Addressing cognitive biases in the treatment of irritable bowel syndrome with mindfulness based therapy



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Abstract

Addressing cognitive biases in the treatment of irritable bowel syndrome with mindfulness based therapy

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Irritable Bowel Syndrome (IBS) is a chronic disorder of brain-gut interaction. Using the translational model of treatment development, the aim of this thesis was twofold: 1) to identify cognitive factors involved in maintaining IBS, and 2) to subsequently adapt and test a treatment addressing these factors. Previous research has highlighted the role of illness-specific cognitions (e.g., gastrointestinal symptom-specific anxiety, pain-catastrophizing) for maintaining IBS, predominantly using self-report measures. Employing a cross-sectional design, I compared IBS patients and healthy participants on implicit reaction-time based measures of attentional control (i.e., executive attentional regulation) and identification with illness and health. IBS patients showed a deficit in attentional control and biased self-referential processing of information relating to health. The findings corroborated my theoretical premise that Mindfulness-Based Cognitive Therapy (MBCT) adapted for patients with IBS would address the identified maintenance factors. In order to determine the best time point to measure changes in implicit cognitive functions in mindfulness-based interventions, I designed a quasi-experimental proof-of-concept study. It found that an increase in attentional control in healthy students can be measured after two weeks of the 'Finding Peace in a Frantic World' programme. Subsequently, a treatment protocol of MBCT for IBS was developed, which aimed to reduce IBS symptoms and increase quality of life. It was hypothesised that this treatment would alleviate symptoms by attenuating illness-specific cognitions, supported by improvements in attentional control, and by changing how cognitive, emotional, illness and health related information is processed. A randomised wait-list controlled clinical trial assessed the efficacy of MBCT for IBS at four time points. MBCT for IBS reduced IBS symptom severity by reducing maladaptive illness-specific cognitions paired with a shift towards self-referential processing of health related information and more accepting, non-judgemental processing of emotions and thoughts. These results suggest that MBCT for IBS is a promising treatment for IBS patients. The treatment protocol awaits further testing in bigger samples and with active control groups.

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Table of contents

Chapter 1: General Introduction 21

1.1 Abstract 21

1.2 Thesis Aims 22

1.3 Irritable Bowel Syndrome 22

1.3.1 Dietary treatments 23

1.3.2 Pharmacological treatments 23

1.4 Biopsychological Pathways in IBS 24

1.5 Challenges and Solutions in the Field of Intervention Design for IBS 25

1.6 The NIH Stage Model of Intervention Development 26

1.6.1 The Stages of the model 27

1.7 Relevant Clinical and Theoretical Accounts 29

1.7.1 Psychological factors in irritable bowel syndrome 31

1.7.2 Cognitive biases in IBS 34

1.7.3 Hypothesized maintaining factors of IBS 36

1.8 Previously Developed Psychological Treatments for IBS 38

1.9 A new Psychological Treatment for IBS 39

1.9.1 Treatment model 40

1.9.2 Addressing the hypothesized maintaining factors 40

1.9.3 Adapting a treatment approach to patients with IBS 43

1.9.4 Testing mechanism of change 43

1.10 Thesis Objectives 43

1.10.1 Thesis outline 44

Chapter 2: Biased Implicit Self-referential Processing of Illness and Health in Patients with Irritable Bowel Syndrome (IBS) 47

2.1 Abstract 47

2.1.1 Objectives 47

2.1.2 Methods 47

2.1.3 Results 47

2.1.4 Conclusion *47*

2.2 INTRODUCTION 48

2.3 METHODS 51

2.3.1 Design and general procedure *51*

2.3.2 Participants *51*

2.3.3 Questionnaires *54*

2.3.4 Cognitive task *56*

2.3.5 Procedure *60*

2.4 RESULTS 61

2.4.1 Participant characteristics *61*

2.4.2 Results IAT *64*

2.4.3 EAT-score differences between groups *66*

2.4.4 Correlational analysis *66*

2.4.5 Post-hoc moderation analysis *68*

2.5 DISCUSSION 69

2.5.1 Implications for treatment *71*

2.5.2 Limitations *72*

2.5.3 Conclusion *73*

Chapter 3: Altered Attentional Control Linked to Catastrophizing in Patients with Irritable Bowel Syndrome (IBS) **75**

3.1 ABSTRACT 75

3.1.1 Objectives *75*

3.1.2 Design and methods *75*

3.1.3 Results *75*

3.1.4 Conclusions *76*

3.2 INTRODUCTION 77

3.2.1 Summary and hypotheses *81*

3.3 METHODS 82

3.3.1 Measures *82*

3.3.2 Questionnaires *83*

3.3.3 Cognitive task *84*

3.3.4 Procedure *86*

3.3.5 Statistical plan *86*

3.4 RESULTS 87

3.4.1 Participants and clinical characteristics *87*

3.4.2 Analysis of attentional functions *89*

3.4.3 Subgroup analysis *90*

3.4.4 Relationship between symptom severity and IBS-catastrophizing *92*

3.5 DISCUSSION 94

3.5.1 Implications for treatment *97*

3.5.2 Limitations *99*

3.5.3 Conclusion *100*

Chapter 4: The Effect of Mindfulness on Attentional Control, Attentional Focus, Anxiety and Wellbeing in Students 101

4.1 ABSTRACT 101

4.1.1 Introduction and objectives *101*

4.1.2 Methods *102*

4.1.3 Results *102*

4.1.4 Discussion and conclusion *102*

4.2 INTRODUCTION 103

4.2.1 Mindfulness for students *108*

4.2.2 Objectives and hypotheses *110*

4.3 METHODS 111

4.3.1 General procedure *111*

4.3.2 Participant recruitment *112*

4.3.3 Inclusion and exclusion criteria *113*

4.3.4 Intervention *113*

4.3.5 Control group *114*

4.3.6 Testing schedule *114*

4.3.7 Reaction time-based measures *114*

4.3.8 Self-report measures *117*

4.3.9 Participant flow *121*

4.3.10 Statistical analysis *122*

4.4 RESULTS 123

4.4.1 Participant characteristics *123*

4.4.2 Differences in attentional control between the mindfulness group and the control group *125*

4.4.3 Changes in attentional focus and attentional shifting in the MG *129*

4.4.4 Changes in anxiety *133*

4.4.5 Changes in attentional control, alerting and orienting attention at t.1, t.3 and t.9 between groups *135*

4.4.6 Post-hoc analysis: correlation between changes in attentional control and attentional focus from t.1 to t.3 ..... *139*

4.4.7 Post-hoc analysis: relationship between changes in attentional focus between t.1 and t.3 and changes in anxiety between t.1 and t.9 in the mindfulness group *139*

4.4.8 Changes between t.1, t.3 and t.9 on self-reported psychological outcomes *139*

4.4.9 Home practice in the mindfulness group *148*

4.5 DISCUSSION 150

4.5.1 Clinical implications *155*

4.5.2 Limitations *156*

4.5.3 Conclusion *156*

Chapter 5: Developing Mindfulness-Based Cognitive Therapy for Irritable Bowel Syndrome (MBCT for IBS) **159**

5.1 ABSTRACT 159

5.2 INTRODUCTION 160

5.3 COGNITIVE, BEHAVIOURAL AND MINDFULNESS-BASED MODELS OF IBS AND EVIDENCE FOR THEIR TREATMENT EFFICACY 160

5.3.1 Cognitive and cognitive-behavioural models *161*

5.3.2 Mindfulness for patients with IBS *165*

5.3.3 Summary *174*

5.4 Rationale for Adapting MBCT for Patients with IBS 174
5.4.1 Theoretical background of MBCT for recurrent depression 176
5.4.2 Adopting MBCT to patients with IBS 177
5.5 Linking Key Skills Learned in MBCT for IBS with the Hypothesized Mechanisms of Change 181
5.5.1 Concentration 181
5.5.2 Decentring 182
5.5.3 Sensory, experiential processing 184
5.5.4 Developing a friendly relationship towards the body 185
5.6 Rationale for Structural Adaptations and Additional of Modules 186
5.6.1 Adaptations to the structure of the MBCT programme 186
5.7 MBCT for IBS Treatment Outline and General Structure 190
5.7.1 Guiding principles 191
5.8 MBCT for IBS Treatment Protocol 192
5.8.1 General modules repeated throughout the sessions 195
5.8.2 MBCT for IBS - Sessions 0-6 196
5.9 MBCT for IBS – linking mechanisms with intervention techniques 214
5.9.1 Attentional control 215
5.9.2 Pain and IBS catastrophizing 215
5.9.3 Self-referential processing of Illness and health 215
5.9.4 Visceral anxiety sensitivity 216
5.9.5 Adaptive coping 216
5.10 The stages of treatment development in this thesis - a critical assessment 216
5.11 Summary and Conclusion 218

Chapter 6: Mindfulness-Based Cognitive Therapy Reduces the Severity of Irritable Bowel Syndrome (IBS): Results from a Randomised, Controlled Study 219

6.1 Abstract 219
6.1.1 Objectives 219
6.1.2 Design and methods 219
6.1.3 Results 220

6.1.4 Conclusion *220*

6.2 INTRODUCTION 221

6.2.1 Hypotheses *221*

6.3 METHODS 222

6.3.1 Design and general procedure *222*

6.3.2 Participants *223*

6.3.3 Random assignment and flow of participants *224*

6.3.4 Intervention conditions *228*

6.3.5 Testing schedule *230*

6.3.6 Outcome measures *231*

6.3.7 Process measures *232*

6.3.8 Statistical analyses *234*

6.4 RESULTS 236

6.4.1 Participant characteristics at baseline *236*

6.4.2 Outcomes *239*

6.4.3 Differences between participants who withdrew after group allocation and participants who continued with the study *262*

6.4.4 Graphical illustrations of treatment trajectories for the MG and the WL *262*

6.5 DISCUSSION 269

6.5.1 Limitations *274*

6.5.2 Conclusion *275*

Chapter 7: Mechanisms of Change in Mindfulness-Based Cognitive Therapy (MBCT) for Irritable Bowel Syndrome (IBS) **277**

7.1 ABSTRACT 277

7.1.1 Background and objectives *277*

7.1.2 Design and methods *277*

7.1.3 Results *278*

7.1.4 Conclusion *278*

7.2 INTRODUCTION 279

7.2.1 Hypotheses *284*

7.3 METHODS 284
7.3.1 Design and general procedure 284
7.3.2 Self-report outcome measures 286
7.3.3 Reaction-time based outcome measures 287
7.3.4 Statistical analyses 288
7.4 RESULTS 291
7.4.1 Participant characteristics 291
7.4.2 Between groups analysis 292
7.4.3 Simple mediation analyses: IBS symptom severity 306
7.4.4 Serial mediation analysis 313
7.4.5 Simple mediation analysis: Quality of Life 320
7.5 DISCUSSION 325
7.5.1 Strengths and limitations 330
7.5.2 Conclusion 331
Chapter 8: General Discussion and Conclusion 333
8.1 ABSTRACT 333
8.2 SUMMARY 334
8.2.1 Background and aims 334
8.2.2 Summary of translational steps 334
8.2.3 Summary of findings 335
8.3 DISCUSSION OF FINDINGS 338
8.3.1 Biased self-referential processing of illness and health – cognitive marker of changes in self-related processing 338
8.3.2 Attentional control 340
8.3.3 Mindfulness-based interventions for IBS 344
8.3.4 Mechanisms of change of MBCT for IBS 346
8.4 STRENGTHS 349
8.5 LIMITATIONS 350
8.6 LOOKING AHEAD 352
8.6.1 Implementation 352

8.6.2 Staging MBCT for IBS among other therapeutic interventions 355

8.7 FUTURE RESEARCH PERSPECTIVES 357

8.7.1 Suggested research proposals within the NIH stage model 358

8.7.2 Interdisciplinary research groups 362

8.8 CONCLUSION 363

Chapter 9: Appendices 365

9.1 APPENDICES CHAPTER 2 AND CHAPTER 3 365

9.1.1 Participant Information Sheet for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH): patients with IBS 365

9.1.2 Participant Information Sheet for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH): healthy participants 370

9.1.3 Consent Form for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH) 375

9.1.4 Screening Questionnaire for the study "Cognitive and Emotional Factors in Illness and Healthy" (CEFIH) 378

9.1.5 Overview of Questionnaires in the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH) 381

9.1.6 Overview and sequence of cognitive computerized tasks in the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH) 382

9.2 APPENDICES CHAPTER 4 383

9.2.1 Participant Information Sheet for the study "Time Course of Cognitive Changes" (TCCC): Participants in the mindfulness group 383

9.2.2 Participant Information Sheet for the study "Time Course of Cognitive Changes" (TCCC): Participants in the control group 388

9.2.3 Online Consent Form for the study "Time Course of Cognitive Changes" (TCCC): Participants in the control group 393

9.2.4 Participant Flowchart of the Time Course of Cognitive Changes Study 395

9.2.5 Summary of the course structure of the "Finding Peace in a Frantic World" Course 396

9.2.6 Course and Assessment Schedule 398

9.3 APPENDICES FOR CHAPTER 5 399

9.3.1 Item Similarities between the Cognitive Scale for Functional Bowel Disorders (CSFBD) and the Gastrointestinal (GI) - Cognitions Questionnaire. *399*

9.3.2 MBCT for IBS – Handouts for participants *400*

Day/Date *421*

Practice *421*

Comments *421*

9.4 APPENDICES FOR CHAPTER 6 460

9.4.1 Participant Information Sheet for the Study "Mindfulness for Irritable Bowel Syndrome" (MIBS) *460*

9.4.2 Consent form for the study "Mindfulness for Irritable Bowel Syndrome" (MIBS) *471*

9.4.3 Screening Questionnaire of the study Mindfulness for Irritable Bowel Syndrome (MIBS) 473

9.4.4 Overview and sequence of cognitive computerized tasks in the Study "Mindfulness for Irritable Bowel Syndrome (MIBS). *485*

9.4.5 List of validated questionnaires and assessment points in the study "Mindfulness for Irritable Bowel Syndrome" (MIBS). *486*

9.4.6 Diary Card for the study "Mindfulness for Irritable Bowel Syndrome" *488*

Chapter 10: References **490**

Chapter 1: General Introduction

1.1 Abstract

Irritable Bowel Syndrome (IBS) is a chronic illness with insufficient treatment options. The biopsychological mechanisms that are believed to play a part in the manifestation of symptoms will be explained. I will then argue that it is necessary to use a systematic approach to guide the development of a new therapeutic intervention for IBS. This approach follows the recommendations of the National Institute of Health (NIH) Stage Model of Intervention Development such that theoretical models, empirical evidence from the literature on IBS, and basic clinical science will be incorporated in the design of a new psychological treatment for IBS. Within this framework, investigations into potential treatment targets and the rationale for Mindfulness-Based Cognitive Therapy for the treatment of IBS (MBCT for IBS) will be discussed. Finally, this thesis' objectives will be summarized and an outline of the Chapters will be presented.

1.2 Thesis Aims

Given the shortage of translational studies that integrate basic cognitive science research into intervention development, the aim of the current thesis is to first identify the underlying psychological processes related to Irritable Bowel syndrome (IBS) and to subsequently develop and evaluate a clinical treatment targeting these maintenance processes.

1.3 Irritable Bowel Syndrome

Irritable bowel syndrome (IBS) is a chronic gastrointestinal disorder characterized by abdominal pain, discomfort, bloating and stool irregularities such as diarrhoea and constipation (Blanchard, Greene, Scharff, & Schwarz-McMorris, 1993; Cash, Sullivan, & Barghout, 2005;. Chang et al., 2006; Enck et al., 2016). It is considered a disorder of gut-brain interaction (it was previously referred to as a functional syndrome), that lacks agreed upon biological markers. Indeed, current routine diagnostic tools do not detect structural or bio-chemical abnormalities in patients with the illness (Enck et al., 2016; Tack & Drossman, 2017). IBS is therefore diagnosed using symptom based criteria (Chang et al., 2006; Drossman, 2006; Enck et al., 2016; Schoepfer, Trummler, Seeholzer, Seibold-Schmid, & Seibold, 2008), most commonly with the Rome Criteria for functional gastrointestinal disorders (fGIDs). New Rome guidelines (Rome IV) have recently been published (Tack & Drossman, 2017), however the Rome III criteria for IBS (Longstreth, Thompson, Chey, & Houghton, 2006) were applied in the studies of this thesis as these were the most up-to date criteria when the studies were planned and implemented. These diagnostic criteria specify that recurrent abdominal pain or discomfort has to be present for at least three days per month for the past three months. In addition, the abdominal pain or discomfort has to be associated with two of the following symptoms: (a) improvement with bowel movements, (b) the onset of pain/discomfort is associated with changes in the frequency of bowel movements or (c) the onset of pain/discomfort is associated with changes in the form of stool. IBS affects women more than men (Odds Ratio 1.67, Lovell & Ford, 2012a) and proportionally IBS tends to affect more people under the age of 50 (Lovell & Ford, 2012b). IBS has a prevalence rate of approximately 12% in the European Union and North America (Lovell & Ford, 2012b) and the prevalence rate in the UK is

12.7% (Enck et al., 2016). Finally, it was estimated that the cost of IBS to the healthcare system is up to €1,600 per year per patient in the UK (at the time of publication €1,600 were approximately £1,098) (Quigley, Bytzer, Jones, & Mearin, 2006; "XE Currency Table: EUR Euro," n.d.). Several non-psychological treatments, including pharmacological and dietary treatment approaches for IBS have been developed, with varying treatment efficacy and patient acceptability (Ford et al., 2014; Ford, Talley, Schoenfeld, Quigley, & Moayyedi, 2009; Foxx-Orenstein, 2016; Grundmann & Yoon, 2010; Halland & Saito, 2015; Henrich et al., 2015; Lackner, Mesmer, Morley, Dowzer, & Hamilton, 2004; Rao, Yu, & Fedewa, 2015; Spiller et al., 2007). These treatments are summarized below.

1.3.1 Dietary treatments

The "low Fermentable, Oligo-, Di-, Mono-saccharides and Polyol" (low FODMAP) diet focuses on reduced intake of fermentable, short-chain carbohydrates, lactose (disaccharide), fructose (monosaccharide) and sorbitol (polyol) (Schumann et al., 2017). As part of this diet, high FODMAP fruit such as apples, watermelons or mangos are replaced with low FODMAP fruit such as bananas, kiwifruit and lemon (Nanayakkara, Skidmore, O'Brien, Wilkinson, & Gearry, 2016). This diet has been found to reduce IBS symptoms in the short term (up to 3 months) (Schumann et al., 2017). However, the low FODMAP diet appears to work best for patients presenting with diarrhoea (and not for those presenting with constipation) and not all patients improve (25% do not improve). In addition the long-term consequences of this diet on both IBS symptoms and general health have not yet been established (Schumann et al., 2017).

1.3.2 Pharmacological treatments

A recent meta-analysis showed that antidepressants (tricyclic antidepressants and selective serotonin reuptake inhibitors) are more effective in reducing IBS symptoms than placebo (Ford et al., 2014). This indicates that antidepressants may address an underlying neurochemical vulnerability factor of IBS, which could also be related to depression, highlighting the bio-psychological nature of IBS. Nonetheless, 43% of patients receiving the actual drug also did not

improve, showing that antidepressants may address the underlying pathology in some but not all IBS patients.

To conclude, dietary and pharmacological treatments appear to be suitable for some but not all patients with IBS. In addition, not all IBS patients may be prepared to significantly change their diet according to FODMAP or, given potential side effects, take antidepressant medication over the long term. Therefore, given the drawbacks of dietary and pharmacological treatments and evidence of disordered functioning of brain-gut interaction in IBS patients (outlined in more detail below), psychological therapies appear to be a suitable alternative.

1.4 Biopsychological Pathways in IBS

It is now widely recognised that a complex interaction of biological, neural, immunological, social and psychological factors plays a role in the aetiology and maintenance of IBS (Buckley, O'Mahony, & O'Malley, 2014; Drossman, 2006; Elsenbruch, 2011; Öhman, Törnblom, & Simrén, 2014; Kristine Phillips & Clauw, 2011; Van Oudenhove et al., 2016). The early biopsychosocial model for health and disease (Engel, 1981) has been the first driver behind the scientific exploration of interactions among biological, psychological and social factors that play a role in the pathophysiology and maintenance of IBS. Based on nearly 40 years of research, IBS has been recognized as a disorder of gut-brain interaction. The bidirectional system purported to support this interaction is the so-called brain-gut axis (Mayer & Tillisch, 2011). The brain-gut axis consists of the autonomic nervous system and the hypothalamic–pituitary–adrenal axis (HPA axis) which link the enteric nervous system in the gut (a large interconnected structure of neurons that govern the function of the gastrointestinal (GI) tract (Costa, Brookes, & Hennig, 2000)) with the brain. Along the brain-gut axis, afferent pathways communicate homeostatic information about the physiological condition of the body to the brain (Van Oudenhove et al., 2016). This information is then modulated by cognitive and affective brain circuits, which influences the perception of intrinsic physiological signals (e.g., discomfort) (Van Oudenhove et al., 2016). In addition, psychological processes can modify the functioning of the GI tract via efferent pathways (Van Oudenhove et al., 2016). For example emotional or cognitive arousal (e.g., stress) can affect

motor, immune and barrier functioning of the GI tract via the autonomic nervous system (ANS) and HPA Axis (Van Oudenhove et al., 2016). This effect has recently been illustrated in a study that explored the effects of Cognitive Behavioural Therapy (CBT) on the ANS in patients with IBS (Jang, Hwang, Padhye, & Meininger, 2017). It was shown that CBT affects heart rate variability (a non-invasive measure of ANS activity) and the magnitude of change in this measure was associated with the degree of changes in IBS symptom severity (Jang et al., 2017). A recently published comprehensive review of the biopsychological mechanisms relevant for disorders of brain-gut interaction offers additional information on the topic (Van Oudenhove et al., 2016). The treatment and the cognitive factors that are explored in this thesis are thought to exert their influence on IBS symptom severity via the above mentioned brain-gut axis.

1.5 Challenges and Solutions in the Field of Intervention Design for IBS

One fundamental problem of psychological interventions targeted at patients with psychological and physiological complaints is that the mechanisms leading to symptom changes are often unclear (Kazdin, 2009; Onken, Carroll, Shoham, Cuthbert, & Riddle, 2014). This is problematic because it hinders the improvement of existing interventions and creates unnecessary obstacles when newly developed interventions are implemented in a wider health care setting (Onken et al., 2014). Among psychological interventions for IBS, several types of treatments are effective, but only recently have researchers started to investigate actual change mechanisms. The use and exploration of theory in intervention design for IBS is also rather weak. For example, 79% of studies mentioned theory based predictors of change in the corresponding scientific articles, 44% measured changes in a theory-relevant construct and only 5% tested whether the intervention operates via the hypothesised mechanism (Henrich, 2012). One principle way of approaching this challenge is the National Institute of Health (NIH) Stage Model of Intervention Development (Onken et al., 2014). This model integrates the investigation of mechanisms of change into the development and improvement of interventions from the outset. This allows treatments to bridge missing links between the basic and applied clinical sciences (Onken et al., 2014) in pursuit of

building maximally effective interventions. Based on this model the strategy for developing a new psychological treatment would be to explore theoretical explanations and empirical evidence for the risk, vulnerability and maintaining factors of the illness. The resulting treatment model would then guide an investigation into how an intervention could target the identified vulnerabilities. In addition, intervention development science is improved by linking the hypothesized mechanisms to intervention techniques. This establishes clear links between the theory or model, the techniques or modules in the intervention, the maintaining factors and the and clinical outcomes (Michie & Prestwich, 2010).

This thesis will use the NIH Stage model of Intervention Development as a framework to guide the exploration of a possible treatment for IBS. I will apply relevant theoretical models and use the available empirical evidence and basic clinical science to identify maintenance factors and change mechanisms. Subsequently I will build on this knowledge, to theorise which treatment model might be helpful in targeting these mechanisms. The treatment will be developed and it will be tested if the treatment leads to symptom improvement, if the treatment affects the identified maintaining factors and if changes in maintaining factors are in return associated with symptom improvement. With this aim in mind, the NIH stage model of intervention development will be outlined next, before theoretical approaches, and known and hypothesized maintaining and mediating factors will be discussed.

1.6 The NIH Stage Model of Intervention Development

The core of the updated NIH Stage Model of Intervention Development centres on investigating change mechanisms to understand why and how a particular intervention works (Onken et al., 2014). The driving purpose is that

> "With a better understanding of mechanisms of disorders, the promise for a new generation of more efficient and implementable interventions is improved" (Onken et al., 2014, p. 3).

1.6.1 The Stages of the model

The model has five interconnected stages, and researchers can move between stages, depending on findings generated from each stage (please see Figure 1.1). For this thesis stages 0, 1 and 2 are most relevant. Therefore these stages will be described in more detail than the remaining stages (3, 4 and 5).

1.6.1.1 Stage 0

Stage 0 is a basic science component which can be performed before, during and after intervention development. Basic research that is conducted prior to intervention development can identify theory-derived psychological and biochemical treatment targets, and integrated basic science can aid the exploration of change mechanisms (through mediator and moderator analyses) (Onken et al., 2014).

1.6.1.2 Stage 1

This stage is reserved for the development or modification of existing interventions (Stage 1A) and the pilot testing of interventions (Stage 1B). Activities of stage 1A include identifying relevant basic or clinical findings for the development or refinement of the intervention, formulating theories or hypotheses about the mechanisms through which the intervention will exert its effects, and further refining and modifying existing interventions. The intervention is then pilot tested in stage 1B. This also includes testing the hypothesized mechanisms (Onken et al., 2014).

1.6.1.3 Stage 2

Stage 2 specifies that the new or refined intervention is tested in a research setting with research therapists to evaluate the treatment's efficacy and to further explore mechanisms. This can be done using randomized clinical trials and other methodologies such as multiple baseline single-case designs. The information gathered in this stage can be used to decide if the intervention should undergo further development (e.g., at Stage 1) or if it should be tested in a community setting (e.g., at stage 3) (Onken et al., 2014).

1.6.1.4 Stage 3

Stage 3 demands that the intervention is tested in a community setting, with community service providers whilst keeping a controlled study design and ensuring treatment fidelity. Additional Stage 1 work may be necessary to adapt the intervention to a community setting (Onken et al., 2014).

1.6.1.5 Stage 4

Stage 4 is an effectiveness trial in the community that assesses the feasibility and benefits of implementing and disseminating the intervention more broadly (Onken et al., 2014). As some interventions have to be adapted for the community setting, it is necessary to ensure that critical mechanisms are addressed in all modified versions of the intervention.

1.6.1.6 Stage 5

Stage 5 concerns research on the implementation and dissemination of the intervention to benefit the community. This type of research typically focuses on the factors that facilitate the implementation of the intervention into the existing (health-care) system (Onken et al., 2014).

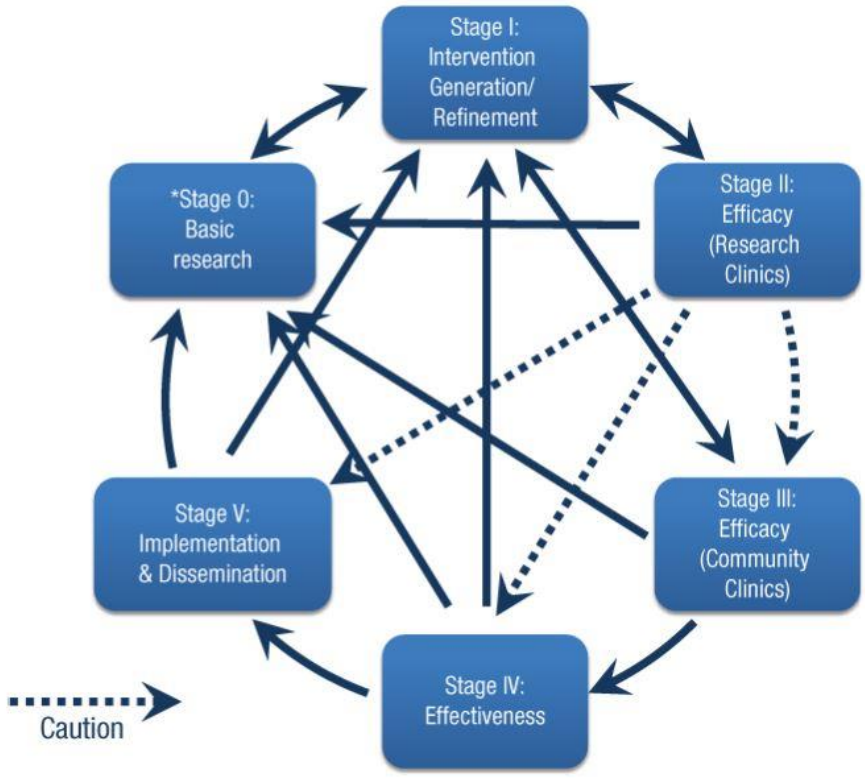


Figure 1.1 NIH Stage Model of Intervention Development. Reproduced from Onken, L.S., Carroll, K.M., Shoham, V., Cuthbert, B.N., Riddle, M., 2014. "Reenvisioning Clinical Science: Unifying the Discipline to Improve the Public Health". Clin Psychol Sci 2, 22–34. *Note.* Solid arrows represent recommended pathways; dotted arrows represent steps that should be undertaken with caution.

1.7 Relevant Clinical and Theoretical Accounts

In keeping with the NIH Model, the search for causes, maintaining factors and mediators of IBS symptoms should be guided by theory. The Cognitive Therapy (CT) model developed by Aaron Beck (1976; 1979) and the Differential Activation Hypothesis (DAH) developed by Teasdale (1988) provide two useful, related theoretical accounts that can guide the exploration of the psychological factors implicated in IBS. Both models were developed to understand depression and subsequently became frameworks for human cognition and its relationship to well-being in a broader sense (Fennell & Segal, 2011). Accordingly the CT model and the DAH have been applied to a wide range of psychological and physiological conditions to create illness specific models. So far, CT has been the main theoretical account upon which the development of psychological treatments for IBS was based. In this thesis the DAH, an extension of the CT model, will guide the

exploration of maintaining factors and treatments for IBS. To provide context for the history of these treatments as well as a solid base for the development of a new treatment as part of this thesis, both theories will be described here. In addition, Attentional Control Theory (Eysenck & Derakshan, 2011; Eysenck, Derakshan, Santos, & Calvo, 2007) which was developed to explain cognitive deficits in patients with anxiety may also offer some useful insights into potential maintaining factors of IBS. The theories are described in more detail below and their application for patients with IBS will be discussed in this Chapter, as well as Chapters 2, 3 and 5.

The CT model (Beck, 1976; Beck et al., 1979) states that thoughts, emotions and behaviours mutually influence each other. Specifically, maladaptive cognitions such as dysfunctional thoughts and cognitive distortions are seen as maintaining factors of psychopathology through their influence on emotions and behaviours. Maladaptive cognitions such as automatic negative thoughts are powerfully influenced by underlying core beliefs (i.e., schema) and assumptions about oneself and the world. Within this model, a maladaptive core belief (e.g., "I am not good enough") informs unhelpful assumptions (e.g., "I have to be perfect at everything I do") which, when triggered by an event (e.g., failing a test) can set off an avalanche of negative automatic thoughts and ensuing low mood (Fennell & Segal, 2011). Furthermore, the underlying core beliefs guide the encoding, interpretation and retrieval of information under most circumstances (MacLeod, 1990) and thus influence how a person perceives and interprets events.

The DAH has added a crucial theoretical component, 'cognitive reactivity', to the cognitive science account of depression and human cognition in general (Lau, Segal, & Williams, 2004; Teasdale, 1988). Cognitive reactivity is the assumption that with each repeated episodes of depression, stronger associations are formed between low mood and negative, maladaptive thinking patterns. As a consequence, even mild episodes of low mood or other symptoms (e.g., fatigue) during remission can trigger maladaptive thinking patterns (Fennell & Segal, 2011; Lau et al., 2004). Crucially not only the content of cognition is re-activated, but also how they are processed – that is loaded with self-referent, negative meaning and based on the assumption that thoughts are reflecting the truth. The conclusion drawn from this account is that the way patients

'relate to' their cognitions (and other internal events) rather than the content of the cognitions per se is a vital mechanism for affect instability in depression. The overarching concept - how people relate to their experiences determines the impact of these experiences- is, just as the CT model, applicable to human mental and physical health in general.

Finally, among the theoretical accounts for anxiety disorders, Attentional Control Theory (ACT) explains effects of anxiety on both dysfunctional cognitive biases and executive functioning (Eysenck & Derakshan, 2011; Eysenck et al., 2007) and puts them in relation to dysfunctional cognition. This renders ACT uniquely suited to study thought, executive functioning and biased processing in IBS patients. Specifically, ACT proposes that anxiety impairs the efficient functioning of the executive functions related to intentional, goal related attention and favours stimulus driven processing (Eysenck & Derakshan, 2011; Eysenck et al., 2007). Attentional control is an important inhibitory executive function that is responsible for limiting the interference of irrelevant stimuli, including dysfunctional thoughts. According to the theory, anxiety decreases attentional control, and increases attention to threat-related stimuli.

1.7.1 Psychological factors in irritable bowel syndrome

Consistent with the NIH stage model, relevant and promising intervention targets should be identified from the existing literature (e.g., possible mediators and predictors of symptom improvement) and compared to the theoretical accounts. The aim of this step is to generate a knowledge base which informs the development of the intervention. Identified psychological factors can be targeted in psychological interventions and their role in symptom improvement can then be tested. Laying out the existing knowledge based also helps to recognize psychological factors which may not have been considered previously.

Generally, co-morbid psychological disorders adversely affect symptom burden, quality of life, overall functioning and prognosis of patients with a chronic medical condition (Dindo & Lackner, 2017; Löwe et al., 2008). A recent survey of the general population in the Netherlands that involved over 90,000 participants showed that people with IBS have higher rates of mood and

anxiety disorders compared to participants without a functional somatic syndrome (FSS) (Janssens, Zijlema, Joustra, & Rosmalen, 2015). For example the rate of any anxiety disorder in participants with IBS was twice as high (16.9%) as that in people without any FSS (8.4%), however it is lower than that of patients with Chronic Fatigue Syndrome (24%) or Fibromyalgia (18%). The prevalence of psychological comorbidities is even higher in IBS patients who seek treatment. For example, up to 94% of patients with IBS have a lifetime diagnosis of a psychiatric disorder, most commonly anxiety and depression (Whitehead, Palsson, & Jones, 2002). The prevalence of recurrent depression in patients with IBS is not well recorded, however in tertiary care (gastroenterology clinics), between 42-61% of IBS patients have a current co-morbid Axis I psychiatric illness, which is greater than the prevalence of psychiatric illnesses with an organic gastrointestinal disorder (< 25%) (Gaynes & Drossman, 1999). In addition, the risk of developing IBS is greater in individuals with a diagnosis of a depression or anxiety disorder than in people without such a psychological illness (Sibelli et al., 2016). This suggests that there may be shared vulnerabilities between IBS and mental health disorders. However, despite the apparent higher degree of psychological illnesses in IBS patients, many people with IBS also do not have a co-morbid psychiatric illness (Janssens et al., 2015). Moreover, it has been shown that psychiatric illnesses can, but do not always precede the onset of IBS (Koloski, Jones, Talley, & Talley, 2016; Sibelli et al., 2016; Sykes, Blanchard, Lackner, Keefer, & Krasner, 2003). This suggests that the presence of a mood or anxiety disorder is not a pre-requisite for the development of IBS, however it also points to a bi-directional pathway between brain and gut (Koloski et al., 2016). Finally, due to the apparent overlap of psychological and physiological symptoms, and the findings that psychological problems can precede illness onset, some treatments for IBS have aimed to reduce IBS symptom severity through reducing psychological distress (Greene & Blanchard, 1994; Jones, Koloski, Boyce, & Talley, 2011; Lackner et al., 2007; Payne & Blanchard, 1995). It is important to note that evidence relating improvements in psychological distress to improvements in IBS symptoms is mixed (Chilcot & Moss-Morris, 2013; Henrich et al., 2015; Jones et al., 2011; Lackner et al., 2007). For example, a recent meta-analysis found that across a variety of treatment approaches (48 randomized treatment studies), improvements in psychological distress were

associated with improvements in IBS symptoms (Henrich et al., 2015). Similarly, Jones (2011) found that CBT was related to reductions in anxiety and depression, which was in turn related to IBS symptom changes which led to further reductions in anxiety and depression. In contrast, using structural equation modelling on a previously published three-arm randomized controlled trial of CBT for IBS (Blanchard et al., 2007), Lackner and colleagues (2007) found that changes in psychological distress did not precede changes in symptom severity. A more recent mediation analysis of CBT (self-management) for IBS found that the intervention had no effect on anxiety and depression (Chilcot & Moss-Morris, 2013), indicating that symptom changes can occur in the absence of improvements on psychological distress. Finally, a study investigating psychodynamic interpersonal therapy and antidepressants in the treatment of IBS also found that the therapeutic effects of either psychological or pharmacotherapy on pain severity and health related quality of life were independent from the treatment's effect on symptoms of depression (Creed et al., 2003).

Taken together the evidence suggests that even though there might be shared vulnerabilities involved in the development of IBS and mental health disorders, a mental illness may neither be the cause nor a crucial maintaining factor of IBS for many patients. However, given that psychological distress generally increases the burden of chronic illnesses, improvements in depression and anxiety in patients with IBS are a desirable treatment outcome.

Evaluations of cognitive mediators in psychological treatments for IBS have repeatedly shown that changes in visceral anxiety sensitivity and pain/IBS catastrophizing predict changes in IBS symptom severity and IBS related quality of life when treated with CBT or Mindfulness-Based Stress Reduction (MBSR) (Garland et al., 2012; Hunt, Moshier, & Milonova, 2009; Labus et al., 2013; Ljotsson et al., 2013; Wolitzky-Taylor, Craske, Labus, Mayer, & Naliboff, 2012). Pain and IBS catastrophizing describes the magnification of the meaning and the consequences of pain and IBS symptoms, also referred to as an 'exaggerated, negative mental set' (Hunt, Ertel, Coello, & Rodriguez, 2014b; Sullivan et al., 2001; Sullivan, Bishop, & Pivik, 1995) (e.g.,"It's terrible and I think it's never going to get any better" (Sullivan, 2009)). The term visceral anxiety sensitivity refers to anxiety about gastrointestinal sensations and the context in which they may occur (Labus

et al., 2004). It also refers to near constant awareness that IBS could interfere with activities and hypervigilance of abdominal sensations (Labus et al., 2004). Results of a recent review of change mechanisms in psychological treatments for IBS support the conclusion that illness specific cognitions such as catastrophizing and visceral anxiety sensitivity and illness specific behaviours predict IBS symptom severity (Windgassen et al., 2017). This suggests, that although pain catastrophizing and visceral anxiety sensitivity may not have caused IBS in the first place, these cognitions may maintain the illness once it has commenced. Mediation studies that explore these illness-specific factors will be reviewed in Chapter 5.

