energy balance resulting in the development of obesity and related health problems (Cai & Liu, 2011; 2012; Elmquist & Flier, 2004; Flier & Maratos-Flier, 1998; Schwartz & Porte, 2005). The hypothalamo-neurohypophyseal neuropeptide OXT is classically known for its functions in reproductive physiology of mammalian females (Soloff, Alexandrova & Fernstrom, 1979). However, growing evidence indicates that many of the classical and non-classical actions of OXT are also associated with feeding changes (Arletti et al., 1989; Douglas et al., 2007; Leng et al., 2008; Ho & Blevins, 2013). In early studies of hypothalamic function, lesions of OXT-containing hypothalamic nuclei were shown to result in an increase in food intake and body weight (Leibowitz, Hammer & Chang., 1981; Shor-Posner, Azar, Insinga & Leibowitz, 1985; Sims & Lorden, 1986; Kirchgessner, Sclafani & Nilaver, 1988). Then, in the 1990s, several studies reported anorexigenic effects of central OXT (Arletti et al., 1989; Olson, Drutarosky, Chow et al., 1991), and a number of recent studies linked OXT to the hypothalamus-brain stem circuits that work to inhibit feeding (Baskin et al., 2010; Blevins et al., 2004; Blouet et al., 2009). Exogenous OXT administration has been shown to reduce caloric consumption, particularly of palatable foods, in animal and human studies (Arletti et al., 1989; Lawson, Marengi, DeSanti et al., 2015; Maejima, Rita, Santoso et al., 2015; Olson et al., 1991). Longer term central infusions of OXT were also reported to reduce body weight gain in rats (*Rattus norvegicus*) given a high-fat diet, but in contrast to OXT’s acute effects, chronic OXT infusions did not alter total food intake or meal patterning, but instead appeared to stimulate lipid metabolism in adipose tissue (Deblon et al., 2011). Several recent studies revealed that obesity could be significantly attributed to OXT release defect, and OXT treatment was able to effectively
correct overeating and obesity (Cai & Purkayastha, 2013; Deblon et al., 2011; Maejima et al., 2011; Zhang & Cai, 2011; Zhang et al., 2011; Zhang et al., 2013). Research demonstrated that when delivered systemically OXT causes reduction in fat mass and adipocyte size (Maejima et al., 2011), whereas deficiency in OXTR incurs an opposite effect (Takayanagi, Kasahara, Onaka et al., 2008). A recent clinical trial revealed that OXT treatment in humans not only leads to body weight reduction, but also improves the lipid profile of the patients by lowering serum LOW DENSITY LIPOPROTEIN (LDL) and cholesterol levels and a propensity for HIGH DENSITY LIPOPROTEIN (HDL) level (Zhang et al., 2013).

There is a lack of strong evidence to suggest molecular links between particular genetic variants of the OXTR and obesity-related eating disorders. However, two recent studies have investigated associations between OXTR genetic variants and eating disorders, of which the polymorphisms related to bulimia nervosa are of particular interest. A positive association between the G allele of rs53576 and bulimia nervosa has been found in a clinical sample of 90 women with bulimia nervosa compared to controls (Kim, Kim, Kim, Shin, & Treasure, 2015). Amongst patients with anorexia nervosa, anorexia nervosa (weight-recovered), bulimia nervosa and controls, subjects with rs53576 and rs2254298 GG/GG haplotype had lower scores on overall eating disorder psychopathology measures, less body shape and food preoccupation, fewer obsessive compulsive behaviours, and lower anxiety (Acevedo, Valencia, Lutter, & McAdams, 2015). Most recently, an investigation of 3698 women from the Avon Longitudinal Study of Parents and Children (ALSPAC) sample revealed that the GG rs53576 genotype was associated with binge eating and purging, and the rs2254298 AG/AA genotype with restrictive eating lifetime. In addition, the rs2254298 AG/AA genotype interacted with poor maternal care to increase the odds of binge eating and purging (Micali, Crous-Bou, Treasure & Lawson, 2017).
ARGinine VASOPRESSIN RECEPTOR 1A (AVPR1A).

VASOPRESSIN (AVP), also called antidiuretic hormone, is a neurohypophyseal peptide involved in diverse physiological functions and released in conditions of hypotension and high plasma osmolality. AVP exerts antidiuretic effects through the vasopressin 2 receptor in the kidney (Lolait, O'Carroll, McBride et al., 1992), whereas the vasopressin 1a receptor (V1aR) is involved in platelet aggregation, vasoconstriction, liver gluconeogenesis and liver glycogenolysis (Filep & Rosenkranz, 1987; Keppens & de Wulf, 1979; Ohlstein & Berkowitz, 1986; Whitton, Rodrigues & Hems, 1978), and the vasopressin 1b receptor (V1bR) is found in the pituitary gland and pancreas, where it mediates secretion of the adrenocorticotropic hormone (ACTH), insulin and glucagon (Abu-Basha, Yibchok-anun & Hsu, 2002; Holmes, Landry & Granton, 2003). V1aR knock-out mice have a phenotype of elevated plasma glucose levels and fat-diet induced diabetes mellitus, as well as low triglyceride levels (Aoyagi, Birumachi, Hiroyama et al., 2007; Hiroyama, Aoyagi, Fujiwara et al., 2007). Although research targeting the human AVPR1A gene is very limited, the T-allele carriers of rs1042615 in AVPR1A have been found to have altered plasma glucose and triglyceride levels and an increased diabetes mellitus prevalence among those with a high fat intake (Enhörning, Leosdottir, Wallström et al., 2009), a phenotype strongly resembling the phenotype of the V1aR knock-out mice. Furthermore, the same polymorphism has been associated with elevated BMI in male T-allele carriers (Masuki, Mori, Tabara et al., 2010). More recently, significant associations have been found between the major allele of rs35810727 in AVPRIB and elevated BMI and waist circumference suggesting that genetic variance of AVPRIB contributes to overweight (Enhörning, Sjögren, Hedblad et al., 2016).
**DOPAMINE RECEPTOR D2 (DRD2) and DOPAMINE RECEPTOR D3 (DRD3).**

Dopamine is a key neurotransmitter associated with motivated behaviours involving both food and drug reinforcement and is found in brain regions associated with reward such as the ventral tegmental area and amygdala (Volkow, Fowler, Wang, Swanson, & Telang, 2007; Volkow et al., 2011). Appetitive stimuli, including primary reinforcers such as food, increase dopamine release in brain reward centres (Cheng, de Bruin, & Feenstra, 2003) and it is thought that increases in dopamine release are directly related to motivation and reinforcement (Salamone & Correa, 2002). It has been postulated that obese people may experience less reward from food due to a lower striatal dopamine release after food intake (Volkow et al., 2011), which could consequently lead to overeating behaviour to compensate for the reward deficit. Several lines of research have demonstrated that obese people have decreased DRD2/DRD3 availability in the striatum (De Weijer, Van de Giessen, van Amelsvoort et al., 2011; Wang, Volkow, Logan et al., 2001a). It has also been suggested that striatal dopamine release may be blunted in obese individuals due to overstimulation caused by frequent consumption of palatable foods (Van de Giessen, Celik, Schweitzer, van den Brink & Booij, 2014). Polymorphisms in the *DRD2*, including the ANKK1 or Taq1A allele, that lead to a reduction in DRD2 receptor levels, have been associated with obesity (Spitz, Detry, Pillow et al., 2000; Thomas, Critchley, Tomlinson, Cockram, & Chan, 2001), increased energy intake (Epstein, Leddy, Temple & Faith, 2007; Epstein, Wright, Paluch et al., 2004) and high food reinforcement (Epstein et al., 2007). Individuals with the Taq1A allele have been shown to be less responsive to weight loss programs and have greater weight regain during the maintenance phase (Winkler, Woehning, Schultz et al., 2012). Additionally, studies with functional magnetic resonance imaging in response to imagined intake of palatable foods have confirmed that future increases in body mass can be predicted by weaker brain activation of specific brain...
areas, particularly in individuals carrying low functioning variants of dopamine receptor genes, such as the \textit{DRD2} TaqIA A1 allele (Stice, Spoor, Bohon & Small, 2008; Stice, Yokum, Bohon, Marti & Smolen, 2010).

\textit{DOPAMINE RECEPTOR D4 (DRD4).}

The DRD4 is a G protein-coupled receptor encoded by the \textit{DRD4} gene and activated by the neurotransmitter dopamine. \textit{DRD4} contains highly polymorphic variable number tandem 48-bp repeats within the exon three, which is located in the third cytoplasmic loop of the receptor (DiMaio et al., 2003; Kebir, Tabbane, Sengupta & Joober, 2009; Van Tol, Wu, Guan et al., 1992). The exon III 7-repeat allele (7R) of \textit{DRD4} has been associated with markedly decreased affinity for dopamine and impaired intracellular signalling in comparison to other exon III alleles (Asghari, Sanyal, Buchwaldt et al., 1995). A number of studies have shown correlations between \textit{DRD4} and higher BMI (Guo, North & Choi, 2006; Levitan, Masellis, Basile et al., 2004; Levitan, Masellis, Lam et al., 2004; Sikora, Gese, Czypicki et al., 2013), particularly in carriers of the 7R allele in the third exon of the gene (Fuemmeler et al., 2008; Guo et al., 2006; Levitan et al., 2004a; 2004b; Sikora et al.; 2013). Similar results were found in women with bulimia nervosa (Kaplan, Levitan, Yilmaz et al., 2008; Levitan, Kaplan, Davis, Lam & Kennedy, 2010), where there was an additional \textit{DRD4/BDNF} gene-gene interaction associated with maximum BMI in women with bulimia nervosa (Kaplan et al., 2008). The \textit{DRD4} 7-repeat carriers also reported significantly more craving for food in a cue-elicited food-craving test (Sobik, Hutchison & Craighead, 2005). Although a couple of studies reported no links between \textit{DRD4} polymorphisms and obesity (Roth, Hinney, Schur, Elfers & Reinehr, 2013; Uzun, Saglar, Kucukyildirim et al., 2015), they have not assessed any gender differences. Given the significant evidence for sex differences in eating behaviour and obesity
STUDY OF GENE NETWORKS

(Cooke & Wardle, 2005; Galloway, 2007), as well as for brain reward processes (Hurd, Svensson & Pontén, 1999; Adinoff, Devous, Best et al., 2003), it may be that the exon III 7-repeat allele affects BMI only in female subjects.

**INTERLEUKIN 6 (IL-6).**

IL6 is an important cytokine which is secreted by macrophages, adipocytes, and other sources including skeletal muscle, fibroblasts, and endothelial cells (Febbraio & Pedersen, 2002; Sundararaj, Samuvel, Li et al., 2009). It is coded by the *IL-6* gene which is located on the 7 chromosome at 7p21-p14, between D7S135 and D7S370 (Shimabukuro, Koyama, Chen et al., 1997), and it consists of 5 exons and is 5kb long (Stunkard, Sørensen, Hanis et al., 1986). IL-6 is a systemic regulator of body weight and lipid metabolism (Mohamed-Ali, Goodrick, Rawesh et al., 1997; Shoelson, Lee & Goldfine, 2006). Up to 30% of IL-6 in the blood stream is secreted by adipose tissue, and the cytokine level has been shown to positively correlate with BMI (Mohamed-Ali et al., 1997; Vgontzas, Papanicolaou, Bixler et al., 1997). High levels of IL-6 have been consistently associated with obesity and insulin resistance (Abduljabbar, Al-Sahaly, Kellesarian et al., 2016; Di Renzo, Bertoli, Bigioni et al., 2008; Engeli, Feldpausch, Gorzelniak et al., 2003; Ottobelli Chielle, de Souza, da Silva, Moresco & Moretto, 2016; Pang, Nguyen, Rhodes et al., 2016; Popko, Gorska, Stelmasczyk-Emmel et al., 2010). However it has been unclear whether IL-6 played a harmful (Eder, Baffy, Falus & Fulop, 2009; Schultz, Oberhauser, Saech et al., 2010; Senn, Klover, Nowak & Mooney, 2002) or a protective role (Mauer, Chaurasia, Goldau et al., 2014; Pedersen & Febbraio, 2007) in this regard. Recent findings assessing the patterns of *IL-6* transcription revealed significantly higher *IL-6* mRNA levels in the adipose tissue of obese individuals compared to lean/overweight counterparts (Sindhu, Thomas, Shihab et al., 2015). This suggests that obesity was a positive modulator of *IL-6* transcription.
Several studies have indicated a relationship between some genetic variants of the *IL-6* and risks of developing obesity and/or obesity-related conditions. The rs2069845 and the rs1800795 polymorphisms in the *IL-6* have been associated with the risk of developing obesity (Todendi, Klinger, Ferreira et al., 2015; Underwood, Chamarthi, Williams et al., 2012), and the occurrence of the *IL-6* -174G/C polymorphism in individuals with excessive weight has been suggested to increase the risk of developing obesity-related metabolic disorders, especially insulin resistance (Di Renzo et al., 2008; Goyenechea, Parra & Martínez, 2007; Herbert, Liu, Karamohamed et al., 2006; Stephens, Hurel, Cooper et al., 2007; Tretjakovs, Latkovskis, Licis et al., 2007). Some lines of research have suggested that the -174 G/C *IL-6* promoter polymorphism represented a marker which could help to identify, "vulnerable" individuals at risk of obesity related disorders (Di Renzo et al., 2008). Although some studies found no association between the *IL-6* polymorphisms and obesity (Bouhaha, Baroudi, Ennafaa et al., 2010), most research evidence seems to suggest otherwise.

**INTERLEUKIN 1 RECEPTOR ANTAGONIST (IL-1RN).**

IL-1RN is an endogenous competitive inhibitor of proinflammatory IL-1α and IL-1β (Perrier, Darakhshan & Hajduch, 2006) and is highly secreted by the white adipose tissue (Juge-Aubry, Somm, Giusti et al., 2003). Obesity-related increase in IL-1RA has been suggested to contribute to the central resistance to LEPTIN in obese patients (Meier, Bobbioni, Gabay et al., 2002), similar to the inhibition of the hypothalamic signalling of LEPTIN by IL-1RA in rodents (Somm, Henrichot, Pernin et al., 2005). The human *IL-1RA* gene has a Variable Number Tandem Repeat (VNTR) polymorphism within intron 2 due to variation in the number of copies of an 86 bp sequence. To date, six distinct alleles corresponding to 1, 2, 3, 4, 5, and 6 copies of the repeat sequence have been identified (Vamvakopoulos, Taylor, Morris-Stiff, Green & Metcalfe, 2002). The 4-repeat (allele I) and 2-repeat (allele II) are most frequently
found in the general population, while the other four alleles (alleles III, IV, V, and VI) are rarely observed (Tarlow, Blakemore, Lennard et al., 1993). This VNTR, particularly homozygosity for allele II, has been variably associated with various conditions such as obesity, inflammatory bowel disease, and coronary artery disease in different ethnic populations worldwide (see Witkin, Gerber & Ledger, 2002 for a review).

IL-1RA serum level is increased in human obesity and is under strong genetic control (Juge-Aubry et al., 2003), partly by the IL-1RA VNTR polymorphism. In normal subjects, carriers of the IL-1RA allele II have higher IL-1RA circulating levels (Hurme & Santtila, 1998), which have been shown to positively correlate with BMI in adolescents (Jung, Gerdes, Fritzenwanger & Figulla, 2010). However, research identifying the links between the IL-1RN polymorphisms and obesity has been somewhat inconsistent. Four previous Asian studies found no significant association of IL-1RA VNTR with BMI or overall obesity status in Koreans (Um, Lee & Kim, 2004; Um, Kim, Mun, Song & Hong, 2006), North Indians (Manchanda, Bid, Achyut et al., 2007) and Malaysians (Kok, Ong & Say, 2017), but in the latter study IL-1RA VNTR was associated with total body fat value and overall adiposity status which were significantly higher in those with IL-1RA II allele compared with I allele (Kok et al., 2017). On the other hand, Yang and colleagues (Yang, Qiao & Li, 2012b) showed that inflammatory factors IL-1β and IL-1RA significantly correlated with obesity, and patients who carried T allele of IL-1β gene promoter region (-511) and V allele of IL-1RA were at high risk of obesity. Andersson and colleagues (Andersson, Strandberg, Nilsson et al., 2009) found an association between the rs4252041 polymorphism of the IL-1RA and the primary outcome total fat mass and regional fat masses, but not with lean body mass or serum IL-1RN levels. Taken together, evidence suggests that some IL-1RA VNTR polymorphisms may be genetic markers for overall adiposity.
**5-HYDROXYTRYPTAMINE RECEPTOR 2A (HTR2A).**

5-HTR2A modulates the physiological mechanisms of feeding through its interaction with the 5-HT (Simansky, 1996). The 5-*HTR2A* is located in 13q14-21 and contains three exons separated by two introns (Chen, Yang, Grimsby, & Shih, 1992). Several polymorphic variants including -1438G>A, T25N, T102C, I197V, A447V and H452Y have been described in 5-*HTR2A* (Enoch, Kaye, Rotondo et al., 1998; Harvey, Reid, Ma et al., 2003; Inayama, Yoneda, Sakai et al., 1996). All of these variants have been analysed within the framework of genetic determinants of various psychotic disturbances (Arranz, Munro, Owen et al., 1998; Enoch et al., 1998; Harvey et al., 2003; Inayama et al., 1996), with the polymorphism -1438G>A (rs6311), in the regulatory region, being specifically associated with alterations in food intake (Collier, Arranz, Li et al., 1997; Enoch et al., 1998; Matsushita et al., 2002; Ricca, Nacmias, Boldrini et al., 2004). A number of studies have examined the potential association between the -1438 A allele and eating disorders (Collier et al., 1997; Gorwood, Ades, Bellodi et al., 2002; Hinney, Ziegler, Nöthen, Remschmidt & Hebebrand, 1997; Martášková, Slachtová, Kemlink, Záhoráková & Papezová, 2009; Nacmias, Ricca, Tedde et al., 1999; Matsushita et al., 2002; Ricca, Nacmias, Cellini et al., 2002; Ricca et al., 2004; Rybakowski, Slopien, Dmitrzak-Weglarz et al., 2006; Sorbi, Nacmias, Tedde et al., 1998), but its association with obesity risk has not been studied to the same extent, and findings have not always been consistent. For example, Rosmond and colleagues (Rosmond, Bouchard & Björntorp, 2002a; 2002b) found that homozygotes for the -1438G allele had, in comparison with -1438A/A subjects, higher BMI, waist-to-hip ratio, and abdominal sagittal diameter suggesting that the risk allele carriers were at an increased risk of developing abdominal obesity. The same risk allele has also been found to predict the presence of metabolic syndrome in adults (Halder, Muldoon, Ferrell & Manuck, 2007) and affect energy and macronutrient intake in children and
adolescents (Herbeth, Aubry, Fumeron et al., 2005). Additionally, it has been demonstrated that bulimic patients who carry the low-function -1438G/A G allele show reduced responsiveness to multimodal treatments and smaller reductions in binge eating (Steiger, Joober, Gauvin et al., 2008).

On the other hand, Sorlí and colleagues (Sorlí, Francés, González et al., 2008) found no association between the -1438G>A polymorphism and obesity. However, when only the obese group was analysed, it was observed that AA subjects presented a lower BMI and waist circumference than G allele carriers suggesting that although the -1438G>A polymorphism may not be a relevant marker for obesity risk, this variant may play a role in determining BMI in obese subjects. Similarly Kring and colleagues (Kring et al., 2009) observed no significant associations between the 5-HTR2A rs6311 and obesity. However, they obtained significant associations when combined genotype of 5-HTR2C rs3813929 and COMT rs4680 were examined in relation to BMI, fat-BMI, waist, and cholesterol.

The role of the -1438G>A polymorphism in obesity seems to be quite trackable but evidence is emerging to suggest that other polymorphisms may be involved as well. For example, a relatively recent study showed significant association between the HTR2A rs912127 polymorphism and BMI (Li, Tiwari, Lin et al., 2014). Additionally, the same study suggested a gender-by-SNP interaction for rs1745837 in HTR2A, which implied that variants in 5-HTR2A might have stronger effects on BMI in men than in women (Li et al., 2014). Carr and colleagues (Carr, Lin, Fletcher et al., 2013) found that the SNP rs6314 in 5-HTR2A moderated the effect of food reinforcement on BMI, accounting for an additional 5-10% variance and revealed a potential role of the SNP as a differential susceptibility factor for obesity.
**BRAIN DERIVED NEUROTROPHIC FACTOR (BDNF).**

BDNF is a member of the neurotrophin family with a major role in neuronal survival, differentiation, plasticity and connectivity in the brain (Noble, Billington, Kotz & Wang, 2011). This neurotrophin regulates energy balance and homeostasis, food intake and feeding behaviour, since, besides the brain, it is also located in adipose tissue, skeletal and smooth muscle, and liver (Noble et al., 2011). The evidence suggests that the reduced BDNF signalling is associated with obesity (Schwartz & Mobbs, 2012). BDNF's role in weight regulation, development of obesity and increased BMI (Lebrun, Bariohay, Moyse & Jean, 2006; Noble et al., 2011; Rios, 2013) is based on the findings showing altered (Araya, Orellana & Espinoza, 2008; Bus, Molendijk, Penninx et al., 2011; Gray, Yeo, Cox et al., 2006; Han, Liu, Jones et al., 2008; Iughetti, Casarosa, Predieri, Patianna & Luisi, 2011) or low (Saito, Saito, Watanabe & Hashimoto, 2009) blood BDNF levels in obesity, and on a positive association between BDNF polymorphisms and BMI (Speliotes, Willer, Berndt et al., 2010). A common single nucleotide polymorphism (Egan, Kojima, Callicott et al., 2003), that results in a valine (Val) to methionine (Met) substitution at codon 66 of the BDNF locus (BDNF Val66Met, rs6265), has been repeatedly reported to be associated with BMI (Friedel, Horro, Wermter et al., 2005; Gunstad, Schofield, Paul et al., 2006; Shugart, Chen, Day et al., 2009; Skledar, Nikolac, Dodig-Curkovic et al., 2012; Thorleifsson, Walters, Gudbjartsson et al., 2009; Wu, Xi, Zhang et al., 2010) and eating disorders (Gratacòs, González, Mercader et al., 2007; Ribasés, Gratacòs, Armengol et al., 2003). Additionally the obesity risk allele at rs6265 in BDNF was also associated with greater weight regain at two year follow-up among those who lost 3% or more of their initial weight at six-months following an intensive lifestyle intervention (Delahanty, Pan, Jablonski et al., 2012). These findings were further replicated with the risk allele carriers showing greater weight regain at four year follow-up (McCaffery, Papandonatos, Huggins et al., 2013).
However, the reports on the association between BDNF Val66Met variants and obesity or BMI in healthy subjects are slightly conflicting, as both Met (Beckers, Peeters, Zegers et al., 2008; Skledar et al., 2012) and Val (Gunstad et al., 2006; Hong, Lim, Go et al., 2012; Shugart et al., 2009; Timpano, Schmidt, Wheaton, Wendland & Murphy, 2011) alleles have been associated with obesity and it has been hypothesised that mutation in the Val66Met polymorphisms influences individual differences in BMI (Hong et al., 2012). On the other hand, a relatively recent longitudinal study has not found a significant association between the BDNF Val66Met and either BMI gain or changes in BMI during a period of 35 years of follow-up in adult/older healthy subjects (Nikolac Perkovic, Mustapic, Pavlovic et al., 2013). However, the study was limited to small sample size and insufficient statistical power which might have prevented the authors from detecting a significant effect.

5.1.4. Discussion

The identification of obesity susceptibility loci have provided new insights into the molecular genetic factors that contribute to the development of obesity. However, the current lack of understanding of the numerous gene-gene and gene-environment interactions in obesity poses one of the major obstacles for the development of effective, preventive, and therapeutic intervention strategies (Stryjecki & Mutch, 2011).

The functions of many genes have not yet been fully elucidated. This issue has become even more complex with the recent identification of many novel non-coding genes (Zhao, Li, Fang et al., 2016). With the development of high-throughput technologies including microarrays and RNA sequencing, and their respective data-analysis methods, the functional status of a gene can now be identified from a systematic perspective (Carpenter & Sabatini, 2004; Van Dam, Craig & de Magalhães, 2015). One method to infer gene function and gene–disease associations from genome-wide gene expression is co-expression network analysis, an
STUDY OF GENE NETWORKS

approach that constructs networks of genes with a tendency to co-activate across a group of samples and subsequently interrogates and analyses this network (Van Dam, Võsa, van der Graaf, Franke & de Magalhães, 2017).

A hypothesis in gene expression suggests that when genes are co-expressed, they might be regulated by the same molecular genetic pathway (Van Dam et al., 2017). Gene co-expression networks can, therefore, be used to associate genes of unknown function with biological processes, to prioritize candidate disease genes or to discern transcriptional regulatory programmes.

Although co-expression networks are effectively only able to identify correlations, and cannot normally confer information about causality or distinguish between regulatory and regulated genes, they are the foundation for the differential co-expression analysis (Amar, Safer & Shamir, 2013; Bhar, Haubrock, Mukhopadhyay et al., 2013; Fiannaca, La Rosa, La Paglia, Rizzo & Urso, 2015; Zeisel, Muñoz-Manchado, Codeluppi et al., 2015). This method can then be used to identify genes that are more likely to be regulators that underlie phenotypic differences linked to a particular disease.

Protein domains are one of the most convenient and practically important levels at which to understand the evolution of protein function. Homologous sequence is assumed to have similar function, whatever the context, so these “modules” or “mobile domains” allow the transfer of functional information, such as being involved in a particular kind of interaction, between distinct protein classes (Copley, Doerks, Letunic & Bork, 2002). The exact extent to which functional information can be usefully transferred, however, varies greatly and may be difficult to establish a priori, although the higher the proportion of shared domains in two proteins, the more similar their functions (Hegyi & Gerstein, 2001). Identifying the level of shared protein domains between two genes involved in obesity may, therefore, greatly enhance
STUDY OF GENE NETWORKS

the current understanding of the particular function of these genes in relation to obesity and obesity-related eating psychopathology.

In addition to co-expression and shared protein domains the present study also identified several co-localizations of different genes (Warde-Farley et al., 2010). Understanding the localization of gene expression enables researchers to identify the regions that may be associated with a particular disease. Overlaps of genetic association in different diseases have been widely observed, and are thought to reflect shared aetiology between diseases (Cotsapas, Voight, Rossin et al., 2011). However, showing that a variant is associated with two traits does not demonstrate that it is causal for both: this may be due to distinct variants in linkage disequilibrium (Plagnol, Smyth, Todd & Clayton, 2009). Identifying co-localization of genes involved in the same disease is a precursor to co-localization analyses which are used to study whether potential causal variants are shared by combining information across multiple SNPs in a region (Fortune, Guo, Burren et al., 2015).

From the perspective of the present PhD study, which subsequently analyses expression levels of the OXTR in response to the PPI, observed interactions with the OXTR are of particular interest here, as they may help elucidate through which potential molecular genetic pathways the intervention functions. This work provides promising evidence on the interactions between genes related to QOL domains and obesity-related genes, and propose potential molecular genetic pathways through which PPI’s might function (Figure 5.1.).
Figure 5.1. Interactions between the *OXTR* and components that might be involved in Obesity-Related Eating Disorders. The main components of these interactions are depicted in the diagram, but additional elements have been omitted for clarity. Comprehensive reviews are available (Andersson et al., 2009; Enhörning et al., 2009; 2016; Guo et al., 2016; Klauke et al., 2014; Mollereau et al., 1994; Porro et al., 2014; Sharma et al., 2008; Van de Giessen et al., 2014; Zain et al., 2015), and should be referred to for additional pieces of information.

The present study identified co-expression between the *OXTR* gene and *NPY*, *IL37*, *OPRL1* and *DRD2*. The role of *NPY* and *DRD2* in obesity has already been discussed.

The protein encoded by the *OPRL1* is a member of the 7 transmembrane-spanning G protein-coupled receptor family, and functions as a receptor for the endogenous, opioid-related neuropeptide, nociceptin/orphanin FQ. This receptor-ligand system modulates a variety of biological functions and neuro-behaviour, including stress responses and anxiety behaviour, learning and memory, locomotor activity, and inflammatory and immune responses. (Mollereau, Parmentier, Mailleux, et al., 1994).
With respect to the other two co-expressed genes, research indicates that the IL-37 (Kumar, McDonnell, Lehr et al., 2000) may protect against obesity-induced inflammation and insulin resistance (Ballak, van Diepen, Moschen et al., 2014). During acute and chronic inflammation, IL-37 shifts the cytokine balance away from excessive inflammation (Dinarello & Bufler, 2013), thereby showing potential as a key factor to restore the inflammatory balance in obesity. Confirming this hypothesis, the inflammatory status of adipose tissue has been detected to inversely correlate with IL-37 mRNA expression levels in humans (Ballak et al., 2014). Following weight loss surgery, IL37 expression levels in adipose tissue increase significantly (Moschen, Molnar, Enrich et al., 2011) changing the adipose expression profile of IL37 toward a more anti-inflammatory direction.

AVPR1A, AVPR1B, AVPR2, GPR31, NPSRI have been identified to have shared protein domains with the OXTR. These findings indicate that even though AVPR2, GPR31 and NPSR1 have not been implicated in pathways involved in obesity or obesity-related eating disorders, sharing protein domains with the OXTR gene may allow the transfer of functional information.

The present study also identified co-localisation between the OXTR and IL-1RN which could potentially serve as a pre-cursor to co-localisation analysis. The role of IL-1RN in obesity has been extensively researched and several links with particular variants of this gene have been identified (see section 5.1.3. for detail). Previous research has identified links between the OXT and feeding changes (Arletti et al., 1989; Douglas et al., 2007; Leng et al., 2008; Ho & Blevins, 2013). However, there is a lack of strong evidence to suggest a link between particular genetic polymorphisms of the OXTR and obesity or related feeding behaviour. Co-localisation analysis conducted on the basis of the present research findings might help elucidate whether potential causal variants in OXTR and IL-1RN are shared in obese populations.
CHAPTER 6: Pilot Studies

6.1. Introduction

Obesity represents a world-wide health problem with substantial medical, social, and economic consequences (Arterburn et al., 2005; Yach et al., 2006; Runge, 2007). In addition to the physical health risks associated with obesity, it has long-lasting negative effects on self-esteem, self and body image perception and overall life satisfaction (Sikorski et al., 2015). Despite public health warnings of the dangers of increased body weight, record rates of dieting, a variety of interventions, and drug and hospital treatments, obesity is still on the rise (HSCIC, 2016). Up to date, there seems to be inconsistent evidence for long-lasting effects or health improvements of any currently applied obesity treatments (Fradkin et al., 2016). The rapid growth of obesity and the seriousness of some cases, suggest that there is a need for development of alternative treatments.

Positive psychology has been successfully applied to some psychological disorders related to obesity. Interventions based on positive psychology have been shown to effectively reduce depressive symptoms (Layous & Lyubomirsky, 2014; Sin & Lyubomirsky, 2009), substance use and addictions (Krentzman, 2013), alcohol dependence (Akhtar & Boniwell, 2010), use of nicotine and drugs (Peltzer & Pengpid, 2013), problem gambling (Loo et al., 2014), overeating (Bardone-Cone et al., 2012) and binge eating disorder (Pinto-Gouveia et al., 2017). A number of studies have reported positive effects of mindfulness-based approaches to obesity-related eating pathology (Dalen et al., 2010; Katterman et al., 2014; Kristeller & Wolever, 2011; Mason et al., 2016) with some authors even suggesting that mindfulness is an essential component of holistic obesity treatment (Douglass, 2011; Kristeller & Wolever, 2011); see Chapter 2 for a detailed review). In recent years, research has been increasingly
PILOT STUDIES - INTRODUCTION

focusing on the possibility of applying mindfulness-based interventions to aid weight loss in individuals with obesity (Dalen et al., 2010; Daubenmier et al., 2011; Mason et al., 2016). However, research applying more complex PPIs is lacking.

A couple of studies have investigated the role of positive psychology in weight maintenance and weight loss attempts of people suffering with obesity (Robertson et al., 2013; 2015a). The findings suggested that despite failure to lose weight, obese individuals possess some positive psychological assets, including life satisfaction, gratitude, strengths, optimism and mindfulness, which was proposed to be a good starting point for potentially successful weight management using positive psychology (Robertson et al., 2013). Up to date, there has only been one study where more comprehensive PPI was applied in a community sample of obese Australians (Robertson, 2015). The total sample consisted of four women with BMI over 30 kg/m², who participated in a 16-week PPI, which incorporated concepts of hope (pathways and goals training; and agentic thinking), strengths and gratitude. Group sessions were delivered on a weekly basis with each session lasting 60 minutes. Overall, the participants’ well-being improved after the intervention. However, the weight change was inconsistent, with some participants losing but others gaining weight. This preliminary investigation offered a good basis for the potential applicability of positive psychology to obese populations. However, the sample was too small to draw any firm conclusions. Up to this date, there has not been any comprehensive PPI delivered to individuals with weight problems, which would be validated on large samples and multiple diverse groups.

Over the past decade there has been a growing body of research focusing on emotion and behaviour regulation strategies in disordered eating (Anestis, Selby, Fink & Joiner, 2007), which is one of the most commonly occurring comorbidity with obesity (see Da Luz, Sainsbury, Mannan et al., 2017 for a review). A major finding in this line of research is that the way an individual interprets, relates, and reacts to difficult private events, such as negative
affect and body dissatisfaction, plays a crucial role in the onset and maintenance of disordered eating (Anestis et al., 2007; Corstorphine, 2006). Positive psychology shares a number of aspects with the new wave cognitive and behavioural therapies, which explicitly target the reduction of maladaptive regulation strategies and the promotion of alternative and adaptive regulation strategies (e.g., acceptance, mindfulness) in the treatment of disordered eating. Body image flexibility is a construct developed to reflect adaptive regulation strategies in the context of experiencing body dissatisfaction and disordered eating (Sandoz, Wilson, Merwin & Kellum, 2013). Research has shown that body image flexibility is associated with general psychological flexibility (Sandoz et al., 2013), body dissatisfaction (Sandoz et al., 2013), and disordered eating (Hill, Masuda & Latzman, 2013; Sandoz et al., 2013; Wendell, Masuda & Le, 2012). In fact, body image flexibility has been identified as a significant predictor of disordered eating, and individuals with low body image flexibility and high body dissatisfaction endorsed the importance of being thin and more disordered eating behaviours (Ferreira, Pinto-Gouveia, & Duarte, 2011). Given the comorbidity between obesity and eating disorders, the role of body image flexibility in obesity deserves further investigation.

The purpose of the present studies was to pilot a PPI for weight management (see Chapter 4 for details about the PPI design and development), and assess its effectiveness on well-being (with additional measures of symptoms of depression and anxiety in the second pilot study), body-image flexibility and weight loss. Since high levels of motivation have been considered a critical necessity for many weight loss programs (Dixon, Laurie, Anderson et al., 2009), the present studies also assessed the relationship between readiness to change and the intervention outcomes.

It was hypothesized that there would be a significant effect of the PPI on the participants’ overall well-being and body-image flexibility, which would be related to their readiness to change prior commencing the intervention. After adding measures of depression
and anxiety in the second pilot study, it was expected that the levels of depression and anxiety would drop significantly after the PPI. Although, the intervention did not incorporate any dietary advice or nutritional education, it was expected that weight loss may occur as a by-product in response to the PPI, and as a result of improvement in mediational factors linked to health behaviours, as described in Chapter 4.
6.2. Pilot Study I.

6.2.1. Material and methods

Design and recruitment

The present study used a quasi-experimental within-subjects research design employing a 6-week PPI for weight management. For the first pilot study, convenience sampling was used to recruit student participants from the University of Bolton. The target number of participants was set to be 40 with reference to the number of samples needed for a successful RT-qPCR (see Chapter 3 for details). The standard calculation of required sample size (Kadam & Bhalerao, 2010) was not used, as this was not a clinical trial. Students from different departments were approached via email (with the approval of the Head of the Department), at the beginning or at the end of their lectures (with an approval of the Head of the Department and the lecturing tutors), and in person in the university public areas. Additionally, advertisements were placed around the campus with the agreement of the Head of Facilities. However, despite the use of various methods, it proved incredibly difficult to recruit a sufficient number of participants, who would be willing to commit their time for the six weeks. The recruitment was therefore opened to the University members of staff, some of whom did not have any weight problems, but wanted to join the intervention in order to improve their overall well-being. Because of the recruitment difficulties, the requirements for participation had to be re-defined; even though, the study was opened primarily to overweight or obese individuals, people with normal weight were not excluded, if they wished to take part. However, their weight change could not be considered as relevant to the obesity-related scope of this research,
even though their data were included in the study evaluation (see the results section for details). The subjects were offered no incentive for their participation.

Participants

The participants were a mix of students and staff members recruited from the University of Bolton. Twenty two participants, three males and 19 females, completed the initial assessment but only 15 attended at least one session of the PPI. The data were analysed for 14 participants \((n = 14)\), two males and 12 females, who all attended at least half of the PPI sessions and completed both, pre- and post-intervention assessments. Out of these, nine were students and five members of staff. The majority of the participants were aged between 41 and 50 years, three subjects were aged between 20 and 30 years, one between 51 and 60 years, and one participant was over 60 years old. Twelve subjects identified themselves as “white British” or “white other”, two participants were of “Asian/Asian British” background. Out of the 14, nine participants were classed as overweight or obese \((\text{BMI} > 25 \text{ kg/m}^2)\), and five were within the normal weight range \((\text{BMI} \text{ between } 18.5 \text{ and } 25 \text{ kg/m}^2)\).

Measures

A study information sheet and consent form (Appendix G) was distributed, and signed consent forms were collected prior to initial assessment. A set of self-report questionnaires including a demographic information sheet (Appendix H) were then used to carry out psychological assessment before and after the intervention. Pre and post intervention measurements of the participants’ weight and height were taken individually using the facilities in the Department of Health at the University of Bolton. Their BMI was calculated using the standard equation: \(\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2}\). The demographic information collected included age, gender, ethnicity, nationality, marital status, children, education and
employment. The psychological assessments consisted of three reliable, validated scales which were chosen for their ease of application:

**The Change Questionnaire.**

The Change Questionnaire (Miller & Johnson, 2008) is a brief 12-item measure of motivation for change, using common dimensions of natural language (language that is used by clients to describe their own motivation). In particular, the measure covers six sub-dimensions of change language (i.e. Desire, Ability, Reasons, Need, and Commitment to change, and Taking steps toward change) with two items per dimension. However, only total score is calculated by adding all 12 items together. Each item is rated on a 11-point Likert scale ranging from 0 (“Definitely not”) to 10 (“Definitely”), indicating agreement with each of the 12 statements. Total score ranges from 0 to 110 with the higher scores indicating higher motivation to change. The questionnaire is designed in a way that each individual relates their readiness to change to a particular change of their choice. In the present studies participants were told that this change could, but did not have to be related to weight loss/body shape. Total scores were calculated for each participant. Based on the analysis of the present study, the scale showed high internal consistency determined by a Cronbach’s $\alpha$ of 0.92.

**The PERMA scale.**

Well-being as a multidimensional construct in positive education, was measured using Seligman’s PERMA model of “flourishing” (Seligman, 2011). PERMA is an acronym that makes up five important building blocks of flourishing: (1) **Positive emotions**, (2) **Engagement**, (3) **Relationships**, (4) **Meaning**, and (5) **Accomplishment**. It is proposed that subjective happiness and psychological well-being can be increased by focusing on combinations of feeling good, living meaningfully, establishing supportive and friendly relationships,
The PERMA Questionnaire is a 23-item measure of flourishing with five basic dimensions (subscales): positive emotions (items 5, 10, 22), engagement (items 3, 11, 21), relationships (items 6, 15, 19), meaning (items 1, 9, 17), and accomplishment (items 2, 8, 16). Further scores are achieved on negative affect (items 7, 14, 20), loneliness (item 12), physical health (items 4, 13, 18) and happiness (item 23). Each question is scored using an 11-point Likert scale varying from 0 (“Never”/”Not at all”) to 10 (“Excellent”/”Completely”/”Always”). A total flourishing score is achieved by adding the scores from all five subscales, and items in physical health and happiness subdomains, and reverse-scored items in negative affect and loneliness subdomains. The scale has been shown to have good validity in a sample of Australian students ($n = 516$) (Kern et al., 2015). In the present study, Cronbach's alpha of the measure was .91.

**The Body Image Acceptance and Action Questionnaire.**

The Body Image Acceptance and Action Questionnaire (BI-AAQ; Sandoz et al., 2013) is a 12-item scale designed to measure psychological flexibility in the context of body dissatisfaction. The BI-AAQ includes items adapted from the original Acceptance and Action Questionnaire (AAQ; Bond & Bruce, 2003; Bond, Hayes, Baer et al., 2011; Hayes, Strosahl, Wilson et al., 2004), but these items focus on body image issues related to weight and shape and the extent to which the participants' attempts to control and avoid these negative private events and the extent to which body dissatisfaction interfere their daily functioning. Participants are asked to rate to what degree each statement applies to them using a 7-point Likert-like scale, ranging from 1 (“Never true”) to 7 (“Always true”). All items are reversed, so higher scores on this measure indicate lower body image acceptance and flexibility. Possible scores range from 7 to 84. The scale has been shown to have an adequate internal consistency with a Cronbach’s alpha coefficient of .93. The measure also demonstrated good construct validity in an undergraduate sample ($n = 183$) and good concurrent validity with measures.
PILOT STUDIES – PILOT STUDY I.

of mindfulness and acceptance as well as self-report measures of disordered eating behaviour and body image concerns (Sandoz et al., 2013). Additionally, the BI-AAQ has been able to successfully discriminate between patients with eating disorders and a convenience sample (Ferreira et al., 2011). In the present study, Cronbach's alpha of the measure was .96.

Procedure

One month was allowed for recruitment of participants. They were approached in a number of different ways, including distribution of leaflets across the university campus, all student/staff emails, presentations in lectures and one-to-one approaches. The research with all recruitment strategies was approved by the University of Bolton Ethics Committee based on the British Psychological Society (BPS) guidelines (BPS, 2014; see Appendix I for the original Ethics approval with all additions for the subsequent studies). All student/staff emails were sent out with a written agreement from the Heads of Departments and Heads of Schools. Students were approached in their lectures with an agreement from the Head of School and the lecturing tutor(s). Prior-intervention meetings were scheduled for all individuals, who expressed their initial interest and a desire to participate in the study. They were informed about the study requirements and expectations, as well as their rights as participants, and the structure of the PPI. Based on that information, they could then decide to sign the consent form. An individual assessment was carried out one week before the start of the intervention. Each participant was given a time slot for their assessment, where they completed the psychological questionnaires and their height and weight measurements were taken. The same procedure was repeated for the post-intervention assessments one week after the end of the intervention. The researcher explained the questions to the participants and/or read it out loud to them, if they
PILOT STUDIES – PILOT STUDY I.

did not understand it, ensuring reliability of the responses. Participants were given as much
time as they needed to complete the questionnaires.

After the initial assessment participants took part in a 6-week PPI for weight
management, which combined experiential group work with online learning (see Chapter 4 for
details on structure and design of the PPI). The researcher kept a reflective diary throughout
the process (see Appendix E). Upon completion, all participants received a Certificate of
Award confirming their participation in a 6-week PPI for weight management.

Data from the three measures together with participant demographic information were
inputted into IBM SPSS Statistics 23 software and a series of tests were carried out. All scales
met the assumptions for parametric testing. Paired samples t-tests were carried out to determine
significance from the time before to the time after the intervention, and sets of Pearson’s r
correlations were used to assess relationship between the participants’ readiness to change and
the intervention outcome. Further linear regression was conducted to assess the ability of the
pre-intervention scores on well-being and body image flexibility to predict readiness to change,
and the ability of readiness to change to predict the intervention outcome on both measures.
Weight was assessed before and after the intervention using facilities in the Department of
Health at the University of Bolton. Final data analysis included only those participants who
attended at least half of the group sessions.

6.2.2. Results

A paired-samples t-test was conducted to evaluate the impact of the intervention on the
participants’ well-being (PERMATotal) and body image flexibility (BIAAQTotal).
PILOT STUDIES – PILOT STUDY I.

There was a statistically significant increase in PERMATotal scores from the time before the intervention (PERMATotalA, $M = 156, SD = 13.86$) to the time after the intervention (PERMATotalB, $M = 166, SD = 20.89$), $t(13) = -2.693, p = .018$ (two-tailed). The eta squared statistic (.36) indicated a large effect size of the PPI on the participants’ overall well-being. Additionally, there was a significant increase in the scores on the positive emotions subscale (PERMAPositiveEmotion) from the time before the intervention (PERMAPositiveEmotionA, $M = 20.93, SD = 2.5$) to the time after the intervention (PERMAPositiveEmotionB, $M = 22.5, SD = 3.5$), $t(13) = -2.44, p = .03$ (two-tailed). The eta squared statistic (.31) indicated a large effect size of the PPI on the participants’ positive emotions. There was also a significant increase in the scores on the health subscale (PERMAHealth) from the time before the intervention (PERMAHealthA, $M = 18.29, SD = 5.98$) to the time after the intervention (PERMAHealthB, $M = 20.07, SD = 5.77$), $t(13) = -2.358, p = .035$ (two-tailed). The eta squared statistic (.30) indicated a large effect size of the PPI on the participants’ perception of their health. There was a difference in another PERMA subscale indicating the happiness level (PERMAHappiness), which was just above the level of significance. The participants’ happiness increased from the time before the intervention (PERMAHappinessA, $M = 7.5, SD = .76$) to the time after the intervention (PERMAHappinessB, $M = 8.07, SD = 1.14$), $t(13) = -2.104, p = .055$ (two-tailed). The eta squared statistic (.25) indicated a large effect size of the PPI on the participants’ happiness. No significant effect of the PPI was observed on any other PERMA subscales. Neither was there any significant change in the participants’ body image flexibility (BIAAQTotal) (Table 6.1.).
PILOT STUDIES – PILOT STUDY I.

Table 6.1. Paired-samples T-test analysis of the effect of the PPI on well-being and body-image flexibility (pilot study I.).

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PERMATotalA &amp; PERMATotalB</td>
<td>-10.000</td>
<td>13.89</td>
<td>-2.693*</td>
<td>13</td>
<td>.018</td>
<td>.36</td>
</tr>
<tr>
<td>3. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-.071</td>
<td>2.40</td>
<td>-.111</td>
<td>13</td>
<td>.391</td>
<td>.00</td>
</tr>
<tr>
<td>4. PERMARelationshipA &amp; PERMARelationshipB</td>
<td>-.857</td>
<td>2.25</td>
<td>-1.426</td>
<td>13</td>
<td>.281</td>
<td>.14</td>
</tr>
<tr>
<td>5. PERMAMeaningA &amp; PERMAMeaningB</td>
<td>-.929</td>
<td>2.53</td>
<td>-1.376</td>
<td>13</td>
<td>.192</td>
<td>.13</td>
</tr>
<tr>
<td>6. PERMAAccomplishmentA &amp; PERMAAccomplishmentB</td>
<td>-1.786</td>
<td>3.64</td>
<td>-1.835</td>
<td>13</td>
<td>.089</td>
<td>.21</td>
</tr>
<tr>
<td>7. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>1.357</td>
<td>3.08</td>
<td>1.649</td>
<td>13</td>
<td>.123</td>
<td>.17</td>
</tr>
<tr>
<td>8. PERMANegativeEmotionA &amp; PERMANegativeEmotionB</td>
<td>.357</td>
<td>3.43</td>
<td>.389</td>
<td>13</td>
<td>.703</td>
<td>.01</td>
</tr>
<tr>
<td>10. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-.571</td>
<td>1.02</td>
<td>-2.104</td>
<td>13</td>
<td>.055</td>
<td>.25</td>
</tr>
<tr>
<td>11. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>3.571</td>
<td>8.43</td>
<td>1.586</td>
<td>13</td>
<td>.137</td>
<td>.16</td>
</tr>
</tbody>
</table>

*p<.05 (2-tailed); After applying the Bonferroni correction, the adjusted value of p = .004. If this very stringent criterion is applied, none of the above results reaches significance.
Pearson’s $r$ correlation was used to assess the relationship between the participants’ determination to change (as measured by the CHANGETotal) and their well-being (PERMATotal) and body image flexibility (BIAAQTotal). (see Table 6.2. for details.) For the purpose of comparison the correlation was assessed before (PERMATotalA; BIAAQTotalA) and after (PERMATotalB; BIAAQTotalB) the PPI. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. There was a significant positive correlation between determination to change (CHANGETotal) and body image flexibility before the PPI (BIAAQTotalA), $r = .542, n = 14, p = .045$ (two-tailed). This correlation became nonsignificant after the intervention (BIAAQTotalB). There was no significant correlation between the participants’ determination to change (CHANGETotal) and their well-being before (PERMATotalA) or after (PERMATotalB) the PPI.

**Table 6.2.** Pearson product-moment correlations between measures of readiness to change and well-being and body-image flexibility before and after the intervention (pilot study I.).

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.CHANGETotal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.PERMATotalA</td>
<td>-.056</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.PERMATotalB</td>
<td>.299</td>
<td>.752**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.BIAAQTotalA</td>
<td>.542*</td>
<td>.088</td>
<td>.064</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5.BIAAQTotalB</td>
<td>.493</td>
<td>-.030</td>
<td>-.097</td>
<td>.828***</td>
<td>1</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01, ***p<.001 (2-tailed)

Given the correlation matrix, an additional linear regression was performed to assess the ability of body image flexibility before the PPI (BIAAQTotalA) to predict the participants’ determination to change (CHANGETotal). Preliminary analyses confirmed that the
PILOT STUDIES – PILOT STUDY I.

assumptions of normality, linearity, multicollinearity and homoscedasticity were not violated. Body image flexibility explained 29.4% of variance in determination to change (\(R = .542, R^2 = .294\)), suggesting a good degree of prediction, \(F (1, 12) = 4.99, p = .045\).

In addition to the mental health improvement, seven participants lost between 1 and 5 kg of body weight after undertaking the 6-week PPI and one participant achieved their desired weight gain of 1kg (Table 6.3.).
### Table 6.3. Participant characteristics and weight data before and after the PPI (pilot study I.).

<table>
<thead>
<tr>
<th>Participant no.</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Weight (kg) before</th>
<th>Weight (kg) after</th>
<th>BMI (kg/m²) before</th>
<th>BMI (kg/m²) after</th>
<th>Weight change (+/-/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
<td>Female</td>
<td>92</td>
<td>94</td>
<td>37.8</td>
<td>38.6</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>Female</td>
<td>75</td>
<td>72</td>
<td>28.2</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>52</td>
<td>Male</td>
<td>82</td>
<td>82</td>
<td>23.9</td>
<td>23.9</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>Female</td>
<td>56</td>
<td>56</td>
<td>22.2</td>
<td>22.2</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>46</td>
<td>Female</td>
<td>61</td>
<td>62*</td>
<td>22.1</td>
<td>22.5</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>48</td>
<td>Female</td>
<td>65</td>
<td>62</td>
<td>26.7</td>
<td>25.4</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
<td>Female</td>
<td>80</td>
<td>75</td>
<td>32.9</td>
<td>31.2</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>42</td>
<td>Female</td>
<td>115</td>
<td>116</td>
<td>38</td>
<td>38.8</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>64</td>
<td>Female</td>
<td>64</td>
<td>63</td>
<td>24.7</td>
<td>23.7</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>49</td>
<td>Female</td>
<td>79</td>
<td>76</td>
<td>31.6</td>
<td>31.2</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>21</td>
<td>Female</td>
<td>66</td>
<td>66</td>
<td>27.8</td>
<td>27.8</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>45</td>
<td>Male</td>
<td>90</td>
<td>87</td>
<td>27.7</td>
<td>26.8</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>20</td>
<td>Female</td>
<td>63</td>
<td>61</td>
<td>22.3</td>
<td>21.6</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>41</td>
<td>Female</td>
<td>82</td>
<td>82</td>
<td>36.4</td>
<td>36.4</td>
<td>0</td>
</tr>
</tbody>
</table>

*desired weight gain
6.3. Pilot Study II.

6.3.1. Material and methods

Design and recruitment

The second pilot study used the same quasi-experimental within-subjects research design employing a 6-week PPI for weight management. Because of the recruitment difficulties during the first pilot study, a different approach needed to be used in the second pilot study in order to increase the final number of participants. The researcher prepared a proposal to the Dean of the School of Education and Psychology suggesting to incorporate the PPI into the Introduction to Counselling Concepts module delivered to the first year Psychology, Psychotherapy, and Counselling students. She proposed that as the PPI used experiential group work, it would be a unique opportunity for the students to learn about counselling and psychotherapy through experience, yet in a safe educational environment. Additionally, this was an opportunity for the students to learn about the new developing field of positive psychotherapy, and explore potential options of their future career. The use of the PPI within teaching was approved by the Dean of the Faculty, and it was incorporated into the Introduction to Counselling Concepts module; the group sessions were delivered on Tuesdays during the times of the module workshops, as per the students’ timetable, and the PowerPoint presentations forming the online part of the intervention were uploaded on the university e-learning portal, Moodle, every Monday, Wednesday, and Friday. In the morning, all students received an email reminder to log-in to their Moodle account and view the presentation for the day. As the university requires all of its students to regularly engage in Moodle activities set by their tutors, the online part of the intervention could be well used to cover this requirement.
PILOT STUDIES – PILOT STUDY II.

The reason, why the PPI in this study was delivered within teaching was, because in the first pilot study it has proven very difficult to recruit sufficient number of overweight or obese participants who could commit their time for 6 weeks. While there was no guarantee of overweight or obese participants in this study, it was assumed that given the current statistics of overweight and obesity in England, there would still be sufficient number of students with weight problems enrolled on the module. As expected, 68% of the student sample (17 out of 25 subjects) fitted the criteria for overweight or obesity according to their BMI (for weight and BMI data, see the results section).

As all the PPI group sessions ran during the exact times of the students’ scheduled classes, they had to attend them in order to pass the module. However, their participation in the actual research, and submission of their data was completely voluntary. Should there be anyone, who would struggle with the actual group setting and the way the PPI was delivered, they were going to be offered individual study support by their tutor in order to pass the module requirements related to the PPI assessment without having to attend the group sessions. Most of the students (n = 24) agreed to take part in the study. The subjects were offered no incentive for their participation.

Participants

The participants were first year students of Psychology, Psychotherapy and Counselling at the University of Bolton. There were 30 students enrolled on the module, of which 24 agreed to take part in the study (n = 24). The majority of participants were aged between 20 and 30 years. Eight participants were younger than 20 years, two participants were aged between 31 and 40 years and one was within the 41-50 years range. Nineteen subjects identified themselves as “white British”, three as “Black/African/Carribean/Black British”, one participant was “Asian/Asian British” and one was of “Mixed” ethnic background. Out of the 24, five
participants were classed as overweight (BMI between 25 and 29.9 kg/m²), six were classed as obese (BMI between 30 and 39.9 kg/m²), four were classed as morbidly obese (BMI >40 kg/m²), and nine participants were within the normal weight range (BMI between 18.5 and 25 kg/m²).

The assessment in this study was carried out with two additional measures: Generalised Anxiety Disorder 7-item scale (GAD7; Spitzer, Kroenke, Williams & Löwe, 2006), and Patient Health Questionnaire 9-item scale (PHQ9; Kroenke, Spitzer & Williams, 2001; see the following section for details). Out of the 24, six participants scored above the cut-off point of 10 on the GAD7 identifying moderate anxiety and a further six individuals scored above 15 identifying severe anxiety before the PPI. On the PHQ9, six participants scored between 15 and 19 identifying moderately-severe depression and four scores were above 20 identifying severe depression before the PPI.

**Measures**

In addition to the questionnaires used in the first pilot study (see section 6.2.1. of this chapter), GAD7 and PHQ9 were used in this study to carry out psychological assessment before and after the intervention (Appendix J). These were also used in the main trial (Chapter 7). The reason for this was to assess symptoms of depression and anxiety in university students, who are increasingly more vulnerable to mental health problems (Nerdrum, Rustøen, Rønnestad, 2006; Stanley & Manthorpe, 2001; Stewart-Brown, Evans, Patterson et al., 2000), with increased rates particularly in psychology undergraduate students (Peluso, Carleton & Asmundson, 2011). As positive psychology has been successfully applied to a number of mental health problems, including depression and anxiety (e.g. Layous & Lyubomirsky, 2014; Sin & Lyubomirsky, 2009), it was concluded that it would be beneficial to assess the effects of the PPI on the students’ mental health. The GAD7 and PHQ9 were selected for their ease of
PILOT STUDIES – PILOT STUDY II.

application. As in the first pilot study, the participants’ weight and height were taken individually before and after the intervention using the same facilities in the Department of Health at the University of Bolton. Their BMI was calculated using the standard equation: BMI = weight (kg)/height (m)².

*Generalised Anxiety Disorder 7-item scale.*

The generalized anxiety disorder seven-item scale (GAD7) was validated in 2,740 primary care patients (Spitzer et al., 2006). The GAD7 has good sensitivity and specificity for a range of anxiety disorders: panic disorder (S=0.74, Sp=0.81), social anxiety disorder (S=0.72, Sp=0.82), generalized anxiety disorder (S=0.89, Sp=0.82) and post-traumatic stress disorder (S=0.66, Sp=0.91) (Kroenke, Spitzer, Williams, Monahan & Löwe, 2007). All seven items of the scale refer to the frequency of experiencing the feelings of anxiety over the past 2 weeks. Each of the seven items on the GAD7 is scored between 0 and 3 (0 – “Not at all”, 1 – “Several days”, 2 – “Over half the days”, 3 – “Nearly every day”). All scores are summed up to generate a total score ranging from 0 to 21. The GAD7 severity cut-off point scores are 5 for mild, 10 for moderate, and 15 for severe anxiety.

*Patient Health Questionnaire 9-item scale.*

The Patient Health Questionnaire-9 (PHQ9) is a nine-item scale developed to measure depression and its severity (Kroenke et al., 2001). It has been tested for validity and reliability in a range of languages and it has been validated for use in a variety of populations showing good sensitivity and specificity (Cassin, Sockalingam, Hawa et al., 2013). It has also been shown to have excellent internal reliability (Cronbach’s α 0.86-0.89). All nine items of the scale refer to the frequency of experiencing depressing feelings or thoughts over the past 2 weeks. Each of the nine items on the PHQ9 is scored between 0 and 3 (0 – “Not at all”, 1 – “Several days”, 2 – “More than half the days”, 3 – “Nearly every day”). All scores are summed
PILOT STUDIES – PILOT STUDY II.

up to generate a total score ranging from 0 to 27. PHQ9 severity cut-off point scores are 5 for mild, 10 for moderate, 15 for moderately severe and 20 for severe depressive symptoms.

**Procedure**

The participants were recruited during the first introductory session to the module. They received an overview of the module, and it was explained that the reason why the PPI was incorporated into the module was because it offered a unique opportunity to learn about counselling and psychotherapy through experience, which was considered as relevant and beneficial by the module leader, as well as the Dean of the Faculty. They were told that they had to attend all the workshop sessions involving the PPI and complete the exercises in order to pass the module, but they did not have to participate in the actual research itself; that is, they did not have to undertake any of the assessments or submit any of their data for research purposes. Those students who wished to take part were informed about the study requirements and expectations, as well as their rights as participants, and the structure of the PPI. Questionnaires were distributed and completed during the module introductory session, after all students who agreed to participate in the research read the study information sheet, and signed their consent forms. Their height and weight measurements were taken individually after the end of the introductory session. The same procedure was repeated for the post-intervention assessments one week after the end of the intervention.

For the purpose of the afternoon workshops during which the intervention ran, the students were split into two groups: one attended the 6 week-PPI, while the other group watched *In Treatment* videos of therapeutic sessions with patients. After the 6 weeks (half

---

9 *In Treatment* is an American HBO drama, produced and developed by Rodrigo Garcia, about a psychologist, and his weekly sessions with patients. Each episode of *In Treatment* focuses on one patient, including the psychologist himself, who is seeing his clinical supervisor and psychotherapist.
PILOT STUDIES – PILOT STUDY II.

way through the term) both groups swapped. There was no control group in this study, as the intervention first needed to be piloted in the new (educational) settings.

The first group session was scheduled for the second teaching week (week following the introductory session during which all the prior-intervention assessments were taken). However, the students were informed that they would be receiving the online part of the intervention (PowerPoints with self-help exercises) from the following day (Wednesday). Every Wednesday, Friday, and Monday they would receive a “welcome-to-new-day” email prompting them to log-in to their Moodle accounts to view the presentation for the day (see Appendix K for all of the email messages sent over the 6 weeks of the intervention). Every Tuesday afternoon during the module workshops, they would then gather for the group session and conclude each week of the PPI. The researcher kept a reflective diary throughout the process (see Appendix E). Upon completion, all participants received a Certificate of Award confirming their participation in a 6-week PPI for weight management.

The procedure of data analysis for the same as in the first pilot study (see section 6.2.1. above).