1.7.1.1 How does theory account for these findings?

Both CT and the DAH would predict that the presence of illness specific cognitions in patients with IBS (i.e., catastrophizing and visceral anxiety sensitivity) is maladaptive and contributes to symptom severity. Whereas from the perspective of CT the occurrence and content of these thoughts is seen as problematic, the DAH would predict that the processing of these cognitions as self-referential and true (e.g., that the thought "IBS will ruin my life" is true) contributes to their power to maintain the illness. Thus illness specific cognitions appear to be important maintaining factors and therefore potential treatment targets.

1.7.2 Cognitive biases in IBS

In the development and evaluation of therapies for psychiatric disorders, illness specific cognitive biases have played an important role for both understanding psychiatric disorders and how treatments exert their effect. Similarly, evidence of altered cognitive processes in patients with IBS would supply valuable information for the development of psychological treatments for IBS as well as the selection of specific treatment components. This would be particularly true if altered implicit cognitive processes were shown to contribute directly or indirectly to IBS symptom severity.

This strategy was informed by studies that showed implicit biases in patients with depression and anxiety as well as changes in these biases as a result of treatment. Particularly, experimental studies revealed that patients with depression often show a lower recognition of

positive facial expressions (Harmer et al., 2009b). This was considered a risk mechanism and it was consequently demonstrated that pharmacological agents associated with symptom amelioration facilitate recognition of positive facial expressions in depressed patients after only 1 dose of antidepressant (Harmer et al., 2009a, 2009b). In another study it was shown that changes in cognitive biases after one session of exposure based CBT for panic disorder both precede and predict clinical symptom changes (Reinecke, Waldenmaier, Cooper, & Harmer, 2013). In both cases, subconscious cognitive changes were measurable after a small dose of the treatment (Harmer et al., 2009b; Harmer et al., 2011; Murphy et al., 2008; Reinecke et al., 2013). These studies demonstrate the link between basic and clinical science that is advocated by the NIH stage model. The idea that changes in subconscious biases after a small dose of treatment can predict treatment efficacy and may therefore be relevant for the development of a new treatment for IBS will be explored in this thesis.

The presence and role of implicit cognitive biases in IBS patients has been the focus of some experimental studies. For example, hypervigilance, an automatic cognitive process that serves the rapid detection of symptom cues has been found in patients with IBS (Afzal, Potokar, Probert, & Munafò, 2006; Chapman & Martin, 2011; Kristy Phillips, Wright, & Kent, 2014; Tkalcic, Domijan, Pletikosic, Setic, & Hauser, 2014). In addition, one study found a subtle deficit in episodic visuospatial memory in IBS patients, which was correlated with altered morning cortisol levels (Kennedy et al., 2013). This was interpreted as evidence for a possible link between the HPA-axis and cognitive performance (Kennedy et al., 2013). However, despite the detection of these cognitive biases in IBS patients and efforts to link these with neurobiological and hormonal dysfunction, translational studies that link these findings from basic science with the development of psychological interventions have not yet been conducted. Such a translational approach is likely to aid the understanding of the mechanisms of change in the treatment of IBS with psychological therapies.

1.7.2.1 How does theory account for these findings?

Given the high prevalence of anxiety and visceral anxiety sensitivity in patients with IBS, ACT would predict the presence of hypervigilance for symptoms (which was found in several studies). Hypervigilance is a form of stimulus driven processing that is aimed at detecting threat quickly and should therefore be heightened in IBS patients with anxiety and visceral anxiety sensitivity.

1.7.3 Hypothesized maintaining factors of IBS

In line with the NIH model, potential psychological maintaining factors, including altered implicit cognitive processes, as well as mediators of treatments should be derived from theory and previous empirical findings (Onken et al., 2014). Therefore the above mentioned theoretical accounts and findings from the literature were combined to hypothesise about altered cognitive processes and their role as maintaining factors in patients with IBS.

1.7.3.1 Biased implicit self-referential processing

In the context of recurrent depression (i.e., the mood disorder, whose recurrence the DAH seeks to explain), "cognitive reactivity" (re-activated depressive *content* and *processing*) has been highlighted as maintaining and triggering factors of depressive episodes (Lau et al., 2004; Segal, Williams, & Teasdale, 2013). Importantly, cognitive reactivity is often characterized by overly identifying with symptoms (e.g., feeling low again means that I am a fragile person) and 'discrepancy-based processing' of symptoms (Williams, 2008). Discrepancy-based processing is a typical reaction to unpleasant experiences that involves a focus on the perceived distance between current and idealized self-representations (van der Velden et al., 2015) and mental elaboration (e.g., rumination) in an attempt to close this perceived distance (Williams, 2008). Ironically, mental attempts to reduce or eliminate unwanted experiences such as negative thoughts, low moods and painful sensations by cognitively elaborating on them (i.e., by using discrepancy based processing) often perpetuate rather than solves the problem (Watkins & Moulds, 2005).

Applying the concepts implicit cognitive processes and of cognitive reactivity to patients with IBS, it is proposed that IBS patients implicitly identify with their illness and engage in

implicit discrepancy-based processing in the form of reduced identification with health (i.e., self-health discrepancy). Within this thesis, the combination of these two processes will be referred to as implicit "biased self-referential processing of illness and health". In line with the DAH, we hypothesize that the degree to which IBS patients implicitly process illness and health self-referentially is related to IBS symptom severity. This will be explored in more detail in Chapter 2, including other transdiagnostic approaches (e.g., the Schema Enmeshment Model of Chronic Pain) that produce similar predictions.

1.7.3.2 Attentional control

Theoretical predictions and empirical findings in the literature point to the potential role of attentional control in IBS. To begin with, attentional control is an important executive function related to complex cognitive tasks important for mental health (Diamond, 2013). Briefly, attentional control (often referred to as executive attention (Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Fan, McCandliss, Sommer, Raz, & Posner, 2002) is an executive cognitive function that relates to an individual's ability to pay attention to an intended point of focus (e.g., an object or a task) and to ignore distraction. It involves sustained attention as well as monitoring and resolving responses to conflicting information (e.g., distracting information) (Fan et al., 2002). It is said to contain two functions, an inhibition function that "prevents task-irrelevant stimuli and responses from disrupting performance" (Eysenck & Derakshan, 2011, p. 956) and a shifting function that allocates attention to the most relevant stimuli to enhance performance (Eysenck & Derakshan, 2011). In this thesis, the inhibition function of attentional control will be investigated, and hereafter the term attentional control will refer to the inhibitory function of attentional control. Given previous findings of stimulus driven processing (i.e., hypervigilance), and higher levels of anxiety and visceral anxiety sensitivity in patients with IBS, Attentional Control Theory (ACT) would predict that patients with IBS have lower levels of attentional control. Importantly, low attentional control has been associated with maladaptive cognitive thinking styles such as worrying and catastrophizing (Fox, Dutton, Yates, Georgiou, & Mouchlianitis, 2015; Heathcote et al., 2015). For example, Fox and colleagues (2015) showed that deficits in attentional control were associated

with greater difficulty in controlling negative thought intrusions and that "improvements in attentional control were associated with improvements in the ability to suppress worry related thought intrusions" in people with pathological worries (Fox et al., 2015, p. 593). Similarly, in IBS patients, the degree of IBS catastrophizing could be partly dependent on their levels of attentional control, where higher catastrophizing relates to lower attentional control. This may be due to a reduced ability to disengage from distracting catastrophic thoughts. Understanding attentional control in IBS patients and how it relates to IBS catastrophizing may be helpful in developing treatments for IBS. Chapter 3 describes a study that investigated whether patients with IBS have lower attentional control compared to healthy participants and whether levels of attentional control are related to levels of catastrophizing in patients with IBS.

1.8 Previously Developed Psychological Treatments for IBS

In the process of developing a new psychological intervention it is important to map the effects, feasibility of implementation and user acceptability of existing treatments. This provides an overview from which opportunities for improvement can be identified. Given the evolving complexity of the aetiology of IBS, many different treatment types have been developed that focus on targeting different causes and maintaining factors (e.g., depression, illness specific cognitions and behaviours) (Ford et al., 2014, 2009; Foxx-Orenstein, 2016; Halland & Saito, 2015; Henrich et al., 2015; Lackner et al., 2004; Rao et al., 2015; Spiller et al., 2007).

Several meta-analyses and reviews have established that psychological treatments for IBS can reduce the symptom severity and increase mental health, daily functioning and quality of life of patients with IBS (Ford et al., 2014, 2009; Henrich et al., 2015; Lackner et al., 2004; Laird, Tanner-Smith, Russell, Hollon, & Walker, 2017; Li, Xiong, Zhang, Yu, & Chen, 2014). The positive effects on IBS symptom severity appear to be stable over short (1-6 months) and longer-term (6-12 months) follow-up periods and in many cases the effect sizes at follow-up are greater than those observed directly after treatment (Laird, Tanner-Smith, Russell, Hollon, & Walker, 2016).

The most common psychological treatments for IBS are 1) cognitive behavioural therapy (CBT), 2) cognitive therapy, 3) interpersonal psychotherapy, 4) gut-directed hypnotherapy and 5) relaxation. Most recently, Mindfulness-Based Interventions (MBIs) have shown promising results (Gaylord et al., 2011; Zernicke et al., 2013). In the UK, cognitive behavioural therapy, hypnotherapy and psychotherapy are the recommended psychological treatments for IBS patients whose symptoms do not respond to pharmacological agents (National Institute for Health and Care Excellence [NICE], 2008, updated 2017). While there is reported efficacy for each of these psychological treatment approaches (Ford et al., 2014, 2009; Henrich et al., 2015) the best available evidence (in terms of quantity and quality of studies) exists for interventions based on CBT (Enck et al., 2016), where medium to large effect sizes for reductions in symptom severity have been reported (Ford et al., 2014). However it should be noted that superiority of CBT compared to other treatments (direct comparison) has not been established (Enck et al., 2016).

Psychological therapies are not offered routinely to IBS patients (only if IBS symptoms persist after twelve months of first line treatment options, e.g., low FODMAP diet, laxatives, anti-depressants (National Institute for Health and Care Excellence [NICE], 2008; NHS, 2014)). This may be because high quality interventions are costly for the health care system and CBT for IBS has been evaluated as cost-ineffective in the long term (McCrone et al., 2008). An ongoing trial is therefore evaluating and comparing the clinical-effectiveness and cost-effectiveness of therapist-delivered CBT (via telephone) and web-delivered CBT (Everitt et al., 2015). Given the sheer size of the population that suffers from IBS (nearly 13% in the UK) a resource-saving, effective psychological treatment for IBS is needed.

1.9 A new Psychological Treatment for IBS

The available evidence points to the need to develop a group-based treatment that effectively targets the maintaining factors of IBS. To develop this treatment and to be able to test the hypothesised mechanisms of change of this treatment, it is important to provide a treatment model that delineates the known and hypothesised maintaining factors.

1.9.1 Treatment model

In this treatment model, illness-specific cognitions (i.e., visceral anxiety sensitivity and catastrophizing) are important maintaining factors that contribute to IBS symptoms and act as mediators of treatment. Based on the Differential Activation Hypothesis (DAH) it is suggested that an IBS patient's relationship to these illness-specific thoughts is more important than the content of these thoughts. Similarly, how patients relate to their illness and, as a result, the degree to which illness and health are processed self-referentially is hypothesized to directly or indirectly perpetuate the illness. Based on ACT and empirical findings linking attentional control to dysfunctional cognitions and attentional biases (i.e., hypervigilance), it is also suggested that low attentional control, through its hypothesized relationship with catastrophizing, could be indirectly perpetuating IBS symptoms. Based on this model, how patients relate to their symptoms and thoughts about symptoms and control over attention should be targeted in treatment.

1.9.2 Addressing the hypothesized maintaining factors

The literature has shown that both CBT and Mindfulness-Based Cognitive Therapy (MBCT) are effective for patient groups whose illness is assumed to be maintained and exacerbated by disordered cognitions (Fennell & Segal, 2011). For example, CBT has been successfully applied to a wide range of conditions, including psychological (e.g., anxiety) and physical health problems (e.g., fibromyalgia). MBCT was originally developed for patients with recurrent depression (Segal, Williams, & Teasdale, 2002; Segal et al., 2013) and it has been shown to be effective in reducing its recurrence (Kuyken et al., 2008). It has since then been adapted to several other conditions, including chronic fatigue syndrome/ME (Rimes and Wingrove, 2013), health anxiety (Surawy et al., 2014), disordered eating (Baer et al., 2005), bipolar disorder (Miklowitz et al., 2009; Williams et al., 2008) and people at risk of suicide (Williams et al., 2015). In practice, MBCT is a fusion of mindfulness meditation rooted in both Buddhist philosophy, as introduced in Mindfulness-Based Stress Reduction (MBSR), and cognitive science (Fennell & Segal, 2011). It is delivered in a secular, non-religious way, usually in a group setting.

Whilst both MBCT and CBT use a similar disease models (i.e., dysfunctional cognitions and behaviours are part of the general treatment model) they are based on divergent theoretical accounts. CBT is based on the cognitive therapy account whilst MBCT is built upon the Differential Activation Hypothesis (DAH). Both CBT and MBCT aim to reduce the underlying cognitive vulnerabilities such as maladaptive cognitions, yet they implement different treatment approaches. Whilst both types of therapies facilitate the recognition of unhelpful thought patterns, CBT encourages patients to approach these analytically (e.g., examining their accuracy) and to reframe them more adaptively with the goal to eventually reduce their occurrence. From the MBCT perspective the vulnerability lies in the relationship a person holds with thoughts, emotions and physical sensations, rather than in their content and therefore MBCT addresses this relationship explicitly (Segal et al., 2013; Surawy, McManus, Muse, & Williams, 2014). Whilst the CBT approach may change the perspective on thoughts indirectly, as a consequence of analysing and challenging thoughts, MBCT employs aspects of CBT (e.g., psychoeducation) and Mindfulness-Based Stress Reduction (MBSR; e.g., mindfulness meditation) to develop a decentred perspective (Baer, 2003; Segal et al., 2013). This decentred perspective is characterized by a focus on the present moment, curiosity and a non-judgemental observing stance towards the elements of the present moment (i.e., thoughts, emotions, sensations). Repeatedly practising this decentred perspective is thought to reduce self-referent negative processing of experiences (Segal et al., 2013).

In the case of IBS, a patient's relationship to IBS-specific cognitions (visceral anxiety sensitivity, pain/IBS catastrophizing) could thus be addressed indirectly through CBT and more directly through MBCT. There is empirical support that both CBT and mindfulness-based treatments can reduce IBS specific cognitions, and improve symptoms as well as quality of life (Garland et al., 2012; Gaylord et al., 2011; Hunt et al., 2009; Labus et al., 2013; Wolitzky-Taylor et al., 2012). Theoretically, MBCT, with its aim to establish a decentred perspective (Segal et al., 2013; Williams, 2008), should be able to reduce the impact of these IBS-specific cognitions by changing how patients relate to their thoughts and symptoms. As such a case can be made for both

CBT and MBCT for patients with IBS. Additional findings supporting the DAH's focus on processing rather than content when applied to patients with IBS would provide additional empirical support for adapting MBCT to patients with IBS.

For example, if as hypothesized, IBS patients showed biased implicit self-referential processing of illness and health, it could be argued that a treatment which specifically targets how illness and health related information is processed would be suitable. Specifically, decentring and interoceptive awareness (awareness of stimuli arising within the body), both cognitive abilities theorised to be trained with mindfulness mediation (Crane et al., 2016; Farb et al., 2015; Segal et al., 2013), may be critical in attenuating cognitive biases relating to self-referential processing of illness and health relevant stimuli. In addition, if patients with IBS show reduced attentional control, then a suitable new treatment should include techniques that can increase attentional control. Although ACT explains how anxiety may affect attentional control, it does not specify which types of techniques should be used to train it. Several researchers have proposed that attentional control is a mechanism of action of mindfulness meditation. For example Hölzel, and colleagues (Hölzel et al., 2011; Tang, Hölzel, & Posner, 2015) suggested that attentional control (also referred to as attentional regulation) is one key mechanisms (next to emotion regulation and self-awareness) that leads to improved self-regulation. In a different model, Shapiro and colleagues (2006) suggest that the practice of mindfulness should lead to improvements in sustained (focused) attention, the ability to shift attention and to cognitive inhibition (i.e. "the ability to inhibit secondary processing of thoughts, feelings and sensations" (Shapiro et al., 2006, p. 367)). Sustained (focused) attention and cognitive inhibition closely relates to attentional control: It involves focusing on one object whilst inhibiting or ignoring distracting information (conflict monitoring). Therefore, MBCT, with its concentrative meditation practices, may have the potential to increase attentional control. The meditation practices taught in MBCT are thought to train "the ability to deploy and maintain attention on a particular focus" (Segal et al., 2013, p. 91) which is akin to attentional control. Indeed, previous studies have shown that training in mindfulness can improve attentional control (Ainsworth, Eddershaw, Meron, Baldwin, & Garner, 2013; Becerra,

Dandrade, & Harms, 2017; Tang et al., 2007). However, even though theories emphasize the role of attentional control and attentional regulation, no study has yet tested attentional control as a change mechanism (Gu, Strauss, Bond, & Cavanagh, 2015). In addition, no study has tested specifically if MBCT can affect attentional control and if mindfulness induced changes in attentional control are predictive of changes in self-reported outcomes such as improved concentration or reduced catastrophizing.

1.9.3 Adapting a treatment approach to patients with IBS

Subject to the results of the basic science studies of this thesis, an existing treatment protocol would be adapted to target the identified risk and maintaining factors of IBS. Particularly extending mindfulness based interventions to new conditions may require modifications to the original programme to address the specific mechanisms of patients with that condition (Dimidjian & Segal, 2015) (i.e. in stages 0 and 1 in the NIH model). For example, using theory and empirical evidence, MBCT has been adapted to different patient groups by placing the emphasis on experiences relevant to each particular illness (Fennell & Segal, 2011). This process will be described in Chapter 5 of this thesis.

1.9.4 Testing mechanism of change

It is not yet known at which time-point the new treatment would affect implicit cognitive biases. Therefore it is necessary to conduct a proof of concept study that identifies the likely time-point of such changes (the dose of treatment that is necessary to affect implicit cognitive processes) and if they are related to relevant outcomes. These findings could then be used in the development of a new treatment for IBS and in the design of a study that investigates mechanisms of change.

1.10 Thesis Objectives

The goal that spans over the chapters of this thesis is to use a translational approach that applies both basic and clinical science to develop an effective psychological treatment for patients with IBS. The first objective of this thesis was therefore to conduct stage 0 experimental research to identify new cognitive maintaining factors of IBS. The second objective was to investigate

suitable time points during an intervention to measures changes in these maintaining factors. The third objective was to combine findings from the literature and experimental research conducted as part of this thesis to develop a new psychological treatment for patients with irritable bowel syndrome (stage 1A of the NIH model). The fourth objective was to evaluate the efficacy of this treatment in reducing IBS symptom severity and increasing quality of life using a randomized controlled trial design. Finally, the fifth objective was to examine mechanisms of change in the new treatment for irritable bowel syndrome, having integrated basic cognitive science research into the design of the trial. The last two objectives broadly combine the NIH stage 1B (pilot testing) and NIH stage 2 (efficacy testing) in clinical research settings.

1.10.1 Thesis outline

1.10.1.1 Chapters 2 and 3

Chapters 2 and 3 report the results of a cross-sectional study (Cognitive and Emotional Factors in illness and health (CEFIH)) that compared 42 patients with IBS with 41 healthy participants on implicit self-referential processing of illness and health and attentional control. The study's aims were to identify implicit cognitive mechanisms that play a role in IBS symptom severity and dysfunctional illness cognitions (i.e., catastrophizing).

1.10.1.2 Chapter 4

Chapter 4 describes a proof of concept study with 32 participants in an "MBCT for students" course and 32 students in a control condition. The main objective of the study was to identify if MBCT for students induces changes in attentional control and when these changes would be detectable. In addition it was examined if change in attentional control early in the course is predictive of changes in self-reported concentration and anxiety. The results informed the design of the study described in Chapters 6 and 7 (Mindfulness for Irritable Bowel Syndrome (MIBS)).

1.10.1.3 Chapter 5

Chapter 5 describes the development of MBCT for IBS. It explicitly explains the rationale for applying and adapting MBCT for patients with IBS. The Chapter outlines the structure and

content of MBCT for IBS and links its treatment techniques (specific intervention content/modules) to the hypothesized mechanisms of change.

1.10.1.4 Chapter 6

The results of the MIBS study, a randomized controlled trial that evaluated the effect of MBCT for IBS on IBS symptom severity; IBS Quality of life; and psychological distress (depression, anxiety and stress), are presented in Chapter 6. Sixty-seven patients with IBS participated in this study and were allocated to the immediate treatment group or a waiting-list control group. Results are reported both with the intention to treat (ITT) and per protocol sample.

1.10.1.5 Chapter 7

Mechanisms of change in MBCT for IBS were examined in Chapter 7. Here, self-reported cognitive factors (visceral anxiety sensitivity, pain-catastrophizing, IBS-catastrophizing, non-judgemental awareness) and implicit cognitive processes (implicit self-referential processing of illness and health, attentional control) were included in mediation analyses to determine how MBCT for IBS exerts its influence on IBS symptom severity.

1.10.1.6 Chapter 8

A summary of the results from Chapters 2-7 will be presented and subsequently discussed within the context of the recent literature pertaining to cognitive factors in IBS and MBCT. In addition, the strength and limitations of the thesis will be described. Finally, ideas and recommendations for future research will be presented before the final conclusions are drawn.

Chapter 2: Biased Implicit Self-referential Processing of Illness and Health in Patients with Irritable Bowel Syndrome (IBS)

2.1 Abstract

2.1.1 Objectives

I investigate to what degree the processing of illness and health is self-referential in patients with IBS. In addition, I will examine if the degree of bias in self-referential processing of illness and health is related to IBS symptom severity and additional physical and psychological variables.

2.1.2 Methods

In this cross-sectional study, 42 participants with IBS and 41 healthy participants completed an Implicit Association Test (IAT) to measure the degree of identification with illness and health. Data on illness duration, explicit illness associations, IBS severity, depression, anxiety and stress and additional symptoms were obtained.

2.1.3 Results

IBS patients scored significantly lower on identification with health than healthy participants. The level of identification with health was correlated with 'Nonspecific Somatic Symptoms' in IBS patients.

2.1.4 Conclusion

Reduced health identification is associated with irritable bowel syndrome and it may be a maintaining factor of the illness. Psychological treatments could target this implicit bias and it may be possible to use the IAT to monitor the course of recovery.

2.2 Introduction

In this chapter I aim to explore whether cognitive self-referential reactions to symptoms could be a maintaining mechanism for somatic symptom severity in IBS patients compared to healthy volunteers and to discuss possible clinical implications. As described in Chapter 1, the focus on reactions to symptoms as a risk and maintaining factor has been highlighted by the Differential Activation framework in the context of recurrent depression (Lau et al., 2004; Teasdale, 1988). The DAH emphasises *reactions* to symptoms, specifically *cognitive reactivity* as an important variable driving the maintenance of affect instability. Cognitive reactivity is typically characterized by over-identifying with symptoms and discrepancy-based processing (i.e., attempts to reduce the gap between current and desired experience, (Williams, 2008)). Whilst discrepancy-based processing is an understandable response to aversive thoughts and feelings, the strategies typically evoked to deal with it – such as suppression, avoidance and rumination – predominantly backfire (Abramowitz, Tolin, & Street, 2001; Magee, Harden, & Teachman, 2012; Watkins & Moulds, 2005; Wenzlaff & Wegner, 2000). For example, it has been shown that suppression paradoxically increases the intensity and frequency of intrusions rather than reducing them (Abramowitz et al., 2001; Magee et al., 2012; Wenzlaff & Wegner, 2000). Thus, an individual's reactions to their experiences are perceived as impactful (Lau et al., 2004). Whilst the DAH provides a cognitive account specifically for relapse/recurrence of depression, the underlying mechanism has been seen as important trans-diagnostically, including in pain conditions (Hayes, Follette, & Linehan, 2004).

Applied to IBS, over-identification with symptoms and discrepancy-based processing could be a maintaining factor of the illness. I was specifically interested in the *implicit* manifestation of cognitive reactivity due to the correlation that has been found between implicit cognitive biases and symptom severity in the treatment of psychiatric disorders (Harmer, O'Sullivan, et al., 2009; Harmer et al., 2011; Harmer, Goodwin, et al., 2009; Murphy et al., 2008; Reinecke, Waldenmaier, et al., 2013) (see Chapter 1). To study these processes in patients with IBS I defined over-identification as "implicit identification with the illness" and discrepancy-based

processing as "implicit self-health discrepancy". Together, these processes are referred to as "biased self-referential processing of illness and health". Implicit self-health discrepancy will also be referred to in the context of identification with health: reduced identification with health signifies greater self-health discrepancy.

The emphasis on reactions to symptoms as a maintaining factor is also proposed by Pincus and Morley (Pincus & Morley, 2001) in their Schema Enmeshment Model of Pain. They postulate that as a result of (over-) identification, illness-related information (e.g., pain) may be classified as highly relevant to the self and may thus be processed more elaborately. Prioritised processing of illness-congruent information as a result of self-illness enmeshment is one of the model's principles of prioritising information. The model also assumes that the discrepancy between actual and ideal selves causes distress in patients with chronic pain. The perceived distance between the actual and the ideal-self is directly related to the prioritised processing of illness-congruent information (Pincus & Morley, 2001). In addition, the repeated comparison between the actual-self and the ideal-self, a process described by self-discrepancy theory (Higgins, 1987) may be a form of implicit discrepancy-based processing that reduces the identification with health. Patients may de-identify from what they perceive not to be - healthy, strong and resilient (i.e., aspects of their ideal-healthy-self). Hence, self-referential processing of illness-related information reinforces a focus on aversive symptoms such as pain, increases the discrepancy between the actual-self and the ideal-self (including the ensuing distress) and is thus maladaptive. The Schema Enmeshment Model, although it was developed for patients with chronic pain, has many similarities with the DAH. Parallels exist in terms of the focus on reactions to symptoms that contribute to symptom exacerbation. In particular the reaction to symptoms involves both an over-identification with symptoms and a process that focuses on the discrepancy between actual and ideal self-states. In both models, the relationship to symptoms is characterized by negative, self-referent processing which is hypothesized to be a crucial maintaining factor (Lau et al., 2004; Pincus & Morley, 2001; Teasdale, 1988). Based on both models, I suggest that a capacity to reduce biased self-referential processing of illness and health is a meaningful therapeutic goal.

How might self-referential processing of the illness develop in IBS patients? The Schema Enmeshment Model specifies that in patients with a chronic pain condition, enmeshment between the self, illness and pain schemas (i.e., illness identification, pain identification) is a function of frequent, concurrent activation of the self and the pain/illness schema under distress, for example when pain interferes with personal goals. Within this model it is thus the chronic, disruptive nature of IBS that is thought to strengthen the association between the self and illness concepts. From the perspective of the DAH, the degree of self-referent processing may vary within the IBS population, based on the interpretation of the events (e.g., if symptoms or their interference with plans is interpreted as particularly negative, identification with illness may be stronger). In support of these predictions, pain-self schema-enmeshment was recently found in patients with chronic pain (Van Ryckeghem et al., 2013). In addition, it is likely that at an explicit level, IBS patients will find illness-related material particularly relevant to themselves, because their illness may play a prominent role in their lives.

There are several reasons why self-referential processing of *illness in general* might be particularly pronounced in the IBS population. Individuals with IBS often experience many other symptoms in addition to pain, diarrhoea and constipation, namely a feeling of urgency, and feeling nauseous. They also frequently attribute unrelated symptoms to be part of their IBS, for example 50% reported fatigue, 30% reported headaches and hot or cold spells and sweating and 25% reported palpitations, racing heart or chest pains as part of their IBS (Martin & Crane, 2003). Hence I propose that an illness schema in IBS is likely to be activated by symptoms that the individual believes to be part of their illness rather than being limited to abdominal symptoms, and that enmeshment between the general illness schema and the self signifies illness identification. It is this self-referential processing of *illness and health in general* that is problematic, as a wide range of somatic sensations throughout the body are likely to trigger maladaptive coping strategies such as avoidance or hypervigilance. Self-referential processing of illness and health is likely to be represented on a continuum and an individual's place on this continuum is likely to be influenced by that individual's association with both illness and health.

I hypothesised that compared to healthy participants, IBS patients (1) will implicitly identify with illness, (2) will show implicit self-health discrepancy (reduced identification with health) and (3) will explicitly associate more with illness than health. I hypothesised that in IBS patients only, IBS severity, illness duration, presence of additional unrelated somatic symptoms and explicit illness associations will be positively correlated with biased self-referential processing of illness and health.

To measure the level of identification with illness and health I used the Implicit Association Test (IAT). The strength of the IAT is that it measures associations with the self implicitly and thus prevents the occurrence of response bias that is commonly associated with self-report measures. To the best of my knowledge, this is the first study to experimentally investigate biased self-referential processing of illness and health in individuals with IBS.

2.3 Methods

2.3.1 Design and general procedure

I adopted a cross-sectional design in which patient and non-patient groups were matched for gender and age. Figure 2.1 shows the subject flow for participants. The study "Cognitive and Emotional Factors in Illness and Health" (CEFIH) was given ethical approval by the University's Research Ethics Committee (REC. Ref. Number MSD-IDREC-C1-2014-092) and the NHS Health Research Authority (Rec. Ref. Number 14/NW/1341). The Participant Information Sheets (PIS) and the Consent Form (CF) of this study can be found in sections 9.1.1 (PIS for IBS patients) 9.1.2 (PIS for healthy participants) and 9.1.3 (CF) in the Appendices. A-priori sample size calculations with the programme G*Power (Faul, 2014; Faul, Erdfelder, Lang, & Buchner, 2007) showed that a sample size of 45 participants per group would be needed to detect between-group differences with a medium effect size of d = .6 or higher assuming a power of .80 and alpha of .05.

2.3.2 Participants

Participants were recruited between October 2014 and April 2016. Patients with IBS were recruited through the referral of a doctor at the Gastroenterology clinic at the Oxford University

Hospitals NHS Foundation Trust, online advertisements, posters and email messages through the University's departments and colleges. Healthy participants were recruited from the University and the general public via University-based study participation recruitment schemes and email messages. Psychology students of the University were able to receive credits for participating and non-students received monetary compensation for their time and travel costs.

Participants were screened for eligibility by the project coordinator (JH) using a self-report questionnaire (see section 9.1.4 in the Appendices). The final sample consisted of 42 participants in the IBS group and 41 participants in the healthy group.

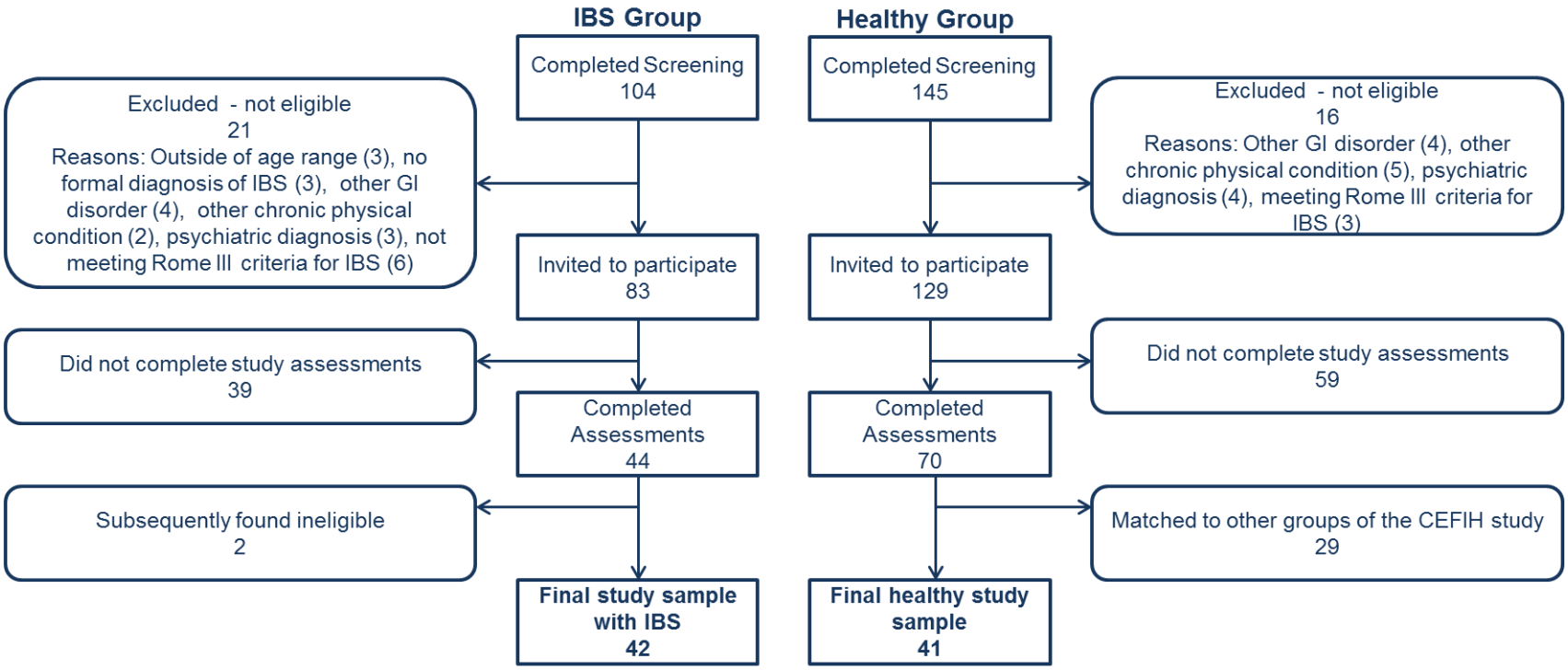


Figure 2.1. Participant Flowchart of the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH). ***Note.*** **IBS is Irritable Bowel Syndrome; GI disorder is gastrointestinal disorder**

2.3.2.1 Eligibility

2.3.2.1.1 Inclusion criteria

All participants had to (a) be at least 18 years and less than 70 years of age, (b) speak English fluently and (c) have normal or corrected to normal vision. Participants with IBS were required to have a diagnosis of IBS from their GP or Gastroenterologist and meet the Rome III criteria for IBS.

2.3.2.1.2 Exclusion criteria

Participants were excluded if they (a) had insufficient manual dexterity to complete the computerized tasks (b) had a diagnosis of dementia, amnesia or delirium; a dissociative disorder; an eating disorder; a personality disorder; schizophrenia or any other psychotic disorder; a substance-related or induced disorder (c) a diagnosis of a gastrointestinal disorder other than IBS (e.g., Crohn's disease, ulcerative colitis, coeliac disease) or (d) a chronic physical condition involving pain other than IBS. Healthy participants were excluded if they met the Rome III criteria for IBS.

Participants were excluded if they had any of the listed psychiatric diagnoses because some of these patients may not have been able to give informed consent for the study (e.g., patients with dementia). In addition it was not known how a co-morbid psychiatric illness would interact with the main outcome illness identity, and thus could potentially confound the specificity of the findings.

2.3.3 Questionnaires

2.3.3.1 Demographic variables and length of illness

I asked participants for their date of birth, gender, level of education, how long they have had symptoms of IBS and how long they have had a diagnosis of IBS (in years and months).

2.3.3.2 Gastrointestinal Symptom Rating Scale – IBS (GSRS-IBS)

IBS symptom severity was measured with the Gastrointestinal Symptom Rating Scale for IBS (GSRS-IBS) (Wiklund et al., 2003). The GSRS-IBS is a 13-item self-report rating scale that

assesses the severity of IBS specific symptoms over the past week on a 1-7 point scale that ranges from 'no discomfort at all' to 'very severe discomfort'. The total score can range between 13 and 91 and higher scores indicate higher symptom severity. This scale has 5 subscales: Pain (2 items), bloating (3 items), constipation (2 items), diarrhoea (4 items) and satiety (2 items). The questionnaire's subscales have high internal consistency, with Cronbach's alpha ranging from .74 to .85 (Wiklund et al., 2003). Test-retest reliability ranges between .55 and .70 for the different subscales and the questionnaire has good convergent validity (Wiklund et al., 2003). In the current study, Cronbach's alpha for the total scale in the IBS group was .76.

2.3.3.3 Depression Anxiety Stress Scale (DASS)

Symptoms of depression, anxiety and stress were measured with the short version of the Depression-Anxiety-Stress Scale (DASS-21) (Henry & Crawford, 2005; Lovibond & Lovibond, 1995). The DASS-21 has 21 items and three subscales (7 items per subscale): depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). Items are measured on a 4-point Likert scale ranging from 0 - 3 (0 = not at all, 1 = sometimes, 2 = often, 3 = almost always). Scores for each subscale where multiplied by two to allow for comparison with the original 42 item scale and its classifications for symptom severity (Henry & Crawford, 2005). Subscale scores range between 0 and 42, and higher scores indicate higher depression, anxiety and stress. Good convergent and discriminant validity has been reported for the DASS (Crawford & Henry, 2003; Henry & Crawford, 2005). The DASS subscales have satisfactory reliability (internal consistencies) in clinical samples (Cronbach's alpha DASS-D: .96; DASS-A: .89, DASS-S: .93) (Brown, Chorpita, Korotitsch, & Barlow, 1997) and nonclinical samples (Cronbach's alpha DASS-D: .88; DASS-A: .82, DASS-S: .90) (Henry & Crawford, 2005). In the present study, Cronbach's alphas for depression, anxiety and stress were .85, .63 and .89 in the healthy group and .92, .83 and .85 in the IBS group.

2.3.3.4 Asthma Symptom Checklist (ASC)

The asthma symptom checklist (Brooks et al., 1989; Kinsman, Luparello, O'Banion, & Spector, 1973) is a self-report measure consisting of a list of 29 symptoms, that cluster into five

subscales: panic fear (5 items), airways obstruction (8 items), hyperventilation (7 items), fatigue (5 items) and irritability (4 items). The subscales 'hyperventilation' and 'fatigue' were of interest for the current research, as they appeared to measure physical symptoms that are not restricted to asthma – most people have experienced these symptoms. Although the subscale was called 'hyperventilation' (Brooks et al., 1989), the term 'Nonspecific Somatic Symptoms' seemed preferable for this study. The scale 'Nonspecific Somatic Symptoms' consists of the following items: cramps, numbness, headache, dizziness, pins and needles, tingling in spots and chest pain. Fatigue consists of the following items: weak, tired, fatigued, exhausted, no energy. Participants were asked to rate how frequently they experienced the listed symptoms within the past year on a 1-5 scale (1 is never, 5 is always). The two chosen subscales showed high reliability (internal consistencies) in an asthma outpatient population (Brooks et al., 1989): Cronbach's alpha 'Nonspecific Somatic Symptoms' (Hyperventilation) was .84 and Fatigue was .95. In the present study, Cronbach's alphas in the healthy group were .76 for 'Nonspecific Somatic Symptoms' and .85 for fatigue. In the IBS group Cronbach's alphas were .69 for 'Nonspecific Somatic Symptoms' and .94 for fatigue.