6.3.2. Results

A paired-samples t-test was conducted to evaluate the impact of the intervention on the participants’ well-being (PERMATotal), body image flexibility (BIAAQTotal), anxiety (GAD7Total) and depression (PHQ9Total).

As in pilot study I., there was a statistically significant increase in PERMATotal scores from the time before the intervention (PERMATotalA, $M = 141.5, SD = 30.37$) to the time after the intervention (PERMATotalB, $M = 159.67, SD = 26.65$), $t (23) = -4.330, p < .001$ (two-tailed). The eta squared statistic (.45) indicated a large effect size of the PPI on the participants’ overall well-being. There were also significant increases in the scores on another six of the
PILOT STUDIES – PILOT STUDY II.

PERMA subscales: positive emotions, relationships, meaning, accomplishment, health, and happiness; all with large effect sizes (Table 6.4.). Additionally, there was an increase on the engagement scores from the time before the intervention (PERMAEngagementA, $M = 22$, $SD = 4.41$) to the time after the intervention (PERMAEngagementB, $M = 23.33$, $SD = 3.34$) which was just above the level of significance ($t (23) = -2.042$, $p = .053$) but with a large effect size (eta squared = .15). There was no significant difference in the loneliness and negative emotions subscales of the PERMA measure.

Unlike in the pilot study I., there was a significant decrease in BIAAQTotal scores, indicating an increase in body-image flexibility, from the time before the intervention (BIAAQTotalA, $M = 51.79$, $SD = 20.22$) to the time after the intervention (BIAAQTotalB, $M = 45.13$, $SD = 19.90$), $t (23) = 3.282$, $p = .003$ (two-tailed) with the eta squared statistic (.32) indicating a large effect size. In addition, a significant decrease was observed on both, anxiety and depression measures. Anxiety before the intervention (GAD7TotalA, $M = 10.79$, $SD = 5.79$) decreased after the intervention (GAD7TotalB, $M = 8.04$, $SD = 5.06$), $t (23) = 2.343$, $p = .028$ (two-tailed) with large effect size (eta squared = .19). Depression before the intervention (PHQ9TotalA, $M = 12.88$, $SD = 6.45$) decreased after the intervention (PHQ9TotalB, $M = 9.92$, $SD = 7.08$), $t (23) = 3.356$, $p = .003$ (two-tailed) with large effect size (eta squared = .33) (Table 6.4.).
Table 6.4. Paired-samples T-test analysis of the effect of the PPI on well-being, body-image flexibility, anxiety and depression (pilot study II.).

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>(\eta^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PERMATotalA &amp; PERMATotalB</td>
<td>-18.167</td>
<td>20.55</td>
<td>-4.330**</td>
<td>23</td>
<td>&lt;.001</td>
<td>.45</td>
</tr>
<tr>
<td>2. PERMAPositiveEmotionA &amp; PERMAPositiveEmotionB</td>
<td>-5.042</td>
<td>6.22</td>
<td>-3.973**</td>
<td>23</td>
<td>&lt;.001</td>
<td>.41</td>
</tr>
<tr>
<td>3. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-7.08</td>
<td>3.18</td>
<td>-1.090</td>
<td>23</td>
<td>.053</td>
<td>.05</td>
</tr>
<tr>
<td>4. PERMARElationshipA &amp; PERMARElationshipB</td>
<td>-1.333</td>
<td>2.99</td>
<td>-2.186*</td>
<td>23</td>
<td>.026</td>
<td>.17</td>
</tr>
<tr>
<td>5. PERMAMeaningA &amp; PERMAMeaningB</td>
<td>-2.625</td>
<td>3.77</td>
<td>-3.397*</td>
<td>23</td>
<td>.002</td>
<td>.33</td>
</tr>
<tr>
<td>6. PERMAAccomplishmentA &amp; PERMAAccomplishmentB</td>
<td>-2.917</td>
<td>3.93</td>
<td>-3.633**</td>
<td>23</td>
<td>.001</td>
<td>.50</td>
</tr>
<tr>
<td>7. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>.917</td>
<td>2.92</td>
<td>1.539</td>
<td>23</td>
<td>.137</td>
<td>.09</td>
</tr>
<tr>
<td>10. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-1.000</td>
<td>1.53</td>
<td>-3.197*</td>
<td>23</td>
<td>.004</td>
<td>.31</td>
</tr>
<tr>
<td>11. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>6.667</td>
<td>9.95</td>
<td>3.282*</td>
<td>23</td>
<td>.003</td>
<td>.32</td>
</tr>
<tr>
<td>12. GAD7TotalA &amp; GAD7TotalB</td>
<td>2.750</td>
<td>5.75</td>
<td>2.343*</td>
<td>23</td>
<td>.028</td>
<td>.19</td>
</tr>
<tr>
<td>13. PHQ9TotalA &amp; PHQ9TotalB</td>
<td>2.958</td>
<td>4.32</td>
<td>3.356*</td>
<td>23</td>
<td>.003</td>
<td>.33</td>
</tr>
</tbody>
</table>

*p<.05, **p</.001 (2-tailed); After applying the Bonferroni correction, the adjusted value of \(p = .0038\). Even after applying this stringent criterion, six out of the 13 comparisons (PERMATotal, PERMAPositiveEmotion, PERMAMeaning, PERMAAccomplishment, BIAAQTotal, and PHQ9Total) remain significant.
Pearson’s $r$ correlation was used to assess the relationship between the participants’ determination to change (as measured by the CHANGETotal) and their well-being (PERMATotal), body image flexibility (BIAAQTotal), anxiety (GAD7Total) and depression (PHQ9Total) (see Table 6.5. for details). The correlation was assessed before (PERMATotalA; BIAAQTotalA; GAD7TotalA; PHQ9TotalA) and after (PERMATotalB; BIAAQTotalB; GAD7TotalB; PHQ9TotalB) the PPI. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. The determination to change (CHANGETotal) correlated significantly positively with the PERMATotal scores before (PERMATotalA), $r = .445, n = 24, p = .029$ and after the PPI (PERMATotalB), $r = .621, n = 24, p = .001$. It correlated significantly negatively with the PHQ9Total scores before (PHQ9TotalA), $r = -.608, n = 24, p = .002$ and after the PPI (PHQ9TotalB), $r = -.552, n = 24, p = .005$. Significant negative correlation was also found with the anxiety scores after the intervention (GAD7TotalB), $r = -.548, n = 24, p = .006$ but not before. Unlike in pilot study I., there was no significant correlation between the determination to change and body-image flexibility at any time.

Given the correlation matrix, an additional set of linear regression analyses was performed to assess the ability of the participants’ determination to change (CHANGETotal) to predict the intervention outcome on well-being (PERMATotalB), anxiety (GAD7TotalB), and depression (PHQ9TotalB). Preliminary analyses confirmed that the assumptions of normality, linearity, multicollinearity and homoscedasticity were not violated. Readiness to change explained 38.6% of variance in well-being scores after the intervention ($R = .621, R^2 = .386$), suggesting a good degree of prediction, $F (1, 22) = 13.83, p = .001$. It also explained 30.1% of variance in anxiety scores after the intervention ($R = .548, R^2 = .301$), suggesting a good degree of prediction, $F (1, 22) = 9.46, p = .006$. Readiness to change could also be used
to predict the intervention outcome on depression, $F (1, 22) = 9.63, p = .005$, explaining 30.4\% of variance in depression scores after the intervention ($R = .552, R^2 = .304$).

In addition to the improvements in mental health and well-being, 5 participants lost between 1 and 5 kg of body weight after undertaking the 6-week PPI and 2 participants achieved their desired weight gain of 1kg (Table 6.6.).
PILOT STUDIES – PILOT STUDY II.

**Table 6.5.** Pearson product-moment correlations between measures of readiness to change and well-being and body-image flexibility and anxiety and depression before and after the intervention (pilot study II.).

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.CHANGETotal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.PERMATotalA</td>
<td>.445*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.PERMATotalB</td>
<td>.621***</td>
<td>.748***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.BIAAQTotalA</td>
<td>-.116</td>
<td>-.444*</td>
<td>-.511*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.BIAAQTotalB</td>
<td>-.157</td>
<td>-.292</td>
<td>-.488*</td>
<td>.877***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.GAD7TotalA</td>
<td>-.296</td>
<td>-.800***</td>
<td>-.540**</td>
<td>.250</td>
<td>.104</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.GAD7TotalB</td>
<td>-.548**</td>
<td>-.462*</td>
<td>-.610**</td>
<td>.308</td>
<td>.394</td>
<td>.445*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.PHQ9TotalA</td>
<td>-.608**</td>
<td>-.785***</td>
<td>-.756***</td>
<td>.426*</td>
<td>.385</td>
<td>.752***</td>
<td>.658***</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9.PHQ9TotalB</td>
<td>-.552**</td>
<td>-.528**</td>
<td>-.694***</td>
<td>.411*</td>
<td>.526**</td>
<td>.468*</td>
<td>.899***</td>
<td>.800***</td>
<td>1</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01, ***p<.001 (2-tailed)
### PILOT STUDIES – PILOT STUDY II.

<table>
<thead>
<tr>
<th>Participant no.</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Weight (kg) before</th>
<th>Weight (kg) after</th>
<th>BMI (kg/m²) before</th>
<th>BMI (kg/m²) after</th>
<th>Weight change (+/-/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>Female</td>
<td>106</td>
<td>106</td>
<td>35.2</td>
<td>35.2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>Female</td>
<td>74</td>
<td>74</td>
<td>28.7</td>
<td>28.7</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>32</td>
<td>Male</td>
<td>98</td>
<td>97</td>
<td>35.7</td>
<td>35.4</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>Female</td>
<td>125</td>
<td>128</td>
<td>42.3</td>
<td>43.3</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>Female</td>
<td>79</td>
<td>78</td>
<td>26.2</td>
<td>25.9</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>Female</td>
<td>84</td>
<td>85</td>
<td>32.2</td>
<td>32.6</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>Female</td>
<td>84</td>
<td>85</td>
<td>32.4</td>
<td>32.8</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>22</td>
<td>Female</td>
<td>79</td>
<td>80</td>
<td>28.8</td>
<td>29.2</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>Female</td>
<td>122</td>
<td>126</td>
<td>42.2</td>
<td>43.6</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>Female</td>
<td>51</td>
<td>55</td>
<td>20.4</td>
<td>22</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>18</td>
<td>Female</td>
<td>70</td>
<td>71</td>
<td>26.7</td>
<td>27</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>Male</td>
<td>88</td>
<td>83</td>
<td>29.7</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>23</td>
<td>Female (pregnant)</td>
<td>86</td>
<td>95</td>
<td>34.9</td>
<td>38.5</td>
<td>+</td>
</tr>
</tbody>
</table>
Table 6.6. Participant characteristics and weight data before and after the PPI (pilot study II.).

*desired weight gain. Unlike in the first pilot study, while five participants lost weight, 11 gained.
6.4. Discussion

The purpose of the present studies was to pilot the PPI for weight management, and assess its effectiveness on well-being (with additional measures of symptoms of depression and anxiety in second pilot study), body-image flexibility and weight loss. Since high levels of motivation have been considered a critical necessity for many weight loss programs (Dixon et al., 2009), the present studies also assessed the relationship between readiness to change and the intervention outcomes.

It was hypothesized that there would be a significant effect of the PPI on the participants’ overall well-being and body-image flexibility, which would be related to their readiness to change prior to commencing the intervention. After adding measures of depression and anxiety in the second pilot study, it was expected that the levels of depression and anxiety would drop significantly after the PPI. Although, the intervention did not incorporate any dietary advice or nutritional education, it was expected that weight loss may occur as a by-product in response to the PPI, and as a result of improvement in mediational factors linked to health behaviours (see Chapter 4).

6.4.1. Happiness and well-being

Previous research provides evidence for the effectiveness of positive psychology interventions in terms of enhancement of subjective and psychological well-being (see Bolier at al., 2013b for a review). As expected, after six weeks of the PPI participants demonstrated increased overall well-being in both studies. In the first pilot study the participants’ perception of their health improved and their positive emotions increased. The effects of the PPI were
even greater in the second pilot study. In addition to the improvements of well-being, health and positive emotions, the participants’ scores on relationships, meaning, accomplishment and happiness also increased. All these aspects form an essential part of well-being and if neglected, flourishing cannot be achieved (Seligman, 2011). There was a notable difference between the participants of the two pilot studies in terms of their perception of happiness and well-being throughout the intervention. The first pilot group seemed to have more of “future time perspective” (Zimbardo & Boyd, 1999) from the beginning of the PPI all the way to the end, which might have been the reason why their progress was smaller compared to the second pilot group.

The intervention was delivered to first year university students in the second pilot study, who seemed to be more present-oriented in the beginning, often talking about happiness in terms of finishing their next assignment or passing a driving test. Towards the end, they all seemed to have matured and their growth was apparent mainly when they talked about their hopes, which were mostly future oriented with specific long-term goals. They developed the fundamental skills for making their hopes happen (Lopez, 2014). However, the shift from hedonic to eudaimonic well-being (Ryan & Deci, 2001) was apparent in both studies throughout the six weeks. The participants were more aware of their potential and they were able to see more and different ways of achieving it towards the end of the intervention.

6.4.2. Determination to change in relation to body-image flexibility, depression, anxiety and well-being

Body dissatisfaction and body image flexibility are related to disordered eating behaviour (Hill, Masuda, Moore, & Twohig, 2015), but little is known about the relationship between body image flexibility and readiness to change. The first pilot study findings suggested that low body image flexibility before the intervention is strongly associated with high
readiness to change, and it could be even used to predict readiness to change. It was expected that after the PPI significant positive correlations would become negative, indicating that high readiness to change before would be related to high body image flexibility after the PPI. This was not supported. However, the correlation became insignificant, suggesting some increase in the participants’ body image flexibility in response to the PPI. This suggests that positive psychology may play an important role in the process of individual development and application of adaptive regulation strategies when experiencing body dissatisfaction and engaging in disordered eating. The way individuals interpret, relate and react to difficult private circumstances and experiences contributes to the onset and maintenance of disordered eating and can lead to the development of weight-related issues (Anestis et al., 2007). Individuals with high body-image flexibility are able to experience body dissatisfaction fully and completely but still engage in value-consistent behaviours (Sandoz et al., 2013). In other words, if an individual with high body-image flexibility experiences body dissatisfaction, because they feel that their thighs are too big, they will still be able to control their eating behaviour and choose to eat a balanced diet, because it is consistent with them valuing their body and wanting to be healthy (Hill et al., 2013). This is in line with mindful eating which refers to one’s ability to assess appropriately hunger and satiety cues, the quality of foods craved and consumed and the emotional and cognitive states associated with eating (Dalen et al., 2010). Individuals who eat mindfully are aware and fully in charge of their decisions and actions. Before they choose to consume certain foods they take into consideration where it came from, what nutrients it will give to their bodies, how it will affect their body from the long-term perspective, and whether it is worth it. They will not feel guilty or engage in compensating behaviours after eating a cake because they will know that at that time and in that situation, eating a cake was the right choice. From this perspective, it is possible that engaging in the PPI has motivated the participants to eat more mindfully, which had led to the observed increases in body-image flexibility.
In the second pilot study, however, there was no correlation between the participants’ determination to change and body-image flexibility. Yet, there was a positive correlation between the determination to change and well-being suggesting that the more determined to change the participants were, the better their well-being was. However, this was not the case in the first pilot study. This inconsistency in the pilot findings suggests that the way determination to change affects well-being and body-image flexibility needs further investigation.

Considering the relationship between readiness to change and mental health, in the second pilot study, where measures of depression and anxiety were added, readiness to change was strongly negatively associated with both depression and anxiety, and could be even used to predict the intervention outcome on those two measures. Research has shown that particularly in clinical populations suffering with depression (or populations with a high level of clinical morbidity, in this case), scores on readiness to change could be used to predict treatment outcome (Lewis, Simons, Silva et al., 2009). Regardless of the treatment modality, higher readiness to change scores have been shown to result in better treatment outcomes (Lewis et al., 2009), which was confirmed by the present study findings. Scores on depression were also strongly correlated with the readiness to change at the time before the intervention which was in line with previous research suggesting that severity of depression is associated with greater recognition of the need for change (Myers, van der Westhuizen, Naledi, Stein & Sorsdahl, 2016).

6.4.3. Anxiety and depression

The mental health of university students is an area of increasing concern worldwide (Bayram & Bilgel, 2008; Ibrahim, Kelly, Adams & Glazebrook, 2013). Evidence suggests that university students are vulnerable to mental health problems, especially depression and anxiety.
PILOT STUDIES – DISCUSSION

(Nerdrum et al., 2006; Stanley & Manthorpe, 2001; Stewart-Brown et al., 2000). Since the second pilot study solely used a student population, two additional measures were used to assess the effectiveness of the PPI on the levels of student anxiety and depression. As expected, there was a significant decrease in both, the students’ anxiety and depression after the PPI. But the effect of the intervention was not only statistically but also clinically significant. Before the PPI there were six students who scored above the cut-off point for severe anxiety on the GAD7 questionnaire. Four out of the six dropped down by two cut-off points after the intervention reporting only mild or no anxiety. Before the PPI six students scored between 15 and 19 identifying moderately-severe depression on the PHQ9 and four scores were above 20 identifying severe depression. One out of the four severely depressed students has dropped down by two cut-off points to moderate depression and all out of the six students with moderately-severe depression have moved down by at least one cut-off point to a moderate depression (one student even dropped down to the score range for no depression at all). As a number of previous researchers proposed (e.g. Gander et al., 2016; Sin & Lyubomirsky, 2009), positive psychology clearly helps to ameliorate anxiety and depressive symptoms. In terms of future research, it would be worth assessing the students’ academic performance in relationship to the decreases in their anxiety and depression symptoms, and as a response to the PPI.

6.4.4. Weight loss

In addition to the positive psychological outcomes of the PPI, 12 participants lost significant amounts of weight, and 3 participants achieved their desired weight gain. Having 15 individuals out of 38 achieving their desired weight change without primarily focusing on it, suggested that, as proposed, the PPI may have been able to affect weight loss through improvement in mediational factors linked to health behaviours (Huffman et al., 2015). A number of studies confirm that there is a link between well-being and better physical health.
proposing that this link may be mediated by a healthy lifestyle (Diener & Chan, 2011; Howell et al., 2007; Lamers et al., 2012). Given this perspective, the PPI may have initiated a change in lifestyle in terms of the participants becoming more mindful of their eating habits and physical activity, and thus contributing to their weight loss. This would confirm previous notions about the difference between mindful eating and dieting. Research suggests that consecutive efforts to restrict food intake and follow a reducing diet can paradoxically lead to future weight gain (Lowe et al., 2013). On the other hand, there is growing evidence that not eating mindfully plays an important role in disordered eating (Katterman et al., 2014; Pinto-Gouveia et al., 2017), which largely contributes to weight gain and development of overweight issues. As such, positive psychology may aid weight loss, however, this notion would need to be further explored with appropriate assessment in place.

6.5. Conclusion

The current studies’ findings suggest that the PPI can make an effective contribution to mental health and overall well-being, and it may have an important implications for future weight loss treatment approaches. Positive psychology seems to hold a good potential for increasing body-image flexibility, which is an important factor in body image acceptance and disordered eating pathology (Hill et al., 2015). Significant improvements in the participants’ body-image flexibility in the second pilot study suggest, that positive psychology may not only have implications for weight loss, but it might also contribute to improvements in individual’s perceptions and beliefs about their body. The second pilot study findings have confirmed previous concerns related to the mental health of university students (Bayram & Bilgel, 2008), especially with reference to a growing incidence of clinical levels of anxiety, and depression (Nerdrum et al., 2006; Stanley & Manthorpe, 2001; Stewart-Brown et al., 2000) and low life satisfaction in general (Seligman, Ernst, Gillham, Reivich & Linkins, 2009). The fact that
PILOT STUDIES – DISCUSSION

application of the PPI in class, resulted in significant improvements in the students’ anxiety and depression levels, may present an important argument for incorporation of positive psychological approaches into education. This may also have additional benefits of broadening students’ attention (Bolte, Goschke & Kuhl, 2003; Fredrickson, 1998; 2001; Fredrickson & Branigan, 2005; Kristjánsson, 2012; Rowe, Hirsh, Anderson & Smith, 2007), and enabling more creative thinking (Isen, Daubman & Nowicki, 1987; Estrada, Isen & Young, 1994) and more holistic thinking (Isen, Rosenzweig & Young, 1991; Kuhl, 1983; 2000), which are believed to be conducive to learning. It should be noted that the current studies also had certain limitations which included lack of comparison/control groups, small sample sizes, and use of non-clinical populations. Despite these issues, weight problems were observed in 68% of the student sample in the second pilot study, and based on their scores on the GAD7 and PHQ9 a number of participants were also at the baseline for clinical anxiety and depression. It is recommended to take the current pilot forward to a full study, bearing in mind the limitations identified here.
CHAPTER 7: Randomised Controlled Trial

7.1. Introduction

The use of PPIs may be considered as a complementary strategy in mental health promotion and treatment. Since the publication of Seligman and Csikszentmihaly’s seminal article (Seligman & Csikszentmihaly, 2000), the number of studies applying the principles of positive psychology and flourishing has greatly increased. Many of these studies demonstrated the efficacy of PPIs such as counting your blessings (Emmons & McCullough, 2003; Seligman et al., 2005), practicing kindness (Otake et al., 2006), setting personal goals (Green et al., 2006; Sheldon et al., 2002), expressing gratitude (Seligman et al., 2005; Sheldon & Lyubomirsky, 2006) and using personal strengths (Seligman et al., 2005) to enhance well-being, and, in some cases, to alleviate symptoms of depression (Seligman et al., 2005).

A relatively recent meta-analytical review focusing on PPIs tested in randomised controlled trials with general/non-clinical populations (Bollier et al., 2013b) showed that PPIs indeed can be effective in the enhancement of subjective (Cohen’s $d = 0.34$) and psychological well-being (Cohen’s $d = 0.20$), as well as in helping to reduce depressive symptoms (Cohen’s $d = 0.23$). In most reviewed trials the PPI was delivered using self-help approaches (Abbott, Klein, Hamilton & Rosenthal, 2009; Boehm et al., 2011; Buchanan & Bardi, 2010; Burton & King, 2004; Emmons & McCullough, 2003; Frieswijk, Steverink, Buunk & Slaets, 2006; Gander, Proyer, Ruch, & Wyss, 2013; Goldstein, 2007; Grant, 2012; Hurley & Kwon, 2012; King, 2001; Layous, Nelson & Lyubomirsky, 2013; Luthans, Avey & Patera, 2008; Lyubomirsky et al., 2011; Lyubomirsky, Sousa & Dickerhoof, 2006; Martínez-Martí et al., 2010; Mitchell, Stanimirovic, Klein & Vella-Brodrick, 2009; Mongrain & Anselmo-Matthews, 2012; Mongrain, Chin & Shapira, 2011; Peters, Flink, Boersma, & Linton, 2010; Quoidbach,
Wood & Hansen, 2009; Schueller & Parks, 2012; Seligman et al., 2005; Sergeant & Mongrain, 2011; Shapira & Mongrain, 2010; Sheldon & Lyubomirsky, 2006; Wing, Schutte & Byrne, 2006). Eight studies used group PPIs (Cheavens, Feldman, Gum, Michael & Snyder, 2006; Feldman & Dreher, 2012; Green et al., 2006; Kremers, Steverink, Albersnagel & Slaets, 2006; Luthans et al., 2008; Page & Vella-Brodrick, 2013; Seligman et al., 2006; Sheldon et al., 2002) and five used individual PPIs (Fava, Rafanelli, Cazzaro, Conti & Grandi, 1998; Fava, Ruini, Rafanelli et al., 2005; Grant, Curtayne & Burton, 2009; Seligman et al., 2006; Spence & Grant, 2007). Intensity varied considerably across studies, ranging from a short one-day exercise (Peters et al., 2010) and a two-week self-help intervention (Luthans et al., 2008) to intensive therapy (Fava et al., 1998; 2005; Seligman et al., 2006) and coaching (Green et al., 2006; Spence & Grant, 2007). Ten studies compared a PPI with a no-intervention control group (Buchanan & Bardi, 2010; Emmons & McCullough, 2003; Feldman & Dreher, 2012; Hurley & Kwon, 2012; Kremers et al., 2006; Lyubomirsky et al., 2006; Page & Vella-Brodrick, 2013; Quoidbach et al., 2009; Schueller & Parks, 2012; Seligman et al., 2006), 17 studies compared a PPI with a placebo intervention (Boehm et al., 2011; Burton & King, 2004; Emmons & McCullough, 2003; Gander et al., 2013; King, 2001; Layous et al., 2013; Luthans, Avey, Avolio & Peterson, 2010; Luthans et al., 2008; Lyubomirsky et al., 2011; Martínez-Martí et al., 2010; Mitchell et al., 2009; Mongrain & Anselmo-Matthews, 2012; Mongrain et al., 2011; Peters et al., 2010; Seligman et al., 2005; Sergeant & Mongrain, 2011; Shapira & Mongrain, 2010; Sheldon et al., 2002; Sheldon & Lyubomirsky, 2006; Wing et al., 2006), six studies with a waiting list control group (Abbott et al., 2009; Cheavens et al., 2006; Frieswijk et al., 2006; Grant et al., 2009; Green et al., 2006; Spence & Grant, 2007) and five studies with another active intervention (Fava et al., 1998; 2005; Goldstein, 2007; Grant, 2012; Seligman et al., 2006). While most studies worked with healthy individuals, a minority of seven studies (Cheavens et al., 2006; Fava et al., 1998; 2005; Frieswijk et al., 2006; Kremers et al., 2006;
Seligman et al., 2006) targeted a specific group with psychosocial problems such as symptoms of depression and anxiety.

Since the latest meta-analytical review (Bolier et al., 2013b) a number of RCTs have further demonstrated that PPIs effectively enhance well-being (Carr & Finnegan, 2015; Gander et al., 2016; Neff & Germer, 2013; O’Connell, O’Shea & Gallagher, 2017; Proyer, Gander, Wellenzohn & Ruch, 2015; Schotanus-Dijkstra, Ssaert, Pieterse et al., 2017) and reduce depressive symptoms (Bolier, Haverman, Kramer et al., 2013a; Carr & Finnegan, 2015; Cavanagh, Strauss, Cicconi et al., 2013; Gander et al., 2016; O’Connell et al., 2017; Proyer et al., 2015; Schotanus-Dijkstra et al., 2017) in the general population.

Literature on the applications of positive psychology to overweight and/or obesity has focused almost exclusively on mindfulness-based approaches (see Chapter 2). The most recent systematic review and meta-analysis evaluated 18 studies applying mindfulness-based interventions (MBIs) for weight loss and obesity-related eating behaviours (Carrière, Khoury, Günak & Knäuper, 2017). Out of those, 14 were randomised controlled trials which included four unpublished doctoral theses (Blevins, 2008; Davis, 2008; Hamel, 2010; Spadaro, 2008). Two studies compared MBI with a waitlist control group (Daubenmier et al., 2011; Timmerman & Brown, 2012), seven studies compared MBI with a standard weight loss program [of which five used a diet and exercise component similar to lifestyle change programs (Alberts et al., 2010; Blevins, 2008; Hamel, 2010; Mason et al., 2016), one used a diabetes self-management program (Daly, Pace, Berg, Menon & Szalacha, 2016) and one used psychoeducation for nutrition and exercise (Spadaro, 2008)], and five studies compared MBI with an active control group (Corsica, Hood, Katterman, Kleinman & Ivan, 2014; Davis, 2008; Mantzios & Giannou, 2014; Mantzios & Wilson, 2014; Mantzios & Wilson, 2015a). Results of the meta-analysis indicated that MBIs are moderately effective for weight loss (Hedge’s $g = .42$) and largely effective in reducing obesity-related eating behaviours (Hedge’s $g = .70$).
Larger effects on weight loss were found in studies that used a combination of informal and formal meditation practice (Alberts et al., 2010; Dalen et al., 2010; Daubenmier et al., 2011; Davis, 2008; Mason et al., 2016; Miller et al., 2012; Spadaro, 2008) (Hedge’s $g = .55$) compared with formal meditation practice alone (Blevins, 2008; Corsica et al., 2014; Mantzios & Giannou, 2014; Mantzios & Wilson, 2015a) (Hedge’s $g = .46$) (Carrière et al., 2017).

Most reviewed trials provided some kind of nutrition or energy balance education and/or incorporated mindful eating meditation in the beginning and/or during the entire MBI (Alberts et al., 2010; Corsica et al., 2014; Dalen et al., 2010; Daly et al., 2016; Daubenmier et al., 2011; Miller et al., 2012; Timmerman & Brown, 2012). One study used a complex mindfulness-based diet and exercise intervention which involved lifestyle changes in diet, exercise, and stress management (Mason et al., 2016). Only two studies did not provide the participants with any nutritional information or dietary advice (Mantzios & Giannou, 2014; Mantzios & Wilson, 2014), however, they were both advertised as a weight loss program for people who wanted to lose weight and were about to start their diet and the MBI content was related to mindful eating and dieting.

From the evidence above, it is apparent that mindfulness based approaches can be used to aid weight loss. However, it is not clear to what extent is the achieved weight loss the result of the positive psychological aspect of the MBI and to what extent it is the result of the nutritional/dietary aspect. Furthermore, there does not seem to be any research investigating effectiveness of more complex PPIs incorporating other positive psychological constructs apart from mindfulness to aid weight loss. Therefore, the aim of the present study was to test the feasibility and efficacy of a complex PPI which was piloted in two previous studies (see Chapter 6) in a full randomised controlled trial using an immediate intervention group and a wait list control group. It was hypothesised that the PPI would lead to significant improvements in the participants’ well-being, and body-image flexibility and significant decreases in
depression, and anxiety levels. It was also hypothesised that there would be a relationship between the participants’ determination to change and their post-intervention scores on well-being, body-image flexibility, depression and anxiety. Additionally, the PPI was expected to lead to weight loss in the immediate intervention group compared to the wait list control group.

7.2. Material and Methods

7.2.1. Design and randomisation

The present study was a quasi-randomised two-armed single-blinded trial where participants were randomly allocated to either immediate intervention group or a delayed intervention (wait list) control group. Following the same recruitment strategy as in Pilot study II. (Chapter 6), participants in this trial were the first year Psychology, Psychotherapy and Counselling students from the University of Bolton. The PPI was delivered as a part of the Introduction to Counselling Concepts module. Participants were assigned to two groups (immediate intervention or wait list control) with a randomization ratio of 1:1. Since the randomisation was performed by the researcher, it was prone to a selection bias. However, this was minimalized by avoiding predictability of group allocation. Double-randomization was used to ensure that the researcher would be unaware to which treatment group the next participant would be allotted. Names of all students enrolled on the module (N = 33) written on slips of paper were placed in one envelope and the conditions (“Intervention” and “Control”) were placed in another envelope. There were 34 paper slips identifying the group with equal number of slips (17) for each condition. Selection of each participant’s name was followed by a selection of the condition they were going to be assigned to. While double blinding was not possible due to limited resources, the next highest possible blinding, single-blinding, was
chosen in order to minimise bias (Kabisch et al., 2011). Only the researcher was aware of the intervention condition each participant was assigned to. The participants were only given the name of the person they were going to have a session with. They were told that for their afternoon workshops they would be with that person for the first six weeks of the module and then they would swap over. They were told that while undertaking the module it was also an opportunity for them to participate in a research related to their studied program which was, however, voluntary. No data was collected from those students who did not wish to take part in the research. However, they remained in their allotted group.

Standardised methods of assessment, data collection, treatment delivery, communication with participants, and evaluation were in place to ensure “fair” comparison between the groups. Assessment and data collection was carried out by two independent student research assistants who applied for a position of a PhD research assistant advertised to third year undergraduate students as an opportunity to complete their required placement hours. Applicants were shortlisted on the basis of their motivational letter and interviewed by the researcher and an independent senior member of academic staff from the University of Bolton. Communication with participants was set to be solely through their university email, and any information sent to the participants by the researcher was also received by the project supervisors, and the module lead in a copy.

7.2.2. Participants

The participants were first year students from the University of Bolton. While there were 33 students enrolled on the module, there has never been 100% attendance. Initially, 23 students agreed to take part in the research but three of them had to be withdrawn due to their low attendance, leaving the final number of 20 participants \( n = 20 \), 10 in each group, for the
final data analyses. There were five males and 15 females. Most participants were aged 30 or younger: four were younger than 20; six participants were aged between 21 and 30 years. Five participants were aged between 31 and 40 years, three were aged between 41-50 years, and one was within the 51 – 60 years range. Fourteen subjects identified themselves as “white British” or “white other”, four as “Black/African/Carribean/Black British”, one participant was “Asian/Asian British” and one was of “Other” ethnic background. Out of the 20, six participants were classed as overweight (BMI between 25 and 29.9 kg/m²), obese (BMI between 30 and 39.9 kg/m²), or morbidly obese (BMI >40 kg/m²). Thirteen participants were within the normal weight range (BMI between 18.5 and 25 kg/m²), and one was classed as underweight (BMI <18.5 kg/m²). Out of the 20, two participants scored above the cut-off point of 10 on the GAD7 identifying moderate anxiety and a further three individuals scored above 15 identifying severe anxiety before the PPI. On the PHQ9, four participants scored between 10 and 14 identifying moderate depression, two participants scored between 15 and 19 indicating moderately-severe depression and two scores were above 20 identifying severe depression before the PPI.

7.2.3. Measures

The same set of self-report questionnaires that were used in the second pilot study (The Change Questionnaire, BIAAQ, PERMA, GAD7, PHQ9), were used to carry out psychological assessment in this trial (see Chapter 6 for more details about the measures). The data were collected from both groups at Time A (before the intervention group received the PPI) and Time B (after the intervention group received the full PPI but before the control group started any of their sessions).
7.2.4. Procedure

During the module introductory session, students were informed about the structure of their afternoon workshops which would include six weeks of positive psychology and six weeks of observation and analysis of In-Treatment videos with patients undertaking psychotherapy. They were told that while this was a newly introduced structure of the module, it was also an opportunity for them to participate in research related to their mode of study. After obtaining a consent form from those students who agreed to submit their data, physiological and self-report psychological assessments were conducted. Participants were then informed about their group allocation which was decided prior to the official module commencement. All participants met within their group once a week for 90 minutes for six consecutive weeks. Individuals in the intervention group were additionally receiving three PowerPoint presentations a week with self-help exercises to complete (see Chapter 4 for details about the PPI structure and design). Post-treatment data from both groups were gathered immediately after the final session at week seven of the module.

7.3. Results

7.3.1. Analysis of covariance (ANCOVA)

Prior to the main analysis, an independent samples t-test was conducted to assess any differences between the groups at baseline. Upon detecting no significant differences in scores on any of the measures, a set of ANCOVA was conducted to assess the effectiveness of the PPI when compared with the wait list control group. The independent variable was the group to which participants were randomly allocated to (“Intervention”/”Control”), and the
dependent variable consisted of the post-intervention scores on the following measures: BIAAQTotal, PERMATotal, GAD7Total, and PHQ9Total. Pre-intervention scores were used as the covariate in all analyses. Additional ANCOVA was run for each of the PERMA subscales to identify any differences in the separate domains of flourishing.

Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After controlling for pre-intervention scores, there was a significant difference between the intervention group and the control group on post-intervention scores on the PERMA total: $F(1, 17) = 6.18, p = .024$, explaining 26.7% of variance (partial eta squared = .267), and the GAD7 total: $F(1, 17) = 9.4, p = .007$, explaining 35.6% of variance (partial eta squared = .356). While controlling for the independent variable (“Intervention”/“Control” group) there was a significant relationship between the pre-intervention and post-intervention scores on PERMA total: $F(1, 17) = 50.73, p < .001$, with the covariate explaining 74.9% of variance in the dependent variable (partial eta squared = .749). Similarly, there was a significant relationship between the pre-intervention and post-intervention scores on GAD7 total: $F(1, 17) = 35.69, p < .001$, with the covariate explaining 67.7% of variance in the dependent variable (partial eta squared = .677). There was no significant difference between the intervention group and the control group on post-intervention scores on the BIAAQ total: $F(1, 17) = 1.02, p = .327$, partial eta squared = .056, or on the PHQ9 total: $F(1, 17) = 1.88, p = .188$, partial eta squared = .100 after controlling for pre-intervention scores. However, there was a strong relationship between the pre-intervention and post-intervention scores on the BIAAQ total scale, as indicated by a partial eta squared value of .567, as well as on the PHQ9 total which also indicated a large effect size of the covariate (partial eta squared = .603). (See Table 7.1. for a summary of the between-subjects effects on the post-intervention scores on all measures).
Table 7.1. Between subjects-effects showing the effects of the condition (“Intervention”/”Control” group) on the post-intervention total scores on all measures taken at Time B.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>F</th>
<th>p-value</th>
<th>Partial eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIAAQTotalB</td>
<td>1.02</td>
<td>.327</td>
<td>.056</td>
</tr>
<tr>
<td>PERMATotalB</td>
<td>6.18*</td>
<td>.024</td>
<td>.267</td>
</tr>
<tr>
<td>GAD7TotalB</td>
<td>9.4*</td>
<td>.007</td>
<td>.356</td>
</tr>
<tr>
<td>PHQ9TotalB</td>
<td>1.88</td>
<td>.188</td>
<td>.100</td>
</tr>
</tbody>
</table>

*p<.05 (2-tailed)

Given the significant findings on the PERMATotal scale, further ANCOVA was conducted to assess the effectiveness of the PPI on the separate domains of flourishing. After controlling for pre-intervention scores, there was a significant difference between the intervention group and the control group on post-intervention scores on the PERMARelationshipB: $F(1, 17) = 8.31, p = .010$, explaining 32.8% of variance (partial eta squared = .328), and the PERMAAccomplishmentB: $F(1, 17) = 6.46, p = .021$, explaining 27.5% of variance (partial eta squared = .275). While controlling for the independent variable (“Intervention”/”Control” group) there was a significant relationship between the pre-intervention and post-intervention scores on both PERMARelationship: $F(1, 17) = 10.63, p = .005$, with the covariate explaining 38.5% of variance in the dependent variable (partial eta squatted = .385), and PERMAAccomplishment: $F(1, 17) = 43.33, p<.001$, with the covariate explaining 71.8% of variance in the dependent variable (partial eta squatted = .718). (See Table 7.2. for a summary of the between-subjects effects on the post-intervention scores on all PERMA subscales.)
There was no significant difference between the intervention group and the control group on post-intervention scores on any of the other PERMA subscales. However, there was a strong relationship between the pre-intervention and post-intervention scores on all PERMA subscales indicating significance of all covariates with large effect sizes (Cohen, 1988, p. 284 - 287) (Table 7.3). Descriptive statistics for both groups and all dependent variables assessed are presented in Table 7.4.

**Table 7.2.** Between subjects-effects showing the effects of the condition (“Intervention”/”Control” group) on the post-intervention scores on all PERMA subscales taken at Time B.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>F</th>
<th>p-value</th>
<th>Partial eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMAPositiveEmotionB</td>
<td>1.49</td>
<td>.239</td>
<td>.081</td>
</tr>
<tr>
<td>PERMAEngagementB</td>
<td>1.37</td>
<td>.258</td>
<td>.074</td>
</tr>
<tr>
<td>PERMARelationshipB</td>
<td><strong>8.31</strong>*</td>
<td>.010</td>
<td>.328</td>
</tr>
<tr>
<td>PERRAMeaningB</td>
<td>.03</td>
<td>.864</td>
<td>.002</td>
</tr>
<tr>
<td>PERMAAccomplishmentB</td>
<td><strong>6.46</strong>*</td>
<td>.021</td>
<td>.275</td>
</tr>
<tr>
<td>PERMALonelinessB</td>
<td>1.31</td>
<td>.268</td>
<td>.072</td>
</tr>
<tr>
<td>PERMANegativeEmotionB</td>
<td>3.43</td>
<td>.081</td>
<td>.168</td>
</tr>
<tr>
<td>PERMAHealthB</td>
<td>.04</td>
<td>.838</td>
<td>.003</td>
</tr>
<tr>
<td>PERMAHappinessB</td>
<td>3.90</td>
<td>.065</td>
<td>.187</td>
</tr>
</tbody>
</table>

*p<.05 (2-tailed)
Table 7.3. Between subjects-effects showing the effects of the covariate on the post-intervention scores on all PERMA subscales after controlling for the condition (“Intervention”/”Control” group).

<table>
<thead>
<tr>
<th>Covariate</th>
<th>F</th>
<th>p-value</th>
<th>Partial eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMAPositiveEmotionA</td>
<td>9.12*</td>
<td>.008</td>
<td>.349</td>
</tr>
<tr>
<td>PERMAEngagementA</td>
<td>18.24**</td>
<td>.001</td>
<td>.518</td>
</tr>
<tr>
<td>PERMARelationshipA</td>
<td>10.63*</td>
<td>.005</td>
<td>.385</td>
</tr>
<tr>
<td>PERMAMeaningA</td>
<td>39.99**</td>
<td>&lt;.001</td>
<td>.702</td>
</tr>
<tr>
<td>PERMAAccomplishmentA</td>
<td>43.33**</td>
<td>&lt;.001</td>
<td>.718</td>
</tr>
<tr>
<td>PERMALonelinessA</td>
<td>6.71*</td>
<td>.019</td>
<td>.283</td>
</tr>
<tr>
<td>PERMANegativeEmotionA</td>
<td>15.49**</td>
<td>.001</td>
<td>.477</td>
</tr>
<tr>
<td>PERMAHealthA</td>
<td>71.69**</td>
<td>&lt;.001</td>
<td>.808</td>
</tr>
<tr>
<td>PERMAHappinessA</td>
<td>8.03*</td>
<td>.011</td>
<td>.321</td>
</tr>
</tbody>
</table>

*p<.05 (2-tailed); **p<.001
Table 7.4. Means and standard deviations at Time A and Time B for both groups and all variables, including all PERMA subscales.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention group</th>
<th>Control group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>GAD7TotalA</td>
<td>5.70</td>
<td>4.00</td>
<td>10.20</td>
<td>8.05</td>
</tr>
<tr>
<td>GAD7TotalB</td>
<td>2.30</td>
<td>2.21</td>
<td>9.80</td>
<td>7.04</td>
</tr>
<tr>
<td>PHQ9TotalA</td>
<td>4.60</td>
<td>4.65</td>
<td>10.20</td>
<td>9.05</td>
</tr>
<tr>
<td>PHQ9TotalB</td>
<td>3.40</td>
<td>2.503</td>
<td>9.20</td>
<td>7.53</td>
</tr>
<tr>
<td>BIAAQTotalA</td>
<td>34.30</td>
<td>19.45</td>
<td>29.80</td>
<td>18.07</td>
</tr>
<tr>
<td>BIAAQTotalB</td>
<td>30.30</td>
<td>12.52</td>
<td>24.30</td>
<td>12.06</td>
</tr>
<tr>
<td>PERMATotalA</td>
<td>164.20</td>
<td>27.12</td>
<td>153.90</td>
<td>37.84</td>
</tr>
<tr>
<td>PERMATotalB</td>
<td>178.20</td>
<td>22.22</td>
<td>153.70</td>
<td>34.09</td>
</tr>
<tr>
<td>PERMAPositiveEmotionA</td>
<td>22.40</td>
<td>3.92</td>
<td>20.40</td>
<td>5.95</td>
</tr>
<tr>
<td>PERMAPositiveEmotionB</td>
<td>23.90</td>
<td>2.51</td>
<td>21.10</td>
<td>5.09</td>
</tr>
<tr>
<td>PERMAEngagementA</td>
<td>21.50</td>
<td>4.33</td>
<td>20.90</td>
<td>6.47</td>
</tr>
<tr>
<td>PERMAEngagementB</td>
<td>23.50</td>
<td>3.69</td>
<td>21.60</td>
<td>4.65</td>
</tr>
<tr>
<td>PERMARelationshipA</td>
<td>23.50</td>
<td>4.81</td>
<td>20.00</td>
<td>4.74</td>
</tr>
<tr>
<td>PERMARelationshipB</td>
<td>25.50</td>
<td>2.84</td>
<td>18.30</td>
<td>5.83</td>
</tr>
<tr>
<td>PERMA MeaningA</td>
<td>23.20</td>
<td>3.43</td>
<td>23.30</td>
<td>6.75</td>
</tr>
<tr>
<td>PERMA MeaningB</td>
<td>24.50</td>
<td>2.32</td>
<td>24.40</td>
<td>4.48</td>
</tr>
<tr>
<td>PERMA Accomplishment A</td>
<td>PERMA Accomplishment B</td>
<td>PERMA Loneliness A</td>
<td>PERMA Loneliness B</td>
<td>PERMA Negative Emotion A</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>23.10</td>
<td>2.92</td>
<td>22.10</td>
<td>4.91</td>
<td>4.30</td>
</tr>
<tr>
<td>24.70</td>
<td>2.63</td>
<td>21.20</td>
<td>5.31</td>
<td>3.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There seemed to be some discrepancies between the observed significant/non-significant results on the ANCOVA and the expected results when observing the mean scores on some of the PERMA subscales (Table 7.4.). For example, the mean score on negative emotions (PERMANegativeEmotion) decreased by 2.6 in the intervention group but increased by 0.3 in the control group creating a difference of 2.9 of the mean change between the two conditions. Or the mean score on engagement (PERMAEngagement) increased by 2.0 in the intervention group but only by 0.7 in the control group creating a difference of 1.3 of the mean change between the two conditions. When compared with the happiness subscale (PERMAHappiness) where the difference of the mean change between the two conditions was 0.8 which nearly reached significance (p=.065), it would be expected for the
PERMAEngagement to be significant. Similar discrepancies were observed on a number of the PERMA subscales which might have been due to a small sample size resulting in small power. Therefore, a decision was made to conduct an additional analysis without the covariates.

7.3.2. Paired-samples t-test

A paired-samples t-test was carried out to further evaluate the impact of the intervention on the participants’ anxiety (GAD7Total), depression (PHQ9Total), body image flexibility (BIAAQTotal), and well-being (PERMATotal), while considering the small sample size. The split-file function was used to organize the output by group to be able to identify any differences between the two conditions.

In the intervention group, there was a significant decrease in anxiety GAD7Total scores from the time before the intervention (GAD7TotalA, $M = 5.7$, $SD = 4.00$) to the time after the intervention (GAD7TotalB, $M = 2.3$, $SD = 2.21$), $t (9) = 3.25$, $p = .01$ (two-tailed). The eta squared statistic (.54) indicated a large effect size of the PPI on the participants’ anxiety. There was no significant difference in the PHQ9Total scores ($t (9) = 1.25$, $p = .245$) or in the BIAAQTotal scores ($t (9) = 1.44$, $p = .184$). However, the effect size was large for both measures (PHQ9Total eta squared = 0.15; BIAAQTotal eta squared = 0.19). There was a significant increase in PERMATotal scores from the time before the intervention (PERMATotalA, $M = 164.2$, $SD = 27.12$) to the time after the intervention (PERMATotalB, $M = 178.2$, $SD = 22.22$), $t (9) = -3.686$, $p = .005$ (two-tailed). The eta squared statistic (.60) indicated a large effect size of the PPI on overall well-being of the participants in the intervention group. There were also significant increases in the scores on another two of the PERMA subscales. Engagement before the intervention (PERMAEngagementA, $M = 21.5$, $SD = 4.33$) increased after the intervention (PERMAEngagementB, $M = 23.5$, $SD = 3.69$), $t (9) = -2.335$, $p = .044$ (two-tailed) with large effect size (eta squared = .38). Accomplishment before
the intervention (PERMAAccomplishmentA, $M = 23.1$, $SD = 2.92$) increased after the intervention (PERMAAccomplishmentB, $M = 24.7$, $SD = 2.63$), $t(9) = -2.388$, $p = .041$ (two-tailed) with large effect size (eta squared = .39). An additional three PERMA subscales (PERMAPositiveEmotion, PERMARelationship, PERMAHappiness) were marginally significant (Table 7.5.). In the control group, none of the scores on any of the tested scales or subscales was significant (Table 7.6.) suggesting a clear difference between the intervention group and the wait list control group.

In addition to the mental health improvement, 5 participants in the intervention group lost between 1 and 12 kg of body weight after undertaking the PPI, whereas in the control group 5 participants gained between 1 and 3 kg (Table 7.7.).
Table 7.5. Paired-samples T-test analysis of the effect of the PPI on anxiety, depression, body-image flexibility, and well-being of the participants in the intervention group.

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GAD7TotalA &amp; GAD7TotalB</td>
<td>3.40</td>
<td>3.31</td>
<td>3.252*</td>
<td>9</td>
<td>.010</td>
<td>.54</td>
</tr>
<tr>
<td>2. PHQ9TotalA &amp; PHQ9TotalB</td>
<td>1.20</td>
<td>3.05</td>
<td>1.245</td>
<td>9</td>
<td>.245</td>
<td>.15</td>
</tr>
<tr>
<td>3. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>4.00</td>
<td>8.79</td>
<td>1.438</td>
<td>9</td>
<td>.184</td>
<td>.19</td>
</tr>
<tr>
<td>4. PERMATotalA &amp; PERMATotalB</td>
<td>-14.00</td>
<td>12.01</td>
<td>-3.686*</td>
<td>9</td>
<td>.005</td>
<td>.60</td>
</tr>
<tr>
<td>5. PERMAPositiveEmotionA &amp; PERMAPositiveEmotionB</td>
<td>-1.50</td>
<td>2.12</td>
<td>-2.236</td>
<td>9</td>
<td>.052</td>
<td>.36</td>
</tr>
<tr>
<td>6. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-2.00</td>
<td>2.71</td>
<td>-2.335*</td>
<td>9</td>
<td>.044</td>
<td>.38</td>
</tr>
<tr>
<td>7. PERMARelationshipA &amp; PERMARelationshipB</td>
<td>-2.00</td>
<td>2.83</td>
<td>-2.236</td>
<td>9</td>
<td>.052</td>
<td>.36</td>
</tr>
<tr>
<td>8. PERMAMeaningA &amp; PERMAMeaningB</td>
<td>-1.30</td>
<td>2.71</td>
<td>-1.517</td>
<td>9</td>
<td>.164</td>
<td>.20</td>
</tr>
<tr>
<td>9. PERMAAccomplishmentA &amp; PERMAAccomplishmentB</td>
<td>-1.60</td>
<td>2.12</td>
<td>-2.388*</td>
<td>9</td>
<td>.041</td>
<td>.39</td>
</tr>
<tr>
<td>10. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>1.20</td>
<td>1.87</td>
<td>2.025</td>
<td>9</td>
<td>.074</td>
<td>.31</td>
</tr>
<tr>
<td>12. PERMAHealthA &amp; PERMAHealthB</td>
<td>-.90</td>
<td>2.96</td>
<td>-.961</td>
<td>9</td>
<td>.362</td>
<td>.09</td>
</tr>
<tr>
<td>13. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-.90</td>
<td>1.29</td>
<td>-2.212</td>
<td>9</td>
<td>.054</td>
<td>.35</td>
</tr>
</tbody>
</table>

*p<.05
Table 7.6. Paired-samples T-test analysis of the effect of the PPI on anxiety, depression, body-image flexibility, and well-being of the participants in the control group.

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GAD7TotalA &amp; GAD7TotalB</td>
<td>.40</td>
<td>3.89</td>
<td>.325</td>
<td>9</td>
<td>.753</td>
<td>.01</td>
</tr>
<tr>
<td>2. PHQ9TotalA &amp; PHQ9TotalB</td>
<td>1.00</td>
<td>5.64</td>
<td>.561</td>
<td>9</td>
<td>.589</td>
<td>.03</td>
</tr>
<tr>
<td>3. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>5.50</td>
<td>15.31</td>
<td>1.136</td>
<td>9</td>
<td>.285</td>
<td>.13</td>
</tr>
<tr>
<td>4. PERMATotalA &amp; PERMATotalB</td>
<td>.20</td>
<td>20.00</td>
<td>.032</td>
<td>9</td>
<td>.975</td>
<td>.00</td>
</tr>
<tr>
<td>5. PERMAPositiveEmotionA &amp; PERMAPositiveEmotionB</td>
<td>-.70</td>
<td>5.54</td>
<td>-.400</td>
<td>9</td>
<td>.699</td>
<td>.02</td>
</tr>
<tr>
<td>6. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-.70</td>
<td>4.69</td>
<td>-.472</td>
<td>9</td>
<td>.648</td>
<td>.02</td>
</tr>
<tr>
<td>7. PERMARelationshipA &amp; PERMARelationshipB</td>
<td>1.70</td>
<td>5.03</td>
<td>1.068</td>
<td>9</td>
<td>.313</td>
<td>.11</td>
</tr>
<tr>
<td>8. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-1.10</td>
<td>3.38</td>
<td>-1.029</td>
<td>9</td>
<td>.330</td>
<td>.11</td>
</tr>
<tr>
<td>10. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>.10</td>
<td>3.21</td>
<td>.098</td>
<td>9</td>
<td>.924</td>
<td>.00</td>
</tr>
<tr>
<td>11. PERMANegativeEmotionA &amp; PERMANegativeEmotionB</td>
<td>-.30</td>
<td>3.65</td>
<td>-.260</td>
<td>9</td>
<td>.801</td>
<td>.01</td>
</tr>
<tr>
<td>12. PERMAHealthA &amp; PERMAHealthB</td>
<td>-.10</td>
<td>3.54</td>
<td>-.089</td>
<td>9</td>
<td>.931</td>
<td>.00</td>
</tr>
<tr>
<td>13. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-.10</td>
<td>1.91</td>
<td>-.165</td>
<td>9</td>
<td>.801</td>
<td>.00</td>
</tr>
</tbody>
</table>
### Table 7.7. Participant characteristics and weight data at Time A and Time B (both groups).

<table>
<thead>
<tr>
<th>Group</th>
<th>Participant no.</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Weight (kg) before</th>
<th>Weight (kg) after</th>
<th>BMI (kg/m²) before</th>
<th>BMI (kg/m²) after</th>
<th>Weight change (+/-/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention</strong></td>
<td>1</td>
<td>39</td>
<td>Female</td>
<td>65</td>
<td>65</td>
<td>23.6</td>
<td>23.6</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>Male</td>
<td>162</td>
<td><strong>150</strong></td>
<td>51.9</td>
<td>41.1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>Female</td>
<td>56</td>
<td><strong>55</strong></td>
<td>22.2</td>
<td>21.8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>Female</td>
<td>60</td>
<td><strong>58</strong></td>
<td>20.8</td>
<td>20.1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>22</td>
<td>Female</td>
<td>117</td>
<td><strong>112</strong></td>
<td>39.5</td>
<td>37.9</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>20</td>
<td>Female</td>
<td>67</td>
<td><strong>66</strong></td>
<td>27.9</td>
<td>27.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>27</td>
<td>Female</td>
<td>54</td>
<td>56</td>
<td>19.4</td>
<td>19.4</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>20</td>
<td>Female</td>
<td>68</td>
<td>68</td>
<td>23.5</td>
<td>23.5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>18</td>
<td>Female</td>
<td>55</td>
<td>55</td>
<td>21.2</td>
<td>21.2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>58</td>
<td>Male</td>
<td>91</td>
<td>91</td>
<td>29.7</td>
<td>29.7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>17</td>
<td>34</td>
<td>Female</td>
<td>59</td>
<td>61</td>
<td>22.2</td>
<td>22.2</td>
<td>+</td>
</tr>
<tr>
<td>18</td>
<td>42</td>
<td>Female</td>
<td>94</td>
<td>95</td>
<td>33.7</td>
<td>33.7</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>24</td>
<td>Female</td>
<td>43</td>
<td>43</td>
<td>16.8</td>
<td>16.8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>Female</td>
<td>57</td>
<td>57</td>
<td>22.8</td>
<td>22.8</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
## RANDOMISED CONTROLLED TRIAL

<table>
<thead>
<tr>
<th>Age</th>
<th>Hrs</th>
<th>Gen</th>
<th>1st Score</th>
<th>2nd Score</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>45</td>
<td>Female</td>
<td>65</td>
<td>66</td>
<td>22.2</td>
</tr>
<tr>
<td>25</td>
<td>38</td>
<td>Female</td>
<td>86</td>
<td>89</td>
<td>30.8</td>
</tr>
<tr>
<td>27</td>
<td>19</td>
<td>Male</td>
<td>70</td>
<td>70</td>
<td>22.3</td>
</tr>
<tr>
<td>28</td>
<td>33</td>
<td>Male</td>
<td>65</td>
<td>65</td>
<td>23.8</td>
</tr>
<tr>
<td>31</td>
<td>23</td>
<td>Male</td>
<td>76</td>
<td>77</td>
<td>22.4</td>
</tr>
<tr>
<td>33</td>
<td>31</td>
<td>Female</td>
<td>60</td>
<td>57</td>
<td>21.0</td>
</tr>
</tbody>
</table>
7.3.3. Determination to change

Pearson’s $r$ correlation was used to assess the relationship between the participants’ determination to change (as measured by the CHANGETotal) and their well-being (PERMATotalB), body image flexibility (BIAAQTotalB), anxiety (GAD7TotalB), and depression (PHQ9TotalB) after the PPI. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. There was no significant correlation between the participants’ determination to change and any of the assessed measures (Table 7.8.).

Table 7.8. Pearson product-moment correlations between measures of readiness to change and well-being, body-image flexibility, anxiety and depression after the intervention.

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANGETotal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMATotalB</td>
<td>.026</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIAAQTotalB</td>
<td>-.358</td>
<td>-.305</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAD7TotalB</td>
<td>-.259</td>
<td>-.593</td>
<td>.169</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHQ9TotalB</td>
<td>-.314</td>
<td>-.533</td>
<td>.067</td>
<td>.958*</td>
<td>1</td>
</tr>
</tbody>
</table>

*p<.001
7.4. Discussion

The purpose of the present study was to examine the effectiveness of a PPI designed for individuals with weight problems for improving an overall well-being, increasing body-image flexibility, and reducing symptoms of depression and anxiety. It was hypothesised that the mental health benefits would be linked with the participants’ determination to change. Additionally, the PPI was expected to lead to weight loss in the immediate intervention group compared to the wait list control group.

7.4.1. Happiness and well-being

It has been previously demonstrated that PPIs can be used to effectively increase subjective and psychological well-being in non-clinical populations (see Bolier et al., 2013b for a review). The results of the present research were in line with earlier studies which have shown that complex PPIs addressing multiple positive psychological concepts enhance well-being and ameliorate symptoms of depression (Gander et al., 2016; Neff & Germer, 2013; Schotanus-Dijkstra et al., 2017). As expected, participants in the immediate intervention group reported significantly higher levels of overall well-being compared to the participants in the control condition. When controlling for the pre-intervention scores, there were two domains of flourishing, relationships and accomplishment that appeared to be affected the most by the intervention. The large between-group effects on the PERMA measure of flourishing and its subscales were similar to the effects sizes found in some previous multicomponent positive interventions (Page & Vella-Brodrick, 2013; Rashid, 2015). Furthermore, the present study found considerably larger effect sizes than have been found in the recent meta-analysis of RCT's (Bolier et al., 2013b) where the reviewed studies used mostly single
component PPIs, indicating that it seems more effective to invest in multicomponent well-being interventions. This could be partly explained by the use of a wait-list control group rather than treatment as usual (Sin & Lyubomirsky, 2009). In addition, the large-sized effects might have been partly due to the design of the PPI where the weekly sessions were supplemented with online learning and email support from the researcher. This corresponds to findings of an earlier study (Andersson & Cuijpers, 2009) which demonstrated that effect sizes of web-based treatments for depression increase when personal support is added to the treatment.

A surprising finding of this study was that positive emotions, as measured by the first PERMA subscale did not reach statistical significance, even though after carrying out further analysis, positive emotions were marginally significant. This could have been caused by having much smaller sample size than usually observed in RCTs applying a PPI to enhance well-being (see Bolier et al., 2013b for a review). Although, some previous studies with the same sample size as the one used in the present research have noted significant increases in positive emotions (e.g. Akhtar & Boniwell, 2010). From this perspective, another possible explanation might be that although the participants in the wait list control group were not receiving any education related to positive psychology between Time A and Time B, they were engaging in counselling and psychotherapy activities/exercises related to their course work. These activities might have increased their level of positive emotions making the difference between the two groups statistically non-significant.

7.4.2. Symptoms of depression and anxiety

As predicted, compared to the control group, participants in the immediate intervention condition reported significantly lower levels of anxiety after the PPI as measured by the GAD7. This was in line with previous findings which demonstrated that interventions incorporating...
positive psychology decrease symptoms of anxiety in student populations (Shoshani & Steinmetz, 2014), and can be even used to enhance the treatment of generalized anxiety disorder (Fava et al., 2005). This is important not only from the perspective of psychotherapy but also from the perspective of education. The mental health of university students is an area of increasing concern worldwide (Bayram & Bilgel, 2008). Research has demonstrated that university students are vulnerable to mental health problems, especially depression and anxiety (Nerdrum et al., 2006; Stanley & Manthorpe, 2001; Stewart-Brown et al., 2000) which are known to impair student performance. Given the present study findings, incorporating positive psychology into education might be an effective way of reducing anxiety among university students which could potentially lead to an increase in academic performance.