2.3.4 Cognitive task

The Implicit Association Test (IAT) is a cognitive reaction time (RT)-based task that provides an index of the relative strength of associations between concepts in memory such as illness, health and the self (Greenwald, Mcghee, & Schwartz, 1998). It has satisfactory psychometric properties and across studies the IAT had internal consistencies of Cronbach's alpha .70 to .90 (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Nosek, Greenwald, & Banaji, 2005; Schnabel, Asendorpf, & Greenwald, 2008). The current task was based on an IAT described by Teachman and colleagues (2008).

In this version of the IAT (Teachman et al., 2008), two concepts are paired on either side of the screen (Figure 2.2). Participants were asked to classify word stimuli (e.g., sick, my) into one of the concept pairs (e.g., Illness & Me, Health & Others – please see Table 2.1 for a list of the stimuli for each concept). Reaction times are typically faster when pairs of concepts match the

individual's own associations (e.g., me and illness) compared to those that contradict their associations (e.g., me and health). Stronger associations between concepts have been interpreted as closer associations between schema (i.e., enmeshment) (Van Ryckeghem et al., 2013). In the current study the relationship between the self/others and illness/health concepts were assessed. Closer association between self and illness reflect identification with illness, whereas closer associations between self and health reflect identification with health.

The IAT consists of 4 blocks: 1) a brief practice IAT, 2) an experimental block with the congruent illness self-concept (illness-me, health-not me) 3) an experimental block with the incongruent health self-concept (health-me, illness-other) and 4) a word rating block where participants are asked to rate the relevance of each stimulus to their lives on a 1-7 scale. To learn the general procedure of the task, participants complete an unrelated IAT with a different set of categories (animal and plants, cities and countries) during the brief practice IAT. Prior to each experimental block, participants are shown a list with the correct words for each pair of categories. Each experimental block consists of one 16-trial training period and one 48-trial critical period. Words are presented randomly within each block. The ordering of the experimental blocks is counterbalanced, which produces two versions of the IAT (A, B). Participants were assigned to version A or B based on whether the last digit of their participant ID was odd or even. During the practice IAT and the experimental blocks, stimulus words were presented in a black colour (Arial, size 24) on a white background in the centre of the computer screen for 5 seconds or until a response had been made. Participants were instructed to classify the stimuli as quickly and accurately as possible, using the 'X'-key for stimuli that belong to either category on the upper left side and the 'M'-key for stimuli that belong to either category on the upper right side of the screen. Feedback was presented for correct ("Correct!" in blue) and incorrect classifications ("Incorrect." in red) and for lack of response ("No response detected" in red) for 1000ms each. The inter-trial interval before a new word appeared was 500ms.

Following the main task, participants completed the Explicit Association Test (EAT). During the EAT, all eight health and illness related words were presented one by one in a random

order on the upper half of the screen. A seven-point relevance scale (1 = very irrelevant, 4 = neutral, 7 = very relevant) was displayed in the centre of the screen and participants were asked to rate each word by pressing the corresponding number on the keyboard.

In line with van Ryckeghem et al (2013) an exclusion criterion was set at an error rate of greater than 30% on the RT trials. No participant was excluded based on this criterion.

Table 2.1. Implicit Association Test (IAT) stimuli list.

Category Label	**Health**	**Illness**	**Me**	**Not me**
Stimuli	healthy	illness	me	not me
	healing	pain	my	other
	strong	chronic	self	them
	vitality	sick	I	they

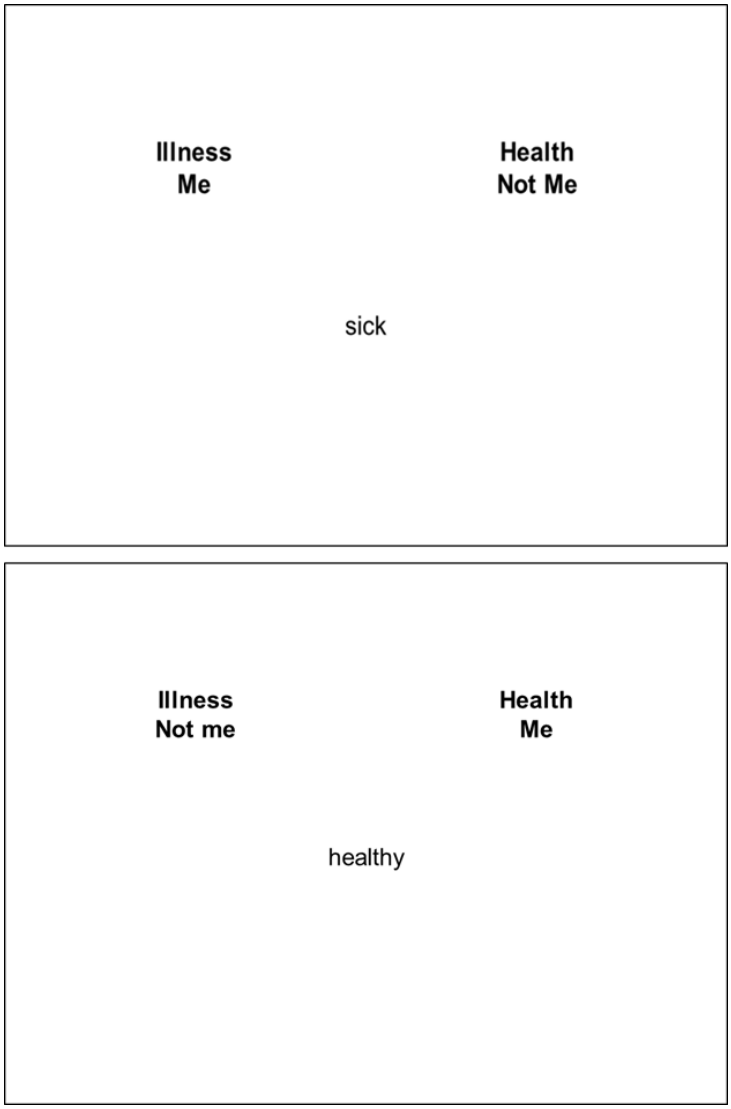


Figure 2.2. Example response screens of the Implicit Association Test (IAT) measuring identification with illness and health. *Note.* The top image is an example for the Self-Illness concept with an illness stimulus (sick) in the centre; the bottom image is an example for the Self-Health concept with a health stimulus (healthy) in the centre.

2.3.4.1 IAT data preparation.

RT data were scored using the improved scoring algorithm for the IAT D6 index developed by Greenwald, Nosek and Banaji (2003). Only critical trials were used in this analysis, as this is a shortened version of the IAT that does not involve single word categorization. Following the procedure of Greenwald, Nosek and Banaji (2003), a reaction time penalty of 600ms was added to trials in which stimuli had been misclassified.

RT differences between groups on the congruent trials reflect differences in identification with illness. RT differences in the incongruent trials reflect differences in identification with health. Lower identification with health is considered to reflect self-health discrepancy. The final IAT score was calculated by subtracting the mean RT to classify stimuli in the congruent trials (me-illness, not me-health) from the mean RT in the incongruent trials (me-health, not me-illness) divided by the standard deviation of both trials ((RT incongruent – RT congruent) /SD (across all trials). This index is called IAT-D score. A positive IAT-D score reflects relatively faster RTs for self-illness associations and negative score reflects relatively faster RTs for self-health associations.

Mean relevance ratings were computed and an 'EAT-score' was calculated by subtracting the mean relevance rating for health related words from the mean relevance rating for illness related words, divided by the SD of both (mean relevance illness – mean relevance health) /SD (across categories)). Positive scores indicate relatively higher relevance of illness words and negative scores indicate higher relevance of health words.

2.3.5 Procedure

Informed consent was obtained from all individual participants included in the study prior to the study procedures. Participants completed a set of questionnaires and provided demographic information via the online platform LimeSurvey (LimeSurvey Project Team & Schmitz, 2015) at least a day before completing the computer-based task. The experimental session took 1.5-2.0 hours per participant. All participants carried out several tasks as part of the CEFIH study and the IAT was one of these. The IAT was administered on a Dell desktop computer with a 41×25.5 cm screen. Stimulus presentation and data collection were performed using E-Prime 2.0 (Psychology Software Tools, 2012). Participants responded by using the computer keyboard. Completion of the IAT takes between 10-15 minutes. The complete set of questionnaires and computerized tasks that participants were asked to complete can be found in sections 9.1.5 and 9.1.6 in the appendices.

2.3.5.1 Statistical analysis

Data were analysed using SPSS version 22 (IBM Corp., 2013). Effect sizes were reported using the Partial Eta Squared index (ηp^2) and Cohen's *d*. Following Cohen (1988) Olejnik and Algina (2000) for ηp^2 a small effect size = 0.01; medium effect size = 0.06; large effect size = 0.14, for Cohen's *d* a small effect size = 0.2; medium effect size = 0.5; large effect size = 0.8.

2.4 Results

2.4.1 Participant characteristics

Participants were between 18 and 69 years old. The two groups did not differ in terms of age, gender or achieved education level (see Table 2.2). The IBS group had higher IBS symptom severity scores compared to the healthy group, and they reported more nonspecific somatic symptoms and fatigue (see Table 2.2, Table 2.3). Participants with IBS had been experiencing symptoms for a mean of 86.9 months (7.2 years), and were diagnosed with IBS on average 45.1 months (3.8 years) ago. Additionally, the IBS group scored significantly higher on DASS depression, anxiety and stress indices (see Table 2.3).

Table 2.2. Participant Characteristics.

	IBS Group (n = 42)		Healthy Control Group (n = 41)		t-value/χ^2 value
	Mean	(S.D.)	Mean	(S.D.)	
Age (years)	34.74	(15.62)	35.49	(16.09)	0.215
Gender	81.0% female; 19.0% male		82.9% female; 17.1% male		0.055
Highest Educational Level Reached	38% Up to and including A-levels[2]; 62% Tertiary Education[3]		27% Up to and including A-levels[2]; 73% Tertiary Education[3]		1.2
IBS Symptom (GSRS-IBS[1])	46.48	(10.69)	18.66	(7.58)	-13.65***
Time since symptoms started (months)	86.88 (Minimum 7, maximum 360)	(84.79)			N/A
Time since diagnosis (months)	45.1 (minimum 0, maximum 246)	(61.54)			N/A

[1]GSRS-IBS is Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [2]no formal qualifications, GCSE, NVQ or vocational qualification or at least 12 years of schooling; [3]University degree (Undergraduate, Masters, Post-Graduate);

*** $p < .001$

Table 2.3. Psychological and physiological variables for the IBS group and healthy control group.

	IBS Group (n = 42)		Healthy Control Group (n = 41)		t-value
	Mean	(SD)	Mean	(SD)	
Nonspecific Somatic Symptoms (ASC[1])	15.81	(3.71)	12.46	(3.11)	4.45***
Fatigue (ASC[1])	16.29	(4.22)	11.68	(2.97)	5.74***
Depression (DASS-21[2])	12.24	(9.99)	5.22	(5.76)	3.91***
Anxiety (DASS-21[2])	10.57	(8.91)	3.22	(3.79)	4.87***
Stress (DASS-21[2])	17.52	(8.76)	8.93	(7.95)	4.68***

[1]ASC is Asthma Symptom Checklist; [2]DASS-21 is Depression Anxiety Stress Scale-21 items;

* is p< .05; ** is p< .01; *** p<.001

2.4.2 Results IAT

2.4.2.1 Error rate and outliers

Across groups, 98.48% of IAT trials were included in the analysis. In the healthy group, 1.91% and in the IBS Group 1.14% of trials were considered outliers (RTs < 400ms or > 10,000ms) and excluded from further analysis. The mean number of incorrect responses in the healthy group was 3.66 (*SD* 2.81) and 5.05 (*SD* 5.56) in the IBS group.

2.4.2.2 IAT versions

39 participants received version 'A' and 44 participants received version 'B' of the IAT. I ran a group (healthy, IBS) x version (A, B) between groups ANOVA to check if these two versions of the IAT produced different results across and between groups. Results indicated no main effect of version ($F(1, 79) = 2.692$, $p = .105$, $\eta p^2 = .03$) and no interaction ($F(1, 79) = 0.36$, $p = .549$, $\eta p^2 = .01$) between version and group. The main effect of group was significant ($F(1, 79) = 10.85$, $p = .001$, $\eta p^2 = .12$). This indicated that using the data collected from the two versions of the IAT in the same analysis of between group differences was appropriate.

2.4.2.3 IAT-D score differences between groups

A one way ANOVA with the IAT-D score as dependent variable and group (IBS, Healthy) as between group variable showed a main effect of group ($F(1, 81) = 11.83$, $p = .001$, $\eta p^2 = .13$, $d = .75$, 95% CI 0.31 – 1.20). The IAT-D score for the healthy group was significantly lower ($M = -.65$, $SD = .43$) than the IAT-D score of the IBS group ($M = -.33$, $SD = .42$).Figure 2.3 shows the differences between groups. The analysis was then repeated with DASS depression and DASS anxiety scores as covariates. Results indicated that depression and anxiety had no significant influence (*F*s were 0.63, $p = .429$ and .67, $p = .415$ respectively) and the main effect of group remained significant (F 1, 79) = 9.36, $p = .003$, $\eta p^2 = .106$).

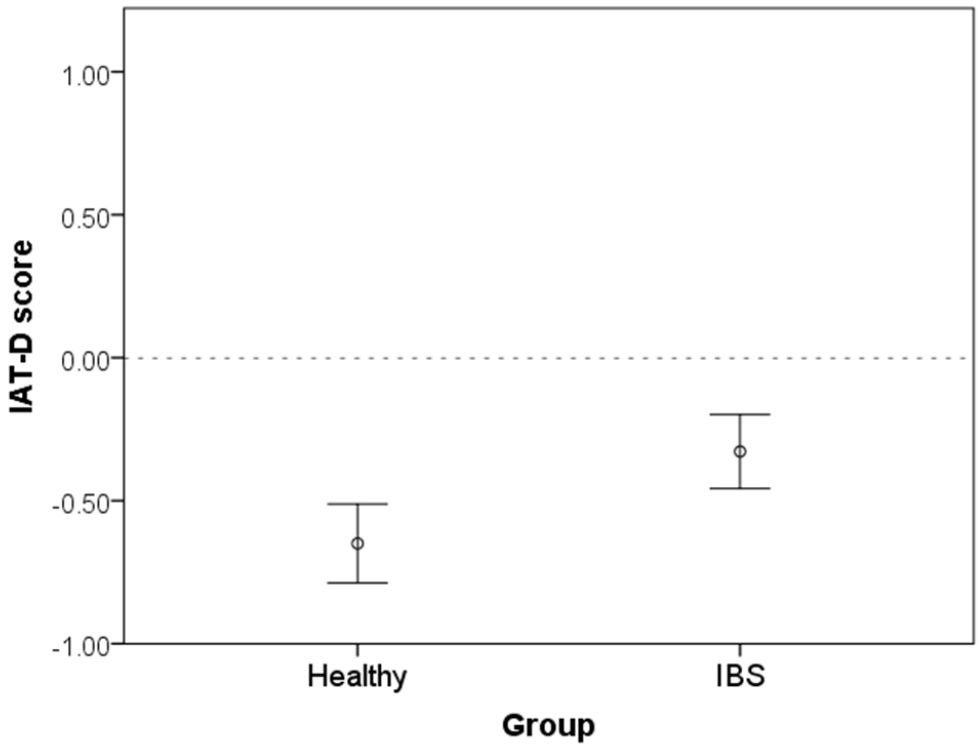


Figure 2.3. Group differences on the IAT-D score. The IAT-D score represents identification with illness and health and was calculated from the reaction time data of the Implicit Association Test (IAT). *Note.* IBS is Irritable Bowel Syndrome; Error bars are 95% CI.

2.4.2.3.1 RT differences in the congruent and incongruent conditions

To disentangle whether the difference on the IAT-D score comes from RT differences in the congruent (illness/me), the incongruent (health/me) or both conditions, additional independent sample t-test were run with each condition between groups. In the congruent condition (me/illness), RTs were not significantly different between the healthy group (M = 892.46, SD = 219.93) and the IBS Group (M = 989.59, SD = 440.52), (t(60.56) = -1.275, p = .207, equal variances not assumed). In the incongruent (me/healthy) condition, the participants in the healthy group (M = 701.30, SD = 204.58) were significantly faster than participants in the IBS group (M = 873.32, SD = 391.87), (t(62.13) = -2.525, p = .014, equal variances not assumed). There was no significant difference in overall average response latency between the healthy group (M = 797.46, SD = 191.57) and the IBS group (M = 931.27, SD = 400.21), t(59.17) = -1.950, p = .056, equal variances not assumed.

2.4.3 EAT-score differences between groups

EAT-scores were not normally distributed in the IBS and the healthy group, therefore a bootstrapped independent samples t-test was chosen to investigate differences between groups. The IBS group had significantly higher EAT-scores (M = -.05, SD = 1.21) compared to the healthy control group (M = -1.49, SD = .488), t(54.099) = -7.109, p < .001, (equal variances not assumed). The mean difference in EAT-scores was -1.44, BCa 95% [-1.805, -1.066], with a large effect size of d = 2.96.

2.4.4 Correlational analysis

In the IBS group only, correlational analyses were run with IAT-D, the EAT-score, 'time since diagnosis', IBS symptom severity, 'Nonspecific Somatic Symptoms', and fatigue. For correlation analysis, Spearman's rho was used as two variables were not normally distributed (EAT-score and illness duration).

The IAT-D score significantly correlated with 'Nonspecific Somatic Symptoms' (*rho* (40) = .36, p =.018). Contrary to our hypothesis, the IAT-D score did not significantly correlate with IBS symptom severity, time since diagnosis, fatigue or the EAT-score in the IBS group (all *rho*s < .18, all ps > .05).

Table 2.4 displays the bivariate correlations between the IAT-D score, the EAT-score, time since diagnosis, IBS symptom severity, nonspecific somatic symptoms, fatigue, depression, anxiety and stress.

Table 2.4. Spearman correlation coefficients (Spearman's rho (ϱ)) and p-values (2-tailed) in patients with Irritable Bowel Syndrome (n = 42)

		1.	2.	3.	4.	5.	6.	7.	8.	9.
1. IAT[1]-D score	ρ	1.00								
	p-value									
2. EAT[2]-Score	ρ	0.16	1.00							
	p-value	0.320								
3. Time since diagnosis	ρ	-0.06	-0.18	1.00						
	p-value	0.703	0.264							
4. IBS symptom severity (GSRS-IBS[3])	ρ	0.07	0.25	0.08	1.00					
	p-value	0.654	0.117	0.616						
5. Nonspecific Somatic Symptoms (ASC[4])	ρ	.36*	.39**	-.35*	0.14	1.00				
	p-value	0.018	0.010	0.024	0.384					
6. Fatigue (ASC[4])	ρ	0.12	.58***	-0.09	0.17	.43**	1.00			
	p-value	0.453	0.000	0.592	0.290	0.005				
7. Depression (DASS-21[5])	ρ	0.07	.37*	-0.17	0.11	.443**	0.27	1.00		
	p-value	0.663	0.017	0.285	0.479	0.003	0.080			
8. Anxiety (DASS-21[5])	ρ	0.00	0.28	-0.07	0.03	.43**	.33*	.50***	1.00	
	p-value	1.000	0.072	0.645	0.850	0.005	0.033	0.001		
9. Stress (DASS-21[5])	ρ	0.00	0.16	0.05	0.05	.45**	0.14	.55***	.57***	1.00
	p-value	0.978	0.297	0.776	0.738	0.003	0.361	0.000	0.000	

[1]Implicit Association Test; [2]Explicit Association Test; [3]Gastrointestinal Symptom Rating Scale - Irritable Bowel Syndrome; [4]Asthma Symptom Checklist; [5]Depression Anxiety Stress Scale – 21 items;

For convenient visual reference, asterisks were added to significant correlation coefficients: * is $p < .05$, ** is $p < .01$, *** is $p < .001$

2.4.5 Post-hoc moderation analysis

In the IBS group only, the EAT-score, rather than being normally distributed showed two distinct subgroups: one group with scores below zero (relevance health > relevance illness; n = 24) and one group with scores above zero (relevance illness > relevance health; n = 18). To evaluate whether the relationship between the IAT-D score and 'additional somatic symptoms' differed for each subgroup, I ran a moderation analysis with the PROCESS Model macro for SPSS (A. F. Hayes, 2013).

The subgroup analysis revealed that EAT-scores (below or above zero) moderate the relationship between IAT-D scores and 'Nonspecific Somatic Symptoms', as shown by a significant interaction effect between EAT-subgroups and IAT-D scores, b = 5.126, 95% CI [0.375, 9.960], t = 2.18, p = .035. Specifically, when EAT-scores are above zero, there is a significant positive relationship between IAT-D scores and 'Nonspecific Somatic Symptoms', b = 6.39, 95% CI [2.295, 10.486], t = 3.159, p = .003. However, when EAT-scores are below zero, the positive relationship between IAT-D scores and 'Nonspecific Somatic Symptoms' is non-significant, b = 1.22, 95% CI [-1.266, 3.712], t = 0.995, p = .326. Please see Table 2.5.

The EAT-score subgroups did not differ in level of general somatic symptoms ($t(40)$ = -1.668, p = .103) or IAT-D scores ($t(40)$ = -0.437, p = .664).

Table 2.5. Linear model of predictors of 'nonspecific somatic symptoms' in the IBS Group.

	b [95% CI]	SE B	t	p
Constant	15.73 [14.65, 16.83]	0.54	29.232	0.000
EAT[1]-score subgroups (centred)	1.65 [-4.88, 3.79]	1.06	1.562	0.127
IAT[2]-D score (centred)	3.44 [1.18, 5.70]	1.12	3.081	0.004
EAT[1]-score subgroups x IAT[2]-D score	5.1674 [.38, 9.96]	2.37	2.183	0.035

Note. R^2= .23

[1]Explicit Association Test; [2]Implicit Association Test

2.5 Discussion

The current study shows that patients with IBS have a weaker implicit identification with health compared to healthy participants. To our knowledge, this is the first study to demonstrate reduced implicit identification with health (i.e., self-health discrepancy) in IBS patients as measured by the Implicit Association Test (IAT). In IBS patients, the magnitude of identification with health (self-health discrepancy) was negatively related to the accumulation of nonspecific symptoms, but not to self-reported IBS symptom severity, illness duration, fatigue or explicit illness associations. In other words, IBS patients with nonspecific, unrelated bodily symptoms such as headaches, numbness or dizziness showed a weaker implicit identification with health. In addition, IBS patients showed greater explicit associations with illness than healthy participants. Subgroup analysis showed that in IBS patients, explicit illness associations moderate the relationship between implicit identification with health and the level of nonspecific somatic symptoms.

The current findings with IBS patients are comparable to those found in patients with somatoform disorders (SFD, i.e., somatization disorder, pain disorder, and undifferentiated somatoform disorder) showing reduced implicit identification with health compared to healthy control groups (Riebel, Egloff, & Witthöft, 2013). The analysis of raw reaction time-scores in the current study showed that the difference between participants suffering from IBS and healthy participants was based on differences in the self-health condition rather than the self-illness condition in the IAT. In other words, the results show a self-health discrepancy in patients with IBS, where healthy participants show no such disassociation. As theorised in the introduction of this chapter, this discrepancy may highlight the contrast between one's idealized state (e.g., healthy, strong) and one's perceived self (e.g., not healthy, weak). Keeping this contrast or discrepancy in mind may implicitly emphasize a focus on somatic symptoms that confirm and reinforce the bias. This interpretation aligns with our findings showing a correlation between nonspecific somatic symptoms and a self-health discrepancy. Future studies should compare IBS patients with patients with illnesses for which biological markers have been found (e.g.,

inflammatory bowel disease, IBD) to investigate if self-referential processing plays a unique role in patients with a functional illness. For example, having a clear medical diagnosis for complaints may help to accept the illness and reduce uncertainty about illness progression. This may reduce comparisons with an idealized health self-concept in patients with IBD.

The results from the current study do not support the hypothesis that the self- and illness-schema mesh in IBS patients or that IBS patients identify with their illness. It is possible that identification with illness can only be expected in patients whose life is more severely affected by IBS (e.g., frequent absence from work due to IBS) or whose IBS symptoms are present most of the time. For example, patients with chronic pain have been shown to identify with their illness (Van Ryckeghem et al., 2013). In addition, it is possible that a strong identification with illness would be more pronounced in subgroups of IBS patients with more pain as part of their symptoms or those whose symptoms are less predictable (e.g., diarrhoea predominant IBS). This study was however not designed to look at differences in illness identification between IBS subtypes (e.g., IBS-Diarrhoea, IBS-Constipation, IBS-Mixed symptoms). Moreover, it would be worthwhile to test if IBS patients show enmeshment between their self-schema and an IBS-specific schema. Similarly, the expected relationship between the level of self-referential processing and IBS symptom severity may have emerged, had I used a mixture of IBS specific (e.g., 'bloating') and general illness (e.g. chronic) stimuli. However, the correlation between nonspecific somatic symptoms and identification with illness fits well with Crane and Martin's studies (2002, 2004) in which they found that IBS patients consider many unrelated symptoms to be part of their IBS.

Finally, IBS patients with greater explicit illness associations showed a stronger relationship between reduced identification with health and somatic symptoms. Perhaps the bond between weaker associations with health and somatic symptoms is strengthened in patients who explicitly afford symptoms a greater role in their lives by allowing these symptoms to interfere more with their personal goals. This would be in line with the Schema Enmeshment Model which predicts that frequent disruption due to symptoms affects identity related cognitive processes (Pincus & Morley, 2001). Counter to the mechanisms spelled out in the Schema Enmeshment

Model, I did not find that distress co-varied with the level of enmeshment between self and illness. This model predicts that the self-schema is most likely to merge with the illness schema when symptoms occur in the context of distress. Thus, assessing schema enmeshment when symptoms co-occur with distress would enable a more valid test of this particular aspect of the model. As the length of time since diagnosis with IBS was not related to reduced identification with health, it would be important to clarify whether the chronicity of IBS is related to the development of this implicit bias. To assess this, it would be necessary to compare IBS patients to participants with a temporary, manageable illness such as a cold or influenza. Finally, the lack of correlation between explicit and implicit associations with illness and health presumably suggests that there are two different processes involved, one below conscious awareness and one above.

To summarise, the results of this study provide partial support for both the DAH and the Schema Enmeshment Model, when applied to patients with IBS. Both models predicted that patients would implicitly identify with their illness, which was not supported by the data of this study. Both models also predicted that IBS patients would show self-health discrepancy (i.e., reductions in the identification with health). This hypothesis was supported by the results of this study.

2.5.1 Implications for treatment

Within the context of the NIH Stage model of Intervention Development, our findings provide Stage 0 basic research that, together with the available evidence in the literature and theoretical models, can be used to guide the development of a new intervention. The results are in keeping with a recent review that suggests that reductions in maladaptive cognitive reactions to symptoms mediate IBS symptom improvement (Windgassen et al., 2017). As such, it would be worthwhile exploring if biased implicit self-referential processing of health is a mediator of IBS symptom improvement in the treatment of IBS with psychological therapies. Chapter 5 will theoretically explore how self-health discrepancy in patients with IBS could be addressed with a psychological treatment.

Our findings show that the IAT is sensitive to detect differences in implicit self-referential processing of illness and health between groups (i.e., healthy and IBS). The IAT could be used in future research as well as in clinical settings as a tool for informing choice of optimal treatment. Our moderation analysis suggests that treatments targeting self-health discrepancy may be particularly relevant for patients with greater explicit illness associations who also suffer from additional somatic complaints.

2.5.2 Limitations

Given the cross-sectional case control design of the current study, the conclusions from this study (presented in this Chapter and in Chapter 3) are limited by several factors (Kazdin, 2016). Firstly, as the data were obtained at a single point in time, it is not possible to infer a temporal association between the outcome and the hypothesised maintaining and risk factors (Kazdin, 2016). Secondly, although it is possible to infer an association between the outcome (IBS) and the hypothesised risk and maintenance factor (biased self-referential processing of illness and health), it is not possible to infer a causal relationship. Thirdly, the possibility that a different, third variable caused both the hypothesised risk factor and the illness cannot be excluded with a cross-sectional design. As such, it is unclear if biased self-referential processing of illness and health is a risk factor for developing IBS, if the bias developed as a consequence of having IBS or if a third variable led to the development of both IBS and self-health discrepancy. Longitudinal and intervention studies would be necessary to establish directional and causal links between IBS, associated nonspecific somatic symptoms and implicitly biased health-identity.

An additional limitation of the study is its relatively small sample size (n = 83), which was slightly lower than the intended sample size of (n = 90). Although the current sample size was chosen to detect a medium defect size, a larger sample would have been able to detect smaller effects which would have reduced the probability of making type 2 (ß) errors. For example, there may be a small effect of identification with illness in IBS patients (e.g., $d = 0.2$) but to detect it a sample size of n = 786 would have been necessary. In addition a larger sample increases the chance of having selected a study sample that is representative of the general IBS population, thereby

increasing the prospect of generalizing the results. It would therefore be beneficial to replicate the current study with a larger sample.

2.5.3 Conclusion

The study provides evidence that individuals with IBS showed reduced implicit identification with health compared to healthy participants, and the magnitude of this bias was related to reporting a higher level of non-specific somatic symptoms. To address the shortcomings of cross-sectional study designs, longitudinal studies are necessary to explore if implicit self-health discrepancy is a maintaining factor of IBS symptoms that could be targeted in psychological treatments for IBS.

Chapter 3: Altered Attentional Control Linked to Catastrophizing in Patients with Irritable Bowel Syndrome (IBS)

3.1 Abstract

3.1.1 Objectives

This study aimed to 1) investigate differences in attentional control between patients with Irritable Bowel Syndrome (IBS) and healthy participants and 2) examine the link between attentional control and IBS catastrophizing. Previous research has shown that patients with chronic functional illnesses have lower levels of attentional control. However, no previous study has found altered attentional control in IBS patients nor directly investigated the link between attentional control and catastrophizing. With references to Attentional Control Theory, I also aimed to establish whether anxiety is associated with attentional functions in patients with IBS.

3.1.2 Design and methods

In this cross-sectional study, we compared 41 IBS patients with 39 healthy age and gender matched control participants on attentional functions using an Attention Network Task (ANT). IBS catastrophizing (Gastrointestinal-Cognitions), IBS symptom severity (GSRS-IBS), depression, anxiety and stress (DASS-21), and visceral anxiety sensitivity (VSI) were assessed using self-report measures.

3.1.3 Results

IBS patients had lower attentional control compared to healthy participants ($t(1, 78) = -27.7559$, $p = .007$, $d = 0.62$). Groups did not differ in alerting or orienting attention. IBS patients with lower attentional control scored higher on IBS catastrophizing than those with higher

attention control, $t(38.59) = 2.186$, $p = .032$, $d = 0.665$. Higher anxiety was correlated with faster orienting attention in the IBS group (*rho* = .38, $p = .015$).

3.1.4 Conclusions

IBS patients displayed reduced attentional control compared to healthy participants. Crucially, those IBS patients with lower attentional control also had more catastrophizing thoughts than IBS patients with better attentional control. These findings suggest an association between attentional control and catastrophizing that could be relevant for the development of psychological interventions for IBS.

3.2 Introduction

Catastrophizing, which is a tendency to think about and believe in the likely occurrence of the worst possible outcomes of a situation, has been linked to the affective dimension of pain (i.e., pain suffering) in IBS patients (Lackner & Quigley, 2005). Importantly, in the majority of analyses of mechanisms reductions in general catastrophic thinking and pain-specific catastrophizing have been shown to mediate symptom improvement and quality of life in IBS patients (Garland et al., 2012; Hunt et al., 2009). In one study by Labus and colleagues (2013) the mediation effect of catastrophizing on symptom severity was only trending towards significance. They also found that the mediating effect of catastrophizing is dependent on baseline levels of quality of life, with stronger mediation effects when quality of life is low before treatment begins (Labus et al., 2013).

In addition, subliminal cognitive processes could play a role in symptom maintenance in IBS. For example, cognitive biases that serve the automatic detection of symptom cues (e.g., hypervigilance) have been found in IBS patients (Afzal et al., 2006; Chapman & Martin, 2011; Kristy Phillips et al., 2014; Tkalcic et al., 2014). Fewer studies have examined alterations in more general cognitive processes such as executive functioning (Hubbard et al., 2015) or memory (Kennedy et al., 2013) in IBS patients. Altered executive functions have been recorded in other chronic functional illnesses such as Chronic Fatigue Syndrome/ME (Hou et al., 2014; Hughes, Chalder, Hirsch, & Moss-Morris, 2017; Togo, Lange, Natelson, & Quigley, 2015) and Fibromyalgia (Miró et al., 2011), indicating that executive functions may be affected in patients with functional illnesses.

It is important to investigate executive functions in patients with IBS, because they are highly relevant for mental and physical health (Diamond, 2013; O'Bryan, Kraemer, Johnson, McLeish, & McLaughlin, 2017; Posner & Rothbart, 1998; Richey, Keough, & Schmidt, 2012). Attentional control is one fundamental executive function related to complex higher order cognitive tasks (e.g., reasoning, problem solving) and it is highly relevant for emotional regulation and goal attainment (Diamond, 2013; O'Bryan et al., 2017; Posner & Rothbart, 1998; Richey et al., 2012). For example, greater attentional control has been linked with the ability to engage in goal

related behaviours when upset (O'Bryan et al., 2017). As such, attentional control may be a vital component for emotional, social and occupational wellbeing in patients with a chronic illness. Good attentional control may be particularly relevant for patients who have to cope with an illness such as IBS that involves frequent episodes of pain and disturbed bodily functions (e.g., diarrhoea). Due to the hypothesized importance of attentional control for patients with IBS this topic has received more attention recently. For example Hubbard and colleagues (2015) tested attentional mechanisms in a group of IBS patients in an MRI scanner and they found no differences in attentional control between IBS patients and a healthy control group. This study had a small sample size (15 IBS patients and 14 control participants) and as a result it had limited power to detect differences between groups. It is therefore important to investigate attentional control with a larger sample size which may yield more reliable findings.

Attentional control is characterized by intentional, effortful control over attention that serves to inhibit task-irrelevant distraction (Derakshan & Eysenck, 2009). Importantly, low attentional control has been associated with maladaptive cognitive thinking styles such as worrying and catastrophizing (Fox et al., 2015; Heathcote et al., 2015). For example, Fox and colleagues (2015) showed that deficits in attentional control were associated with greater difficulty in controlling negative thought intrusions and that.

> "improvements in attentional control were associated with improvements in the ability to suppress worry related thought intrusions" in people with pathological worries (Fox et al., 2015, p. 593).

To examine the relationship between attentional control and maladaptive illness-specific catastrophizing in IBS patients, IBS catastrophizing was operationalized as symptom-specific catastrophic thoughts as described in the Gastrointestinal Cognitions Questionnaire (Hunt et al., 2014b). In IBS patients, the degree of IBS catastrophizing could be partly dependent on their levels of attentional control. IBS patients with the greatest deficits in attentional control may be those who suffer most from illness-specific catastrophizing. Understanding attentional control in IBS patients and how it relates to IBS catastrophizing may be helpful in developing treatments for IBS.

Why might IBS patients have altered attentional control? One possibility is that lower attentional control is one of the symptoms IBS. For example, previous studies found deficits in attentional control in patients with Chronic Fatigue Syndrome (CFS) (Hou et al., 2014; Togo et al., 2015) and Fibromyalgia (Miró et al., 2011) compared to healthy participants. This suggests that there could be a bio-psychological interaction that is common to several functional illnesses that plays a role in the aetiology, disease progression and maintenance. However, given the complex bio-psychological nature of IBS, other possibilities need to be considered. The presence of selective processing of GI-(threat) related stimuli in patients with IBS (Afzal et al., 2006; Chapman & Martin, 2011; Gibbs-Gallagher et al., 2001; Kristy Phillips et al., 2014; Posserud, Svedlund, Wallin, & Simrén, 2009; Tkalcic et al., 2014) is to a large extent consistent with the anxiety literature (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). For example, patients with high trait anxiety show an attentional bias towards threating facial expressions (i.e., selective processing of threat) when measured with the reaction time-based dot-probe task (Bradley, Mogg, Falla, & Hamilton, 1998). Several theoretical approaches from the literature on anxiety could at least partially account for the findings on selective processing of threat in patients with IBS. For example, the vigilance-avoidance hypothesis proposes that anxious individuals initially direct their attention towards threat before they rapidly disengage from it in an attempt to reduce their anxiety (e.g., through distraction) (Bradley et al., 1998; Mogg, Bradley, de Bono, & Painter, 1997; Mogg, Bradley, Miles, & Dixon, 2004). The hypervigilance that was found in patients with IBS (Chapman & Martin, 2011; Posserud et al., 2009) would be explained by the initial orienting towards threat as suggested by the vigilance-avoidance hypothesis, however it is unclear if patients with IBS also avoid processing of IBS related material at a later stage of attention. Given that patients with IBS show enhanced memory of IBS-related material (Gibbs-Gallagher et al., 2001), it is likely that they do process IBS-related information more elaborately rather than avoid it. These findings are also in line with the cognitive-behavioural approach to anxiety which would suggest that underlying core beliefs (e.g., threat schema) guide the initial selection and further processing of schema-congruent information (MacLeod, 1990; MacLeod & Mathews, 1988). Although the above mentioned theories of anxiety are relevant for IBS, they do

not take into account the effect that anxiety can have on executive functions (they are more concerned with stimulus-driven processing). Given the importance of attentional control for mental health and emotional regulation (Diamond, 2013), a theory that incorporates both stimulus-driven processing and executive functions seems particularly promising for understanding cognitive functions IBS patients.