Previous research has demonstrated that in addition to improving well-being, interventions based on positive psychology can be used to alleviate symptoms of depression (Bolier et al., 2013a; Carr & Finnegan, 2015; Cavanagh et al., 2013; Cheavens et al., 2006; Fava et al., 1998; 2005; Frieswijk et al., 2006; Gander et al., 2016; Kremers et al., 2006; O’Connell et al., 2017; Proyer et al., 2015; Schotanus-Dijkstra et al., 2017; Seligman et al., 2006). Contrary to expectations, in the present study, there were no significant differences between the intervention group and the control group in their depression scores, as measured by the PHQ9. This might be a result of the positive skewness at baseline leaving not much room for growth. Most of the present study participants scored very low on the PHQ9 to start with (none of the pre-intervention scores in the intervention group indicated clinical significance) and their overall well-being scores were also at the higher end. Research has previously noted that the measurement precision at the higher end of the well-being continuum can be less accurate (Schotanus-Dijkstra, ten Klooster, Drossaert et al., 2016) which could explain the unexpected outcomes of the present study. However, although the difference between the intervention group and the control group in their PHQ9 scores was not statistically
randomised controlled trial

significant, it became much more apparent when calculated in percentages. From the table of means (Table 7.4.) it was clear that the PHQ9 scores decreased only slightly: by 1.2 in the intervention group and 1.0 in the control group. When calculated in percentages, however, the depression levels in the intervention group decreased by 26%, but in the control group, it was only by 9.8%.

7.4.3. Readiness to change (RTC)

High levels of motivation have been considered a critical necessity for behavioural weight loss programs (Dixon et al., 2009). According to the stage-of-change theory (Prochaska, 1994) a person’s readiness to make changes on relevant behaviours can be assessed or assigned to a stage, and that treatment efficacy can be enhanced by applying the cognitive and behavioural change processes that are best suited to the person’s stage (Prochaska, 1994). Although RTC has been shown to predict treatment outcome of a number of obesity-related mental health problems such as eating disorders (Bewell & Carter, 2008) or substance use and addictions (Demmel, Beck, Richter & Reker, 2004), its relationship with weight loss outcomes has been somewhat inconsistent. While some authors showed that RTC is directly related to BMI (Logue, Sutton, Jarjoura & Smucker, 2000), others have found no relationship with weight loss (Dixon et al., 2009), or suggested that the weight loss outcome is dependent on the actual stage of person’s RTC (Ghannadiasl, Mahdavi & AsghariJafarabadi, 2014; Sutton, Logue, Jarjoura et al., 2003). A recent review noted that since RTC is typically measured by self-report, it cannot be reliably used to predict either treatment adherence or the magnitude of weight loss among persons pursuing a variety of weight control methods (Casazza, Brown, Astrup et al., 2015; Casazza, Fontaine, Astrup et al., 2013). However, it may be used to assess other treatment outcomes. In the present study, participants’ RTC before the intervention was
expected to be related to their well-being, body-image flexibility, anxiety, and depression scores after the intervention. This hypothesis was not supported. The lack of significant findings may be due to the fact that the present study participants were a convenience sample of first year university students who undertook the intervention as a part of their module. As such, they may not have even considered any change to start with. Another explanation might be the already mentioned limitation of self-report assessments of readiness (Casazza et al., 2013; 2015). Individuals may overestimate their readiness because they do not clearly understand what behaviors are needed to make them successful, or because they greatly desire the positive outcome, whatever that might be.

7.4.4. Weight loss

After evaluating the second pilot study findings (Chapter 6), it seemed that when the PPI was not advertised as a weight management intervention and was delivered to the first year cohort as a part of the curriculum, it was much less effective for weight loss. On that basis the PPI in this trial was expected to lead to weight loss in the immediate intervention group while the wait list control group might show increases in weight. Confirming this hypothesis, five individuals in the intervention group lost between 1 and 12 kg of body weight, whereas in the control group the outcomes were exactly the opposite; five participants gained between 1 and 3 kg. Previous studies documented multiple determinants of weight gain among first year university students, including environmental and lifestyle factors such as access to on-campus dining facilities (Kapinos, Yakusheva & Eisenberg, 2014; Levitsky, Halbmaier & Mrdjenovic, 2004), physical activity (Kasparek, Corwin, Valois, Sargent & Morris, 2008), alcohol consumption (Economos, Hildebrandt & Hyatt, 2008; Lloyd-Richardson, Lucero, DiBello, Jacobson & Wing, 2008), snacking habits (Levitsky et al., 2004), dieting behaviour (Lowe,
RANDOMISED CONTROLLED TRIAL

Annunziato, Markowitz et al., 2006), sex (Cluskey & Grobe, 2009; Gropper, Simmons, Gaines et al., 2009; Hoffman, Policastro, Quick & Lee, 2006; Holm-Denoma, Joiner, Vohs & Heatherton, 2008; Lloyd-Richardson, Bailey, Fava, Wing & Tobacco Etiology Research Network 2009; Mifsud, Duval & Doucet, 2009; Mihalopoulos, Auinger & Klein, 2008; Zagorsky & Smith, 2011), race/ethnicity (Gillen & Lefkowitz, 2011), and residence type (Brunt & Rhee, 2008; Vella-Zarb & Elgar, 2010). The fact that weight gain was observed in the control but not in the intervention group suggests that the PPI may have helped the participants cope better with the aforementioned determinants of weight gain among first year university students. As several genetic networks (FTO, DRD2, DRD4) have linked emotional functioning with disordered eating (e.g., Bauer, 2014; Heni, Kullmann, Ahlqvist et al., 2016; Ptacek, Kuzelova & Stefano, 2011; Rask-Andersen, Olszewski, Levine & Schioth, 2010; Wang, Li, Zhang et al., 2011; Wheeler, Huang, Bochukova et al., 2013), it is possible that the weight loss observed in the intervention group was a result of potential gene-gene and gene-environment interactions (see Chapter 5). However, this notion would require further complex investigations of gene networks using global gene expression analyses.

7.5. Conclusions and Limitations

The present study highlighted the potential of positive psychology as a strategy individuals can independently engage in to improve their well-being, and possibly manage their weight. The current findings confirmed that interventions such as the present PPI can make an effective contribution to mental health and overall well-being and may have an important implications for future weight loss treatment approaches. Additionally, the fact that the PPI addressed commonly observed mental health issues of university students may present an important argument for incorporation of positive psychological approaches into teaching at
RANDOMISED CONTROLLED TRIAL

higher education institutions. Over the past two decades research has demonstrated that schools that incorporate positive psychology as a comprehensive school approach produce significant mental health benefits for students (see Joseph, 2015 for an overview). However, very little research has been done on the effects of positive psychological approaches on education at colleges or universities. From this perspective the current research may present an important step towards positive education in higher education.

It ought to be mentioned that the present study had a number of limitations. In addition to already mentioned small sample size which was, however, comparable to some other group-based PPI studies (e.g. Akhtar & Boniwell, 2010; Seligman et al., 2006), this study had a population limitation. All participants were psychology university students which may well limit the generalizability of the PPI to other populations varying in age, ethnicity, socioeconomic status, and IQ. Additionally, all the students were on the Psychology, Psychotherapy and Counselling pathway with potentially very good counselling skills which may have affected their behaviour in the group sessions. And finally, the present study sample was not an accurate representation of the current statistics of overweight and obesity in the UK (HSCIC, 2017). Unlike in previous studies (Chapter 6) most of this study’s participants were in the normal weight range which limited the applicability of the PPI to individuals with weight problems. Given these limitations, future trials should focus on applying the PPI to more diverse populations and individuals who seek weight loss.
CHAPTER 8: Protocols Adopted for the RT-qPCR, Results of the OXTR Gene Expression Analyses Combining Samples from All Studies, and Combined Results from the Psychological Analyses for Comparison.

It has been previously mentioned that one of the limitations of positive psychology is that it largely relies on self-report measures which are often subject to social desirability and reference biases (West, 2014), and may be contaminated by psychosocial factors (see Chapter 2 for more details). It has been argued that integration of biological, neuropsychological, social, and personality sciences may greatly aid positive psychological research, and enhance the validity and reliability of interventions (Rock & Page, 2009; Rothbart et al., 2007). Therefore, one of the aims of the present PhD research was to validate the PPI by using OXTR gene expression as a model system. Out of the possible methods of gene expression analysis (see Chapter 3 and Appendix F for an overview) RT-qPCT was evaluated as the most suitable for the purposes of this research.

The purpose of this chapter is to present the protocols adopted for the RT-qPCR and report the results from all separate RT-qPCRs conducted in each study. To enable comparison with the psychological findings of this research, data obtained from the psychological assessments were merged to create a single data file. No adjustments have been made to the PPI to enable this data merge. Section 8.2. will present the results of the combined analysis. Section 8.3. will conclude with discussing the potential implication of these findings which will be further evaluated in Chapter 9.
8.1. OXTR Gene Expression Analysis

Risk assessment was conducted for each of the four steps of gene expression analysis using RT-qPCR (sample collection and RNA isolation, cDNA synthesis, real-time qPCR, and post-PCR gel electrophoresis; see Appendix L).

8.1.1. Sample collection and RNA isolation

Saliva samples were collected by Sarstedt Salivettes (Sarstedt, Germany) and treated with 2mL of RNAlater® (Ambion, Austin, Texas) before they were placed in -20°C for further analysis. RNA stabilization using RNAlater® in a saliva samples is a prerequisite for a reliable gene expression analysis using real-time RT-PCR, or other nucleic acid based technologies. This is because changes in the gene expression pattern occur immediately after saliva collection due to unspecific and specific RNA degradation, as well as transcriptional induction. Also, since saliva contains bacteria in addition to cells and free circulating molecules (e.g. nucleic acids) of human origin, it is important to prevent any uncontrolled growth of bacteria, which could affect the gene expression profile.

RNAlater® reagent stabilizes the gene expression profile in saliva samples, which can then be stored and transported at ambient temperature. RNA in saliva samples is already degrading prior to collection and stabilization with RNAlater®. This means that RNA purified from saliva samples will be of lower quality than RNA purified from other sample types, such as cultured cells and tissues. However, for better preservation the treated samples have been placed in -20°C.

An adapted protocol of the RNeasy Protocol (Qiagen, cat. no. 74104) was used for the RNA extraction from saliva samples. Briefly, 1mL of Trizol (Invitrogen Life Technologies,
OXTR EXPRESSION ANALYSES AND COMBINED PSYCHOLOGICAL ANALYSES

Carlsbad, CA, USA) was added to the Sarstedt-Salivettes. After spinning down at 12 000 g for 10 minutes at 4°C, the supernatant was transferred into another tube; 200ml chloroform was added to the supernatant, vortexed for 15 seconds and centrifuged for 15 minutes at 12 000 g at 4°C. The upper aqueous phase was transferred into a clean tube and an equal volume of freshly prepared 70% ethanol was added, after which the sample was loaded onto an RNeasy column.

RNA quantity was measured on Qubit™ 3.0 Fluorometer (Invitrogen) using the Qubit® RNA Assay Kit (Thermo Fisher Scientific Inc.) and the quality was determined by a 2100 BioAnalyzer (Agilent Technologies, Palo Alto, CA, USA). RNA integrity number (RIN) was used to assess the RNA quality (scale 1 – 10, with 1 being the lowest and 10 being the highest RNA quality). qPCR (quantitative PCR) assays using nitrogen-specific primer pairs revealed high Ct values of ≥ 37, showing that the amounts of DNA in our samples were negligible.

8.1.2. DNA marker and primers sequences

Sequences of the primer pairs and expected fragments are shown below (Table 8.1.). The primer pairs were designed (Invitrogen) to span the 30-most intron to avoid amplification of DNA templates that may be present in trace amounts in the RNA samples.

Table 8.1. Primer sets used in this study and expected fragments sizes.

<table>
<thead>
<tr>
<th>Gene</th>
<th>Accession number</th>
<th>Reverse primer sequence</th>
<th>Forward primer sequence</th>
<th>Amplicon length (bp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OXTR</td>
<td>NM_000916</td>
<td>5'-GCTGAAACTTGATGGCTCCG-3'</td>
<td>5'-TTCTGGGGTGCTATGGG-3'</td>
<td>67</td>
</tr>
<tr>
<td>ACTβ</td>
<td>NM_001101</td>
<td>5'-CCCAGCCATGTACGTTGCTA-3'</td>
<td>5'-TCACCGGATCCATACGGA-3'</td>
<td>65</td>
</tr>
<tr>
<td>TUBa</td>
<td>NM_006082</td>
<td>5'-CTTTGAGCCAGCCAACCAGA-3'</td>
<td>5'-GTACAAACAGCCAGCAAGCCAT-3'</td>
<td>72</td>
</tr>
</tbody>
</table>
8.1.3. RNA quality

Because the overall RNA quality is a major factor in studies on gene expression, it had to be determined whether the RIN value was influenced by confounding factors. The mean RIN of the saliva samples of the three interventions, was 7.2 +/- 0.6. However, there was no significant difference in RIN values between the experimental samples and the control group (z = -1.529, p = 0.126).

8.1.4. cDNA synthesis

For each sample, an equal quantity of RNA (300 ng) was used for the synthesis of cDNA, mixed with 4.1 μl mixture of oligo dT (100 μg ml⁻¹) and 10 x hexanucleotide (Roche, Basel, Switzerland; 40:1), heated to 80°C for 10 minutes, after which the tubes were quickly transferred into ice. Then, 1 μl reverse transcriptase Superscript II (Invitrogen Life Technologies) was added together with a mixture of 5 μl 5 x first-strand buffer, 2.5 μl 100 mM dithiothreitol, 1.5 μl 10mM dNTPs and 0.5 μl RNase inhibitor. The synthesis reaction was allowed to proceed for 1 hour at 42 °C, after which cDNA was stored at -20 °C for further analysis or used immediately.

8.1.5. Quantitative PCR

Specific qPCR reactions (Figure 8.1.) were carried out to examine the expression levels of OXTR in saliva collected from the three interventions/studies. The qPCR reaction contained 10 μl 2 x SYBR Green Mastermix (Applied Biosystems, Foster City, CA, USA), 1 μl of each
primer pair (1μM) and 5μl (equivalent to 2 ng μl⁻¹ total RNA) of template cDNA in a 20 μl reaction volume.

The qPCR reactions were performed using an ArialMx real-time PCR System (Agilent Technologies) at the University of Bolton. The cycling parameters for the amplification reaction were as follows: 10 minutes at 95 °C followed by 40 cycles of 15 seconds at 72 °C and 1 minute at 60 °C. The specificity of the amplification was checked by melting curve analysis and electrophoresis of the products on an 0.8% agarose gel. Sterile distilled water, RNA samples without addition of reverse transcriptase in the cDNA synthesis, and DNA samples were used as a control.

**Figure 8.1.** Steps and variables of mRNA and DNA quantification using RT-qPCR.
The linearity of qPCR assay was tested by preparing a series of dilutions of the same stock cDNA in multiple plates. A normalization strategy was used for gene quantification (see below). The relative absolute amount of the target genes were calculated by $10^{10 \times E_{ct}} (E=10^{(\frac{1}{slope})})$ method (Kamphuis, Schneemann, van Beek et al., 2001).

8.1.6. Normalization strategy and considerations in relation to the reference genes

There are a number of reports indicating that the classic reference genes may be regulated under certain conditions. Therefore they might be unsuitable for normalization purposes. Currently, in the present study, a combination of two reference genes was used for normalization, according to the geNorm program, using the pairwise comparison. To remove sampling-related differences (RNA quality and RNA quantity), a normalization strategy based upon the geNorm approach was followed (Hellemans et al, 2007). The normalization factor was the genomic mean of the $ACTIN\beta$ ($ACT\beta$) and $TUBULIN\alpha$ ($TUB\alpha$) genes. The absolute amount of transcript determined, was then divided by the normalization factor to obtain the normalized values.

8.1.7. Statistical analysis

Statistical analysis was conducted with IBM SPSS Statistics 23 software. The differences between the samples and the intervention sessions were statistically evaluated by the non-parametric Mann-Whitney U-test. For a full description of non-parametric tests see Siegel (1956).
8.1.8. Results

In order to examine the regulation of *OXTR* gene expression in response to PPI, a qRT-PCR was exploited. In the qRT-PCR, the amount of cDNA was measured after each cycle via fluorescent dyes that yielded increasing fluorescent signal in direct proportion to the number of PCR product molecules (amplicons) generated. Data collected in the exponential phase of the reaction yielded quantitative information on the starting quantity of the amplification target. By plotting fluorescence against the cycle number, the real-time PCR instrument generated an amplification plot that represented the accumulation of product over the duration of the entire PCR reaction.

As described earlier, three studies (two pilot studies and an RCT) have been carried out within this PhD research. For the purpose of presentation of the results from the *OXTR* expression analyses, and for simplicity, these studies have been labelled as Pilot Study I, II, and III. Results from the three Pilot Studies are presented in a box-plot diagram in Figure 8.2., Figure 8.3., and Figure 8.4.

Quantitative analysis of the data collected from the Pilot Study I (Figure 8.2.; \( n_{\text{max.}} = 12 \)), Pilot Study II (Figure 8.3.; \( n_{\text{max.}} = 11 \)), and Pilot Study III (Figure 8.4.; \( n_{\text{max.}} = 8 \)) showed significant increases (fold change) in the *OXTR* gene expression levels in response to the PPI.

Interestingly, after the Week 4 in all Pilot Studies, participants had slightly higher levels (median) of *OXTR* before the start of PPI, compared to the *OXTR* levels determined in Week 1 – Week 4.
Figure 8.2. Box and whisker plot of OXTR gene expression levels in saliva samples collected from participants in Pilot Study I, as assessed by qRT-PCR.

Week Xa: mRNA expressed before the start of the PPI; Week Xb: mRNA expressed after the end of the PPI; OXTR: Ref. Seq. ID NM_00916; ACTb Ref. Seq. ID NM_001101; TUBα: Ref. Seq. ID NM_006082. \( n \text{ max.} = 12 \)

Figure 8.3. Box and whisker plot of OXTR gene expression levels in saliva samples collected from participants in Pilot Study II, as assessed by qRT-PCR.

Week Xa: mRNA expressed before the start of the PPI; Week Xb: mRNA expressed after the end of the PPI; OXTR: Ref. Seq. ID NM_00916; ACTb Ref. Seq. ID NM_001101; TUBα: Ref. Seq. ID NM_006082. \( n \text{ max.} = 11 \)
Figure 8.4. Box and whisker plot of OXTR gene expression levels in saliva samples collected from participants in Pilot Study III, as assessed by qRT-PCR.

Week Xa: mRNA expressed before the start of the PPI; Week Xb: mRNA expressed after the end of the PPI; OXTR: Ref. Seq. ID NM_000916; ACTb Ref. Seq. ID NM_001101; Ref. Seq. ID TUBα: NM_006082. n\text{\_max.} = 8
8.2. Psychological Outcomes of the PPI Combining Data from All Studies

8.2.1. Material and methods

The present study used a quasi-experimental within-subjects research design to assess the effectiveness of the current PPI on the participants’ well-being, body image flexibility, depression and anxiety combining data from all previous studies reported in Chapters 6 and 7. Both chapters also give details about the participants, recruitment strategies and procedures; details about the measures can be found in Chapter 6.

To enable data merge into one data file ensuring that each participant could still be identified, the participant numbers had to be re-coded. Since saliva samples were not collected from the second group of pilot study II. and from the control group of the RCT, participants in these groups were not included in the data merge. Subjects included in the current analyses were assigned new participant numbers which are presented in Table 8.2.
Table 8.2. List of participant numbers in pilot study I., pilot study II., and the intervention group of the RCT before and after data merge.

<table>
<thead>
<tr>
<th>Study</th>
<th>Participant number before merging</th>
<th>Participant number after merging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Study I.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Pilot Study II. – group 1 only</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>RCT – intervention group only (Pilot Study III)</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>38</td>
</tr>
</tbody>
</table>
8.2.2. Results

Two sets of paired-samples t-test were conducted to evaluate the impact of the intervention on the participants’ well-being (PERMATotal), body image flexibility (BIAAQTotal), anxiety (GAD7Total), and depression (PHQ9Total). The first analysis was carried out with all participants ($n = 38$) but included only the measure of well-being (PERMA) with all its subscales, and the measure of body image flexibility (BIAAQ), as the first pilot study did not include measures of depression and anxiety (PHQ9, GAD7). For the purpose of the second analysis which included all the measures, first pilot study participants were removed leaving the total number of 24 subjects ($n = 24$).

Analysis I.

There was a statistically significant decrease in BIAAQTotal scores from the time before the intervention (BIAAQTotalA, $M = 44.47$, $SD = 18.63$) to the time after the intervention (BIAAQTotalB, $M = 39.03$, $SD = 16.02$), $t (37) = 3.663$, $p = .001$ (two-tailed), indicating an increase in the participants’ body-image flexibility in response to the intervention with large effect size (eta squared = .27). There was also a statistically significant increase in PERMATotal scores from the time before the intervention (PERMATotalA, $M = 147.03$, $SD = 26.93$) to the time after the intervention (PERMATotalB, $M = 162.13$, $SD = 24.23$), $t (37) = -5.319$, $p < .001$ (two-tailed). The eta squared statistic (.43) indicated a large effect size of the PPI on the participants’ overall well-being. Additionally, there were significant changes in the scores on all nine of the PERMA subscales with large effect sizes for eight subscales (PERMAPositiveEmotion, PERMARelationship, PERMAMeaning, PERMAAccomplishment, PERMALoneliness, PERMANegativeEmotion, PERMAHealth,
OXTR EXPRESSION ANALYSES AND COMBINED PSYCHOLOGICAL ANALYSES

PERMAHappiness), and moderate effect size for one subscale (PERMAEngagement). While scores on PERMAPositiveEmotion, PERMAEngagement, PERMARelationship, PERMAMeaning, PERMAAccomplishment, PERMAHealth, and PERMAHappiness significantly increased, scores on PERMALoneliness and PERMANegativeEmotion significantly decreased (Table 8.3).

Table 8.3. Paired-samples T-test analysis of the effect of the PPI on body-image flexibility,

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>5.45</td>
<td>9.17</td>
<td>3.663**</td>
<td>37</td>
<td>.001</td>
<td>.27</td>
</tr>
<tr>
<td>2. PERMATotalA &amp; PERMATotalB</td>
<td>-15.11</td>
<td>17.51</td>
<td>-5.519**</td>
<td>37</td>
<td>&lt;.001</td>
<td>.43</td>
</tr>
<tr>
<td>3. PERMAPositiveEmotionA &amp; PERMAPositiveEmotionB</td>
<td>-2.29</td>
<td>3.18</td>
<td>-4.440**</td>
<td>37</td>
<td>&lt;.001</td>
<td>.35</td>
</tr>
<tr>
<td>4. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-1.08</td>
<td>2.83</td>
<td>-2.348*</td>
<td>37</td>
<td>.024</td>
<td>.13</td>
</tr>
<tr>
<td>5. PERMARelationshipA &amp; PERMARelationshipB</td>
<td>-1.76</td>
<td>3.60</td>
<td>-3.021*</td>
<td>37</td>
<td>.005</td>
<td>.20</td>
</tr>
<tr>
<td>6. PERMAMeaningA &amp; PERMAMeaningB</td>
<td>-1.76</td>
<td>3.18</td>
<td>-3.415*</td>
<td>37</td>
<td>.002</td>
<td>.24</td>
</tr>
<tr>
<td>7. PERMAAccomplishmentA &amp; PERMAAccomplishmentB</td>
<td>-2.61</td>
<td>3.70</td>
<td>-4.338**</td>
<td>37</td>
<td>&lt;.001</td>
<td>.34</td>
</tr>
<tr>
<td>8. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>1.18</td>
<td>2.47</td>
<td>2.956*</td>
<td>37</td>
<td>.005</td>
<td>.19</td>
</tr>
<tr>
<td>9. PERMANegativeEmotionA &amp; PERMANegativeEmotionB</td>
<td>1.66</td>
<td>4.05</td>
<td>2.524*</td>
<td>37</td>
<td>.016</td>
<td>.15</td>
</tr>
<tr>
<td>10. PERMAHealthA &amp; PERMAHealthB</td>
<td>-2.42</td>
<td>3.76</td>
<td>-3.793**</td>
<td>37</td>
<td>.001</td>
<td>.28</td>
</tr>
<tr>
<td>11. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-.76</td>
<td>1.15</td>
<td>-4.093**</td>
<td>37</td>
<td>&lt;.001</td>
<td>.31</td>
</tr>
</tbody>
</table>

and well-being of the participants in pilot study I., pilot study II., and the intervention group of the RCT.

**p<=.001; *p<.05
OXTR EXPRESSION ANALYSES AND COMBINED PSYCHOLOGICAL ANALYSES

Analysis II.

There was a statistically significant decrease in GAD7Total scores from the time before the intervention (GAD7TotalA, $M = 10.25$, $SD = 5.99$) to the time after the intervention (GAD7TotalB, $M = 6.71$, $SD = 5.46$), $t (23) = 3.358$, $p = .003$ (two-tailed) with large effect size as indicated by the eta squared statistic (.33). The depression scores (PHQ9Total) also decreased significantly from the time before the intervention (PHQ9TotalA, $M = 11.25$, $SD = 5.58$) to the time after the intervention (PHQ9TotalB, $M = 8.83$, $SD = 6.81$), $t (23) = 3.098$, $p = .005$ (two-tailed) with large effect size (eta squared =.29). Similarly, as in the first analysis, there was also a statistically significant decrease in BIAAQTotal scores from the time before the intervention (BIAAQTotalA, $M = 47.08$, $SD = 20.66$) to the time after the intervention (BIAAQTotalB, $M = 40.54$, $SD = 16.90$), $t (23) = 3.348$, $p = .003$ (two-tailed), indicating an increase in the participants’ body-image flexibility in response to the intervention with large effect size (eta squared =.33). PERMATotal scores from the time before the intervention (PERMATotalA, $M = 141.79$, $SD = 31.32$) to the time after the intervention (PERMATotalB, $M = 159.00$, $SD = 26.14$) increased significantly as well: $t (23) = -4.678$, $p < .001$ (two-tailed). The eta squared statistic (.49) indicated a large effect size of the PPI on the participants’ overall well-being. Additionally, there were significant changes in the scores on all nine of the PERMA subscales with large effect sizes for all (PERMAPositiveEmotion, PERMAEngagement, PERMARelationship, PERMA Meaning, PERMA Accomplishment, PERMALoneliness PERMANegativeEmotion, PERMAHealth, PERMAHappiness). While scores on PERMAPositiveEmotion, PERMAEngagement, PERMARelationship, PERMA Meaning, PERMA Accomplishment, PERMAHealth, and PERMAHappiness significantly increased,
scores on PERMALoneliness and PERMANegativeEmotion significantly decreased (Table 8.4.).

**Table 8.4.** Paired-samples T-test analysis of the effect of the PPI on body-image flexibility, and well-being of the participants in the first group of pilot study II., and the intervention group of the RCT.

<table>
<thead>
<tr>
<th>Paired variables</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GAD7TotalA &amp; GAD7TotalB</td>
<td>3.54</td>
<td>5.17</td>
<td>3.358*</td>
<td>23</td>
<td>.003</td>
<td>.33</td>
</tr>
<tr>
<td>2. PHQ9TotalA &amp; PHQ9TotalB</td>
<td>2.42</td>
<td>3.82</td>
<td>3.098*</td>
<td>23</td>
<td>.005</td>
<td>.29</td>
</tr>
<tr>
<td>3. BIAAQTotalA &amp; BIAAQTotalB</td>
<td>6.54</td>
<td>9.57</td>
<td>3.348*</td>
<td>23</td>
<td>.003</td>
<td>.33</td>
</tr>
<tr>
<td>4. PERMATotalA &amp; PERMATotalB</td>
<td>-18.08</td>
<td>18.94</td>
<td>-4.678**</td>
<td>23</td>
<td>&lt;.001</td>
<td>.49</td>
</tr>
<tr>
<td>5. PERMAPositiveEmotionA &amp; PERMAPositiveEmotionB</td>
<td>-2.71</td>
<td>3.53</td>
<td>-3.756**</td>
<td>23</td>
<td>.001</td>
<td>.38</td>
</tr>
<tr>
<td>6. PERMAEngagementA &amp; PERMAEngagementB</td>
<td>-1.38</td>
<td>3.06</td>
<td>-2.200*</td>
<td>23</td>
<td>.038</td>
<td>.17</td>
</tr>
<tr>
<td>7. PERMARelationshipA &amp; PERMARelationshipB</td>
<td>-2.21</td>
<td>3.74</td>
<td>-2.892*</td>
<td>23</td>
<td>.008</td>
<td>.27</td>
</tr>
<tr>
<td>8. PERMAMeaningA &amp; PERMAMeaningB</td>
<td>-2.25</td>
<td>3.47</td>
<td>-3.179*</td>
<td>23</td>
<td>.004</td>
<td>.31</td>
</tr>
<tr>
<td>9. PERMAAccomplishmentA &amp; PERMAAccomplishmentB</td>
<td>-3.08</td>
<td>3.73</td>
<td>-4.051**</td>
<td>23</td>
<td>&lt;.001</td>
<td>.42</td>
</tr>
<tr>
<td>10. PERMALonelinessA &amp; PERMALonelinessB</td>
<td>1.08</td>
<td>2.10</td>
<td>2.522*</td>
<td>23</td>
<td>.019</td>
<td>.23</td>
</tr>
<tr>
<td>12. PERMAHealthA &amp; PERMAHealthB</td>
<td>-2.63</td>
<td>4.24</td>
<td>-3.032*</td>
<td>23</td>
<td>.006</td>
<td>.41</td>
</tr>
<tr>
<td>13. PERMAHappinessA &amp; PERMAHappinessB</td>
<td>-0.88</td>
<td>1.23</td>
<td>-3.494*</td>
<td>23</td>
<td>.002</td>
<td>.35</td>
</tr>
</tbody>
</table>

**p</=.001; *p<.05

In addition to the mental health improvements, 15 participants lost between 1 and 12 kg of their body weight, and one participant achieved their desired weight gain after undertaking
the PPI, leaving the total of 16 out of 38 participants achieving their desired weight change (Table 8.5.).

Table 8.5. Participant characteristics and weight data before and after receiving the PPI (all studies).

<table>
<thead>
<tr>
<th>Study</th>
<th>Participant no.</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Weight (kg) before</th>
<th>Weight (kg) after</th>
<th>BMI (kg/m²) before</th>
<th>BMI (kg/m²) after</th>
<th>Weight change (+/-/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot study I.</td>
<td>1</td>
<td>41</td>
<td>Female</td>
<td>92</td>
<td>94</td>
<td>37.8</td>
<td>38.6</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>45</td>
<td>Female</td>
<td>75</td>
<td>72</td>
<td>28.2</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>52</td>
<td>Male</td>
<td>82</td>
<td>82</td>
<td>23.9</td>
<td>23.9</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>20</td>
<td>Female</td>
<td>56</td>
<td>56</td>
<td>22.2</td>
<td>22.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>46</td>
<td>Female</td>
<td>61</td>
<td>62</td>
<td>22.1</td>
<td>22.5</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>48</td>
<td>Female</td>
<td>65</td>
<td>62</td>
<td>26.7</td>
<td>25.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>47</td>
<td>Female</td>
<td>80</td>
<td>75</td>
<td>32.9</td>
<td>31.2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>42</td>
<td>Female</td>
<td>115</td>
<td>116</td>
<td>38</td>
<td>38.8</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>64</td>
<td>Female</td>
<td>64</td>
<td>63</td>
<td>24.7</td>
<td>23.7</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>49</td>
<td>Female</td>
<td>79</td>
<td>76</td>
<td>31.6</td>
<td>31.2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>21</td>
<td>Female</td>
<td>66</td>
<td>66</td>
<td>27.8</td>
<td>27.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>45</td>
<td>Male</td>
<td>90</td>
<td>87</td>
<td>27.7</td>
<td>26.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>20</td>
<td>Female</td>
<td>63</td>
<td>61</td>
<td>22.3</td>
<td>21.6</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>41</td>
<td>Female</td>
<td>82</td>
<td>82</td>
<td>36.4</td>
<td>36.4</td>
<td>0</td>
</tr>
<tr>
<td>Pilot study II.</td>
<td>15</td>
<td>20</td>
<td>Female</td>
<td>106</td>
<td>106</td>
<td>35.2</td>
<td>35.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>19</td>
<td>Female</td>
<td>74</td>
<td>74</td>
<td>28.7</td>
<td>28.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>32</td>
<td>Male</td>
<td>98</td>
<td>97</td>
<td>35.7</td>
<td>35.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>18</td>
<td>Female</td>
<td>125</td>
<td>128</td>
<td>42.3</td>
<td>43.3</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>30</td>
<td>Female</td>
<td>79</td>
<td>78</td>
<td>26.2</td>
<td>25.9</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>20</td>
<td>Female</td>
<td>84</td>
<td>85</td>
<td>32.2</td>
<td>32.6</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>19</td>
<td>Female</td>
<td>84</td>
<td>85</td>
<td>32.4</td>
<td>32.8</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>22</td>
<td>Female</td>
<td>79</td>
<td>80</td>
<td>28.8</td>
<td>29.2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>21</td>
<td>Female</td>
<td>122</td>
<td>126</td>
<td>42.2</td>
<td>43.6</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>18</td>
<td>Female</td>
<td>51</td>
<td>55</td>
<td>20.4</td>
<td>22</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>18</td>
<td>Female</td>
<td>70</td>
<td>71</td>
<td>26.7</td>
<td>27</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>18</td>
<td>Male</td>
<td>88</td>
<td>83</td>
<td>29.7</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>23</td>
<td>Female (pregnant)</td>
<td>86</td>
<td>95</td>
<td>34.9</td>
<td>38.5</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>24</td>
<td>Female</td>
<td>120</td>
<td>120</td>
<td>43.5</td>
<td>43.5</td>
<td>0</td>
</tr>
<tr>
<td>RCT – intervention group</td>
<td>29</td>
<td>39</td>
<td>Female</td>
<td>65</td>
<td>65</td>
<td>23.6</td>
<td>23.6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>50</td>
<td>Male</td>
<td>162</td>
<td>150</td>
<td>51.9</td>
<td>41.1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>22</td>
<td>Female</td>
<td>56</td>
<td>55</td>
<td>22.2</td>
<td>21.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>24</td>
<td>Female</td>
<td>60</td>
<td>58</td>
<td>20.8</td>
<td>20.1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>22</td>
<td>Female</td>
<td>117</td>
<td>112</td>
<td>39.5</td>
<td>37.9</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>20</td>
<td>Female</td>
<td>67</td>
<td>66</td>
<td>27.9</td>
<td>27.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>27</td>
<td>Female</td>
<td>54</td>
<td>56</td>
<td>19.4</td>
<td>19.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>20</td>
<td>Female</td>
<td>68</td>
<td>68</td>
<td>23.5</td>
<td>23.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>18</td>
<td>Female</td>
<td>55</td>
<td>55</td>
<td>21.2</td>
<td>21.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>58</td>
<td>Male</td>
<td>91</td>
<td>91</td>
<td>29.7</td>
<td>29.7</td>
<td>0</td>
</tr>
</tbody>
</table>

*desired weight gain
Two sets of Pearson’s $r$ correlation were conducted to investigate the relationship between the participants’ determination to change (as measured by the CHANGETotal) and their well-being (PERMATotalB), body image flexibility (BIAAQTotalB), anxiety (GAD7TotalB), and depression (PHQ9TotalB) after the PPI. To enable comparisons with the pre-intervention scores, the following variables were also entered into the correlation matrices: PERMATotalA, BIAAQTotalB, GAD7TotalA, and PHQ9TotalA. The first analysis included only the measures of well-being (PERMA) and body image flexibility (BIAAQ), as the first pilot study did not include measures of anxiety and depression (GAD7, PHQ9). For the purpose of the second analysis which included all measures, first pilot study participants were removed. Preliminary analyses were performed for both correlations to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

**Analysis I.**

There were positive correlations between the participant’s readiness to change (CHANGETotal) and their post-intervention scores on well-being (PERMATotalB), $r = .214$, $n = 38$, $p = .198$, and body image flexibility scores after the intervention (BIAAQTotalB), $r = .109$, $n = 38$, $p = .517$. However, none of these was significant. Interestingly, a significant negative correlation was identified between the post-intervention scores on well-being (PERMATotalB) and post-intervention scores on body-image flexibility (BIAAQTotalB) where higher score indicates lower body image flexibility, $r = -.399$, $n = 38$, $p = .014$. The same relationship was observed for the pre-intervention scores on both measures suggesting that the better the level of well-being, the higher the body-image flexibility (Table 8.6.).
**Table 8.6.** Pearson product-moment correlations between measures of readiness to change and well-being, and body-image flexibility with the participants from pilot study I., pilot study II., and the intervention group of the RCT.

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANGETotal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMATotalA</td>
<td>.088</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMATotalB</td>
<td>.214</td>
<td>.771**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIAAQTotalA</td>
<td>.111</td>
<td>-.490*</td>
<td>-.424*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BIAAQTotalB</td>
<td>.109</td>
<td>-.365*</td>
<td>-.399*</td>
<td>.871**</td>
<td>1</td>
</tr>
</tbody>
</table>

**p<.001; *p<.05**

**Analysis II.**

There were negative correlations between the participant’s readiness to change (CHANGETotal) and their post-intervention scores on body image flexibility (BIAAQTotalB), $r = -.114$, $n = 24$, $p = .597$, anxiety (GAD7TotalB), $r = -.282$, $n = 24$, $p = .181$, and depression (PHQ9TotalB), $r = -.257$, $n = 24$, $p = .225$. The correlation with post-intervention scores on well-being (PERMATotalB) was positive, $r = .180$, $n = 24$, $p = .400$. However, as in the first analysis, none of these were significant. There was a significant negative correlation between the post-intervention scores on well-being (PERMATotalB) and post-intervention scores on body-image flexibility (BIAAQTotalB), $r = -.504$, $n = 24$, $p = .012$. The same relationship was observed for the pre-intervention scores on both measures suggesting that the better well-being, the higher body-image flexibility. Unsurprisingly, there were significant negative correlations between the post-intervention scores on well-being (PERMATotalB) and anxiety (GAD7TotalB), $r = -.775$, $n = 24$, $p < .001$, as well as depression (PHQ9TotalB), $r = -.809$, $n = 24$, $p < .001$. There were also significant positive correlations between the post-intervention...
scores on body image flexibility (BIAAQTotalB) and anxiety (GAD7TotalB), \( r = .498, n = 24, p = .013 \), as well as depression (PHQ9TotalB), \( r = .542, n = 24, p = .006 \) (Table 8.7).

**Table 8.7.** Pearson product-moment correlations between measures of readiness to change well-being, body-image flexibility, anxiety, and depression with the participants from pilot study II., and the intervention group of the RCT.

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANGETotal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMATotalA</td>
<td>.152</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMATotalB</td>
<td>.180</td>
<td>.797**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIAAQTotalA</td>
<td>-.082</td>
<td>-.566*</td>
<td>-.558*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIAAQTotalB</td>
<td>-.114</td>
<td>-.430*</td>
<td>-.504*</td>
<td>.889**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAD7TotalA</td>
<td>-.076</td>
<td>-.843**</td>
<td>-.680**</td>
<td>.423*</td>
<td>.278</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAD7TotalB</td>
<td>-.282</td>
<td>-.658**</td>
<td>-.775**</td>
<td>.407*</td>
<td>.498*</td>
<td>.596**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHQ9TotalA</td>
<td>-.229</td>
<td>-.855**</td>
<td>-.808**</td>
<td>.577*</td>
<td>.504*</td>
<td>.850**</td>
<td>.847**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHQ9TotalB</td>
<td>-.257</td>
<td>-.669**</td>
<td>-.809**</td>
<td>.459*</td>
<td>.542*</td>
<td>.611*</td>
<td>.959**</td>
<td>.864**</td>
<td>1</td>
</tr>
</tbody>
</table>

*p<.05; **p<.001
8.3. Discussion and Conclusions

The expression of the *OXTR* gene has been associated with emotional wellbeing (see Chapter 5 for a comprehensive review). In this study, the salivary *OXTR* gene expression levels, in response to the described PPI, were determined by qRT-PCR. The abundance of *OXTR* mRNA was normalised to the expression levels of *ACTβ* and *TUBα* reference genes.

Results taken from the three studies (two pilot studies and an RCT) showed significant increases (expressed as fold change) of the *OXTR* expression levels in response to the PPI. By comparing samples that have been collected from participants before the start, and just after the end of each session of the PPI, an increased abundance of *OXTR* was quantified in the three studies.

Concurrently, the PPI had a significant effect on participants’ emotional wellbeing (Chapter 6 and Chapter 7). It is possible that the significant effect of PPI on participants’ emotional wellbeing to be modulated via the *OXTR* molecular genetic pathway.

Interestingly, after the Week 4 in all three studies, participants had slightly higher levels (median) of *OXTR* before the start of PPI, compared to the *OXTR* levels determined in Week 1 – Week 4. This could be another long term positive effect of the PPI on participant’s emotional wellbeing. However, the potential long-term positive effect of the PPI (as observed in Week 5 and Week 6) is limited by the fact that increasingly more psychological interventions are delivered in short periods of time (often 6-8 weeks; see Chapter 2). Hence, it is proposed that PPIs with duration of more than six weeks, might be more effective.

It is therefore reasonable to suppose that the proposed PPI can supplement conventional psychology interventions that relieve depression symptoms in response to eating-related
OXTR EXPRESSION ANALYSES AND COMBINED PSYCHOLOGICAL ANALYSES

disorders. With the increasing amount of research in this area, it is highly likely that in near future, several PPIs will be developed with the aim to increase happiness, and decrease depressive symptoms related to eating and other type of disorders.

In conclusion, the OXTR gene expression levels could be used as a potential biomarker in validation of PPIs, promoting the practical legacy of positive psychology.
Obesity represents a world-wide health problem with substantial medical, social, and economic consequences (Tremmel et al., 2017). Despite the public health warnings of increased body weight, there is inconsistent evidence for long-lasting effects of any of the currently applied treatments (Fradkin et al., 2016). The purpose of the present PhD project was to explore the possibility of using positive psychology as an alternative approach to obesity treatment. Incorporating molecular genetic approaches, this research had the following four aims:

2. Develop a positive psychological intervention (PPI) for individuals with weight problems.
3. Assess its effectiveness on well-being (overall well-being, body image flexibility, depression and anxiety), and weight loss in non-clinical populations.
4. Identify potential molecular genetic pathways through which the intervention functions.
5. Validate the intervention by using OXTR expression as a model system.

A 6-week PPI combining online learning with experiential group work was developed within the scope of this PhD (see Chapter 4 for details about the PPI design). It was piloted in two studies with the total of 38 participants (Chapter 6) and subsequently tested in an RCT with 20 participants (Chapter 7). To enable consistency in assessment of the OXTR gene expression levels across all groups, the intervention remained unchanged (i.e. the identical intervention was delivered to all participants in both pilot studies, as well as in the RCT).
DISCUSSION

It was expected that the PPI would result in significant increases in overall well-being, and body-image flexibility, and decreases in anxiety and depression across all studies. Although, the intervention did not incorporate any dietary advice or nutritional education, it was expected that weight loss may occur in response to the PPI, particularly in those participants who would carry genetic polymorphisms causing increased responsiveness to positive psychological stimuli (Beevers et al., 2011). As high levels of motivation have been considered a critical necessity for behavioural weight loss programs (Dixon et al., 2009), and readiness to change has been shown to predict treatment outcome of a number of obesity-related mental health problems such as eating disorders (Bewell & Carter, 2008) or substance use and addictions (Demmel et al., 2004), the present PhD research also assessed participants’ readiness to change and its effect on the outcome of the intervention.

9.1. Effectiveness of the PPI on Overall Well-being

Over the past two decades, many studies have demonstrated that engaging in intentional activities that promote flourishing, such as counting one’s blessings (Emmons & McCullough, 2003; Seligman et al., 2005), practicing kindness (Otake et al., 2006), setting personal goals (Green et al., 2006; Sheldon et al., 2002), expressing gratitude (Seligman et al., 2005; Sheldon & Lyubomirsky, 2006) and using personal strengths (Seligman et al., 2005) can be used to enhance well-being, and, in some cases, to alleviate symptoms of depression (Seligman et al., 2005). Two independent meta-analyses (Sin & Lyubomirsky, 2009; Bolier et al., 2013b) covering a total of 69 randomized controlled studies have provided support for the effectiveness of PPIs in terms of increases in subjective and psychological well-being, and amelioration of depression. The interventions that have been developed and evaluated thus far focus on a broad variety of psychological constructs (e.g., gratitude, hope, goal-attainment, compassion,
humour, etc.) and use diverse techniques. Also, most of them do not refer explicitly to a theoretical framework or aim at directly targeting different components of a well-being theory, which has been seen as a potential limitation (Gander et al., 2016). As some well-being components may be more susceptible to change than others (Gander et al., 2016), the present research aimed to combine the advantages of using different psychological constructs within a PPI, and evaluating their impact on different aspects of well-being using a particular theoretical framework; the Well-Being Theory (Seligman, 2011).

9.1.1. Well-being

Across all studies conducted within this PhD, the PPI has consistently shown to be effective for increasing overall well-being, which was in line with past research that directly evaluated interventions based on the five components (Positive emotions, Engagement, Relationships, Meaning, and Accomplishment) of Seligman’s (2011) Well-Being Theory (Giannopoulos & Vella-Brodrick, 2011; Gander et al., 2016). After the 6-week intervention participants’ levels of flourishing increased significantly with large effect sizes in both pilot studies, as well as in the intervention group of the RCT. This confirmed previous findings suggesting that PPIs that include a variety of psychological constructs can be used to increase well-being in non-clinical populations (Bolier et al., 2013b).

The benefits of well-being have been previously recorded in both cross-sectional and longitudinal research and include improved productivity at work, having more meaningful relationships and less health care uptake (Keyes & Grzywacz, 2005). Wellbeing has also been positively associated with better physical health (Diener & Chan, 2011; Howell et al., 2007; Lamers et al., 2012), which is of particular importance with regards to the obesity-focus of the present research. It is possible that this association is mediated by a healthy lifestyle and a
DISCUSSION

healthier immune system, which buffers the adverse influence of stress (Pressman & Cohen, 2005). Increasing well-being in individuals with weight problems, may play an important role in their ability to cope with stressful life events which would normally lead to emotional eating (Singh, 2014). In addition, the available evidence suggests that well-being reduces the risk of developing mental symptoms and disorders (Keyes et al., 2010; Wood & Joseph, 2010) and helps reduce mortality risks in people with physical disease (Lamers et al., 2012), which is again highly relevant to obese populations. From this perspective, the significant findings of the present research are encouraging, however, it would be worth investigating whether the positive change was maintained over time.

Positive emotions

When further evaluating the five components of flourishing, both pilot studies showed significant increases in positive emotions, which was partially observable in the RCT as well. When compared to the control group positive emotions were marginally significant but this was only true for one of the tests. Findings on the ANCOVA were non-significant which could have been the result of a small sample size. After combining all data from all studies, positive emotions were, indeed, significantly higher at post-intervention assessment which was in accordance with previous findings on the effectiveness of interventions based on pleasure, engagement and meaning (Giannopoulos & Vella-Brodrick, 2011; Gander et al., 2016).

Looking at more general research, there is an increasing awareness within the field of the important role that positive emotions play in psychopathology (Carl, Soskin, Kerns, & Barlow, 2013; Garland et al., 2010). It has been gradually more apparent that positive affect should become a focus of treatment (Werner-Seidler, Banks, Dunn, & Moulds, 2013). Although it has not always proven more effective than traditional treatment approaches (Chaves, Lopez-Gomez, Hervas & Vazquez, 2017), affect-focus has been shown to have
DISCUSSION

significant positive relationships with symptomatic improvement in various forms of psychotherapy (Diener, Hilsenroth & Weinberger, 2007; Hunt, Schloss, Moonat, Poulos & Wieland, 2007; Watson, Gordon, Stermac, Kalogerakos & Steckley, 2003). Contemporary studies have also highlighted strong positive relationships between the facilitation of in-session client affective experiences and healthy therapeutic alliances (Bachelor, 1995; Sexton, Hembre, & Kvarme, 1996), as well as patient-rated session quality and clinical progress (Saunders, 1999). Considering the fact that the present intervention was delivered to the Psychology, Psychotherapy and Counselling students, and hence potential future therapists, the observed increase in positive emotions is highly important, as it may help to enhance professional skills necessary for good psychotherapy (e.g. affect experiencing; Cramer, 2013), in addition to having personal benefits.

Engagement

Findings on engagement were slightly less consistent across the three studies. In the first pilot study, participants’ engagement was not significantly different from the time before to the time after the intervention, which was a similar effect to the one observed in a relatively recent trial where the intervention group showed a stronger increase in positive emotions and self-efficacy compared to the control group, but not on engagement (Ouweneel, Le Blanc & Schaufeli, 2013).

In the second pilot study, on the other hand, where the sample size was much bigger, engagement was close to the level of significance (p = .053). When compared to the controls in the main trial, participants in the immediate intervention group showed significantly higher levels of engagement on all tests. Similarly, when analysing merged data combining all studies, engagement increased significantly after the intervention, which was in line with studies
assessing effectiveness of interventions that targeted the concept of engagement directly (Giannopoulos & Vella-Brodrick, 2011; Gander et al., 2016).

Findings of the present research argue against previously presented idea in positive psychology suggesting that PPIs are most effective for those people in the middle range of the well-being continuum and potentially less useful for those who are very depressed or already flourishing (Gander et al., 2016). Results of the current studies seem to be much more in line with the two aforementioned meta-analyses that reported stronger effects for those participants with elevated scores in depression or those suffering with specific psychosocial problems (Bolier et al., 2013b; Sin & Lyubomirsky, 2009). From this perspective, engagement might be moderated by the intervention design. When interventions are overseen by a therapist, they may be less prone to the participants’ self-regulation than self-administered interventions (Proyer, Ruch & Buschor, 2013), which could be the reason why group work has a larger effect on engagement.

**Relationships**

Similarly to the engagement concept, effectiveness of the PPI on relationships was not 100 per cent consistent across the studies. In the first pilot study, relationships did not change significantly, whereas in the second pilot study, they did. Results from the main trial showed marginal significance but only on one of the tests. However, when all data were combined, relationships increased significantly from the time before to the time after the intervention. Emerging research has identified social support as one key characteristic influencing intervention effectiveness (Lyubomirsky & Layous, 2013), and interventions fostering social kindness and gratitude have been shown to significantly strengthened relationship satisfaction (O'Connell, O'Shea & Gallagher, 2016). The present research findings support a previously
highlighted need for interventions designed to increase social closeness (Kok & Fredrickson, 2013), which plays an important role in overall well-being and life satisfaction (Chu, Saucier, & Hafner, 2010; Lyubomirsky et al., 2005a). However, it would be beneficial to conduct this research with a larger sample size which would be likely to positively affect all of the other flourishing sub-domains. Furthermore, information on the size and quality of the participants’ social networks should be considered, since these factors might be important moderators of the effectiveness of this intervention.

**Meaning**

Findings on the meaning component of flourishing were only significant in the second pilot study. Results from the first pilot study, as well as from the RCT (all tests) showed non-significant effects of the intervention on meaning. This finding was in line with previous research that assessed the effectiveness of interventions based on pleasure, engagement and meaning on well-being (Giannopoulos & Vella-Brodrick, 2011). It seems that the meaning aspect was not as influenced by the PPI as positive emotions, engagement or relationships, possibly due to the impact of societal conditioning which places much emphasis on hedonia. Research has demonstrated that meaning in life is, indeed, affected by a PPI when the participants’ life circumstances take a dramatic shift away from hedonia. For example, a recent study has shown that PPI enhances meaning in life of mothers of children diagnosed with cancer (Damreihani, Behzadipour, Haghpanh & Bordbar, 2018).

On the other hand, the current research results could have been affected by small sample sizes. In the overall analysis which included data from all separate studies, meaning actually did increase significantly after the intervention. This somehow confirmed the notion that some well-being components may be more susceptible to change than others (Gander et al., 2016).
DISCUSSION

It has been previously argued that addressing different aspects of well-being based on an individual's well-being profile and their preferences may increase the “fit” between the person and the activity, and therefore the effectiveness of an intervention (e.g., Schueller, 2012; Senf & Liau, 2013; Proyer et al., 2015a; Proyer, Wellenzohn, Gander & Ruch, 2015). From this perspective, participants from the first pilot study and the RCT may have been less of a “meaning profile” than the second study participants who were more responsive to the intervention in terms of meaning.

Accomplishment

Previous research has identified accomplishment based interventions as strongly related to happiness and well-being (Gander et al., 2016). In the majority of studies carried out within this PhD, accomplishment was positively affected by the PPI. In the intervention group of the RCT, all tests showed significant increases in accomplishment compared to the control group. Given the fact that the trial was conducted with just 20 participants (10 in each group), these findings were encouraging. Similarly, in the second pilot study, the participants’ perception of accomplishment also increased significantly from the time before to the time after the intervention. Although, the findings from the first pilot study were non-significant, they were relatively close to the significance level suggesting that this was potentially caused by a small sample size. When all the data were combined, accomplishment, indeed, was significantly higher after the intervention. Although no follow-up assessment was carried out in the present studies, previous findings indicated that this effect can last up to six months after the intervention has come to end (Gander et al., 2016).

The significant increases in accomplishment reported here are particularly interesting from the perspective of education. Participants in all studies of this research were first year
university students (except for the first pilot which was conducted with a mixed sample of students and staff), who tend to have high expectations in terms of academic achievement (Kandiko & Mawer, 2013). They want to enhance their learning but also be supported by their institution. The PPI may have affected accomplishment though broadening the students’ attention (Bolte et al., 2003; Fredrickson, 1998; 2001; Fredrickson & Branigan, 2005; Kristjánsson, 2012; Rowe et al., 2007), and enabling more creative (Isen et al., 1987; Estrada et al., 1994) and more holistic thinking (Isen et al., 1991; Kuhl, 1983; 2000), which are believed to be conducive to learning. Over the past two decades, there has been an increasing support for a new era of student-centred teaching practices dedicated to enhancing student wellbeing which has come not only from researchers and psychologists, but also from school and education authorities, who are showing an increased appetite for integrating positive psychology-based programs into the learning curriculum (Chodkiewicz & Boyle, 2016). The fact that the present intervention increased not only the student’s overall well-being, but also accomplishment, presents an important argument for the application of positive teaching and learning approaches into the higher education sector.

9.1.2. Symptoms of depression and anxiety

Over the past few decades, many psychological treatments have been developed for common mental problems and disorders such as depression and anxiety. Effectiveness has been established for cognitive behavioural therapy (Curran, Machin & Gournay, 2006; Haddad, Rogers & Gournay, 2007), problem-solving therapy (Cuijpers, de Wit, Kleiboer, Karyotaki & Ebert, 2018) and interpersonal therapy (Cuijpers, Geraedts, van Oppen et al., 2011). On the other side, there has been an expanding research on PPIs for treating depression that have
DISCUSSION

proven to be particularly useful for addressing a paucity of positive affect, engagement, and life meaning that characterize depression (Forbes & Dahl, 2005; Seligman et al., 2006).

Although the primary target of the present research was not depression, it was an important aspect of the treatment outcome, as depression has been repeatedly established as one of the most commonly occurring conditions comorbid with obesity (Luppino et al., 2010). Previous research has demonstrated the efficacy of PPIs to alleviate depressive symptoms in both clinical (Sin & Lyubomirsky, 2009) and non-clinical populations (Bolier et al., 2013b).

Results of the studies conducted within this PhD were very much in line with these findings. In the first pilot study, anxiety and depression were not assessed. However, in the second pilot study, they both decreased significantly after the intervention which was not only statistically significant, but for a number of participants also clinically significant (NHS, 2011). Before the PPI there were six students who scored above the cut-off point for severe anxiety on the GAD7 questionnaire. Four out of the six dropped down by two cut-off points after the intervention reporting only mild or no anxiety. Before the PPI six students scored between 15 and 19 identifying moderately-severe depression on the PHQ9 and four scores were above 20 identifying severe depression. One out of the four severely depressed students dropped down by two cut-off points to moderate depression and all the six students with moderately-severe depression moved down by at least one cut-off point to a moderate depression (one student even dropped down to the score range for no depression at all). This was very important given the fact that the mental health of university students has been an area of increasing concern worldwide (Bayram & Bilgel, 2008; Ibrahim et al., 2013). Previous research has provided evidence to suggest that university students are vulnerable to mental health problems, especially depression and anxiety (Nerdrum et al., 2006; Stanley & Manthorpe, 2001; Stewart-Brown et al., 2000) which was also demonstrated in the second pilot study of this research.
DISCUSSION

Targeting mood disorders in university students may not only improve their mental health and well-being, but also increase their performance. An early finding that students experiencing high levels of anxiety or depression are at risk for poor academic performance (Hembree, 1988) has been replicated in many countries including South Africa (Jegede, 1996), Finland (Fröjd, Nissinen, Pelkonen et al., 2008), Australia (Kouzma & Kennedy, 2004), the UK (Putwain, 2009), Germany, the USA, and others (Seipp, 1991). Furthermore, it has been repeatedly argued that increases in well-being and positive emotions broaden students’ attention (Bolte et al., 2003; Fredrickson, 1998; 2001; Fredrickson & Branigan, 2005; Kristjánsson, 2012; Rowe et al., 2007), and enable more creative thinking (Isen et al., 1987; Estrada et al., 1994), and more holistic thinking (Isen et al., 1991; Kuhl, 1983; 2000) which are conducive to learning. From this perspective, the present PPI may be a useful teaching tool for increasing academic performance in university students, which could subsequently have positive effects on their employability.

In the RCT, the intervention group scored significantly lower on anxiety compared to the control group which was also confirmed in further analysis. There was no significant difference between the two groups in their depression scores on either of the tests used, even though the mean scores actually did decrease. This might have been a result of the positive skewness at baseline leaving not much room for growth. Most of the RCT participants scored very low on the PHQ9 to start with (none of the pre-intervention scores in the intervention group indicated clinical significance) and their overall well-being scores were also at the higher end. Research has previously noted that the measurement precision at the higher end of the well-being continuum can be less accurate (Schotanus-Dijkstra et al., 2016) which could explain the unexpected outcomes of the trial. Indeed, when all the data were combined for the purpose of further analysis, both depression and anxiety scores dropped significantly from the time before to the time after the intervention. This confirmed previous findings from two
DISCUSSION

Independent meta-analyses showing effectiveness of PPIs in the amelioration of anxiety and depressive symptoms (Bolier et al., 2013b; Sin & Lyubomirsky, 2009).

The ability of the present intervention to reduce depression and anxiety is also important from the perspective of obesity treatment. The link between mood disorders and abnormal eating has been repeatedly established (see Singh, 2014 for a review). It is hypothesized that individuals regulate their emotions and mood by changing both food choices and quantities. It is also apparent that mood can affect the self-rewarding mechanisms of food consumption (Morris & Reilly, 1987). Specific types of food tend to be preferred under certain psychological conditions (i.e. stress, anxiety, and depression) due to the influence of foods on the activity of brain reward centres (Rangel, 2013; Jauch-Chara & Oltmanns, 2014; Weltens, Zhao & Van Oudenhove, 2014). Positive feedback loops can result in enhancement of appetite leading to obesity. Interestingly, highly palatable foods activate the same brain regions of reward and pleasure that are active in drug addiction (Volkow, Wang, Fowler, Tomasi & Baler, 2012), suggesting a neuronal mechanism of food addiction leading to overeating and obesity (Davis, Curtis, Levitan et al., 2011; Davis, Levitan, Kaplan, Kennedy & Carter, 2014; DiLeone, Taylor & Picciotto, 2012; Volkow et al., 2012; Dagher, 2013; Davis, 2013; Ziauddeen & Fletcher, 2013; Pai, Vella & Richardson, 2014; Potenza, 2014).

Given the link between mood and food addiction, tackling symptoms of depression and anxiety through positive psychology may be an effective way of preventing overeating and obesity.
9.1.3. Body image flexibility

Disordered eating which is commonly observed among individuals suffering with obesity (see Chapter 2 for a review) has been associated with several factors, including body dissatisfaction, body image flexibility, and BMI (Hill et al., 2015). While the roles of body dissatisfaction and BMI have been well researched, body image flexibility is a more recent concept (Hill et al., 2013). It is based on a growing body of research that focuses on changing maladaptive emotion and behaviour regulation strategies, such as avoidance, thought suppression, and rumination that have been shown to play a crucial role in the onset and maintenance of disordered eating (Anestis et al., 2007; Aldao, Nolen-Hoeksema & Schweizer, 2010; Corstorphine, 2006). Positive psychology and new wave Cognitive Behaviour Therapies, such as Acceptance and Commitment Therapy (ACT; Berman, Boutelle, & Crow, 2009), Dialectical Behaviour Therapy (DBT; Safer et al., 2001b), and Mindfulness-Based Cognitive Therapy (MBCT; Baer et al., 2005), explicitly target the reduction of maladaptive regulation strategies and the promotion of alternative and adaptive regulation strategies (e.g., acceptance, mindfulness) in the treatment of disordered eating.