Eysenck's Attentional Control Theory (Eysenck & Derakshan, 2011; Eysenck et al., 2007) proposes that anxiety impairs the smooth functioning of the executive functions related to intentional, goal-directed attention and favours stimulus-driven processing. These stimuli could be exogenous (e.g., an angry face) or endogenous (e.g., a threat-related thought) (Derakshan & Eysenck, 2009). It specifies that executive inhibitory processes such as attentional control are responsible for limiting the interference of irrelevant stimuli (Eysenck & Derakshan, 2011; Eysenck et al., 2007). The theory also proposes that attentional control could be negatively affected by anxiety and crucially that these executive inhibitory processes would be impaired even in the absence of threat (Eysenck & Derakshan, 2011; Eysenck et al., 2007). This is because the most effective strategy to detect the onset of an unpredictable threat is to allocate attention widely, rather than keep it focused on a particular task (Eysenck et al., 2007). The shift from intentional, goal-directed attention towards stimulus-driven processing as described by Eysenck's theory would correspond to the concept of hypervigilance in IBS patients. Hypervigilance is a process that facilitates stimulus-driven processing and the above mentioned findings about hypervigilance in IBS patients support this theoretical approach. In addition, to detect threat quickly, it would also be adaptive to orient towards threat (shift attention towards threat) at a faster rate in order to prioritize processing sensory input from that location. This and shifting attention towards locations that hold valuable information for goal attainment are the aims of attentional orienting (Fan et al., 2002; Petersen & Posner, 2012). More specifically, orienting attention involves "disengaging attention from its current focus, moving attention to the new target or modality, and engaging attention at the new target or modality" (Fan et al., 2009, p. 210). Anxiety may enhance the efficiency of the orienting network by heightening the relevance of threat-related and goal-related cues. Many IBS

patients have a co-morbid anxiety disorder (Enck et al., 2016; Janssens et al., 2015) and feel anxious about experiencing sensations in the abdominal region as well as the context in which they may occur (visceral anxiety sensitivity) (Labus, Mayer, Chang, Bolus, & Naliboff, 2007; Porcelli, De Carne, & Leandro, 2014). It is therefore important to investigate if IBS patients have lower levels of attentional control and higher orienting attention, and if so, if attentional functioning is related to their levels of anxiety and visceral anxiety sensitivity.

Attentional control and orienting attention can be objectively measured with the reaction time based Attention Network Task (ANT) (Fan et al., 2002). The use of the ANT is based on the premise that reaction time measures can capture the processing efficiency of these attentional functions (Fan et al., 2002). This task also measures phasic alertness or alerting attention, which is defined as "the ability to increase in response readiness to a target subsequent to an external warning stimulus" (Fan et al., 2009, p. 209). Although considered largely independent functional and structural networks, attentional control, orienting and alerting attention are considered to be three main attentional functions that have been shown to interact with each other (Fan et al., 2009). For example, activated alerting attention seems to inhibit attentional control (in the form of conflict resolution), whereas cues that orient attention towards a target appear to enhance conflict resolution (Fan et al., 2009). The focus of the current investigation is on differences in attentional control and orienting attention between IBS patients and healthy participants. Findings on alerting attention measure will also be reported.

3.2.1 Summary and hypotheses

To summarise, the hypothesised effect of anxiety and visceral anxiety sensitivity on attentional control in patients with IBS could be a contributing factor of catastrophizing thoughts, an established maintenance mechanisms of IBS symptom severity. Therefore investigating these factors and their relationship to each other is clinically relevant and important from a perspective of treatment development. To the best of our knowledge no previous study has investigated the relationship between attentional control and maladaptive illness cognitions in IBS patients. In the

hypotheses below, attentional control and orienting attention refer to the attentional control and the orienting attention indices of the ANT.

Primary Hypothesis:

1. Patients with IBS have lower attentional control compared to healthy participants.

Secondary Hypotheses:

2. In patients with IBS, the level of attentional control correlates with levels of anxiety and visceral anxiety sensitivity, where higher scores on the attentional control index (lower attentional control) relate to higher anxiety and visceral anxiety sensitivity.
3. Patients with IBS with lower attentional control have higher scores on IBS catastrophizing compared to patients with IBS with higher attentional control.
4. Patients with IBS have better orienting attention compared to healthy participants.
5. In patients with IBS, the level of orienting attention correlates with levels of anxiety and visceral anxiety sensitivity, where higher scores on the orienting index relate to higher anxiety and visceral anxiety sensitivity.

3.3 Methods

Chapters 2 and 3 report results from the same cross-sectional study (CEFIH). The method of recruitment, eligibility criteria, study procedures and participants are therefore identical to those described in Chapter 2 and not repeated here.

3.3.1 Measures

Questionnaires and computer tasks relevant to this chapter that were not covered in Chapter 2 will be described here. A brief summary will be given for questionnaires that were also used in Chapter 2.

3.3.2 Questionnaires

3.3.2.1 IBS Symptom severity

The Gastrointestinal Symptom Rating Scale for IBS (GSRS-IBS) (Wiklund et al., 2003) is a 13-item self-report rating scale that assesses the severity of IBS specific-symptoms over the past week. Symptom severity is measured on a 7-point scale that ranges from 'no discomfort at all' (1) to 'very severe discomfort' (7). The total score ranges from 13 to 91.

3.3.2.2 Gastrointestinal Cognitions Questionnaire

The Gastrointestinal Cognitions Questionnaire (GI-Cognitions) is a 16-item questionnaire that measures the extent to which participants believe in catastrophic cognitions about their IBS symptoms on a 5-point scale (0 = not at all, 4 = very much) (Hunt et al., 2014b). Specifically, it measures the degree of symptom interference with social and occupational situations, the belief that other people will react negatively to symptoms, and the belief that symptoms are disgusting. This questionnaire has been shown to discriminate between patients with IBS, patients with Crohn's disease and healthy controls and it explains unique variance in symptom severity (Hunt et al., 2014b). In the current study, Cronbach's alpha was .89 in the IBS group.

3.3.2.3 Depression Anxiety Stress Scale

The short version of the Depression-Anxiety-Stress Scale (DASS-21) measures symptoms of depression, anxiety and stress (Henry & Crawford, 2005). The scale has 21 items and three subscales: depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). Each item is measured on a 4-point Likert scale ranging from 0 to 3 (0 = not at all, 3 = almost always). Scores for each subscale where multiplied by two to allow for comparison with the original 42 item scale and its classifications for symptom severity (Henry & Crawford, 2005).

3.3.2.4 Visceral Sensitivity Index (VSI)

Gastrointestinal-specific anxiety was assessed with the 15-item Visceral Sensitivity Index (VSI) (Labus et al., 2004). Participants indicated their level of agreement with items on a scale ranging from 1 (strongly agree) to 6 (strongly disagree). Items relate to anticipatory anxiety about sensations in the abdominal region (e.g., I often feel discomfort in my belly could be a sign of a

serious illness). All items were reverse-scored so that higher scores reflect higher gastrointestinal anxiety. Previously the scale showed excellent internal consistency (Cronbach's alpha = .93) and good convergent, concurrent and divergent validity was demonstrated (Labus et al., 2004, 2007). Cronbach's alpha in the current sample was .90 in the IBS group and .95 in the healthy group.

3.3.3 Cognitive task

3.3.3.1 Attention Network Task

The attention network task (ANT) measures attentional control, orienting and alerting attention (Fan et al., 2002). A short version (Hou et al., 2014) of the original task was used in this study. In the task, a string of five white arrows was presented on a black background above or below a central fixation cross on a computer monitor. The central arrow pointed either in the same (→→→→→, congruent) or opposite (→→←→→, incongruent) direction of the four peripheral arrows (Figure 3.1). Participants were instructed to indicate the direction of the central arrow using the computer's keyboard. The difference in reaction time (RT) between the incongruent and congruent condition is referred to as a conflict score and it reflects executive attentional control. Higher conflict scores reflect lower executive attentional control. To assess alerting and orienting attention, the display of arrows is preceded by three cue conditions (Figure 3.1): 1) no cue, 2) central warning cue and 3) a spatial cue, which indicates the upcoming location of the string of arrows. Higher orienting scores reflect faster responses to trials in which the location of the arrows was cued. The task consisted of 16 practice and 96 experimental trials. Each trial started with a central fixation cross (displayed for 400ms, 800ms, 1200ms or 1600ms), then a cue was displayed (100ms), followed by another central fixation cross (400ms) and finally the arrows were displayed until a response was made or for a maximum of 2000ms. The experimental trials were counterbalanced for cue condition, target location (above or below fixation), target direction (left or right), and congruency (congruent or non-congruent), giving 24 trials, each repeated 4 times and presented in a random order (4 repetitions x 24 trials = 96 block trials).

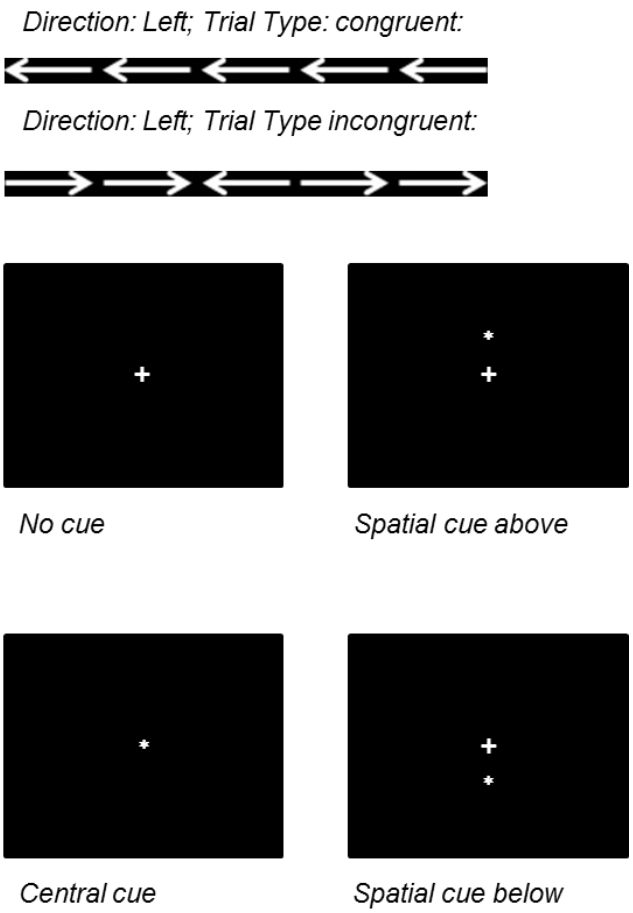


Figure 3.1. Attention Network Task (ANT). Displayed are examples of congruent and incongruent arrow displays and examples of each cue condition.

3.3.3.1.1 ANT Data preparation, error rates and outliers

Practice trials were not included in the analysis. In line with Hou et al. (2014), trials with errors and RT outliers (< 200ms and > 2SD above each participant's mean) were excluded from the statistical analyses. Participants with error rates greater than 10% were not included and therefore one participant in the healthy group and one participant in the IBS group were excluded from further analysis.

Conflict (attentional control), alerting and orienting indices were computed using the following formulae:

Conflict score = mean RT incongruent trials – mean RT congruent trials;

Alerting score = mean RT trials preceded by no cue - mean RT trials preceded by a central cue;

Orienting score = mean RT trials preceded by a central cue - mean RT trials preceded by a spatial cue.

After calculating these indices, one participant in the healthy group was considered an outlier as the participant scored more than three standard deviations above the group mean conflict score. The participant was subsequently excluded from further analyses.

3.3.4 Procedure

All participants completed several computerised tasks and a range of questionnaires as part of the CEFIH Study (see section 9.1.5 and 9.1.6 in the Appendices; for details please see Chapter 2). The ANT was one of these computer-based tasks. Stimulus presentation and data collection were performed via E-Prime 2.0 (Psychology Software Tools, 2012). Our version of the ANT took approximately 5 minutes to complete.

3.3.5 Statistical plan

To analyse differences in attentional control and orienting attention between groups (IBS and Healthy), separate independent samples *t*-tests with conflict and orienting scores as dependent variables and group as between-subjects variable were performed. To determine if these levels of attentional control and orienting attention were related to levels of anxiety and visceral anxiety sensitivity, bivariate correlations were employed. Differences in mean alerting attention between groups were analysed with an independent samples *t*-tests. To investigate if IBS patients with lower attentional control have higher GI-cognition scores (IBS catastrophizing) than IBS patients with higher attentional control, a one-way ANOVA with GI-Cognition scores as dependent variable and Group (IBS with low attentional control, IBS with high attentional control, healthy controls) was used. For this analysis the IBS group was split by their median attentional control score. Bivariate correlation analyses were run to investigate relations between IBS catastrophizing and symptom severity. Data were analysed using SPSS version 22 (IBM Corp., 2013). Effect sizes

were reported using Cohen's *d*. Following Cohen (1988) and Olejnik and Algina (2000) for Cohen's *d*, a small effect size would be considered as $d = 0.2$, a medium effect size as $d = 0.5$, and a large effect size as $d = 0.8$.

3.4 Results

3.4.1 Participants and clinical characteristics

The final sample included in the analysis consisted of 39 participants in the healthy group and 41 participants in the IBS group. Participant characteristics can be seen in Table 3.1. In the analysis of the ANT, on average 2.01 trials (2.1%) were excluded due to erroneous responses. In addition, on average 3.56 (3.7%) outliers were excluded. Consequently, 94.2 % of trials were included in the analysis. The groups did not differ significantly in trial-outliers, errors and number of trials included in the analysis (independent samples *t*-test, all $p > .05$). The groups also did not differ in overall reaction time (Healthy: $M_{healthy} = 544.98$, $SD_{healthy} = 100.06$; IBS: $M_{IBS} = 557.78$, $SD_{IBS} = 101.58$, $t(79) = -0.571$, $p > .05$). Prior to the analysis, assumptions of normality were assessed. In the IBS group, the conflict, depression and anxiety scores were not normally distributed and in the healthy group, the gastrointestinal cognitions, depression, anxiety, stress and VSI scores were not normally distributed.

Table 3.1. Participant Characteristics.

	IBS[1] Group (n = 41)		Healthy Control Group (n = 39)		t-value/ χ^2 value
	Mean	**(S.D.)**	**Mean**	**(S.D.)**	
Age (years)	34.44	(15.7)	35.00	(15.63)	0.16
Gender	82.9% female; 17.1% male		84.6% female; 15.4% male		0.042
Educational Level	39% Up to and including A-levels[2]; 61.0% Tertiary Education[3]		28% Up to and including A-levels[2]; 71.8% Tertiary Education[3]		1.046
IBS Symptoms (GSRS-IBS)[4]	46.37	(10.8)	18.82	(7.72)	13.18***
IBS Catastrophizing (GI-C)[5]	25.24	(12.55)	12.77	(11.36)	4.666***
Depression (DASS)[6]	12.24	(10.11)	5.49	(5.78)	3.691***
Stress (DASS)[6]	17.51	(8.87)	9.28	(7.98)	4.366***
Anxiety (DASS)[6]	10.78	(8.92)	3.33	(3.85)	4.889***
Visceral Anxiety Sensitivity (VSI)[7]	58.24	(14.83)	26.28	(15.06)	9.563***

[1]Irritable Bowel Syndrome; [2]no formal qualifications, GCSE, NVQ or vocational Qualification or at least 12 years of schooling; [3]University degree (Undergraduate, Masters, Post-Graduate); [4]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [5]Gastrointestinal Cognitions Questionnaire; [6]Depression, Anxiety, Stress Scale; [7]Visceral Sensitivity Index

*** $p < .001$

3.4.2 Analysis of attentional functions

The analysis of attentional functions (attentional control, orienting and alerting attention) and their relationship with anxiety and visceral anxiety sensitivity is shown below. Please see Table 3.2 for means and standard deviations of the conflict, orienting and alerting scores and the mean reaction time for each group (IBS, healthy).

3.4.2.1 Attentional control

An independent samples *t*-test with group (IBS, healthy) as between-subjects variable and the conflict score as dependent variable was run. The IBS group had significantly higher conflict scores than the healthy group ($t(78) = 2.75$, $p = .007$), with a mean difference of -17.07, BCa 95% CI [-27.97, -5.12]) and an effect size of $d = 0.62$.

3.4.2.1.1 Relationship between attentional control, anxiety and VSI

A bivariate correlation analysis was run with the conflict, anxiety and visceral anxiety sensitivity (VSI) scores in the IBS group. It was found that the conflict score was not significantly correlated with anxiety or VSI (all *rho*s < +/- .18, all *p*s > .05).

3.4.2.2 Orienting attention

An independent samples *t*-test with group (IBS, healthy) as between-subjects variable and orienting score as dependent variable was run. The IBS group's orienting scores were not significantly different from those of the healthy group ($t(78) = 1.03$, $p = .305$) with a mean difference of -6.07 BCa 95%CI [-17.35, 5.22]) and an effect size of $d = 0.23$.

3.4.2.2.1 Relationship between orienting attention, anxiety and VSI

Bivariate correlation analyses were run with orienting attention, anxiety and VSI scores in the IBS group. Anxiety significantly correlated with orienting attention (*rho*(39) = .38, $p = .015$). The correlation between VSI and orienting scores was not significant (*rho*(39) = .14, $p = .395$.

3.4.2.3 Alerting attention

An independent samples *t*-test comparing the IBS and the healthy group on alerting attention revealed no significant difference between groups, ($t(78) = 1.20$, $p = .232$). The mean difference was 6.28 with BCa 95% CI [-4.08, 17.66] and an effect size of $d = 0.27$.

Table 3.2. Attention Network Task (ANT) indices (msec) in the IBS and the healthy groups. Conflict, alerting and orienting scores reflect differences among cue conditions of the ANT.

	IBS (n = 41)		Healthy (n = 39)	
ANT Index	**M (SD)**		**M (SD)**	
Conflict score[1]	80.69	(31.67)	63.62	(22.83)
Alerting score	8.06	(18.14)	14.34	(27.69)
Orienting score	38.19	(26.94)	32.11	(25.61)
Overall mean RT[2]	557.78	(101.58)	544.98	(100.06)

[1]Higher Conflict scores reflect poorer attentional control; [2]Overall mean RT is the mean reaction time across all cue conditions in the Attention Network Task.

3.4.3 Subgroup analysis

To address hypothesis 2.2, the IBS group was split into two groups with high and low conflict scores based on the median ANT conflict scores of the IBS group (median = 72.45). The range in this group was 138.10 (min. score: 34.98; max. score: 173.08). The group with lower conflict scores (n = 20) had a mean conflict score of 55.88 (*SD* = 11.45) and the group with higher conflict scores (n = 21) had a mean conflict score of 104.32 (*SD* = 26.07). This analysis and way of establishing a cut-off score was based on a previously published analysis with CFS patients who were split into groups with high and low conflict scores based on the median conflict score of the entire patient group. Groups were then compared to each other as well as a healthy group on a third variable (Hou et al., 2014).

A one-way ANOVA with GI-cognition scores as the dependent variable and group (IBS with high conflict scores, IBS with low conflict scores, healthy controls) as between-subjects variable showed a main effect of group ($F(2, 77) = 13.75$, $p < .001$). Planned contrasts between the

IBS group with low conflict scores and the IBS group with high conflict scores showed that the participants with higher conflict scores had significantly higher GI-cognition scores (M = 29.14, SD = 12.89) compared to the IBS group with low conflict scores (M = 21.15, SD = 11.05), t(38.59) = -2.186, p = .032, d = .67, 95% CI [0.035, 1.294], see Figure 3.2.

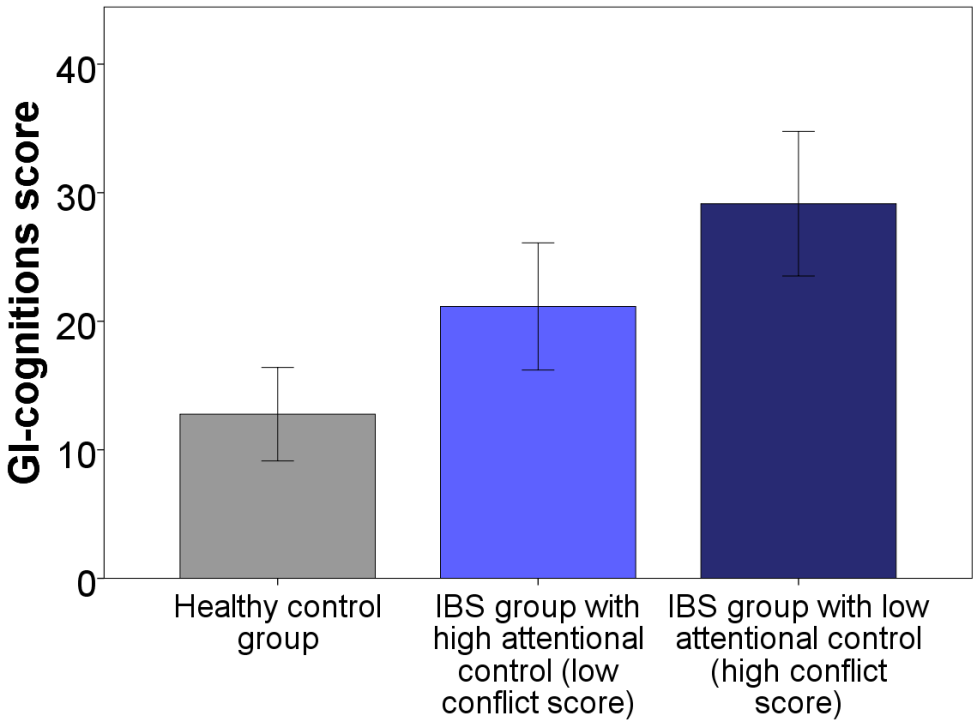


Figure 3.2. Gastrointestinal-Cognitions (IBS-catastrophizing) in the healthy control group, IBS patients with high attentional control (low conflict score) and IBS-patients with low attentional control (high conflict score). ***Note.*** **Error Bars represent two standard errors.**

The low and high conflict score subgroups did not differ significantly on IBS symptoms (GSRS-IBS), depressive symptoms, anxiety, stress (DASS), number of trials included in the analysis, or error rate (all ts(39) < 1.366; all ps > .05). The subgroups also did not differ significantly on gender ($\chi^2(1)$ = .199, Fisher's exact test p = 1.0), or education ($\chi^2(1)$ = 3.228, p = .072).

3.4.4 Relationship between symptom severity and IBS-catastrophizing

A correlational analysis with symptom severity (GSRS-IBS) and GI-Cognitions was run in the IBS group. GSRS-IBS scores were positively correlated with GI-cognition scores (*rho*(39) = .34, *p* = .029). Table 3.3displays the bivariate correlations between the conflict score, alerting score, orienting score, IBS symptom severity, catastrophizing, visceral anxiety sensitivity, depression, anxiety and stress.

Table 3.3 Spearman correlation coefficients (Spearman's rho (ϱ)) and p-values (2-tailed) in patients with Irritable Bowel Syndrome (n = 41)

		1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Conflict score (ANT[1])	ρ	1.00								
	p-value									
2. Alerting score (ANT[1])	ρ	-0.04	1.00							
	p-value	0.783								
3. Orienting score (ANT[1])	ρ	-0.14	-0.04	1.00						
	p-value	0.377	0.811							
4. IBS symptom Severity (GSRS-IBS[2])	ρ	-0.20	-0.13	-0.01	1.00					
	p-value	0.202	0.416	0.953						
5. IBS Catastrophizing (GI-C[3])	ρ	0.18	0.12	-0.04	.34*	1.00				
	p-value	0.254	0.449	0.813	0.029					
6. Visceral Anxiety Sensitivity (VSI[4])	ρ	-0.01	-0.20	0.14	.41**	.37*	1.00			
	p-value	0.935	0.199	0.395	0.007	0.018				
7. Anxiety (DASS-21[5])	ρ	-0.18	0.14	.38*	0.06	0.17	.35*	1.00		
	p-value	0.249	0.370	0.015	0.727	0.277	0.025			
8. Depression (DASS-21[5])	ρ	0.12	0.18	0.26	0.11	0.23	0.08	.52**	1.00	
	p-value	0.442	0.267	0.094	0.495	0.153	0.635	0.001		
9. Stress (DASS-21[5])	ρ	0.08	0.08	0.20	0.05	0.15	0.19	.59**	.54**	1.00
	p-value	0.636	0.619	0.215	0.748	0.354	0.228	0.000	0.000	

[1]Attention Network Task; [2]Gastrointestinal Symptom Rating Scale - Irritable Bowel Syndrome; [3]Gastrointestinal Cognitions Questionnaire; [4]Visceral Sensitivity Index; [5]Depression Anxiety Stress Scale – 21 items

For convenient visual reference, asterisks were added to significant correlation coefficients: * is $p < .05$, ** is $p < .01$, *** is $p < .001$

3.5 Discussion

The aims of this study were twofold: Firstly, to investigate if patients with IBS have lower attentional control and enhanced orienting attention compared to healthy participants and to examine if these levels of attentional control and orienting attention are related to levels of anxiety and visceral anxiety sensitivity. Secondly, the aim was to study the association between attentional control and catastrophizing. The results revealed significantly lower levels of attentional control in patients with IBS compared to healthy participants (Hypothesis 1 was confirmed). In addition, IBS patients with lower levels of attentional control had more catastrophizing thoughts about IBS symptoms compared to IBS patients with higher attentional control (Hypothesis 3 was confirmed). However, levels of attentional control were not related to levels of anxiety or visceral anxiety sensitivity in IBS patients (Hypothesis 2 was not confirmed). Moreover, there was no significant difference in orienting attention between groups (Hypothesis 4 was not confirmed). However, levels of anxiety were positively related to enhanced orienting attention in IBS patients (Hypothesis 5 was partially confirmed). This is the first study demonstrating altered attentional control in IBS patients and the relationship between attentional control and IBS specific negative thoughts (catastrophizing).

In contrast to our findings, Hubbard and colleagues (2015) found that compared to a healthy control group, IBS patients have heightened alerting and orienting attention, but they found no difference in attentional control. Due to their small sample size (15 IBS, 14 controls), the authors reported effect sizes rather than *p*-values to avoid making Type 1 or Type 2 errors. Hubbard and colleagues found a large effect for orienting attention (Hedge's g = -.91) whereas we found a small effect (Cohen's d = 0.18), our respective effect sizes for alerting attention were similarly small (g = -.34, d = -.27) and Hubbard and colleagues found a small effect for attentional control (g = -.20), where we found a medium effect (d = .62). Irrespective of differences in the statistical method of reporting between the two studies, Hubbard et al.'s findings are largely inconsistent with the present study. Perhaps the inconsistencies are moderated by a third variable. One possible explanation is that participants completed the task under different conditions in the

two studies. In Hubbard (2015), participants completed the computer task in a functional magnetic resonance imaging (fMRI) scanner whereas participants in the current study completed the task in a non-medical setting. Although fMRI scans are generally known to be safe, lying in a giant, noisy magnetic tube in a hospital setting could induce a temporary heightened level of stress which might have altered task performance differentially for the IBS and the control group. In the scanner setting, the IBS patients had lower scores on orienting attention and similar scores on attentional control, compared to their matched healthy control subjects under the same conditions. In the current study (without the scanner), the IBS group had lower attentional control and similar levels of orienting attention compared to their matched healthy control subjects. This would indicate a differential response between groups (healthy and IBS) on orienting attention and attentional control under potentially stressful or more demanding situations. Hence, IBS patient's performance on orienting attention tasks (i.e., the orienting index of the ANT) is perhaps different in situations with acute elevated stress levels (as in the Hubbard study) and more similar to the performance of healthy participants under conditions of lower stress (in the current study). Similarly IBS patients' performance on attentional control tasks (i.e., the conflict index of the ANT) may be different in situations with low stress levels (as in the current study) and more similar to the performance of healthy participants under conditions of elevated stress (in the Hubbard study). Thus examining the orienting attention and attentional control response under varied levels of stress in IBS patients may be a fruitful area for future study. Alternatively, the lack of a statistical difference in attentional control in the Hubbard (2015) study could be explained by their small sample size (15 IBS patients, 14 healthy controls) and thus lower power to detect differences between groups. Given that the only two published studies that measured attentional control in IBS patients have conflicting findings, more needs to be learned about the stability of attentional functions compared to healthy control participants. Finally, the reliability (e.g., split-half and test-retest reliability) of the scores of attentional functions obtained by the ANT is not ideal (Macleod et al., 2010). The reliability of the index of attentional control is moderate and the reliability for the indices of orienting and alerting attention is low (Macleod et al., 2010). Thus the differences between the two

studies could be due to measurement error as a result of the low to moderate reliability of the measure (the ANT).

In the IBS group, a large positive correlation between anxiety and orienting attention was found. This could be an indicator that anxiety interacts with the orienting functions of the attentional network. However, no directional or causal inferences can be made.

Counter to our hypothesis, which was based on Attentional Control Theory, we found no evidence for impaired attentional control as a function of anxiety. Specifically, we had proposed that levels of anxiety and visceral anxiety sensitivity would be correlated with levels of attentional control in patients with IBS. It is possible that in IBS patients, the effects of anxiety and visceral anxiety sensitivity on attentional control are only observable when a feared threat is present. For example, such an effect has often been observed in anxious individuals on the emotional Stroop Task, where anxious participants are slower in naming the colour of a word, when the word itself is threat related (Bar-Haim et al., 2007; Derakshan & Eysenck, 2009). Applied to IBS patients, the relationship between anxiety and attentional control might be stronger in the presence of IBS related distracting stimuli during an attentional control task (e.g., IBS-related words such as diarrhoea). This could be tested using experimental study designs.

We also found evidence that IBS patients with lower attentional control had more catastrophizing thoughts related to IBS compared to IBS patients with comparatively higher attentional control. Our findings align with those of Fox and colleagues (2015) who found that the higher levels of worrying (assessed by the level of difficulty in suppressing experimentally induced negative thought intrusions), was related to lower levels of attentional control. Although worrying and catastrophizing are considered to be distinct concepts (Lackner & Quigley, 2005), they also share some important similarities. They are both negative and intrusive. Importantly, both have the potential to exacerbate IBS symptoms, physical pain and the affective dimension of pain (Lackner & Quigley, 2005). In the broader context, empirical evidence seems to point towards a clinically

relevant association between attentional control and negative intrusive thoughts that awaits further scrutiny.

3.5.1 Implications for treatment

Since this study found a relationship between attentional control and catastrophizing (a maintaining factor of IBS symptom severity), improving attention control might be a promising avenue to explore in order to reduce catastrophizing and IBS symptoms. Although the data of this study do not allow to make interferences on directionality, theoretical frameworks (Eysenck & Derakshan, 2011; Eysenck et al., 2007; e.g., Hirsch & Mathews, 2012) and the success of approaches that aimed to increase attentional control in an effort to reduce thought intrusions (Fox et al., 2015) suggest that improvements in attentional control could aid the reduction of in catastrophizing. Computerized attentional control and working memory training as well as mindfulness meditation are two promising intervention techniques that could increase attentional control.

The cognitive model of pathological worry introduced by Hirsch and Mathews (2012) suggests that worry arises from an interaction between cognitive biases favouring threat content and executive functioning such as attentional control. It also proposes that attentional control is beneficial, if it is used to oppose initial threat related distraction before it turns into a verbal form of worry. However when attentional control is redirected to worry content it can be maladaptive (Hirsch & Mathews, 2012). One treatment implication from this model is that training in attentional control could be beneficial, if the increase in attentional control is used to resist initial intrusion but not if it is used to focus on worries. This is largely in line with predictions which would be made from attentional control theory (Derakshan & Eysenck, 2009). For example, given the hypothesized relationship between attentional control and distractibility by exogenous or endogenous stimuli (including thoughts), improvements in attentional control should be related to reductions in distractibility by catastrophizing thoughts. The increased inhibition function of attentional control may aid the resistance to distraction by thoughts, especially at an early stage of catastrophizing, before thoughts consume attentional resources.

Recent studies have aimed to improve attentional control both directly through attentional control training (Fox et al., 2015) and indirectly via working memory training (Hotton, Derakshan, & Fox, 2017; Sari, Koster, Pourtois, & Derakshan, 2015). Attentional control is considered to be a main function of working memory (Course-Choi, Saville, & Derakshan, 2017; Shipstead, Lindsey, Marshall, & Engle, 2014) which is why improvements in working memory are thought to transfer to increases in attentional control. Indeed, a recent study showed that improvements on a working memory task were positively correlated with improvements in attentional control (Course-Choi et al., 2017). However, one study did not show a transfer effect from working memory training on a simple attentional control task, suggesting that the transfer gains may be detectable in more difficult attentional control tasks only (Hotton et al., 2017). Two studies show that attentional control can be trained using different computerized methods (e.g., a flanker task and a progressively more difficult n-back task). Importantly, improvements in attentional control were related to relevant clinical targets such as a reduction in thought intrusions and anxiety (Fox et al., 2015; Sari et al., 2015). Training on these tasks can easily be implemented using online computerized training modules. This means that computerized training modules could be added to existing treatments for IBS that aim to reduce intrusive illness related cognitions without large increases in healthcare costs. For example, a recent study demonstrated that the combination of mindfulness and computerized working memory training led to a greater reduction in worry compared to either training alone (Course-Choi et al., 2017).

Cognitive models of mindfulness predict that mindfulness-based interventions are well-suited to train attention regulation and attentional control (Hölzel et al., 2011; Teasdale, Segal, & Williams, 1995). Indeed, previous studies have shown that various types of mindfulness programmes can affect attentional control (Becerra et al., 2017; Jha, Krompinger, & Baime, 2007; Tang et al., 2007) in healthy participants. Mindfulness interventions have also been shown to increase working memory capacity (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013) and reduce reaction time variability in working memory tasks (van Vugt & Jha, 2011). Given the close relationship between working memory and attentional control, it is also possible that mindfulness

practice trains attentional control through improving working memory capacity. Therefore, mindfulness meditation may be a suitable training method to improve attentional control (and working memory) in an effort to reduce catastrophizing thoughts. However, it should be noted that mindfulness programmes are not attentional control training programs per se, although the techniques used in mindfulness meditation are hypothesised to improve attentional control (Hölzel et al., 2011). The main hypothesized mechanism though which for example MBCT reduces maladaptive thoughts is by changing the relationship to thoughts (Lau et al., 2004) and the concentration developed through meditation practice is thought to support this process (Segal et al., 2013).

3.5.2 Limitations

The limitations about cross sectional designs that were discussed in Chapter 2 also apply to this study. Therefore, definitive conclusions about the directionality of the effects between attentional control and IBS cannot be drawn. Alternative explanations for our findings need to be considered, particularly because the hypothesized relationship between anxiety and attentional control was not found. Firstly, it is possible that lower attentional control was present before the onset of the illness and made participants more susceptible to developing IBS. For example, Posner and Rothbart (2007) have suggested that functioning of the attentional networks may be a trait characteristic. This would indicate that particular cognitive traits prior to the onset of symptoms may predispose individuals to develop more severe catastrophizing cognitions if symptoms do occur. Secondly, it has not been established whether moderate reliability on the conflict score of the Attention Network Task (ANT) is due to task characteristics or variability among individuals (Macleod et al., 2010). If the ANT does not reliably capture attentional control, then the findings of this study might not be replicable with this measure and a more reliable task would need to be used to measure attentional control in patient groups. If individuals show high inter-personal variability in attentional control even if tested under the same conditions, then attentional control may not be a stable predictor of catastrophizing. In addition, the questionnaire measures were obtained before the attentional task was completed. It is thus also possible that catastrophizing impairs attentional

control. This alternative interpretation would also explain why patients high in catastrophizing had lower levels of attentional control in this study. As such, a prospective study would be necessary to confirm our hypothesis that attentional control is predictive of IBS catastrophizing. Moreover, the participants in our study generally had a high level of education which might limit the generalizability of our findings. Finally, symptoms were not measured directly prior to testing, thus the possibility that IBS patients had low lower attentional control due to distracting pain or other symptoms needs to be acknowledged.

3.5.3 Conclusion

Using a previously validated, computerised, reaction time-based method to test attentional networks implicitly, this study found that patients with IBS have lower attentional control, compared to healthy participants. Those patients with attentional control below the cut-off were also those who had more catastrophizing thoughts about their condition. The temporal and causal relationship between attentional control and catastrophizing has not yet been established. However previous research on intrusive thoughts (i.e., worries) suggests that strengthening attentional control might be one way to reduce catastrophizing. Several simple methods of attentional control training are available to test this hypothesis.

Chapter 4: The Effect of Mindfulness on Attentional Control, Attentional Focus, Anxiety and Wellbeing in Students

4.1 Abstract

4.1.1 Introduction and objectives

Attentional control has been linked to psychological well-being, and studies have shown that various mindfulness programs can affect attentional control. Patients with IBS have been shown to have lower attentional control compared to healthy participants, and low attentional control has been linked to an important mediator of symptom improvement in IBS patients: catastrophizing (Chapter 3). These findings suggest that improving attentional control through mindfulness may be beneficial for patients with IBS in terms of reducing the adverse effects of catastrophizing. To explore if Mindfulness-Based cognitive therapy (MBCT) affects attentional control and which treatment dose may be necessary to affect attentional control, I designed a proof-of-concept study with healthy participants. The three main aims of this study were:

A. To investigate if MBCT for students leads to improvements in attentional control early in the intervention
B. To establish whether changes in attentional control would predict changes in self-reported attentional focus and anxiety after the course
C. To determine whether the MBCT for students course is associated with changes in psychological outcomes relevant to the well-being of students. In addition, it was investigated whether levels of home practice are related to changes in all variables

4.1.2 Methods

This quasi-experimental study included two groups of participants. The mindfulness group consisted of 32 participants who attended an 8-week MBCT for students course. The control group of 32 participants did not attend the course. All participants were assessed weekly (for nine consecutive weeks starting pre-treatment) on attentional control with the Attention Network Task (ANT), self-reported attentional focus and shifting (ACS), depression, anxiety, stress (DASS) and positive and negative affect (PANAS). Mindfulness (FFMQ) and satisfaction with life (SWLS) were measured pre- and post-course. Weekly mindfulness home practice was recorded.

4.1.3 Results

After two session of the MBCT course, the participants in the mindfulness group had significantly improved their attentional control compared to the control group. In the mindfulness group reaction-time based attentional control after 2 sessions predicted changes in attentional focus, but not anxiety, after the course had finished. Post-hoc analysis showed that changes in attentional focus after 2 sessions of mindfulness training predicted changes in anxiety at post-training. After the course, the mindfulness group showed significant reductions in depression, anxiety, stress and negative affect and increases in satisfaction with life and mindfulness. Positive affect remained unchanged. Changes in mindfulness and stress were related to the number of times participants had meditated, whereas no other outcomes showed home practice dependent changes.

4.1.4 Discussion and conclusion

These findings can be used to identify time-points to measure mindfulness-induced changes in attentional control during treatment. They informed the design of a study that tests the effect of mindfulness on attentional functioning in patients with IBS. Intervention studies aiming to reduce anxiety in students may be more effective if they include techniques to increase attentional focus early during the treatment phase. Larger-scale randomised controlled studies are necessary to determine the effect of MBCT courses for students on relevant psychological variables.

4.2 Introduction

As outlined in Chapters 1 and 3, attentional control is linked to a range of important psychological variables related to mental health and achievement. Patients with IBS do not only have lower attentional control compared to healthy participants, but lower attentional control was also linked to higher catastrophizing in these patients (Chapter 3). Taken together, these findings suggest that improving attentional control may help in reducing catastrophizing in patients with IBS. In order to make this information relevant for treatment development and evaluation, it is important to ascertain if and when a potential treatment is likely to affect attentional control. It is therefore important to investigate both the techniques that can improve attentional control and also the relationship between changes in attentional control and psychological outcomes.

The training of attention is a central practice of mindfulness (Baer, 2003; Kabat-Zinn, Lipworth, & Burney, 1985). For example, a core mindfulness meditation practice is to stabilize and return one's attention to an intended point of focus (e.g., the breath). Recent neurophysiological and psychological models of mindfulness also place attentional control as a core cognitive process that facilitates other emotional and cognitive changes (Hölzel et al., 2011; Malinowski, 2013; Tang et al., 2015). Empirical studies using objective, reaction time (RT)-based measures of attentional control are particularly informative in delineating the association between mindfulness and attentional control, as they are less influenced by response biases. However, the results from studies investigating the effect of mindfulness on attentional control as measured with the RT-based Attention Network Task (ANT) are mixed and therefore inconclusive. Heterogeneous study designs may account for inconsistencies in findings which will be discussed below. Among studies that compared experienced meditators with participants naive to meditation (novices) two studies showed that experienced meditators have increased attentional control (i.e., conflict monitoring) (Cozza, 2010; Jha et al., 2007), however, other studies showed no such effect (Isbel & Mahar, 2015; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010). In another study, one week of intensive mindfulness training was related to increased attentional control (Elliott, Wallace, & Giesbrecht, 2014). In this study participants that were tested after the training were compared to

participants that were tested before the training had begun (Elliott et al., 2014). Among studies with pre-post experimental designs most showed increased attentional control in the mindfulness group compared to various types of control groups (Ainsworth et al., 2013; Becerra et al., 2017; Tang et al., 2007), but one study did not (Jha et al., 2007). These inconsistencies in findings may in part be due to the heterogeneity in study designs. For example, an assortment of mindfulness meditation traditions and styles, including Mindfulness-Based Stress Reduction (MBSR), Samatha (focused attention meditation), open monitoring (Vipassana) or mind-body interventions that included aspects of mindfulness and Chinese medicine were investigated in relation to attentional control (Ainsworth et al., 2013; Cozza, 2010; Elliott et al., 2014; Isbel & Mahar, 2015; Jha et al., 2007; Tang et al., 2007; van den Hurk et al., 2010). In addition the amount of meditation practice (i.e., the treatment dose) also varied across studies. For example, participants practised meditation between 3-4 hours per day for one week (Elliott et al., 2014), 5 x 20 minutes over the course of 5 days (Tang et al., 2007), three one-hour sessions in eight days (Ainsworth et al., 2013) and four fortnightly group practices over the course of eight weeks with daily meditation home practice (Becerra et al., 2017).

Despite the continuing interest in the effects of different mindfulness interventions on attention, no study has yet investigated if the "Finding Peace in a Frantic World Course" (hereafter referred to as the "Finding Peace" course) can alter attentional control. The Finding Peace course (Oxford-Mindfulness-Centre, 2017; Williams & Penman, 2011) is a mindfulness course for students based upon the original MBCT course to prevent relapse for people with recurrent depression (Segal et al., 2013). Evaluating this course's effect on attentional control as measured with the ANT in healthy participants is particularly relevant to this doctoral thesis, as this investigation serves as a proof of concept study. The results from this study will inform the design of a clinical trial that evaluates the effect of MBCT on attentional control in patients with IBS (Chapters 6 and 7). This aids the smooth transition between the basic science findings in Chapters 2 and 3 and the development of an effective treatment based on the translational approach advocated by the NIH stage model. Repetition on the ANT is likely to produce a training effect that

results in improved performance on this task. Therefore, it is important to have a control group in this study, which engages in the same task repetition, but does not follow the Finding Peace course. Differences between the mindfulness group and the control group would then indicate the additional effect of mindfulness over and above the training effect. In this study, no specific predictions were made about orienting and alerting attention, which the ANT also measures (Fan et al., 2002). However, findings on these attentional functions will be reported.

Changes in subconscious cognitive biases in anxiety and mood disorders have been shown to occur after one dose of antidepressant and one session of CBT and these changes occurred prior to and predicted self-reported symptom changes (please see Chapter 1 for more details) (Harmer, O'Sullivan, et al., 2009; Harmer et al., 2011; Murphy et al., 2008; Reinecke, Waldenmaier, et al., 2013; Teachman et al., 2008). However, it is not clear whether one dose of mindfulness meditation (i.e., one course session) would lead to changes in implicit cognitive functions such as attentional control, nor is it clear if changes in attentional control are related to self-reported psychological outcomes. Linking changes in implicit cognitive functions to clinical outcomes requires knowledge of the most likely time points at which the hypothesised changes can be measured. For example, changes in attentional control may become noticeable after three sessions and these changes may predict changes in anxiety. In this case, measuring attentional control after one session would be a futile attempt to investigate the effect of mindfulness on attentional control and the relationship between mindfulness induced increases in attentional control and changes in anxiety. To maximise the impact of studies aiming to identify and measure implicit mediators of treatment it is critical to identify precise time points. As Dimidjian and Segal (2015) pointed out, in the field of mindfulness-based Interventions (MBIs), it is critical to proceed from 'mere' effect studies to understanding the mechanisms of an intervention. Specifically, delineating temporal patterns of change is important, because if early changes of cognitive measures are related to later changes in desired outcomes, then treatment responders can be identified early. In addition, successful new treatments may be identified by their effectiveness in leading to changes in the mediators and such successful treatments might be shortened to a precise treatment dose that affects the mediator. The

current study therefore aims to investigate the effect of the Finding Peace course on attentional control as well as the time-scale of such changes. In addition, this study will investigate if early changes in attentional control predict later changes in psychological outcome variables hypothesised to be linked with attentional control.

Whilst the typical intervention length of the Finding Peace course is eight weeks, previous findings from the literature indicate that changes in attentional control may be expected within the first three weeks of mindfulness training. For example, one previous study has shown that just three one-hour sessions of focused attention meditation can enhance attentional control (Ainsworth et al., 2013). However, it is still unclear if changes in attentional control happened after the first, second or third session. In addition, the first few sessions of the Finding Peace course are concerned with the development of focused attention and it is therefore to be expected that the early phase of the course is related to improvements in attentional control (Chiesa, Calati, & Serretti, 2011). It is therefore hypothesised that improvements in attentional control will be detected after one, two, or three sessions of the Finding Peace course. This study aims to narrow this range down to a more specific treatment dose. Furthermore, as this is the first study investigating the relationship between the Finding Peace course and attentional control it was of interest to see if changes in attentional control would also be detectable within one week after the completion of the course.

Previous research and theoretical frameworks involving attentional control indicate that self-reported attentional focus and anxiety may be two important functions that would be affected by changes in attentional control. RT-based attentional control (measured with the ANT) and self-reported attentional focus both reflect resistance to distraction and have previously shown to correlate with each other (Reinholdt-Dunne, Mogg, & Bradley, 2013). Attentional focus as measured with the "focused attention" subscale of the Attentional Control Scale (ACS) measures peoples' perceived ability to concentrate and resist distraction in general (e.g., "It's very hard for me to concentrate on a difficult task when there are noises around"; Derryberry & Reed, 2002). Both RT-based attentional control and attentional focus provide an index of a person's ability to

inhibit reactions to distraction, however the ANT is a behavioural task that measures attentional control over the course of approximately five minutes, whereas the attentional focus scale measures a person's general perceived ability to concentrate. Both measures have been designed to measure the underlying construct of executive attention and are based on the original work by Posner and Peterson (1990) who subdivided the attentional system into three distinct networks, one of which was executive attention, also referred to as attentional control (Posner & Petersen, 1990). If, as previously established, changes in cognitive processes occur before changes in related psychological variables are perceived, then early changes in attentional control (as measured with the ANT) should predict later changes in self-reported focused attention (as measured with the ACS).

Finally, as discussed in the introduction and Chapter 3, it is worthwhile to investigate the interaction between anxiety and cognitive functioning from the perspective of Eysenck's Attentional Control Theory (ACT) (Eysenck & Derakshan, 2011; Eysenck et al., 2007). To reiterate, the theory proposes that anxiety impairs the smooth functioning of the top-down, goal-directed attentional system including attentional control and enhances the processing of bottom-up, stimulus-driven processing. In students, this increased distractibility is likely to lead to more anxiety as it interferes with the focused concentration that is required to reach academic success. For example, distractibility is likely to lead to worries about academic performance which may then heighten anxiety. This would be in line with the cognitive model of pathological worry which suggests that attentional control can oppose initial intrusive thoughts before they turn into worries (Hirsch & Mathews, 2012). This model was developed to explain general anxiety disorder (GAD) (Hirsch & Mathews, 2012) and may be applicable to other conditions involving anxiety. Therefore, improvements in attentional control which have been trained by resisting internal (thought based distraction) might precede and predict reductions in anxiety in students. Therefore, this study investigates if early changes in attentional control predict changes in self-reported anxiety in participants of the Finding Peace course. It was predicted that mindfulness would lead to improvements in attentional control, which would in turn predict later reductions in anxiety.

4.2.1 Mindfulness for students

Several universities, including the University of Cambridge (Galante et al., 2016) and the University of Oxford, are offering 8-week Finding Peace courses to their students. The course is based around the content and structure of the MBCT based self-help book "Mindfulness a Practical Guide to Finding Peace in a Frantic World" (Williams & Penman, 2011). The prospective effects of the Finding Peace course on students' wellbeing during the exam period has recently been evaluated, showing that participants that were randomized to the Finding Peace plus care as usual group had significant reductions distress compared to the care as usual control group (with a moderate effect size) (Galante et al., 2017). However no study has yet evaluated the effect of the Finding Peace course on variables other than psychological distress during exam-time. As this course is given to a large number of students on a yearly basis, an initial evaluation of the effectiveness of the course on relevant psychological variables is essential. This is important, because if students' well-being is a priority, then available resources should be spent on interventions that have evidence for reliable effects on indicators of student well-being.

Results from studies evaluating other MBCT-derived courses for university students are promising as they show that MBCT-based programmes are associated with changes in key psychological outcomes. Two randomized wait-list controlled trials evaluated the effects of the original MBCT course and a MBCT self-help-intervention (Kaviani, Javaheri, & Hatami, 2011; Taylor, Strauss, Cavanagh, & Jones, 2014). The participants in the self-help course were instructed to read the book "Mindfulness a Practical Guide to Finding Peace in a Frantic World" (Williams & Penman, 2011). In addition, with a one-group pre-post design, Collard and colleagues (2008) evaluated the effect of the original MBCT for depression course in sixteen students studying for a diploma in counselling. Counselling students attending the original MBCT course showed no changes in positive affect and a significant decrease in negative affect at post-treatment (Collard et al., 2008). Additionally, reductions in depression, anxiety and stress as well as positive changes in mindfulness were found consistently in two of the studies (Kaviani et al., 2011; Taylor et al., 2014) whereas findings on satisfaction with life were mixed – one study showed improvements (Taylor et

al., 2014) and one study reported no changes (Collard et al., 2008). Given overlap in intervention content and target population it is expected that the Finding Peace course will show similarly positive effects.

In accordance with my aim to assess the Finding Peace course's effectiveness at increasing students' well-being, I chose to assess outcome variables relevant to students, specifically attentional focus, attentional shifting, depression, anxiety, stress, mood, satisfaction with life and mindfulness. The Finding Peace course is offered to all students of Oxford University at a reduced cost, however, it is expected that a majority of those students who seek out to participate have elevated baseline levels of depression, anxiety, stress and negative affect, for which they may be seeking help.

Moreover, one hallmark of MBCT is that it emphasises the importance of daily home practice for the duration of the treatment (Segal et al., 2013). However, the association between home practice and desired treatment outcomes has not been clearly established. In a review of mindfulness courses (Vettese, Toneatto, Stea, Nguyen, & Wang, 2009), only thirteen of 24 studies (just more than 50%) showed at least partial support for the association between home practice and study specific outcomes (e.g., mood, mindfulness, stress, severity of hot flashes, relationship happiness). None of the studies included in this review utilised MBCT programs. More recently, three studies on MBCT for depression and bipolar disorder found that home practice was significantly associated with improvements in clinical outcomes (Crane et al., 2014; Hawley et al., 2014; Perich, Manicavasagar, Mitchell, & Ball, 2013) whereas one study did not (Bondolfi et al., 2010). It was also reported that those participants that engaged in home practice three or more times per week were half as likely to relapse into depression (Crane et al., 2014), had lower anxiety post-treatment and lower depression twelve months after treatment (Perich et al., 2013). This suggests that a minimum dose of home practice may be necessary (at least three times per week) for clinical and meaningful changes to take place. The Finding Peace course was designed for a busy student population and daily home practice has been reduced to 20-30 minutes, compared to 45-60 minutes in the original programme. To our knowledge, no study has yet tested the

relationship between home practice and outcomes in this course. The current study therefore examines the relationship between amount of practice and improvements in outcomes in the Finding Peace course.

4.2.2 Objectives and hypotheses

4.2.2.1 Primary and secondary objectives

The primary objective of this study was to investigate if the Finding Peace course can improve attentional control and to determine the time point of such changes. I therefore investigated at which time point during the course changes in attentional control were greater in the mindfulness group compared to the control group. The secondary objective was to investigate if early changes in attentional control would predict later changes in attentional focus and anxiety.

Hypotheses:

1. Participants of the mindfulness intervention will show a significant increase in attentional control compared to the control group from baseline to either week 1, week 2 or week 3 of the course.
2. Compared to the control group, participants in the mindfulness course will show significantly higher increases in attentional control from baseline to post-intervention.
3. Participants in the mindfulness course will show an increase in attentional focus and anxiety from baseline to post-intervention.
4. Changes in attentional control (the specific time-point depends on the results from hypothesis 1) will occur prior to and predict changes in attentional focus and anxiety at post-intervention.

4.2.2.2 Tertiary objectives

The third objective was to evaluate if the Finding Peace course would be associated with changes in psychological outcomes that are relevant for students, and if levels of engagement with home practice affect changes in all outcomes.

Hypotheses:

5. Participants in the mindfulness course will show a significant decrease in negative psychological outcomes (negative affect, depression and stress) from baseline to post-intervention.
6. Participants in the mindfulness course will show a significant increase in positive psychological outcomes (positive affect, satisfaction with life, mindfulness and attentional shifting) from baseline to post-intervention.
7. In the mindfulness group only, the number of home practice sessions and amount of home practice (in minutes) will correlate with changes in attentional control between t.1 and t.4 (the specific time-point depends on the results from hypothesis 1). Participants that practise three or more times per week will show greater changes in attentional control than participants that practise fewer than three times per week.
8. In the mindfulness group only the number of home practice sessions and amount of home practice (in minutes) will correlate with changes in positive outcomes (including attentional focus and attentional control) and negative outcomes from baseline to post-intervention. Participants that practise three or more times per week will show greater changes in positive and negative self-reported outcomes between baseline and post-intervention than participants that practise fewer than three times per week.

4.3 Methods

4.3.1 General procedure

This study had a longitudinal, quasi-experimental design with two groups, a mindfulness group (MG) that completed the Finding Peace course and a control group (CG) that did not receive an intervention. Data collection took place online via LimeSurvey (LimeSurvey Project Team & Schmitz, 2015) and Inquisit (Millisecond, 2015). The study was approved by Oxford University's Medical Sciences Inter-Divisional Research Ethics Committee (REC. Ref. Number MS-IDREC-C1-2015-133) and took place between August 2015 and March 2016. The Participant Information Sheets (PIS) and the Consent Form (CF) of this study can be found in sections 9.2.1 (PIS for

participants in the mindfulness group) 9.2.2 (PIS for participants in the control group) and 9.2.3 (CF) in the Appendices.

4.3.2 Participant recruitment

Participants for the mindfulness group were recruited from students who had enrolled in the 8-week Finding Peace course. Between September 2015 and January 2016, each student who had enrolled in the course was sent general information about the study and how to register for it. The original recruitment plan had specified that participants in the CG would be recruited from the waiting list of the Finding Peace course. However, in August 2015 the waiting-list was empty. This may be explained by a steep increase in the price of the course from £40 to £80, which may have deterred students. As a consequence, rather than having no control group at all, I changed the recruitment strategy for the CG to finding students with a matching age and gender composition. The main aim of this adjusted control group was to provide a comparison for the training effects of repeating the computerised task. The original intention was to compare the results of the mindfulness group with those of the control group on all outcome measures. However this modified control group was unsuitable as a control group for the self-report based outcome measure. This is because participants in the mindfulness course were seeking an intervention (i.e., a course advertised through college nurses to help reduce stress and anxiety) whereas the participants in the control group were not. Therefore, the two groups may have had important psychological differences (e.g., emotion regulation abilities, motivation to change, baseline levels of stress, anxiety and depression), which could influence changes in the outcome measures. Participants for the CG were recruited via email messages throughout the university's colleges and the university-based study participation recruitment schemes. All participants of the study were compensated financially with £25 for their time and effort. Students who registered for the study were screened for eligibility by the project coordinator (JH). Figure 9.1 in the appendices (section 9.2.4) shows the flow of participants through the study's procedures.

4.3.3 Inclusion and exclusion criteria

4.3.3.1 Inclusion

To be included into the study, all participants had to (a) be at least 18 years and less than 70 years of age, (b) have normal or corrected-to-normal vision; and (c) be fluent English speakers.

4.3.3.2 Exclusion

Participants were excluded if they met any of the study's exclusion criteria: (a) Prior participation in an 8–week mindfulness course (MBSR, MBCT) or any other structured mindfulness training, prior participation in Vipassana meditation courses or regular meditation practice (meditating more than once per month); (b) a diagnosis of dementia, amnesia, delirium, a dissociative disorder, a personality disorder, schizophrenia or any other psychotic disorder, a substance-related or induced disorder (such as alcoholism), attention deficit hyperactivity disorder (ADHD), attention deficit disorder (ADD), a primary diagnosis of obsessive compulsive disorder (OCD); (c) suicidality or regular deliberate self-harm; (d) no access to a computer on which the software for the online programme can be downloaded; no access to the internet; (e) visual impairment; (f) consent not given.

4.3.4 Intervention

The intervention was a standardised mindfulness course offered by the Oxford Mindfulness Centre (OMC) to students of Oxford University. It was structured around the book "Finding Peace in a Frantic World" by Mark Williams and Denny Penman (Williams & Penman, 2011) and constitutes an adaptation of MBCT for non-clinical settings (Oxford-Mindfulness-Centre, 2017). It has similar psychoeducational elements as the original MBCT course, however the elements from cognitive psychology are made more relevant for general well-being and stress. The Finding Peace course entails eight weekly sessions that last 90 minutes each. In each session, groups of up to 30 students are led by one trained teacher. Each session contains psychoeducation, guided meditation and a period for inquiry. Inquiry is an opportunity for participants to share their experiences from their own meditation and the teacher responds to these experiences with a mindful approach. Outside of these sessions, participants are instructed to do 20-30 minutes of

home practice (e.g., meditation and exercises from cognitive psychology) on six of seven days of the week. All sessions except the first include time for participants to discuss their experiences from home practice. A summary of the course structure and the content can be found in section 9.2.5 of the Appendices.

4.3.5 Control group

The control group did not participate in any mindfulness-based activities during the duration of the study. The CG was instructed to repeat the ANT on a weekly basis, as explained in section 4.3.6 'Testing Schedule'.

4.3.6 Testing schedule

All participants were asked to complete online assessments, which included filling-in validated questionnaires and completing the computerised ANT. Participants completed their online assessments each week over the course of nine weeks. For the MG, the first online assessment took place one week before the mindfulness course commenced (baseline). Participants of the MG then completed the online assessments each week for the duration of their mindfulness course (after the weekly session and before the next session). The final online assessment was completed after the final mindfulness session (post-intervention). The CG completed their online assessments in the same time period and followed the same weekly schedule. Each online assessment took between 20 and 30 minutes to complete; the ANT took 5 minutes and the questionnaires between 15 and 25 minutes (a schematic representation of the testing schedule can be found in section 9.2.6 of the Appendices). Informed consent was obtained online before participants completed the first online assessment.

4.3.7 Reaction time-based measures

4.3.7.1 Attention Network Task

The Attention Network Task (ANT) measures executive attentional control, orienting and alerting attention (Fan et al., 2002). In this study, a short version (Hou et al., 2014) of the original task was used that is similar to the version of the ANT that was used in Chapter 3. In the task, a string of five black arrows on a white background was presented above or below a central fixation

cross. The central arrow either pointed in the same (→→→→→, congruent) or opposite (→→←→→, incongruent) direction to the other four peripheral arrows (see Figure 4.1). Participants were instructed to indicate the direction of the central arrow by pressing the "E" key for left and the "I" key for right. Each arrow display was preceded by one of four cue conditions (Figure 4.1) no cue, 2) central warning cue and 3) double cue and 4) spatial cue, which indicated the location of the string of arrows.

The task consisted of 16 practice trials and two blocks of 64 experimental trials (a total of 128 experimental trials). Each trial started with a central fixation cross (displayed for 400ms, 500ms, 600ms, 700ms, 800ms, 900ms, 1000ms, 1100ms 1200ms in random order), then a cue was displayed (100ms), followed by another central fixation cross (400ms) and finally the arrows were displayed until a response was made or for a maximum of 1500ms. This sequence was then followed by an inter-trial-interval of 500ms. The experimental trials were counterbalanced for four cue conditions, two target locations (above or below fixation), two target directions (left or right), and two types of cue congruency (congruent or non-congruent), giving 32 possible trials, each repeated twice in each block and presented in a random order (2 repetitions x 32 trials = 64 block trials). During the practice trials, the arrow display was followed by one of three feedback displays: "Error", "Correct", or "No response detected". Data were presented and recorded with Inquisit (Millisecond, 2015).

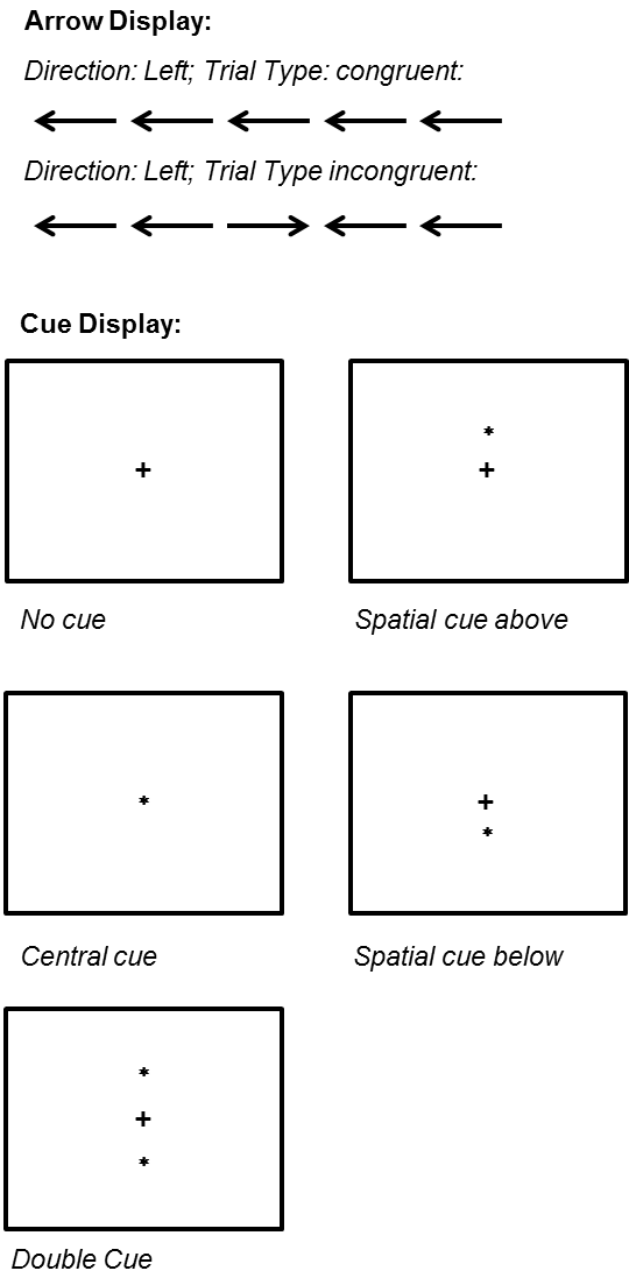


Figure 4.1. Arrow and cue display examples of the Attention Network Task (ANT).

4.3.7.1.1 Data preparation

Practice trials of the ANT were not included in the analysis. In line with Hou et al. (2014), RT trials with errors and outliers (<200ms and >2SD above each participant's mean) were excluded from analysis.

Conflict, alerting and orienting indices were then computed. The index for attentional control (conflict score) and alerting attention was calculated with the same formula described in

Chapter 3. The index for orienting attention (orienting score) was calculated with the following formula:

Orienting Score = mean RT trials preceded by the double cue - mean RT trials preceded by the spatial warning cue

Higher orienting scores result from relatively faster reaction times when the location of the arrow set was cued compared to when the specific location (above or below the fixation cross) was not cued, but an alerting (double) cue was displayed. Means for each condition were calculated as the average median score of the congruent and incongruent trials. For example:

Mean no cue condition = (median RT no cue trials with congruent arrow set + median RT no cue trials with incongruent arrow set)/2.

4.3.8 Self-report measures

4.3.8.1 Demographic variables

Participants reported their date of birth, gender and level of education.

4.3.8.2 Attentional Control Scale

Self-reported attentional focus and attentional shifting was measured with the Attentional Control Scale (ACS) (Derryberry & Reed, 2002). The ACS is a 20 item questionnaire and factor analysis supports two subscales (Ólafsson et al., 2011): focusing (e.g., "My concentration is good even if there is music in the room around me") and shifting (e.g., "It is easy for me to alternate between two different tasks"). Participants are asked to rate how much each item describes them on a scale from 1-4 (almost never – always). Based on the factor analysis by Ólafsson and colleagues (2011), "focusing" was calculated using items 1, 2, 3, 4, 5, 6, 7, 8 and 12 and "shifting" was calculated using items 10, 11, 13, 14, 15, 16, 17, 18, 19 and 20. Item 9 was excluded from the calculation of scores and the analyses. Previous studies (Ólafsson et al., 2011; Verstraeten, Vasey, Claes, & Bijttebier, 2010) found that item 9 has only a few significant correlations with other items of the scale, therefore they excluded item 9 from factor analysis and recommended not using item 9 when calculating the subscales and the total score. In the current study, item 9 was significantly

correlated with only one other item (item 13). Cronbach's alphas at baseline (t.1) for the MG were α = .82 (focusing), α = .68 (shifting) and α = .82 (total excl. Item 9). Cronbach's alphas at baseline for the CG were α = .80 (focusing), α = .72 (shifting) and α = .85 (total excl. Item 9). At t.9, Cronbach's alphas for the MG were α = .81 (focusing), α = .81 (shifting) and α = .87 (total excl. Item 9). The maximum total score is 76, the maximum score for the focusing subscale is 36, and the maximum score for the shifting subscale is 40. Higher scores indicate higher self-reported attentional focus and attentional shifting.

4.3.8.3 Depression Anxiety Stress Scale

The short version of the Depression-Anxiety-Stress Scale (DASS-21) measures symptoms of depression, anxiety and stress (Henry & Crawford, 2005). This scale was described in detail in chapter 2. Briefly, scores for the subscales depression, anxiety, and stress range between 0 and 42, and higher scores indicate higher symptom severity. Scores between 0-9 for depression, 0-6 for anxiety, and 0-13 for stress are within the normal range. Scores between 10-19 for depression, 7-14 for anxiety and 14-25 for stress are considered mild to moderate. Scores between 20-42 for depression, 15-42 for anxiety and 27-42 for stress are within the severe to extremely severe range (Lovibond & Lovibond, 1995). In the present study, at baseline (t.1) Cronbach's alphas for depression, anxiety and stress were .79, .58 and .82 in the MG and .85, .73, and .88 in the CG. At t.9 Cronbach's alphas for depression, anxiety and stress were .83, .79 and .88 in the MG.

4.3.8.4 Positive Affect Negative Affect Schedule

Positive and negative mood was measured with the 20-item Positive Negative Affect Schedule (PANAS) (Crawford & Henry, 2004; Watson, Clark, & Tellegen, 1988). The PANAS has ten items for positive affect (e.g., inspired, interested) and 10 items negative affect (e.g., upset, nervous). Participants are asked to what extent they have felt each item during the past week. Participants answer on a 1-5 point scale (very slightly, or not at all - extremely). Previously, internal consistency was Cronbach's α = .89 for the positive affect scale (PA) and α = .85 for the negative affect scale (NA) in a large non-clinical adult population (Crawford & Henry, 2004). In the current study Cronbach's alphas at baseline for the MG were PA α = .86 and NA α = .78, and

for the CG PA α = .86 and NA α = .85. Cronbach's alphas at t.9 for the MG were PA α = .95 and NA α = .90. The maximum score for PA and NA is 50 and higher scores indicate higher positive and higher negative affect. Normative data suggest that for PA a raw score of 26 is just below the 25th percentile, 31 is just below the 50th percentile and 36 is just below the 75th percentile. For NA, raw score of 12 is just above the 25th percentile, 14 is just below the 50th percentile and 18 is just below the 75th percentile (Crawford & Henry, 2004).

4.3.8.5 Five Factor Mindfulness Questionnaire

Mindfulness was assessed with the Five Facet Mindfulness Questionnaire Short Form (FFMQ – 24) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Bohlmeijer, Ten Klooster, Fledderus, Veehof, & Baer, 2011). The original 39-item FFMQ was developed using Exploratory Factor Analysis on five independently developed mindfulness scales (Baer et al., 2006). The scale has 24 items to assess five aspects of mindfulness: observing, describing, acting with awareness, non-judging of inner experiences and non-reactivity to inner experience). Participants rate how well each item describes them on a 1-5 point scale (never or very rarely true – very often or always true). 'Observing' refers to paying attention to sensory internal and external experiences (e.g., "I pay attention to physical experiences, such as the wind in my hair or sun on my face", 'Describing' refers to the level of ability to accurately describe one's experiences (e.g., "I'm good at finding words to describe my feelings"), 'Acting with Awareness' involves paying attention to one's present moment experience and engaging in activities without being on 'autopilot' (e.g., "I rush through activities without being really attentive to them"), 'Non-judgemental of inner experience' includes being non-judgemental or non-evaluative of one's thoughts or emotions (e.g., "I tell myself that I shouldn't be thinking the way I'm thinking"), and 'Non-reactivity to inner experience' involves an ability to de-centre from thoughts and emotions, and letting them go if one chooses not to engage with them (e.g., "When I have distressing thoughts or images, I don't let myself be carried away by them"). The five factors can be assessed individually and combined as a total score. All items of the 'Non-judgemental of inner experience' subscale (items 4, 7, 14, 19, 24), all items of the 'Acting with Awareness' subscale (items 8, 12, 17, 22, 23) and two items of

the ‘Describing’ subscale (items 5, 22) were reverse scored. These items were phrased negatively – that is, rating these items as very true indicates low mindfulness (e.g., “I think some of my emotions are bad or inappropriate and I shouldn’t feel them”). When reverse scored, low agreement with negative items indicates higher mindfulness. All other items were scored normally with higher agreement indicating higher mindfulness (e.g., “Usually when I have distressing thoughts or images I can just notice them without reacting”). The reliability of the factors of the FFMQ-24 were (Cronbach’s Alpha) α = .81 (Observe), α = .87 (Describe), α = .83 (Act with Awareness), α = .83 (Non-judging) and α = .75 (non-reacting) in a sample of 376 people with depressive symptomatology (Bohlmeijer et al., 2011). A recent evaluation of the factor structure of the FFMQ (Gu et al., 2016) indicated that the ‘observing’ factor of the FFMQ may not be valid for evaluating pre-post interventions or comparing meditators to non-meditators, as the scale behaves differently in these populations. This is because, in meditators, the five-factor structure of the FFMQ emerges, whereas in non-meditators a four factor structure without the ‘observe’ aspect emerges. A possible explanation for this phenomenon was that the quality of observing may be different between meditators and non-meditators, where high observing scores in non-meditators may not necessarily be indicative of mindful observation but perhaps of a neutral or even maladaptive observation style (e.g., hypervigilance or somatosensory amplification) (Baer et al., 2008; Gu et al., 2016). The authors (Gu et al., 2016) therefore recommended computing the total score without the ‘observe’ items. Based on this recommendation, I decided to use the FFMQ total score without the observing scale (FFMQtotal-obs) in this study. At t.1 Cronbach’s alpha in the MG for the FFMQtotal-obs was α = .84 (CG α =.79) and α = .87 at t.9. The maximum score of the FFMQtotal-Obs is 100, the maximum score for each of the subscales is 25.

4.3.8.6 Satisfaction with Life Scale

Global satisfaction with life was assessed with the Satisfaction with Life Scale (SWLS) (Diener, Emmons, Larsen, & Griffin, 1985). The SWLS consists of 5 items, such as “In most ways my life is close to my ideal”. Participants indicate how much they agree or disagree with each statement on a 1 - 7 point scale (strongly disagree - strongly agree). The maximum score is 35, and

higher scores are indicative of higher satisfaction with life. The SWLS has good psychometric properties, with Cronbach's α of .85 and a two week and one month test-retest reliability of .84 (Pavot, Diener, Colvin, & Sandvik, 1991). In the current study, Cronbach's α was .82 (MG) and α = .72 (CG) at t.1 and .85 (MG) at t.9.

4.3.8.7 Treatment adherence

Each week, participants in the MG reported whether they had attended that week's mindfulness session. They also indicated the amount of formal home practice (meditation only) they had completed by specifying the number of times they meditated in a given week and the average length of the sessions (in minutes). Two outcome measures of engagement with home practice were calculated:

'Total number of home practice sessions' = sum of the number of times participants had meditated each week,

and

*'Total home practice' = '(number of times meditated in week 1 (t.2) * (average length of session) + '(number of times meditated in week 2 (t.3) * (average length of session) + …+ '(number of times meditated in week 8 (t.9) * (average length of session).*

4.3.9 Participant flow

Of the 104 students enrolled in the mindfulness course who expressed an interest in taking part in the study, 85 completed the online screening questionnaire. Of these 85, 18 were excluded from the study, as they did not meet the study's eligibility criteria (one had impaired vision, two had previously taken part in an MBSR or MBCT course, two had previously been involved in a structured mindfulness training, three had a regular meditation practice, six had a diagnosis of ADHD or ADD and four were experiencing suicidal thoughts). Sixty-seven students were eligible and invited to take part in the study. Of those 67, 48 completed the first assessment and 36 participants completed at least eight of the nine assessments. Participants were included in the analysis if they had attended at least five of the eight sessions of the mindfulness course. Previous

MBCT trials included participants who attended at least four out of eight sessions (Kuyken et al., 2008; J. M. G. Williams et al., 2014), as this was considered the minimum adequate dose of treatment. However a more conservative value was chosen, as the adapted course is shorter (90 minute instead of 150 minutes per session) and more sessions may be needed to lead to a comparable level of improvement. Four participants had attended four or fewer sessions and the final participant number in the MG for the data analysis was n = 32.

Of the 131 students not registered for a mindfulness course who expressed an interest in taking part in the study, 68 completed the online screening questionnaire. Of these 68, five were excluded from the study, as they did not meet the study's eligibility criteria (one had previously been involved in a structured mindfulness training, two had a regular meditation practice, two were experiencing suicidal thoughts) and 63 were eligible and invited to take part in the study. Of these 63, 47 completed the first assessment and 33 completed at least eight of the nine assessments. One participant was subsequently excluded because they indicated that they had followed alternative mindfulness training during the duration of the study. The final sample size for the control group was 32 (see Figure 9.1 in the appendices).

4.3.10 Statistical analysis

A priori sample size calculation using G*Power 3.1 (Faul, 2014; Faul et al., 2007) indicated that a total sample size of n = 62 was required to draw conclusions about the main question of this study (at which time point changes in attentional control would be different in the MG compared to the CG). This was calculated with the following parameters: a medium effect size of ηp^2 of .06 or higher, a desired power of .8 and an alpha level of .05 for an analysis with a mixed design repeated-measures ANOVA (2 Groups, 4 measures, G*Power Option: as calculated in SPSS). Whilst expecting a drop-out rate of 30-40% (due to the longitudinal nature of this study) 45-50 participants were recruited per group to arrive at a sample size of at least 31 participants per group.

Data were analysed using SPSS version 24 (IBM Corp., 2016). When main effects were found in addition to interaction effects, simple main effects were calculated. Effect sizes were reported using the Partial Eta Squared index (ηp^2) and Cohen's *d*. Following Cohen (Cohen, 1988) and Olejnik and Algina (2000) for ηp^2 a small effect size = 0.01; medium effect size = 0.06; large effect size = 0.14, for Cohen's *d* a small effect size = 0.2; medium effect size = 0.5; large effect size = 0.8. Cohen's *d* for independent samples t-tests were calculated using the formula $d = (M_{MG} - M_{CG})/ SD_{CG}$, as given in Field (2013 p. 387). For correlation analysis with several variables, an alpha (α) value smaller than or equal to 0.01 was chosen to denote significance. A Bonferroni-correction was considered too conservative, given the small sample size.

Change scores were calculated for the conflict score from t.1 to t.3 (conflict score at t.3 – conflict score at t.1) and from t.1 to t.9 (conflict score at t.9 – conflict score at t.1). Negative scores indicate an improvement in attentional control and positive scores indicate a deterioration in attentional control. Change scores for week one to week nine were calculated for all self-reported outcomes by subtracting the scores of t.1 from the scores of t.9 (t.9-t.1).

All Cronbach's alphas for the self-report measures were calculated with all participants who had completed at least eight of the nine assessments (MG = 36; CG = 32).

4.4 Results

4.4.1 Participant characteristics

Table 4.1 includes all participants that met the inclusion criteria. One eligible participant in the MG completed all but the ninth assessment, therefore analysis for pre (t.1) –post (t.9) data includes n = 31 (rather than n = 32) participants for the MG.

Table 4.1. Participant Characteristics.