Body image flexibility is a construct developed to reflect these adaptive regulation strategies in the context of experiencing body dissatisfaction and disordered eating (Sandoz et al., 2013). Previous research suggested that clinical improvement is achieved through increased adaptive regulation processes and the promotion of value-consistent behaviours, rather than through the elimination of negative thoughts and feelings about body size, shape, and appearance (Hayes, Villatte, Levin & Hildebrandt, 2011), which is in line with the positive psychology approach used in the present research.
DISCUSSION

Several studies have demonstrated that body image flexibility is negatively associated with body dissatisfaction (Sandoz et al., 2013), and disordered eating (Sandoz et al., 2013; Wendell et al., 2012), but positively associated with general psychological flexibility (Sandoz et al., 2013) which can be boosted by positive interventions (Hayes et al., 1999). Therefore, in the present research it was expected that participants’ body image flexibility would increase in response to the PPI.

Although some of the findings confirmed the predicted outcome, the results were quite inconsistent across the three studies conducted within the scope of this PhD. In the first pilot study, there were no significant changes in body image flexibility. But in the second pilot study, which was conducted with a much larger number of participants, there was a significant increase in body image flexibility from the time before to the time after the intervention. In the RCT, there were no significant differences between the immediate intervention group and the wait list control group in their scores on body image flexibility. However, when the data from all three studies were combined, there was a significant increase in body image flexibility from the time before to the time after the intervention suggesting that the lack of significant findings in the first pilot study and in the RCT might have been due to small sample sizes.

Another possible explanation for the discrepancies across the three studies could be the slightly positive skewness at baseline scores in the first pilot study and the RCT leaving less room for improvement compared to the second pilot study. On the BI-AAQ questionnaire (Sandoz et al., 2013), higher scores indicate low body image flexibility. The mean pre-intervention score in the first pilot was 40 (out of the maximum of 84) while in the second pilot study, it was 52. The apparent mean score difference suggests that the participants in the second pilot study had much lower levels of body image flexibility than the first pilot participants. Similarly in the RCT the intervention group scored 34 on the pre-intervention assessment indicating relatively high body image flexibility to start with. Additionally, there were notable
DISCUSSION

Differences in clinical morbidity between the participants in each study which may have played an important role in the different outcomes. Out of all three studies, participants in the second pilot were the ones with the most weight problems and the highest clinical morbidity, making that study the most directly comparable to past research. In the second pilot study, four out of 24 participants (17%) were morbidly obese (BMI > 40 kg/m²), whereas in the first pilot there was nobody, and in the RCT only one person reached this level of clinical morbidity.

Taking this into account the present research may have somewhat confirmed previous findings suggesting that low body image flexibility is related to disordered eating (Sandoz et al., 2013; Wendell et al., 2012), and in clinical populations, to binge eating severity (Lucena-Santos, Carvalho, Oliveira & Pinto-Gouveia, 2017) which is a strong risk factor for obesity (Grucza, Przybeck & Cloninger, 2007). However, since the current research did not assess disordered eating patterns, and it did not monitor participants’ eating habits over the six weeks of the intervention, this notion would need to be further explored with the relevant assessment in place.

9.2. Effectiveness of the PPI on Weight Loss

Previous research has argued that PPIs may represent a promising strategy to increase positive psychological cognitions and emotions in patients with chronic conditions (Huffman et al., 2015). Without directly targeting particular health behaviours, a feasible PPI might lead to better health behaviour adherence by boosting positive affect, optimism and psychological well-being. The theoretical model adopted for the purpose of this research (Huffman et al., 2015) proposed that positive psychological well-being leads to improvement in mediational factors linked to health behaviours (see Chapter 4 for more details). On the basis of this model
it was argued that the present PPI would lead to improvement in health behaviours (i.e. physical activity, diet) which would be mediated by an improvement in the participants’ psychological and social resources directly targeted by the intervention. As such, the PPI could initiate weight loss without it being the primary focus. Evidence exists in the literature to suggest that positive states improve people’s social, psychological, and physical resources (Aspinwall, 1998; Aspinwall & Tedeschi, 2010; Fredrickson, 1998). Positive affect, in particular, has been linked to improved coping and problem solving skills (Aspinwall & Tedeschi, 2010; Yi-Frazier et al., 2012) which are often primarily maladaptive in individuals with obesity (Conradt et al., 2008).

Initially, the weight loss findings of the present research were quite promising. In the first pilot study seven participants lost between 1 and 5 kg of body weight after undertaking the 6-week PPI and one participant achieved their desired weight gain of 1 kg. Having eight out of 14 people achieving a desired weight change looked very hopeful. However, it ought to be noted that two of those people were within the normal weight range, and therefore their weight loss could not really be considered as relevant to the obesity-related scope of this research. Also for the first pilot study, the intervention was advertised as a program for weight management which might have contributed to the positive weight change outcome. Previous research has shown that mindfulness based approaches to weight loss are more successful if they target individuals who want to lose weight and/or are about to start a diet (Mantzios & Giannou, 2014; Mantzios & Wilson, 2014).

For all subsequent studies, participants undertook the intervention as a part of their university studies, and although some of them actually did identify their goal as being weight loss or healthier eating, the intervention was not advertised as a weight loss program. However, the participants were briefed about the purpose of the research and they were aware that the intervention was developed for individuals with weight problems. While the well-being outcomes of the PPI in second pilot study were very positive, the weight loss was almost non-
DISCUSSION

existent. Although, there were five participants (out of 24) who lost between 1 and 5 kg after the PPI, and two participants who achieved their desired weight gain of 1 kg, there were also 11 participants who gained a notable amount of weight (between 1 and 6 kg) without desiring it. These findings were (to certain extent) in line with a recent meta-analysis of studies applying mindfulness-based interventions (MBIs) to aid weight loss which showed that MBIs are only moderately effective for weight loss (Carrière et al., 2017). The major difference between the present research and the studies included in the meta-analysis was that most of the reviewed trials provided some kind of nutrition or energy balance education and/or incorporated mindful eating meditation in the beginning and/or during the entire MBI (see Chapter 7 for more details). It seems that such education, with a particular focus on mindful eating and nutrition, plays an important role in weight loss success.

Another possible explanation for the difference in weight loss findings between the two pilot studies is that participants in the second pilot study displayed much higher levels of clinical morbidity, and they also suffered with high levels of depression and anxiety which might have contributed to the poor weight loss outcome. Several studies have reported that obesity and major depressive disorder (MDD) and/or anxiety disorders often co-occur and are bi-directionally inter-related (Afari, Noonan, Goldberg et al., 2010; De Wit, Fokkema, van Straten et al., 2010; Luppino et al., 2010). Recently, it has been demonstrated that when combined with MDD and/or anxiety disorders, obesity affects physical quality of life more than each of the conditions alone, making it more difficult to treat those individuals who suffer with the co-morbidity (Nigatu, Reijneveld, Jonge, Rossum & Bültmann, 2016). Although, depression and anxiety were not assessed in the first pilot study, the mean score on the PERMA questionnaire ($M = 156$) indicated that the overall well-being of the participants in the first pilot was much higher than the well-being of participants of the second pilot study ($M = 141$). The
DISCUSSION

weight morbidity was also not present in the first study making it much less likely for depression and/or anxiety to occur in that sample.

Additionally, several previously mentioned studies have documented multiple determinants of weight gain among first year university students, including environmental and lifestyle factors such as access to on-campus dining facilities (Kapinos et al., 2014; Levitsky et al., 2004), physical activity (Kasparek et al., 2008), alcohol consumption (Economos et al., 2008; Lloyd-Richardson et al., 2008), snacking habits (Levitsky et al., 2004), dieting behaviour (Lowe et al., 2006), sex (Cluskey & Grobe, 2009; Gropper et al., 2009; Hoffman et al., 2006; Holm-Denoma et al., 2008; Lloyd-Richardson et al., 2009; Mifsud et al., 2009; Mihalopoulos et al., 2008; Zagorsky & Smith, 2011), race/ethnicity (Gillen & Lefkowitz, 2011), and residence type (Brunt & Rhee, 2008; Vella-Zarb & Elgar, 2010). Given this research evidence, participants in the second pilot study who were, unlike the first pilot participants, first year university students, were at an increased risk of weight gain regardless of the PPI.

Findings from the RCT confirmed that the poor weight loss outcomes in the second pilot study may have been due to the participants being first year university students with high rates of clinical morbidity, and an increased occurrence of co-morbidities with depression and anxiety. In the intervention group, five out of 10 participants lost between 1 and 12 kg of body weight after undertaking the PPI, whereas in the control group the results were almost exactly the opposite: five out of 10 participants gained between 1 and 3 kg of body weight while waiting to undertake the intervention. Although, this finding was encouraging, it ought to be noted that two of the individuals in the intervention group who lost weight were in the normal BMI range (18.5 – 24.99 kg/m²), and one person was only overweight, not obese (BMI = 25 – 29.99 kg/m²). Also, none of the participants who lost weight displayed symptoms of clinical depression and/or anxiety.
DISCUSSION

From this perspective, it is unlikely that the PPI on its own would be an effective approach to weight loss in obese individuals with co-morbidities. There was only one previous study which was conducted as a part of a PhD research that used a similar (i.e. more comprehensive) PPI to aid weight loss in a non-clinical sample of obese women (Robertson, 2015). It was a 16-week intervention which incorporated the concepts of hope, strengths and gratitude. However, similarly as in this PhD research, the weight loss findings of that study were inconsistent with some participants losing but others gaining weight. Furthermore, their sample consisted of only four participants and excluded individuals with severe depression and anxiety. As such, the present research is only reliably comparable to the previously mentioned MBIs for weight loss which have been shown to be the most effective when a dietary/mindful eating components are added (see Carrière et al., 2017). On that basis, it is possible that had the present intervention included some form of nutritional education or dietary guidance, the weight loss would have been more consistent across the three studies.

It is possible that the PPI affected weight loss through unknown molecular genetic pathways, which offers another possible explanation for the discrepancies in weight loss findings between the three studies. Several genetic networks (FTO, DRD2, DRD4) have linked emotional functioning with disordered eating (e.g., Bauer, 2014; Heni et al., 2016; Ptacek et al., 2011; Rask-Andersen et al., 2010; Wang et al., 2011; Wheeler et al., 2013). Some of these networks have identified genetic polymorphisms of different genes as high risk variants that influence the development and maintenance of disordered eating and obesity (see Chapter 5 for a review). Interestingly, recent evidence suggests that although many common genetic variants increase vulnerability for the development of psychopathology in response to environmental stressors, they also appear to predict increased sensitivity to positive aspects of the environment (Assary, Vincent, Keers & Pluess, 2018). In the present research, some participants were clearly more responsive to the intervention than others, suggesting that those
DISCUSSION

individuals were possibly carriers of genetic polymorphisms causing increased responsiveness to a positive psychological stimuli. However, as prior-intervention screening for genetic polymorphisms was not carried out, this notion could not be confirmed, and would require further investigation.

9.3. Readiness to Change (RTC) and the Intervention Outcome

High levels of motivation have been considered a critical necessity for behavioural weight loss programs (Dixon et al., 2009). Although RTC has been shown to predict treatment outcome of a number of obesity-related mental health problems such as eating disorders (Bewell & Carter, 2008) or substance use and addictions (Demmel et al., 2004), its relationship with weight loss outcomes has been somewhat inconsistent. Although some authors showed that RTC is directly related to BMI (Logue et al., 2000), more recent reviews noted that since RTC is typically measured by self-report, it cannot be reliably used to predict either treatment adherence or the magnitude of weight loss among persons pursuing a variety of weight control methods (Casazza et al., 2013; 2015). Therefore, in the present research, RTC was assessed in relation to the psychological outcomes of the intervention only.

In the first pilot study RTC was strongly (negatively) associated with body image flexibility before the intervention suggesting that low body image flexibility predicts high determination to change. However, there was no significant correlation with the post-intervention scores suggesting that the intervention outcome on body image flexibility could not be reliably determined on the basis of the participants’ RTC. There was no significant correlation with the well-being scores either. However, in the second pilot study, RTC was strongly positively correlated with the post-intervention scores on well-being indicating that
DISCUSSION

the greater the determination to change is, the greater will be the improvements on well-being after the intervention. Confirming this notion, there were also significant (negative) correlations between the RTC and post-intervention scores on depression and anxiety.

Research has shown that particularly in clinical populations suffering with depression (or populations with high level of clinical morbidity, in this case), scores on RTC could be used to predict the treatment outcome (Lewis et al., 2009). Regardless of the treatment modality, higher RTC scores have been shown to result in better treatment outcomes (Lewis et al., 2009) which was clearly observable in the second pilot study of the present research. Scores on depression were also strongly correlated with the RTC at the time before the intervention which was in line with previous research suggesting that severity of depression is associated with greater recognition of the need for change (Myers et al., 2016). Curiously, body image flexibility was not affected by the participants’ determination to change in the second pilot study. Research in obesity-related eating disorders has indicated that high pre-treatment scores on motivation predict lower post-treatment scores on measures of eating preoccupations and body weight and shape concerns (Mansour, Bruce, Steiger et al., 2012). However, it has also been demonstrated that patients with eating disorders are ambivalent about their eating disorder symptoms (Schmidt & Treasure, 2006). On one hand, the eating disorder is perceived as a burden, but on the other hand, it also provides reasons to hold on to it (Serpell & Treasure, 2002). From this perspective, it is possible that in the second pilot study where the participants displayed much higher levels of clinical morbidity compared to the first pilot study participants, the lack of significant relationship between RTC and body image flexibility was caused by ambivalent attitudes about body weight and shape, and related eating habits of the participants. However, this notion would need to be further explored.

Contrary to expectations, in the main trial, readiness to change was not related to any of the post-intervention scores. The lack of significant findings may be due to the fact that the
present study participants were a convenience sample of first year university students who undertook the intervention as a part of their module. As such, they may not have even considered any change to start with. However, participants for the second pilot study were recruited the same way, and their post-treatment scores were determined by their pre-intervention RTC. It is, therefore, much more likely that the non-significant findings in the main trial were due to a small sample size (there were only 10 participants in the intervention group). Another explanation might be the limitation of self-report assessments of readiness (Casazza et al., 2013; 2015). It has been argued that individuals may overestimate their readiness because they do not clearly understand what behaviors are needed to make them successful, or because they greatly desire the positive outcome, whatever that might be (Casazza et al., 2013; 2015). Additionally, the baseline assessment of the RCT participants revealed lack of clinical morbidity on all measures suggesting that these participants may have simply had no reason to consider any change. RTC was not significantly related to any of the post-treatment measures even after combining data from all studies suggesting that determination to change is very unstable concept and should not be used to predict the treatment outcome. Previous reviews have warned about the instability of RTC self-report measures arguing that they cannot be reliably used to predict treatment outcome among persons pursuing a variety of weight control methods (Casazza et al., 2013; 2015).

Inconsistent findings across the three studies of the present research confirmed that self-report measures of RTC may not be able to reliably predict not only weight loss magnitude but also psychological outcomes of treatment modalities. However, it ought to be mentioned that the present research participants were a non-clinical sample, and therefore, it may be worthwhile to replicate these studies in clinical settings to identify whether RTC could affect treatment outcome in clinical populations.
9.4. Identifying Potential Molecular Genetic Pathways through which the PPI Functions

Gene-environment interaction research has typically been couched in a diathesis-stress framework (Monroe & Simons, 1991), which proposes that some individuals, due to a genetic vulnerability, are disproportionately likely to be adversely impacted by an environmental stressor compared to individuals carrying the “protective” genotype. The consequences being that those individuals carrying the “risk” genotype are more likely to develop a psychological illness when exposed to an adverse environment.

Gene-environment interaction studies have typically focused on a restricted range of environments, predominantly emphasizing adverse environments and the impact for negative psychological outcomes. Very few studies have measured positive environmental variables (aside from the absence of adversity) or considered the effects for adaptive functioning and outcomes (aside from the absence of dysfunction) (Belsky & Pluess, 2009).

The differential-susceptibility hypothesis (Belsky, Bakermans-Kranenburg & van Ijzendoorn, 2007; Belsky, Jonassaint, Pluess et al., 2009; Belsky & Pluess, 2009) and biological sensitivity to context framework (Boyce & Ellis, 2005) argue that “vulnerability” genes may be a misnomer. Instead those individuals considered “vulnerable” by virtue of their genetic make-up, and thus most adversely affected by “negative” (repressed or non inductive) environments may in fact benefit the most from enriched and supportive environments. In this way, individual differences in developmental plasticity and susceptibility to environmental influences may result in genetic influences that act in a “for better and for worse” manner (Belsky et al., 2007). Some individuals are more likely to be affected than others by both,
DISCUSSION

negative and positive environmental conditions. Data from a number of studies investigating a range of molecular biomarkers (e.g. \textit{MAOA}, \textit{SHTTLPR}, \textit{DRD2}, \textit{DRD4}, \textit{DAT1}, \textit{TPH1}, \textit{HT2RA}) have shown that individuals carrying the putative “risk allele” do show a for better and for worse pattern, functioning most poorly when exposed to “negative” environments but showing least problems when they encounter the absence of adversity or positive environments (see Belsky & Pluess, 2009 for a review).

Psychological treatment and therapies for various disorders and psychopathologies are not universally effective with response varying considerably between patients. While many people experience positive outcomes of therapy, approximately 35-45\% of individuals retain significant impairments with a small number getting worse with treatment (DeRubeis, Hollon, Amsterdam et al., 2005; James, Soler & Weatherall, 2005). There is an increasing interest in identifying molecular genetic biomarkers, which predict differential treatment response.

The interaction between a therapeutic intervention and genotype represents a special case of gene-environment interaction (Uher, 2011). Examining a positive experience within a gene-environment interaction framework is relatively rare. The use of a therapeutic intervention, particularly a psychological intervention, is an unusually powerful gene-environment interaction design. The “environment” is positive and predictable, thus allowing any potential moderating genetic effects to be investigated prospectively (unlike typical gene-environment interaction designs which examine stressful life events that are unpredictable and commonly assessed retrospectively) (Lester & Eley, 2013).

The present research examined the interaction between a positive psychological stimuli (the PPI) and the \textit{OXTR} gene assessing the outcome of this interaction in terms of well-being, and obesity (weight loss). Differential gene expression analysis using a real time RT-qPCR
DISCUSSION

approach revealed significant increases in the OXTR expression levels in response to the intervention. This could suggest that the PPI may be able to modulate expression of genes related to positive psychological functioning leading to increased well-being. Bioinformatic approaches revealed a number of gene x gene interactions elucidating potential novel molecular genetic pathways that may affect psychological wellbeing. Figure 9.1. presents a model with hypothesised links between the observed increases in OXTR gene expression and enhanced well-being of participants, and the potential indirect effect of this relationship on obesity-related eating disorders genes. In addition, the model also presents a potential direct link between the OXTR gene and other obesity/eating disorder-related genes, which could affect weight loss/weight change.
DISCUSSION

**Positive Psychology Intervention**
Six-weeks of positive experiential group work supplemented with online learning with each week focusing on a different positive psychological theme: (1) Gratitude, (2) Mindfulness, (3) Self-compassion, (4) Strengths, (5) Hope, (6) Happiness. Identifying the effects on well-being, body-image flexibility, depression, anxiety, and weight loss.

**Enhanced Psychological Well-being**
Promotion of well-being, and repression of depression and anxiety symptoms in non-clinical sample of university students.

**Overeating Disorders**
Connections between eating disorders and emotional and physical well-being.

**Oxytocin Receptor mRNA Transcripts**
The gene encodes a precursor protein that is processed to produce oxytocin and neurophysin I.

**Wet Lab Analysis**
Differential Gene Expression, Real Time RT-PCR.

**In-Silico Analysis**
DNA & protein interactions, co-expression, co-localization and protein domain

**Figure 9.1.** Model suggesting modulation of obesity genes and genes related to positive psychological functioning by the *OXTR* gene activated by the PPI.
DISCUSSION

As discussed in Chapter 5, a relationship exists between the OXTR gene and a number of other genes which have been found to be implicated in obesity. In particular, co-expression interaction was identified between the OXTR and NPY, IL-37, and DRD2. Protein similarity was found with AVPRIA, and AVPRIB and co-localization was found with the IL-1RN.

9.4.1. OXTR and co-expressed genes

NPY is well known for its role in food intake (Lin et al., 2004), and obesity (Dryden et al., 1995; Kuo et al., 2007). Also the adipogenic and antilipolytic effects of NPY have been widely reported (Baker et al., 2009; Kuo et al., 2007; Rosmaninho-Salgado et al., 2012).

The role of DRD2 in obesity has been repeatedly established through the activity of DRD in brain reward centres (Cheng et al., 2003), and its direct relation to motivation and reinforcement (Salamone & Correa, 2002).

With regards to the IL-37, it seems that the gene may actually have a protective function against obesity-induced inflammation and insulin resistance (Ballak et al., 2014; Moschen et al., 2011). During acute and chronic inflammation, IL-37 shifts the cytokine balance away from excessive inflammation (Dinarello & Bufler, 2013), thereby showing potential as a key factor to restore the inflammatory balance in obesity.

The fact that NPY, DRD2, and IL-37 are expressed at the same level as the OXTR suggests that they may be modulated by the same molecular genetic pathway or signal, which could be useful for future co-expression network analyses identifying potential novel functions of the target genes.
9.4.2. **OXTR** and protein similarity

The current research found shared protein domains between the **OXTR** and vasopressin receptors 1A and 1B, which have not been widely researched in human samples. However, even though the research targeting the human variation of these two genes is limited, some evidence does exist to suggest their potential role in obesity.

The T-allele carriers of rs1042615 in **AVPR1A** have been found to have altered plasma glucose and triglyceride levels and an increased diabetes mellitus prevalence among those with a high fat intake (Enhörning et al., 2009). Furthermore, the same polymorphism has been associated with elevated BMI in male T-allele carriers (Masuki et al., 2010). More recently, significant associations have been found between the major allele of rs35810727 in **AVPR1B** and elevated BMI and waist circumference suggesting that genetic variance of **AVPR1B** contributes to overweight (Enhörning et al., 2016).

Homologous sequence is assumed to have similar function, whatever the context, so these “modules” or “mobile domains” allow the transfer of functional information, such as being involved in a particular kind of interaction, between distinct protein classes (Copley et al., 2002). The fact that the current research identified shared protein domains between the **OXTR** and **AVPR1A**, and **AVPR1B** may allow transfer of some information known about the function of the **OXTR** onto the **AVPR1A** and **AVPR1B** genes. As such, this research may help further elucidate the functional role of the vasopressin receptors 1A and 1B in obesity.
9.4.3. *OXTR* and co-localized genes

Understanding the localization of gene expression enables researchers to identify the regions that may be associated with a particular disease, which can lead to identification of shared aetiology between two or more different diseases (Cotsapas et al., 2011). Many studies have confirmed that there is a link between *IL-1RN* polymorphisms and obesity and overall adiposity (see Chapter 5 for a review). Some studies also suggested that obesity-related increase in IL-1RA contributes to the central resistance to leptin in obese patients (Meier et al., 2002). In terms of OXT, the evidence is not so clear. While many studies found link between OXT and food intake and body weight, there is a lack of evidence for associations between particular genetic variants of the *OXTR* and obesity. The fact that the present research identified co-localization between the *OXTR* and *IL-1RN* genes may help elucidate the role of the *OXTR* gene in the aetiology of obesity.

9.5. *OXTR* Gene Expression as a Model System for Validation of PPIs

Increasingly more research evidence is emerging to suggest that positive psychological stimuli produces changes on a molecular genetic level with differences in responsiveness to the stimuli depending on individual genotype (Beevers et al., 2011; Fox, Zougkou, Ridgewell & Garner, 2011). Several molecular genetic studies have shown associations between polymorphisms in human *OXTR* and phenotypes related to social cognition and face processing (Ebstein, Knafo, Mankuta, Chew & Lai, 2012; LoParo & Waldman, 2015; Skuse, Lori, Cubells et al., 2014; Tost, Kolachana, Hakimi et al., 2010; Westberg & Walum, 2013).

---

10 *OXTR* - G-protein-coupled OXT receptor which mediates the effects of OXT (Hovey, Henningsson, Cortes et al., 2017).
DISCUSSION

and emotion recognition (Chen, Kumsta, Dvorak et al., 2015; Hovey, Henningsson, Cortes et al., 2017; Melchers, Montag, Felten, & Reuter, 2013; Rodrigues, Saslow, Garcia, John & Keltner, 2009). Furthermore, polymorphisms in the OXTR have been related to psychological resources of optimism, mastery, and self-esteem (Saphire-Bernstein, Way, Kim, Sherman & Taylor, 2011), which have been found to be significant predictors of effective stress management, neurophysiological responses to stress, and physical and psychological health-related outcomes in previous research (Carver, Scheier & Segerstrom, 2010; Taylor, 2010; Taylor & Broffman, 2011; Taylor, Lerner, Sherman, Sage & McDowell, 2003).

Interestingly, recent findings seem to suggest that while many common genetic variants increase vulnerability for the development of psychopathology in response to environmental stressors, they also appear to predict increased sensitivity to positive aspects of the environment (Assary et al., 2018).

An association between the expression of OXTR gene and emotional wellbeing has been previously identified (see Maud, Ryan, McIntosh & Olsson, 2018 for a review). However, the ability of the OXTR gene to respond to a positive psychological stimuli has not yet been investigated. In this research, OXTR gene expression levels were assessed in response to the described PPI using real-time RT-qPCR.

Results taken from the two pilot studies and the RCT showed significant increases (expressed as fold change) of the OXTR expression levels in response to the PPI. By comparing samples that have been collected from participants before the start, and just after the end of each session of the PPI, an increased ambudance of OXTR was quantified in the three studies. As discussed earlier the PPI had a significant effect on the participants’ emotional wellbeing. Considering the findings obtained from the RT-qPCR analyses, it is possible that the significant
effect of the PPI on the participants’ emotional wellbeing was modulated via the $OXTR$ molecular genetic pathway.

Interestingly, after the Week 4 in all three studies, participants had slightly higher levels (median) of $OXTR$ before the start of PPI, compared to the $OXTR$ levels determined in Week 1 – Week 4. This could be another long term positive effect of the PPI on participant’s emotional wellbeing. However, the potential long-term positive effect of the PPI (as observed in Week 5 and Week 6) is limited by the fact that increasingly more psychological interventions are delivered in short periods of time (often 6-8 weeks; see Chapter 2). Hence, it is proposed that PPIs with duration of more than six weeks, might be more effective.

It is therefore reasonable to suppose that the proposed PPI can supplement conventional psychology interventions that relieve symptoms of depression in response to eating-related disorders. It is highly likely that in near future, several PPIs will be developed with the aim to increase happiness, and decrease depressive symptoms related to eating and other type of disorders.

On the basis of the present research findings, it seems that $OXTR$ gene expression levels could be used as a potential biomarker in validation of PPIs, promoting the practical legacy of positive psychology.

9.6. Limitations

Several limitations of this doctoral research have to be acknowledged. One of the most obvious limitations were small numbers of participants in all three studies. Although in each study there were some significant findings, it could be expected that these would be much
DISCUSSION

stronger with larger numbers of participants. Indeed, when data from all studies were combined, the significant outcomes of the PPI were apparent on all measures and all subscales.

The same issue presented a challenge for the OXTR expression analyses. Real time RT-qPCR was selected as the best method for analysing the data for its extreme sensitivity, low technical difficulty and low set up and running costs (see Fryer et al., 2002 for comparison with other methods of global gene expression). One of the biggest challenges using real time RT-qPCR is that it requires a large number of samples, which was difficult to obtain with the small number of participants in each study.

On the other hand, the participant sample size in all three studies of the present research was comparable to some other group-based PPI studies (e.g. Akhtar & Boniwell, 2010; Seligman et al., 2006), which can only be effective in smaller groups. Considering the fact that the group part of the intervention could only delivered by the researcher alone, it would not be feasible to have larger numbers of participants. In order to be able to address this limitation effectively, there would need to be more researchers/practitioners trained to deliver the present intervention to be able to facilitate multiple groups at the same time.

Another apparent limitation of the current research was that it lacked any follow-up assessment, and therefore was unable to identify whether the positive outcomes of the intervention were sustained over time, as demonstrated by some other studies (e.g. Frieswijk et al., 2006; Gander et al., 2013; 2016; Kremers et al., 2006; Lyubomirsky et al., 2011; Mitchell et al., 2009; Page & Vella-Brodrick, 2013; Seligman et al., 2006; Shapira & Mongrain, 2010). However, literature on methodology argues that for a follow-up assessment to be an accurate representation of sustained changes, it should be conducted at least one year after the intervention has come to end, but two to three year follow-ups are more desirable (Behar &
DISCUSSION

Borkovec, 2003). It is also recommended to include several follow-up assessments to allow for detection of non-linear trends (Behar & Borkovec, 2003).

Generally, there have been very few trials that conducted a follow-up assessment, and none of them was carried out more than 12 months post-intervention (see Bolier et al., 2013b for a review). In order to establish sustainability of the positive change resulting from the present studies, future research should attempt to replicate the present research findings with at least 12 months follow-up.

Participants in the present studies were not from clinical population, which greatly limited transferability of the findings into clinical settings. It has proven very challenging to recruit a sufficient number of participants with the target body/weight characteristics using only a sample of university students. Unfortunately, due to the lack of timely resources, extension of participant recruitment to clinical settings was not feasible. Therefore, each study inevitably included participants with no weight problems, as well as overweight and/or obese individuals. Nonetheless, it ought to be mentioned that a number of participants, particularly in the second pilot study, displayed clinical morbidity in both, symptoms of depression and anxiety, as well as obesity. Findings from that study indicated that the present intervention could be successfully applied to treat depression and anxiety, and increase well-being in depressed and anxious individuals, which was in line with previous research conducted with both clinical (Sin & Lyubomirsky, 2009) and non-clinical populations (Bolier et al., 2013b). In terms of obesity, however, the intervention, in its current form, has not proven to be an effective/sufficient tool for weight loss.

Reviewing previous literature on MBIs for weight management, most trials provided some kind of nutrition or energy balance education and/or incorporated mindful eating meditation in the beginning and/or during the entire MBI (see Carrière et al., 2017 for a review).
It seems that such education, with a particular focus on mindful eating and nutrition, plays an important role in weight loss success. Given the findings of the present research, it is unlikely that positive psychology on its own could be used as an alternative method of obesity treatment, particularly in populations with high levels of clinical morbidity, and obesity co-morbidities.

Another aspect limiting the findings of this research was the fact that most participants (except for the first pilot study) were psychology university students. Such population limitation presents a challenge for generalizability of the PPI to other populations varying in age, ethnicity, socioeconomic status, and IQ. Furthermore, all the students were on the Psychology, Psychotherapy and Counselling pathway with potentially very good counselling skills which may have affected their behaviour in the group sessions.

As with many other studies examining PPIs (e.g., Bolier et al., 2013a; Gander et al., 2013; 2016; Lyubomirsky et al., 2011; Mitchell et al., 2009), the present studies did not have a balanced gender-ratio. Although there does not seem to be a reason to expect gender effects, and no study so far has reported an impact of gender on the effectiveness of PPIs, it would be worth examining why such interventions attract more females than males or whether gender makes a difference when participants are not self-selected.

Inevitably, the present research was prone to contamination, especially in the second pilot study, and in the main trial, where the intervention was delivered to students in one class, who were all enrolled on the same module. In the first pilot study, where participants were a mix of students and staff, the contamination was controlled for by the time factor. The group sessions in that study were running on the same day with the second group slot directly following the first group slot, giving the participants practically no chance to share the session contents. This arrangement was not possible for the second pilot study and the RCT. Having the second group in the pilot study and the control group in the trial share classes with the
DISCUSSION

students in the immediate intervention group presented a possibility for information transfer, and thus potential reduction in the effectiveness of the intervention.

Some researchers in the past suggested the use of cluster randomisation as an effective way of preventing contamination in trials (Campbell & Grimshaw, 1998). However, others argued that cluster trials are associated with problems of recruitment bias and the need for larger samples than would be required in similar, individually randomised trials (Torgerson, 2001). It has been argued that although the threat of contamination is an issue in some controlled trials, it may be not be of much practical importance in many, and researchers should be certain that contamination is a real (rather than a theoretical possibility) before considering cluster randomisation (Torgerson, 2001). With reference to the present research, the main question was whether the participants in the immediate intervention group were really going to pass on the PPI content in such a way as to alter behaviour in the control arm of the trial. The online part of the intervention was made available to only those participants who were receiving the intervention at the time. Even though they could download the PowerPoint presentations, their content was too large to be sent as an email attachment. Therefore, the only way to share the presentations with their control group classmates was to place them on a pen drive. While sharing of the online material was a theoretical possibility, the group experience and the group dynamics could not be transferred that way. However, the participants could share their in-group experiences with their classmates verbally, which would have allowed some transfer of information. Considering the potential for such contamination, it would be beneficial, if similar trials were to be conducted in the future, to use students from different study pathways who would not share classes or know each other in any way.

Another important limitation of this project was related to the assessment design and related evaluation of the main findings. The psychology part of this research followed the standard method of assessment using self-report questionnaires which were distributed before
and after the intervention to determine changes over the six weeks. However, to be able to assess effectiveness of the intervention on a molecular genetic level (using *OXTR* gene expression), saliva samples needed to be collected and analysed on a weekly basis. This enabled the researchers to identify genetic responsiveness of each participant to each session of the 6-week PPI, which could not be compared to any psychological assessments. Although the participants were prompted to self-assess their positive emotions before and after each session using a scale from 1 to 10, this data was not recorded consistently, and therefore could not be used for further analysis. It would be suggested for future research to use (or perhaps even develop) more effective measures of self-assessment that could be easily incorporated into the beginning and end of each group session, and could be subsequently used in correlational analysis against the gene-expression data.

Last, but not least, combination of the psychological part of the present research with molecular genetic approaches has proven to be very challenging, mainly due to the nature of this type of research and lack of time resources. While the nature of this research was very unique, it could not overcome some of the commonly discussed aspects limiting single candidate gene studies such as the complex polygenic nature of most disorders or difficulties related to replication of the main findings (Assary et al., 2018). Although research in gene-environment interaction has recently begun to shift towards new genome-wide and polygenic approaches, these studies are currently limited by small samples, which was a substantial limitation of the present research as well. In addition to adequate statistical power (i.e., larger samples), studies like the ones conducted within the scope of this PhD also require better and more accurate measurement of the environment. While saliva samples in all studies were collected on a weekly basis before and after each session, it was not feasible to control for other potential environmental influences the participants may have been exposed to during the course of the intervention.
9.7. Implications of the Main Findings and Suggestions for Future Research

The main findings of the present research clearly indicated that the current PPI increases all aspects of flourishing, improves body-image flexibility and leads to decreases in the symptoms of depression and anxiety. The fact that this finding was observed in a student population may present important implications for education. Research has shown that university students are vulnerable to mental health problems, especially depression and anxiety (Nerdrum et al., 2006; Stanley & Manthorpe, 2001; Stewart-Brown et al., 2000). Therefore, it seems to be increasingly more important for higher education institutions to be able to target mood disorders in their students. This may not only improve their mental health and well-being, but also increase their performance, which has been shown to be impaired by high levels of anxiety or depression (Fröjd et al., 2008; Hembree, 1988; Jegede, 1996; Kouzma & Kennedy, 2004; Putwain, 2009; Seipp, 1991). It has been demonstrated that increases in well-being and positive emotions broaden students’ attention (Bolte et al., 2003; Fredrickson, 1998; 2001; Fredrickson & Branigan, 2005; Kristjánsson, 2012; Rowe et al., 2007), and enable more creative thinking (Isen et al., 1987; Estrada et al., 1994), and more holistic thinking (Isen et al., 1991; Kuhl, 1983; 2000) which are conducive to learning. From this perspective, the present PPI may be a useful teaching tool for increasing academic performance in university students, which could subsequently have positive effects on their employability.

Implications of this research in terms of weight loss were not as clear. Although, across the three studies many participants lost a notable amount of weight after the intervention, only a few of those were actually obese. Most of those participants who displayed symptoms of clinical morbidity either maintained their weight or gained weight. As discussed earlier, this
DISCUSSION

may have been caused by the fact that they were first year university students who have been repeatedly shown to be at an increased risk of weight gain (see Hootman, Guertin & Cassano, 2018 for a review). However, it is unlikely that the present PPI, without any dietary components or nutritional education, could be used as an effective treatment modality for obesity. As many previous studies have applied mindfulness-based interventions to aid weight loss, it would be interesting, for future research, to conduct a trial where a revisited version of the current PPI (with components of nutritional education) would be compared with MBI, and no intervention control groups. Future trials should assess effectiveness of the present intervention in clinical populations with a particular focus on individuals with obesity comorbidities.

Considering gene network and gene-environment interaction studies, it is possible that the PPI affected weight loss through unknown molecular genetic pathways. Several genetic networks (FTO, DRD2, DRD4) have linked emotional functioning with disordered eating (e.g., Bauer, 2014; Heni et al., 2016; Ptacek et al., 2011; Rask-Andersen et al., 2010; Wang et al., 2011; Wheeler et al., 2013). Evidence from gene-environment interaction studies confirms that an interaction between a specific genetic polymorphism(s) in a gene and adverse environmental influences can lead to a development of psychopathology. The SLC6A4, MAOA, DRD4, DRD2, COMT, and BDNF are some of the most commonly examined candidate genes in relation to psychiatric disorders (i.e., depression, antisocial behaviour, schizophrenia, and bipolar disorder; see Assary et al., 2018 for a review). Considering the high comorbidity of psychiatric disorders (Kessler, McGonagle, Zhao et al., 1994) and their shared genetic aetiology, it is not surprising that many of these candidate genes have been examined and associated with multiple disorders. Indeed, some of the genetic variants in these genes have been associated with disordered eating and obesity (Chapter 5).
DISCUSSION

Interestingly, recent evidence suggests that although many common genetic variants increase vulnerability for the development of psychopathology in response to environmental stressors, they also appear to predict increased sensitivity to positive aspects of the environment (Assary et al., 2018). Due to the nature and design of the present research, genotyping and DNA sequencing could not be performed. However, as some individuals were clearly more responsive to the PPI than others, future research should attempt to identify the *OXTR* genetic variants that would predict increased responsiveness to a positive psychological stimuli, and could subsequently be used to predict a treatment/weight loss outcome.

Previous research has highlighted the need for greater synthesis of various levels of research information (Biswas-Diener, 2011), proposing that integration of biological, neuropsychological, social, and personality sciences may greatly aid positive psychological research, and enhance validity and reliability of interventions (Rock & Page, 2009; Rothbart et al., 2007). Considering the findings from the *OXTR* expression analyses, one of the major implications of this research is that the *OXTR* expression levels could be used as a potential biomarker in validation of PPIs, promoting the practical legacy of positive psychology.

It seems appropriate to consider the implications of the unique design of the present intervention (i.e. combination of group work and online learning). Group interventions are well known to be the most beneficial form of therapy, right after individual interventions (Baskin & Enright, 2004; Sin & Lyubomirsky, 2009), and even though self-administered positive activities are not as effective as individual or group therapies, they still significantly enhance well-being when compared to engaging in neutral activities or no activities at all (Sin & Lyubomirsky, 2009). Research in clinical psychology has found that the Internet can serve as an effective modality for administering a psychological intervention (e.g. Andersson & Cuijpers, 2009). In the present research, participants received three PowerPoint presentations.
DISCUSSION

each week, which were specially designed considering user engagement, dosage, and user choice, which have been recently proposed as the three major factors defining an innovative design of an online intervention (Parks, 2014). The participants were encouraged to network with each other and share their experiences using the intervention online portal set up on their student accounts. Such form of social networking has been proposed as an important factor encouraging participants not only to try an intervention, but also to stick with it (Eysenbach, 2005). Since attrition rates present a major challenge for online interventions (Christensen, Griffiths, & Farrer, 2009; Wanner, Martin-Diener, Bauer, Braun-Fahrländer, & Martin, 2010), minimization of drop-out was an important aspect of the present PPI. The reason why participants received three PowerPoint presentations a week with multiple positive activities, was to increase the dosage of the PPI, and thus achieve greater improvement, as demonstrated by previous studies using a variety of positive activities in online PPIs (e.g. Parks, Della Porta, Pierce, Zilca & Lyubomirsky, 2012). At the same time, the participants could only access those presentations and activities that were strategically made available to them by the researcher. Previous research has shown that although users tend to prefer an internet intervention where they can skip around and access all parts of the site freely, they ultimately spend more time on, and report learning more from, a “tunnelled” version where they can access the content of the site sequentially (Crutzen, Cyr & de Vries, 2012). Having considered the user engagement, dosage and the user choice, the online part of the PPI provided a strong supplementary material to the group sessions. As such the intervention resulted in significant improvements in well-being and reduction in depressive symptoms, regardless of the limitations related to sample sizes in all three studies.

Additionally, one of the practical implications of this research was that with every PowerPoint presentation and before every group session the participants received an email reminder to complete the exercise for the day or attend the group session. Sending reminders
to complete an exercise has been suggested to increase participants’ commitment (Gander et al., 2016) which may have played an important role in the present research findings and implications. It would be suggested for future research to include email reminders or personalised messages in addition to group or individual work to increase participants’ commitment and thus potentially reduce drop-out rates and increase effectiveness of psychological interventions.
CHAPTER 10: Conclusions

The purpose of the present PhD research was to explore whether positive psychology could be used as an alternative approach to obesity treatment. Incorporating molecular genetics, this novel approach had four main aims:

1. Develop a PPI for individuals with weight problems.
2. Assess its effectiveness on well-being (overall well-being, body image flexibility, depression and anxiety), and weight loss in non-clinical populations.
3. Identify potential molecular genetic pathways through which the intervention might function.
4. Validate the intervention by using OXTR expression as a model system.

The aim of this chapter is to (1) present the general conclusions derived from the findings of the current research considering each of the above four aims, and (2) highlight the original contributions to knowledge arising from this PhD.
10.1. General Conclusions

10.1.1. Development of PPI for individuals with weight problems

A 6-week PPI for weight management was developed within the scope of this PhD targeting six positive psychological concepts: (1) Gratitude, (2) Mindfulness, (3) Self-compassion, (4) Strengths, (5) Hope, and (6) Happiness. Each theme was selected on the basis of previous research investigating the role of positive psychology in weight management and reduction of overweight and obesity, and related to eating disorder psychopathology. Additionally, as the importance of well-being in holistic obesity treatment has been highlighted before (Kolotkin & Andersen, 2017), each concept in the present PPI was also evaluated from the perspective of its benefits on well-being (see Chapter 4).

The PPI was a combination of experiential group work and online learning. The purpose of using this unique intervention design was to amplify its effectiveness by combining the benefits of group interventions (Baskin & Enright, 2004; Sin & Lyubomirsky, 2009) with the benefits of self-administered positive activities (Sin & Lyubomirsky, 2009).

The whole intervention was designed in a way for the participants to first receive the online part and do some independent work for each week, which would then be concluded by a 90-minute group session. The online intervention consisted of three PowerPoint presentations for each week followed by a self-help home exercise, which was explained at the end of each presentation. They were specially designed considering user engagement, dosage, and user choice, which have been proposed as the three major factors defining an innovative design of an online intervention (Parks, 2014). The purpose of the experiential groups was then to conclude each theme of the week. Using self-reflection, experience sharing, group support and
CONCLUSIONS

exercises, the sessions were designed to reinforce the effect of the online part of the intervention leading to increased self-awareness, and subsequently towards increased happiness and life satisfaction, and an improvement in overall well-being.

10.1.2. Effectiveness of the PPI on well-being and weight loss

The PPI was initially piloted in two separate studies with a total of 38 participants (Chapter 6), and subsequently tested in an RCT with 20 participants (Chapter 7). Findings from all studies were evaluated in terms of weight loss and overall well-being which was assessed by the PERMA measure of flourishing, the BI-AAQ measure of body-image flexibility, the GAD7 measure of anxiety, and the PHQ9 measure of depression.

The results from both pilot studies, as well as the RCT, confirmed findings from previous research demonstrating that engaging in positive activities that promote flourishing can be used to enhance well-being (Sin & Lyubomirsky, 2009; Bolier et al., 2013b), and to alleviate symptoms of anxiety and depression (Seligman et al., 2005). These findings were important not only from the perspective of well-being in general, but also from the perspective of obesity. Obese individuals are known to suffer with a number of comorbidities, including anxiety and depression (see Luppino et al., 2010 for a review). Therefore, addressing symptoms of depression and anxiety in individuals with weight problems may be crucial to their treatment progress. Additionally, previous research has argued that increasing well-being in individuals with weight problems, may play an important role in their ability to cope with stressful life events which would normally lead to emotional eating (Singh, 2014).

In terms of weight loss, the findings were not as consistent. The present research did not use any treatment modalities that would address weight loss directly (e.g. nutritional
CONCLUSIONS

education, meal planning, physical activity monitoring). However, it was expected that weight loss may occur as a by-product of an improvement in mediational factors linked to health behaviours (Huffman et al., 2015), which were directly targeted by the PPI (see Figure 4.2. in Chapter 4). This hypothesis was only partially supported. While the findings from the first pilot study and the RCT indicated that the present PPI could be used to aid weight loss, findings from the second pilot study showed the opposite results. However, since the characteristics of the second pilot study participants were much closer to those observed in clinical populations (i.e. high levels of clinical morbidity, and frequent comorbidities of depression and anxiety), it is unlikely that PPI in its current form (i.e. without any dietary/mindful eating intervention) could be used as an effective tool to aid weight loss in clinical populations.

10.1.3. Identification of potential molecular genetic pathways through which PPIs function

The identification of obesity susceptibility loci have provided new insights into the molecular genetic factors that contribute to the development of obesity. However, the current lack of understanding of the numerous gene-gene and gene-environment interactions in obesity poses one of the major obstacles for the development of effective, preventive, and therapeutic intervention strategies (Stryjecki & Mutch, 2011). To help address this obstacle, the present research used co-expression network analysis to infer gene function and gene–disease associations from genome-wide gene expression.

Using in-silico approaches co-expressions, co-localizations and similarities in protein domains (Warde-Farley et al., 2010) were identified between the OXTR gene and several genes related to the QOL domains addressed by the PPI.
CONCLUSIONS

A hypothesis in gene expression suggests that when genes are co-expressed, they might be regulated by the same molecular genetic pathway (Van Dam et al., 2017). Gene co-expression networks can, therefore, be used to associate genes of unknown function with biological processes, to prioritize candidate disease genes or to discern transcriptional regulatory programmes.

Protein domains are one of the most convenient and practically important levels at which to understand the evolution of protein function. Homologous sequence is assumed to have similar function, whatever the context, so these “modules” or “mobile domains” allow the transfer of functional information, such as being involved in a particular kind of interaction, between distinct protein classes (Copley et al., 2002). Therefore, identifying the level of shared protein domains between two genes involved in obesity may greatly enhance the current understanding of the particular function of these genes in relation to obesity and obesity-related eating psychopathology.

Understanding the localization of gene expression enables researchers to identify the regions that may be associated with a particular disease. By identifying co-localization of genes involved in obesity and genes involved in QOL domains the present research findings may be a precursor to co-localization analysis, which could be used to study whether potential obesity-causal variants are shared by combining information across multiple SNPs in a region (Fortune et al., 2015).

By identifying metabolic pathways and molecular genetic markers associated with QOL domains and obesity this work provided promising evidence on the interactions between genes related to QOL domains and obesity-related genes. As such this research proposed potential molecular genetic pathways through which PPIs might function (see Figure 5.1. in Chapter 5).
CONCLUSIONS

10.1.4. Using \textit{OXTR} gene expression as a model system to validate PPIs

Previous research has noted that while some genetic variants increase vulnerability for the development of psychopathology in response to environmental stressors, they also appear to predict increased sensitivity to positive aspects of the environment (Assary et al., 2018). Hence, it may be more appropriate to consider these gene variants as markers of \textit{Environmental Sensitivity} (Pluess, 2015), rather than as risk factors for psychiatric disorders.

The present research assessed sensitivity of the \textit{OXTR} gene to a positive psychological stimuli (i.e. the PPI). Relative \textit{OXTR} gene expression in response to the PPI for weight management was determined using real-time RT-qPCR.

Findings from the two pilot studies, as well as the RCT, revealed increased \textit{OXTR} levels in response to the PPI. Interestingly, in Week 5 and Week 6 the levels of \textit{OXTR} before the start of the intervention were slightly higher compared to the pre-session levels in the first four weeks, which was consistent across all three studies. On that basis, it could be assumed that PPIs with duration of more than six weeks, might be more effective, as they could potentially lead to a long-lasting increase in \textit{OXTR}. Comparing the findings from the \textit{OXTR} expression analyses with the psychological results of this research, it seems that \textit{OXTR} might be linked to the improved values of participants’ emotional well-being. As such this research concludes that the \textit{OXTR} expression levels could be used as a potential biomarker in validation of PPIs, promoting the practical legacy of positive psychology.
10.2. Contributions to Knowledge

Achieving the research aims discussed above, the present project brought four main contributions to knowledge that are original in this PhD:

5. This thesis represents the first empirical research applying a comprehensive PPI as a holistic approach to the treatment of overweight and obesity.

6. It is one of the first studies to supplement experiential group work with online learning.

7. It is the first study to incorporate molecular genetics into a positive psychological approach to overweight and obesity treatment bringing the fields of positive psychology, obesity and molecular genetics together.

8. Similarly, it is the first study to attempt to validate a PPI by using OXTR expression as a model system.


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Bastard, J. P., Maachi, M., Lagathu, C., Kim, M. J., Caron, M., Vidal, H., … Feve, B. (2006). Recent advances in the relationship between obesity, inflammation, and insulin resistance. European Cytokine Network, 17(1), 4 - 12. doi: 10.1.1.477.2088


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Clifton, P. M., Bastiaans, K., & Keogh, J. B. (2009). High protein diets decrease total and abdominal fat and improve CVD risk profile in overweight and obese men and women with elevated triacylglycerol. *Nutrition, Metabolism and Cardiovascular Diseases, 19*(8), 548 - 554. doi: 10.1016/j.numecd.2008.10.006


REFERENCES


Crutzen, R., Cyr, D., & de Vries, N. K. (2012). The role of user control in adherence to and knowledge gained from a website: Randomized comparison between a tunneled version and a freedom-of-choice version. *Journal of Medical Internet Research, 14*(2), e45. doi:10.2196/jmir.1922


D


REFERENCES


REFERENCES


386
REFERENCES


REFERENCES


REFERENCES


---

E


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Friedman, K. E., Reichmann, S. K., Costanzo, P. R., & Musante, G. J. (2002). Body image partially mediates the relationship between obesity and psychological distress. *Obesity, 10*(1), 33 – 41. doi: 10.1038/oby.2002.5


REFERENCES


G


REFERENCES


REFERENCES


Giles-Corti, B., & Donovan, R. J. (2002). Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. *Preventive Medicine, 35*(6), 601-611. doi:10.1006/pmed.2002.1115


REFERENCES


REFERENCES


REFERENCES

Haddad, M., Rogers, P., & Gournay, K. (2007). Cognitive behaviour therapy in primary care: Mark Haddad, Paul Rogers and Kevin Gournay outline the importance of cognitive behaviour therapy and examine ways of providing it in the primary care setting. Primary Health Care, 17(10), 32-34. doi:10.7748/phc.17.10.32.s27


REFERENCES


Hayden, E. P., Klein, D. N., Dougherty, L. R., Olino, T. M., Laptook, R. S., Dyson, M. W., … Singh, S. M. (2010). The dopamine D2 receptor gene and depressive and anxious symptoms in
REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Hurme, M., & Santtila, S. (1998). IL-1 receptor antagonist (IL-1Ra) plasma levels are co-ordinately regulated by both IL-1Ra and IL-1beta genes. European Journal of Immunology, 28(8), 2598.


I


REFERENCES


J


REFERENCES


REFERENCES


REFERENCES


K


REFERENCES


REFERENCES


REFERENCES


REFERENCES


L


REFERENCES


---

425
REFERENCES


Levitan, R. D., Masellis, M., Basile, V. S., Lam, R. W., Kaplan, A. S., Davis, C., . . . Macciardi, F. (2004; Levitan et al., 2004a). The dopamine-4 receptor gene associated with binge eating and


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Mifsud, G., Duval, K., & Doucet, É. (2009). Low body fat and high cardiorespiratory fitness at the onset of the freshmen year may not protect against weight gain. British Journal of Nutrition, 101(9), 1406-1412. doi:10.1017/S0007114508067639


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Proyer, R. T., Wellenzohn, S., Gander, F., & Ruch, W. (2015; Proyer et al., 2015b). Toward a better understanding of what makes positive psychology interventions work: Predicting happiness
and depression from the person × intervention fit in a follow-up after 3.5 years. *Applied Psychology. Health and Well-being, 7*(1), 108.


R


REFERENCES


REFERENCES


REFERENCES


REFERENCES


S


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES

on receptor-bound conformations and interactions with vasopressin and oxytocin receptors. *Journal of Medicinal Chemistry, 49*(8), 2463.


REFERENCES


REFERENCES


REFERENCES


T

REFERENCES


473
REFERENCES


REFERENCES


Towne, J. E., Garka, K. E., Renshaw, B. R., Virca, G. D., & Sims, J. E. (2004). Interleukin (IL)-1F6, IL-1F8, and IL-1F9 signal through IL-1Rrp2 and IL-1RAcP to activate the pathway leading to NF-kappaB and MAPKs. Journal of Biological Chemistry, 279(14), 13677.


Clinical Chemistry and Laboratory Medicine, 45(9), 1145 – 1148. doi: 10.1515/CCLM.2007.260


V


against recurrent major depression. *Molecular Psychiatry, 9*(3), 287-292. doi:10.1038/sj.mp.4001420


subcutaneous adipose tissue. *Journal of Clinical Investigation, 98*(2), 251 - 255. doi: 10.1172/JCI118786


W


REFERENCES


REFERENCES


REFERENCES


REFERENCES


REFERENCES


Wing, R. R., Blair, E. H., Marcus, M. D., Epstein, L. H., & Harvey, J. (1994). Year-long weight loss treatment for obese patients with Type 2 diabetes: Does including an intermittent very-low-
calorie diet improve outcome? American Journal of Medicine, 97(4), 354 – 362. doi: 10.1016/0002-9343(94)90302-6


REFERENCES


487
REFERENCES


X


Y


REFERENCES


Appendix A.

Assessment of an Obese Patient Seeking Weight Loss Intervention

For a long time, obesity was perceived as a behavioural disorder, and as a result of lack of will and personal control. It has only been a matter of the past two decades that obesity has been recognised as a medical illness meeting all of the clinical definitions of a disease (Atkinson, 2002). The acknowledgement of obesity being a medical illness comes with a requirement of proper medical evaluation of the overweight patients, including assessment of potential complications associated with obesity, in order for the treatment to be tailored accordingly. The purpose of this section is to briefly discuss the methods of medical and behavioural assessments of obese patients, who seek weight reduction.

**Physical examination.**

Excess weight is most commonly identified by a body mass index (BMI), a measure which combines person’s height and weight to estimate their adiposity. It is computed as weight (in kilograms) divided by height (in meters) squared. The given value is age dependent and the same for men and women. The World Health Organization (WHO, 2000) and the National Heart, Lung and Blood Institute (NHLBI, 1998) have classified the adult BMI rates as follows: < 18.5 kg/ m² is underweight; 18.5 – 24.9 kg/ m² is a normal or healthy weight range; 25 – 29.9 kg/ m² is classed as overweight; and ≥ 30 kg/ m² is obese (Field, Barnoya & Colditz, 2002). However, BMI should be interpreted with caution, especially in highly muscular individuals, as it can be a less accurate estimate of adiposity in this group of patients (NICE, 2014).

Overall, BMI can be used adequately to assess adiposity in young and middle aged adults. However, it is less accurate for elderly individuals. With increasing age lean body mass decreases and the distribution of body fat changes with increases of fat mass observable
specifically in the abdominal region, an area associated with cardiovascular disease and diabetes (St-Onge & Gallagher, 2010). Therefore, it is recommended to measure the waist circumference in addition to the BMI when assessing body weight and risk of disease among elderly people (Field et al., 2002). Taking the measurement of waist circumference is also recommended for patients with BMI less than 35, in order to assess their overall health risks with higher accuracy (NICE, 2014; HSCIC, 2016). Men with waist circumferences greater than 102 cm, and women with waist circumferences above 88 cm are considered to be at higher risk of diabetes, dyslipidemia, hypertension, and cardiovascular disease because of excess abdominal fat (NHLBI & NAASO, 2000). However, the risks of health complications generally increase with increasing BMI (Atkinson, 2002; Calle et al. 2003; Patterson et al., 2004). Another important aspect to take into consideration is that BMI may not correspond to the same degree of adiposity in different populations and that the BMI values typically associated with particular health risks may also vary across populations (WHO, 2004b). For example, the proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMI’s lower than the existing WHO cut-off point for overweight (≥ 25 kg/m²) in European populations (WHO, 2004b). Due to the increasing evidence of different percentage and distribution of body fat in different populations, the WHO has been debating about the potential needs for developing different BMI cut-off points for different ethnic groups. Table 2.1. presents the current international classification of adult BMI cut-off points recommended in 2004 by the WHO Expert Consultation.

---

11 NAASO – North American Association for the Study of Obesity
### Table 2.1. The International Classification of adult underweight, overweight and obesity according to BMI.

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI(kg/m(^2))</th>
<th>Principal cut-off points</th>
<th>Additional cut-off points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Underweight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe thinness</td>
<td>&lt;16.00</td>
<td>&lt;16.00</td>
<td></td>
</tr>
<tr>
<td>Moderate thinness</td>
<td>16.00 - 16.99</td>
<td>16.00 - 16.99</td>
<td></td>
</tr>
<tr>
<td>Mild thinness</td>
<td>17.00 - 18.49</td>
<td>17.00 - 18.49</td>
<td></td>
</tr>
<tr>
<td><strong>Normal range</strong></td>
<td>18.50 - 24.99</td>
<td>18.50 - 22.99</td>
<td>23.00 - 24.99</td>
</tr>
<tr>
<td><strong>Overweight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-obese</td>
<td>≥25.00</td>
<td>≥25.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25.00 - 29.99</td>
<td>25.00 - 27.49</td>
<td>27.50 - 29.99</td>
</tr>
<tr>
<td><strong>Obese</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese class I</td>
<td>≥30.00</td>
<td>≥30.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30.00 - 34.99</td>
<td>30.00 - 32.49</td>
<td>32.50 - 34.99</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.00 - 39.99</td>
<td>35.00 - 37.49</td>
<td>37.50 - 39.99</td>
</tr>
<tr>
<td>Obese class III</td>
<td>≥40.00</td>
<td>≥40.00</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from WHO (1995), and WHO (2004b)

**History of the patient’s illness.**

Understanding the history of the obese patient’s illness is the key for the practitioner to be able to suggest the best suitable weight management strategies for each individual. The patients must be given an opportunity to describe the onset and progression of their weight gain, as well as their previous attempts to lose weight and family history of obesity (National Obesity Forum, NOF, n.d.; Wadden & Phelan, 2002). Any previous events associated with rapid weight gain or loss in the past should also be discussed (Atkinson, 2002), and the family history of the illness should be explored in order to identify potential genetic contributions to the patient’s obesity (Bray, 1998a). A possible occurrence of single-gene or multiple-gene defects (Bouchard et al., 1998; Chagnon, Pérusse, Weisnagel, Rankinen & Bouchard, 2000; Chagnon, Rankinen, Snyder et al., 2003), especially in patients with morbid obesity, are...
important factors for consideration. Finally, an assessment of commonly occurring comorbidities and health complications associated with obesity (e.g. diabetes, hypertension, heart disease, respiratory disease, osteoarthritis, dyslipidaemia and sleep apnoea), should be carried out (National Institute for Health and Care Excellence, NICE, 2014). A general medical history appropriate for all patients, should also be taken (Atkinson, 2002).