	MG[1] (n=32)	CG[2] (n=32)	t-value/ χ^2 value
	Mean (S.D.)	Mean (S.D.)	
Age (years)	25.47 (5.77)	23.25 (3.40)	1.874
Gender	66% female; 31% male; 3% non-binary gender identity	59% female; 41% male; 0% non-binary gender identity	1.434[a]
Highest Educational Level Reached	19% Up to and including A-levels[9]; 81% Tertiary Education[10];	19% Up to and including A-levels[9]; 81% Tertiary Education[10];	0.000
Depression (DASS[3])	7.81 (6.00)	8.69 (7.46)	-0.517
Anxiety (DASS[3])	6.88 (5.35)	6.56 (5.64)	0.227
Stress (DASS[3])	15.69 (8.80)	10.81 (8.62)	2.239*
Positive Affect (PANAS[4])	32.59 (6.54)	33.56 (6.69)	-0.586
Negative Affect (PANAS[4])	22.75 (6.57)	21.75 (6.95)	0.591
Satisfaction with Life (SWLS[5])	23.16 (6.65)	24.78 (4.96)	-1.109
Mindfulness (FFMQ[6])	58.93 (8.79)	64.43 (7.72)	-2.658*
Attentional Focus (ACS[7])	21.34 (6.11)	24.50 (5.73)	-2.133*
Attentional Shifting (ACS[7])	24.50 (5.03)	25.78 (4.92)	-1.030
Attentional Control (ANT[8,12])	69.81 (19.52)	63.98 (17.17)	1.218

*p < .05; **p < .01; ***p < .001; [a] Fisher's Exact test values were used

[1] Mindfulness Group; [2] Control Group; [3] Depression Anxiety Stress Scale; [4] Positive Affect Negative Affect Scale; [5] Satisfaction With Life Scale; [6] Five Factor Mindfulness Questionnaire excluding the Observation Subscale; [7] Attentional Control Scale; [8] Attention Network Task; [9] no formal qualifications, GCSE, NVQ or vocational Qualification or at least 12 years of schooling; [10] University degree (Undergraduate, Masters, Post-Graduate);[12] Participants were included if they had an error rate of < 100% (MG = 31, CG = 30)

4.4.2 Differences in attentional control between the mindfulness group and the control group

4.4.2.1 Accuracy and error rates

Overall task accuracy was recorded at each time point. Participants with an error rate of 100% (the participant did not respond or the data was not recorded) were excluded from the following examination of accuracy and the analysis. 100% error rates were recorded for $n_{t.1} = 3$, $n_{t.2} = 1$, $n_{t.3} = 1$ and $n_{t.4} = 1$ (n_{tx} signifies the number of participants at each testing time).

Error rates across groups were 4.02% at t.1, 4.76% at t.2, 4.81% at t.3 and 6.79% at t.4. Detailed visual inspection of error rates indicated that the mean error rate and SD of error rates increased with time for both groups (see Table 4.2). A mixed design ANOVA with mean error rates at t.1, t.2, t.3 and t.4 as within group factor and Group (MG, CG) as between group factor confirmed different error rates across testing times (see Table 4.2): There was a main effect of time ($F(3, 174) = 5.58$, $p = .001$, $\eta p^2 = .09$), no main effect of group ($F(3, 58) = 2.87$, $p = .095$, $\eta p^2 < .05$) and the interaction between time and group was not significant ($F(3, 174) = 1.32$, $p = .27$, $\eta p^2 = .02$).

Table 4.2. Weekly error rates on the Attention Network Task (ANT) per group (means and standard deviations (SD)).

		t.1			t.2			t.3			t.4		
		Mean	(SD)	N	Mean	(SD)	N	Mean	(SD)	N	Mean	(SD)	N
Group	MG[1]	3.70	(2.74)	31	4.15	(2.87)	32	4.00	(3.65)	32	5.09	(4.79)	31
	CG[2]	4.35	(3.11)	30	5.39	(4.02)	31	5.65	(4.73)	31	8.49	(9.10)	31
	Total	4.02	(2.92)	61	4.76	(3.51)	63	4.81	(4.26)	63	6.79	(7.96)	62

[1]Mindfulness group, [2]Control group

For the main analysis of conflict scores (attentional control), it was therefore decided that a standard cut-off score of error rates was not applicable. Instead, for each time point, the participant was included if the error rate was below 2SD of the mean for the particular time point. Thus error rate cut-off scores (Mean + 2SD) were 9.86 for t.1, 11.78 for t.2, 13.33 for t.3 and 22.7 for t.4. The number of participants that did not meet the weekly error rate inclusion criteria was $n_{t.1}$ = 2 (MG:1, CG:1), $n_{t.2}$ = 3 (MG:1, CG:2), $n_{t.3}$ = 2 (MG:0, CG:2), $n_{t.4}$ = 2 (MG:0, CG:2).

4.4.2.2 Between group differences on attentional control

A mixed design ANOVA with time (t.1, t.2, t.3, t.4) as within-group factor and group (MG, CG) as between-group factor was employed to investigate at which point during the first four testing sessions differences in attentional control between the MG and the CG would occur. There was a significant main effect of time (F(3, 156) = 6.17, p = .001, ηp^2 = .11), indicating that both groups improved on scores of attentional control (please see means and SDs in Table 4.3). There was no main effect of group (F(3, 52) < .001, p = .99, ηp^2 < .01). The interaction between group and time was not significant (F(3, 156) = 2.07, p =.107, ηp^2 = .04).

Planned simple contrasts comparing t.1 to t.2, t.3 and t.4 revealed a significant interaction between time and group at t.3 (F(1, 52) = 5.15, p =.027, ηp^2 = .09), indicating that significant differences in attentional control between the groups (MG and CG) appeared after the second session. Planned contrasts between t.1 and t.2 and t.1 and t.4 were not significant (interaction for t.1 and t.2 F(1, 52) = 0.22, p =.643, ηp^2 < .01, interaction for t.1 and t.4 F(1, 52) = 3.58, p = .064, ηp^2 < .06). Please see Table 4.3 for means and SDs at t.1 to t.2, t.3 and t.4 and Figure 4.2 for a graphical representation of the results.

Table 4.3. Means and standard deviations (SD) of attentional control[1] (conflict score) at t.1, t.2, t.3 and t.4 for the mindfulness group (MG) and the control group (CG).

		t.1		t.2		t.3		t.4	
		Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Group (n)	MG (28)	69.01	(18.03)	63.12	(19.76)	55.66	(14.94)	56.37	(13.70)
	CG (26)	63.97	(18.76)	60.38	(17.88)	59.99	(14.78)	60.05	(14.34)

[1]Measured with the Attention Network Task

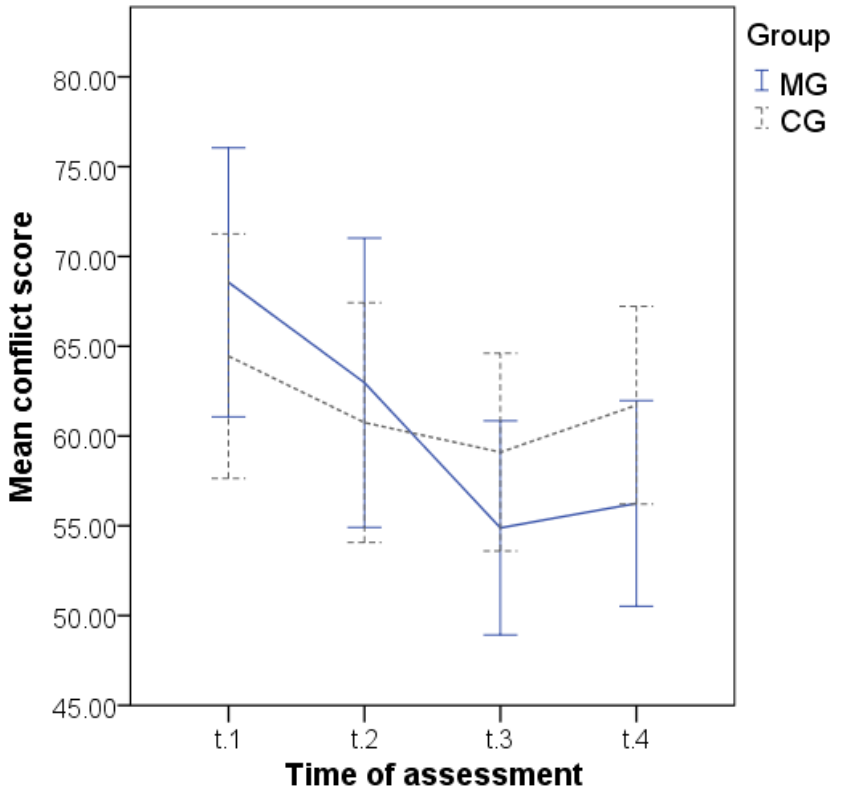


Figure 4.2. Mean attentional control (conflict score) measured with the Attention Network Task (ANT) at t.1 (baseline), t.2 (after 1 week), t.3 (after 2 weeks) and t.4 (after 3 weeks) for the mindfulness group (MG) and the control group (CG). *Note.* Error bars represent 95% Confidence Intervals (95% CI).

4.4.3 Changes in attentional focus and attentional shifting in the MG

The planned analyses with t.1 and t.9 were supplemented with data from t.3 to examine if changes in attentional shifting and attentional focus had also occurred by t.3, when changes in attentional control had been detected. Two separate repeated measures ANOVAS were run in the mindfulness group only for the ACS-focus and the ACS-shifting subscales.

4.4.3.1 Changes in attentional focus

A repeated-measures ANOVA with ACS-focus scores at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(1.768, 53.032) = 14.78$, $p < .001$, $\eta p^2 = .33$, Huynh-Feldt corrected) indicating that the MG had increased in attentional focus across time (please see Table 4.4 for means and SDs). Planned within subject contrasts (simple) showed significantly different ACS-focus scores between t.1 and t.3 ($F(1, 30) = 11.84$, $p = .002$, $\eta p^2 = .28$)

and significantly different ACS-focus scores between t.1 and t.9 ($F(1, 30) = 20.54$, $p < .001$, $\eta p^2 = .41$). Please also see Figure 4.3 and Table 4.4.

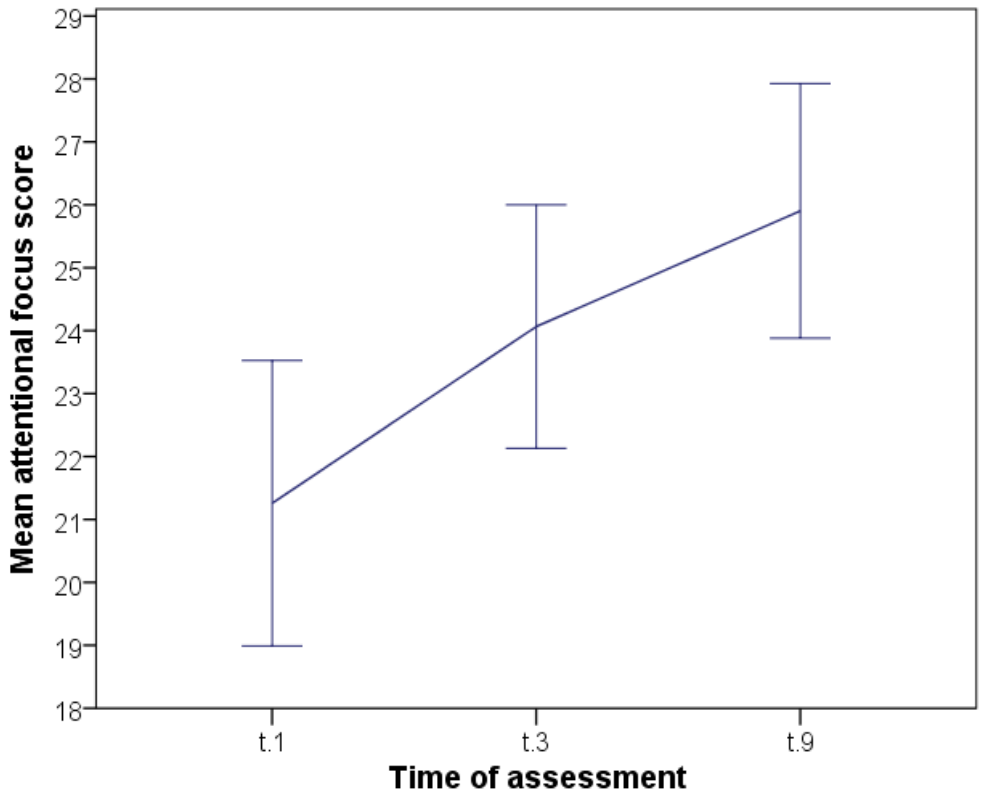


Figure 4.3. Mean self-reported attentional focus at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) for the mindfulness group. *Note.* Measured with the focus subscale of the Attentional Control Scale (ACS). Error bars represent 95% Confidence Intervals (95% CI).

Table 4.4. Means and standard deviations (SD) for self-reported levels of attentional focus and attentional shifting at baseline (t.1), after two weeks of mindfulness practice (t.3) and post-treatment (t.9) for the mindfulness group (n=31).

	t.1		t.3		t.9		Within group t.1-t.3	Within group t.1-t.9	Main effect of time
	Mean	SD	Mean	SD	Mean	SD	*Mean Difference*	*Mean Difference*	*F*
Attentional focus (ACS[1])	21.26	(6.19)	24.06	(5.27)	25.90	(5.52)	2.806**	4.645***	14.779***
Attentional shifting (ACS[1])	24.32	(5.01)	25.68	(5.84)	27.87	(5.09)	1.36	3.548***	11.355***

*p < .05; **p < .01; ***p < .001

[1]Attentional Control Scale

4.4.3.1.1 Relationship between changes in attentional control between t.1 and t.3 and changes in attentional focus between t.1 and t.9 in the mindfulness group

Participants were included in the analysis if they met the error-rate criterion for the relevant weeks set under 'section 4.4.2.1 Accuracy and Error Rates' for the ANT. One participant in the MG was excluded based on this criterion. Change scores were then screened for outliers. Two participants were excluded from the analysis because they had change scores of ± 2SD of the mean attentional control change score (M = -13.72, SD = 13.49).

A simple linear regression with bootstrapped confidence intervals for the regression coefficients was run to calculate if changes in attentional control (conflict scores) from t.1 to t.3 predict changes in self-reported attentional focus scores from t.1 to t.9. The model was trending towards statistical significance ($F(1, 25) = 4.00$, $p = .056$, $R^2 = .14$), and the changes in RT-based attentional control between t.1 and t.3 significantly predicted changes in self-reported attentional focus between t.1 and t.9. Table 4.5 displays the model parameters. These results may indicate that reaction-time based attentional control does predict self-reported attentional focus, but as the model accounts for only 14% of the variance in self-reported attentional focus, it is likely that other factors contributed to it.

Table 4.5. Linear model of changes in attentional control[1] at t.3 as a predictor for changes in attentional focus at t.9 in the mindfulness group.

	b [95% CI]	*SE B*	*ß*	*t*	*p*
Constant	1.1508 [-0.910, 4.105]	1.214		0.845	0.219
Changes in attentional control (ANT[1]) t.3-t.1	-0.203 [-.339, -.048]	0.083	-0.371	-2.000	0.013

Note. $R^2 = .14$, $F(1, 25) = 4.000$, $p = .056$

[1]Attention Network Task (ANT) conflict score; [2]Attentional Control Scale (focus subscale)

4.4.3.2 Changes in attentional shifting in the mindfulness group

A repeated-measures ANOVA with ACS-shift scores at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(2, 60) = 11.36$, $p < .001$, $\eta p^2 = .20$) indicating that the MG had increased in attentional shifting across time (please see Table 4.4 for means and

SDs). Planned within-subject contrasts (simple) showed no significant difference between ACS-shifting scores at t.1 and t.3 ($F(1, 30) = 3.77$, $p = .062$, $\eta p^2 = .11$). ACS-shift scores between t.1 and t.9 were significantly different ($F(1, 30) = 19.79$, $p < .001$, $\eta p^2 = .40$). Please also see Figure 4.4 and Table 4.4.

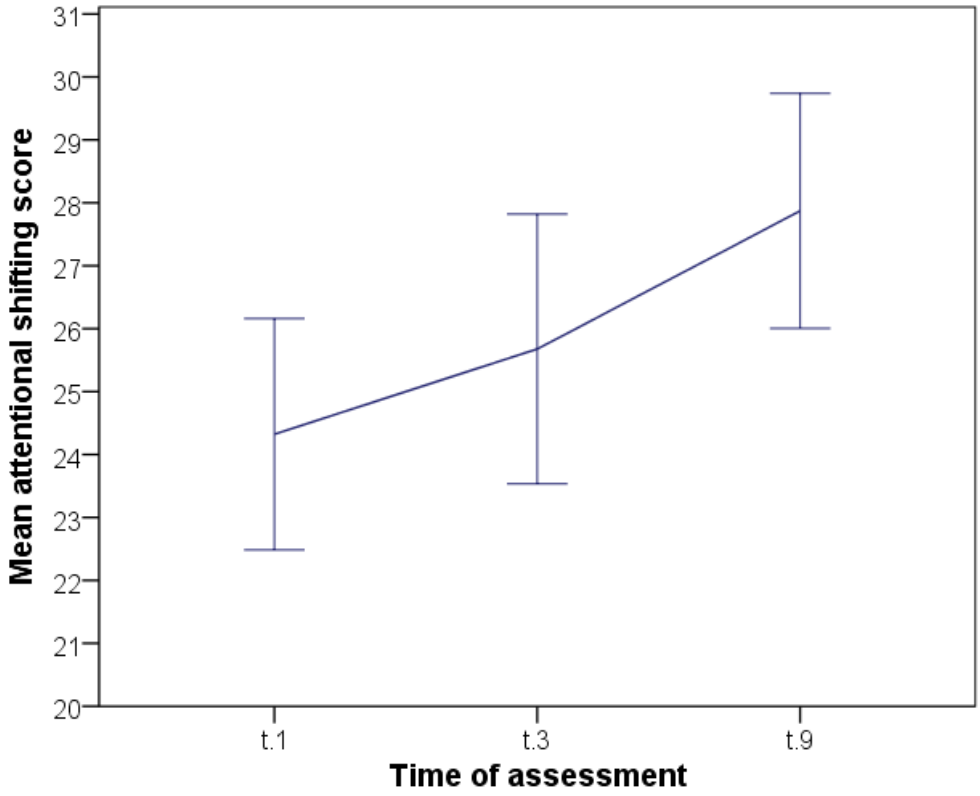


Figure 4.4. Mean self-reported attentional shifting at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) for the mindfulness group. *Note*. Measured with the shift subscale of the Attentional Control Scale (ACS). Error bars represent 95% Confidence Intervals (95% CI).

4.4.4 Changes in anxiety

This planned analysis was supplemented with data from t.3 (in addition to t.1 and t.9) to examine if changes in anxiety were already visible at t.3, when changes in attentional control had been detected. A repeated-measures ANOVA with DASS-anxiety scores at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(2, 60) = 4.84$, $p = .011$, $\eta p^2 = .14$) indicating that the MG had decreased in anxiety across time (please see Table 4.8 for means and SDs). Planned within-subject contrasts (simple) showed that there was no difference in DASS-anxiety scores between t.1 and t.3 ($F(1, 30) = 0.072$, $p = .790$, $\eta p^2 < .01$). The difference in DASS-

anxiety scores was however significant between t.1 and t.9 ($F(1, 30) = 8.49$, $p = .007$, $\eta p^2 = .22$). Please also see Figure 4.5**Error! Reference source not found.**.

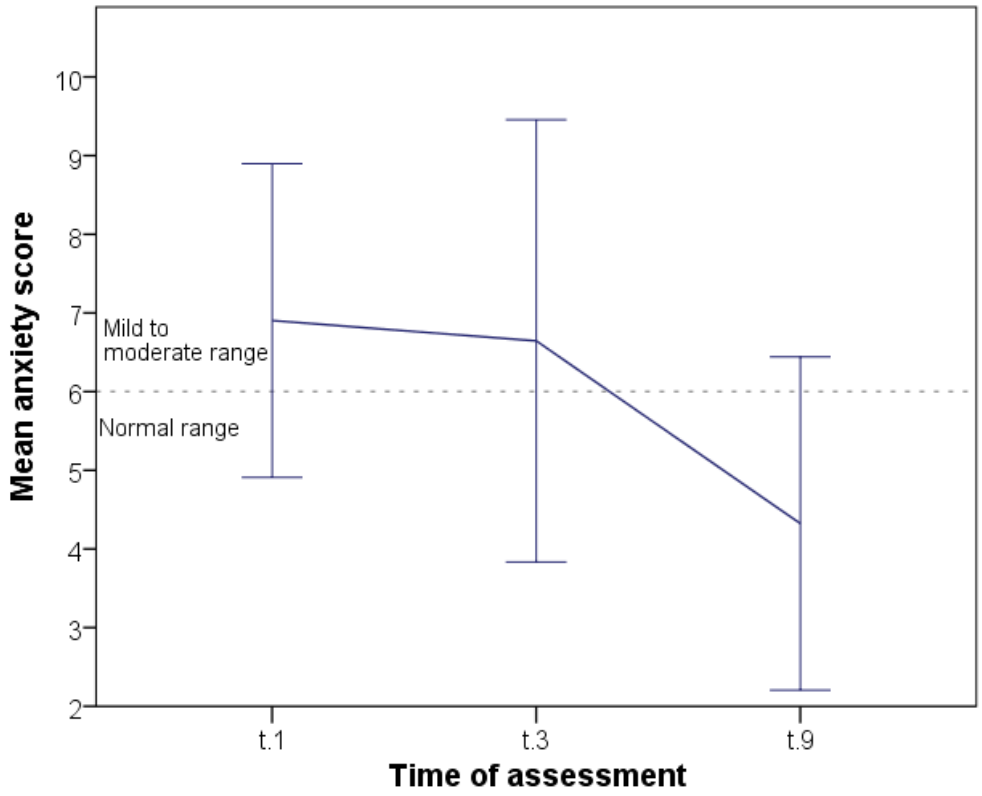


Figure 4.5. Anxiety scores at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) in the mindfulness group. *Note.* Measured with the anxiety subscale of the Depression Anxiety Stress Scale - 21 (DASS-21). Error bars represent 95% Confidence Intervals (95% CI).

4.4.4.1 Relationship between changes in attentional control between t.1 and t.3 and changes in anxiety between t.1 and t.9 in the mindfulness group

As in the previous regression analysis, two participants were excluded from the analysis because they had change scores of ± 2SD of the mean attentional control change score. A simple linear regression with bootstrapped confidence intervals for the regression coefficients was run to calculate if changes in attentional control (conflict scores) from t.1 to t.3 would predict changes in self-reported anxiety (DASS-anxiety) scores from t.1 to t.9. The model was not significant ($F(1, 25) = 0.79$, $p = .382$, $R^2 = .03$), and the changes in RT-based attentional control between t.1 and t.3 did not predict changes in self-reported anxiety between t.1 and t.9 ($b_{constant} = -1.367$, $b = .083$, $SE_b = .099$, $\beta = .175$, 95%BCa [-.095, .284], $t = 0.891$, $p = .378$).

4.4.5 Changes in attentional control, alerting and orienting attention at t.1, t.3 and t.9 between groups

4.4.5.1 Attentional control

As before, participants were included in the analysis if they had error rates below 2 SD above the mean error rate of that week. In week 8 (t.9), the mean error rate was m = 6.30, SD was 7.03. Thus error rate cut-off scores (Mean + 2SD) were 9.86 for t.1 (see Table 4.2) and 20.46 for t.9. At t.9, 2 participants (MG:2, CG:0) were excluded from the analysis due to the cut-off score.

We ran a mixed design ANOVA with attentional control scores at t.1 and t.9 as within group factor and group (MG, CG) as the between group factor. There was a main effect of time ($F(1, 54) = 22.76$, $p < .001$, $\eta p^2 = .30$), but no main effect of group ($F(1, 54) = .008$, $p = .931$, $\eta p^2 < .01$). The interaction between group and time was significant ($F(1, 54) = 6.39$, $p = .014$, $\eta p^2 = .11$), indicating that there was a group-dependent change in attentional control between t.1 and t.9.

To interpret the interaction effect and qualify the main effect of time, simple effects for time were calculated. Analysis of simple main effects of time showed that the MG had significantly lower conflict scores at t.9 compared to t.1 ($F(1, 54) = 25.71$, $p < .001$, $\eta p^2 = .32$), the mean difference was -17.736, 95%CI [-24.75, -10.72]. However, the difference in conflict scores was not significant for the CG ($F(1, 54) = 2.61$, $p = .112$, $\eta p^2 = .05$), the mean difference was -5.453, 95%CI [-12.22, 1.314]. This indicates that the main effect of time was driven by the interaction effect, and that compared to the CG, the MG significantly increased in attentional control. Please see Table 4.6 for means and SDs and Figure 4.6.

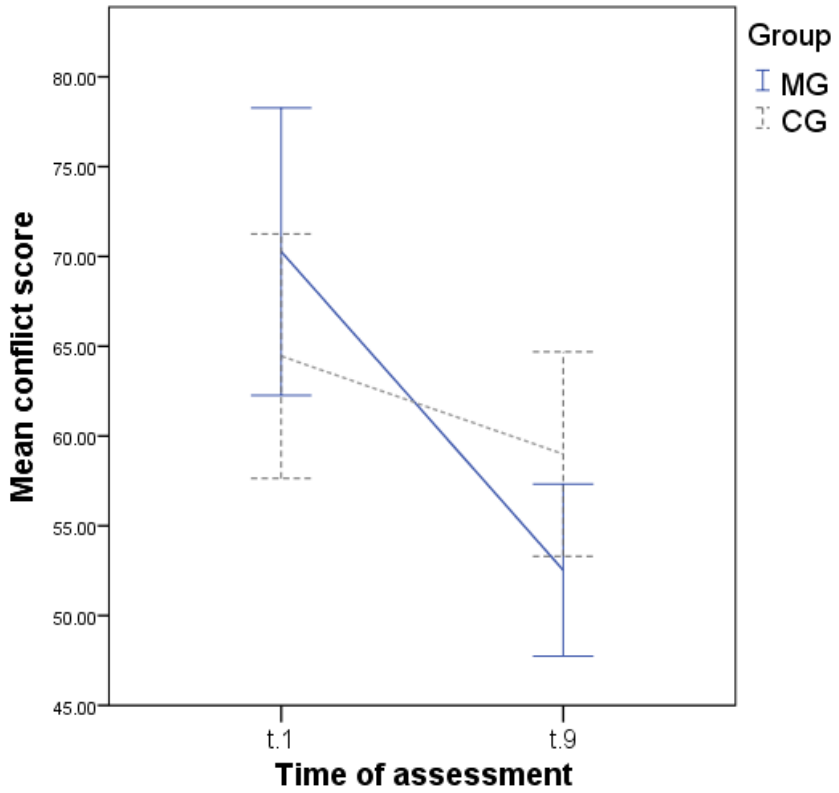


Figure 4.6. Mean attentional control (conflict scores) at t.1 (baseline) and t.9 (post-intervention) for the mindfulness group (MG) and the control Group (CG) measured with the Attention Network Task (ANT). *Note.* Error bars represent 95% Confidence Intervals (95% CI).

4.4.5.2 Differences between groups at baseline (t.1), after week 2 (t.3) and after the intervention (t.9) on orienting attention and alerting attention

As no specific predictions were made with regards to orienting and alerting attention, exploratory analyses were run with these two variables to see if there were group-dependent changes in these aspects of attentional functioning at the time-points when changes in attentional control had been found (t.3 and t.9). As before, participants were included in the analysis if they had error rates below 2 SD above the mean error rate of that week.

4.4.5.2.1 Orienting attention

We ran a mixed design ANOVA with orienting scores at t.1, t.3 and t.9 as within group factor and group (MG, CG) as the between group factor. There was a main effect of time ($F(2, 106) = 3.45$, $p = .035$, $\eta p^2 = .06$), indicating that both groups had decreased in orienting scores (please see Table 4.6 for means and SDs). There was no main effect of group ($F(1, 53) = 1.28$, $p = .263$, $\eta p^2 = .02$) and no interaction between group and time ($F(2, 106) = 0.37$, $p = .690$, $\eta p^2 = .01$).

4.4.5.2.2 Alerting attention

We ran a mixed design ANOVA with alerting scores at t.1, t.3 and t.9 as within group factor and group (MG, CG) as the between group factor. There was a main effect of time ($F(2, 106) = 3.48$, $p = .034$, $\eta p^2 = .06$), indicating that both groups had increased in alerting scores, as can be seen from the means and standard deviations in Table 4.6. There was no main effect of group ($F(1, 53) = 0.024$, $p = .878$, $\eta p^2 < .01$) and no interaction between group and time ($F(2, 106) = 0.20$, $p = .818$, $\eta p^2 < .01$).

Table 4.6. Means and standard deviations (SD) for attentional control, alerting attention and orienting attention at baseline (t.1), t.3 and post treatment (t.9) for the mindfulness group (MG, n = 27) and the control group (CG, n = 28).

		t.1		t.3		t.9		Within group t.1-t.3	Within group t.1-t.9	*F* interaction effect
		Mean	SD	Mean	SD	Mean	SD	*Mean Difference*	*Mean Difference*	*F*
Attentional control (ANT[1,3])	MG	70.27	(20.23)	N/A[4]		52.53	(12.11)	N/A[4]	17.736***	6.386*
	CG	64.45	(17.90)	N/A[4]		59.00	(14.95)	N/A[4]	2.61	
Alerting attention (ANT[1,3])	MG	14.74	(29.69)	25.05	(19.13)	21.03	(15.03)	N/A[2]	N/A[2]	0.201
	CG	14.63	(17.54)	22.07	(18.18)	22.50	(16.74)	N/A[2]	N/A[2]	
Orienting attention (ANT[1,3])	MG	20.96	(20.99)	12.44	(17.86)	12.56	(14.94)	N/A[2]	N/A[2]	0.372
	CG	14.62	(15.32)	9.94	(17.98)	10.69	(12.43)	N/A[2]	N/A[2]	

*p < .05; **p < .01; ***p < .001

[1]Attention Network Task; [2]These were only calculated if the interaction between time and group was significant.; [3]Participants were included in the analysis if they had an error rate of < 2SD above the weeks mean (n_{MG} = 27, n_{CG} = 28); [4]t.3 was not included in this analysis, because it was included in a previous analysis that investigated changes in attentional control at t.3

4.4.6 Post-hoc analysis: correlation between changes in attentional control and attentional focus from t.1 to t.3

As the participants in the MG had displayed significant changes in both reaction-time based attentional control and self-reported attentional focus from t.1 to t.3, a post-hoc correlational analysis was run for these variables. Changes in attentional control and attentional focus between baseline and t.3 were not significantly correlated $r(26) = -.128$, $p = .516$.

4.4.7 Post-hoc analysis: relationship between changes in attentional focus between t.1 and t.3 and changes in anxiety between t.1 and t.9 in the mindfulness group

In order to examine the underlying mechanisms of change for anxiety in the Finding Peace course, it was examined if early changes in attentional focus predicted later changes in anxiety. Linear regression with bootstrapped confidence intervals for the regression coefficients was run to calculate if changes in self-reported attentional focus from t.1 to t.3 predict changes in self-reported DASS-anxiety scores from t.1 to t.9. The model was significant ($F(1, 29) = 7.81$, $p = .009$, $R^2 = .21$) and showed that changes is attentional focus significantly predicted anxiety. Table 4.7 displays the model parameters.

Table 4.7. Linear model of changes in attentional focus[1] from t.1 to t.3 as a predictor for changes in anxiety[2] from t.1 to t.9 in the mindfulness group.

	b [95% CI]	*SE B*	*ß*	*t*	*p*
Constant	-1.177 [-3.141, .368]	0.966		-1.247	0.223
Changes in attentional focus (ACS[1]) t.3-t.1	-0.500 [-.789, -.225]	0.145	-0.461	-2.794	0.002

Note. $R^2 = .21$, $F(1, 29) = 7.809$, $p = .009$

[1]Attentional Control Scale (focus subscale); [2]Depression Anxiety Stress Scale (anxiety subscale)

4.4.8 Changes between t.1, t.3 and t.9 on self-reported psychological outcomes

To determine if participants in the MG changed in depression, stress, positive affect, negative affect, mindfulness and satisfaction with life, separate repeated measures ANOVAs were run with t.1 and t.9. For all measures except mindfulness and satisfaction with life, data from t.3

were also included to examine if changes in these outcomes were already visible at t.3, when changes in attentional control had been detected.

4.4.8.1 Depression

A repeated-measures ANOVA with DASS-depression scores at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(2, 60) = 3.72$, $p = .030$, $\eta p^2 = .11$) indicating that the MG had decreased in depression across time (please see Table 4.8 for means and SDs). Planned within-subject contrasts (simple) showed that there was no difference in DASS-depression scores between t.1 and t.3 ($F(1, 30) = 0.11$, $p = .743$, $\eta p^2 < .01$). The difference in DASS-depression scores was however significant between t.1 and t.9 ($F(1, 30) = 5.24$, $p = .029$, $\eta p^2 = .15$). Please also see Figure 4.7.

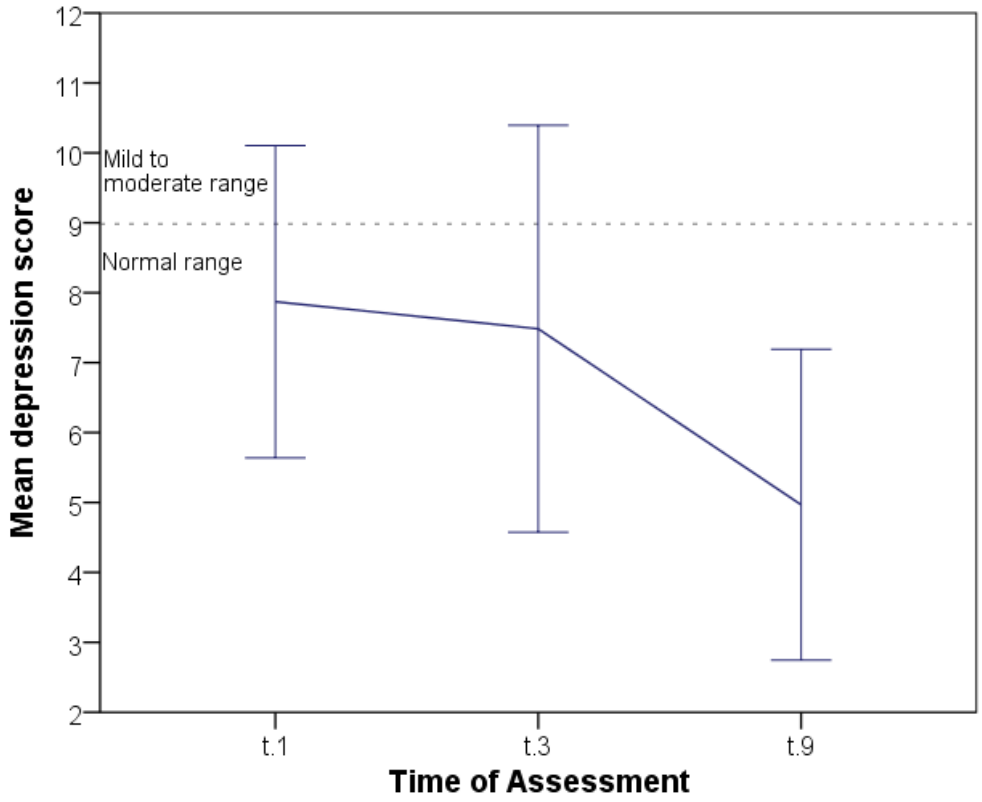


Figure 4.7. Depression scores at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) in the mindfulness group. *Note.* Measured with the depression subscale of the Depression Anxiety Stress Scale -21 (DASS-21). Error bars represent 95% Confidence Intervals (95% CI).

4.4.8.2 Stress

A repeated-measures ANOVA with DASS-stress scores at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(2, 60) = 12.84$, $p < .001$, $\eta p^2 = .30$) indicating that the MG had decreased in stress across time (please see Table 4.8 for means and SDs). Planned within-subject contrasts (simple) showed that there was no difference in DASS-stress scores between t.1 and t.3 ($F(1, 30) = 1.170$, $p = .29$, $\eta p^2 = .04$). The difference in DASS-stress scores was however significant between t.1 and t.9 ($F(1, 30) = 22.21$, $p < .001$, $\eta p^2 = .43$). Please also see Figure 4.8**Error! Reference source not found.**.

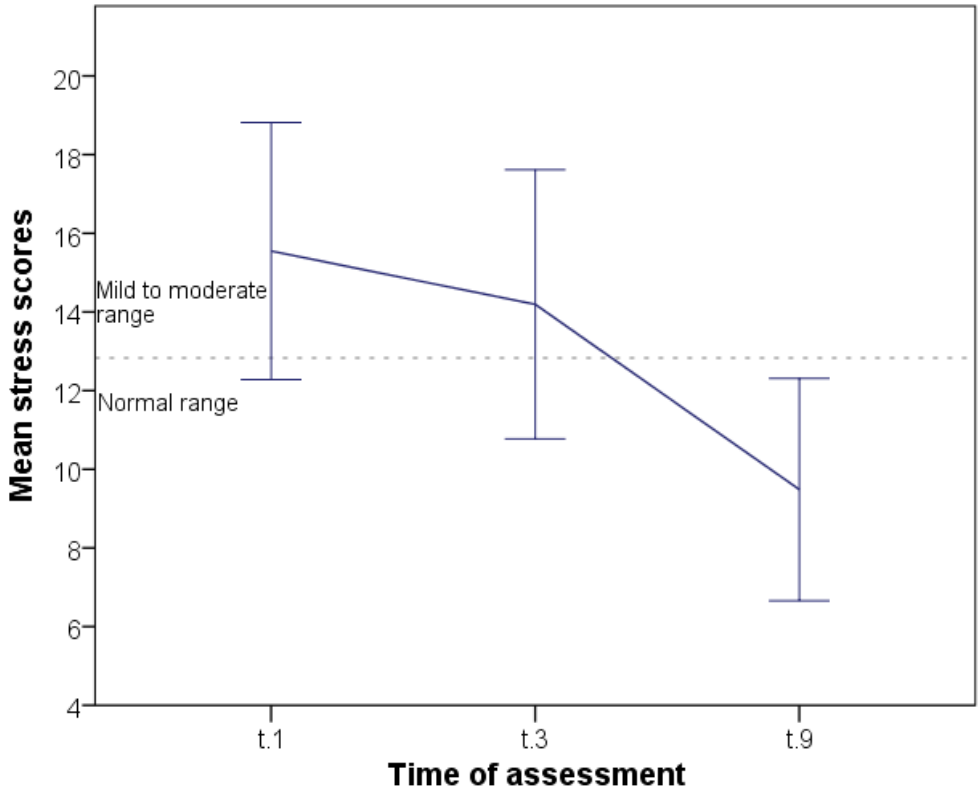


Figure 4.8. Stress scores at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) in the mindfulness group. *Note.* Measured with the stress subscale of the Depression Anxiety Stress Scale -21 (DASS-21). Error bars represent 95% Confidence Intervals (95% CI).