**Assessment of the aetiologies of the patient’s obesity.**

The causes of obesity and factors contributing to its development may vary for each person, and it is important to understand the underlying mechanisms in the individual patients in order to make the right treatment decisions. For example, an obese individual may suffer with some kind of endocrine dysfunction, such as hypothyroidism (Sanyal & Raychaudhuri, 2016), syndromes of excess insulin and insulin resistance (Hardy, Czech & Corvera, 2012), Cushing’s syndrome (Leibowitz, Tsur, Chayen et al., 1996), polycystic ovary syndrome (Gambineri, Pelusi, Vicennati, Pagotto & Pasquali, 2002), hypogonadism (Dandona & Dhindsa, 2011), hypothalamic damage (Daousi, Dunn, Foy, MacFarlane & Pinkney, 2005), growth hormone deficiency or impaired responsiveness to growth hormone signalling (Germain-Lee, 2006; Williams, Berelowitz, Joffe et al., 1984), leptin deficiency or mutations in leptin receptor gene (Clément, Vaisse, Lahlou et al., 1998; Gotoda, Manning, Goldstone et al., 1997), and pseudohypoparathyroidism (Dekelbab, Aughton & Levine, 2009; Germain-Lee, 2006). Even though some recent studies argue that those dysfunctions are a consequence, rather than a cause of obesity (Longhi & Radetti, 2013; Reinehr, 2010; Williams et al., 1984), the underlying pathways are not fully understood, and failure to diagnose an underlying endocrine disorder may have a detrimental impact on the patient’s health (Atkinson, 2002). Unfortunately, an extensive amount of research shows that, until now, many health care providers hold negative attitudes and stereotypes about people with obesity (Maddox & Leiderman, 1969; Phelan, Burgess, Yeazel et al., 2015; Price, Desmond, Krol, Snyder &
APPENDICES

O’Connell, 1987; Puhl & Brownell, 2001), which often impacts the quality of care delivered to the patients. This may result in the patient’s avoidance of care or poor outcomes, mistrust in the health care professionals and lack of adherence among people with obesity (Lee & Pausé, 2016; Phelan et al., 2015). Physical complaints are often ignored in obese patients, whereas they would be taken seriously in case of lean individuals (Forhan & Salas, 2013).

Assessment of the patient’s diet, physical activity and weight loss efforts.

The initial consultation should explore the patient’s eating patterns and physical activity levels as well as their beliefs about eating, physical activity and weight gain (NICE, 2014). Evidence shows that environmental factors contribute to the development of obesity much more than genetic factors (Horgen & Brownell, 1998; Horgen & Brownell, 2002; Stein & Keller, 2015), which makes the assessment of the patient’s eating habits and activity levels an imperative. The Weight and Lifestyle Inventory (WALI, Wadden & Foster, 2006) is designed to obtain information about the patients’ (1) weight and dieting histories, (2) eating and exercise habits, and (3) their relationships with family and friends, which makes it a comprehensive tool that can be used to carry out an effective behavioural assessment of an obese patient. For many individuals, decisions concerning food intake and food choice are strongly associated with environmental cues, such as people, times, emotions, social events and activities (Prinsen, de Riddler & de Vet, 2013). Individuals, who binge eat often report that they overeat because of emotional distress (Geliepter & Aversa, 2003; Torres & Nowson, 2007). Therefore, it may be useful for practitioners to consider identifying each patient’s cues associated with their overeating, as this might facilitate and improve treatment outcomes significantly.

Summary and identification of treatment goals.

The assessment of each patient should always conclude by briefly summarizing what has been learnt about the contributors to the patient’s obesity, about their psychosocial status,
and about the timing of their current weight loss effort (Wadden & Phelan, 2002). Even though the patient’s goals and treatment expectations would have been discussed in an initial interview, they should be clarified towards the end of assessment, as “patients often have implicit assumptions or goals that need to be articulated” (Wadden & Phelan, 2002, p. 201). Patient motivation, involvement and investment are crucial for success. Therefore, an assessment of their readiness to make the necessary lifestyle changes should be considered before suggesting a treatment. According to the National Institutes of Health (NIH), evaluation of readiness should include the following: (1) reasons and motivation for weight loss, (2) previous attempts at weight loss, (3) support expected from family and friends, (4) understanding of risks and benefits, (5) attitudes toward physical activity, (6) time availability, and (7) potential barriers, including financial limitations, to the patient’s adoption of change (NHLBI & NAASO, 2000). Identification of treatment goals, whether it means to lose weight or prevent a further weight gain, must be made jointly between the clinician and patient (NHLBI, 1998). It is important to educate the patients about realistic weight loss goals in order to prevent disappointment and drop out from therapy due to unrealistic expectations (Foster, Wadden, Vogt, & Brewer, 1997). The panel set by the NHLBI recommends that an achievable goal patients should aim for is 10 percent of baseline weight, to be lost at a rate of 1 to 2 lb/week, establishing an energy deficit of 500 to 1,000 kcal/day (NHLBI, 1998, p. 71 - 72).
Appendix B. 

The Selection Process of Appropriate Obesity Treatment Based on a Comprehensive Assessment of the Obese Patient

Obesity is a chronic disease, and therefore both, practitioner and patient must understand that “successful treatment requires a lifelong effort”, and that weight-loss management involves not only the loss of weight itself but also maintenance of body weight and control of other health risk factors (NHLBI & NAASO, 2000, p. 1). Careful consideration and evaluation of all these aspects together are necessary, in order to suggest the most appropriate treatment approaches for each particular individual. Figure 2.7. presents an algorithm for selecting treatment proposed in 2002 by Wadden and colleagues (Wadden et al., 2002). According to this model, a particular type of intervention should be recommended to the patients based on their BMI and associated risks of health complications. Generally, all individuals are encouraged to control their weight by consuming less calorie-dense foods and increasing their physical activity. Individuals with lower BMI are usually advised to take less intensive and less expensive approaches, which often focus simply on prevention of weight gain. In this regard, self-directed attempts and/or a consultation with a primary care physician may be sufficient. Individuals with higher BMI may opt for more aggressive (and expensive) interventions, if they are unable to lose weight just by adjusting their diet and lifestyle. For example, pharmacotherapy may be an option for people with BMI over 30 kg/m², and bariatric surgery could be recommended to morbidly obese individuals with BMI over 40 kg/m² (NHLBI, 1998; NHLBI & NAASO, 2000). However, history of the patient’s previous efforts to reduce weight should be taken into consideration when selecting a suitable treatment.
approach. Based on their BMI a person may be eligible for pharmacotherapy but if they have never participated in a traditional behavioural weight management program, this option may be more appropriate for them considering both, its costs and risks of health complications (Wadden & Osei, 2002). On the other hand, some treatment approaches (i.e. commercial and self-help programs) may be attractive for their safety and low cost but they often bring minimal results in terms of weight loss and weight maintenance (Gudzune, Doshi, Mehta et al., 2015; Tsai & Wadden, 2005; Womble, Wang & Wadden, 2002), which makes them less suitable for people who need to lose 10% of their initial weight to improve any weight-related health complications (Wadden & Osei, 2002). Therefore, efficacy of each intervention, as well as its safety and cost, should be considered during the selection process.
### Figure 2.7. Obesity treatment algorithm: A conceptual scheme showing a three-stage process for selecting treatment (adapted from Wadden, Brownell & Foster, 2002).

<table>
<thead>
<tr>
<th>Classification decision</th>
<th>Stepped-care decision</th>
<th>Matching decision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 27 kg/m²</td>
<td>Self-directed diet and exercise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physician counselling</td>
<td></td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>BMI 27 - 29 kg/m²</td>
<td>Self-help program</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial program</td>
<td></td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>BMI 30 - 39 kg/m²</td>
<td>Portion-controlled, low-calorie diet (900 – 1200 kcal/day)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pharmacotherapy</td>
<td></td>
</tr>
<tr>
<td><strong>Level 4</strong></td>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>BMI ≥ 40 kg/m²</td>
<td>Bariatric surgery</td>
<td></td>
</tr>
</tbody>
</table>

**Suggested treatment**

- Less intensive option
- More intensive option

**Less intensive option:**

- No primary risk factor(s)
- Lower-body obesity

**More intensive option:**

- Primary risk factor(s)
- Upper-body obesity

**Other considerations:**

- Previous efforts
- Patient preferences
- Emotional distress
Appendix C.

Dietary Interventions and Exercise Recommendations – The Most Commonly Applied Obesity Treatments

Dietary approaches to the treatment of overweight and obesity

 Millions of individuals all around the world are constantly striving to lose excess weight using different approaches, ranging from dietary and exercise interventions, self-help methods and behavioural therapies, to more aggressive pharmacotherapy and surgical treatments (Wyatt, 2013). The increasing obesity prevalence worldwide, however, suggests that most people fail to lose their weight some time during the process, which often leaves them discouraged and even more obese (NHLBI, 1998; NHLBI & NAASO, 2000). Given the overwhelming amount of books, magazines, papers and smartphone applications offering dietary information and weight loss advice (Freedman, King & Kennedy, 2001), it is not surprising that most people are left confused, which often leads them to make inappropriate lifestyle choices (Bland, 2016). This section will attempt to bring some light into the confusion by reviewing the most popular diets used to treat obesity and evaluating their effectiveness.

Criteria of healthy weight control.

 Each diet plan should always consider a number of criteria in order for the individual to achieve and maintain a healthy weight loss. Melanson and Dwyer (2002) evaluate the criteria for weight loss strategies, summarising them into seven essential components (“seven C’s”) of healthy weight control plans (Table 2.2.).
Table 2.2. Seven essential criteria for healthy weight control plans.

<table>
<thead>
<tr>
<th>1. Calories</th>
<th>6. Components of sound weight management:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Healthy hypocaloric diet</td>
</tr>
<tr>
<td>2. Composition</td>
<td>• Physical activity and exercise</td>
</tr>
<tr>
<td>3. Costs</td>
<td>• Behavioural modification</td>
</tr>
<tr>
<td>4. Consumer friendliness</td>
<td>• Psychological and social support</td>
</tr>
<tr>
<td>5. Coping with coexisting health risks and conditions</td>
<td>• Decreased food intake compared to that prior to dieting</td>
</tr>
<tr>
<td></td>
<td>• Increased physical activity and exercise</td>
</tr>
</tbody>
</table>

Adapted from Melanson and Dwyer (2002).

*Calories.* Since the amount of weight loss depends on the size of calorie deficit\(^\text{12}\), an assessment of energy needs is a necessary component in every nutrition care plan (Frankenfield, Roth-Yousey & Compher, 2005). Each individual needs a certain caloric intake in order to cover the basic metabolic needs of their body and maintain the whole organism in homeostasis (Henry, 2005). This is called the basal or resting metabolic rate (BMR or RMR) and it is gender and age dependent. There have been several approaches to the calculations of estimates of the RMR with the most accurate being the Mifflin-St Jeor equation\(^\text{13}\) (Frankenfield et al., 2005) presented below:

Males: \[10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} + 5\]

Females: \[10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} - 161\]

Total daily calorie expenditure can be calculated by multiplying the RMR by an activity factor, based on the individual’s level of physical activity: 1.2 for individuals who are very sedentary, 1.5 for moderately active people, and 1.8 for very active individuals (Melanson &

---

\(^{12}\) Calorie deficit is the difference between the amount of calories usually consumed and the amount of calories contained in the selected diet.

\(^{13}\) Mifflin-St Jeor equation – Mifflin, St Jeor, Hill et al. (1990)
Dwyer, 2002). For example, a 28 year old woman with a height of 173 cm and weight of 65 kg, would have an estimated RMR of 1,430 kcal/day. If she was moderately active, her total energy expenditure per day would be around 2,145 kcal. Although errors can occur, estimating energy expenditure prior attempting a weight loss, is a good starting point, and on the basis of which a weight control regime can be designed.

Composition. The composition of the reduction diet is very important, as it may influence the actual composition of the weight loss, as well as overall nutritional status. Fasting and very-low calorie diets (VLCD) can cause a significant loss of lean muscle tissue, and losses of water and important minerals (Van Itallie & Yang, 1977; Yang & Van Itallie, 1976). Some forms of the VLCD, such as the liquid protein-modified fast, have even been found to lead to sudden death in young people (Isner, Sours, Paris, Ferrans & Roberts, 1979). Although now VLCDs are nutritionally complete, they still attract much negative publicity (Cook, 2014) and they should not be used routinely for weight loss therapy (NHLBI & NAASO, 2000). The importance of a complete and well-balanced diet containing all essential macronutrients and micronutrients, cannot be emphasized enough, and all patients should always receive a good dietary education. According to the Dietary Guidelines for Americans (U. S. Department of Health and Human Services & U. S. Department of Agriculture, USDHHS & USDA, 2015), all patients attempting weight loss should focus on variety, nutrient density, and amount. Regardless of the type of diet they decide to follow, they should always strive to meet nutrient needs within calorie limits of the selected diet, choose nutrient dense foods across and within all food groups in recommended amounts, and limit calories from added sugars and saturated fats (Table 2.3.). Foods with high micronutrients density but low energy density are especially important on a reducing diet. Dietary fibre, which is non-caloric but chemically similar to carbohydrate, should also be included in every reducing diet to facilitate normal laxation (Melanson & Dwyer, 2002).
### Table 2.3. Guidelines for composition of healthy weight control plans.

<table>
<thead>
<tr>
<th>Component</th>
<th>VLCD* (≥ 50g/day)</th>
<th>LCD (≥ 100g/day)</th>
<th>BDD (0.8 g/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carbohydrate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLCD</td>
<td>≥ 50g/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Protein**
- VLCD: 1.5 g/kg body weight
- LCD: 1.0 g/kg body weight
- BDD: 0.8 g/kg body weight

**Fat**
- ≤ 30% of dietary energy from total fat
- ≤ 10% of dietary energy from saturated fat

**Fibre**
- 20 – 30 g/day

**Water**
- 8 glasses (cca 2 litres)

**Vitamins/minerals**
- Supplemented on VLCD and LCD (to recommended daily allowance)
- Iron and calcium for women of reproductive age

**Alcohol**
- Minimal to none

*Note: *VLCD, very low calorie diet (< 800 kcal/day); LCD, low calorie diet (800 – 1200 kcal/day); BDD, balanced-deficit diet (> 1200 kcal/day). (NHLBI, 1998; NHLBI & NAASO, 2000). **The lower the diet is in calories, the more likely it is that other essential nutrients and electrolytes will be low, and thus, would need to be supplemented (Atkinson, Dietz, Foreyt et al., 1993).*

---

**Cost and Consumer friendliness.** The cost of weight loss programs is probably one of the reasons why most people tend to seek dietary advice on internet and in popular diet books. Apart from the exemption for obesity behavioural counselling in primary care settings, which has been put forward by Medicare (CMS, 2011), most insurance companies and health maintenance organisations do not consider obesity as a reimbursable expense. Although some governments do offer free access to group counselling or vouchers for commercial weight loss programs, the cost effectiveness of those programs is very low (Cobiac, Vos & Veerman, 2010). Usually, it is expected that the overweight or obese individual would pay for most of the treatment costs by themselves, which makes the price for weight loss an important point
for consideration. Although there does not seem to be any standardised information summarizing the effectiveness and costs of different approaches, the Federal Trade Commission (FTC) have already encouraged commercial weight loss programs to voluntarily disclose their costs and results of treatment, so that consumers can make informed decisions when selecting treatment (FTC, 1999).

*Coping with coexisting health risks and conditions.* Potential underlying health complications are another important factor to consider before engaging in any kind of dietary therapy for weight loss. Many overweight or obese individuals attempt to complete a weight reduction diet by themselves, completely disregarding the fact that there may be some health complications that may go unrecognised or neglected (Melanson & Dwyer, 2002), or that self-administered dieting can actually cause physical or mental health complications, if not monitored (Cogan & Ernsberger, 1999; French & Jeffery, 1994; Putterman & Linden, 2004; Rashidi, Mohammadpour-Ahranjani, Karandish et al., 2007). Diet books and programs should certainly warn their consumers about these concerns, and individuals who wish or need to lose larger amount of weight should always consult their physician prior engaging in any diets of their own devising.

*Components of sound weight management and Continuation of provisions for long-term maintenance.* Weight management includes not only the loss of weight itself, but also a long-term maintenance of the reduced weight and prevention of weight gain (NHLBI & NAASO, 2000). According to the national health institutes, a weight loss therapy should include three major components: dietary therapy, increased physical activity and behavioural therapy, which should last at least 6 months before a pharmacotherapy is considered (NHLBI, 1998; NHLBI & NAASO, 2000). During the dietary intervention, some lean tissue is often lost alongside with the fat mass, which results in a slight decrease in the RMR (Connolly, Romano & Patruno, 1999). Therefore, during weight maintenance, energy intake must be somewhat
lower, and the structure of meals needs to be different than it was prior to the reduction diet (Aller, Larsen, Claus et al., 2014) and a regular exercise should be incorporated into the new lifestyle (Kayman, Bruvold & Stern, 1990). Indeed, such changes can be quite challenging, and maintaining those changes can be even more difficult. Success in maintaining weight loss is more likely when the individual is provided with information, tools, social support (Amick & Ockene, 1994; Berkman & Syme, 1979; House, Landis & Umberson, 1988; Livhits, Mercado, Yermilov et al., 2010; Verheijden, Bakx, van Weel, Koelen & van Staveren, 2005), and associated lifestyle behaviours to make the long-term changes that are required (Wadden, Webb, Moran & Bailer, 2012). Many individuals also find help in different forms of psychological support, including lapse and relapse prevention, re-motivation, behavioural modification strategies, and cognitive restructuring (Melanson & Dwyer, 2002).

Reducing diets and regimens.

Total fasts. Total fasting involves temporary starvation of the organism, which is associated with significant health risks, such as metabolic changes, electrolyte imbalances and excessive loss of lean tissue (Aoki & Finley, 1986; Ziaee, Razaee, Ahmadinejad et al., 2006). Lack of energy and nutrients results in decreases in physical activity, lethargy, dizziness, weakness, and episodes of fainting when standing, resulting in decreases in energy output that slow weight loss (Melanson & Dwyer, 2002). Prolonged periods of starvation can induce protein and fat catabolism, which leads to loss of cellular volume and function, resulting in adverse effects on all major organs of the body and their function (Mehler & Brown, 2015). Because of these complications total fasting is not recommended for weight reduction under any circumstances (Melanson & Dwyer, 2002), and if it is carried out, it should only be conducted under medical supervision. However, during 1950s and 1960s therapeutic fasting was accepted as an in-patient treatment modality for morbid obesity (Johnstone, 2015), and a number of studies were carried out at that time. The history of total fasting goes back to the
classical experimental starvation studies in 1915 (Benedict, 1915), and continued with further research on lean and obese individuals, who were treated by a total withdrawal of food for periods ranging from 10 to 117 days (Bloom, 1959; Cahill, 1970; Drenick, Swendsoid, Blahd & Tuttle, 1964; Duncan, Jenson, Fraser & Cristofori, 1962; Gilliland, 1968). The longest ever fast for a total of 382 days was conducted in 1973 on an obese man in Dundee. The subject lost approximately 75% of his body weight, making the Guinness Book of Records as the longest total fast (Stuart & Flemming, 1973). Interestingly, research evidence suggests that there is minimal or no decrease in mean hunger during the fast regardless of the total period of starvation (Bolinger, Lukert, Brown, Guevara & Steinberg, 1966; Lappalainen, Sjödén, Hursti & Vesa, 1990; Silverstone, Stark & Buckle, 1966). Since hunger/craving is one of the main reasons people fail to comply with their diets, these data may present an important consideration.

**Very-low-calorie diets.** Very-low calorie diets (VLCDs) are designed to completely replace usual food intake. Over the years the definition of VLCDs have changed with regards to the calorie-restriction level, and they are now defined as “total diet replacements with < 800 and > 400 to 450 kcal/day” (Saris, 2001, p. 295S). Even though it may seem that VLCDs are an invention of the twenty first century, their origins go as far back as 1929 (Cook, 2014). At that time, a 400-calorie diet was introduced as a new dietary approach to obesity reducing the nutritional intake to an incredible 6 – 8 kcal per kilo of body mass (Evans & Strang, 1929). It was believed that this extremely low energy diet would help to ameliorate the effects of “overindulgence” in morbidly obese individuals, leading to larger and more rapid weight loss than was possible with conventional diets, but avoiding the dangers of total starvation at the same time (Atkinson, Dietz, Foreyt et al., 1993). The development of VLCDs in 1920s (Evans, 1938; Evans & Strang, 1929; Evans & Strang, 1931; Mason, 1924; Strang, McClugage & Evans, 1930) created a foundation for its absolute explosion in 1980s, when VLCDs were
considered a major form of treatment for obesity (Bray, 2007). The popularity of VLCDs grew largely in 1970s with the introduction of the “protein-sparing modified fast” (Bistrian, Blackburn & Stanbury, 1977; Blackburn, Bistrian, Flatt et al., 1975), a diet consisting of 650 – 800 kcal/day provided by high protein foods. However, this solid-food based form was adapted and refined as liquid formula preparations in the late 1970s (Baird & Howard, 1977; Genuth, 1979; Genuth, Castro & Vertes, 1974; Howard & Baird, 1977; Howard, Grant, Edwards, Littlewood & McLean Baird, 1978; Vertes, Genuth & Hazelton, 1977), which was made of hydrolysed collagen. Containing only protein of very low biologic value with no addition of adequate amounts of vitamins, minerals, and electrolytes, the VLCDs in the form of liquid-protein modified fast, have been reported to lead to sudden deaths (Isner et al. 1979), which brought this type of diet to a formal Public Health Service investigation (Centers for Disease Control, 1979). The complications in the early days led to more conservative use of the VLCDs and improvement in the quality of the formulas, which are now nutritionally balanced with sufficient contents of protein with high biologic value (Anderson, Hamilton & Brinkman-Kaplan, 1992). Although the adverse publicity has marked VLCDs for many years, there have been several reports of successful uses of nutritionally balanced VLCDs (Anderson, Konz, Frederich & Wood, 2001; Astrup & Rössner, 2000; Ayyad & Andersen, 2000; Kreitzman & Beeson, 1996; Tsai & Wadden, 2006), resulting in hundreds of people losing large amounts of weight. The VLCDs in use today are standardized by the Codex standardization (NOF, 2010), and are considered to be safe and effective, provided that they are used under medical supervision with the recommended supplementation (Atkinson et al., 1993, NHLBI & NAASO, 2000; Tsai & Wadden, 2006). Yet, even current forms of VLCDs are not considered to be suitable for everyone, as they may aggravate existing health conditions (Cook, 2014). However, they are recommended for a few specific groups of patients (Table 2.4.), such as persons with a BMI ≥ 30 kg/m² or individuals with BMI > 27 kg/m² with one or more
comorbidities, when the medical risks of obesity are so high that an immediate action in the form of rapid weight loss is needed (Melanson & Dwyer, 2002). Several studies have shown a positive effects of VLCDs on glycemic control (Baker, Jerums, Proietto, 2009), with significant reductions in fasting glucose, LDL\textsuperscript{14} and total cholesterol levels in patients with type 2 diabetes (Yip, Go, DeSheilds et al., 2001). Overall, if VLCD is used to initiate weight loss, it should only be applied under a close medical supervision for a maximum duration of 12 – 16 weeks (NICE, 2014), in order to avoid risks of cardiac problems associated with loss of lean body mass (Brown & Kuk, 2015).

\textsuperscript{14} LDL – low-density lipoprotein
Table 2.4. Indications and contraindications for VLCDs.

<table>
<thead>
<tr>
<th>Suitable for a VLCD</th>
<th>Caution required</th>
<th>Absolute contraindication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with a BMI &gt; 30 kg/m²</td>
<td>Age &gt; 65</td>
<td>Pregnancy/lactation</td>
</tr>
<tr>
<td>Individuals in a structured MDT* program for weight loss</td>
<td>Those with a BMI &gt; 25 kg/m², plus one of the comorbidities</td>
<td>Recent angina, MIn*, stroke</td>
</tr>
<tr>
<td>Patients who are in the pathway for bariatric surgery</td>
<td>Those with a BMI &lt; 25 kg/m²</td>
<td>Major psychiatric illness</td>
</tr>
<tr>
<td>Overweight patients with comorbidities, such as diabetes, IHD*, asthma, hypertension in a supervised environment</td>
<td>Children &lt; 16/18 years</td>
<td>Severe renal/hepatic disease</td>
</tr>
<tr>
<td></td>
<td>Gout</td>
<td>Malignancy</td>
</tr>
<tr>
<td></td>
<td>Type 1 diabetes</td>
<td>Eating disorder</td>
</tr>
<tr>
<td></td>
<td>Gout/cholelithiasis</td>
<td>Major dysrhythmia</td>
</tr>
</tbody>
</table>

*MDT program – multidisciplinary teemed program; IHD – ischemic heart disease; MIn – myocardial infarction (Adapted from Cook, 2014.)

Low-calorie, low-fat diets. Similarly to the VLCDs, providing between 1000 – 1200 kcal/day (NHLBI, 1998; NHLBI & NAASO, 2000) low calorie diets (LCDs) are also below the resting metabolic rate (RMR) for most adults, but their effects on metabolism are far less pronounced compared to the VLCDs (Melanson & Dwyer, 2002). One of the key factors in many LCDs is that they promote low fat intake as a practical way to reduce overall energy intake in a day (NHLBI, 1998). A number of large randomised studies have demonstrated that consumption of low-fat diets results in greater weight loss compared to standard lifestyle
interventions (Hammer, Barrier, Roundy, Bradford & Fisher, 1989; Look AHEAD Research Group, 2010; Makris & Foster 2005). Most LCDs last around 6 months or more, resulting in a mean weight loss of about 8% of body weight (NHLBI, 1998), and significant decreases in abdominal fat (Katzel, Bleecker, Colmen et al., 1995) reducing the risks of coronary heart disease, hypertension and diabetes (Anderssen, Holme, Urdal, & Hjermann, 1995; Davis, Blaufax, Oberman et al. 1993; Makris & Foster, 2005). Interestingly, even without an instruction on specific calorie intake, following a low fat diet helps to maintain weight loss better than following a diet higher in fat (Howard, Van Horn, Hsia et al. 2006). However, even though low calorie and low fat diets seem to produce positive results in terms of weight loss and reduction of comorbidities, they are not immune to poor long-term adherence. In fact, it seems that greater short-term restrictions in energy and fat intake are more difficult to follow over the long-term, resulting in greater weight regain (Azadbakht, Mirmiran, Esmailzadeh & Azizi, 2007). Curiously, even matching treatment preferences have not been shown to produce better weight loss outcomes (Borradaile, Halpern, Wyatt et al., 2012; Burke, Warziski, Styn et al., 2008) suggesting that receiving one’s treatment preference does not necessarily result in greater weight reduction or maintenance.

Balanced-deficit, moderate-fat diets. Balanced-deficit diets (BDD) tend to be lower in calories, providing 1200 kcal/day or more, but the profile of daily energy and macronutrients intake is much more similar to the profile recommended for good health among non-dieters (U. S. Department of Health and Human Services, & U. S. Department of Agriculture; USDHHS & USDA, 2015). They are relatively low or moderate in fat, high in complex carbohydrate, moderate in protein, high in fibre and devoid of or very low in alcohol (Melanson & Dwyer, 2002). Some of the BDDs are quite similar to Mediterranean diets, which usually contain high proportion of mono-saturated fatty acids and recommend high intake of plant foods, and fibre, and limited consumption of saturated fats from animal foods (Makris & Foster, 2011). A few
APPENDICES

studies compared BDDs with low fat diets, reporting similar (Brehm, Lattin, Summer et al., 2009; Jenkins, Chiavaroli, Wong et al., 2010) to slightly better (Shai, Schwarzfuchs, Henkin et al., 2008) weight losses observed in individuals on BDDs (Makris & Foster, 2011), particularly when combined with increased physical activity (Esposito, Kastorini, Panagiotakos & Giugliano, 2011). It seems that the higher energy levels of the BDDs make it easier to comply with the calorie restriction, resulting in better weight loss maintenance over time when compared with VLCDs and LCDs (Makris & Foster 2005; Wadden, Foster & Letizia, 1994). In addition to leading to weight loss, it seems that dietary composition modifies an expression of metabolic biomarkers, which play an important role in weight regulation mechanisms (Bastard, Maachi, Lagathu et al., 2006). In particular, consumption of mono-saturated fats has been found to improve insulin sensitivity (Esposito, Marfella, Ciotola et al., 2004; Lara-Castro & Garvey, 2004; Schwenke, 2005), which may explain the favourable effects of BDD on glucose and insulin levels (Shai et al., 2008). The major disadvantage of BDDs, however, is that weight loss occurs much more gradually than on the more drastic regimens (Wadden et al., 1994), making it more challenging to maintain motivation, patience and adherence (Melanson & Dwyer, 2002). It is recommended that patients choose the dieting approach that best suits their metabolic needs and preferences (Shai et al., 2008), although, as showed earlier, receiving one’s preferred treatment is not always a guarantee of better weight loss results (Borradaile et al., 2012; Burke et al., 2008).

_High-protein diets._ Recommendations of increased protein consumption for weight loss are the most commonly appearing regimens in popular press. Although there is no standardised definition of what exactly is “high protein” intake, a diet containing above 25%, would be considered as high in protein (HP) (Eisenstein, Roberts, Dallal & Saltzman, 2002). Generally, all HP diets are low in carbohydrates but they can be quite different in fat contents. Some plans, such as the Atkins diet (Atkins, 1998), minimize carbohydrate intake without fat restriction,
whereas other (e.g. Ornish diet; Ornish, 1997) restrict fat intake significantly (Dansinger, Gleason, Griffith, Selker & Shaefel, 2005). Up to date, research in the efficacy, health benefits and sustainability of HP diets, has yielded mixed findings. Several studies have reported greater weight loss and improvements in body composition in individuals on HP diet compared to those on low-fat diet (Clifton, Bastiaans & Keogh, 2009; Clifton, Keogh, & Noakes; 2008; Wycherley, Noakes, Clifton et al., 2010). Other studies, on the other hand, have not found any significant advantages of HP diets in terms of weight loss or body composition (Dansinger et al., 2005; Larsen, Mann, Maclean & Shaw, 2011; Noakes, Keogh, Foster & Clifton, 2005). However, there is a convincing amount of evidence showing that higher protein intake increases thermogenesis and satiety leading to reduced subsequent energy intake (Halton & Hu, 2004; Rolls, Hetherington & Burley, 1988; Stubbs, van Wyk, Johnstone, & Barbron, 1996). Some studies have proposed that the thermic effect of food is blunted in obese individuals (De Jonge & Bray, 1997; Granata & Brandon, 2002), but this notion would require further investigation. There have been some concerns in the past regarding the overall safety of HP diets (Melanson & Dwyer, 2002). However, more recent studies have revealed no adverse effects of HP diets on cardiovascular health, kidney or liver function and bone health (Kerksick, Wismann-Bunn, Fogt et al., 2010; Larsen et al., 2011; Shai et al., 2008). High protein diets are considered a safe and effective option for medically supervised weight loss in severely obese individuals (Krebs, Gao, Gralla, Colins & Johnson, 2010).

*Low-carbohydrate diets.* Even though guidelines to follow a high–complex carbohydrate, low-fat, energy-deficient diet to achieve weight loss are generally accepted (NHLBI, 1998; NHLBI & NAASO, 2000), considerable public interest has focused on low-carbohydrate or ketogenic diets (very-low-carbohydrate-ketogenic-diets; VLCKD; Foster, Hyatt, Hill et al., 2003; Stern, Iqbal, Seshadri et al., 2004). The use of ketogenic diets has been well known mainly for treating epilepsy (Kessler, Neal, Camfield & Kossoff, 2011), but they
have become even more popular for weight loss in 1970 (Paoli, Rubini, Volek & Grimaldi, 2013), especially with the introduction of the Atkin’s diet. Similarly to the HP diets, there have been some concerns about the long-term safety of very-low-carbohydrate diets and their efficacy compared to BDDs (Nordmann, Nordmann, Briel et al., 2006). However, a number of recent studies have demonstrated that reduction of carbohydrate intake to the point of inducing ketosis, has numerous health benefits (Brehm, Seeley, Daniels & D’Alessio; 2003; Shai et al., 2008; Volek, Phinney, Forsythe et al, 2009; see Paoli et al., 2013 for a review). A large amount of evidence shows that the use of ketogenic diets is effective for weight reduction, although, there are some arguments regarding the pathways through which they initiate weight loss. Some researchers propose that weight loss is simply a result of reduced energy intake, due to increased satiety from consumption of higher amounts of protein (Westerterp-Plantenga, Nieuwenhuizen, Tome, Soenen, Westerterp, 2009), whereas other claim that the VLCKDs have distinct metabolic advantages (Feinman & Fine, 2007). Findings from long-term investigation show mixed results. When some studies reported greater reductions in weight in individuals on low-carbohydrate diet compared to those on low-fat diet (Shai et al., 2008), others have found no difference between the two (Hu, Mills, Yao et al., 2012).

Diets based on glycaemic index. Carbohydrates vary in the degree to which they raise glucose and insulin levels in the blood (Makris & Foster, 2011). The term “glycaemic index” (GI) is a dietary concept that has recently become very popular. It describes the changes in blood glucose levels resulting from a consumption of food containing a particular amount of carbohydrate (usually 50g) relative to the same amount of carbohydrate contained in a control food\textsuperscript{15} (Wolever, Jenkins, Jenkins & Josse, 1991). Originally, it was developed as a strategy to

\textsuperscript{15} In the context of GI, control food refers to pure glucose or white bread, which both have GI of 100 (Melanson & Dwyer, 2202), and other carbohydrate containing foods are ranked in relation to those. Foods with a GI between 0-55 are considered low GI, whereas foods with a GI of 70 or greater are considered high GI. Those that fall between these two ranges are categorized as intermediate GI foods (Makris & Foster, 2011).
help guide patients with diabetes in maintaining stable blood glucose levels, but more recent debates in the literature suggest that GI-based diet may be one possible way of obesity treatment and prevention (Ludwig, Majzorub, Al-Zahrani et al., 1999). Short-term research indicates that consumption of carbohydrates with high GI may increase hunger and promote overeating, and thus contribute to the development of obesity (Roberts, 2000). Low GI foods, on the other hand, have been shown to increase satiety, delay hunger and decrease \textit{ad libitum} food intake (McMillan-Price & Brand-Miller, 2006; Ford & Frost, 2010). Given their potential to affect glucose and insulin levels, GI-based diets may play an important role in the treatment and prevention of metabolic and cardiovascular diseases (Makris & Foster, 2011). However, the effects of GI on weight maintenance are unclear (Larsen, Dalskov, van Baak et al., 2010; Philippou, Neary, Chaudhri et al., 2009), and there is currently a lack of convincing evidence in long-term, well powered studies to suggest that a low GI diet is superior to other diets in reducing body weight (Sloth & Astrup, 2006).

\textbf{Exercise and weight management}

Although there is no range of data summarizing all the specific contributors to the increasing prevalence of obesity, most experts and guidelines acknowledge the role of physical inactivity in its aetiology (Grundy, Blackburn, Higgins et al., 1999; NHLBI, 1998; WHO, 2000, WHO 2016a). It is believed that successful restoration of normal weight in many overweight and obese individuals, requires a higher level of energy expenditure in addition to dietary alterations (NHLBI, 1998, NHLBI & NAASO, 2000). Therefore, increased physical activity (PA) and exercise training should be integrated into any treatment plan of obese individuals regardless of weight loss goals (Swift, Johannsen, Lavie, Earnest, & Church, 2014), not only for its weight management benefits but also to improve other health risks associated with
A large amount of research evidence shows that high levels of PA are inversely associated with cardio-vascular disease, type 2 diabetes and overall mortality (Haskell, Lee, Pate et al., 2007; Swift, Lavie, Johannsen et al., 2013), and that weight loss induced by increased physical activity substantially reduces abdominal obesity (Ross, Dagnone, Jones et al., 2000). Although PA, on its own, has minimal effects on the actual weight loss (Blair & Leermakers, 2002), it seems to be crucial for its maintenance (Kayman et al., 1990). Regular aerobic and resistance exercise is also important for muscle maintenance and bone health (Manore, Larson-Meyer, Lindsay, Hongu & Houtkooper, 2017). If weight reduction is achieved by energy restriction alone, approximately 25% of the lost weight is lean muscle tissue (Heymsfield, Gonzalez, Shen, Redman, & Thomas, 2014) leading to decreases in physical strength and RMR, which subsequently results in an overall reduction in total energy expenditure (Manore et al., 2017). On the other hand, if restriction of caloric intake is combined with PA, significantly less muscle is lost (Donnelly, Blair, Jakicic et al., 2009), which can further enhance weight loss, as muscle mass is more metabolically active than fat mass (Redman, Heilbronn, Martin et al., 2009). However, since weight loss as a result of aerobic exercise is very heterogenous, clinicians should always consult their patients on what are realistic expectations based on particular weight reduction program. Although, based on evidence from clinical trials, exercise training with even no or modest weight loss (< 5 kg), still produces significant health benefits in terms of cardiovascular fitness (Church, Earnest, Skinner & Blair, 2007), glucose control (Sigal, Kenny, Boulé et al., 2007), high density lipoprotein cholesterol levels (Kodama, Tanaka, Sailto et al., 2007), and overall improvements in quality of life (Myers, McVay, Brashear et al., 2013), and reductions in the symptoms of depression (Gournay, 2012; Rethorst, Wipfli & Landers, 2009). Additionally, observational and prospective evidence suggest that high levels of physical activity may facilitate weight loss maintenance and prevent weight gain (Fogelholm & Kukkonen-Harjula, 2000). Therefore,
overweight or obese individuals should certainly be encouraged to keep physically active, regardless of whether it brings any significant reductions in weight or not.
Appendix D.

Drug and Surgical Treatment Approaches for More Severe Cases of Obesity – A Brief Overview

Drug treatment of obesity

Drug therapy presents perhaps the most exciting advance among all obesity treatment approaches. It can be prescribed in addition to or as a part of comprehensive weight loss program including diet and physical activity to adult patients with BMI > 30 kg/m² or at least 27 kg/m², if accompanied by at least one obesity-related comorbidity (NHLBI, 1998; NHLBI & NAASO, 2000). The mechanisms through which drugs can affect weight loss are either reduction in food intake, alterations in metabolism, and/or increase in energy expenditure (Bray, 2002). Unfortunately, drug treatment for obesity has been accompanied by a number of disasters (Bray, 1998b). Detrimental side effects of various obesity drugs (e.g. fenfluramine, dexfenfluramine, phenylproplamine, sibutramine, rimonabant) initially approved by the US Food and Drug Administration (FDA), have resulted in their termination (Wyatt, 2013). Currently there are four major weight loss medications that have been evaluated and approved for long-term treatment of obesity: Liraglutide, Lorcasein, Naltrexone/Buproprion, and Phentermine/Topiramate (Ollendorf, Shore, Cameron et al., 2015). However, these medications can only be continued, if patients lose weight and maintain the weight loss without displaying significant side-effects, as observed previously in a number of appetite suppressants (Noël & Pugh, 2002).
Surgical treatment of obesity

Bariatric surgery has become widely accepted as the most effective approach to the treatment of morbid obesity (BMI ≥40, or a BMI ≥ 35 with comorbid conditions; Lo Menzo, Ordonez, Szomstein & Rosenthal, 2016) generally resulting in greater sustained weight loss and resolution of comorbidities than non-surgical management (Ollendorf et al., 2015). Although the effectiveness and safety of bariatric surgery procedures varies based on the patient characteristics (i.e. age, gender, race, ethnicity, initial BMI, psychosocial factors), generally it provides medically significant weight loss (7 – 8 kg/m² or 30 – 40% of total body weight), which is sustained for more than 5 years in most patients (NHLBI & NAASO, 2000). Up to date, several types of operations have proven to be effective for weight reduction and treatment of obesity related comorbidities: restriction of gastric volume (banded gastroplasty), digestion alteration (Roux-en-Y gastric bypass), sleeve gastrectomy, and gastric band surgery. All of these methods are applied in addition to limiting food intake, they each have advantages and disadvantages, and they also vary in efficacy.

It ought to be mentioned that even though the methods of bariatric surgery have become safer in recent years, they are still associated with high rates of morbidity, and mortality and they present a significant economic burden (Schauer, Bhatt, Kirwan et al., 2014). According to the most recent meta-analytical study, the complication rate related to bariatric surgery was 17% and 7% of patients had to be re-operated on (Chang, Stoll, Song et al., 2014). Additionally, it should be noted that bariatric surgery does not represent an “easy escape” from lifestyle interventions, including dietary changes and regular exercise, as many people might think. All patients have to follow a comprehensive post-operation program which provides them with guidance on diet, physical activity and psychosocial support. It has been confirmed that changes in total caloric intake and macronutrient composition produce greater weight loss 10 years after bariatric surgery (Kanerva, Larsoon, Peltonenlindroos, & Carlsson, 2017). All
patients also have to agree with lifelong medical monitoring after the surgery. Therefore, this approach should be reserved for *only* highly motivated patients, in whom other previously discussed methods of treatment have failed (NHLBI, 1998; NHLBI & NAASO, 2000).

The most recent advances in obesity treatment strategies have been studying endoluminal interventions (performed by using flexible gastrointestinal endoscopy) as an alternative approach for the modulation of gastric emptying (Choi & Chun, 2017). These are reversible endoscopic bariatric approaches that do not require the patient to commit to permanent surgical modifications of the gastrointestinal tract. Although several applications of this approach have yielded promising results in terms of weight loss and adverse effects (Bazerbachi, Vargas Valls & Abu Dayyeh, 2017; Hurt, Frazier & Mundi, 2017), more research evidence overcoming its therapeutic limitations is needed, in order to identify the role of endoscopy in obesity treatment.
Appendix E.

Reflective Reviews from Each Session of the Pilot Studies and the RCT

Pilot Study I. – Group Session Reflections

Session 1 – Gratitude, Group 1 02/11/2016

Participants: JF, CN, NK, HB, BL, AS, KT, RI

Session reflection:

The participants seemed to be quite excited about the first session. CN seemed to be sceptical in the beginning but he might have just been insecure and unsure what to expect. I had relaxation music playing in the background which seemed like a nice thought initially but when the session begun and people started talking, it was rather distracting. I went back to the computer several times, to switch it off and on again which, I felt, didn’t make a good impression and could have been perceived as a distraction.

Ianis had a nice introduction in the beginning explaining the molecular genetics approach we will be using to analyse the saliva samples, which seemed to have caught the participants’ interest. They were ensured that all health and safety procedures would be strictly followed when handling the samples. They were also told that they may receive the findings of the molecular genetics analyses, if they wished to.

In the first part of the session we spent some time discussing and sharing experiences from the online part of the intervention in the gratitude week. CN said that when he wrote a letter of gratitude to his wife, she seemed to perceive it as “odd” and rather unusual for him to express his thanks verbally. I told him that although I don’t know his wife, I was sure she actually appreciated it, as women do like to hear things. He seemed to agree with that. Many participants found the random acts of kindness exercise challenging. When they had to think about it, it didn’t seem spontaneous and random anymore… HB, however, found this exercise very nice and she felt it was a good opportunity for her to just express thanks to her sister by giving her a bunch of flowers. They all appreciated the exercise of writing down three things they were grateful for in that day. It made them slow down and think about the little things in life they usually tend to take for granted.
In the group, we then did a 10 minutes of gratitude meditation with a meditation music playing in the background. The participants were instructed to find a comfortable position and just spend the 10 minutes reflecting on things in their life they had to be thankful for. They were told to remember to show gratitude to the things that they had usually taken for granted. NK seemed to have particularly enjoyed the gratitude meditation exercise.

At the end of the session, each participant received a Complaint Free World bracelet. They were told that they could use the bracelet to help them become more aware of the times and situations they find themselves complaining. Whenever they would complain, they should switch the wrists on which they were wearing the bracelet. Complaining could be seen as the opposite of gratitude. Therefore, be increasing our awareness of complaining, we can become more grateful and happier at the same time.

Session 1 – Gratitude, Group 2

Participants: ROL, PV, CM, AS, KT, RI

Session reflection:

PV and ROL seemed to be quite excited about the first session. CM looked very tired and it seemed that her mind was just wandering off but I tried to keep her engaged by asking direct questions which seemed to be helpful. To avoid unnecessary distraction, I did not put the relaxation music on this time. I felt very tired and exhausted after delivering the intervention to the first group already, which might have affected the session slightly, although I tried to hide it and motivate myself knowing that the second group deserves an equally good session as the first group.

Ianis had a nice introduction in the beginning explaining the molecular genetics approach we will be using to analyse the saliva samples, which seemed to have caught the participants’ interest. They were ensured that all health and safety procedures would be strictly followed when handling the samples. They were also told that they may receive the findings of the molecular genetics analyses, if they wished to.

In the first part of the session we spent some time discussing and sharing experiences from the online part of the intervention in the gratitude week. PV was very excited about all the online part of the intervention claiming that it was just “so nice to stop for a while and show gratitude to the people and things we usually just take for granted”. I appreciated very much his spirit and contribution given the fact that I felt very exhausted. It really helped me to keep going. CM didn’t do much talking, even though I tried to engage her. It was a bit difficult for me to get to her, and I couldn’t guess what she was thinking but she seemed to be listening whenever I related the session topic with a family or children. Especially when I noted that whatever we
do for our children now will greatly contribute to the development of their parenting styles in the future.

When we did the 10 minutes of gratitude meditation in the session, ROL seemed to be particularly engaging and everyone responded positively to me sharing my personal experiences with gratitude and realisations I made thanks to living with my Congolese husband. They were also told to remember to show gratitude to the things that they had usually taken for granted.

At the end of the session, each participant received a Complaint Free World bracelet. They were told that they could use the bracelet to help them become more aware of the times and situations they find themselves complaining. Whenever they would complain, they should switch the wrists on which they were wearing the bracelet. Complaining could be seen as the opposite of gratitude. Therefore, by increasing our awareness of complaining, we can become more grateful and happier at the same time.

Session 2 – Mindfulness, Group 1

09/11/2016

Participants: JF, CN, NK, RH, BL, AV, AS, KT, RI

Session reflection:

For me, this was the worst session so far – and it’s just week 2! I always want to get everything set up and ready early enough, so that I have some time to calm down and prepare internally for the session. However, this was impossible this week because I couldn’t get access to the room. Although I requested the room to be opened at 3 pm, it wasn’t. I was running around like a headless chicken up and down to the Main Reception, ringing the Facilities to get hold of the caretakers who could open the room. I had to ring three times until somebody came over, so the room didn’t get opened until 3:35. The majority of the participants were already there – all waiting in front of the door. I felt really bad and embarrassed, especially after emphasising punctuality last week! When we got in, we started to move the tables and chairs and mess with all feedback sheets, and questionnaires. It was pathetic! I tried to remain calm and not to show anything because I really wanted this session to go well, but I just found it really challenging. We were ready to start at 3:45 when RH rang that she had been called for a first aid and whether it’s too late to come for the session. As we were already running late and she’s only 5 minutes away, I told her to come. Unfortunately she went to a different building, so when she finally found the room, it was almost 4 pm. We got to start more than half hour late which I found incredibly embarrassing and all the stress before the session just threw me off. I still tried to focus but inside, I just felt like this session was everything but mindful! Because of the late start I literally had to rush through the session content and whenever I asked the participants to share their experiences from the week, I just found it extremely difficult to concentrate on what
they were saying. However, generally, they seemed to engage more than last week and they also seemed to be more comfortable in the group.

I felt bad because we didn’t get to do mindful listening exercise or even mindful eating. We only managed to complete the Mindful eating scale and score it but it was very quick and we didn’t get chance to discuss it really. RH and JF had to leave at 5 pm, which meant they had to give their saliva samples. That again broke the group, so I felt there was no point trying to do any more stuff with the rest. There was no time for them to complete the feedback sheet either, so I asked them if they could email it scanned to me or bring it next week. I felt that was the only choice I had. The whole session just didn’t go anywhere near of what I imagined it would be like. Before leaving NK asked if we could do the meditation again next week which made me feel like she expected something like that in the mindfulness session but didn’t get it, so she was disappointed.

All this might have been just my personal perception of the whole session and perhaps the participants didn’t feel it was bad or disorganised as much but I’ve learned my lesson and I will avoid any similar problems in the future. I will get a key for the room to be able to access it early and we’ll be starting on time regardless of who’s there and who isn’t. If someone comes late, fine. But we will not wait for half an hour again, that’s for sure.

Session 2 – Mindfulness, Group 2 09/11/2016

Participants: CM, ROL, CZ, SF, PV, HB, AS, KT, RI

Session reflection:

Compared to the first group, this session went extremely well. Although I didn’t get any break, we started on time. I was calm by then and I was determined to deliver a good session - complete everything in peace and give the participants sufficient time to share their experiences and do some group exercises on mindfulness. I was very pleased to see two more people there who weren’t able to attend the session last week – SF and CZ. HB attended the first group last week, so she was not familiar with this group setting but she didn’t seem to have any problems engaging fully.

I went through the session content slowly and I no longer had a feeling that I didn’t know what I was talking about. Compared to the last week, everyone seemed to be a lot more open and comfortable sharing their experiences. Last week, PV seemed to do most of the talking, which was not the case this time. Everyone was equally engaged. I was very pleased with CM who opened up a lot more compared to the first session. Perhaps this was because her best friend, Sharon was there this time. They both were very talkative this time and I felt like they actually enjoyed the session. CZ was very quiet, so I tried to keep him engaged by asking some direct
APPENDICES

questions. Unlike CM last week, he actually seemed to be there mentally, but he just appears more as a reflective quiet person. It was a little bit hard for me to get to him but from the few responses and non-verbal cues he gave out, I felt that quite a few things mentioned in the session and points made, were interesting realisations for him.

Everyone was very interested in the Mindful eating scale and they were comparing their results. We didn’t have enough time to do the mindful listening exercise but we did mindful eating in stead which was much better choice. All participants had a choice to eat an apple or a mandarin mindfully. It was a very nice experience with a beautiful atmosphere.

After the session, KT wanted to have a private chat. She disclosed to me she struggled with bulimia nervosa and she wondered whether mindful eating may help her given it’s successful application to eating disorders. I felt the conversation was well managed and I was selecting my words carefully to ensure that KT would feel secure and supported. I told her that according to my opinion and personal experience with the illness, I do not believe she would be successful if she attempted to apply mindful eating by herself. It needs to be guided by a therapist and even then there’s no guarantee. She’s currently seeing the University counsellor but doesn’t feel he’s been very helpful. I told her she can ask to be referred to a CBT clinic.

Session 3 – Self-compassion, Group 1 16/11/2016

Participants: JF, BL, AS, KT, RI

Session reflection:

I was determined to begin on time this week. I had a key to the room, so everything was set up early enough and it seemed like it was just going to go all smoothly. Unfortunately, I cannot start without Ianis because he has the kits for sample collection and RNA later for stabilization, so once again we got to start very late. In addition to that only two participants turned up for the session, so in the beginning I was feeling very little motivation to do anything. Ianis had his student assistant with him today who seemed very nice but very nervous as well. I felt it was not fair to him that we were starting so late because he was put under extreme pressure and he was just shaking from head to toes. This was just an additional challenge for me to cope with. I was trying to remain calm and in control because I know that stress and strong emotional events influence gene expression significantly and I just wanted to avoid any biased results. But once again it wasn’t an easy start for me.

However, once we got started, the session itself went really well. I think that both, BL and JF actually do keep up with all the online stuff I’m sending out three times a week. They both always engage very well in the session and they are happy to share their experiences. BL said that she was quite successful in praising herself this week but probably because it was a
particularly good week. This lead to an interesting realisation – she finds it quite easy to praise herself if she manages to do all or majority of things on her “to do list” for that day. But if she doesn’t attend all the items on the list, she then finds it very difficult to praise herself because she feels there is nothing to praise herself for… I could relate to that experience very well myself which I shared. I tried to offer her a different perspective. It’s not like she did nothing in that day – she managed to get up from bed in the morning, take care of her daughter, attend to the family friends who unexpectedly visit them, tidy the house up etc. She didn’t do the things on her “to do list” not because she wouldn’t be efficient enough but because other things happened during that day that were out of her control. BL seemed to have appreciate this perspective. JF was very supportive – nodding in agreement. They both saw a big difference between the way we treat ourselves and the way we treat others. JF shared her view of it being due to the way we are all raised. We are conditioned to care very little about ourselves and when we do something to treat ourselves, we tend to feel guilty or we perceive it as an additional task to our already long “to do list”. I said that self-compassion is something that doesn’t come naturally to most of us unfortunately but it can be learned. However, it requires time and patience and we cannot expect to succeed 100% on a first attempt. This view seemed to be shared.

We watched a short video on the power of your thoughts with Nick Vujicic which appeared to be a very good tool to demonstrate the importance of self-compassion, believing in oneself and positive life attitude. Ianis wasn’t there at the time, so we couldn’t collect an additional sample which would have been beneficial.

We concluded the session with an exercise on discovering your critical self. Jean volunteered to role play in “the criticizer, the criticized and the compassionate observer” exercise. The situation that elicited a strong self-critical thoughts in JF was when her friend calls her but she doesn’t want to pick up the phone because it always ends up being a long exhausting conversation. From my perspective, JF tends to be excessively critical towards herself – her inner critic would keep on talking and pointing finger at her always finding some more blaming words to say. Her criticized self, on the other hand, had very little to say in her defence. She seemed to just accept all the harsh words and feel guilty and ashamed, miserable and worthless. Both positions elicited very strong emotional reactions in her, so I didn’t let the conversation go on for a long. When JF occupied the position of the compassionate observer, she was able to see the criticiser and the criticized selves from a distance and she was able to offer understanding compassionate words to both of them. This exercise was a strong experience for everyone and they were able to offer JF a very good feedback and a strong support. I felt there was a lot of bonding going on. I ensured that JF was feeling emotionally stable before leaving and offered her to contact me or my supervisors if she felt she needed an additional support.
Session 3 – Self-compassion, Group 2

Participants: CM, ROL, SF, PV, HB, AV, AS, KT, RI

Session reflection:

I was very pleased by the outcomes of the first session, so I was feeling very positive and motivated for this session. Also, I was pleased to see more people there. Interestingly enough, I felt that this session was worse compared to the first group. Participants in this group seemed to be a lot less responsive than BL and JF. They also admitted that they didn’t have the time to complete all the exercises given in the online part of the intervention which might have been the main reason for them being less talkative. However, I think I dealt with it quite well asking them to think about it in the session. One of the exercises was to reflect upon and become more aware of how much we take care of ourselves already. It turned out that the majority of them actually do very little for themselves and if they do get to treat themselves, it feels odd or unnatural to them. Once again I pointed out that self-compassion is something that doesn’t come naturally to most of us unfortunately but it can be learned. However, it requires time and patience and we cannot expect to succeed 100% on a first attempt. This view seemed to be shared. ROL shared a nice experience when she treated herself with a facial which was something she’d never done before. She actually felt very good for doing it and she decided to do it more often. CM also seemed to be more aware of how many times she actually goes out of her way to treat others but she forgets about herself. Particularly this is in a relationship with her 11 year old daughter who sends her texts from her bedroom or even kitchen asking her to come over in stead of moving herself when she wants something. CM now started ignoring most of those texts realising that if her daughter wants something, she can come to her and CM will not need to constantly interrupt doing whatever she’s working on.

Just like the first group, the second group too, saw a big difference between the way we treat ourselves and the way we treat others. SF shared her view of it being due to the way we are all raised. We are conditioned to care very little about ourselves and when we do something to treat ourselves, we tend to feel guilty or we perceive it as an additional task to our already long “to do list”. When I talked about the benefits of self-compassion and unconditional self-acceptance I felt I was repeating myself a bit which made me feel slightly insecure and lost. Although I have made a good progress in my life, I’m obviously still bothered about what people think about me and I’m seeking approval. However, I used that to my advantage in facilitation of the group and I shared my experience using an example of the current challenges I’m going through – doing my PhD while having a baby and comparing myself with my fellow students, who do not have families and thus can concentrate fully on their PhDs. The group responded with much understanding and compassion.
We watched a short video on the power of your thoughts with Nick Vujicic which appeared to be a very good tool to demonstrate the importance of self-compassion, believing in oneself and positive life attitude. Everyone seemed to be very moved by the video and some participants were close to tears even. At this point, Ianis decided to collect an additional saliva sample.

We concluded the session with an exercise on discovering your critical self. HB volunteered to role play in “the criticizer, the criticized and the compassionate observer” exercise. I was pleasantly surprised to see that she was a lot more accepting towards herself than I expected. She struggled a bit with the exercise setting which required some abstract thinking. She struggled with using the format “you are, you do…” etc in all three positions. I had to guide her through. I’ve noticed an interesting thing that she was constantly looking at me whenever she said something as if she was looking for approval. When we reflected upon the exercise, she admitted that it was difficult and that she is very much bothered about what will people think about her. She fears negative judgement and she wants to please people. At the same time, however, she seems to be accepting towards herself more than most other people. Everyone in the group was very supportive again and provided a positive and constructive feedback to HB. Once again, I ensured that HB was feeling emotionally stable before leaving and I offered her to contact me or my supervisors if she felt she needed an additional support.

Session 4 – Strengths, Group 1

Participants: BL, RH, NK, AV, AS, KT, RI

Session reflection:

I wasn’t feeling very good in the beginning of this session. The strengths topic did not resonate with me too much, so I was a bit worried how the whole session would go. However, I started to feel much better when the participants began to turn up – they brought a lot of positive energy with them and it appeared to me that they were really looking forward to the session too. The session was very interactive even during the theoretical parts. When I asked them to share their experiences from the online part of the intervention received earlier on that week, they were all equally engaging. I particularly liked when we talked about their greatest life achievements and I asked them to try to link those to their strengths. RH felt that her family was her biggest success but she said it in a way that sounded almost apologetic as if it was “not a big deal”. I fed back to her saying that when we are asked to think about our life successes, we tend to think “career” first. But that is just a reflection of the type of world/society we are living in and it does not have to be true. There are many people who do not have the opportunity to study or have a job. Does that mean that they cannot succeed in their lives? That really triggered some thoughts in the group. Everyone agreed that it didn’t. So, I told RH that the fact that she perceives her family as her greatest achievement suggests to me that she is probably
very loving, caring, giving and supportive. Those are all amazing character strengths that make her who she is.

BL said that she almost felt guilty for saying that her life success was the fact that she managed to get to university, get a placement that she’s doing and achieve all this in a different country with no family support. She said she should probably say family too because they strived for a baby with her husband for 8 years and they were beyond happy when it finally happened. But she worked so hard to get this placement and succeed in her education that she really felt that was a great achievement in her life. Everyone in the group was very supportive at that point – especially NK and RH who are lecturers at the university and appreciate hard-working students very much. I said that BL had all rights to feel extremely proud of herself and that didn’t mean she would not appreciate her family. The perception of our successes changes throughout the life and that’s how it’s supposed to be.

BL’s story motivated AV to share some of her life struggles too. She found it very challenging to come and live in a different country and keep her family and children together at that time when her husband was not there for them. She managed to get into education and succeed at university level.

I planned to do a group exercise with them where they would share their character strengths with others and explore more ways of using those strengths. However, as this exercise is designed for and works best in larger groups (at least 15 people), I decided against it, which appeared to be a good choice. Instead, I asked them to outline their hands and write one of their strengths to each of the fingers. This turned out to be very pro-active exercise and although the participants had known each other for just 4 weeks, they were helping each other. I then told them to outline the other hand and asked them what they thought they would write there. Everyone except for NK shouted “weaknesses” with a bright smile on their face. NK was the only one who answered correctly: “more strengths”. It was very interesting feedback for everyone to realise how much they are really conditioned to focus on their weaknesses and how much easier they find it to talk about those.

We watched a short video about character strengths and I also gave everyone a link to the VIA institute on character where they could take the VIA strengths test. I gave them the dyslexia friendly version developed by Chathurika Kannangara which was very much appreciated by a number of participants.
Session reflection:

I was feeling quite hopeful in the beginning of the session that it would go well. As hope has always been something quite vague and unrealistic for me, I wanted to make sure to explain the concept of hope and the theory of hope really clearly. It seemed to work quite well with everyone except CN. I really appreciated that he attended this session because I could tell that it was very challenging for him. When we were discussing the meaning of hope and what it represented to each one of us, CN said in a very straightforward way that to him it didn’t mean anything. It represented almost a religious concept to him which seemed to trigger very negative emotions and almost aversive attitude. I agreed that many people actually misuse the concept of hope and that it can create a boundary for some of us. I tried to explain the concept of hope as a combination of goals and mental willpower and waypower that people have in order to achieve their goals. But this didn’t seem to resonate with CN either. He said that he doesn’t have any goals to pursue and that he’s happy with what he’s got. When I said that this could suggest that he was actually hopeful for maintaining his life as it was, he couldn’t relate to that. I asked him, how would he feel if he actually lost everything he had. This seemed to make him think a little but then he just concluded that he probably wouldn’t care really. I tried to be understanding and accept his views allowing him more time. I just felt there was nothing else I could do at that stage. On the other hand, it was very nice to see the group reaction to that. I could observe a lot of group support and bonding going on there.

NK said that she noticed that her weight loss has improved since she started doing the intervention – she attends the Slimming world program. When we did the gift of hope exercise, I started and I said that I was really hopeful that this program will be actually beneficial for them and that all this time and effort of all of them is not in vain. I got very emotional and started crying which was very unexpected. I felt extremely grateful for each one of the participants. Everyone was able to share their hopes apart from CN who just quietly passed the box on. But overall, I could see very positive responses in everyone. Even though CN is a challenging member of the group, I believe there is a reason for him to be there and if he wasn’t getting anything from it, he wouldn’t be coming still…

We watched another video with Nick Vujicic as a group and I decided to take an additional saliva sample after that. It was a bit long video, about 14 minutes but I felt it was quite powerful.
Participants: CM, BL, PV, AV, ROL, KT, RI

Session reflection:

I was actually feeling really good after the first session, even though I was very tired. The second group brought a lot of positive energy with them. Especially PV and AV seem to be really excited about each session. PV said that it really helped him to approach things in everyday life differently and that he feels better every single time he leaves the room on Wednesdays. ROL agreed that it makes her think as well. Everyone was very open to share their experiences from the online part of the intervention. PV and AV both used to believe that hope was something outside of their locus of control and this program helped them to understand the real meaning of hope. AV realised that she was actually a very hopeful person without being aware of it before. PV said that he certainly approaches his life with more hope than ever before. For ROL and BL, talking about motivation was the most significant aspect. They too believed that hope was something rather vague and uncontrollable but when we talked about motivation and action steps, it resonated with them very well. BL in particular really seems like a “doer”. We watched another video with Nick Vujicic as a group and I decided to take an additional saliva sample after that. It was a bit long video, about 14 minutes but I felt it was quite powerful.

We concluded with the Gift of hope exercise which turned out to be extremely powerful. I started again and I thought I was going to handle my emotions well because it was already a second time but I started crying again. The fact that all those people were still there filled me with great hope and a strong feeling of gratitude and I just felt that if this whole intervention was useful to one person, it would be great for me. Following my emotional sharing PV said that he is also hopeful that this program will help him live more happy life and he already felt great changes in his life. AV realised that she was actually very hopeful when after having multiple negative experiences with men, she didn’t give up and at last found a perfect person for her who she wants to share her life with – PV. It was extremely powerful to have the two of them in the same group at that moment. When BL received the Gift of hope, she couldn’t stop crying – she’s hopeful that she will finish her course despite her learning difficulties “because of people like ROL”, who provide her with all the additional help and support that she needed and could ever ask for. CM got emotional for a very first time and she actually started crying. She, too was hopeful that she would be able to do her course with good marks despite being autistic. She disclosed her son was diagnosed with autism and then later on herself too was diagnosed with Asperger’s syndrome. It was an incredible experience to see that within this group setting, CM was capable of expressing such strong emotions despite being “hard-faced” normally. She also thanked ROL for all her support and ROL was just very moved by all that. She said that she hoped that she could just keep on doing a good job and supporting the people who needed it.
Overall the whole session went extremely well and it was incredibly powerful and emotional. I allowed sufficient time for everyone to calm down until they were ready to leave.

Session 6 – Happiness, Group 1 07/12/2016

Participants: CN, AS, RI

Session reflection:

I was feeling quite positive in the beginning of the session believing that it would go well. I received a message from a couple of people who couldn’t make it for the last session and some other participants said that they would attend the second session. However, I was still surprised that only CN turned up for the first group. Although RI and AS submit their data as participants too, they are my assistants, who take this as a part of their Applied work experience module. So, it really was just CN there. I was a bit worried how the whole session was going to go and “what the hell” we’re going to talk about for 90 minutes! However, it turned out to be a surprisingly nice session. I’m not sure if we could ever get CN into a more emotional state – it would probably take much longer than 6 weeks. But although there was not any crying or laughing, I felt that for CN this was a really good opportunity to have a one-to-one session which he deserved. I was surprised that he didn’t feel uncomfortable at all with this setting and he actually talked a lot. I felt that this was an opportunity for him to get some things “off his chest”. He opened up quite a lot about his relationship with his boss, which wasn’t good. He found it very difficult to work with that person because of his character and approach to people in general. As I know his boss, and I happened to have similar experience with him too, it was slightly challenging for me to remain professional and maintain distance. But I felt I handled the situation quite well. I said that some people act in certain ways that may challenge us for a reason. It may be their way of coping with their own insecurities or they may have just been conditioned to act that way in the past – depending on their life experience they may have just created some defence mechanisms which seem to work for them somehow. However, all this is something we cannot change. I tried to challenge CN a bit by asking him who is responsible for his feelings and actions. He confirmed it was him and therefore it was also him who could change those feelings or actions or thoughts. His boss may be a complete “jerk” but it is each person’s choice whether he/she will get affected by it. I felt that CN could actually understand it and that it made him think a little, although he was trying to argue about it a bit. At that point I offered him understanding and empathy but I rejected his suggestion that he would be responsible for another person’s feelings or actions or vice-versa. As an employee and a manager, it may be his work duty and responsibility to ensure that people below him complete their jobs but that has nothing to do with a responsibility on a personal level. We came to agreement on that, which I felt was an accomplishment at that stage.
APPENDICES

We didn’t have much time to do the group games, which I felt was a pity but perhaps it was meant to be that way. May be CN needed more time to express himself fully and it was more beneficial for him than games. However, we did get to play “suck it up” and “bend a friend” and CN actually did really well in both, so I gave him a little Christmas present (jelly candle), which he said would give to his wife. Overall he gave me a positive feedback on the 6 weeks of the intervention and he said he definitely did not regret his decision to take part. That was good enough for me and I felt we actually got somewhere – may be not far but at least not backwards…

I gave him a hardcopy of the whole intervention on a CD and a certificate of award for completion of the PPI. This was accepted with a smile.

Session 6 – Happiness, Group 2 07/12/2016

Participants: CM, SF, PV, AV, ROL, HB, NK, AS, RI

Session reflection:

I was feeling quite well after the first one-to-one session with CN, even though I felt I would need some time to process everything he talked about. However, I had to go straight into the next session. I recovered and regained my energy quite quickly as I saw everyone coming in. A few people who would normally come for the first session, attended the second one, so it was much larger group than usually which made me feel very positive. The participants also brought a lot of positive energy with them and they all seemed to be happy to be there. They all shared their experiences from the online part of the intervention, although none of them could replicate an experiment seen in a short video where they had to forgive someone they currently held grudge against. This was actually nice to hear – especially when PV said that this intervention had helped him to cope with certain people and situations better than he normally would. Overall the feedback I received for the whole 6 weeks was extremely positive. I expected that majority of people would have had the best experience in the hope session, because it was very emotional. But I was pleasantly surprised that was not the case. They all seemed to have found something significant for themselves in different sessions. NK had the strongest experience with gratitude realising that she does take things and people in her life for granted. PV liked mindfulness and strengths, because he learned to look at things from distance and with patience and without judgement and he discovered new ways of using his strengths. AV liked hope and strengths the most because she understood the concept of hope from a different perspective and realised that she was actually a very hopeful person and she discovered many strengths of hers that she was previously unaware of, or thought were useless (e.g. gratitude). HB liked strengths realising that it is because of her strengths that she ended up doing her job well and she enjoys it. She also liked the happiness theme which helped her realise that happiness does not depend on external things but is a state of mind rather. ROL
said that she absolutely “embraced” the self-compassion and she started doing things for herself she’d never done before (e.g. facial, pilates, yoga, massage, regular swimming) on a regular basis. CM said that mindfulness had a strong impact on her because she realised it was okay for her to “do nothing” (mainly not to respond to her 11 year old daughter’s texts who was just in another room). SF liked the self-compassion which helped her to start accepting herself the way she was.

All this was very valuable feedback for me and I was pleased when everyone said that it was very beneficial to them and that they didn’t regret their decisions to take part.

We moved on to the group games which was really a lot of fun compared to the first session. It produced outbursts of laughter, which was exactly what I was hoping to see. The fact that the group was bigger definitely had a positive impact on the games’ outcome. I stretched the “suck-it-up” exercise a bit, so after moving sweets from one plate to another using a straw, I had the two best people do the same with chopsticks. It was absolutely hilarious. PV won despite the fact that he’d never used chopsticks before. We then played the “bend a friend” game where they had to pick up a cereal box with their teeth. The box got cut down each round. The positioning of everyone trying to get to the box was so funny again and everyone was just laughing out loud. NK won this one. PV and NK were each given a Christmas present of a jelly candle for their performances.

We concluded with awarding the certificates. This was received so well and everyone was pleased to receive a hardcopy of the whole intervention on a CD. Everyone was also very interested in finding out the results of all gene expression analyses and they were all keen on joining any following studies.
Pilot Study II. – Group Session Reflections

Session 1 – Gratitude, Group 1

Participants: BF, SP, GP, PT, MK, CA, BR, HH, RD, IH, ZR, SH

Session reflection:

The participants seemed to be quite excited about the first session. They all brought some sort of positive energy with them, which was quite encouraging. However, the external environment was not suitable. The room we were in was very small, very hot and dark and there was no way for us to improve those conditions. The projector I was using was incredibly slow and extremely loud and even though I tried to keep my emotions under control and just do the best I could, I found the noise of it very distracting. In addition to that, the picture projected on the screen was very small, so it was very hard to see anything on the presentation. I did apologise a number of times for the conditions and the students seemed to be very tolerant and patient and just fine with it but I certainly felt uncomfortable delivering the session. I am determined to get a better room for the very next session. In addition to that, Ianis came 25 minutes late again, so that didn’t make things easier either. I had significantly less time to deliver the session which meant that not everyone had an opportunity to share. However, I felt that I handled it quite well – I was observing carefully the participants non-verbal expressions and I was able to tell who was keen to share and who wasn’t. So I encouraged those who seemed to be wanting to share their experiences.

Overall, despite the external circumstances, I felt that the session went extremely well. The participants seemed to be very comfortable within the group setting – I could see that they bonded well and that they truly were supportive to each other. Clearly the fact that they have known each other before (doing the same course at the university), has made the group setting a lot more friendly and open. However, I was still surprised by courage of some of the participants and their trust in me as the group facilitator. They’ve only just met me but some of them were very keen to share their personal experiences, which suggested that I must have gained their trust very quickly. PT wanted to read her “Letter of gratitude” that she wrote to her sister to the whole group. That sharing brought tears to some people’s eyes (myself included). I appreciated her courage and thanked her for sharing her experience. HH started crying when she shared about her being thankful for her job. She reflected upon her original family setting where the financial situation wasn’t easy and she was just very appreciative of her opportunity to study at university level and live a decent life. The group was very supportive and empathetic at that point and a couple of close friends tapped HH on her back. I gave her time to deal with her emotions and I just told her that living off a very limited budget was something I could understand myself very well and that I thought that appreciating our jobs is
very important because it is not always easy to get and maintain a job. At the emotional points, I always made sure that I gave the person sufficient time to digest the moment and I asked them whether they were all right to continue. When they confirmed, and I could see that they were calm, I continued then.

Many participants agreed that they found it a bit challenging to perform random acts of kindness reporting that when they had to think about it, it didn’t “feel natural” anymore. I did agree with that but I said that this exercise was to increase their awareness of acts of kindness – it was something that they could do on everyday basis without focusing on that. I was pleasantly surprised by how many people actually did write a letter of gratitude to someone. I considered that as quite a difficult exercise, which can take a long time sometimes. But the participants seems to appreciate it and most of them agreed that it helped them to become more aware of how much they have to be grateful for.

Towards the end of the session, we did a 10 minute of gratitude meditation with meditation music playing in the background. The participants were instructed to find a comfortable position and just spend the 10 minutes reflecting on things in their life they had to be thankful for. They were told to remember to show gratitude for the things that they had usually taken for granted. I felt that this exercise didn’t have the impact I intended due to the uncomfortable environment. The noise of the projector was disturbing the meditation music, and there was just no way people could have found themselves a comfortable position. I think I was distracting them as well because I had to label the salivettes, since Ianis had gone. I couldn’t do any better but I still wasn’t happy about the outcome of this exercise.

At the end of the session, each participant received a Complaint Free World bracelet. They were told that they could use the bracelet to help them become more aware of the times and situations they find themselves complaining. Whenever they would complain, they should switch the wrists on which they were wearing the bracelet. Complaining could be seen as the opposite of gratitude. Therefore, by increasing our awareness of complaining, we can become more grateful and happier at the same time.

Session 1 – Gratitude, Group 2

Participants: BeF, VC, CG, ET, RF, NT, EG, DMC, SM, NS

Present (not participating): DD, JD, NZ

Session reflection:

Unlike the first group, the participants didn’t seem too excited about the first session. I couldn’t be sure what was the reason for that but I had some information from ZN that there might have been a negative influence from the first group. Even though I wasn’t going to let that
APPENDICES

information influence me, I felt I needed to ensure that there was no misunderstanding in terms of the purpose of the PPI and the group sessions. Ianis came in the class earlier in the morning explaining the molecular genetics approaches we were using and the rationale behind those. It seemed important to me to address these clearly to ensure that everyone knew what were their samples going to be used for. Unfortunately, Ianis couldn’t make it to the session itself, so we didn’t collect any samples this time.

I spent a bit more time with addressing the ground rules. I explained them one by one in greater detail and I was asking the participants how they understood each one of them. I wanted to be sure that we were all on the same page. I emphasised quite a few times throughout the session that we weren’t there to talk about their private life and that I only wanted to know about their experiences with the PPI itself. If they decided to disclose any personal information, it would have been their choice and of course we would keep it strictly confidential. It seemed that they all understood it and they seemed a little more at ease. However, the whole session was rather quiet. People were a bit reluctant to share anything really. But on the other hand that may suggest that this group is a lot more mature and that the group dynamics will develop gradually and as expected.

Quite a few people were taking a lot of notes throughout the session. BeF was quite engaged and probably the only one who was willing to open up a bit. She brought her letter of gratitude that she wrote to her mum and she read it out loud. I felt very touched by that myself. I accepted the fact that people weren’t feeling comfortable to speak up yet, so I just did most of the talking and I was addressing self-awareness quite a lot throughout the session. I was asking many open-ended questions without requiring any answers (e.g. Why are you here? What do you expect from this course? What do you want to achieve in your life? What makes you stick with your partners? Why haven’t you walked out of here yet, if you don’t believe in gratitude?) I felt that this made quite a few people think more. DMC seemed very reflective and very engaged – even though he was not very vocal. I felt the same about SM and NS. None of them agreed to take part last week but they all changed their mind towards the end of the session. That was a very positive feedback for me. Also, I felt that NT was very much into the whole PPI, even though he didn’t say a word at all. But he stayed after everyone left just to say “thanks” and that he was looking forward to next week.

Towards the end of the session, we did a 10 minute of gratitude meditation with meditation music playing in the background. The participants were instructed to find a comfortable position and just spend the 10 minutes reflecting on things in their life they had to be thankful for. They were told to remember to show gratitude for the things that they had usually taken for granted. I felt that this exercise went much better than when we did it in the first group. The environment was much more comfortable and it made a big difference.

Overall, it was a good session. This group seems a lot more reflective than the first group which after all may be a good thing. Hopefully they will feel more comfortable in the up-coming weeks, so that we won’t have to finish 30 minutes earlier every week…
Participants: BF, SP, GP, PT, MK, CA, BR, RD, IH, ZR, SH, PM, RH

Session reflection:

The session seemed to go very well. Ianis was 25 minutes earlier, so even though we struggled with setting up the IT equipment, we were prepared and ready to start on time. I felt a lot more confident talking about mindfulness than in the first Pilot study. But I still have to admit that this topic doesn’t resonate with me so much. However, I must have been selling it quite well because everyone seemed to be “soaking it in” like a sponge. I have even seen a few people taking notes vigorously as if my words were golden. I found that very encouraging. Everyone seemed to have completed the online part of the intervention, which too, was encouraging. But many participants reported to struggle with the mindful breathing exercise and 10 minutes of doing completely nothing. They agreed that the breathing felt strange and unnatural and that the 10 minutes of doing nothing constantly lead them to think that they should do something or think of what they were going to do as soon as the 10 minutes would be over. I linked all those experiences to self-awareness. I told them that I did not actually expect them to succeed in these exercises 100% on the very first attempt but I said that it was more for them to become aware of all the distracting, restless, critical, negative thoughts that come to our head every minute without us even realising that. They seemed to be quite astonished by taking this perspective. Observing their faces, I could see a few “AHA-effect” responses there.

When discussing beliefs, I felt that most people thought about beliefs from an abstract point of view but couldn’t come up with anything that would apply to them personally. We spend a little time on this to make sure that they did understand the meaning and importance of this exercise. I shared my own beliefs and the way they drove my life, which helped the students to understand what it was all about. When I said that I believed that I had to be perfect in everything, many of them were nodding in agreement, suggesting that this was their belief as well. I said that I believed that all women should always maintain their homes tidy, and take care of their families and cook for their men, which seemed to resonate with quite a few women too. I said I believed that all men liked their comfort and doing nothing, many people laughed finding resemblance in that statement. Given better understanding of beliefs and attitudes, I encouraged them to do the exercise again to see what they’d come up with. I encouraged them to trace the roots of their beliefs and attitudes and identify whether they were actually helpful or maladaptive. By that, they would then be able to decide whether they’d choose to keep those beliefs or change them.

We had just enough time to do the mindful listening exercise, even though we didn’t complete the reflection sheets on this exercise. But the students were encouraged to reflect upon the exercise at home. Quite a few people became very emotional when sharing what was stressful
for them at that time. I really appreciated how supportive the group members were. They were very empathetic and encouraging, they listened actively and they showed a lot of understanding. Once again, I was surprised by the group dynamics and by how fast they got comfortable within the group setting. BF shared rather major stressful event of her life, which lead me to take some action steps to ensure safety of all group members.

Overall, the session went very well and the participants seemed to have gained a lot of valuable knowledge and information, and share personal insights.

**Session 2 – Mindfulness, Group 2**  
29/03/2017

Participants: ET RF, NT, EG, DMC, SM, NS

Present (not participating): DD, JD

**Session reflection:**

Unfortunately, this week was a third week in a row Ianis couldn’t come to collect the samples. I wasn’t feeling good about that at all not only because I will have to deal with missing data later on but because I just found it very disrespectful towards the students, who agreed to take part. I knew I had to calm down to be able to deliver a good mindful session, so I just focused on the present moment and on the people coming in to the class. It made me feel better and ready to start the session on a more positive note.

The participants came in with much better, open-minded attitude than last week. I felt that they were more relaxed and probably even felt more secure. I still went over the ground rules in the beginning of the session to ensure that clinical practice was maintained. They were still very quiet and a lot more reflective, which is probably a good thing. But on the other hand, it made me wonder at times, whether they were really fully present or whether they understood what I was talking about. I was very pleased to hear that a couple of people, DD and DMC, have done mindfulness before. I asked them to share some of their experiences with mindfulness and they both confirmed that it was not as easy in the beginning and the more they did it, the easier it became. I was grateful for their sharing because not everything had to come from me at that point. It seemed that majority of people struggled to complete the online exercises but they at least seemed to have attempted it. The majority of people admitted that they struggled with “doing nothing for 10 minutes” but most of they did not watch the video attached to the Friday presentation, so used this opportunity to watch it in the group session. I felt that was beneficial because it helped me talk about and emphasise a number of important aspects that I wouldn’t have normally fitted in the session. It helped me give a clearer explanation of the concept and purpose of mindfulness. I gave a few examples from my personal life again which was well accepted. At that point I have noticed an interesting thing in myself that was related to my
clinical practice. I felt a lot more secure and comfortable sharing my personal experiences than I did with the previous group. I felt I had to be extremely cautious and careful what I decided to share with the first group because I just felt like I couldn’t trust those people with confidentiality. They would challenge me many times as if they just wanted to test my abilities and see how I would handle that. I might have handled it really well but I simply couldn’t have trust in the first group. They were very unpredictable, perhaps because they were very insecure themselves. The second group, however, is a lot more reflective and observing their non-verbal communication, I can tell that they are “taking it all in” and that they do believe that they can truly learn something from the PPI. Given that interest and respect, I naturally feel like I do want to give them more and offer them the opportunity to learn and test and analyse, even though that will be done using my personal life experiences. So, once again I have learned about the importance of boundaries, transference and counter-transference, and trusting my instinct. I have a feeling that the dynamics of this group will follow a lot more linear and smooth pattern.

We spend quite a bit of time talking about beliefs and attitudes which was something they were supposed to do at home but no one everyone managed to do that and I felt that some of them were not even that clear on what beliefs were. So, once again I used a couple of examples from my own wide range of beliefs (i.e. “Women should do all the house work.” and “All men are useless.”), and I let them think about how those beliefs would affect my life, my feelings, thoughts, actions and relationships… They were very engaging at this point and it seemed to have helped them understand the importance of their own beliefs they might not be aware of. Asking direct and open-ended questions, I got them to speak up a bit more and use their critical thinking which I then used to draw a link to self-awareness and qualities of a good counsellor/therapist…

We concluded the session with the mindful listening exercise. I was pleased to see a lot of support in the group during this exercise. I started it and I just felt like being open and genuine, so I said that the one thing that was stressing me out was that I had no clue of what they were thinking or feeling and I couldn’t tell whether whatever we’re doing in the PPI was beneficial to any of them at all. Knowing that I was a perfectionist, I couldn’t help but perceive that as a big pressure. It was incredibly empathic and sweet that at that point some of them were just trying to help me and make me feel better. In myself, I knew I didn’t need that because I know who I am and what my struggles are and what I’m supposed to do about them, but the fact that these students felt the desire to support me or may be even rescue me somehow, was very pleasing. NS gave me very nice feedback at the end of the session saying that I shouldn’t worry at all that it really was beneficial to them. It was only a couple of sentences but it was a valuable feedback for me.

Overall, it was a good session and it made me feel hopeful.
Session 3 – Self-Compassion, Group 1  14/02/2017

Participants: BF, SP, GP, PT, MK, CA, BR, RD, IH, ZR, SH, RH

Session reflection:

I wasn’t feeling well on the day and I had to leave my sick daughter at home crying for me, which was not helpful. I felt guilty and I found it very difficult to concentrate. However, I wanted to put on a good session. I felt that the atmosphere in the room was kind of negatively affected by my own feelings, but it might have been just my perception. Everyone seemed to be happy to engage in the session and share their views and experiences. In the beginning it seemed that everyone could relate to what I was saying but when we talked about the online part of the intervention, it turned out that many people actually struggled with the topic of self-compassion. They found it difficult to do nice things for themselves and treat themselves with kindness. MK said that she doesn’t really feel joy doing things for herself. She said that everything she’s been doing in her life was because it was necessary, rather than pleasurable and that she “pitying herself” would make her feel worse. I did point out that self-compassion didn’t equal self-pity but no matter how much I tried, people didn’t seem to understand the difference between compassion and pity. There was a moment in the session when I felt I was just staring at a bunch of blank faces of people, who had no clue of what I was trying to say. I found that moment very difficult and for a minute I really just wanted to wrap it all up and go. However, I have noticed one interesting thing. These are all Psychology/Counselling students and their counselling skills are rapidly improving. They are very empathetic towards each other at this stage already, which is a good sign on one hand. Unfortunately, some members of the group have gone through very difficult life situations, which they feel keen to share because they feel comfortable in this group setting. I’ve noticed that in the last session with BF, who disclosed that she was sexually assaulted by her friend. This event has clearly had a major impact on her life and it does need individual attention and a very sensitive approach. In this session, I realised that I was much more aware of BF’s issue and I felt an intense pressure to deliver the session in a sensitive way. I found it very difficult to maintain the purpose of the session and the group focus. I felt more and more that the session was BF-focused, which really wasn’t the plan. It made me realise that before I start working with the next group I will need to clearly state what the sessions are and are NOT for.

Overall the session was intense and emotional but we could feel more of the negative emotions than positive… Everyone connected really well after watching the short video with Nick Vujicic. I was surprised to find out that the majority of the students have known about Nick before. That was different compared to the first pilot study.

We concluded the session with the “criticiser, the criticised and the compassionate observer” exercise. SP volunteered to role play but she struggled to verbalise her inner voices using the 1st person. She kept looking at me, as if she was looking for approval. I asked her whether she’d
rather not do it and she just said that she didn’t know what she was supposed to be saying. After seeing the demonstration, everyone else seemed to be hesitant to try themselves. I felt like they were worried what would come out and they didn’t want to put themselves in such a vulnerable position in front of their classmates. That was a reason, why I decided to demonstrate the exercise myself. It was not easy because I became very emotional (as expected) but I still had to facilitate the session. I felt I’ve managed it all well, but I wandered whether it might have been a bit too intense for everyone.

We concluded the session on a good note. We had a short chat with BF and ZR afterwards and we all agreed that it would be more beneficial for BF to withdraw from the study and focus on her well-being and mental health recovery.

Session 3 – Self-Compassion, Group 2 04/04/2017

Participants: DMC, BeF, RF, CG, NT

Present (not participating): DD, JD, NZ

Session reflection:

I felt quite relaxed in the beginning of the session even though I was disappointed once again that no saliva samples would be collected. I decided not to address that in the group anymore as it made me feel insecure and very uncomfortable and it just wasn’t helping anything.

The session seemed a lot more interactive than the previous two sessions. The dynamics of the group started to change slightly. People seemed to feel more relaxed and a lot more comfortable within the group setting and with the PPI structure. Since the previous group struggled to see the difference between self-compassion and self-pity and the session in general didn’t go too well, I wanted to make sure that the concept of self-compassion was clearly addressed and the distinction between compassion and pity would be made. I was pleased to see that nobody in this group struggled to see this difference, so I made the distinction between the two more interactive. This was beneficial because at that moment the participants felt that they were given the trust that they could come up with correct definitions themselves. They started opening up more. Especially DMC and BeF engaged very passionately in the session and they were discussing many things together throughout the whole session. I was very encouraged by their interaction. I appreciated when CG shared some concrete ways in which she takes care of herself because many people didn’t seem to be able to find anything they do to take care of themselves. So I used this opportunity to bring self-awareness back in the game. One by one, I asked DD, JD and NZ, what they do for themselves and none of them was able to answer properly and they seemed to think that going to the gym or engaging in regular exercise was the only way (or perhaps the right way) to take care of themselves. So at that point I just gave
them a number of other different examples of self-care, which appeared to be quite eye opening for them. I talked about physical, mental and spiritual aspects of self-care and I said that the most important thing was for them to KNOW what it was that actually made them feel good. If we exercise because we think it is the right thing to do but it doesn’t make us feel good in any shape or form, then that is not a self-compassion. “If you don’t know what makes you feel good or what you like doing, then you will struggle with self-compassion”. We also talked about the way our society interferes with self-compassion and that we need to be aware of that to be able to make the right choices that will actually be beneficial for us.

We concluded the session with the “criticiser, the criticised and the compassionate observer” exercise. CG volunteered to role play but she struggled to verbalise her inner voices using the 1st person. She kept looking at me, as if she was looking for approval. I asked her whether she’d rather not do it and she just said that she didn’t know what she was supposed to be saying and that she doesn’t really criticise herself. BF volunteered to do the exercise herself in stead and she was an excellent demonstrator. I was very pleased to see that the criticised part of herself was incredibly balanced – she could clearly step up for herself and she knew what she wanted and she could defend it very well. But at the same time the criticiser was very powerful too and wouldn’t let go of her concerns. I was hoping that the group members would give her more feedback but it was mainly down to me again. But it was still a very good experience for everyone in the group.

There was one point when BF shared rather private experience from her life when she was sexually abused. I just addressed confidentiality immediately but I felt that nobody in this group would even dream of breaking the contract (unlike the previous group). But I was really pleased to see how stable BF was. She was clearly “over it” and it was just an excellent real-life example of how we cannot always influence what happens to us but we can and we do influence the way we react to it. BF did not let that affect her life in a bad way, which might have taken her a long time but she made the right choice which allowed her to be free again.

Overall, this was a very good session and people seemed to bond a lot better. The group dynamics seem to be developing quite linearly and at a steady pace.

Session 4 – Strengths, Group 1

Participants: BF, SP, PT, MK, CA, BR, RD, IH, ZR, HH, RH

Session reflection:

I was slightly concerned about how the session would go because session 3 on Self-compassion didn’t go very well for me and it was followed by a week gap in the intervention due to a conference running at the university. So, I couldn’t predict what mood would the participants
bring with them and I was also concerned that they would have forgotten most of what we had discussed. However, I had to “trust in the process”…

Before the session started, BF came to find me and wanted to have a word. She asked whether she could come back. She said that she was in a completely different mind-set, which I found a bit hard to believe simply because it didn’t seem realistic to achieve that in a 2 weeks time. However, she then said “I really want to come back”, and from her non-verbal expressions, I could sense she was being genuine. So, I decided to welcome her back but stay alert and vigilant in the sessions to ensure safety of all other group members.

Everyone seemed to like the starter activity when they had to think of how to get different animals to a top of a tree without bending it down or using any tool. The purpose of this activity was to get everyone engaged from the very beginning of the session but mainly introduce the topic of strengths in a different, more interactive way. This brought a really positive energy to the group and everyone was keen to share their suggestions or solutions for the puzzle.

I felt that this time, everyone in the group was listening very carefully throughout the whole session. It felt like they were eating all my words, so I was confident that they were going to take a lot for themselves from the session. As expected, the majority of people didn’t remember the online part of the intervention because of the one week gap. But we went though it in the session and completed some of the tasks verbally in the group. I could see that the approach I was using was making them think and perhaps realise many things about themselves they weren’t aware of before. It was apparent that BF was happy that she could come back because she was engaging very positively throughout the entire session. This was good on one hand, because it confirmed to me that the sort of humanistic unconditional acceptance I showed to her, helped to strengthen the relationship of trust, she would rarely develop towards anyone. On the other hand, it made me feel a bit cautious because I felt like that even though it was in a positive way, she was still trying to be in the center of attention. So, I appreciated her contribution but prevented her from interrupting others from talking by clearly setting boundaries to her sharing. In simple words, I was just not giving her any extra amount of attention that she was subconsciously asking for. At one point I may have expected her to become angry but she took it really well, which for me was a confirmation that she accepted my boundaries and I’ve gained her respect.

We concluded the session with the drawing our hands exercise where they had to write down their strengths in each of their hand fingers. Some people like PT and ZR were very quick in writing down their first 5 strengths but they struggled to find another five. Some people like HH struggled to come up even with two strengths but I was happy to see that they were helping each other complete the exercise. I reflected upon the exercise and gave them feedback on their non-verbal expressions which appeared to be very beneficial. We went over a number of reasons why most people don’t seem to be aware of their strengths and we also discussed the fact that some strengths are perceived as more useful than other in the current society.
Overall, the session went very well and I was pleased to see the group dynamics changing and moving towards a more positive direction.

Session 4 – Strengths, Group 2 25/04/2017

Participants: BeF, GW, VC, RF, NT, DMC, SM, NS, RD

Present (not participating): DD, JD, HS

Session reflection:

I was slightly concerned about how the session would go because there’s just been a 2 week gap in the PPI due to the Easter break. The attendance in the session was very good today – there were even 3 people I’ve never seen there before. However, even before we started the session, everyone was so quiet. They did not even talk to each other at all which made it even more difficult for me to facilitate this session. I couldn’t help it but think what “the hell” we were going to do there for 90 minutes if they were this quiet!

The starter activity when they had to think of how to get different animals to a top of a tree without bending it down or using any tool, was a good ice-breaker. The purpose of this activity was to get everyone engaged from the very beginning of the session but mainly introduce the topic of strengths in a different, more interactive way. We did spend a little time on this but it was not sufficient to get them talk for the rest of the session.

For the rest of the session I wasn’t able to determine whether the people sitting there were really present. They might have been just very reflective but I found it very challenging to work with so much quietness. I could not determine or even guess what they were thinking and in order to get any response from them at all, I had to be asking direct questions. I tried to engage HS and RD more because they have never attended any previous sessions.

Overall, whenever I asked someone directly, they would respond well but there was no initiative from their side at all. NS, DMC and BeF were far the most “talkative” in this group and session but even they seemed more reserved than usually. I even felt that they only talked because they could sense my desperation. The way I facilitated the group was definitely affected by this – I wasn’t feeling very confident and couldn’t help it but think that there was something wrong with me.

Towards the end of the session we did the drawing our hands exercise, where they had to write down their strengths in each of their hand fingers. Everyone without an exception, was very quick in writing down their first five strengths. This was a very positive thing to see but it was even more positive to see that when I asked them to outline the other hand and write down another five strengths, the majority of them didn’t seem to struggle with that either. I had to
admit that I was a bit surprised by that because I have never seen so many people in the same
group who would be so self-aware. This was a very positive thing on one hand but on the other
hand it made me wonder whether there was anything at all that I could teach those people…
We went over a number of reasons why most people don’t seem to be aware of their strengths
and we also discussed the fact that some strengths are perceived as more useful than other in
the current society.

We concluded the session with a group exercise when they had to meet others with similar
strengths. They seemed to feel a bit awkward in the beginning but after a couple of minutes
they loosened up a bit and started talking more. I did not think that the exercise was as
beneficial as it could have been but it was a good conclusion of the session.

Overall, the session was very quiet and the most definitely the weakest session with this group
so far. When I read through the feedback sheets, I could see some positive notions there, so
perhaps the session was not as bad as I perceived it. In this group, there is definitely the highest
concentration of reflective and self-aware individuals, I’ve ever seen.

Session 5 – Hope, Group 1

Participants: BF, SP, MK, GP, BR, RD, IH, ZR, HH, SH, PM, RH

Session reflection:

The whole session went faster than expected. The whole group was very quiet compared to the
previous sessions which surprised me a little bit. Looking back to the first pilot study, the group
was very bonded by the time we got to the fifth session and it was far the strongest session out
of the six. People were very open, honest and emotional and it was a bonding session. This
time, however, the group dynamics follow some kind of a strange up-and-down line, which
I’m finding difficult to follow. Indeed, this might be due to a number of reasons. The students
are on the same course and the same pathway, so they spend a lot of time together outside the
sessions, which I cannot control… I have no idea what happened between them in lectures
earlier on that day or week. I have noticed a few changes in “friendships”. SH and ZR used to
sit with and talk to BF quite a lot in the beginning but now it seems that they both intentionally
moved away from her. SP seems to be the closest to BF since the beginning. GP, on the other
hand, moved closer to them recently. Overall, there seems to be some kind of game played
outside the sessions where BF appears to be in the center. My clinical practice supervisor and
the module lecturer confirmed that she had been observing similar patterns in her classes. She
had to impose very strict boundaries on BF earlier on that day, as she was being very disruptive
trying to “pull” people on her side at the same time. This incident, might have been the main
reason for the group quietness. I didn’t feel like I could do much about that, as the focus of our
sessions is not address issues that wouldn’t be related to the PPI. So, I just went through the content at a usual pace accepting that we may finish earlier if people don’t speak.

However, I was pleased to see that everyone seemed to clearly understand the concept of hope and the meaning of it suggesting that they all engaged in the online part of the intervention and they seemed to find this topic meaningful. Hope represented goals, motivation and future aspirations for everyone and they all perceived it as something positive and quite powerful. When asked about the hope-visualisation exercise, GP and BR both agreed that it strengthen their motivation and will power to actually achieve those hopes. BF said that it made her feel good and powerful and positive when she visualised her hope of becoming truly happy in her life. She also said that she was really going to miss our PPI sessions. I appreciated that and a few other people seemed to nod in agreement.

When doing the “Gift of hope” exercise, most people shared similar hopes of academic achievements and passing their driving test. PM’s response stood out for me because he talked about a situation from his past when he was being hopeful, which helped him to overcome his drinking problem. SH’s response was, unlike everyone else’s, oriented towards other people, rather than herself. She said that she had a genuine hope that one day she would be able to help many other people as a therapist. But overall this exercise went very fast and compared to the first pilot study group, it wasn’t emotional at all. Once again, it made me question whether that was due to events that occurred earlier on that day.

Session 5 – Hope, Group 2 02/05/2017

Participants: DMC, VC, CG, RF, NT, SM, NS

Present (not participating): DD, JD

Session reflection:

I think I finally got used to the fact that this group is just generally quiet and reflective. The session went quite well but once again it was nowhere near as powerful as it was in the first pilot study. The first pilot participants were very bonded by the time we got to the fifth session and it was far the strongest session out of the six. People were very open, honest and emotional and it was a bonding session. However, I did feel quite good about this session. I could see that everyone was paying attention and some were taking a lot of notes. Once again they only spoke up if they were questioned directly but from their non-verbal expressions I could see that this wasn’t because they wouldn’t be engaging but simply because they were so reflective. Clearly, for this group, self-reflection and silent reflection are preferred ways of learning.

I was pleased to see that everyone seemed to clearly understand the concept of hope and the meaning of it suggesting that they all engaged in the online part of the intervention and they
seemed to find this topic meaningful. Hope represented goals, motivation and future aspirations for everyone and they all perceived it as something positive and quite powerful. Nobody was very keen to share any deep concrete hopes suggesting that they would feel exposed. However, I could tell that a few of them (NS, DMC, SM, RF) did all the work at home and that they were very concrete when identifying their hopes, motivations and pathways. This was good enough for me and I completely respected their preference to keep all that private. We talked a little more about visualisation because I believe that is something many people struggle with in general. I clarified the concept of visualisation a bit saying that it doesn’t always have to mean sitting down for 10 minutes and picturing oneself certain way. It can include visualisation meditation but it is more of a mind-set or general approach in life. This seemed to resonate with DMC quite a lot. NS said that it made her feel good and powerful and even more determined when she visualised her hopes. I appreciated that and a few other people seemed to nod in agreement.

When doing the “Gift of hope” exercise, most people shared similar hopes of academic achievements. Unlike in the previous group, I got emotional – my gift of hope was a genuine desire to give something back to this country and this university for giving me the opportunity to study and fulfil my dreams and I was hopeful that this PPI would help them become better or happier in their lives in any way. I felt that the reason I did not become emotional in the first group was because I could not trust them they would treat my emotions with respect and confidentiality. I was impressed by DMC’s response who had been writing down so much for the entire session. His gift of hope was the realisation that with the right mind-set he could do anything – a few years ago he helped his mum maintain a house that she was told to move out from; he went to a court and defended her, so that the council had to agree that their request was not justified. Overall this exercise went quite fast but it was definitely more powerful than when we did it with the first group.

Session 6 – Happiness, Group 1

Participants: BF, SP, MK, PT, GP, BR, RD, IH, ZR, SH, PM, RH, CA

Session reflection:

I received an email earlier on that day from Ianis, that he wouldn’t be able to come and collect the samples. I wasn’t really happy about that but at the same time there’s nothing I could do, so I just decided to “go with the flow” and make the most out of it instead. As it was the last session, I wanted to brighten things up a bit. Since we were not going to give saliva samples we were free to eat and drink whatever we wanted, so I brought in some healthy snacks – lots of fruits, some cereal bars and nut and seed snack packages. This was welcomed with a wide smile and it certainly helped to create a really nice atmosphere. Everyone seemed to be in a good mood, perhaps because this was the last session.
We went through the actual content of the session quite fast but I appreciated very much the feedback everyone gave me for the past 6 weeks. GP said that she was a bit worried in the beginning because the sessions turned out to be quite emotional and she cried a few times about something she didn’t expect to feel emotional about. She was worried that she’d just revealed something very private to half of her class but later on she realised that it was actually healthy and helpful that she could “let it out”. As the whole group turned out to be very supportive, she felt safe and accepted unconditionally for who she truly was. A number of people were nodding in agreement at that point. I also felt that it was important for me to acknowledge the group dynamics and bonding. I appreciated their support and I said that I could see how much they’ve grown as individuals and as a group. Sadly, this was a last session, but for the first time I could feel that they came together as a group. Before I could see quite a lot of separation going on with people forming pair or smaller groups of 3-4 with one dominant individual. But this time, they seemed to really bond as one big group. I was very pleased by that. Even IH talked a bit more in this session which was a pleasant surprise. She said that even though she’s very private person and very quiet most of the time, she felt hopeful that she was actually being supportive to other people in the group because they felt comfortable to share their personal issues in her presence. Another pleasant surprise came from MK who said that she really struggled with the self-compassion theme in the beginning but later on, when she “reflected back on it”, she realised that she was being very harsh on herself and that it was not healthy and that it would make her feel much better if she could actually treat herself with kindness sometimes. Given this feedback from a few people, I went back to self-awareness again and I linked it with the module pathway. I said that all this was about was to help them see the most important tool they have to become successful in their lives as individuals and professionals – their self. I threw in a few open questions again just to make them reflect – Who are you? Why are you who you are? What do you want in life? Why are you here? What kind of people yang your chain? Why? Those are all questions they need to be able to answer for themselves before they can become good counselling professionals or psychotherapists. I did not ask anyone directly but from their non-verbal language and all eyes on me, I felt that they understood why I was stressing self-awareness so much in the past 6 weeks.

I presented them with some research backing up the importance of laughter and positive sense of humour, which was a good foundation for the group games. We played “Bend a friend” and “Suck it up” and it was so much fun. Everyone seemed to be really enjoying themselves and we all had a proper belly laugh together. RH and BF won the two prices and I just felt that was something BF needed – finally she genuinely won something and she was in the centre of attention for all the good reasons and she was appreciated and accepted.

I can never know for sure what impact this program had on all these people but I know that we concluded the whole thing on a good note and with smile on our faces. They were all clapping really loudly when receiving their certificates. All this just made me feel that I have done a good job with this group, which was not particularly easy.
Session 6 – Happiness, Group 2 09/05/2017

Participants: DMC, NS, SM, NT, VC, CG

Present (not participating): DD, JD

Session reflection:

As it was the last session, I wanted to brighten things up a bit. Since we were not able to collect saliva samples in this group, we were free to eat and drink. I brought in some healthy snacks – lots of fruits, some cereal bars and nut and seed snack packages. This was welcomed with a wide smile and it certainly helped to create a really nice atmosphere. The attendance was not very high, which was probably because the students did not have any lessons earlier that day, so they had to come in just for the PPI. However, those who did come in seemed to be in a good mood, perhaps because this was the last session.

We went through the actual content of the session quite fast but I appreciated very much the feedback everyone gave me for the past 6 weeks. They still did not say too much but everyone agreed that the whole PPI has been very beneficial to them and that they would not hesitate to do it again. DMC repeated a few times that “it made him think a lot”. Almost everyone seemed to enjoy the theme of gratitude the most. DD liked mindfulness and JD enjoyed self-compassion saying that she realised how the way she treats herself affected others as well. In her written feedback, NS said that the 6 weeks have been really valuable to her, especially the gratitude and mindfulness themes, and it has all impacted her everyday life. SM said that she has learned a lot from the PPI sessions, which she would be able to use well in her personal and professional life.

Given this feedback from a few people, I went back to self-awareness again and I linked it with the module pathway. I said that all this was about was to help them see the most important tool they have to become successful in their lives as individuals and professionals – their self. I threw in a few open questions again just to make them reflect – Who are you? Why are you who you are? What do you want in life? Why are you here? What kind of people yank your chain? Why? Those are all questions they need to be able to answer for themselves before they can become good counselling professionals or psychotherapists. I did not ask anyone directly but from their non-verbal language and all eyes on me, I felt that they understood why I was stressing self-awareness so much in the past 6 weeks.

I presented them with some research backing up the importance of laughter and positive sense of humour, which was a good foundation for the group games. We played “Bend a friend” and “Suck it up” and it was so much fun. Everyone seemed to be really enjoying themselves and we all had a proper belly laugh together. CG and won the two prices and they seemed to be really pleased with the gifts. I felt that they could really sense how much I cared for them and that they appreciated it.
Main Study (RCT) – Group Session Reflections

Session 1 – Gratitude, Group A (Intervention group) 06/02/2018

Participants: JOH, CM, MD, RI, ZJ, ZC, KT, TH, FK, EMR, OJ, AS, DM

Session reflection:

I was a bit concerned how things were going to go this time because I have not delivered a session since this time last year, but at the same time I felt really positive. Initially it seemed like there were only going to be a few people but they all turned up eventually. I started the session with a brief introduction to the whole program and the reasons why it has been incorporated into the first year students’ module, as I could see there were some new people in the group. Ianis was there with his two assistants perfectly on time, so he could give a brief introduction to the molecular genetics.

When we started the actual session, everyone seemed really curious and somehow full of expectations but the atmosphere was very positive. Looking back at the last year’s intervention, these participants reminded me more of the second group in my second pilot studies. People were a lot more reserved and somehow careful not to share too many of their own personal things. However, as the time progressed, they all seemed a bit more relaxed and open. There were a few people, like MD, DM, and JOH, who clearly felt more comfortable with talking than others. Interestingly, all three of them are mature students and much older than the rest of the group. Repeatedly, this seems to be a quality of most mature students. They don’t seem to be afraid to speak up and share their opinions, perhaps because they don’t feel their position could be challenged or shaken by anyone or anything. They certainly do add a lot to the group dynamics. However, I could also see a number of the younger students, who barely said anything during the whole session but they were clearly hanging on every single one of my words. Particularly FK and CM were very vigilant and attentive. CM had tears in her eyes a couple of times when I talked about my own experience with underappreciation of my husband and judgemental attitudes toward some of his habits/behaviours that I did not understand. In fact, at this point, when I talked about my husband who used to sleep in all his clothes and boots because in his country, you may just need to get up in the middle of the night and run away from shooting, many people seemed quite moved. It really did look like most of them realised how many “simple” things we all just take for granted. When we talked about the Monday exercise when they were supposed to write down three things they were grateful for on that day, everyone seemed to have written down things like “my mum”, “my friend”, “my sister/brother”, “my kids” but nobody would think of things like the air, fresh water, meal at least three times a day, healthy body, legs that take us wherever we need to go, etc… MD, who is partially disabled, was paradoxically the only one who said he was grateful for his “health” in a sense that he woke up with less pain on that day.
I was quite pleased to see that most people engaged in the online part of the program because that was not the case last year. About a half of them wrote their letter of gratitude and they even gave it to those people, which is something that happened rarely in the two previous studies. Similarly with the simple acts of kindness exercises – most of them managed to complete it and when we talked about it we touched the topic of “social judgement”. It was quite interesting to see how most people in the group were not aware of the subconscious fear of judgement and social isolation and how powerful they can be.

As simple as gratitude may sound, it was definitely a powerful session and I could feel towards the end that it brought people closer together.

Session 1 – Gratitude, Group B (Control group) 20/03/2018

Participants: AF, PM, LD, MH, AA, LMH, LV, MG, ARR, NM, JK

Session reflection:

I felt very calm and quite positive in the beginning of the session. Gratitude is without a doubt my favourite session, perhaps because it resonates with almost everyone and I just feel like I cannot go wrong with it. I was pleased that the attendance was good and everyone seemed very positive from the beginning. When we talked about the ground rules, they all were very serious and paid maximum attention. I made sure that I clearly defined the purpose of this intervention and the group sessions but also stressed the importance of the students communicating with me in case any of the sessions touches any sensitive issues in their lives. Overall, I felt really positive about the session and I was pleased that, once again most people engaged in the online part of the intervention, and some of them also wrote quite comprehensive feedback and reflection on the exercises. Compared to the first group, there seem to be generally more individuals who are quite open and keen to speak up and share their views. They were all very responsive to my open group questions, and there were some interactions between themselves as well. Generally they seem to be more comfortable with each other that the first group in the beginning which might be simply because they have already spent some time together in the past six weeks and had more time to get to know each other.

When we talked about the meaning of gratitude and its role in our lives, everyone agreed that gratitude is very important and that it can help to enhance well-being and improve relationships. But everyone also agreed that it is much easier to see the negatives than the positives, especially in our partners. From this it was interesting to hear people’s experiences with the online part of the intervention. MH shared that when performing random acts of kindness she noticed that people responded very positively to her kindness but were also quite surprised sometimes. I picked up on that asking everyone else in the group whether they have noticed something interesting in what MH said. I was pleased to see their responsiveness and they soon figured...
my point – that we live in an environment where kindness has become something so rare that it is almost bizarre. When we talked about the letter of gratitude, most people agreed that it made them feel good afterwards and that they received a positive response from their significant others. However, they also agreed that while writing the letter, it felt a bit odd. Matt asked me whether I wrote mine and when I said yes, he asked me how I felt about it. I was genuine and I said that I felt awkward and that the whole thing seemed very unnatural to me. Most of them smiled in agreement then and MG asked me whether I wanted them to feel the same way. I felt it was such a good question and with a great pleasure I turned it back to him asking “what do you think I was trying to do”? I did let them think and I wanted them to answer their own questions. After a bit of an interactive discussion I clarified that one thing is expressing our thanks to the people around us but another thing is to be aware of how we feel about all that and how it affects us. I made it clear that my role there is not to make them do or change anything because that’s not within my control – they are the masters of their own choices, decisions, and actions. But I can be there to help them increase their awareness and self-awareness and support them in their self-reflections.

When we talked about the three good things, most people found that exercise the easiest, except for LV who said that it just made her think about all the things that most people have but she doesn’t (although she did not go into any details, she named friends and family particularly). She said that it just brought negative emotions and she could not quite snap out of it. I appreciated her sharing this and I confirmed that sometimes even positive psychological concepts may trigger some negative experiences in people’s lives. But I also said that it is okay and that it is important to be aware of it and accept it as it is. I asked her to write it all in her reflective journal and try to identify why she might have felt that way. At that point I shared a fictitious story about “Peter and George” which talks about the importance of seeing beyond what’s on the surface. Some people (like George in the story) may appear to be really unsuccessful, bad, negative but for them to be at least that way, it might have taken an incredible amount of work and effort. On the other hand there may be people (like Peter in the story) who appear to be super successful, positive, popular and just overall brilliant but for them to be like that, it may not even require much effort at all. Simply because they might just stand on a really strong foundation built for them by previous generations. Sharing this story I concluded that this is the reason why we should never compare ourselves to other people because we are different and unique individuals and we can never know for sure how would others cope if they were in our situation – perhaps, they might do much worse than us. I felt that this was quite a strong point and that it was good that it’s been made.

We concluded the session with gratitude meditation and as usually I shared a story of my own how an experience with my husband helped me view things from a different perspective and appreciate all the small things I would usually take for granted.

Overall, I felt really positive about the whole session. Quite a few people stayed a bit longer to chat more and share their views. I thought there were some really nice interactions – people would speak up their views but at the same time were very open to listen to each other. PM
said that it was a really good session and that over the week she could realise how many things she takes for granted. She said she really wants to work on that because she feels like it is preventing her from being happier and achieving more in her life. I think she felt a bit more connection with me (i.e. may be positively biased?) particularly because I mentioned that my husband is from the DRC and it turned out that her husband comes from Congo too. LV also stayed a bit longer and she said that although she really believes in the power of gratitude and positive emotions, the group exercise was challenging for her because she “hates” when somebody tells her to do something. She said it does not feel natural and she feels annoyed by that. I very much appreciated her saying it and I agreed that when they are given an exercise, it is never going to feel as natural as if they did it on their own initiative. But I also said that there is a reason for why she feels that challenged by a group exercise and why she feels almost offended when someone tells her to do something. I encouraged her to think about where her feelings might have come from and how they affect her life and reflect upon all that in her journal. I have to say I was very thankful for this after class discussion because it showed that the students were really engaging and that they were actually thinking about what they were doing. I perceived it as very positive and very healthy interaction.

Interestingly, when I asked my two assistants what they thought about the session, I was surprised to hear that everything I perceived as fruitful interactions and sharing of views, they perceived as challenges and arguments made to disapprove what I was saying. From the position of the session facilitator, I can say that I did not feel challenged at all by any of the participants and I was actually quite pleased to see that they were vocal and expressed their thoughts and feelings clearly. I just feel like it is much easier to work with people who express themselves, even if their perceptions differ, than it is to work with quiet participants who do not give anything away. Therefore, I felt extremely grateful for this group and I just hope I am not wrong to think that they were not trying to challenge me but they were just engaging in the session.

Session 2 – Mindfulness, Group A (Intervention group) 13/02/2018

Participants: MD, RI, ZJ, ZC, KT, TH, FK, EMR, OJ, AS, DM

Session reflection:

The session seemed to go quite well, although there was a bit awkward and dense atmosphere before we started which made things a bit more challenging for me. First, there was KT, who came earlier to tell me that she was not feeling well, so she just wanted to sign the register and go home. At that point I was not a researcher but a teacher, so I just told her that she can go home but I could not let her sign the register if she was not going to be in the session. So, she then said she would stay for half an hour, which I still couldn’t agree to. At last she asked if she could leave 10 minutes earlier then which just did not make any sense at all. I kept calm
but my blood was boiling – she either is sick, and then she should go home straight away, or she is not sick and then she should stay for the whole session. She decided to stay, so I just pretended that nothing had happened, although I felt really angry, which was probably because I remembered I taught KT last semester and she used to come to me every other week with the same “issue”.

Second challenge before we even started was when TH came to me asking if she could withdraw from the study. Of course she could, that was her right but I just felt really gutted, mainly because she was one of the few participants in this study, who were actually overweight…

Finally, I was once again stressed about the sample collection because nobody was there 10 minutes past 2 and there was no way for me to find out what was going on. I knew Ianis was teaching, and I did not have a phone number for Dorcas or Abusadat who were supposed to collect saliva samples, so I could not contact them directly. At last Dorcas arrived about 12 minutes past 2, so I helped her label the tubes quickly and we got to start about 15 minutes later overall.

I knew I had to pull myself together and deliver a decent session, so I did my best but my motivation was shaken once again. The room felt heavy and everyone was completely silent with stoned faces, which made me feel really uneasy and somehow judged, although I apologised a number of times. Luckily, the awkwardness melted away a few minutes after I started talking. I felt a lot more confident talking about mindfulness than in the first two pilot studies. But I still have to admit that this topic doesn’t resonate with me so much. However, I must have been selling it quite well because everyone seemed to be really convinced. Once again I was pleasantly surprised how many people actually engaged in the online part of the intervention. They must have understood the idea of mindfulness fairly well from the online materials because they were defining the concept very accurately themselves. MD and EMR said that they practiced mindful breathing and yoga on a regular basis, so they found the mindful breathing exercise quite easy but when I asked them if they could share how it felt at the first time, they both agreed it was difficult and awkward. It was a valuable note for the others because they could see that one’s ability to live mindfully is not acquired over night, but takes time and practice. This was confirmed by the second exercise when they were asked to devote 10 minutes to “doing nothing”. Most people agreed that the 10 minutes of doing nothing constantly lead them to think that they should do something or think of what they were going to do as soon as the 10 minutes would be over. I linked all those experiences to self-awareness. I told them that I did not actually expect them to succeed in these exercises 100% on the very first attempt but I said that it was more for them to become of all the distracting, restless, critical, negative thoughts that come to our head every minute without us even realising that.

With reference to the negative, unhelpful thoughts they were asked to identify on Monday. It seemed that most people did not understand what I meant by that or just could not identify anything from the top of their heads. We spend a little time on this to make sure that they did
understand the meaning and importance of this exercise. I shared my own beliefs and the way they drove my life, which helped the students to understand what it was all about. But I did feel that they may need more time to process it all.

I was nicely surprised how many people enjoyed the mindful eating part of the session, especially ZC seemed to have woken up properly for that bit. We practiced mindful eating in the group with some oranges and I felt that I could guide the practice a lot better than in the two previous studies.

Unfortunately, due to a late start, we did not have enough time to complete the mindful listening exercise but the students were encouraged to do them at home with their family or friends and reflect upon their listening experience in their journals.

**Session 2 – Mindfulness, Group B (Control group)**

Participants: AF, PM, LMH, LV, CH, JG

**Session reflection:**

This session was a first one after the two-week Easter break, so I felt a bit like we were starting from the beginning. Even though all the online materials were uploaded on Moodle and all students were sent reminders to complete the exercises. The attendance in this session was quite poor which might have been due to the morning tutorials taking place in stead of the lecture. However, I felt very relaxed and positive knowing that sometimes sessions with fewer participants can make bigger difference. I have met CH and JG for the first time, so I decided to begin the session with a brief introduction to the whole program and re-citing the ground rules to ensure good clinical practice. Once I had their verbal consent to follow the ground rules throughout the whole program, I could move on to the actual session.

I have to say that I felt the most comfortable talking about mindfulness considering all groups and all studies I have conducted so far. Perhaps this topic is finally becoming “my own”. I felt quite encouraged by LV – I was a bit concerned how she felt because from the first session I remembered she was not comfortable with the exercises reporting that it “puts her off” when someone tells her what to do and when. So in the beginning I just asked her how she was feeling and I was pleasantly surprised to see and hear that she was really well and she even looked very excited! She didn’t just complete all the exercises but she brought them all with her and when I asked she started to pull them all out as if she really wanted to share some kind of break through with me. She did not elaborate and I did not ask her to but it made me feel really encouraged thinking that the session would go well – and it did.

Although I did most of the talking, I could see everyone was really concentrated and almost fascinated by the session hanging on every single word I said as if it was made of gold. Once
again I was very pleased to see that everyone (except for JG and CH who were new to the group) completed all the online exercises and they all reported to find them very insightful. When talking about the three minute mindful breathing exercise, PM said that it felt awkward for her to pay attention to her breath but it made her feel grateful at the same time realising that she can actually breathe. LMH said that she really struggled with this exercise and that she just could not stop thinking about everything else but her breath. She ended up going on youtube and finding a breathing video with a voice saying “breathe in – breathe out” hoping that this would help her concentrate on her breath but she still struggled. At that point I actually felt really inspired by her and I had to express great respect. I told her that I have never seen a single person who would go out of their way like this to complete a single breathing exercise. Most people would give up after a few attempts with the stronger ones reflecting upon their experience. But going on youtube and finding a breathing instruction video with determination to complete this exercise – that, I have seen for the first time. She seemed really pleased to hear that and somehow happy to see that (at least) someone (finally) appreciated her efforts. LV said that she has been practicing mindfulness for some time now, so she did not find these exercises as challenging but interestingly, as she reported, she found the mindful breathing more challenging than the “10 minutes of doing nothing”. She was not sure why but I used her example to demonstrate the importance of practice and time in successful application of mindfulness. I talked about the current society and stressful lives we are living which has taught us to focus on everything but the present moment. I was pleased to see that although JG was new to the group he did complete this exercise and reported that he found it very relaxing and calming when he could finally “do nothing”. He mentioned his severely autistic brother saying that it was very important for him to be able to “switch off” for a change.

When we talked about the negative/unhelpful thoughts that prevent us from being mindful, almost everyone, myself included, agreed that the most powerful thought driving their life was that they were “not good enough”. We identified it as coming from our original families and we talked a little bit about the importance of role models and how they influence our lives.

Everyone seemed to like the mindful eating part of the session, and when we talked about the power of food as a reward, particularly CH and AF appeared to be very interested. Everyone seemed to have enjoyed the mindful eating exercise and I could see that they really understood the role and importance of mindful eating.

We had enough time to also complete the mindful listening exercise which went really well and I was just intrigued to see how it would go with non-counselling students may not have such good listening skills. PM said that listening to other people’s struggles made her feel very empathetic and she just could not concentrate on anything else but thinking how she could help them. At that point I felt it was important to emphasise that even though empathy is a very important skill for a good counselling practice, it is crucial for practitioners to be able to not identify themselves with the lives and struggles of their clients. At that point LMH said she did not share anything during this exercise because she felt it would make her struggles appear as less important compared to others. Although I had no idea what was going on in her life I just
emphasised that there was no such thing as one problem being more or less important than other. What mattered was how she perceived her struggles and if there was someone who judged her, it was not her problem. She seemed really grateful for that small note.

Overall I felt the session went really well and even though I was the one to do most of the talking, it seemed to have left quite a strong impact.

Session 3 – Self-compassion, Group A (Intervention group) 20/02/2018

Participants: JOH, MD, ZC, KT, TH, FK, EMR, OJ, CM, DM

Session reflection:

I felt quite relaxed in the beginning of the session and I had confidence that it would go well. Self-compassion is certainly more preferred topic than mindfulness for me which is probably why I felt more relaxed than last week. Also, there was no stress as to the collection of saliva samples - Abusadat was there 15 minutes before the start and Dorcas arrived just before 2 o’clock. So the beginning was nice and smooth.

Although the session seemed to go quite well overall, I had a feeling that most people were starting to feel tired or may be even bored or not interested. I was a bit disappointed to see that it was only DM and MD who actually engaged in the online part of the intervention – or at least they were pretty much the only ones who could talk about it a bit. This just confirms the well-known fact that most people tend to “cut corners” unless they feel a certain amount of pressure. Perhaps next time, I may put more emphasis on the online learning as well – after all everyone is different and it seems that most people are not ready to work solely on the basis of trust. Looking at the previous groups in the two pilot studies, session 3 seemed to be consistently the session where group dynamics started to change and people would begin to open up a bit more and come closer together. In this group, however, the group seems to be still somehow fractioned. There are a few individuals who are clearly moving forward and benefitting from the whole program but they seem to be moving forward only as individuals. I was very pleased to see the fruits of DM’s and MD’s work – they are clearly engaging in both, the group work and the online learning and I could see how they are becoming increasingly self-aware. I am very grateful for their input and interaction but I am just a bit worried they might be taking a little too much over the rest of the group. At the moment I am just not sure whether the rest of the group is just not interested in talking or whether they feel shut down by the more dominant members… I will pay more attention to individuals in the upcoming weeks to ensure everyone gets an opportunity to share and express their thoughts/feelings.