4.4.8.3 Positive affect

A repeated-measures ANOVA with PANAS-positive affect scores at t.1, t.3 and t.9 as within group factor was run. There was no main effect of time ($F(1.424, 42.731) = 0.70$, $p = .499$, $\eta p^2 = .02$, Greenhouse-Geisser corrected) indicating that the MG had experienced no change in

positive affect (please see Table 4.8 for means and SDs). Planned within-subject contrasts (simple) showed that there was no difference in PANAS-positive affect scores between t.1 and t.3 ($F(1, 30) = 0.12$, $p = .732$, $\eta p^2 < .01$) and no difference between t.1 and t.9 ($F(1, 30) = 0.44$, $p = .512$, $\eta p^2 = .01$). Please also see Figure 4.9**Error! Reference source not found.**.

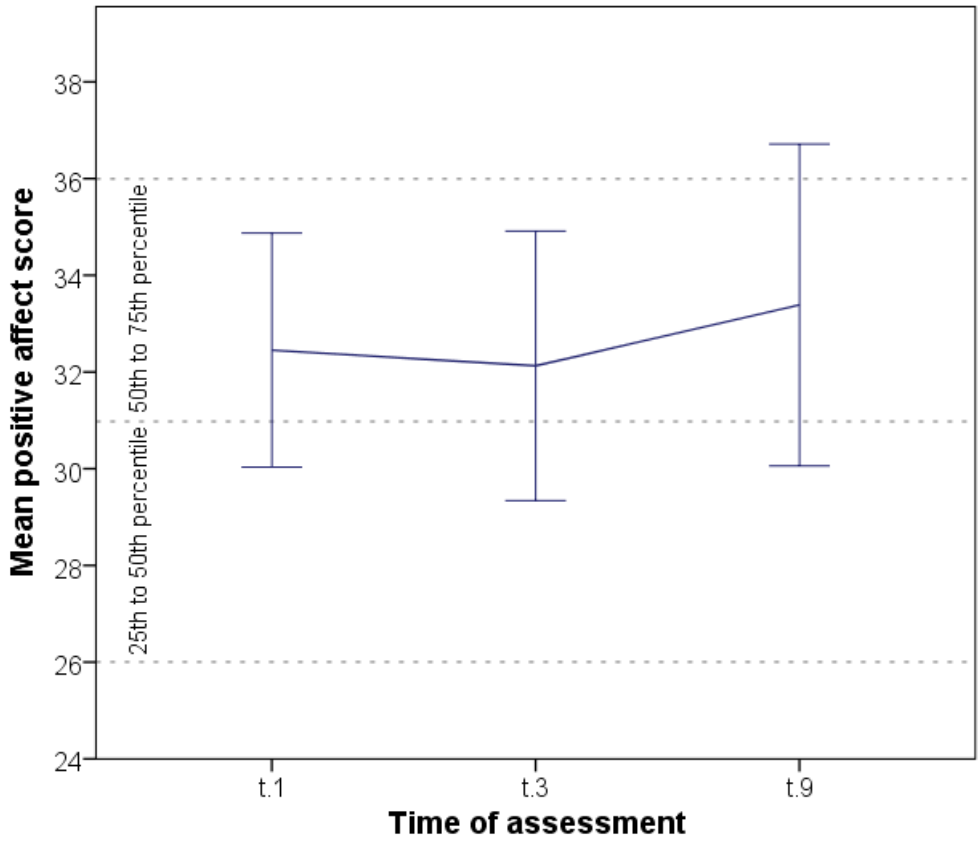


Figure 4.9. Positive affect scores at t.1 (baseline), t.3 (after 2 weeks) and t.9 (post-intervention) in the mindfulness group. Dotted lines indicate the 25th, 50th and 75th percentile given normative data (Crawford & Henry 2004). ***Note.*** **Positive affect was measured with the Positive Affect Negative Affect Scale (PANAS). Error bars represent 95% Confidence Intervals (95% CI).**

4.4.8.4 Negative affect

Repeated-measures ANOVA with PANAS-negative affect at t.1, t.3 and t.9 as within group factor was run. There was a main effect of time ($F(2, 60) = 17.87$, $p < .001$, $\eta p^2 = .37$) indicating that the MG had decreased in negative affect across time (please see Table 4.8 for means and SDs). Planned within-subject contrasts (simple) showed that there was no difference in PANAS-negative affect scores between t.1 and t.3 ($F(1, 30) = 3.98$, $p = .055$, $\eta p^2 = .12$). The difference in PANAS-negative affect scores was however significant between t.1 and t.9 ($F(1, 30) = 50.45$, $p < .001$, $\eta p^2 = .63$). Please also see Figure 4.10.

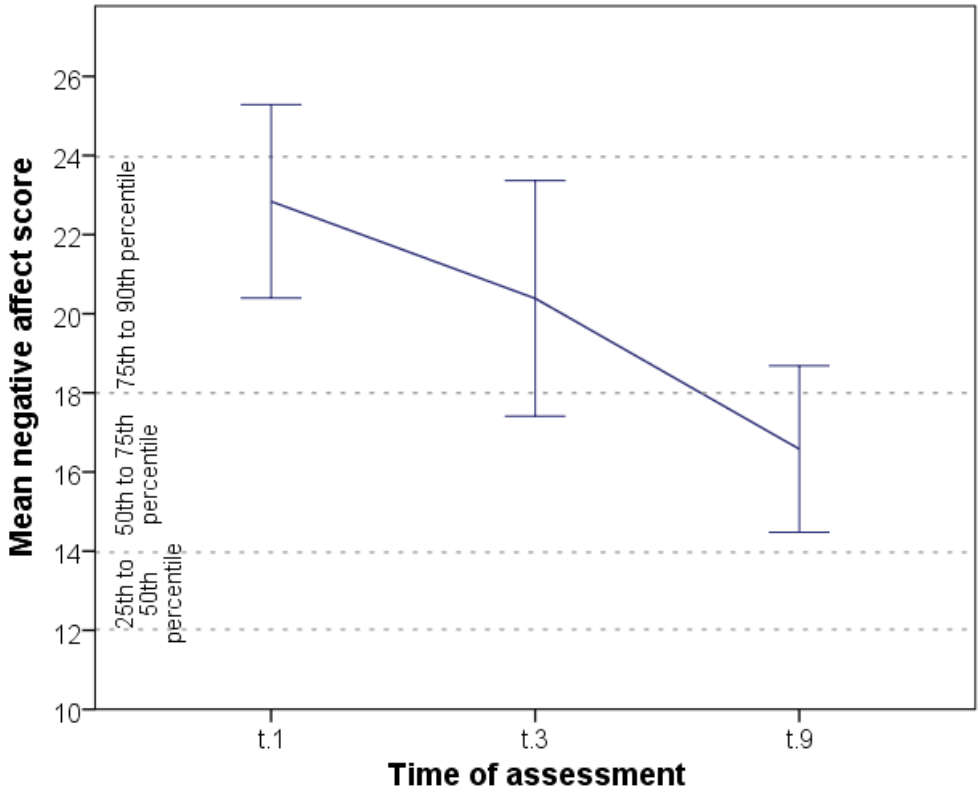


Figure 4.10. Negative affect scores at t.1 (pre-course), t.3 (after 2 weeks) and t.9 (after the course) in the mindfulness group. Dotted lines indicate the 25th, 50th, 75th and 90th percentile given normative data (Crawford & Henry 2004). *Note.* Negative affect was measured with the Positive Affect Negative Affect Scale (PANAS). Error bars represent 95% Confidence Intervals (95% CI).

4.4.8.5 Satisfaction with life

A repeated-measures ANOVA with SWLS scores at t.1 and t.9 as within group factor was run. There was a main effect of time ($F(1, 30) = 8.50$, $p = .007$, $\eta p^2 = .22$) indicating that the MG had increased in satisfaction with life between t.1 and t.9 (please see Table 4.8 for means and SDs, and Figure 4.11).

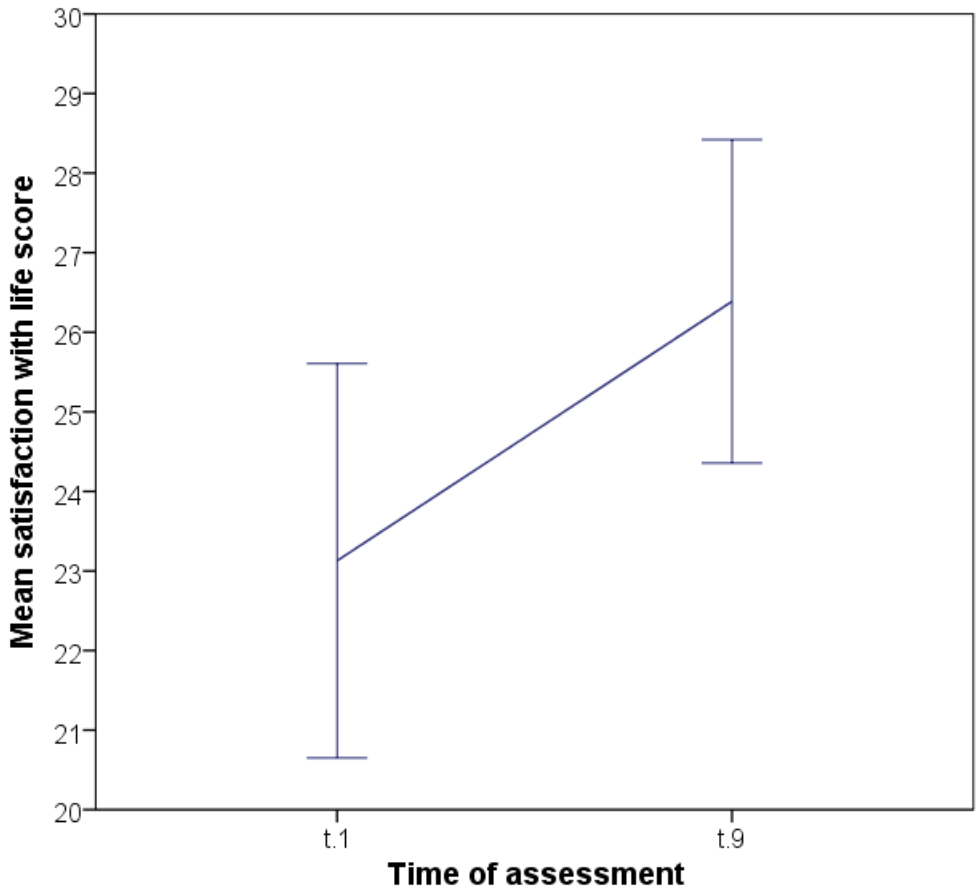


Figure 4.11. Satisfaction with life scores at t.1 (baseline) and t.9 (post-intervention) in the Mindfulness Group. *Note*. Satisfaction with life was measured with the Satisfaction with Life Scale (SWLS). Error bars represent 95% Confidence Intervals (95% CI).

4.4.8.6 Mindfulness

A repeated-measures ANOVA with FFMQ-Obs scores at t.1 and t.9 as within group factor was run. There was a main effect of time ($F(1, 30) = 33.45$, $p < .001$, $\eta p^2 = .52$) indicating that the MG had increased in mindfulness between t.1 and t.9 (please see Table 4.8 for means and SDs and Figure **4.12**).

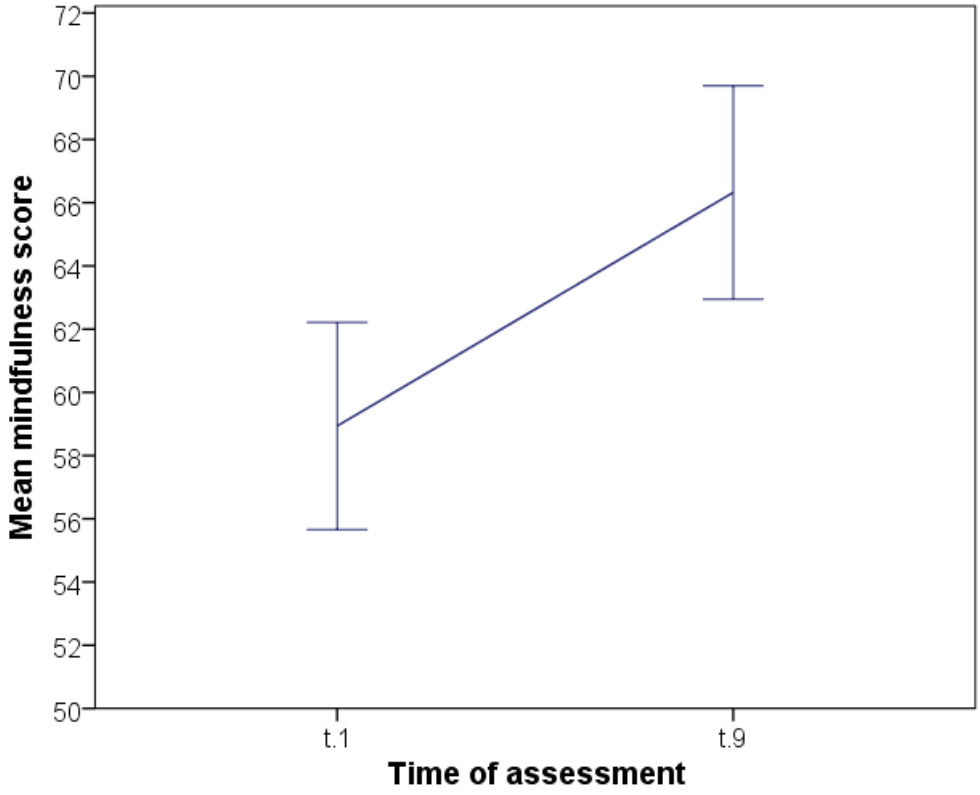


Figure 4.12**. Mindfulness scores measured with the Five Factor Mindfulness Questionnaire (FFMQ) without the observing scale at t.1 (baseline) and t.9 (post-intervention) in the mindfulness group.** ***Note.*** **Error bars represent 95% Confidence Intervals (95% CI).**

4.4.8.7 Self-reported outcomes in the control group

For readers interested in the data from the control group, the means and standard deviations of the self-report measures that were taken at t.1, t.3 and t.9 in the control group are presented in Table 4.9.

Table 4.8. Means and Standard Deviations (SD) for self-reported psychological variables at baseline (t.1), after two weeks (t.3) and post treatment (t.9) for the Mindfulness Group (n = 31).

	t.1		t.3		t.9		Change from t.1 to t.3	Change from t.1 to t.9	Main effect of time
	Mean	(SD)	Mean	(SD)	Mean	(SD)	*F*	*F*	*F*
Depression (DASS[1])	7.87	(6.09)	7.48	(7.93)	4.97	(6.06)	0.109	5.244*	3.718*
Anxiety (DASS[1])	6.90	(5.44)	6.65	(7.67)	4.32	(5.78)	0.072	8.490**	4.841*
Stress (DASS[1])	15.55	(8.91)	14.19	(9.33)	9.48	(7.71)	1.170	22.212***	12.849***
Positive Affect (PANAS[2])	32.45	(6.60)	32.13	(7.60)	33.39	(9.07)	0.119	0.441	0.704
Negative Affect (PANAS[2])	22.84	(6.66)	20.39	(8.12)	16.58	(5.74)	3.982	50.450***	17.837***
Satisfaction with Life (SWLS[3])	23.13	(6.76)	N/A		26.39	(5.54)	N/A	N/A	8.495**
Mindfulness (FFMQ[4])	58.94	(8.94)	N/A		66.32	(9.20)	N/A	N/A	33.446***

*p < .05; **p < .01; ***p < .001

[1]Depression Anxiety Stress Scale; [2]Positive Affect Negative Affect Scale; [3]Satisfaction With Life Scale; [4]Five Factor Mindfulness Questionnaire (excluding the observing subscale)

Table 4.9. Means and Standard Deviations (SD) for self-reported psychological variables at baseline (t.1), after two weeks (t.3) and post treatment (t.9) for the Control Group (n = 32).

	t.1		t.3		t.9		Change from t.1 to t.3	Change from t.1 to t.9	Main effect of time
	Mean	(SD)	Mean	(SD)	Mean	(SD)	*F*	*F*	*F*
Depression (DASS[1])	8.69	(7.46)	6.63	(6.94)	6.13	(6.49)	3.702	3.293	2.562
Anxiety (DASS[1])	6.56	(6.64)	4.50	(5.86)	4.94	(6.18)	5.198*	1.835	2.261
Stress (DASS[1])	10.81	(8.62)	10.88	(7.74)	8.75	(7.22)	0.003	1.738	1.493
Positive Affect (PANAS[2])	33.56	(6.69)	31.66	(6.83)	28.44	(7.86)	3.431	9.856**	7.286**
Negative Affect (PANAS[2])	21.75	(6.95)	18.88	(6.14)	18.03	(7.45)	10.739**	7.810**	5.922*
Satisfaction with Life (SWLS[3])	24.78	(4.96)	N/A		25.72	(4.87)	N/A	N/A	1.991
Mindfulness (FFMQ[4])	64.44	(7.73)	N/A		63.06	(6.91)	N/A	N/A	1.307
Attentional Focus (ACS[5])	24.50	(5.73)	24.75	(4.70)	25.44	(5.62)	.105	1.444	.906
Attentional Shifting (ACS[5])	25.78	(4.92)	26.44	(4.67)	25.72	(4.63)	.973	.014	.902

*p < .05; **p < .01; ***p < .001

[1]Depression Anxiety Stress Scale; [2]Positive Affect Negative Affect Scale; [3]Satisfaction With Life Scale; [4]Five Factor Mindfulness Questionnaire (excluding the observing subscale); [5]Attentional Control Scale

4.4.9 Home practice in the mindfulness group

4.4.9.1 Correlation between home practice and changes in attentional control (conflict score) t.1 – t. 3

Correlational analyses were run with the conflict change score (t.3-t.1), and home practice measures (number of practice sessions at t.3, and total weekly home practice (in minutes) at t.3). For correlation analysis, Spearman's rho was used as "total weekly practice" was not normally distributed. Contrary to our hypothesis, the conflict change score (t.3-t.1) did not significantly correlate with any of the home practice measures (all *rho*s < .20, all *p*s > .01 (and > .05). It was not possible to look at the difference between participants who practised three or more times or less than three times per week, as at this point in the course, all but one participant had practised three or more times per week.

4.4.9.2 Correlations between home practice and changes in attentional control (conflict score) and attentional focus from t.1 to t.9

Correlational analyses were run with number of practice sessions at t.9 and total weekly home practice (in minutes) at t.9, the conflict change score (t.9-t.1) and the attentional focus change score (t.9- t.1). Neither the conflict change score (*r*s <.089, all *p*s > .01 (and > .05)) nor the attentional focus change score (all *r* < .03, all *p*s > .01 (and > .05) correlated significantly with any of the home practice measures.

The MG was then split into participants that had practised less than three times or more than three times per week on average during the duration of the course. Independent sample *t*-tests were employed to test if there was a difference in conflict change scores (t.9-t1.) and attentional focus change scores (t.9-t1.) between those that practised more than three times ($n_{>3}$) and those that practised less than three times per week ($n_{<3}$). No difference between groups was found for conflict change scores ($t(25) = .227$, $p = .823$, $d = .09$; $n_{<3} = 9$, $n_{>3}$ 18) or attentional focus change scores ($t(29) = 1.348$, $p = .190$, $d = .52$; $n_{<3} = 12$, $n_{>3}$ 19).

4.4.9.3 The relationship between home practice and changes in self-reported psychological outcomes at t.9

Correlational analyses were run to see if change scores for each self-reported variable were correlated with the mindfulness home practice measures (amount of total home practice (in minutes) and the total number of home practice) in the MG only. Two change scores were not normally distributed (DASS-depression, SWLS), therefore correlations are reported with Spearman's rho. Total weekly home practice (in minutes) was not correlated with changes in any of the outcomes (all *rho*s <.25, all *p*s >.01 (and >.05). Total number of home practice was significantly correlated with FFMQtotal-obs (*rho*(27) = .48, *p* = .009, please see Figure 4.13) but with no other outcome variable (all *rho*s <.28, all *p*s > .01 (and > .05).

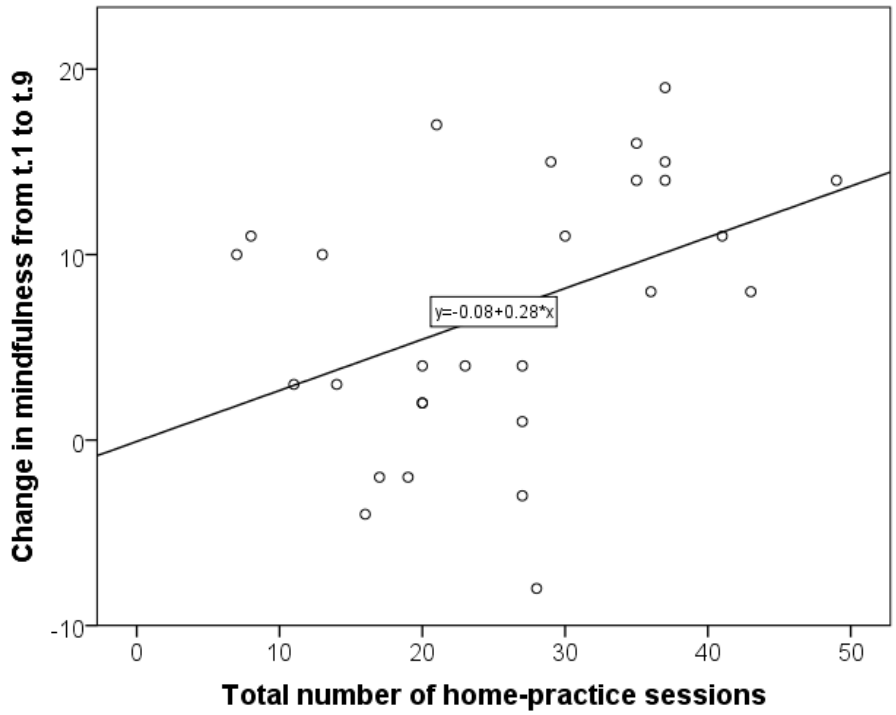


Figure 4.13. Relationship between the total number of home practice sessions over the 8 week Finding Peace course and changes in mindfulness (the total of the FFMQ scale without the observing subscale).

Independent sample *t*-tests were employed to test if there was a difference in change scores between those participants that practiced fewer than three times per week ($n_{<3}$ = 12) and those that practiced three or more times per week ($n_{>3}$ = 19) in positive outcomes (positive affect, FFMQtotal-obs, satisfaction with life) and negative outcomes (negative affect, depression, anxiety

and stress). It was found that the participants that practised three or more times per week increased significantly more on scores of FFMQtotal-obs (M = 9.68, SD = 7.36) compared to participants that practise less than three times per week (M = 3.75, SD = 5.07), ($t(29) = 2.443$, $p = .021$, d = 1.17). It was also found that participants who practised three or more times per week decreased significantly more on scores of DASS-stress scores (M = -7.89, SD = 8.10) compared to participants that practise less than three times per week (M = -3.17, SD = 4.21), ($t(28.256) = 2.129$, $p = .042$, equal variances not assumed, d = 1.12). There were no significant differences between the groups on any of the other outcomes (all ts < 1.778, all ps > .05).

4.5 Discussion

This is the first study to investigate the effect of the Finding Peace course on attentional control in a student sample. Improvements in attentional control were detectable after the second session of the course. These findings corroborate the hypothesis that observable pre-clinical effects can be detected following minimum dosages of treatment (e.g., one dose of antidepressants, or one session of CBT for Panic disorder; Harmer, Goodwin, et al., 2009; Reinecke, Waldenmaier, et al., 2013). In addition, our findings are consistent with previous studies investigating the effects of mindfulness meditation, which found enhanced attentional control after only a few sessions of meditation (Ainsworth et al., 2013; Tang et al., 2007). No changes in orienting and alerting attention were detected. The findings of this study are also in line with previous research on MBCT programs for students (Collard et al., 2008; Kaviani et al., 2011; Taylor et al., 2014) showing reductions in depression, anxiety, stress and negative affect. Moreover, this study showed that the Finding Peace course increased participants' ability to focus and shift attention, and their satisfaction with life.

Interestingly, the gains in attentional control that were observed after two sessions of the Finding Peace course did not continue to grow with additional sessions. Levels of attentional control in the mindfulness group after the third session (mean 56.37) were at a similar, slightly lower level than after the second sessions (mean 55.66) and at a similar, slightly higher level after the course had finished (mean 52.53; lower scores indicate higher attentional control). This may

reflect a possible ceiling effect (Kazdin, 2016). A first explanation for this effect would be that the measure (i.e., the ANT) was not able to pick up on additional improvements. However participants were not scoring close to the upper score of 0 (at a score of 0 the incongruent distractors do not impair performance compared to congruent distractors), which suggests that there was room for improvement on the measure. Another possibility is that after session two of the mindfulness course, participants were performing at their maximum level of attentional control, with little room for further intrapersonal improvement. This would indicate that a score of 0 on the attentional control index of the ANT may not be realistically achievable. Larger scale studies would be necessary to evaluate normative data on the ANT to draw conclusions about maximum performance. Alternatively, the initial gains in attentional control may have been achieved relatively easily (with two sessions of mindfulness mediation), whereas further gains may be more difficult to attain (i.e., requiring more intensive training than an eight week course). Studies with varying intensity levels of mindfulness meditation may be able to explore this hypothesis. Another explanation is that the observed gains may have been the maximum improvements that could have been achieved with repeated mindfulness meditation. This would imply that mindfulness mediation may have no further effect on attentional control over and above the dosage effect of two sessions. If additional gains were possible, other training methods may have to be used. For example, specific types of analgesics (e.g., ibuprofen) can only achieve a limited level of pain-analgesia. For greater analgesic effects, different analgesics would be necessary (e.g., morphine). Therefore, comparing the gains in attentional control that can be achieved with different training methods may be advisable. Given the importance for self-regulation that has been ascribed to attentional control (Diamond, 2013) further studies that explore measurement artefacts, maximum performance, normative data and training methods appear to be desirable.

Our hypothesis that changes in RT-based attentional control predict future changes in attentional focus was supported (albeit tentatively). It was shown that a small dose of mindfulness meditation (just two weeks) can lead to changes in attentional control, and that these changes were markers of later changes in attentional focus (at post-intervention). One possible explanation for

this temporal incongruence is that the accumulated perception of subtle cognitive changes led, over time, to perceived changes in attentional functioning. Along this line, greater changes in attentional control may mark the participants who respond most strongly to mindfulness meditation, thus indicating that the intervention has a greater effect on attentional functions of these participants. This in turn raises the question if changes in attentional control after two weeks of mindfulness would predict an increase in attentional focus six weeks later, even if the training were to be discontinued after two weeks. Interestingly, although previous studies have shown that attentional control and attentional focus are correlated when measured at the same time (Reinholdt-Dunne et al., 2013), significant changes in attentional focus after two weeks were uncorrelated to the concurrent changes in attentional control in the current study. Thus, although attentional control and attentional focus are considered to measure the same underlying construct (i.e., both measure individual differences in a person's ability to resist distraction – attentional inhibition), there may be important individual differences that affect the relationship between the two measures. For example, there may be differences in the extent to which performance on a five-minute long task (i.e., the ANT), transfers to a general ability to focus over longer periods of time. For some people, there may be a strong relationship between attentional control and attentional focus, whereas for others this relationship may be weak. In addition, there may be metacognitive differences in the extent to which people are aware of their ability to resist distraction. In other words, a person may show low attentional control on the ANT and yet report good attentional focus, while another might show high attentional control yet report poor attentional focus. These hypothesised individual differences might explain why concurrent changes in attentional control and attentional focus after two week of mindfulness training did not correlate with each other.

Differences in attentional control between the groups were also significant at the end of the course, perhaps indicating that continuous practice over the course of eight weeks sustained initial improvements in attentional control. This is in contrast to findings from a study by Jha and colleagues (2007), where no differences in attentional control after an eight week mindfulness course were found. The fact that our study showed improvements in attentional control when Jha's

study did not may be attributable to differences in meditation training (MBCT versus MBSR). Another explanation for these contrasting results relates to differences in sample size. Our participant sample was approximately twice the size of Jha's sample, which may have been too small to detect differences between groups. More encouragingly, Becerra (2017) found differences in attentional control after an eight week mindfulness-based training, even though it consisted of only four fortnightly sessions (rather than eight weekly sessions). The mixed findings across these mindfulness programmes may be an indication that different mindfulness-based interventions (MBIs) may have varying effects on attentional control based on the content of the programme. This suggests that it would be worthwhile to investigate the individual effects of specific techniques (i.e., types of meditation such as the body scan, or paying attention to the breath) on varying cognitive functions (e.g., attentional control, working memory).

Analysis of mechanism that could underlie changes in levels of anxiety revealed that increases in attentional focus, but not attentional control early in the course predict changes in anxiety after the course. Although the predicted relationship between attentional control and anxiety was not found, the correlation between attentional focus and anxiety is in line with our current understanding of the close link between anxiety, distractibility and concentration (Eysenck & Derakshan, 2011; Eysenck et al., 2007; Hirsch & Mathews, 2012). This association between anxiety and attentional focus was also found in a cross-sectional study with 727 students, where attentional focus scores significantly predicted anxiety scores (both measured simultaneously) (Ólafsson et al., 2011). The current study takes these results forward by showing that changes in attentional focus both precede and predict changes in anxiety. The improved ability to focus may be particularly important for university students, as increased anxiety may be based on fears of underperforming academically. Perhaps by increasing attentional focus through mindfulness meditation, participants were better able to perform their academic tasks and this in turn lowered their anxiety. After all, attentional control, as measured with the attention network task, may be indirectly related to anxiety: changes in attentional control may be an early sign of future changes in attentional focus which then act to decrease anxiety.

Surprisingly, no changes in positive affect were found, even though MBCT has previously been associated with higher appraisals of positive emotions, taking greater pleasure in activities and enhanced ability to boost momentary positive emotion (Geschwind, Peeters, Drukker, van Os, & Wichers, 2011). One explanation for the findings in the currents study is that the course may have led to a more consistent positive mood over the course period, than would have otherwise been the case. In addition, there may have been a ceiling effect, given that participants were already scoring above the 50th percentile compared to normative data (Crawford & Henry, 2004). Importantly, the mindfulness group increased significantly in self-reported mindfulness, showing that the content of the course did produce its intended outcome. This aligns closely with findings from student samples attending both self-help only and full MBCT courses (Collard et al., 2008; Taylor et al., 2014). It may be an indication that both extensive and less time-intensive courses can create shifts in attitudes related to mindfulness (e.g., being less judgemental, acting with more awareness). Generally, the findings that revealed improvements in several self-reported psychological outcomes (e.g., depression, anxiety, stress, negative affect, mindfulness, attentional focus, attentional shifting, and satisfaction with life) are encouraging. However, the findings have to be interpreted in the context of the eight week term schedule of the University of Oxford during which the Finding Peace course took place. For example, the changes in psychological variables may have been due to the students' progression through the academic term. Participants started their mindfulness course at the beginning of the academic term when they may have felt anxious and stressed in anticipation of their workload. The final course session took place in the final week of the term and the positive changes visible at post-course assessment may have been due to reduced workload and a sense of accomplishment. The current control group completed the assessments during the same time-period, and although they controlled for the effect of the progression through the term, they would not have controlled for the potentially confounding interaction between differences in treatment seekers and non-treatment seekers and the effect of the academic term on mental well-being. Therefore, to confirm the current findings regarding the self-report measures, it would be necessary to repeat this study with a suitable control group.

Moreover, as participation in the study was voluntary for students enrolled in the Finding Peace course, it is likely that only students who felt that they could take on the extra workload presented by the study took part. This may have been the case, as this study's participants had low depression scores (within the normal range) and mild scores for anxiety and stress. As such, those participants who suffered from higher psychological distress may have declined to participate, and it is therefore not clear if this intervention would have had an effect on those students that are most vulnerable.

Finally, despite the emphasis on home practice in MBCT programmes the current study provides little evidence that levels of home practice are related to changes in relevant outcomes for participants in the Finding Peace course, with the exception of mindfulness and stress. Perhaps, effects of mindfulness home practice become visible with higher prescribed doses of home practice such as in the studies on MBCT for depression and relapse for depression (Crane et al., 2014; Perich et al., 2013). For example, in the MBCT for recurrent depression course the prescribed home practice is 45 to 60 minutes on six days per week (Segal et al., 2013), whereas the prescribed home practice in the Finding pace course was 20 to 20 minutes on six days per week.

4.5.1 Clinical implications

Importantly, by focusing on change mechanisms, attentional focus was identified as a potential predictor of reductions in anxiety in an MBCT course adapted for students. As such, MBCT-based interventions that aim to decrease anxiety may benefit from intervention techniques that increase attentional focus in early phases of the intervention. In addition, early changes in attentional control may be a sign of response to treatment which signifies that later changes in attentional focus can be expected.

Crucially, the finding that improvements in attentional control were detected after just two weeks of mindfulness training was used in the design of the clinical trial described in Chapters 6 and 7. This trial measure changes in cognitive biases in IBS patients in response to MBCT adapted

for IBS. The data could also inform other future studies attempting to measure early cognitive changes in participants of MBCT-based courses.

4.5.2 Limitations

The lack of a control group that did not undergo the Finding Peace course but was otherwise similar to the mindfulness group represents a significant limitation to the internal validity of the study. As a result, the possibility that changes in self-reported outcome measures of psychological well-being were due to factors other than mindfulness (e.g., social contact, a therapeutic effect of the teachers, expectations of greater psychological well-being after the course, response biases, regression towards the mean or non-treatment related factors) has to be taken into account. The main task of the modified control group (see "Participant Recruitment" in section 4.3.2) was to control for the effect of repeating the attentional task nine times in the analysis of changes in attentional control. Despite the limitations of the modified control group that are related to potential differences in treatment seekers and non-treatment seekers, response bias and expectations are unlikely to have had an effect on the results of the reaction-time based task for attentional control. This is because behavioural RT-based tests with millisecond precision measure performance on subconscious, underlying cognitive functions, rather than subjectively perceived self-reported abilities. . However, the possibility that differential changes between the mindfulness and the modified control group were due to pre-existing differences such as cognitive vulnerabilities or motivation to change, cannot be ruled out. Finally, although the a priori determined sample size was met, the actual sample that qualified for the analysis was lower than expected. Thus, a replication study of the current findings with a larger sample size is desirable.

4.5.3 Conclusion

This study has shown that the Finding Peace course can improve attentional control in students and that these changes are detectable after two weeks of mindfulness training. These findings can inform studies that aim to measure changes in cognitive processes early in MBCT courses, as they give a more precise anchor point for when during the intervention cognitive changes may take place. It remains to be investigated if early changes in subconscious cognitive

functions as a result of mindfulness meditation are predictive of later changes in self-reported outcomes even in the absence of continued practice. This would suggest that mindfulness programmes could be shortened to a dosage that affects the subconscious mediator. Shorter treatments, if they are effective at leading to the desired outcome, would provide an efficient use of financial resources and time for both mental-health care seekers and providers. Alternatively subconscious changes may accumulate with practice until they are consciously perceived. This would mean that changes in subliminal cognitive processes would identify treatment responders. Early changes in attentional focus, but not attentional control, predicted changes in anxiety after the course, and this may indicate that courses for students that aim to reduce anxiety should emphasize attentional focus as an intermediate intervention target. Students of the mindfulness group showed reduced depression, anxiety, stress and negative affect, along with increases in mindfulness and satisfaction with life after completing the course. Whilst the current study suggests that the Finding Peace programme is an effective intervention to improve mental well-being and decrease psychological distress in students, these associations await further scrutiny.

Chapter 5: Developing Mindfulness-Based Cognitive Therapy for Irritable Bowel Syndrome (MBCT for IBS)

5.1 Abstract

This chapter summarizes and explains previously developed cognitive, cognitive-behavioural and mindfulness-based treatments for IBS, their hypothesized treatment mechanisms, and empirically validated mediators of treatment. Mindfulness-based treatments for IBS have gained popularity recently and studies evaluating these treatments will be reviewed in more detail. Moreover, evidence for illness-specific maintaining factors of IBS will be discussed. Building upon this knowledge and the results from Chapter 2 and Chapter 3, which identified biased implicit self-referential processing of health and altered levels of attentional control in IBS patients, I develop a treatment rationale for adapting MBCT for patients with IBS. Dimidjan and Segal (2015) have argued that investigating the mechanisms of mindfulness based interventions would increase their public health impact. Therefore the hypothesised mechanisms of MBCT for IBS will be explained before I present the treatment protocol of MBCT for IBS. Finally, Michie and Prestwich (2010) highlighted the importance of linking hypothesised mechanisms to treatment techniques. I will therefore explain how the modules of MBCT for IBS are linked to the suggested underlying mediating factors.

5.2 Introduction

Evidence has accumulated that mindfulness-based interventions (MBIs) appear to work for an array of psychological and physiological complaints (Dimidjian & Segal, 2015) (e.g., Insomnia (Gross et al., 2011) or psoriasis (Kabat-Zinn et al., 1998)). The emphasis in the field has been on exploring the range of new applications for MBIs (e.g., does this MBI work for tinnitus), whilst studies that investigate why, how and for whom MBIs work are underrepresented (Dimidjian & Segal, 2015). Having mapped the evidence base of MBIs (e.g., MBSR, MBCT) using the NIH stage approach, Dimidjian and Segal (2015) argue that the lack of focus on mechanisms limits the public health impact of clinically-oriented research. They recommend that investigating how a mindfulness-based intervention affects outcome measure would strengthen the potential public health impact of the intervention. This entails

> "…not only predicting that an MBI will produce clinical benefit, but also specifying plausible mechanisms by which such benefits are attained" (Dimidjian & Segal, 2015, p. 605).

Therefore, I will provide a clear rationale for adapting Mindfulness-Based Cognitive Therapy for patients with irritable bowel syndrome (MBCT for IBS) and the mechanisms through which it is hypothesised to reduce IBS symptom severity and increase quality of life.

5.3 Cognitive, Behavioural and Mindfulness-based Models of IBS and Evidence for their Treatment Efficacy

Each illness may have idiosyncratic maintaining factors and treatments that address these may be more effective. Therefore, when developing a new treatment or modifying and existing intervention, it is important a) to have an understanding of the theoretical frameworks that explain the specific illness; b) to develop a list of relevant and empirically validated intermediate treatment targets; and c) to collect evidence to evaluate treatment efficacy. Intermediate treatment targets are factors whose change is associated with symptom improvement. The psychological change mechanisms that have so far been identified across bio-psychological treatment models and interventions for IBS will be reviewed in the upcoming sections. Evidence for their efficacy will be presented.

Integrated within the larger biopsychological framework of IBS (also see Chapter 1) are the cognitive, cognitive-behavioural and mindfulness-based models of IBS. These models are concerned with the cognitive, affective and behavioural factors that predispose and precede the illness, and crucially, with the psychological factors that contribute to the maintenance of IBS symptoms and low IBS-related in quality of life (Blanchard, 2001; Hauser, Pletikosic, & Tkalcic, 2014).