However, there were a few important moments during this session. When we talked about the domains of self-compassion and how everyone takes care of their physical body, mental well-
being, relationships (etc.), everyone was nodding in agreement that it was important to take a good care of the self. JOH then said “I know this will sound stupid but once a week me and my husband just sit down and put on a face mask”. I thanked her for sharing that and then I turned to everyone else in the group to ask if they noticed something rather strange in JOH’s words. Most people were just turning their heads but the ZC noted that JOH said “I know it will sound stupid…” This was a great moment, and I could see everyone else suddenly realising that. We elaborated on this a bit further discussing the paradox of most people feeling silly awkward or even stupid or guilty when they finally do something for themselves. We have been conditioned to believe that we have to perform and perform and even if we are almost dead, we need to perform some more. Surrounded by responsibilities, duties and endless “to-do lists” we have forgotten one important fact – all these jobs will not get done if we burnout and die with exhaustion. If we do not give ourselves the value we deserve, nobody is going to do it for us. That seemed to resonate with everyone in the group.

There was a nice interaction between DM and ZC at one point. ZC shared how she used to feel worthless and constantly seek people’s approval and how she gradually managed to change and how she now feels so much better, free and happy when she does not depend on anyone’s opinion. DM then shared how his whole life had been affected by one single teacher who once told him that he was not smart and capable enough to achieve anything within an academic setting. ZC then responded to it by asking where was that teacher now and comparing it to how far DM had gone. By that he’d already proved the teacher wrong. I felt that it was very good that someone else than me could give this feedback to DM. I just added a little note to say that there will be a time when he realises he does not have to prove anyone anything because whatever he does, he does it for himself…

When we watched the video with Nick Vujicic, it had the usual impact – everyone seemed to be very moved and suddenly determined to get their life together.

DM volunteered for the exercise of the criticiser, the criticised and the compassionate observer and he was very good in all positions. He chose to demonstrate how his inner critic adopted all the negative attitudes his teacher once had towards DM. In the beginning of the conversation the criticiser was very powerful, arrogant and merciless. In response to that the criticised part of DM was completely shut down, powerless and almost dead admitting everything the criticiser would say. This gave the criticiser even more power, he became even more arrogant and he felt like a winner. After that there was an interesting twist when DM’s criticised self suddenly kicked off and started to defend himself and opposing the oppressing critic. His voice became stronger and his posture was more up right. In response to that the criticiser began to lose his power and admitted that he needed to back off. DM’s compassionate observer was an excellent demonstration of understanding both, the criticiser and the criticised.

This was a very powerful conclusion of the whole session, as it was concrete and real demonstration of what we have been talking about all this time – that the way we feel and the
way we act is entirely our choice and we are the ones to decide which part of us will be in power.

Session 3 – Self-compassion, Group B (Control group) 17/04/2018

Participants: AF, PM, LD, MH, LV, MG, ARR, JK

Session reflection:

I felt quite relaxed in the beginning of the session and I had confidence that it would go well. Although the attendance was not very high (which was probably due to the assignment submission deadline on the following day), the people who did come in, were contributing very well to the session. Once again I was pleased and excited to see that everyone engaged in the online part of the intervention. It seems that most individuals in this group really understand the power of independent work and investment and they certainly seem to benefit from it. I have had some very positive feedback on the online material in terms of how powerful and eye-opening it is. Especially LV and MH were very keen on all the exercises and they seemed to have clearly understood the rationale behind all those exercises – self-awareness and bringing things from sub-conscious mind to the conscious mind in order to be able to work with them. MH said that during the exercise when they were supposed to use self-compassion as motivation instead of criticism, she realised that she tends to criticise herself for criticizing herself which was something she never noticed before. She also said that when she was able to praise and appreciate herself it felt “far more empowering” that when it came from others. We talked quite a bit about the reasons why most people tend to see a difference between compassion for themselves and compassion for others, and why most people find it quite easy to be kind and supportive to others but not so easy to treat themselves with the same kindness. We discussed the paradox of most people feeling silly awkward or even stupid or guilty when they finally do something for themselves. We have been conditioned to believe that we have to perform and perform and even if we are almost dead, we need to perform some more. Surrounded by responsibilities, duties and endless “to-do lists” we have forgotten one important fact – all these jobs will not get done if we suffer burnout and die with exhaustion. If we do not give ourselves the value we deserve, nobody is going to do it for us. That seemed to resonate with everyone in the group.

LV made an interesting point when she said that when offering kindness and support to others, she actually doesn’t have to do anything – she does not have to deal with their struggles or challenges. Although this was a valid point I used it to refer back to what MH shared – that even though compassion towards one self may seem more difficult, it will also be “far more empowering” than any kind of compassion received from another person.
I could also see that the group members were getting closer together and they seemed to have gained trust in each other. I was pleased to see that MG started to open up a bit more because until this point he did not appear to be very comfortable in this group. I know he is best friends with EMR but she was allocated to the first group and it did not look like MG would have any more friends. But members of this group are obviously doing a great job embodying the core values set in the beginning of the program – they are really supportive to one another and very encouraging and empathetic. During the session, MG was one of the most responsive people to group questions. When I asked things like “What is self-compassion? How is it different from self-pity? Why is it important?”, MG was almost always the first one to respond and his answers were incredibly accurate – or better say in line with what I had prepared.

When we watched the video with Nick Vujicic, it had the usual impact – everyone seemed to be very moved and suddenly determined to get their life together.

For the first time there were three volunteers for the exercise of the criticiser, the criticised and the compassionate observer – ARR, LV and AF. I did not want to choose ARR because on the basis of his initial assessment, I was not sure if he would be ready to handle it. I wanted to approach him before the session and ask him not to volunteer himself but he came in late, so I did not have the chance and I did not want to bring it up in the group in front of everyone. In the end – and as expected – he was the first one to raise his hand and the girls were both happy to step down, so I was left with no choice. I let ARR demonstrate the criticiser, the criticised and the compassionate observer. He demonstrated a dialogue between his inner critic who just seemed to have seen his entire life as a “mess” and his criticised self who seemed surprisingly balanced. This was the first time I have seen the criticised part as being more powerful – or at least presenting itself as more powerful, which I could not be sure whether it was genuine. It almost seemed that the criticised one acted more like a compassionate observer. When ARR got into the actual position of the compassionate observer, he struggled to offer compassion to each part of himself individually. He talked to both the criticiser and the criticized together as if they were two kids who had a quarrel at a playground and he was trying to make them say sorry to each other and give a hug. Probably the best part of this exercise was the feedback – for the first time I was not the only one doing the talking. In fact everyone obviously followed my instructions and paid very close attention to ARR’s demonstration because they gave him an incredible feedback on both his verbal and non-verbal cues. In the end ARR came to me and he said that all this is very valuable experience for him and it is helping him “get his shit together”.

This was a very powerful conclusion of the whole session, as it was concrete and real demonstration of what we have been talking about all this time – that the way we feel and the way we act is entirely our choice and we are the ones to decide which part of us will be in power.
Session reflection:

Attendance was quite poor this week, probably due to weather conditions, so we had a rather private session. I started 10 minutes later because we agreed to wait if more people would turn up but I regretted it later because I felt I was rushing towards the end a bit. However, the participants didn’t seem to have noticed that which was good.

I felt quite encouraged in the beginning of the session because DM came to me with some feedback from last week. DM volunteered for demonstration of “the criticizer, the criticized and the compassionate observer” exercise and he said to me that he could not stop thinking about it the following day (Wednesday) and that he never realised how much he was affected by “the criticizer”. I was a bit worried for a moment because I thought he might have been very distressed but did not come for help. So I asked him whether he was feeling okay and I emphasized that it is important for him to come to us (myself, Chathurika, Jerome or the Life Lounge), if at any point he feels upset or distressed in response to the PPI. He agreed but then he said he was only telling me because he wanted to give me a feedback on how he managed the situation – “it was the mindfulness”, he said. He remembered when we talked about mindfulness and the ways it can be used to manage stress and he just did a quick exercise to bring himself back to the “here and now” focusing on his five senses at that moment and “it worked like magic”, he said. I was very pleased to hear that and I just felt incredibly encouraged thinking that at least one person could actually benefit from what we have been doing.

The starter activity when they had to think of how to get different animals to a top of a tree without bending it down or using any tool, was a really good “kick-off”. The purpose of this activity was to get everyone engaged from the very beginning of the session but mainly introduce the topic of strengths in a different, more interactive way. We did spend a little time on this and indeed, I heard some very interactive solutions to the problem – for example, DM, he would flood the area, so the monkey and owl would fly up the tree and the seal, fish and elephant could then swim. ZC said that the elephant could climb on it but would knock it down with his weight, so the seal could get on it easily then. When we talked about the purpose of the exercise and the metaphoric meaning it carried, everyone seemed to have paid really good attention. When I talked about my brother (severely dyslexic) who never even finished any form of HE because he had been conditioned to believe he was stupid and useless, I could see everyone nodding their heads in agreement and perhaps realizing how damaging it can be when we focus on the negatives.

The rest of the session went really well and flew quite smoothly and everyone seemed to be quite engaging, although EMR and JOH still expressed themselves far less than DM, MD and ZC. I could see clearly from Julia’s face that she was being very reflective and was thinking
about everything that was being said. I could not quite tell about EMR. She was very quiet and sometimes I was not sure whether she was truly present – I could see her completing the feedback sheets which was appreciated on one hand but on the other hand I would have preferred her focusing on the session. I did not tell her anything, which I realised is something I struggle with and need to really work on. I feel reserved and I don’t won’t to “tell anyone off” because I am afraid that they would withdraw from the research and/or that it would create an unpleasant atmosphere which could affect my research results in a negative way. I just realised that this position really “sucks” and that I would feel much better and more confident if I was delivering the sessions only as a teacher!

Towards the end of the session we did the drawing our hands exercise, where they had to write down their strengths in each of their hand fingers. Most of them were very quick in writing down their first five strengths, although DM and JOH struggled with the last one. I asked the others to help them and it worked really well – both completed their final strength in few seconds. It was very positive to see that most of them were well aware of their top strengths but it was even more positive to see that when I asked them to outline the other hand and write down another five strengths, the majority of them didn’t seem to struggle with that either – except for DM and JOH. was a bit surprised by that because this usually doesn’t happen but then I remembered the second group in my second pilot study who displayed similar patterns of self-awareness. I shared with them my experiences with other groups and ZC agreed that most of her friends can’t even put down three strengths. We then went over a number of reasons why most people don’t seem to be aware of their strengths and we also discussed the fact that some strengths are perceived as more useful than other in the current society. I encouraged everyone to keep working on their strengths and utilizing them.

We did not have time to complete the other exercise where I ask them to “meet people with similar strengths” but I encouraged them to complete it at home and think of the ways they currently use their character strengths and then try to explore more ways of utilizing them.

Overall, I felt the session went really well despite the fact there were only five people in.

Session 4 – Strengths, Group B (Control group) 24/04/2018

Participants: AF, PM, LD, MH, LV, LMH, ARR, JG, JK

Session reflection:

I felt really relaxed from the beginning of the session and I was confident that it would go well. I felt encouraged to see that the attendance was much better compared to last week, perhaps because there was no close assignment submission deadline this time.
The starter activity when they had to think of how to get different animals to a top of a tree without bending it down or using any tool, was a really good “kick-off”. The purpose of this activity was to get everyone engaged from the very beginning of the session but mainly to introduce the topic of strengths in a different, more interactive way. We did spend a little time on this and indeed, I heard some very interactive solutions to the problem – for example, ARR and AF said that they would let the owl and monkey get to the top first and then they would pray for rain so that the whole area could get flooded and the seal, fish and elephant could then swim. When we talked about the purpose of the exercise and the metaphoric meaning it carried, everyone seemed to have paid really good attention. When I talked about my brother (severely dyslexic) who never even finished any form of HE because he had been conditioned to believe he was stupid and useless, I could see everyone nodding their heads in agreement and perhaps realizing how damaging it can be when we focus on the negatives. We carried on with the discussion for quite a long time (compared to all the previous groups) and when I mentioned the TEDx talk by Eva Katharina Herber and the findings of the study conducted in 2002 by the Corporate Leadership Council, the debate became particularly lively. LV argued that sometimes it could be quite dangerous to “keep telling someone how brilliant they are” even though they’d be “totally rubbish”. I could not but agree but I had to emphasize that when talking about the importance of focusing on one’s strengths, it is essential to be genuine. Falsely believing in the power of strengths that are not there, would be inevitably counterproductive.

The rest of the session went really well and flew quite smoothly and everyone seemed to be quite engaging, although some people, like AF, PM and JK who expressed themselves far less than others, like LV, MH or ARR. I could see clearly from AF’s and PM’s face that they were being very reflective and were thinking about everything that was being said, and the same seemed to be in the case of JK who, I feel, is even more reserved because of her lack of confidence in speaking in English. Although her English is perfectly fine, she seems to feel very limited in her ability to express herself clearly. But I can see that she is very much present in each session and I have been struggling a bit with whether I should ask her directly more frequently or whether I should just leave her some space during the sessions.

Towards the end of the session we did the drawing our hands exercise, where they had to write down their strengths in each of their hand fingers. Similarly as the previous group, most of them were very quick in writing down their first five strengths. It was very positive to see that most of them were well aware of their top strengths but it was even more positive to see that when I asked them to outline the other hand and write down another five strengths, the majority of them didn’t seem to struggle with that either. Once again I was a bit surprised by that because this usually doesn’t happen but then I remembered the last group and the second group in my second pilot study who displayed similar patterns of self-awareness. I shared with them my experiences with other groups and everyone agreed that most of their friends can’t even put down three strengths. We then went over a number of reasons why most people don’t seem to be aware of their strengths and we also discussed the fact that some strengths are perceived as more useful than other in the current society. I encouraged everyone to keep working on their strengths and utilizing them.
APPENDICES

We did not have time to complete the other exercise where I ask them to “meet people with similar strengths” but I encouraged them to complete it at home and think of the ways they currently use their character strengths and then try to explore more ways of utilizing them.

Overall, I felt the session went really well and I had some very positive feedback from LMH and MH. They both said how incredible all these sessions were and how much they really benefited from them. They said they “get them thinking” and help them put things into perspective and find more positive ways of approaching their everyday life hassles.

Session 5 – Hope, Group A (Intervention group) 06/03/2018

Participants: JOH, MD, ZI, EMR, DM, KT, TH, FK, OJ, AS

Session reflection:

I think I am starting to accept the fact that most participants in this group are just generally more quiet and reflective – they do remind me of the second group in my second pilot study. The session went quite well but just as last year (pilot II.), it was nowhere near as powerful as it was in the first pilot study. The first pilot participants were very bonded by the time we got to the fifth session and it was far the strongest session out of the six. People were very open, honest and emotional and it was a bonding session. However, I did feel quite good about this session. I could see that everyone was paying attention and some were taking a lot of notes. Once again, most of them only spoke up if they were questioned directly but from their non-verbal expressions I could see that this wasn’t because they wouldn’t be engaging but simply because they were just more reflective. Interestingly, even DM spoke much less than in previous sessions but he was nodding his head all the time.

I was pleased to see that everyone seemed to clearly understand the concept of hope and the meaning of it suggesting that they all engaged in the online part of the intervention and they seemed to find this topic meaningful. Hope represented goals, motivation and future aspirations for everyone and they all perceived it as something positive and quite powerful. Nobody was very keen to share any deep concrete hopes suggesting that perhaps they might feel exposed and vulnerable. There is a clear difference between last year’s group and this one where participants were randomly allocated. It seems that it is only the mature students who are not so afraid to open up a bit more and do not depend as much on the initial “friendships” they made during the first semester at the university. However, I was pleased to see that most of them engaged in the online part of the program this week and they all seem to be quite clear when identifying their hopes, motivations and pathways, although they did not go in any detail. This was good enough for me and I completely respected their preference to keep all that private. Just as last year, we talked a little more about visualisation because I believe that is something many people struggle with in general. When I asked about the Monday exercise
when they were supposed to visualize their hopes, DM said “I think that’s something I do all the time, Jana”. I was incredibly pleased to hear that because that was something I was going to explain in the next step. So with DM’s help, I clarified the concept of visualisation a bit saying that it doesn’t always have to mean sitting down for 10 minutes and picturing oneself certain way. It can include visualisation meditation but it is more of a mind-set or general approach in life, which is what DM confirmed he has been doing. To use that opportunity, I asked him how he feels when he visualizes himself being where he wants to be. He confirmed that it just makes him feel more motivated and determined and very satisfied with his life.

When doing the “Gift of hope” exercise, most people shared similar hopes of academic achievements. I got slightly emotional when sharing my gift of hope which was a genuine desire to give something back to this country and this university for giving me opportunity to study and fulfil my dreams and I was hopeful that this PPI would help them become better or happier in their lives in any way. I was grateful for every single person in the group and I had a genuine hope that at least one of them would actually benefit from the whole program. The exercise went overall quite fast and when ZJ talked about her gift of hope, she mentioned her little daughter who motivates her a lot to achieve what she wants. That was a first time she shared something little more personal which I thought was quite a progress because she came to me immediately after the random allocation asking if she could swap groups to be with her friends. But it seemed that from that point people got hung up on the motivation bit and started to talk about their hopes and motivations, rather than the gift of hope they received. So, there seemed to be a misunderstanding in their interpretation of this exercise which is perhaps why it was not as powerful as it could have been potentially. I am not sure whether I could have explained it better – I probably could but I felt that my demonstration was clear. However, even though the final exercise was not as powerful, I felt that the whole session was well delivered and resonated with many people, almost as if the power originally assigned to the gift of hope exercise was evenly spread throughout the whole session this time.

I have been worried about AS for the past couple of weeks. She was very quiet during the session but her nonverbal expressions were very upsetting to me. She’s been looking at the ground almost the entire session, moving her legs as if they were twitching and rocking back and forth on her chair. Even though she responded to a couple of my questions, she did not seem to be really present in the session. I wanted to talk to her in the end but she disappeared really quickly as if she could not bear staying in the room any longer. I have been trying to talk to Chathurika about it, just to notify her but could not catch her any time. I will keep trying.
Session 5 – Hope, Group B (Control group) 01/05/2018

Participants: AF, PM, MH, ARR

Session reflection:

The attendance was really poor today, probably because there was no lecture in the morning (only tutorials) but I felt that the right people were present. The session went really well and unlike in the previous groups it was really powerful – probably just as powerful as in the first pilot study. These four participants are very regular attendees and they all engage in the online intervention. They seem to be very well bonded and they are very supportive to each other, and it was definitely the most emotional session out of them all in this group.

Just like in the previous group, I was pleased to see that everyone seemed to clearly understand the concept of hope and the meaning of it suggesting that they all engaged in the online part of the intervention and they seemed to find this topic meaningful. Hope represented goals, motivation and future aspirations for everyone and they all perceived it as something positive and quite powerful. Initially, nobody seemed to be very keen to share any deep concrete hopes and they were all more or less related to finishing their degree and working as counselling professionals. However, some of them send me very comprehensive and thorough feedback sheets talking about their experiences with each of the given exercises, from which I can see how important and meaningful they find this whole program. They display exceptionally high levels of self-awareness and self-reflection which I find really fascinating. LMH could not attend the session due to a sickness but in her feedback she said: “I want to be happy, successful in my studies, I want to be open to new experiences, I want to feel like I am making a positive difference to the lives of others…. I feel now, I am where I am meant to be.” MH, in her feedback said: “I hope to gain knowledge to make difference in other people’s lives…. I hope to move closer to my ideal self on the journey of becoming a fully functioning person. Visualization of my hopes is exciting, fills me with more hope and happiness. I can almost feel the sense of achievement and satisfaction but I am aware of the hard work, focus and dedication it will require.”

MH shared her experience with visualization in the session as well, and she said she felt it was slightly contradicting the mindfulness approach when they were taught to focus on the present moment rather than the past or future. Given that hint, I felt it was important to clarify the purpose of both mindfulness and hopeful thinking. I said that hope and mindfulness are not contradicting but rather complementing each other. Mindful presence in the moment does not mean that there is no room for awareness of the past or hope for the future. We then talked a little more about visualisation and I clarified the concept by saying that it doesn’t always have to mean sitting down for 10 minutes and picturing oneself certain way. It can include visualisation meditation but it is more of a mind-set or general approach in life. This was met with a general agreement.
The “Gift of hope” exercise was very powerful this time. As usually, I got slightly emotional when sharing my gift of hope which was a genuine desire to give something back to this country and this university for giving me opportunity to study and fulfil my dreams and I was hopeful that this PPI would help them become better or happier in their lives in any way. I was grateful for every single person in the group and I had a genuine hope that at least one of them would actually benefit from the whole program. By the time I finished sharing my “gift of hope” MH was in deep tears but did not feel comfortable sharing her “gift of hope”. After the session finished, she came to me to say that she could not share it because she was feeling too emotional but she wanted to tell me. Two years ago she was diagnosed with cancer which had all cleared up now. She said that that was a true gift of hope and she never gave up. That experience was very emotional but very uplifting at the same time, and MH just said how thankful she was to be able to take the PPI and how good it felt to be able to open up. PM shared that her “gift of hope” was having her daughter after having five boys. She talked about how blessed she felt and how much meaning her life had with this gift of hope. Similarly AF talked about her kids who give her so much hope and motivation to achieve her goals.

Overall, the session went really well and I was very grateful for all the participants who were there and I truly felt that this whole program did have a meaning and could actually help other people.

Session 6 – Happiness, Group A (Intervention group) 13/03/2018

Participants: MD, ZJ, EMR, DM, KT, TH, FK, OJ, ZC

Session reflection:

As this was the last session, the purpose of it was mainly to have some good time together. I had a couple of group games prepared but since this group had been so quiet and somehow reserved for the whole time, I was a bit worried nobody might want to play which would leave us with a lot of left over time. But then I just realised it did not really matter because my job was to facilitate the session with respect to the needs of these students, and if that meant finishing early, then let it be. That made me feel a lot calmer and the session went really well. Although the attendance was not brilliant, all people who came in seemed to be in a really good mood which was quite encouraging.

I remember that last time, in the second pilot study, we went through the actual content of the session quite fast but this time we spent on it more time than I expected. We talked a lot more about the online intervention this time and I was pleased to see that everyone actually completed all the exercises. When talking about spending quality time with their friends/family, most people agreed they do it regularly and that this intervention had helped them to realise how important it was. DM said that he cannot spent time with his wife as
regularly as he would like to because of external circumstances but through this program he could see that everything can be dealt with (at least to certain extend) and that everything was his choice. We talked a bit more about the Monday exercise when they were asked to replicate an experiment from the video they received and try to forgive someone they held a grudge against. ZJ said it was very hard and that in the end she just could not forgive the person because it just kept coming back to her that that person was not sorry at all and that he was not even bothered. At that point I did not feel it would be appropriate to ask her any details but I sensed it needed a little elaboration. I said to her that sometimes it is not as easy to forgive someone if they did something really serious which hurt us beyond bearable, like abuse or hurting someone we love. That is a process and it can take years but it is important to understand that we are not forgiving the person to make them feel better but to liberate ourselves. At that point there was an interesting interaction from ZC, who said that whatever happened (regardless of how bad it was), it already happened, the time will not go back and we cannot change it. But we can make sure that it does not affect us any more and further than it already did… I felt that ZJ could understand that point and that it was very good that it came from someone else than me.

I appreciated very much the feedback everyone gave me for the past 6 weeks. Although they did not say too much but everyone agreed that the whole PPI has been very beneficial to them (on a professional, as well as a personal level) and that they would not hesitate to do it again. Unlike in previous studies, these participants did not have a particular session they would favour the most. Only EMR said that she liked gratitude because she really felt that she took people in her life for granted before and this had helped her to appreciate more what she had. Everyone else said that the whole program was really well structured and delivered and that they really enjoyed the variety of resources. ZC said that she really enjoyed the videos because they brought all the concepts to a real life setting and to real people. She mentioned particularly Nick Vujicic – when she saw the short video with him she realised that whatever she worries about is absolutely nothing compared to what Nick has gone through, yet he is tremendously happy and successful in his life. Another precious feedback was from DM who said that it was not just the materials that made the difference but it was my presentation, approach and attitude. He really liked whenever I gave examples from my personal life because it brought the whole thing down the earth and it encouraged him to open up a bit more as well. He said that if it wasn’t for me “putting myself up on the chopping board” he would not have the courage to volunteer in week 3 to do the criticizer, the criticized and the compassionate observer exercise. Also, ZJ said that she enjoyed the whole program a lot more than she thought she would and she was really happy that she stayed in this group (originally she wanted to be put to the control group because her friends were there) where she could bond with other people and share the experience. All this feedback was really precious to me and I was just so grateful that these people could benefit from the program because in the beginning they all seemed to aware and reflective that I just could not stop wandering whether there was anything at all I could give them…

Given this feedback from a few people, I went back to self-awareness again and I linked it with the module pathway. I said that all this was about was to help them see the most important tool
they have to become successful in their lives as individuals and professionals – their self. I threw in a few open questions again just to make them reflect – Who are you? Why are you who you are? What do you want in life? Why are you here? What kind of people yank your chain? Why? Those are all questions they need to be able to answer for themselves before they can become good counselling professionals or psychotherapists. I did not ask anyone directly but from their non-verbal language and all eyes on me, I felt that they understood why I was stressing self-awareness so much in the past 6 weeks.

I presented them with some research backing up the importance of laughter and positive sense of humour, which was a good foundation for the group games. We played “Bend a friend” and “Suck it up” and it was so much fun. Everyone seemed to be really enjoying themselves and we all had a proper belly laugh together. MD and OJ won the two prices and they seemed to be really pleased with the gifts. I felt that they could really sense how much I cared for them and that they appreciated it.

Session 6 – Happiness, Group B (Control group) 08/05/2018

Participants: AF, AA, PM, LV, MH

Session reflection:

As this was the last session, the purpose of it was mainly to have some good time together. I had a couple of group games prepared but since the attendance was so low, I was a bit worried that we would finish really quickly which would leave us with a lot of left over time. But this was actually not the case. We did spend quite a lot of time talking about the online part of the intervention which on one hand was good because I could see that, again, everyone engaged with the online material but on the other hand, we went off the topic quite a few times. LV is very open and likes to share but sometimes it just gets somewhere completely different. When we talked about the Wednesday exercise when I asked them to spend some quality time with their friends/family, LV said that for her it was perhaps slightly different for her than most people as she only gets to look after her son for two weeks in a month. That time is so precious for them, so that it is always quality time. But then she started talking about her son playing games on his xbox which brought up an argument about whether computer games are good or bad for children. And somehow we got from spending quality time to arguing about parenting styles and the way to raise children. I had to step in a few times and point out that was not the purpose of these sessions. When we came back to the program, MH said that she had a really good experience spending quality time with her parents when they were visiting over the weekend. She said that she usually cannot stand listen to her mum talking about anything and everything for hours and she, MH, just tends to switch off and think about what to do next, what to buy for dinner etc. This time, however, she made an effort to mindfully listen to her mum’s stories and she realised that she felt a lot calmer and a lot less stressed and exhausted.
than she usually does when she wonders off during these conversations. This was very insightful experience and I was very grateful for MH to share it. AA said that spending quality time with her friends and family is a regular thing for her but this program helped her to realise how important it was. PM, on the other hand said that for her there is no quality time because nobody is interested in it. She has four boys and one girl and she is a single mum. The children do not respect her and when she wants to spend some time with them or asks them to do anything they would just ignore her and continue to play games on their computers. I did not really know how to react to that so I just expressed empathy saying that must be a very painful experience for her. But I felt that was all I could do at that moment, there was no time or room to go to any depth of this or attend to her individually. But in the end of the session, I did briefly speak to her again and referred her to the Life Lounge if, at any point, she felt she would need some more individual support. With that I felt I did all I could to maintain good clinical practice and provide the necessary amount of support in that moment.

When we talked about the forgiveness exercise, we did not go to too much detail of their individual experiences but I did feel it was important to explain the purpose of that exercise and discuss the power of forgiveness. I emphasised that some things, or probably most things will take much longer to forgive AND forget than one-off attempt but I wanted them to understand that the act of forgiveness is actually to liberate themselves from the pain they feel when they hold grudges. This really resonated with everyone and they all agreed that it is more about “forgive themselves” and letting go.

When we talked about the whole six weeks of the PPI, I received really nice feedback from everyone that was very touching. MH said that she has been learning so much throughout this program and that it has helped her in her personal and professional life more than anything. Her favourite topic was self-compassion because she realised how little she cared about herself but how important it was. She loved the mindfulness and the strengths as well and she said she’s been using it at work to motivate and support her colleagues. AA said that she could not pick a favourite topic because they all had a deep meaning for her and she said that she was surprised how much she enjoyed all the sessions. Initially she was a bit concerned because group talks “wasn’t really her thing” but with everyone in the group being so open and supportive, she felt very comfortable. PM heavily agreed with that saying that she has felt very comfortable sharing everything within the group setting, and some of her experiences were very strong and personal, yet she felt supported by the group. AF said that the whole six weeks have been very powerful experience for her and it has helped her realise and uncover many hidden things. Sometimes these things brought a lot of pain and emotions but she felt it was good that these things could come out and the whole intervention has had a powerful healing effect on her life.

All this was very valuable feedback for me and I just brought it back to to self-awareness again and I linked it with the module pathway. I said that all this was about was to help them see the most important tool they have to become successful in their lives as individuals and professionals – their selves.
I presented them with some research backing up the importance of laughter and positive sense of humour, which was a good foundation for the group games. We played “Bend a friend” and “Suck it up” and it was so much fun. Everyone seemed to be really enjoying themselves and we all had a proper belly laugh together. MH and AF won the two prices and they seemed to be really pleased with the gifts. I felt that everyone could really sense how much I cared for them and that they appreciated it.
Appendix F.

Gene Expression Analyses – Brief Overview

*Sequence-based methods.*

Sequence-based methods such as SAGE, comparative EST sequencing, and MPSS are the most accurate with regards to the transcript identification but, for academic scientists, these approaches are technically challenging and relatively labour-intensive and expensive when analysing many samples (e.g., in large number of patients or in a longitudinal study with repeated measures). In contrast, the hybridization based formats are relatively easy to use, but can be ambiguous in terms of specificity of signal detection as well as difficulty in monitoring low copy number transcripts (Fryer et al., 2002).

*Comparative EST sequencing.* Comparative EST analysis pioneered in the early 1990s (Adams, Soares, Kerlavage, Fields & Venter, 1993, Lee, Weinstock, Kirkness et al., 1995), provided the first largescale analysis of gene expression. An essential part of this approach is creating cDNA libraries representing all expressed mRNAs in a cell or tissue. Then, by sequencing thousands of arbitrarily chosen cDNAs, a database is created that identifies and counts all the genes that are expressed which are termed ESTs. The method has the inherent advantages that it does not require prior knowledge of the existence of a transcript to measure its level of expression. In addition, being a sequence-based method, this strategy is highly reliable with regard to transcript identification. However, comparative EST sequencing has lost its popularity because of significant drawbacks related particularly to the costs of this method. Sequencing enough ESTs to generate a full profile of gene expression is very expensive. This issue is compounded by the fact that most transcripts are of relatively low abundance, so an
investigator must sequence tens or hundreds of thousands of ESTs to generate a statistical sampling of a pool of RNA to identify differentially expressed genes. Nonetheless, EST sequencing will remain an important tool for studies of organisms the genomes of which are not yet sequenced, as other approaches (e.g., microarray, SAGE) typically require a database and/or repository of genes to be useful. Furthermore, this approach can uncover novel transcripts, particularly splice variants that are likely to be missed by other methods.

**SAGE.** SAGE (Velculescu, Vogelstein & Kinzler, 2000; Velculescu, Zhang, Vogelstein & Kinzler, 199) is an analytical method that has been effectively used in studies of cancer (Polyak, Xia, Zweier, Kinzler & Vogelstein, 1997; Zhang, Zhou, Velculescu et al., 1997). SAGE uses a series of biochemical reactions to create a library of short DNA fragments (13 base pairs), each one being derived from a single mRNA molecule in a biological sample. This population of DNA fragments, known as SAGE tags, is concatenated together to form longer DNA molecules that are then sequenced, as done with comparative EST sequencing. However, a single molecule contains DNA fragments representing 130 different RNA molecules, so a single sequencing reaction is sampling the expression of 130 transcripts. A database of SAGE tags is created, and specialty software distinguishes each SAGE tag, bins and counts identical tags, and thus measures the abundance and distribution of each transcript in the RNA pool being studied. Additional software is available to identify the gene that corresponds to each SAGE tag. Performing a comparison of two RNA samples typically involves analyzing 30,000–100,000 SAGE tags in each sample to generate statistically valid comparisons. The advantage of this strategy is that it provides a highly reliable identification of each gene at less cost than EST library sequencing. The major disadvantages of this approach are that it is technically challenging to make SAGE tag libraries, that it is relatively slow to perform a study, that it is costly to perform a single experiment, and, most importantly, that its
power can only be fully appreciated when there is an EST or genome database available to allow identification of each SAGE tag.

MPSS. MPSS, similarly to SAGE, captures the power of sequencing for gene identification and combines it with the clout of a parallel-processing system to provide ultrahigh-throughput analysis (Brenner, Johnson, Bridgham et al., 2000; Tyagi, 2000). It involves construction of a cDNA library which is captured on millions of microbeads and assembled into a planner array. Individual beads are then individually imaged during a series of complex multistep sequencing reactions, and the DNA sequence of hundreds of thousands of transcripts is determined at once. By sequencing 16–20 bases, unique identities are deduced for each molecule, and a database of all transcripts is created. Thus, sequence analysis provides gene identification, and a simple count of the number of copies of each sequence reveals transcript abundance or expression level. This approach was shown to be effective in yeast and human cells for measuring gene expression levels (Brenner et al., 2000). There are several major advantages of this strategy. It provides sequence level gene identification, and it can identify transcripts not previously known to exist. Furthermore, the miniature, parallel-processing system allows interrogation of hundreds of thousands of transcripts at once, providing unprecedented sensitivity. MPSS, like SAGE, is most valuable when used in conjunction with an existing genome or EST database.

RNA-Seq. RNA-Seq (Morin, Bainbridge, Fejes et al., 2008), uses next-generation sequencing technologies to sequence all cDNAs from a sample. Because of its high throughput, RNA-Seq can provide more comprehensive information on the transcriptome other sequence-based methods mentioned above (Wang et al., 2009). RNA-Seq can be used to detect the overall transcriptional activities of many species at the level of single nucleotides (Cloonan, Forrest,
Kolle et al., 2008), discover unknown or rare transcripts (Bertone, Stolc, Royce et al., 2004; David, Huber, Granovskaia et al., 2006), and recognize alternative splicing sites (Sultan, Schulz, Richard et al., 2008) or cSNP (Chepelev, Wei, Tang & Zhao, 2009) accurately. Furthermore, RNA-Seq can be performed with different platforms to deal with different problems, as they have different advantages. For example, using the Illumina Genome Analyzer platform, recent applications include sequencing mammalian transcriptomes (Mortazavi, Williams, McCue, Schaeffer, & Wold, 2008), ABI Solid Sequencing to profile stem cell transcriptomes (Cloonan et al., 2008) or Life Science’s 454 Sequencing to discover SNPs (Barbazuk, Emrich, Chen, Li & Schnable, 2007). Even though each platform has its technical individualities, the information gathered from each is of the same nature. Early technologies were limited by the size of reads, such as ESTs, or the cost, like MPSS and SAGE, or the throughput, as microarray (see below). However, these limiting features are precisely the advantage of RNA-Seq. Furthermore, RNA-Seq seems to be more sensitive and consistent technology compared to other high-throughput platforms (Ping, Wang, Yu et al., 2012).

**Northern blotting.**

The traditional Northern blot (Sabelli & Shewry, 1995) analyses a single gene at a time and is considered by most investigators to be the “gold standard” in terms of quantifying mRNA expression levels. It was originally developed by Alwine and colleagues (Alwine, Kemp & Stark, 1977) as an extension of Southern blotting (Southern, 1975), which uses electrophoresis to hybridize DNA. The inherent limitation of a Northern blot is that typically only one gene at a time is analysed. In addition, there are variations from blot to blot that undermine large-scale quantitative comparisons. Analysing more than 10–20 RNA samples requires multiple blots, and the methods consume considerable amounts of RNA and other reagents that makes large-scale analysis costly and time-consuming.
**Macroarrays.**

In the 1980s and early 1990s, strategies for large-scale analysis of gene expression emerged. Macroarrays were initially developed as “reverse-Northern blots”, in which each gene being analysed was blotted onto a nylon filter membrane and an RNA sample was labelled and hybridized to the blot. Expression levels were quantified using radioactivity and an appropriate scanner. This method has proven very reliable for quantifying gene expression levels and continue to be widely used for analysing proteins and nucleic acids (Miglani, 2015). There are numerous commercial sources providing macroarrays. In general, these “low-tech” arrays are relatively inexpensive, work extremely well, and can be easily scaled to allow analysis of thousands of genes. Furthermore, they have the great advantage that any laboratory can create its own macroarrays using an in-house or a commercially available library of genes (i.e., oligonucleotides or ESTs) to be spotted. The major drawbacks of filter-based macroarrays are that (1) they can be difficult to process in a high-throughput manner due to membrane stretching and other anomalies; (2) there can be problems quantitatively comparing multiple blots because of inconsistencies in labelling, and (3) the blots typically have a high background signal, making it difficult to analyse low-abundance transcripts.

**Microarrays.**

DNA microarrays, or “DNA/RNA chip technology” (Miglani, 2015, p. 27.39), have become the most popular platform among scientists for performing global gene expression analysis (Fryer et al., 2002). Microarrays provide a relatively rapid, reliable, reproducible, and quantitative approach for simultaneously monitoring expression levels of thousands of genes (Hsiao, Stears, Hong & Gullans, 2000; Kurella, Hsiao, Yoshida et al., 2001; Lashkari, De Risi, McCusker et al., 1997; Moch, Schraml, Bubendorf et al., 1999; Nagasawa, Takenaka, Kaimori et al., 2001). Basically, the approach is to create a spotted array of thousands of different DNA
APPENDICES

molecules (i.e., oligonucleotides or cDNAs) corresponding to thousands of different genes. Then, starting with an RNA sample, a series of biochemical reactions generates a fluorescently labelled cRNA or ss-cDNA probe. This probe is then hybridized to the microarray and scanned with a laser scanner. The expression levels are measured by the fluorescence intensity of bound probe to each spot. Multiple microarray platforms now exist from a variety of commercial entities, and many institutions have robotic equipment enabling them to create their own custom microarrays. The two most frequently used methods are the incorporation of fluorescently labeled nucleotides in the cRNA or cDNA synthesis step or the incorporation of a biotin labeled nucleotide in the cRNA synthesis step (Affymetrix oligonucleotide microarrays) (Bumgarner, 2013). Other microarray technologies include “flow-through” microarrays and fiberoptic bead arrays (Walt, 2000). Though important differences exist among the platforms, they share many of the same advantages and disadvantages. In particular, they allow simultaneous analysis of thousands of genes in a single sample. In addition, the identity of each gene is known a priori. It is possible to process many different RNA samples quickly and efficiently, making possible studies of large numbers of patient samples or detailed time course studies. Finally, the data are quantitative and can be compared among laboratories and across different experiments. The disadvantages begin with the fact that microarrays are generally considered to be relatively expensive. In addition, there is always some level of uncertainty regarding binding specificity, so that the measured expression level of one gene may be corrupted by “nonspecific” binding of another gene with similar sequence. That is the signal measured at a given position on a microarray is typically assumed to be proportional to the concentration of a presumed single species in solution that can hybridize to that location (Bumgarner, 2013). A number of strategies seek to reduce this problem, such as the “mismatch” analysis provided by Affymetrix or using informatics to design “gene-specific” oligos for the chip. In addition, the level of sensitivity of microarrays is less than that of sequence-based
methods, though improvements in signal detection have been noted (Schweitzer & Kingsmore, 2001; Stears, Getts & Gullans, 2000; Zhang, Price, Tetradis et al., 2001). Finally, the technical reproducibility has been a major concern in the microarray field (Fryer et al., 2002), as a DNA array can only detect sequences that the array was designed to detect. That is, if the solution being hybridized to the array contains RNA or DNA species for which there is no complimentary sequence on the array, those species will not be detected. For gene expression analysis, this typically means that genes that have not yet been annotated in a genome will not be represented on the array (Bumgarner, 2013).

Differential display RT-PCR.

Differential-display RT-PCR and similar PCR-based techniques were introduced in the early 1990s (Liang & Pardee, 1992; McClelland, Mathieu-Daude & Welsh, 1995) as a way of identifying mRNA expression differences in two or more samples. These techniques use short oligonucleotide primers (e.g., 10mers) to amplify arbitrary subsets of 25–100 genes in an RNA sample. These amplified products are visualized using polyacrylamide gel electrophoresis, and differences in the amount of a PCR product are seen from the intensity of individual bands in the gel. Genes of interest are then cut out of the gel, isolated, and sequenced. This approach has been largely used as a screening tool for identifying differentially expressed genes. However, with some technical modifications and use of more sophisticated instruments and appropriate informatics, investigators have shown that differential display RT-PCR methods can generate quantitative information regarding mRNA expression levels, and individual gene identities can be determined (Shimkets, Lowe, Tai et al., 1999). The great advantage of this approach is that it requires no a priori knowledge that a gene exists or what its sequence is. This make it very useful for studies of organisms for which there is little genomics infrastructure. Moreover, because this approach involves PCR amplification, it often generates new genes that do not exist in public databases. Finally, it is very flexible. The major drawback
APPENDICES

is that it would be difficult for academic laboratories to automate, and there is always some uncertainty regarding the identity of each gene being analysed. cDNA differential display as compared to DNA microarrays and industrial gel-based transcription profiling systems is a subjective evaluation of gels and the fact that data are not available in a quantitative form suitable for database storage and numerical manipulations is a significant disadvantage of this method (Venkatesh, Hettwer, Koopmann & Karlovsky, 2005).
Appendix G.

Study Information Sheet and Consent Form Given to Participants

Prior Initial Assessment

Participant Information Sheet

Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.

My name is Jana Rozehnalova, I am a first year PhD student at the University of Bolton currently working on my thesis. The focus of this study is to develop an alternative approach to obesity intervention combining research in Positive Psychology and molecular genetics. Positive Psychology does not attempt to “fix” what is wrong with a person, but to help people identify and develop their strengths and focus on positive aspects of their life, in order to achieve their full potential. It is proposed that intentional activities aimed at cultivating positive feelings, positive behaviours, or positive cognitions could stimulate a change in particular genes that contribute to obesity development and maintenance. Such change in molecular genetics could then potentially initiate weight loss and improve the participants’ physical, mental, behavioural and social aspects of life.

What does the participation require?

If you agree to take part in the study, you will be asked to actively participate and engage in a 6 week Positive Psychology program. The program will consist of online intervention (positive messages received via email 3 times a week) with self-help exercises (designed to reinforce those positive messages), and a weekly group therapy sessions (6 in total). You will be asked to fill in a set of 3 questionnaires and a demographic information sheet at the beginning and end of the study. This will take approximately 30 – 40 minutes. Each group therapy session will last for 90 minutes. In order to assess the effects of the intervention, your weight and height measurements will be taken before and after the intervention.

This project involves determination of genetic variants and mRNA expression levels of the DOPAMINE DRD4, OXYTOCIN RECEPTOR OXTR, SEROTONIN TRANSPORTER 5-HTT and FAT MASS AND OBESITY ASSOCIATED FTO genes in human saliva samples. The gene encoding β-ACTIN (ACTB) will be used as a reference for sample normalization in determination of the mRNA level of the four genes of interest.

In order to perform the DNA analyses, you will be asked to give a saliva sample on a weekly basis for 6 weeks during the intervention - 12 – 18 samples in total.

What does the participation NOT require?

You will not be asked to engage in any sort of dieting, nutrition monitoring or physical activity other than your normal routine. You will not be asked to take any measurements other than specified above.

Do I have to take part?

Participation in this study is completely voluntary. You can withdraw the study without giving a reason up until session 6. If you do not want to take part, you do not have to justify your reasons and no pressure will be placed on you to change your mind. Please note, if you choose not to participate, or withdraw during the study this will not affect your studies or personal life in any way. Once you have completed the paperwork and signed consent form, your data will be analysed. Your anonymity will be maintained at all times.
Confidentiality.

All the information provided by you **will be confidential** and used for the purposes of this study only. Any participant information collected within this form will be kept confidential and stored securely at all times in accordance with the Data Protection Act 1998 and will be disposed of in a secure manner.

All saliva samples collected from the participants shall be disposed of after analysis has been carried out within a maximum of 18 months. The analysis of the saliva samples **will not reveal or be linked to the identity of any participant**.

Before agreeing to take part in the study, please make sure that you have understood all the information given on this sheet and do not hesitate to ask if you are not sure about anything. If you agree to take part in the study, sign the consent form.

If, at any time you wish to receive more information about the study, you can contact the investigator or a one of the project supervisors:

**Contact details for the investigator:**
- Name: Jana Rozehnalova
- Course/position: PhD, Psychology
- Email: jr2wss@bolton.ac.uk
- Contact mobile: 07413174831

**Contact details for the supervising staff member:**
- Name: Professor Jerome Carson
- Position: Project supervisor (Psychology)
- Email: J.Carson@bolton.ac.uk
- Contact telephone: 01204 903 228

- Name: Dr Ianis Matsoukas
- Position: Secondary supervisor (Molecular genetics)
- Email: I.Matsoukas@bolton.ac.uk

For further help contact the following organization(s):

**Mental health Independent Support Team (MhIST)**
- Website: [www.mhist.co.uk](http://www.mhist.co.uk)
- Contact: help@mhist.co.uk
- Phone: 01204 527200

**University of Bolton Counselling Services**
- Website: [http://www.bolton.ac.uk/Students/AdviceAndSupport/Counselling/Home.aspx](http://www.bolton.ac.uk/Students/AdviceAndSupport/Counselling/Home.aspx)
- Student services appointment booking: 01204 903733

**The Lyme Trust – Registered Charity, Newcastle –under-Lyme**
- Website: [http://www.thelymefrust.co.uk/](http://www.thelymefrust.co.uk/)
- Phone: 07988582530

**Manchester Centre for CBT**
- Website: [http://www.cbt-centre.co.uk/index.html](http://www.cbt-centre.co.uk/index.html)
- Phone: 0845 052 3949 (Reception)

- Dr Styliani Gkika
- BABCP Accredited CBT Therapist

**Manchester Mental Health and Social Care Trust NHS**
- Website: [http://www.mhsc.nhs.uk/services/psychological-services/psychotherapy-service.aspx](http://www.mhsc.nhs.uk/services/psychological-services/psychotherapy-service.aspx)
- Alison Marriott (Clinical Director Psychological Services) Tel: 0161 277 1140
- Gaskell House, Swinton Grove, Manchester, M13 0EU Fax: 0161 277 1142

**THANK YOU VERY MUCH FOR YOUR HELP!**

APPROVED BY THE UNIVERSITY OF BOLTON RESEARCH ETHICS COMMITTEE
RESEARCH ETHICS: CONSENT FORM

Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.

Information about the researcher:

Name: Jana Rozehnalova
Course/position: PhD Psychology – 1st year
Address: University of Bolton, School of Education and Psychology, Deane Road, Bolton, BL3 5AB

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.

2. I understand that the study requires active participation in the Positive Psychology program for 6 weeks. I agree to actively take part to the best of my abilities.

3. I understand and agree to give saliva samples for the DNA testing every week for 6 weeks during the intervention (12 - 18 samples in total).

4. I am aware that any findings from the samples collected will not be linked to my name or reveal my identity. Any details I provide on this form will be stored securely and all information will be kept in strictest confidence.

5. I am further aware that any samples that shall be collected are solely for research purposes. After this purpose is met, the samples will be disposed away as per the protocol.

6. I agree to give up a maximum of 30 minutes of my time for the named researchers above to collect the samples needed for this research.

7. I agree to participate by providing saliva samples before and after a visual stimuli for the purpose of the named research project.

8. I understand that I should not participate in this research if I have a serious infectious disease (such as HIV or Hepatitis). As far as I am aware I currently do not have any serious infectious diseases.

9. I understand and agree to fill in the paperwork specified in the participant information sheet at the beginning and end of the intervention, and any other time if the study design requires it.

10. I understand and agree to have height, weight and waist circumference measurements taken at the beginning and end of the intervention.

11. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

12. I agree with publication of the results of this study in a research journal. I understand that I will not be identified in these publications.
13. I accept all the conditions described above and agree to take part in the above study.

Name of Participant ____________________________ Date ____________________________ Signature ____________________________

Name of Researcher ____________________________ Date ____________________________ Signature ____________________________

**Statement by researcher(s)**

I have provided information about the research to the research participant and believe that he/she understands what is involved.

**Researcher’s signature** ____________________________

**Date** ____________________________

**Researcher’s signature** ____________________________

**Date** ____________________________

**Researcher’s signature** Dr Ianis G. Matsoukas

**Date** ____________________________
Appendix H.

Self-report Measures Used to Conduct Psychological Assessment

Before and After the Intervention in the First Pilot Study: The
Change Questionnaire, BI-AAQ, and PERMA

Change Questionnaire Version 1.2
(Miller & Johnson, 2008)

What is the change that you are considering? Write it here:

to ___________________________________________________

Now answer each of the following questions about this change that you are considering. Wherever you see the words "make this change," think of the change that you have written above, and then circle the one number that best describes where you are right now. For example, if you had written “get a job” on the line above, then for item 1 (I want to make this change) you would indicate how much you want to get a job.

<table>
<thead>
<tr>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I want to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I could make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. There are good reasons for me to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I have to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I intend to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I am trying to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I hope to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I can make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. It is *important* for me to make this change.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. I *need* to make this change.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. I am *going* to make this change.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. I am *doing things* to make this change.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely not</td>
<td>Probably not</td>
<td>May be</td>
<td>Probably</td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Body Image Acceptance and Actions Questionnaire

**BI-AAQ (Sandoz, Wilson, Mervin & Kellum, 2013)**

Directions: Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to make your choices. For instance, if you believe a statement is ‘Always True,’ you would write a 7 next to that statement.

<table>
<thead>
<tr>
<th>Never true</th>
<th>Very seldom true</th>
<th>Seldom true</th>
<th>Sometimes true</th>
<th>Frequently true</th>
<th>Almost always true</th>
<th>Always true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

1. Worrying about my weight makes it difficult for me to live a life that I value.
2. I care too much about my weight and body shape.
3. I shut down when I feel bad about my body shape or weight.
4. My thoughts and feelings about my body weight and shape must change before I can take important steps in my life.
5. Worrying about my body takes up too much of my time.
6. If I start to feel fat, I try to think about something else.
7. Before I can make any serious plans, I have to feel better about my body.
8. I will have better control over my life if I can control my negative thoughts about my body.
9. To control my life, I need to control my weight.
11. When I start thinking about the size and shape of my body, it's hard to do anything else.
12. My relationships would be better if my body weight and/or shape did not bother me.
PERMA Scale of Authentic Happiness

Please read each of the following questions and then circle the point on the scale that you feel best describes you. All questions must be completed for this questionnaire to be scored.

1. **In general, to what extent do you lead a purposeful and meaningful life?**
   
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

2. **How much of the time do you feel you are making progress towards accomplishing your goals?**
   
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

3. **How often do you become absorbed in what you are doing?**
   
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

4. **In general, how would you say your health is?**
   
   Terrible 0 1 2 3 4 5 6 7 8 9 10 Excellent

5. **In general, how often do you feel joyful?**
   
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

6. **To what extent do you receive help and support from others when you need it?**
   
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

7. **In general, how often do you feel anxious?**
   
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

8. **How often do you achieve the important goals you have set for yourself?**
   
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

9. **In general, to what extent do you feel that what you do in your life is valuable and worthwhile?**
   
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely
10. In general, how often do you feel positive?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

11. In general, to what extent do you feel excited and interested in things?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

12. How lonely do you feel in your daily life?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

13. How satisfied are you with your current physical health?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

14. In general, how often do you feel angry?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

15. To what extent have you been feeling loved?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

16. How often are you able to handle your responsibilities?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

17. To what extent do you generally feel you have a sense of direction in your life?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

18. Compared to others of your same age and sex, how is your health?
Terrible 0 1 2 3 4 5 6 7 8 9 10 Excellent

19. How satisfied are you with your personal relationships?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

20. In general, how often do you feel sad?
Never 0 1 2 3 4 5 6 7 8 9 10 Always
21. How often do you lose track of time while doing something you enjoy?

Never 0    1    2    3    4    5    6    7    8    9    10 Always

22. In general, to what extent do you feel contented?

Not at all 0    1    2    3    4    5    6    7    8    9    10 Completely

23. Taking all things together, how happy would you say you are?

Not at all 0    1    2    3    4    5    6    7    8    9    10 Completely
Appendix I.

A Scanned Copy of the Original Ethical Approval to Conduct the First Pilot Study, and Additional Approval of Changes/Additions for the Second Pilot Study and the RCT Granted by the University of Bolton Ethics Committee
RESEARCH ETHICS CHECKLIST

This checklist should be completed for every research project which involves human participants. It is used to identify whether a full application for ethics approval needs to be submitted.

Before completing this form, please refer to the University Code of Practice on Ethical Standards for Research Involving Human Participants. The principal investigator and, where the principal investigator is a student, the supervisor, is responsible for exercising appropriate professional judgment in this review.

This checklist must be completed before potential participants are approached to take part in any research.

Section I: Applicant Details

1. Name of Researcher (applicant): Jana Rozehnalova
2. Status (please click to select): Postgraduate student, PhD – full time
3. Email Address: jr2wss@bolton.ac.uk
4a. Contact Address: University of Bolton, Deane Road, Bolton, BL3 5AB
4b. Telephone Number: 07413174831

Section II: Project Details

5. Project Title: "Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness."

Section III: For Students Only:

6. Course title and module name and number where appropriate: PhD via thesis – full time
   School/Centre: School of Education and Psychology
7. Supervisor’s or module leader’s name: Professor Jerome Carson, Dr lanis Matsoukas (secondary supervisor)
8. Email address: J.Carson@bolton.ac.uk;
   J.Matsoukas@bolton.ac.uk
9. Telephone extension:: 3228 (Prof Carson)

Declaration by Researcher (Please tick the appropriate boxes)

- [x] I have read the University's Code of Practice
- [x] The topic merits further research
- [x] I have the skills to carry out the research
- [x] The participant information sheet, if needed, is appropriate
- [x] The procedures for recruitment and obtaining informed consent, if needed, are
<table>
<thead>
<tr>
<th>appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ The research is exempt from further ethics review according to current University guidelines</td>
</tr>
<tr>
<td>☑ Where relevant, I have read the ethical guidelines of the regulatory body that is relevant to my discipline and verify that the research adheres to these guidelines</td>
</tr>
</tbody>
</table>
Comments from Researcher, and/or from Supervisor if Researcher is Undergraduate or Taught Postgraduate student:

<table>
<thead>
<tr>
<th>Brief description of the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.&quot;</td>
</tr>
</tbody>
</table>

Study focus (briefly summarize the focus of your study):

The purpose of the current study is to develop an alternative approach to obesity intervention combining research in Positive Psychology and molecular genetics. Obesity represents a world-wide problem with numerous serious health risks, such as coronary heart disease, hypertension, diabetes, respiratory diseases, stroke, and certain cancers (Landsberg, Aronne, Lawrence et al., 2013). According to the Statistics on Obesity, Physical Activity and Diet in England 2014, the proportion of adults that were overweight including obese increased between 1993 and 2012 from 13.2% to 24.4% among men and from 16.4% to 25.1% among women (The Health and Social Care Information Centre, 2014). In America, class III obesity currently affects 6% of the adult population (Arterburn, Maciejewski & Tsevat, 2005). The trends in obesity increase can be observed from early childhood and there seems to be inconsistent evidence for long-lasting effects or health improvements of currently applied obesity treatments.

Positive Psychology does not attempt to “fix” what is wrong with a person. It aims to help people identify and develop their strengths and focus on positive aspects of their life, in order to achieve their full potential (Seligman, 2011). It sees an individual as a master of his own choices, decisions and actions. It helps an individual understand that weakness is not a weakness unless we give it the power to make us weak. On that basis weakness can become a strength and facilitate happiness, well-being, positive traits, and the development of meaningful positive relationships, social systems and institutions (Carr, 2011). Using Positive Psychology, this study aims to help individuals suffering with overweight and obesity to shift their focus in life from negativity and depression to gratitude, joy and resilience.

Previous research suggested that there is a relationship between obesity and addiction proposing that some hedonic properties of particular types of foods may have addictive effects. Obese individuals have significantly lower availability of striatal dopamine D2 receptor (Chen, Lin, Chao et al., 2012). This deficiency may be the reason for pathological eating as a means to compensate for decreased activation in motivation and reward circuits modulated by dopamine. In addition, it has been argued that obesity and excessive eating may represent an addiction to endorphins, rather than addiction to particular types of food (Bakkali-Kassemi, El Ouezzani, Magoul et al., 2010). Part of this research will focus on identifying genes underlying the brain mechanisms related to food addiction. The purpose of this research is to identify genes responsible for expression of particular types of dopamine and endorphin, and investigate whether they could be changed, altered or transformed by an external stimuli (i.e. Positive Psychology intervention).

Gene expression profiling will be used to simultaneously compare the expression levels of several genes in response to the proposed intervention. This analysis will help to identify the molecular basis for phenotypic differences and select gene expression targets for in-depth study using other technologies.

Gene expression profiling will provide a valuable insight into the role of differential gene expression in response to the proposed intervention. Quantitative real-time RT-PCR (qPCR) is widely used as the most reliable method for quantifying gene transcript levels because of
its sensitivity, accuracy and specificity. The proposed method will be used for validation of differential gene expression profiles. Different data analysis tools that transform raw data to informative results will be used for a comprehensive understanding of the biological significance of gene expression data.

Human genetic variation is present in many different forms in the genome. Polymorphisms have been classically identified as SNPs, MNP-s, indels and STRs. Gene deletion and gene duplication are genomic variations that can also affect protein function or a particular phenotype. Deletions and duplications in genes have been associated with phenotypic variation in obesity studies. This approach will also be exploited to identify the molecular basis of phenotypic differences in response to the proposed intervention.

**Study objectives/hypotheses:**

The aim of the proposed PhD research is to develop a positive psychology intervention for obese adults and identify its' effects on molecular genetic pathways related to obesity. The first step of the current study is to conduct a pilot study using a university student population on which basis controlled trial of the Positive Psychology intervention for obese adult population in the North West (obesity high-risk) region will be conducted.

The pilot study objectives are:

1. To develop and pilot a Positive Psychology intervention for overweight and obese adults combining online intervention with self-help exercises and a group therapy intervention.
2. To design and pilot a study website where the materials related to the Positive Psychology intervention could be accessed by the participants.
3. To examine the relationship between the participants’ readiness and motivation to adopt changes in life – measured by the Change Questionnaire (Miller & Johnson, 2008), and their positive emotions and subjective feelings of happiness before and after the Positive Psychology intervention - measured by the PERMA questionnaire (Seligman, 2011).
4. To examine the effects of the Positive Psychology intervention on the participants’ body image flexibility measured by the Body Image Acceptance and Action Questionnaire (BI-AAQ; Sanzoz, Wilson, Merwin & Kellem, 2013).
5. To identify through which particular molecular genetic pathways does the Positive Psychology intervention affect obesity – using laboratory equipment for analyses of the participants’ saliva samples.
6. To identify any effects of the Positive Psychology intervention on the genes identified.
7. To identify any effects of the Positive Psychology intervention on the participants’ weight.

The alternative hypotheses are:

a) Those participants who will be more ready to adopt changes in life, will participate in the intervention more actively and they will score higher on the PERMA questionnaires, especially after the intervention.

b) The participants will score high on the BI-AAQ before the intervention, indicating low body image flexibility. Their body image flexibility will increase after the intervention, indicated by lower scores on the BI-AAQ.

c) There will be some genetic change or transformation (in the molecular genetic pathways identified) as a reaction to the intervention.

**Research strategy (briefly summarize what you are going to do):**
The investigator will seek 20 heavily overweight or obese students from the University of Bolton who would volunteer to participate in the study. They will be recruited via different routes which will include responding to leaflets, posters, or email. Students will be also approached in the beginning of their formal lectures with a permission of their lecturing tutor. They will be briefly explained the nature of the study and will receive an information about the first study meeting (i.e. time and location) and contact details for the researcher to confirm their presence. The meeting will then explain in more details what will be required from the participants, including the length of the study and all measurements that will need to be taken. Those participants who will agree to take part in the study will then receive the study information sheet and the consent form to sign which will clearly identify all terms and conditions of their participation.

The Positive Psychology intervention will consist of a daily electronic intervention via email (i.e. participants receiving positive messages, presentations, quotes) with following self-help exercises reinforcing the positive messages, and 6 weekly group therapy sessions with a specific theme for each week (e.g. gratitude, resilience, hope, joy, happiness). Saliva samples for DNA testing will be taken every week during the intervention (6 weeks) and additionally for more accuracy 3 weeks before and after the intervention (12 samples in total).

Measurements of well-being, body-image flexibility and readiness to adopt change in life will be taken before and after the intervention using psychological questionnaires. SPSS software package will be used to analyse the participants' responses and any effects inflicted by the intervention.

Gene expression profiling will be used to simultaneously compare the expression levels of several genes in response to the proposed intervention. This analysis will help to identify the molecular basis for phenotypic differences and select gene expression targets for in-depth study using other technologies.

Gene expression profiling will provide a valuable insight into the role of differential gene expression in response to the proposed intervention. Quantitative real-time RT-PCR (qPCR) is widely used as the most reliable method for quantifying gene transcript levels because of its sensitivity, accuracy and specificity. The proposed method will be used for validation of differential gene expression profiles. Different data analysis tools that transform raw data to informative results will be used for a comprehensive understanding of the biological significance of gene expression data.

Human genetic variation is present in many different forms in the genome. Polymorphisms have been classically identified as SNPs, MNP, indels and STRs. Gene deletion and gene duplication are genomic variations that can also affect protein function or a particular phenotype. Deletions and duplications in genes have been associated with phenotypic variation in obesity studies. This approach will also be exploited to identify the molecular basis of phenotypic differences in response to the proposed intervention.

Materials (detail all materials with references):

Materials required for the psychological part of the study will include 3 questionnaires, consent forms, participant information sheets with contact details for the researcher, both supervisors, the University counselling service and other local professionals providing psychological therapy or counselling. Statistics package (SPSS 20.0) will be used for the questionnaire data analysis.

Additionally, each participant will be taken measurements of weight, height and waist circumference before and after the Positive Psychology intervention.

Questionnaires:

The Change Questionnaire. The Change Questionnaire (Miller & Johnson, 2008) is a brief measure of motivation for change, using common dimensions of natural language (language that is used by clients to describe their own motivation). Each participant can choose which
particular change he/she would like to assess their motivation to adopt. It is a single scale measure consisting of 12 items. Each item is scored using 11-point Likert scale varying from 0 ("Definitely not") to 10 ("Definitely") indicating agreement with each statement. The higher the scores, the more motivated and ready is person to change.

PERMA. The PERMA Questionnaire (Seligman, 2011) is a measure of well-being used in the field of Positive Psychology. PERMA is an acronym that makes up five important building blocks of well-being and happiness: 1) Positive emotions, 2) Engagement, 3) Relationships, 4) Meaning, and 5) Accomplishment. It is proposed that subjective happiness and well-being can be increased by focusing on combinations of feeling good, living meaningfully, establishing supportive and friendly relationships, accomplishing goals, and being fully engaged with life. The PERMA Questionnaire is a 23-item measure with 5 basic dimensions of flourishing (subscales): positive emotions, engagement, relationships, meaning, and accomplishment. Further scores are achieved on negative affect, loneliness, health and overall well-being/happiness. Each question is scored using 11-point Likert scale varying from 0 ("Never/Not at all") to 10 ("Excellent/Cmpletely/Always").

BI-AAQ. The Body Image Acceptance and Action Questionnaire (BI-AAQ; Sandoz, Wilson, Merwin & Kellum, 2013) is proposed as a measure of body image flexibility, which is defined as a potential change process in acceptance-oriented treatments of disordered eating. Body image flexibility is associated with increased psychological flexibility, decreased body image dissatisfaction, and less disordered eating. The BI-AAQ is a single scale measure consisting of 12 items with the higher scores identifying lower body image flexibility. Each question is scored on a 7-point Likert scale varying from 1 to 7 identifying agreement with the statement ("Never true"/"Very seldom true"/"Seldom true"/"Sometimes true"/"Frequently true"/"Almost always true"/"Always true").

Materials for the molecular genetics and biochemical approaches (detail all materials with references):

Streamlined protocols for detecting the gene variants and mRNA expression levels of dopamine DRD4, oxytocin receptor OXTR, serotonin transporter 5-HTT, AMY1 and fat mass and obesity associated FTO genes in human saliva samples will be applied. The gene encoding β-actin (ACTB) will be used as a reference for sample normalization in determination of the mRNA level of genes of interest. An mRNA amplification strategy will be developed to amplify mRNA from nanogram scale followed by reverse transcription-PCR reaction, cleaned up enzymatically, and validated by quantitative Real-Time PCR. Further, the integrity of RNA will be analyzed by the Agilent Bioanalyzer and quantified using a Nanodrop microvolume spectrophotometer. Using these technical approaches, we will be able to identify variants and transcripts of genes of interest in saliva samples.

Methodology/Procedure (including number of participants, ways of recruitment, estimated times, methods used, etc.):

The investigator will seek 20 heavily overweight or obese students from the University of Bolton who would volunteer to participate in the study. They will be recruited via different routes which will include responding to leaflets, posters, or email. Students will be also approached in the beginning of their formal lectures with a permission of their lecturing tutor. They will be briefly explained the nature of the study and will receive an information about the first study meeting (i.e. time and location) and contact details for the researcher to confirm their presence. The meeting will then explain in more details what will be required from the participants, including the length of the study and all measurements that will need to be taken. Those participants who will agree to take part in the study will then receive the study information sheet and the consent form to sign which will clearly identify all terms and conditions of their participation. Contact details will be provided and any study-related
questions will be addressed in accordance to the BPS standard of protection of research participants. The estimated time for all paperwork completion is 30 – 40 minutes. That is at each time the paperwork is completed. The participants will need to complete the paperwork in specifically allocated times during the intervention. All data collected will be kept safely in locked files to ensure confidentiality of all participants. The saliva samples will be collected on a weekly basis, 12 times in total – 3 weeks before and after the intervention and 6 weeks during the intervention. Health and safety procedures will be strictly identified and followed during all laboratory tests.

Analysis:

Bivariate correlations will be used to assess the relationships between scores on the questionnaires. Number of t-tests and analyses of variance (ANOVA) will be used to assess the effect of the intervention on the participants' body flexibility (BI-AAQ), positive thoughts, happiness and well-being (PERMA) and weight. The target genes will be chosen according to the results of a recent GWAS and meta-analysis of GWAS, in which they were found to be significantly associated with different measures of obesity and wellbeing. For the trial experiment, the gene expression will be measured in saliva samples. Total RNA from the different tissues will be extracted using the RNeasy kit (Qiagen, Hilden, Germany) according to the manufacturer's instructions. A DNase digestion step will be included. For first-strand cDNA synthesis, 1 µg total RNA will be reverse transcribed with 1U MMLV Reverse Transcriptase, 1 µg Random Primer, 1 mM deoxynucleotide triphosphate mixture, 1 µl recombinant RNasin® ribonuclease inhibitor and transcription buffer with 5 mM MgCl2 in a final volume of 10 µl (all from Promega, Mannheim, Germany). The reaction mixture will be incubated at 37°C for 60 min, followed by heat inactivation of the enzyme at 95°C for 5 min. After cooling on ice for 5 min, the cDNA will be stored at −20°C until further use. Real-time RT-PCR detection of the target genes and beta-actin as housekeeping gene will be performed using the ABI Prism 7900 TaqMan (Applied Biosystems, Foster City; CA, USA). Primers and probes will be used according to the manufacturer's protocol (Applied Biosystems). The expression levels of the target mRNA will be normalized to ACTB using the DeltaCt method. Parallelism of amplification curves of the target and control will be confirmed.

References:


Section IV: Research Checklist

Please answer each question by ticking the appropriate box:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Will the study involve participants who are particularly vulnerable or who may be unable to give informed consent (e.g. children, people with learning disabilities, emotional difficulties, problems with understanding and/or communication, your own students)?</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited (e.g. students at school, members of self-help group, residents of nursing home)?</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Will deception be necessary, i.e. will participants take part without knowing the true purpose of the study or without their knowledge/consent at the time (e.g. covert observation of people in non-public places)?</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Will the study involve discussion of topics which the participants may find sensitive (e.g. sexual activity, own drug use)?</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Will drugs, placebos or other substances (e.g. food substances, alcohol, nicotine, vitamins) be administered to or ingested by participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Will blood or tissues samples be obtained from participants?</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Will pain or more than mild discomfort be likely to result from the study?</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Will the study involve prolonged or repetitive testing?</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Will participants’ right to withdraw from the study at any time be withheld or not made explicit?</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Will participants’ anonymity be compromised or their right to anonymity be withheld or information they give be identifiable as theirs?</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Might permission for the study need to be sought from the researcher’s or from participants’ employer?</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Will the study involve recruitment of patients or staff through the NHS?</td>
<td></td>
</tr>
</tbody>
</table>

If ALL items in the Declaration are ticked AND if you have answered NO to ALL questions in Section IV, send the completed and signed Form RE1 to your School/Centre Research Ethics Officer for information. You may proceed with the research but should follow any subsequent guidance or requests from the School/Centre Research Ethics Officer or your supervisor/module leader where appropriate. Undergraduate and taught postgraduate students should retain a copy of this form and submit it with their research report or dissertation (bound in at the beginning). MPhil/PhD students should submit a copy to the Board of Studies for Research Degrees with their application for Registration (R1). Work which is submitted without the appropriate ethics form will be returned unassessed.

If ANY of the items in the Declaration are not ticked AND / OR if you have answered YES to ANY of the questions in Section IV, you will need to describe more fully in Section V of the form below how you plan to deal with the ethical issues raised by your research. This does
not mean that you cannot do the research, only that your proposal will need to be approved by the School/Centre Research Ethics Officer or School/Centre Research Ethics Committee or Sub-committee. When submitting the form as described in the above paragraph you should substitute the original Section V with the version authorized by the School/Centre Research Ethics officer.

If you answered YES to question 14, you will also have to submit an application to the appropriate external health authority ethics committee, after you have received approval from the School/Centre Research Ethics Officer/Committee and, where appropriate, the University Research Ethics Committee.
Section V: Addressing Ethical Problems

If you have answered YES to any of questions 1-12 please complete below and submit the form to your School/Centre Research Ethics Officer.

<table>
<thead>
<tr>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principal Investigator/Researcher/Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jana Rozehnalova</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Jerome Carson</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summary of issues and action to be taken to address the ethics problem(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question 2</strong> – The study will not require the cooperation of a gatekeeper for initial access to the groups or individuals to be recruited. However, as student population is to be used for the pilot study, it may require cooperation of some lecturers, so that the students can be approached during their lessons.</td>
</tr>
<tr>
<td><strong>Question 2: Actions to be taken</strong> – The lecturers will be contacted via email where they will be explained the nature of the study. The researcher will ask for a permission to approach their students before or during one of their lectures.</td>
</tr>
<tr>
<td><strong>Question 6</strong> – As part of the study aims to identify particular genes that may play an important role in obesity development, the participants will need to be taken a saliva samples.</td>
</tr>
<tr>
<td><strong>Question 6: Actions to be taken</strong>: The analysis of the saliva samples will not reveal or be linked to the identity of any participant. Any participant information collected within this form will be kept confidential and stored securely at all times. All saliva samples collected from the participants shall be disposed of after analysis has been carried out within a maximum of 18 months.</td>
</tr>
<tr>
<td><strong>Question 8</strong> – Similarly as in case of Question 1, I do not think that participation in the study would cause a psychological stress or anxiety &quot;beyond the risks encountered in normal life&quot;. However, as already explained, individuals suffering with obesity or severe over weight issues may display increased sensitivity or emotional reactions.</td>
</tr>
<tr>
<td><strong>Question 8: Actions to be taken</strong> - If any concerns arise, the participants will be able to contact counselling services offered by the University of Bolton and will also receive contacts for other local psychotherapy and counselling services. The information sheet will also clearly explain the nature and structure of the study, so the participants will have clear picture of what they will be going through before they decide to give their consent. Having previously worked as a facilitator for eating disorders group therapy, the researcher would be able to ensure that the participants would not leave a group therapy session in any state of psychological discomfort.</td>
</tr>
<tr>
<td><strong>Question 9</strong> – The molecular genetics part of the study will require saliva sample to be obtain from the participants on a weekly basis. In order to control for other variables that may induce some response or transformation in the examined genes, the saliva will need to be collected every week for 3 weeks before the intervention begins, 6 weeks during and 3 weeks after the intervention. They will also be asked to fill in a set of questionnaires at the beginning and in the end of the intervention. Weight and height measurements will be taken prior and after the intervention.</td>
</tr>
<tr>
<td><strong>Question 9: Actions to be taken</strong> - The information sheet will clearly explain the nature and structure of the study, so the participants will have clear picture of what they will be going through before they decide to give their consent. They will be informed what measurements</td>
</tr>
</tbody>
</table>
will be taken and how often. It will also be clearly stated that the intervention will not involve any form of dieting, physical activity or nutritional advice and that it will not tackle the weight issue at all. Weight will be observed clearly as a by-product of the intervention.

**Question 12** – As part of the study is genetic assessment, the anonymity of the participants will have to be compromised. The saliva samples will need to be clearly labelled to ensure that their genetic information is not assigned to someone else.

**Question 12: Actions to be taken:** As already explained in the answer to Question 6, the analysis of the saliva samples will not reveal or be linked to the identity of any participant. Any participant information collected within this form will be kept confidential and stored securely at all times. All saliva samples collected from the participants shall be disposed of after analysis has been carried out within a maximum of 18 months.

Please note that it is your responsibility to follow the University's Code of Practice on Ethical Standards and any relevant academic or professional guidelines in the conduct of your study. This includes providing appropriate information sheets and consent forms, and ensuring confidentiality in the storage and use of data. Any significant change to the design or conduct of the research should be notified to the School/Centre Research Ethics Officer and may require a new application for ethics approval.

Signed: [Signature] Principal Investigator/Researcher

Approved: [Signature] Supervisor or module leader

(where appropriate)

Date: [Signature] 16/6/2016

For use by School/Centre Research Ethics Officer:

- No ethical problems are raised by this proposed study
- Appropriate action taken to maintain ethical standards
- The research protocol should be revised to eliminate the ethical concerns or reduce them to an acceptable level, using the attached suggestions
- Please submit School/Centre Application for Ethics Approval (Form RE2(D))
- Please submit University Application for Ethics Approval (Form RE2(U))

Signed: [Signature] Date: [Signature] 17/6/2016

Retain this form on record and return a copy of section V to Researcher

L:\AQASI\Common\Research\Research Ethics\Research Ethics Checklist Form RE1.doc
RISK ASSESSMENT FORM FOR POSTGRADUATE
PSYCHOLOGY PROJECTS

Please check the following and then fill in Part A or Part B as appropriate, in conjunction with your supervisor. When complete and signed by both parties, staple it to the Ethics Form and submit for approval.

I will be collecting my data at the following sites: University of Bolton

I have considered the following when collecting my data if I am collecting outside of the University.

Consideration of local crime rates, and social and political factors
Consultation with police, social workers etc. as necessary
Visit in pairs, or with a companion within earshot – especially if collecting in a public area such as town square
Security locks on vehicles
Anti-theft devices and alarms – on your vehicle
Personal alarm or something to let someone know you need help immediately, i.e., whistle etc.
Letting someone know exactly WHERE you will be at WHAT time and when you plan on returning.
NEVER giving out personal details – ALWAYS use your university email address

Be SMART DON’T TAKE RISKS OF ANY KIND!

PART A.

There are no significant Health and Safety risks associated with this project.

Signed: 
Supervisor: 
Date: 16/6/2016

PART B.

The project is one which requires extra care as specified below (continue overleaf or staple further sheets if needed)

Hazard(s) identified: 

Estimate of likelihood of each identified hazard: 

Risks involved with the project: 

Procedures for reducing risks to the lowest possible level: 

Signed: 
Supervisor: 
Date: 
Participant Information Sheet

Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.

My name is Jana Rozehnalova I am a first year PhD student at the University of Bolton currently working on my thesis. The focus of this study is to develop an alternative approach to obesity intervention combining research in Positive Psychology and molecular genetics. Positive Psychology does not attempt to “fix” what is wrong with a person, but to help people identify and develop their strengths and focus on positive aspects of their life, in order to achieve their full potential. It is proposed that intentional activities aimed at cultivating positive feelings, positive behaviours, or positive cognitions could stimulate a change in particular genes that contribute to obesity development and maintenance. Such change in molecular genetics could then potentially initiate weight loss and improve the participants’ physical, mental, behavioural and social aspects of life.

What does the participation require?

If you agree to take part in the study, you will be asked to actively participate and engage in a 6 week Positive Psychology program. The program will consist of online intervention (positive messages received via email every day) with self-help exercises (designed to reinforce those positive messages), and a weekly group therapy sessions (6 in total). You will be asked to fill in a set of 3 questionnaires and a demographic information sheet at the beginning and end of the study. This will take approximately 30 – 40 minutes. Each group therapy session will last for 60 minutes. All electronic materials will be available online on the study website for you to access at any time. In order to assess the effects of the intervention, your weight, height and waist circumference measurements will be taken before and after the intervention.

This project involves determination of genetic variants and mRNA expression levels of the DOPAMINE DRD4, OXYTOCIN RECEPTOR OXTR, SEROTONIN TRANSPORTER 5-HTT and FAT MASS AND OBESITY ASSOCIATED FTO genes in human saliva samples.

The gene encoding B-ACTIN (ACTB) will be used as a reference for sample normalization in determination of the mRNA level of the four genes of interest.

In order to perform the DNA analyses, you will be asked to give a saliva sample on a weekly basis 3 weeks before and after the intervention and 6 weeks during the intervention - 12 times in total.

What does the participation NOT require?

You will not be asked to engage in any sort of dieting, nutrition monitoring or physical activity other than your normal routine. You will not be asked to take any measurements other than specified above.

Do I have to take part?

Participation in this study is completely voluntary. You can withdraw from the study without giving a reason up until session 6. If you do not want to take part, you do not have to justify your reasons and no pressure will be placed on you to change your mind. Please note, if you choose not to participate, or withdraw during the study this will not affect your studies or personal life in any way. Once you have completed the paperwork and signed the consent form, your data will be analysed. Your anonymity will be maintained at all times.

Confidentiality.

All the information provided by you will be confidential and used for the purposes of this study only. Any participant information collected within this form will be kept confidential and stored securely at all
times in accordance with the Data Protection Act 1998 and will be disposed of in a secure manner. All saliva samples collected from the participants shall be disposed of after analysis has been carried

out within a maximum of 18 months. The analysis of the saliva samples will not reveal or be linked to the identity of any participant.

Before agreeing to take part in the study, please make sure that you have understood all the information given on this sheet and do not hesitate to ask if you are not sure about anything. If you agree to take part in the study, sign the consent form.

If, at any time you wish to receive more information about the study, you can contact the investigator or a one of the project supervisors:

Contact details for the investigator: member:

Name: Jana Rozehnalova
Course/position: PhD, Psychology
Email: jr2wss@bolton.ac.uk
Contact mobile: 07413174831

Contact details for the supervising staff

Name: Professor Jerome Carson
Position: Project supervisor (Psychology)
Email: J.Carson@bolton.ac.uk
Contact telephone: 01204 903 228

Name: Dr Ianis Matsoukas
Position: Secondary supervisor (Molecular genetics)
Email: I.Matsoukas@bolton.ac.uk

For further help contact the following organization(s):

Mental health Independent Support Team (MhiST)
www.mhist.co.uk
help@mhist.co.uk
Phone: 01204 527200

University of Bolton Counselling Services
http://www.bolton.ac.uk/Students/AdviceAndSupport/Counselling/Home.aspx
Student services appointment booking: 01204 903733

The Lyme Trust – Registered Charity, Newcastle –under-Lyme
http://www.thelymetrust.co.uk/
http://www.charitychoice.co.uk/8he-lyme-8trust-237519
Phone: 07988582530

Manchester Centre for CBT
http://www.cbt-centre.co.uk/index.html
info@cbt-centre.co.uk
Phone: 0845 052 3949 (Reception)

Dr Styliani Gkika
BABCP Accredited CBT Therapist

Manchester Mental Health and Social Care Trust NHS
http://www.mhsc.nhs.uk/services/psychological-services/psychotherapy-service.aspx
RESEARCH ETHICS: CONSENT FORM

Positive Psychology as obesity intervention: An investigation into obesity, molecular genetics and happiness.

Information about the researcher:

Name: Jana Rozehnalova
Course/position: PhD Psychology – 1st year
Address: University of Bolton, School of Education and Psychology, Deane Road, Bolton, BL3 5AB

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.

2. I understand that the study requires active participation in the Positive Psychology program for 6 weeks. I agree to actively take part to the best of my abilities.

3. I understand and agree to give a saliva sample for the DNA testing every week for 3 weeks before and after the intervention and 6 weeks during the intervention (12 samples in total).

4. I am aware that any findings from the samples collected will not be linked to my name or reveal my identity. Any details I provide on this form will be stored securely and all information will be kept in strictest confidence.

5. I am further aware that any samples that shall be collected are solely for research purposes. After this purpose is met, the samples will be disposed away as per the protocol.

6. I agree to give up a maximum of 30 minutes of my time for the named researchers above to collect the samples needed for this research.

7. I agree to participate by providing saliva samples before and after a visual stimuli for the purpose of the named research project.

8. I understand that I should not participate in this research if I have a serious infectious disease (such as HIV or Hepatitis). As far as I am aware I currently do not have any serious infectious diseases.

9. I understand and agree to fill in the paperwork specified in the participant information sheet at the beginning and end of the intervention, and any other time if the study design requires it.

10. I understand and agree to have height, weight and waist circumference measurements taken at the beginning and end of the intervention.

Please Initial Box
11. □ I understand that my participation is voluntary and that I am free to withdraw at any time until session 6 without giving any reason.

12. I agree with publication of the results of this study in a research journal. I understand that I will not be identified in these publications.

13. □ I accept all the conditions described above and agree to take part in the above study.

_________________________  ____________________  ____________________
Name of Participant           Date                  Signature

_________________________  ____________________  ____________________
Name of Researcher            Date                  Signature

Statement by researcher(s)
I have provided information about the research to the research participant and believe that he/she understands what is involved.

Researcher's signature

Date

Researcher's signature

Date

Researcher's signature  Dr Ianis G. Matsoukas

Date
Demographic Information Sheet

Please read the following questions and tick the box next to the answer that applies to you. For example if you are female tick ☐ Female.

1. What is your gender?
   ☐ Male
   ☐ Female

2. How old are you? ______

3. What is your ethnicity?
   ☐ White British
   ☐ White Other
   ☐ Mixed/Multiple ethnic groups
   ☐ Black/African/Caribbean/Black British
   ☐ Asian/Asian British
   ☐ Other

4. Are you a British national?
   ☐ Yes
   ☐ No

5. If not, how long have you lived in the UK?
   ☐ Less than 1 year
   ☐ 1 – 5 years
   ☐ 5 – 10 years
   ☐ 10 – 15 years
   ☐ 15 – 20 years
   ☐ Over 20 years

6. What is your current marital status?
   ☐ Married or Registered partnership
   ☐ Widowed
   ☐ Divorced
   ☐ In a relationship
   ☐ Single
   ☐ Separated

7. Do you have children?
   ☐ Yes
   ☐ No
8. What is the highest degree or level of school you have completed? (If currently enrolled, please give the highest degree completed.)

☐ Some high school/college or less (e.g. GCSE, 0-Level, Standards)
☐ Completed high school/college (e.g. A, AS, S-Levles, Highers)
☐ Some University undergraduate (e.g. University examinations but not completed degree)
☐ Completed University undergraduate degree (e.g. BSc, BA)
☐ Post graduate education (e.g. PhD, MSc, MA)
☐ Trade/technical/vocational training (e.g. HNC, HND, NVQ)

9. What is your current employment status?

☐ Employed for wages
☐ Self-employed
☐ Out of work and looking for work
☐ Out of work but not currently looking for work
☐ A homemaker
☐ A student
☐ Military
☐ Retired
☐ Unable to work
PERMA Scale of Authentic Happiness

Please read each of the following questions and then circle the point on the scale that you feel best describes you. All questions must be completed for this questionnaire to be scored.

1. In general, to what extent do you lead a purposeful and meaningful life?
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

2. How much of the time do you feel you are making progress towards accomplishing your goals?
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

3. How often do you become absorbed in what you are doing?
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

4. In general, how would you say your health is?
   Terrible 0 1 2 3 4 5 6 7 8 9 10 Excellent

5. In general, how often do you feel joyful?
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

6. To what extent do you receive help and support from others when you need it?
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

7. In general, how often do you feel anxious?
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

8. How often do you achieve the important goals you have set for yourself?
   Never 0 1 2 3 4 5 6 7 8 9 10 Always

9. In general, to what extent do you feel that what you do in your life is valuable and worthwhile?
   Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely
10. In general, how often do you feel positive?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

11. In general, to what extent do you feel excited and interested in things?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

12. How lonely do you feel in your daily life?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

13. How satisfied are you with your current physical health?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

14. In general, how often do you feel angry?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

15. To what extent have you been feeling loved?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

16. How often are you able to handle your responsibilities?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

17. To what extent do you generally feel you have a sense of direction in your life?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

18. Compared to others of your same age and sex, how is your health?
Terrible 0 1 2 3 4 5 6 7 8 9 10 Excellent

19. How satisfied are you with your personal relationships?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

20. In general, how often do you feel sad?
Never 0 1 2 3 4 5 6 7 8 9 10 Always
21. How often do you lose track of time while doing something you enjoy?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

22. In general, to what extent do you feel contented?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

23. Taking all things together, how happy would you say you are?
Not at all 0 1 2 3 4 5 6 7 8 9 10 Completely

Copyright 2013 University of Pennsylvania.
Change Questionnaire Version 1.2  
(Miller & Johnson, 2008)

What is the change that you are considering? Write it here:  

to

Now answer each of the following questions about this change that you are considering. Wherever you see the words "make this change," think of the change that you have written above, and then circle the one number that best describes where you are right now. For example, if you had written “get a job” on the line above, then for item 1 (I want to make this change) you would indicate how much you want to get a job.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I want to make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I could make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>There are good reasons for me to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I have to make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I intend to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I am trying to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I hope to make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I can make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>It is important for me to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I need to make this change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I am going to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I am doing things to make this change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May be</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Definitely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Body Image Acceptance and Actions Questionnaire
BI-AAQ (Sandoz, Wilson, Mervin & Kellum, 2013)

Directions: Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to make your choices. For instance, if you believe a statement is 'Always True,' you would write a 7 next to that statement.

<table>
<thead>
<tr>
<th>Never true</th>
<th>Very seldom true</th>
<th>Seldom true</th>
<th>Sometimes true</th>
<th>Frequently true</th>
<th>Almost always true</th>
<th>Always true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

1. Worrying about my weight makes it difficult for me to live a life that I value.
2. I care too much about my weight and body shape.
3. I shut down when I feel bad about my body shape or weight.
4. My thoughts and feelings about my body weight and shape must change before I can take important steps in my life.
5. Worrying about my body takes up too much of my time.
6. If I start to feel fat, I try to think about something else.
7. Before I can make any serious plans, I have to feel better about my body.
8. I will have better control over my life if I can control my negative thoughts about my body.
9. To control my life, I need to control my weight.
11. When I start thinking about the size and shape of my body, it's hard to do anything else.
12. My relationships would be better if my body weight and/or shape did not bother me.
Methodology/Procedure (including number of participants, ways of recruitment, estimated times, methods used, etc.):

In addition to recruiting student participants, the researcher will invite members of staff to take part in the study. Those members of staff who have already expressed their interest in the study during the student recruitment, will be approached in person. They will have an opportunity to approach their colleagues to join the study if they wished to do so. The study leaflets will be left in different departments giving the staff an opportunity to contact the researcher if they wanted to take part in the study. Some members of staff will be approached via email after obtaining a permission from the Head of the Department. (See the wording of the email attached.) It will be made clear that participation in the study is completely voluntary and that it will not affect the working duties of the members of staff in any way.

M. Lorne
13/10/16
Dear Staff,

The new academic year always brings many new and exciting opportunities for all students, but the members of staff are usually just left with a lot of work. This time, we are offering an opportunity to all staff members to join a fascinating study, which may enhance their physical and emotional well-being, reduce negative thoughts and emotions, and increase happiness and life satisfaction! This is an exciting opportunity to participate in a unique study conducted as a part of a PhD project carried out by Jana Rozehnalova, a Psychology PhD student at the University of Bolton.

Have you ever wondered how is it possible that some people gain weight from just breathing air and looking at food, whereas other can eat bacon, pasties, crisps, chocolate and drink sugary drinks without adding a single pound on? Well, belonging to the first group myself, I have. There is a great chance that individual genetics play a significant role in this issue. However, according to a recent debate in molecular genetics it may be possible to change or influence expression of some genes by an external stimuli. Genes and environments work together to influence behaviour, and their influences can and do change over time or depending upon circumstances. According to this view, our genetic predispositions to be of certain body weight and shape may be influenced by the environment. What if our mind set and ability to perceive the world around us, has the power to change our genetic predispositions for certain BMI?

This research is a first ever to combine Positive Psychology with the most recent findings in molecular genetics approaching the worldwide health problem of obesity. Using Positive Psychology as an external stimuli, this research aims to identify any potential interaction between genes involved in happiness and genes involved in human obesity. Being one of a kind in its nature, this research may result in an innovative approach to weight management. Participation in this study may be a great opportunity to be part of this innovation...

If you would be interested in joining our research, please contact the main researcher, myself, for more information. Alternatively, you may also contact the research supervisors, Professor Jerome Carson (J.Carson@bolton.ac.uk) or Dr Ianis Matsoukas (I.Matsoukas@bolton.ac.uk).

We will be happy to answer any questions related to the research!

Thank you for your time!

Kind regards.

Jana

---

Jana Rozehnalova

PhD candidate

School of Education and Psychology, University of Bolton

Email: jr2wss@bolton.ac.uk

[Signature]

13/10/16
Materials (detail all materials with references):

Second pilot study will be carried out with two additional measures: GAD7 (Generalised Anxiety Disorder – 7 item scale), and PHQ9 (Patient health Questionnaire – 9 item scale). The mental health of university students is an area of increasing concern worldwide (Bayram & Bilgel, 2008). Evidence suggests that university students are vulnerable to mental health problems, especially depression and anxiety (Nerdrum, Rustøen, Rønnestad, 2006; Stanley & Manthorpe, 2001; Stewart-Brown, Evans, Patterson et al., 2000). Positive Psychology has been successfully applied to a number of mental health problems, including depression and anxiety (e.g. Layous & Lyubomirsky, 2014; Sin & Lyubomirsky, 2009). Therefore, it is believed that it would be beneficial to assess the effects of the positive psychology intervention on the students’ mental health. The GAD7 and PHQ9 were selected as appropriate tools to assess any clinical changes on the student’s depression and anxiety levels.

Questionnaires:

GAD7. The participants’ anxiety levels will be measured using the generalized anxiety disorder seven-item scale (GAD7), a tool validated in 2,740 primary care patients (Spitzer, Kroenke, Williams et al., 2006). The GAD7 has good sensitivity and specificity for a range of anxiety disorders: panic disorder (S=0.74, Sp=0.81), social anxiety disorder (S=0.72, Sp=0.82), generalized anxiety disorder (S=0.89, Sp=0.82) and post-traumatic stress disorder (S=0.66, Sp=0.91) (Kroenke, Spitzer, Williams, et al., 2007). The seven items on the GAD7 are each scored between 0 and 3 and summed to generate a total score (range 0–21). The GAD7 severity cut points are 5 for mild, 10 for moderate, and 15 for severe anxiety.

PHQ9. The participants’ depressive symptoms will be assessed using the Patient Health Questionnaire-9 (PHQ9), a nine item scale with each item scored 0 to 3 and summed to yield a total score (range 0–27) (Kroenke, Spitzer & Williams, 2001). PHQ9 severity cut-point scores are 5 for mild, 10 for moderate, 15 for moderately severe and 20 for severe depressive symptoms. The PHQ9 has been validated in bariatric surgery patient populations and has been shown to have good sensitivity and specificity when compared to structured clinical interview (Cassin, Sockalingam, Hawa et al., 2013).

References


Methodology/Procedure (including number of participants, ways of recruitment, estimated times, methods used, etc.): To increase the total number of participants in the 6-week PPI, a second pilot study will be conducted and the data will be added to the first pilot study. Identical 6-week intervention will be delivered to 1st year Psychology, Psychotherapy and Counselling students after obtaining permission from the Head of School, the pathway leader and the lecturing tutors. The students will undertake the intervention as a part of their “Introduction to counseling concepts” module. It is believed that by being in a therapy themselves, the student’s will be more likely to understand the process of therapy and they will have an opportunity to observe a therapist in practice. Even though, they will need to attend the 6 week program in order to complete the module requirements, they will be able to decide whether they wish to take part in the study itself and submit their data, or not. It will be made clear that participation in the study and submission of their data is completely voluntary and that it will not affect their studies or marks in any way. Participants’ weight and height will be taken privately in a small assessment room in Bolton One before and after the intervention. To ensure maximum privacy and comfort, each participant will be assigned a 15 minute time slot during which their measurements will be taken and they will complete the psychological questionnaires.
Generalized Anxiety Disorder 7-item (GAD-7) scale

<table>
<thead>
<tr>
<th>Over the last 2 weeks, how often have you been bothered by the following problems?</th>
<th>Not at all sure</th>
<th>Several days</th>
<th>Over half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feeling nervous, anxious, or on edge</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Not being able to stop or control worrying</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Worrying too much about different things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Trouble relaxing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Being so restless that it's hard to sit still</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Becoming easily annoyed or irritable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Feeling afraid as if something awful might happen</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

*Add the score for each column + + + +*

**Total Score (add your column scores) =**

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

- Not difficult at all
- Somewhat difficult
- Very difficult
- Extremely difficult

PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

NAME: ____________________________ DATE: ____________________________

Over the last 2 weeks, how often have you been bothered by any of the following problems?
(use “✓” to indicate your answer)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Not at all</th>
<th>Several days</th>
<th>More than half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Feeling down, depressed, or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Trouble falling or staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Moving or speaking so slowly that other people could have noticed. Or the opposite — being so figety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Thoughts that you would be better off dead, or of hurting yourself</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(add columns)

(total)

(Healthcare professional: For interpretation of TOTAL, please refer to accompanying scoring card.)

10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

- Not difficult at all
- Somewhat difficult
- Very difficult
- Extremely difficult

Copyright © 1999 Pfizer Inc. All rights reserved. Reproduced with permission. PRIME-MD® is a trademark of Pfizer Inc.

A2663B 10-04-2005
Materials (detail all materials with references):

The main study will be carried out with one additional measure – Revisited UCLA Loneliness Scale (R-UCLA; Russell, Peplau & Cutrona, 1980). Loneliness can have detrimental effect on health and well-being in a number of ways (Qeen, Stawski, Ryan & Smith, 2014). For example, loneliness has been shown to predict increases in depressive symptoms (Cacioppo, Hawkley, & Thisted, 2010) and has been associated with higher levels of distressed affect (Steptoe, Leigh, & Kumari, 2011), and poor health behaviours (Lauder, Mummery, Jones & Capernom, 2006; Shankar, McMunn, Banks, & Steptoe, 2011). As a complex trait, loneliness is likely to be influenced by the interplay of numerous genetic and environmental factors (Gossens, van Roekel, Verhagen et al., 2015). Studies in behavioural genetics (e.g. Boomsma, Willemsen, Dolan, Hawkley, & Cacioppo, 2005; McGuire & Clifford, 2000; Waaktaar & Torgersen, 2012) indicate that loneliness has a sizable degree of heritability. However, research on gene-environment interactions indicates that social-environmental factors (e.g., low social support) may have a more pronounced effect and lead to higher levels of loneliness if individuals carry the sensitive variant of loneliness candidate genes (Collier, Stober, Li et al., 1996). On the other hand, these factors may be supressed if an individual is exposed to a different environmental stimuli that promotes positivity, health, bonding etc. Positive psychological stimuli have been shown to produce changes on a molecular genetic level with differences in responsiveness to the stimuli depending on individual genotype (Beeveres, Marti, Lee et al., 2011). From this perspective, a positive psychological intervention may serve as an effective tool to address loneliness in genetically predisposed individuals, and thus also help treat related depressive symptoms. To assess the effectiveness of the current positive psychological intervention on loneliness, the following measure will be used in addition to previously approved scales:

Questionnaire:

R - UCLA. The Revisited UCLA Loneliness Scale is a 20-item scale unidimensional measure designed to assess one’s subjective feelings of loneliness as well as feelings of social isolation. Participants rate each item on a four point scale from 1 (“Never”) to 4 (“Often”) with 10 items (1, 4, 5, 6, 9, 10, 15, 16, 19, 20) reverse scored. This measure is a revised version of the original UCLA Loneliness Scale (Russell, Peplau & Ferguson, 1978), which did not have any reverse scored items. The measure has high internal consistency (coefficient alpha = .94) and a test-retest correlation over a two-month period of .73. Concurrent validity is indicated by correlations with measures of related emotional states: significantly correlated with scores on the Beck Depression Inventory (r = .62) and with the Costello-Comrey Anxiety (r = .32) and Depression (r = .55) scales. Loneliness scores were also significantly correlated (all rs, above .40) with feeling abandoned, depressed, empty, hopeless, isolated, and self-enclosed and with not feeling sociable or satisfied.

References


## REVISED UCLA LONELINESS SCALE
(Russell, Peplau & Cutrona, 1980)

INSTRUCTIONS: Indicate how often each of the statements below is descriptive of you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel in tune with the people around me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I lack companionship.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. There is no one I can turn to.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I do not feel alone.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel part of a group of friends.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. I have a lot in common with the people around me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I am no longer close to anyone.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. My interests and ideas are not shared by those around me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I am an outgoing person.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. There are people I feel close to.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I feel left out.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. My social relationships are superficial.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. No one really knows me well.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I feel isolated from others.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I can find companionship when I want it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. There are people who really understand me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. I am unhappy being so withdrawn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. People are around me but not with me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. There are people I can talk to.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. There are people I can turn to.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Additional measures added to the main study via chain's action.

12/1/18
Appendix J.

Additional Self-report Measures Used to Conduct Psychological Assessment Before and After the Intervention in the Second Pilot Study and the RCT: GAD7 and PHQ9

Generalized Anxiety Disorder 7-item (GAD-7) scale

<table>
<thead>
<tr>
<th>Over the last 2 weeks, how often have you been bothered by the following problems?</th>
<th>Not at all sure</th>
<th>Several days</th>
<th>Over half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feeling nervous, anxious, or on edge</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Not being able to stop or control worrying</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Worrying too much about different things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Trouble relaxing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Being so restless that it's hard to sit still</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Becoming easily annoyed or irritable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Feeling afraid as if something awful might happen</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Add the score for each column

<table>
<thead>
<tr>
<th></th>
<th>+</th>
<th>+</th>
<th>+</th>
</tr>
</thead>
</table>

Total Score (add your column scores) =

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all ___________
Somewhat difficult ___________
Very difficult _______________
Extremely difficult __________

### PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

**NAME:** ___________________________  **DATE:** ___________________________

Over the last 2 weeks, how often have you been bothered by any of the following problems?

*Use "X" to indicate your answer*

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Several days</th>
<th>More than half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Feeling down, depressed, or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Trouble falling or staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Moving or speaking so slowly that other people could have noticed. Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Thoughts that you would be better off dead, or of hurting yourself</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(add columns

---

**TOTAL:**

---

**10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?**

- Not difficult at all
- Somewhat difficult
- Very difficult
- Extremely difficult
Appendix K.

PPI Email Notifications Sent to the Participants in Pilot Study II., and the RCT

Week 1, Gratitude – Wednesday

Good morning to you all,

Welcome to a bright new day! Today, we are beginning the first week of the Positive Psychology program which will be devoted to Gratitude. This is just a quick reminder for you to log in to your Moodle accounts and view the presentation for today. It is under "Week 1 - Gratitude" which is at the very bottom of the Introduction to Counselling Concepts module.

There is a music background which is supposed to play at a low volume across the slides but it might need an individual setting on your computer. If it's too much fussing around, just ignore it and enjoy the presentation for today. :o)

For those of you who were not present in the introductory session yesterday, you will be undertaking the positive psychology program in your afternoon workshops for the next six weeks and it will form a part of the module assessment. It is a unique opportunity for you to develop your counselling skills and self-awareness in practical real-life group sessions, which are carried out in the safe classroom environment. The program consists of an online part - thee PowerPoint presentations a week, and a group session (every Tuesday during the times of the workshops in your timetables). You will receive the PowerPoints every Wednesday, Friday and Monday, and all you need to do is view the presentations and complete an exercise that is explained in the end. The group session will contain additional material on the topic and we will also review your experiences with the online part of the program. It is important for you to attend all sessions and actively participate in the program. If you have any questions, please do not hesitate to contact me.

Have a nice week and I will see you all next Tuesday.

Jana
Week 1, Gratitude – Friday

I wish you all a beautiful morning!

I'm sure you all are ready for a well-deserved week-end but before then I have another short presentation for you. This is just a quick notification for you to log in to your Moodle account and view the presentation for Friday under the "Week 1 - Gratitude" section in the Positive Psychology Intervention module.

I wish you all a productive day and a lovely week-end!

Jana

Week 1, Gratitude – Monday

Good morning everyone!

Welcome to a new beautiful day! I hope you've had some rest and that you are ready for another week. Whether you like Mondays or not, it is always good to start a new day and week with Gratitude. So, this is just a quick reminder for you to log in to your Moodle account and view the presentation for today - you will find it under "Week 1 - Gratitude".

There is a music background which is supposed to play at a low volume across the slides but it may need to be individually set up on your computers. If that's too much fussing around, just ignore it, please!

Enjoy the message for today!

I look forward to our first group session tomorrow.

Have a good day and the most productive week.

Jana
Week 1, Gratitude – Tuesday group session

Good morning everyone,

Today we are going to conclude the first week of the positive psychology program, which was devoted to Gratitude. I look forward to seeing you all this afternoon - we will be in T2-26 from 2:00 - 3:30. However, if you have any questions, I will be in the room from about 1:15. You can also come earlier, if you were not in last week and would like some more information about what we will be doing for the next 6 weeks.

Please, remember to have your lunch before 1:30, if possible, for the sake of the sample collection...

Thank you all for your work.

I will see you later.

Regards.

Jana

Week 2, Mindfulness – Wednesday

Good morning to you all,

Welcome to this beautiful bright new day! First of all, I would like to thank you all for your contribution to the group session yesterday. It would not be the same without it...

Today, we are beginning the second week of the Positive Psychology Program which will be devoted to Mindfulness and this is just a quick reminder for you to log in to you Moodle accounts and view the presentation for today. It is under "Week 2 - Mindfulness" in the Positive Psychology Intervention module.

Have a great day!

Jana

Week 2, Mindfulness – Friday

Hello everyone,

I wish you all beautiful morning! I hope you have had a productive week and I'm sure you are looking forward to getting some rest over the week-end. But before your mind wonders off...
APPENDICES

completely, let me "feed you" with some more mindfulness. As usually, I have another short presentation for you and this is just a quick notification for you to log in to your Moodle account and view the presentation for Friday under the "Week 2 - Mindfulness" section in the Positive Psychology Intervention module.

Have a great day and the most beautiful week-end!

Jana

Week 2, Mindfulness – Monday

Good morning everyone!

Welcome to a new beautiful day! I hope you've had some rest and that you are ready for another week. Whether you like Mondays or not, it is always good to start a new day and week mindfully. So, this is just a quick reminder for you to log in to your Moodle account and view the presentation for today - you will find it under "Week 2 - Mindfulness". There is a music background which is supposed to play at a low volume across the slides but it may need to be individually set up on your computers. If that's too much fussing around, just ignore it, please!

Enjoy the message for today!

I look forward to our group session tomorrow.

Have a good day and the most productive week.

Jana

Week 2, Mindfulness – Tuesday group session

Good morning everyone,

Today we are going to conclude the second week of the positive psychology program, which was devoted to Mindfulness. I look forward to seeing you all this afternoon - we will be in T2-26 from 2:00 - 3:30, as usually.

Please, remember to have your lunch before 1:30, if possible, for the sake of the sample collection...

Thank you all for your work.

I will see you later.

Regards.
Good morning to you all,

Welcome to this beautiful bright new day! First of all, I would like to thank you all for your contribution to the group session yesterday. It would not be the same without it...

Today, we are beginning the third week of the Positive psychology program which will be devoted to one of the most important topics of these days - Self-compassion. We've been taught to care for others but how much do we really care for ourselves? That's a question we will be addressing for the next week and this is just a quick reminder for you to log in to you Moodle accounts and view the presentation for today. It is under "Week 3 - Self-compassion" in the Positive Psychology Intervention module.

There is a music background which is supposed to play at a low volume across the slides but it may need to be individually set up on your computers. If that's too much messing around, just ignore it, please, and enjoy the message for today!

Have a great day!

Jana

Good morning everyone!

Welcome to a new bright - and cold - day. I hope you have had a fruitful week and that you have been appreciating yourselves properly. Today, is another day to spend with compassion and self-compassion and as usually I have a short presentation ready for you - please, log in to your Moodle accounts to view it. It is under the "Week 3 - Self-compassion" section in the Positive Psychology Intervention module.

I wish you all a wonderful week-end fill with gratitude, mindfulness and compassion! Enjoy the message for today.

Jana
Week 3, Self-compassion – Monday

Good morning everyone,

Welcome to a new beautiful day! I hope you've had a nice and compassionate weekend full of rest, and that you are ready for another week. Today, is another day to spend with Self-compassion and this is just a quick reminder for you to log in to your Moodle account and view the presentation for today - you will find it under "Week 3 - Self-compassion". Enjoy the message for today!

I look forward to our group session tomorrow.

Have a good day and the most productive week.

Jana

Week 3, Self-compassion – Tuesday group session

Good morning everyone,

I hope you have all started the day with great compassion for yourselves because today we are going to conclude the third week of the positive psychology program which, as you all know, was devoted to Self-compassion. We will have our afternoon session in T2-26 from 2:00 till 3:30 pm, as usually.

I look forward to seeing you all this afternoon!
Thank you all for your work.

Regards.

Jana

Week 4, Strengths – Wednesday

Good morning to you all,

Welcome to this beautiful bright new day! First of all, I would like to thank you all for your contribution to the group session yesterday. There were some very valuable interactions and you all have my great respect.

Today, we are beginning the fourth week of the Positive psychology program which will be devoted to Strengths. We tend to know an awful lot about our weaknesses but how much do we cultivate our strengths is a real question. We will be focusing on strengths for the next week, so this is just a quick reminder for you to log in to you Moodle accounts and view the first
APPENDICES

presentation for today. It is under "Week 4 - Strengths" in the Positive Psychology Intervention module.

Have a great day!

Jana

Week 4, Strengths – Friday

Good morning everyone!

Welcome to a new bright - and veeeery cold - day. I hope you have had a fruitful week applying your strengths whenever you could... Today, is another day to focus on your strengths and as usually I have a short presentation ready for you - please, log in to your Moodle accounts to view it. It is under the "Week 4 - Strengths” section in the Positive Psychology Intervention module.

Let's finish the week strong and make this day count!

I wish you all a wonderful week-end!

Enjoy the message for today.

Jana

Week 4, Strengths – Monday

Good morning everyone!

Welcome to a new beautiful day! I hope you've had some rest and that you are ready for another week. Today, I have a last presentation on Strengths for you and this is just a quick reminder for you to log in to your Moodle account and view it - you will find it under "Week 4 - Strengths".

There is a music background which is supposed to play at a low volume across the slides but it may need to be individually set up on your computers. If that's too much fussing around, just ignore it, please!

Enjoy the message for today!
I look forward to our group session tomorrow.
Have a good day and the most productive week.

Jana

**Week 4, Strengths – Tuesday group session**

Good morning everyone,

It seems that the White Christmas have come with a two month delay... I hope you all managed to get to the university safely because today we are going to conclude the fourth week of the positive psychology program which was devoted to strengths, and you sure don’t want to miss this one. I look forward to seeing you all this afternoon - we will be in T2-26 from 2:00 - 3:30, as usually.

Please, remember to have your lunch before 1:30, if possible, for the sake of the sample collection...

Thank you all for your work!

I will see you later.

Regards.

Jana

**Week 5, Hope – Wednesday**

Good morning to you all,

Welcome to this beautiful bright new day! First of all, I would like to thank you all for your contribution to the group session yesterday. Once again there were some very valuable interactions and I am grateful for every single one of you and your unique input into this program. I uploaded the PowerPoint from yesterday on Moodle, so you should be able to access it and follow the links for the VIA Strengths test, if you wish to complete it. Remember there is a dyslexia friendly version of it developed by Chathurika.

Today, we are beginning the fifth week of the Positive psychology program which will be devoted to Hope. Many people perceive hope as something rather vague, a hollow promise of what is to come but never actually does. For the next week, we will be learning about hope from quite a different perspective which you might not have come across before. So, this is just a quick reminder for you to log in to your Moodle accounts and view the first presentation for today. It is under "Week 5 - Hope" in the Positive Psychology Intervention module.
Welcome to a new veeeery cold and windy, yet beautiful day. I hope you have had a fruitful week full of gratitude, mindfulness, compassion, strengths and hope ... Today, is another day we are going to be focusing on hope and as usually I have a short presentation ready for you - please, log in to your Moodle accounts to view it. It is under the "Week 5 - Hope" section in the Positive Psychology Intervention module.

Have a great day and the most amazing week-end!

Enjoy the message for today.

Jana
Week 5, Hope – Tuesday group session

Good morning everyone,

I hope you have all started the day hopefully because today we are going to conclude the fifth week of the positive psychology program which, as you all know, was devoted to Hope. We will have our afternoon session in T2-26 from 2:00 till 3:30 pm, as usually.

I look forward to seeing you all this afternoon!
Thank you all for your work.

Regards.
Jana

Week 6, Happiness – Wednesday

Good morning to you all,

Welcome to this beautiful and bright new day! First of all, I would like to thank you all for your contribution to the group session yesterday. It would not be the same without it and I truly mean what I said yesterday - I am incredibly grateful for every single one of you and your unique input into this program, and I do have a genuine hope that you will be able to take something useful from it for yourselves. I uploaded the PowerPoint from yesterday on Moodle, so you can access it again if you wish to.

Today, we are beginning the sixth and final week of the Positive psychology program which will be devoted to Happiness. Happiness is a positive psychological construct that has a very personal meaning to most people, so this week you are going to be focusing on cultivating your happiness…. As usually, there is a short presentation for you ready for you on Moodle and this is just a quick reminder for you to log in to your accounts to view it. It is under "Week 6 - Happiness” in the Positive Psychology Intervention module.

I wish you all a great day!

Jana
Week 6, Happiness – Friday

Good morning everyone!

Welcome to a new beautiful day. I hope you have had a fruitful week full of gratitude, mindfulness, compassion, strengths, hope and happiness... Today, is another day we are going to be focusing on happiness and as usually I have a short presentation ready for you - please, log in to your Moodle accounts to view it. It is under the "Week 6 - Happiness" section in the Positive Psychology Intervention module.

Have a great day and the most amazing week-end!

Enjoy the message for today.

Jana

Week 6, Happiness – Monday

Good morning everyone!

Welcome to a new beautiful day. I hope you have had some good rest over the week-end and that you are ready for another week. Today, is the last day we are going to be focusing on happiness, and also the last presentation from me. As usually, this is just a quick reminder for you to log in to your Moodle accounts to view it. It is under the "Week 6 - Happiness" section in the Positive Psychology Intervention module.

Have a great day and I will see you all tomorrow!

Enjoy the message for today.

Jana

Week 6, Happiness – Tuesday group session

Good morning everyone,

I hope you have all started the day mindfully and strong, with compassion, hope and gratitude, and a big smile on your face. Today we are going to conclude the Happiness week of the
positive psychology program which, as you all know, was the last one. We will have our last afternoon session in T2-26 from 2:00 till 3:30 pm, as usually.

I look forward to seeing you all this afternoon!
Thank you all for your work.

Regards.

Jana

**Final thanks**

Good afternoon everyone,

I just wanted to thank you all so much again for your time, effort, contribution and all your hard work for the past six weeks! It has been an incredibly insightful experience for me and a great pleasure to know you all. You all have an amazing personality and I have learned a great deal from each one of you. You are very mature and very self-aware individuals and I am sure you will all make amazing counselling and psychotherapy professionals one day.

Thank you all for your wonderful feedback - it is so incredibly encouraging and it fills me up with much hope to know that you have found the program useful. I wish you all the best in your lives and I hope we will have an opportunity to meet up again one day.

Take care and stay grateful, mindful, compassionate, strong, hopeful and most importantly happy.

Best wishes

Jana
Appendix L.

Risk Assessment for Nucleic Acid Extraction – Polymerase Chain Reaction: Real-Time qPCR

Before any experimental procedure involving the use of chemicals or reagents is undertaken, potential hazards must be identified and an assessment made of the risks posed by these hazards in the work activity in which they are involved. This risk assessment is a legal requirement to comply with the Control of Substances Hazardous to Health (CoSHH) Act and is the responsibility of the research workers supervising the research projects. Before undertaking experimental procedures, all members of staff must read and sign the relevant CoSHH assessments.

Title of Procedure: Nucleic acid extraction - Polymerase chain reaction - Standard and Real Time

Labs Involved: All staff

Brief Description: Amplification of small amounts of DNA (or RNA) using dNTPs, appropriate primers and a polymerase. Restriction of amplified product.

Please note: Known carcinogens, teratogens and mutagens should only be used in consultation with senior staff and the Departmental Safety Officer. All user must have read University supplementary Code of Practice for the use of such substances and comply with its recommendations. It is important to realise that the use of certain carcinogens is banned by law.
## 1. Sample collection and RNA isolation

<table>
<thead>
<tr>
<th>Chemical/Reagent</th>
<th>Hazard</th>
<th>Stock Volume/Quantity</th>
<th>Risk Level</th>
<th>Precautions</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA/RNA template</td>
<td>None / low risk</td>
<td>~2ul</td>
<td>Low</td>
<td>Good Laboratory Practice (GLP) – see below. Decanting from stock should always be done in a fume cupboard. <strong>Warn colleagues who are allergic to this material BEFORE use</strong></td>
<td>Orange bag bin. Autoclaving.</td>
</tr>
<tr>
<td>RNAlater</td>
<td>Not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008.</td>
<td>2ml</td>
<td>Low</td>
<td>GLP and wear gloves</td>
<td>Wash down the sink with copious amounts of water.</td>
</tr>
<tr>
<td>Trizol</td>
<td>Toxic and corrosive.</td>
<td>1ml</td>
<td>Medium</td>
<td>Use butryl gloves and eye protection, handle in fume hood.</td>
<td>Wash down the sink with copious amounts of water.</td>
</tr>
<tr>
<td>Ethanol 70%</td>
<td>Ethanol Highly flammable. Vapours may cause drowsiness and dizziness.</td>
<td>1ml</td>
<td>Low</td>
<td>Decanting from stock should be done in a fume cupboard. Keep away from naked flames and sources of heat.</td>
<td>Allow to evaporate.</td>
</tr>
<tr>
<td>Chloroform</td>
<td>Harmful by ingestion and inhalation. Irritant. Limited evidence of carcinogenic effect.</td>
<td>200ul per 2ml of homogenate</td>
<td>Medium</td>
<td>Decanting from stock should be done in a fume cupboard. Laboratory coat and gloves should be worn</td>
<td>Aqueous solutions or buffer containing phenol were disposed of in shatter proof bottles. Collection by a waste disposal company.</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>Highly flammable. Toxic if inhaled</td>
<td>0.5 ml</td>
<td>Low</td>
<td>GLP. Decanting from stock should be done in a fume cupboard</td>
<td>Allow to evaporate.</td>
</tr>
</tbody>
</table>
2. cDNA synthesis

<table>
<thead>
<tr>
<th>Chemical/Reagent</th>
<th>Hazard</th>
<th>Stock Volume/Quantity</th>
<th>Risk Level</th>
<th>Precautions</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNA wash buffer (Tris HCL/EDTA)</td>
<td>May cause irritation to eyes, skin and respiratory system</td>
<td>50 ml</td>
<td>Low</td>
<td>Good laboratory practice. Wear full PPE.</td>
<td>Do not let product enter drains. Keep in suitable, closed containers for disposal via hazardous waste stream.</td>
</tr>
<tr>
<td>Reverse transcriptase</td>
<td>Not known to be hazardous in amounts used.</td>
<td>1ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>Oligo dT nucleotide primers</td>
<td>None / low risk</td>
<td>4.1ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>First strand buffer</td>
<td>May cause irritation to eyes and skin.</td>
<td>5ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>Dithiothreitol</td>
<td>Harmful by ingestion, inhalation and skin contact.</td>
<td>2.5ul</td>
<td>Low</td>
<td>GLP and wear protective clothing</td>
<td>Waste is to be disposed of via MIB Stores, using the hazardous waste disposal procedure.</td>
</tr>
<tr>
<td>dNTPs</td>
<td>None / low risk</td>
<td>1.5ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>RNase inhibitor</td>
<td>Not hazardous</td>
<td>0.5ul</td>
<td>Low</td>
<td>GLP</td>
<td>Wash down the sink with copious amounts of water.</td>
</tr>
</tbody>
</table>
### 3. Real time qPCR

<table>
<thead>
<tr>
<th>Chemical/Reagent</th>
<th>Hazard</th>
<th>Stock Volume/Quantity</th>
<th>Risk Level</th>
<th>Precautions</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>cDNA template</td>
<td>Low</td>
<td>5ul</td>
<td>Low</td>
<td>GLP</td>
<td>Orange bag bin.</td>
</tr>
<tr>
<td>SYBR Green Mastermix</td>
<td>Irritant</td>
<td>10ul</td>
<td>Low</td>
<td>GLP</td>
<td>Orange bag bin.</td>
</tr>
<tr>
<td>Oligonucleotide primers</td>
<td>None / low risk</td>
<td>1ul of each primer pair</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>Magnesium Chloride</td>
<td>None</td>
<td>0.8ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water Powder - sealed container Orange bag bin.</td>
</tr>
<tr>
<td>Mix of Taq DNA Polymerase, dNTP and Reaction buffer</td>
<td>Taq DNA Polymerase - Minor irritant to skin, eyes and mucous membranes.</td>
<td>2ul</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>Deionised water</td>
<td>None</td>
<td>2.2ul</td>
<td>Low</td>
<td>GLP</td>
<td>Wash down the sink with copious amounts of water.</td>
</tr>
</tbody>
</table>
4. Post-PCR gel electrophoresis

<table>
<thead>
<tr>
<th>Chemical/Reagent</th>
<th>Hazard</th>
<th>Stock Volume/Quantity</th>
<th>Risk Level</th>
<th>Precautions</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agarose</td>
<td>Eye and respiratory system irritation. May cause skin irritation. Dust may cause mechanical irritation.</td>
<td>1g</td>
<td>Low</td>
<td>GLP. Agarose needs to be heated in a microwave to dissolve. Wear thermal gloves when handling molten solution as they can become superheated.</td>
<td>Hazardous route way.</td>
</tr>
<tr>
<td>Tris-Acetate-EDTA buffer (TAE)</td>
<td>Irritating to eyes, respiratory system and skin.</td>
<td>500ml of 1x solution</td>
<td>Low</td>
<td>GLP</td>
<td>Solution - Sink with copious amounts of water.</td>
</tr>
<tr>
<td>Ethidium bromide solution</td>
<td>Mutagenic. Irritant to skin and eyes.</td>
<td>10 µl of 10mg/ml solution = 100µg (&lt;10ul per gel)</td>
<td>Medium</td>
<td>GLP. Wear dust mask and weigh out powder in a fume-hood. Decontaminate using charcoal filtration before releasing to the drain. 1ug-0.5mg/ml use activated charcoal method; &gt;0.5mg/ml dilute to 0.5mg/ml - use chemical method (KMnO4, HCl, NaOH).</td>
<td>Decontaminate using charcoal filtration before releasing to the drain. 1ug-0.5mg/ml use activated charcoal method; &gt;0.5mg/ml dilute to 0.5mg/ml - use chemical method (KMnO4, HCl, NaOH).</td>
</tr>
<tr>
<td>Deionised water</td>
<td>None</td>
<td>Low</td>
<td>GLP</td>
<td>Wash down the sink with copious amounts of water.</td>
<td></td>
</tr>
</tbody>
</table>
Good Laboratory Practice should be adhered to at all times

- Common sense at all times!
- Never eat, drink or apply cosmetics in the laboratory.
- Wash your hands in the designated sinks whenever you have finished your lab work.
- Be familiar with the potential hazards involved in your work and take appropriate precautions.
- Wear protective clothing as needed, lab coats are a minimum.
- Keep your work area clean and tidy.
- Dispose of materials appropriately.
- Use appropriate care with electrical equipment.
- Use appropriate care with sharps
- Use appropriate care with substances of extreme temperatures (liquid nitrogen or hot liquids)
- Operate maintain and service all your equipment properly, if in doubt ask!
- Work in appropriate containment hoods where necessary.

Precautions to be taken:

All the pieces of equipment exploited were recently PAT tested.
EMERGENCY PROCEDURES – FIRST AID

IF PERSONNEL ARE AFFECTED (fumes, contamination/contact) TREATMENT TO BE ADOPTED:

EYES
Irrigate with eye wash for at least 10 minutes. Obtain medical attention.

LUNGS
Remove from exposure. Rest and keep warm. In severe cases obtain medical attention.

SKIN
Drench skin with water. Remove contaminated clothing. In severe cases seek medical attention.

MOUTH
Wash mouth out thoroughly and give very small sips of water. Do not induce vomiting. Obtain medical attention.

Assessed and approved by: I.G. Matsoukas
Date: 15/06/2018