5.3.1 Cognitive and cognitive-behavioural models

The cognitive model of IBS assumes that biased, maladaptive cognitions underlie and maintain IBS symptoms (Greene & Blanchard, 1994; Payne & Blanchard, 1995). These cognitions are thought to be related to anxiety or mood disorders (Greene & Blanchard, 1994; Payne & Blanchard, 1995). It follows that changes in underlying cognitions would be associated with changes in symptoms (Blanchard, 2001; Greene & Blanchard, 1994). The cognitive-behavioural model of IBS assumes that behavioural aspects (e.g., illness related behaviours, unhelpful coping strategies), in addition to cognitive factors, form part of the maintaining factors of IBS (Hauser et al., 2014; Hutton, 2005; Lackner et al., 2012; Ljótsson, Andréewitch, et al., 2010; van Dulmen, Fennis, & Bleijenberg, 1996). For example, avoiding situations in which gastrointestinal symptoms would be embarrassing (e.g., public transport) is posited to maintain symptom severity (Ljótsson, Andréewitch, et al., 2010; Naliboff, Frese, & Rapgay, 2008).

In accordance with these models, treatments that are based on a cognitive understanding of IBS mainly focus on changing the content of maladaptive cognitions such as “the pain will never go away” (Toner et al., 1998). Those treatments that include cognitive and behavioural elements often employ both -techniques that aim to change cognitions and techniques that aim to change behaviour (e.g., reducing avoidant coping through exposure exercises (Hunt et al., 2009). However, this distinction may be too simple, as some cognitive therapy treatments also include some elements intended to change behaviours such as learning better problem solving strategies (e.g., Blanchard et al., 2007). The current versions of CBT for IBS generally aim to change illness attributions, negative illness-related cognitions and core beliefs or schemas about the ‘self’

(Drossman et al., 2003; Hunt et al., 2009; T. Kennedy et al., 2005; Lackner et al., 2012). In addition, the treatments aim to improve coping strategies and reduce tension and stress. However, within CBT treatments, considerable heterogeneity with regards to specific treatment targets and techniques exists (Henrich et al., 2015). Some CBT interventions focus on alleviating *psychological distress* in order to reduce symptoms (Lackner et al., 2007), some focus on *maladaptive behaviours* such as avoiding public transport (Ljótsson, Andréewitch, et al., 2010; Ljótsson, Falk, et al., 2010), and others on *thought patterns* such as catastrophizing (Kennedy et al., 2005; Labus et al., 2013; Reme et al., 2011) or *fear-based processing* such as visceral anxiety sensitivity (Craske et al., 2011; Labus et al., 2013; Wolitzky-Taylor et al., 2012). In a meta-analysis of 18 randomized controlled trials (RCTs), CBT-based treatments have been shown to be more effective at reducing IBS symptom severity and quality of life than waiting list control conditions (Li et al., 2014) and the number needed to treat (NNT) is better than the NNT of the majority of drugs for IBS (Enck et al., 2016; Ford et al., 2014). However when compared to active psychological control groups, CBT was only slightly more effective at reducing symptoms and increasing quality of life (Li et al., 2014).

5.3.1.1 Mediators of CBT for IBS

As discussed in Chapter 1, the evidence for reductions in psychological distress as mediators of symptom improvement in psychological treatments for IBS is inconclusive. Evidence for the role of cognitive, emotional and behavioural *reactions to symptoms* as predictors of treatment efficacy is however accumulating (Windgassen et al., 2017). Specifically, visceral anxiety sensitivity, catastrophizing, and in some cases illness behaviours have been investigated as mediators of symptom severity. Illness behaviours typically involve unhelpful coping strategies such as avoidance of situations in which symptoms are unwanted. In total, five CBT-based studies (Chilcot & Moss-Morris, 2013; Hunt et al., 2009; Labus et al., 2013; Reme et al., 2011; Wolitzky-Taylor et al., 2012) investigated mediators of treatment effects and these will be reviewed next.

Firstly, Hunt (2009) developed a brief CBT for IBS intervention that was delivered via the internet, and found that the treatment led to reductions in symptoms and improvements in quality

of life. The authors investigated general catastrophizing about physical sensations (e.g., thinking of a heart attack when feeling short of breath), gastrointestinal (GI)-specific catastrophizing (e.g., feeling panic when a strong urge to move bowels appears in a public space) and visceral anxiety sensitivity (e.g., hypervigilance for abdominal sensations) as mediators for symptom improvement. The three cognitive factors predicted symptom improvement, but only general catastrophizing was a significant mediator of symptom changes. Quality of life was not mediated by changes in any of these cognitions. This suggests that CBT improves symptom severity via reducing a general tendency to catastrophize and that GI-specific catastrophizing and visceral anxiety sensitivity may also be related to symptom reductions.

Secondly, Reme and colleagues (2011) reanalysed a study that compared mebeverine, an antispasmodic agent, with mebeverine and CBT combined. The original study (T. Kennedy et al., 2005) found that the combined pharmacotherapy plus psychotherapy treatment had significant benefits on symptom severity up to six months after the treatment had finished. Using path analysis, Reme and colleagues (2011) found that the positive changes in symptoms were mediated by changes in illness-related behaviours and illness-related maladaptive cognitions. The scale that was used to measure maladaptive cognitions, the Cognitive Scale for Functional Bowel Disorders (CSFBD (Toner et al., 1998)) has a similar content to the GI-cognitions questionnaire, which measures IBS-related catastrophic thoughts (see Table 9.4 in section 9.3.1 of the appendices for similarities between items). It could therefore be argued that therapeutic gains were mediated by IBS-specific catastrophic thoughts.

Thirdly, Wolitzky-Taylor (2012) compared a CBT-based interoceptive exposure treatment with a CBT-based stress management intervention and an active control group. All three groups improved in symptom severity (Craske et al., 2011; Wolitzky-Taylor et al., 2012), and the interoceptive exposure group had a significantly greater decline in symptoms from pre- to post-treatment than the other groups. Visceral anxiety sensitivity was a mediator for treatment outcomes across all treatment groups, indicating that different treatment forms can affect visceral anxiety.

Fourthly, Labus and colleagues (2013) delivered a CBT-based psychoeducation intervention for groups of IBS patients. It was found that changes in visceral anxiety sensitivity at post-treatment mediated symptom severity at three months follow-up. The mediation effect of catastrophizing on symptom severity was only trending towards significance. Stronger mediation effects of catastrophizing were observed for participants that had started with a lower level of baseline quality of life (moderated mediation), indicating that patients with low quality of life responded particularly well to the treatment. The results suggest that in CBT interventions, changes in visceral anxiety sensitivity and pain catastrophizing appear prior to changes in IBS symptom severity and that changes in these cognitive reactions lead to symptom improvements.

Finally, Chilcot and Moss-Morris (2013) reanalysed a study that compared a CBT self-management intervention with treatment as usual (Moss-Morris, McAlpine, Didsbury, & Spence, 2010). The original study found that the intervention was superior to treatment as usual in leading to symptom relief three months and six months post-treatment. The analysis of mechanisms (Chilcot & Moss-Morris, 2013) found that perceiving the illness less negatively after the intervention mediated changes in symptom improvement at six months follow-up. This suggests that the patients' relationship to symptoms (how negatively or positively they are evaluated) may be a factor that determines symptom severity.

5.3.1.2 Summary of CT and CBT for IBS

To summarize, although the cognitive and cognitive-behavioural treatments for IBS are based on related theoretical models, the actual treatment protocols often vary in terms of specific treatment targets and intervention techniques. The treatment models specify that the content of maladaptive cognitions and behaviours (e.g., avoidance behaviours) as well as anxiety and depression would mediate IBS symptom reduction and improvements in quality of life. Evidence from intervention studies points to the critical role of maladaptive reactions to symptoms including visceral anxiety sensitivity, illness-specific catastrophizing and reappraisal of the illness as mediators of symptom improvement. CBT-based treatments appear to be better at reducing

symptoms than pharmacological interventions, although they are only marginally superior to active control conditions.

5.3.2 Mindfulness for patients with IBS

Mindfulness-based interventions are group of new psychological treatments for patients with IBS. The first study exploring and evaluating the efficacy of mindfulness to relieve IBS symptoms was published only eight years ago (Ljótsson, Andréewitch, et al., 2010). To date, no review evaluating the evidence of mindfulness-based treatments for IBS has been published. In addition, there is no overarching model explaining why mindfulness would be therapeutic for patients with IBS. Therefore I will review in detail the outcomes of published studies and, where available, mediators of treatments, before I describe and synthesise several hypothesised mechanisms of mindfulness for IBS.

5.3.2.1 Review of mindfulness-based interventions for patients IBS

Ten previous studies with varying methodological designs investigated mindfulness-based therapies for patients with IBS. Six of those studies randomized participants to a treatment or a control group (Gaylord et al., 2011; Kafi et al., 2014; Ljotsson et al., 2014; Ljótsson et al., 2011; Ljótsson, Falk, et al., 2010; Zernicke et al., 2013), three had a pre-post design without control groups (Chen et al., 2016; Kearney, McDermott, Martinez, & Simpson, 2011; Ljótsson, Andréewitch, et al., 2010) and one study used a single-case experimental design (Boersma et al., 2016). The studies employed a range of mindfulness-based approaches including Mindfulness-Based Stress Reduction (MBSR) (Chen et al., 2016; Kearney et al., 2011; Zernicke et al., 2013), MBSR adapted for IBS (Gaylord et al., 2011) Mindfulness-Based Cognitive Therapy (MBCT) (Kafi et al., 2014) and CBT with exposure and mindfulness (delivered online and in one-to-one sessions) (Boersma et al., 2016; Ljotsson et al., 2014; Ljótsson et al., 2011; Ljótsson, Andréewitch, et al., 2010; Ljótsson, Falk, et al., 2010).

MBIs for IBS were heterogeneous in terms of treatment content and structure. To simplify, the interventions were categorized into (1) courses that are based on mindfulness (Crane et al., 2016) (e.g., MBSR, MBCT) and (2) CBT courses that include aspects of mindfulness as part of the

programme. This review will focus on the main outcomes of IBS symptom severity, quality of life and psychological distress, including anxiety and depression.

For two studies only the abstracts were available. One of these abstract was from a conference (Chen et al., 2016) and the other abstract was from a study that was published in a non-English journal (Kafi et al., 2014)). These will be outlined briefly at the end of this section, as a full review of the studies and the content of the treatment was not possible.

5.3.2.1.1 Mindfulness-based treatments for IBS

Gaylord and colleagues (2011) conducted a randomized trial comparing MBSR adapted for patients with IBS to an active control treatment. It had the typical length (eight 2.5 hours sessions over eight weeks, with a half day retreat) and content of an MBSR course (Gaylord et al., 2009, 2011). The social support control group was comparable in treatment dose, social contact and treatment expectations with the MBSR for IBS group. The course emphasised the relevance of mindfulness for IBS-related symptoms and perceptions, separating symptoms from thoughts about symptoms and promoting sensory rather than emotional processing of bodily sensations (interoceptive signals). To evaluate the treatment, 75 IBS patients were allocated to the MBSR or a psychoeducation control group. Participants of the MBSR course improved significantly on IBS symptom severity after treatment, compared to the control group. In addition, they had significantly fewer symptoms, higher quality of life, and lower psychological distress three months after the treatment had finished compared to the control group. Twelve months later, participants in the mindfulness group still had lower symptom severity and higher quality of life than the participant of the control group (Faurot et al., 2014). Using multivariate path models, Garland and colleagues (2012) re-analysed the data from this study (Gaylord et al., 2011). They found that their MBSR for IBS course was directly related to changes in interpretations of pain sensations and this in turn was related to symptom improvements. In addition the authors found that the intervention had led to "non-reactivity to inner experience" which was related to a reduction in visceral anxiety sensitivity and pain catastrophizing. Non-reactivity describes the ability to perceive thoughts, emotions and sensations without having to react to them or getting carried away by them.

Reductions in both pain catastrophizing and visceral sensitivity predicted an increase in IBS-related quality of life. Visceral anxiety sensitivity also predicted a reduction in IBS severity. This suggests that changes in how patients react to internal events (e.g., non-reactivity) affect two important change mechanisms: visceral anxiety sensitivity and catastrophizing.

The second randomized mindfulness-based study (Zernicke et al., 2013) had allocated 90 participants to a generic MBSR course (not tailored for IBS patients) or a waiting list control group. Patients in the MBSR group improved in symptom severity and stress after the treatment, but no differences on quality of life or mood were reported between groups. Six months after the treatment had finished, a small effect size for the treatment group was reported for symptom severity in the absence of significant effects for quality of life, mood and stress. This indicates that this course had active ingredients which led to IBS symptom improvement, however the course was less effective at influencing the emotional and stress-related aspects of the illness.

Finally, Kearney and colleagues (2011) measured pre- and post-treatment symptom severity in veterans with IBS who attended a generic MBSR course. Improvements in quality of life were detected six months after treatment, but not directly after the course had finished. Symptom severity was not affected by the treatment.

Taken together, there is some evidence that MBSR programmes adapted to IBS can lead to IBS symptom improvements over the long term (1st study). The efficacy of MBSR programs not specifically designed for IBS (2nd and 3rd study) is not convincing. This indicates that MBSR courses tailored to the illness may be more effective at treating the psychological and physical symptom clusters of IBS compared to generic MBSR courses.

5.3.2.1.2 CBT with mindfulness for IBS

Ljotsson and colleagues (2010) randomized 86 participants to an Internet-delivered exposure and Mindfulness-Based Therapy (ICBT) or an active control group. The treatment consisted of ten weekly sessions and included mindfulness training, psychoeducation about the psychological model of IBS and exposure exercises (e.g., exposure to situations where symptoms

were unwanted such as meetings). The control group took part in an active chat room, where participants were encouraged to talk about their IBS. Compared to the control group, the participants in ICBT reported greater reductions in overall symptom severity, and significant improvements quality of life and general functioning as well as lower depression from baseline to post-treatment. Three months after the treatment, the ICBT group had higher quality of life than directly after the course, in the absence of additional improvements in symptom severity over the same time period. In a later study ICBT was also found to be more effective in reducing IBS symptoms and improving quality of life than an online delivered stress-management program (Ljótsson et al., 2011). The randomized, controlled study comparing these two intervention was run with 195 participants, and the stress-management intervention was comparable in time-commitment and other non-specific treatment factors to ICBT (Ljótsson et al., 2011). Using a parallel-process growth mediation analysis on the data from this study, Ljotsson and colleagues (2013) found that changes in visceral anxiety sensitivity mediated changes in IBS symptom severity in their ICBT programme. In addition, higher engagement with the active therapeutic activities (i.e., exposure and mindfulness) was related to greater reduction in visceral anxiety sensitivity. The authors found no support for reduced stress as a mediator of symptom improvement. The results of this study reiterate the emphasis of gastrointestinal-specific anxiety as an important factor implicated in symptom severity. To disentangle the additional effect of exposure from the effect of mindfulness and psychoeducation, ICBT with exposure was compared to ICBT without the exposure exercises in another study with 309 IBS patients. The treatment with exposure had a greater effect on symptom severity than the treatment without exposure exercises (Ljotsson et al., 2014). However, it should be noted that in all previous studies a large number of participants withdrew from their respective study when the exposure exercises began. This indicates that the participants that continued with exposure may have been those that were more motivated and eager to improve. The exposure exercises might therefore not be feasible for all patients and non-specific factors such as treatment credibility may be implicated in the positive response to the treatment. The content of the treatment was also delivered in twelve one to one therapy sessions in a single-case experimental design involving 13 patients (Boersma et al., 2016).

Visual inspection of the data yielded that 70% of participants improved on symptom severity according to pre-specified criteria (Boersma et al., 2016). The same one-to-one treatment also led to reductions in IBS symptoms from before to after treatment in a recent single group pre-post study with eighteen participants (Edebol-Carlman et al., 2017).

Overall, the multicomponent CBT intervention (psychoeducation + mindfulness + exposure) appears to be effective when delivered online and in person. It works better when the exposure exercises are included, however not all participants are prepared to engage in these exercises. It is thus important to have alternative treatment options.

5.3.2.1.3 Studies with abstracts

For the next two studies only an abstract was available. Chen (2016) found that 41 IBS patients in an MBSR course showed decreased symptoms at post-treatment in addition to increased cerebral blood flow in brain regions associated with sensations (thalamus, posterior insula), memory (hippocampus) and environmental recognition (fusiform gyrus). There was no control group. Kafi (2014) randomized fourteen IBS participants to an MBCT or a control group (it is unclear if this control group is active or passive) and found that those in the MBCT course improved on psychological distress. It is not mentioned if the authors measured IBS symptom severity.

5.3.2.1.4 Summary of mindfulness interventions for IBS

Based on the available studies it can be cautiously concluded that MBSR and ICBT for patients with IBS are associated with symptom reduction and increased quality of life. Effect sizes for symptom reduction and quality of life ranged from 0.39-1.18 (Hedges *g*) for symptoms, and from 0.34-1.03 (Hedges *g*) for quality of life (Henrich et al., 2015). Those studies that tailored their intervention to IBS and the specific cognitive and emotional maintaining factors (Gaylord et al., 2011; Ljótsson, Falk, et al., 2010) were more effective (symptom reduction $g = .58 - 1.18$) than those that did not (Kearney et al., 2011; Zernicke et al., 2013) (symptom reduction $g = .49$), especially in the longer term. There is some evidence that exposure to symptoms and the reduction of avoidance behaviours has additional incremental effects on symptom improvement, although

drop-out rates may suggest that patient preference in exposure-based interventions may be playing a role (Ljotsson et al., 2014). Two mindfulness studies (Garland et al., 2012; Ljotsson et al., 2013) investigated mediators of treatment effects. These studies found that visceral anxiety sensitivity, catastrophizing, non-reactivity to internal events and in some cases illness behaviours mediate symptom severity and quality of life.

5.3.2.2 Hypothesised mechanisms of mindfulness for IBS

How is mindfulness hypothesised to exert its effect on IBS symptom severity, quality of life and the suggested maintaining factors of IBS? Gaylord and colleagues (2009, 2011) suggested that mindfulness may increase interoceptive awareness (i.e., awareness of stimuli arising within the body), self-regulation and control over attentional processes in patients with IBS. By training these processes, mindfulness is thought to decrease (hyper-) sensitivity to pain from intestinal distention, anxiety about the significance of perceived intestinal discomfort and attention to gastrointestinal sensations (Gaylord et al., 2009, 2011). The same research group proposed that the practice of non-reactivity to distressing emotions, cognitions and visceral sensations may decrease both the anxiety of and sensitivity to visceral sensations as well as pain catastrophizing (Garland et al., 2012). The mechanism suggested to effectuate this change was that practicing mindfulness would cultivate interoceptive recovery from distressing experiences, including stress-induced visceral disturbances, perceived as painful by IBS patients. During interoceptive recovery, attention is thought to be shifted from the thought-based, emotional to the sensory aspects of the experience, thereby preventing the distress from being perpetuated through rumination (Farb et al., 2010; Garland et al., 2012). In addition, it was predicted that mindfulness may help IBS patients to distinguish between different aspects of one phenomenological experience (Garland et al., 2012). For example, rather than perceiving one uniform, unchanging sensation of abdominal pain, tight muscles may be perceived in one area, whereas there may be soft, tingling and warmth in another. Increased interoceptive sensitivity may also improve the perception of changes in physical sensations over time. This more differentiated interoceptive processing was suggested to attenuate abdominal pain intensity in IBS patients (Garland et al., 2012). A different research group suggested that sustained,

non-evaluative observation of mental content may give rise to more accurate representations of mental reactions to internal and external stimuli (Zernicke et al., 2013). Zernicke and colleagues (2013) hypothesised that mindfulness training would enhance self-awareness, emotional stability and focused attention. Improvements in these cognitive and emotional functions were thought to increase self-efficacy and sense of control, thereby facilitating adaptive coping mechanisms in IBS patients (Zernicke et al., 2013). Moreover, Kearny and colleagues (2011) theorized that mindfulness fosters the reappraisal of fears, thoughts and beliefs related to sensations in the abdomen and that this reappraisal would be related to reduced gastrointestinal-specific anxiety. Finally, a Swedish research group proposed that behavioural responses to symptoms such as avoidance behaviour and a physiological stress reaction may maintain IBS (Ljotsson et al., 2013). Based on their model and predictions from Acceptance and Commitment Therapy (Hayes, Luoma, Bond, Masuda, & Lillis, 2006), they proposed that mindfulness in combination with exposure exercises would increase psychological flexibility in the presence of IBS-related stimuli (Ljotsson et al., 2013). They also suggested that mindfulness and exposure would decrease experiential avoidance (Ljótsson, Falk, et al., 2010) and that the ensuing acceptance of symptoms would facilitate the extinction of IBS-related anxiety (Ljótsson, Falk, et al., 2010). Taken together, a variety of mechanisms that link mindfulness with important maintaining factors of IBS has been suggested. Whilst this gives insight into the many scientific angles from which the mechanisms of mindfulness for IBS can be understood, it also exposes the absence of an overarching treatment model or theory. This is problematic because therapeutic interventions may be more effective if they are based on a clear and coherent understanding of mechanisms rather than scattered theoretical accounts (Michie & Prestwich, 2010; Michie, West, Campbell, Brown, & Gainforth, 2014). A coherent framework would ideally delineate relationships between previously isolated change processes and be linkable to other theories associating mindfulness with disease outcomes.

The recently published "predictive coding model of mind-body integration" (Farb et al., 2015) may have the potential to reconcile many of the suggested therapeutic mechanisms within one theoretical account. This model aims to explain how the tension between expected and felt

bodily sensation is resolved, and emphasises the role that contemplative practices, including mindfulness, can play in this process. The model is not tied to a specific illness but rather addresses the relationship between cognition and bodily awareness in general. It explains that interoceptive processing involves an iterative comparison between immediate, actual sensations and expected sensations. The expected experience is based on a prior, which is a set of probable states informed by previous events. The comparison may yield a discrepancy between the expected and the actual experience, which the model refers to as a prediction error (PE) (i.e., the sensation is not as expected). A PE is hypothesised to motivate behaviour to resolve the discrepancy. For example, an unexpected headache would be resolved by taking a pain-killer (Farb et al., 2015). This is an example of what the model calls active inference, which is a strategy that regulates the sensations to fit the prior. Other examples of active inference are suppression and distraction (Farb et al., 2015). A second option is to allow the prior to be updated, which is thought to result in a broadening of sensory expectations. This strategy is referred to as perceptual inference, and it involves adjusting one's expectations to match one's actual experience. For example, during a stretching exercise, a person might notice that they cannot extend their leg as far as the previous day. In this case, rather than forcing the stretch or backing out of the stretch completely, the person might observe the sensations of the area that feels tight, perhaps noticing that they are holding tension in the lower back. The person might then attribute this tension to sitting at a desk for eight hours, and update the range of expected sensations (priors). Acceptance and non-interfering observation are additional examples of perceptual inference (Farb et al., 2015).

Taking the perspective that accurate interoception underlies the representation of identity or a coherent sense of self and greater agency in one's environment, the authors of the model (Farb et al., 2015) suggest that dissociative interoception can lead to the dysregulation of health-promoting processes. Building on this assumption, they suggested that many health problems, such as affective disorders, chronic pain and somatoform disorders may involve dysregulated interoceptive processes (Farb et al., 2015). It follows that increasing interoceptive awareness may be therapeutic. The authors (Farb et al., 2015) propose that mindfulness may enhance interoceptive

awareness. They also theorise that mindfulness may increase the importance given to accurate sensory information (i.e., precision weighting) and the use of perceptual inference. Due to heightened precision weighing, mindfulness may decrease the importance of maintaining prior expectations (Farb et al., 2015) and the use of active inference. According to the model, deploying attentional resources to perceptual inference would increase self-awareness, relax appraisal tendencies and change habitual (maladaptive) regulatory behaviour (Farb et al., 2015).

Applied to patients with IBS, the predictive coding model of mind-body integration can account for several of the hypothesised mechanisms of mindfulness for IBS. The model aligns neatly with Gaylord's and Garland's proposal (Garland et al., 2012; Gaylord et al., 2009, 2011) that mindfulness-induced interoceptive awareness reduces sensitivity to pain, anxiety about visceral sensations and enhances self-regulation. For example, by promoting greater accuracy of sensations and increased tolerance of discomfort (Farb et al., 2015), interoceptive awareness may reduce expectations of feared sensations and the patient's sensitivity to them. It also supports the idea that a non-reactive mind-set could decrease visceral sensitivity and pain-catastrophizing: By disengaging from self-referential, linguistic processing (i.e., active inference) and engaging with sensory aspects of the experience, mindfulness would promote interoceptive recovery from distressing experiences (Garland et al., 2012). Farb et al.'s model also proposes that high granularity of sensory experience may challenge biases which guide how sensory experiences are processed. This proposition is akin to Garland's (2012) suggestion that mindfulness, by breaking down the perception of unitary physical experiences into its constituent elements, may alter the way in which pain sensations are attended to and processed. Moreover, based on their model, Farb et al. (2015) suggested that mindfulness-induced enhanced awareness of habitual tendencies (e.g., worrying) together with training in curtailing these tendencies may lead to a greater sense of agency. Indeed, it has been shown that mindfulness training is linked with greater self-efficacy (Chang et al., 2004). This aligns with Zernicke's (2013) suggestion that mindfulness would lead to improved self-efficacy and sense of control, thereby promoting enhanced coping with IBS. Finally, Farb et al (2015) posit that experiential and behavioural avoidance may lead to inadequate updating

of priors, rendering them less precise. They suggested that observing sensations with an accepting attitude, as is practiced in mindfulness, would lead to the updating of priors. This would align with Ljótsson and colleagues (2010) proposition that decreasing experiential avoidance may facilitate extinction of symptom-related anxiety. In conclusion, the predictive coding model of mind-body integration would coherently explain why mindfulness-based interventions may be suitable for patients with IBS.

5.3.3 Summary

In summary, treatments that encompass cognitive behavioural and mindfulness strategies appear to be effective at reducing symptom severity and improving quality of life in patients with IBS. Catastrophizing, visceral anxiety sensitivity and avoidance behaviours appear to be mediating improvements in IBS symptoms and quality of life in across treatment types. This suggests that a new treatment should focus primarily on changing these factors in order to improve IBS symptoms. In addition, re-interpretation of symptoms and pain was found to be related to symptom improvements in two studies (Chilcot & Moss-Morris, 2013; Garland et al., 2012). This indicates that reducing a biased perception and interpretation of symptoms could be a relevant treatment mechanism. Finally, the predictive coding model of mind-body integration (Farb et al., 2015), when applied to IBS, would predict that the development of interoceptive awareness is one key mechanisms through which mindfulness affects IBS symptom severity and the maintaining factors of the illness.

5.4 Rationale for Adapting MBCT for Patients with IBS

Based on theoretical frameworks relating to the mechanisms of mindfulness (Farb et al., 2015; Hölzel et al., 2011; Tang et al., 2015) and MBCT in particular (Lau et al., 2004; Segal et al., 2013; Teasdale, 1988), empirical work showing that mindfulness-based treatments can be therapeutic for patients with IBS (Gaylord et al., 2011; Zernicke et al., 2013), an examination of the mediators of psychological treatments for IBS (section 5.3 in this Chapter) and the results from experimental studies from this thesis (Chapters 2 and 3), I hypothesise that MBCT adapted for the

IBS population could reduce IBS symptoms and improve the patient's quality of life. This postulation is based on the following assumptions:

Firstly, I hypothesis that MBCT for IBS would reduce illness-related catastrophizing and visceral anxiety sensitivity, through the development of a decentred perspective (see Chapter 1) (Crane et al., 2016; Segal et al., 2013) and interoceptive awareness (Farb et al., 2015). Secondly, I hypothesise that concentrative meditation practices that train the regulation of attention (Hölzel et al., 2011; Teasdale et al., 1995) increase attentional control in patients with IBS. Improved attentional control is hypothesised to help curb IBS catastrophizing. Thirdly, based on the assumption that mindfulness changes how a person relates to private events (Fennell & Segal, 2011) and hence how private events are processed (Farb et al., 2015), I predict that MBCT adapted for patients with IBS would reduce biased self-referential processing of illness and health related information which was previously found in IBS patients (Chapter 2). Fourthly, the development of non-judgemental awareness, as practiced during mindfulness mediation (i.e., an accepting and non-self-critical attitude towards private events) (Kabat-Zinn, 1982; Segal et al., 2002) signifies an explicit change in how internal events are processed. I hypothesise that increased non-judgemental awareness will be a key therapeutic mechanism, directly linked to IBS symptom severity.

The following section will explain the theoretical background of MBCT for recurrent depression – with reference to the Differential Activation Hypothesis (Lau et al., 2004; Teasdale, 1988). I will delineate which aspects of MBCT and its theoretical background apply to patients with IBS. This will be discussed in the context of how MBCT might be able to change the maintaining mechanisms of IBS identified in the literature (i.e. catastrophizing, visceral anxiety sensitivity) and in Chapters 2 and 3 of this thesis (i.e., self-health discrepancy, attentional control). Where appropriate I will integrate ideas from the predictive coding model of mind body integration (Farb et al., 2015) along with other models pertaining to the mechanisms of mindfulness (Hölzel et al., 2011; Tang et al., 2015) to explain the hypothesised mechanisms.

5.4.1 Theoretical background of MBCT for recurrent depression

Elaborative, repetitive, problem-solving strategies such as rumination are risk factors of recurrence of depression (Beck et al., 1979; Lau et al., 2004; Nolen-Hoeksema, 1991). Building on this premise, the Differential Activation Hypothesis (DAH) (Lau et al., 2004; Teasdale, 1988) proposes that in patients with recurrent depression, lasting associations have been formed between low mood and negative, ruminative thinking during previous episodes of depression. In patients in remission, a period of temporary dysphoric mood could therefore reactivate negative ruminative thinking patterns, which then perpetuate and worsen low mood. The likelihood of reactivation is thought to be a function of the strength of associations between mood, bodily symptoms and negative, repetitive thinking. As outlined previously (Chapter 1), reactivated depressive thought *content* and *processing* - referred to as cognitive reactivity - are characterized by negative, self-referential, and discrepancy-based processing. Discrepancy-based processing denotes attempts to reduce the discrepancy between current and wanted experience (Williams, 2008). It uses verbal, abstract and analytical reasoning with self-referent material to solve the discrepancy or the problem (Raes et al., 2006). On this tenet, Williams (2008) explained that risk for recurrent depression is a by-product of a universal human vulnerability:

> "having language, taking such language literally, using thought-based processes to elaborate, solve or escape from problems, and persisting in using such strategies even if these do not solve the problem (as in the 'problem' of sad or anxious mood)" (Williams, 2008, p.722).

According to the DAH, (Lau et al., 2004; Teasdale, 1988), individual differences in the extent to which these cognitive processes are triggered by a mild episode of negative mood determine the extent of vulnerability to recurrent episodes of depression.

MBCT for recurrent depression (Segal et al., 2013) is based on the above mentioned cognitive account of depression. The programme was designed to target the above mentioned risk and vulnerability factors. Specifically, it trains participants to notice and recognise when negative thought patterns have been activated without necessarily engaging with them in a striving or achievement oriented attitude. Participants learn to observe these from a decentred perspective and learn to de-identify from them. MBCT also encourages participants to repeatedly disengage from

captivating thoughts and return their attention to an intended focus (during meditation). It is hypothesised that through this practice, participants become more practised in letting go of thoughts if they wish to do so (Segal et al., 2013). Moreover, participants learn to bring a mindful quality of attention to internal events (e.g., thoughts, emotions and physical sensations). Mindful attention is discerning, approach oriented (e.g., curious) and accepting (Crane et al., 2016). Crucially, within this framework, thoughts are not treated as facts or truths, but rather as transient mental events that may or may not be accurate. Taken together, MBCT is assumed to reduce the risk of relapse into an episode of depression, by reducing the strength of cognitive reactivity. Indeed, it has been shown to successfully reduce the risk of relapse (Bieling et al., 2012; Kuyken et al., 2008, 2015, 2016; Segal et al., 2010) and cognitive reactivity (Cladder-Micus et al., 2017; Hargus, Crane, Barnhofer, & Williams, 2010; Kuyken, Watkins, et al., 2010).

5.4.1.1 A note on discrepancy-based processing

It is noteworthy that in MBCT discrepancy-based processing is not discarded as maladaptive per-se. It is considered very useful for solving some types of problems (e.g., how to get from location A to B) and it is recognized that different problems require different mental approaches. Participants in MBCT courses are taught to discern between different types of problems (e.g., the problem of sad mood, or the problem of solving a puzzle) and to notice that they have the choice to engage in the mode of mind that they consider the most appropriate response for each arising situation (Segal et al., 2013).

5.4.2 Adopting MBCT to patients with IBS

IBS and depression are different illnesses, with different symptoms, prognosis and pathology. For example, IBS is a chronic physical illness with frequent symptom onset (at least two or three days per month) rather than an episodic illness like depression where episodes can last months but there can also be long periods of time between episodes. It is therefore necessary to adapt MBCT to the specific maintaining factors that are unique to IBS, whilst addressing universal vulnerabilities implicated in human suffering (e.g., unhelpful habitual patterns of the mind, such as denial and discrepancy-based thinking can create and exacerbate distress) (Crane et al., 2016) .

5.4.2.1 Maintaining factors and treatment mechanisms

Just as in recurrent depression maladaptive cognitive processes (catastrophizing, visceral anxiety sensitivity) seem to be implicated in IBS symptom severity (i.e., for both worsening and ameliorating symptoms) (Lackner & Quigley, 2005; Windgassen et al., 2017). To briefly reiterate, catastrophizing involves threat-based, negative cognitive elaboration of pain and IBS symptoms (e.g. "There's nothing I can do to reduce the intensity of the pain" (Sullivan, 2009)). Visceral anxiety sensitivity is characterized by anxiety of gastrointestinal specific symptoms, triggers of symptoms and corresponding hypervigilance (e.g., "I worry that whenever I eat during the day, bloating and distension in my belly will get worse" (Labus et al., 2004)). In IBS, these cognitions and emotional reactions can be triggered both by situations when symptoms are present and when they are absent. For example, triggers constitute mild symptoms or symptom-like sensations (e.g., a tight belly) as well as situations or thoughts about situations that can a) trigger symptoms (e.g., going to a new restaurant) or b) in which symptoms would be perceived as embarrassing (e.g., in a work meeting). This leaves a range of situations that can activate maladaptive IBS-specific cognitions. In addition, I found that patients with IBS show an implicit discrepancy between their self-concept and their health concept (Chapter 2), which may represent the contrast between the patient's ideal state (e.g., healthy, strong) and the patient's perceived actual state. An implicit focus on this discrepancy may create unnecessary suffering, especially if health is valued very highly and related to other higher order concepts such as self-worth (Farb et al., 2015; Hechler, Endres, & Thorwart, 2016). Thus although the *triggers* and *content* of thought patterns may be different between depression and IBS, and cognitive biases may be illness specific, I hypothesise that changing how these cognitive and emotional patterns and their triggers are processed may be implicated in IBS symptom relief. Whilst the emphasis in MBCT is placed on developing a decentred perspective to reduce the cognitive reactivity associated with reinstating and perpetuating maladaptive thinking patterns (Segal et al., 2013), the predictive coding model of mind-body integration highlights the importance of mindfulness induced interoceptive awareness as a vehicle to create self-awareness, curb illness-specific reactions to internal events, and reduce

self-health discrepancies (Farb et al., 2015). I hypothesise that the combination of developing a decentred perspective and interoceptive awareness will act on the maintaining factors of IBS.

In addition, other models have placed executive attentional regulation as an integral mechanisms linking mindfulness meditation to emotional and self-regulation (Hölzel et al., 2011; Malinowski, 2013; Tang et al., 2015). As outlined in Chapters 1, 3 and 4, attentional control is a key executive function intrinsically involved in many aspects of mental health and wellbeing (Diamond, 2013; O'Bryan et al., 2017; Posner & Rothbart, 1998; Richey et al., 2012). It involves intentional, effortful control over attention and aides the inhibition of task irrelevant distracting information (Diamond, 2013; Posner & Rothbart, 2007). In Chapter 3, patients with IBS were shown to have lower attentional control than healthy participants. In addition, lower levels of attentional control were linked to higher catastrophizing in IBS patients. I hypothesise that the training of attentional regulation through mindfulness meditation would increase attentional control in patients with IBS. Improved attentional control is hypothesised to be advantageous when the aim is to reduce interference from distracting (task-irrelevant) thoughts (Eysenck et al., 2007; Fox et al., 2015) and it may also aid moving attention away from negative (compelling) thoughts once they are present. For example, it has been suggested, that attentional control is important for changing habitual actions (such as engaging in a unhelpful thoughts) (Fan et al., 2009). Accordingly, IBS patients may benefit from attention regulation training as it may provide support in inhibiting thought content from entering awareness.

Finally, non-judgemental awareness could be a therapeutic mechanism of MBCT for patients with IBS. Non-judgemental awareness is a core aspect of mindfulness (Baer et al., 2008, 2006; Crane et al., 2016; Kabat-Zinn et al., 1985). It is characterized by a mental stance from which thoughts and emotions are accepted, rather than critically evaluated. Adopting a non-judgemental and accepting attitude towards distressing thoughts and emotions (e.g., not judging oneself harshly or inferring a global negative meaning such as "having this thought means I am a bad person") may improve emotional regulation and allow a more flexible response to stressful situations. Importantly, stress and perseverative cognition (e.g., worry) have been shown to have

physiological concomitants (Ottaviani et al., 2015; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012) and these may alter functioning of the abdominal tract (Bhatia & Tandon, 2005). A biopsychological mechanism that may link a non-judgemental attitude to the functioning of the gut is the autonomic nervous system (ANS), a part of the brain-gut axis. The ANS has two main functional structures, the inhibitory parasympathetic nervous system (PSNS), which calms the body and the excitatory sympathetic nervous system (SNS) that activates a fight or flight response when threat or danger is perceived. Bodily homeostasis is a function of the constant interplay between the SNS and the PSNS. The vagus nerve (VN), a crucial nerve of the PSNS, connects the brain with the enervation of the heart and the gastrointestinal tract, and it is a vital bi-directional aspect of the brain-gut axis (Bonaz, Bazin, & Pellissier, 2018). For example, the VN's efferent fibres can reduce digestive inflammation, intestinal permeability and indirectly modulate microbiota composition (Bonaz et al., 2018). VN activity can be indirectly measured via vagally mediated Heart Rate Variability (vmHRV), where high vmHRV at resting state indicates greater relative influence of the PNS during stress response (Appelhans & Luecken, 2006). High vmHRV is also considered a sign of the body's ability to respond to stress flexibly (Thayer et al., 2012) and has been proposed as psychobiological marker of higher emotion regulation ability (Appelhans & Luecken, 2006; Holzman & Bridgett, 2017). Low variability at resting state indicates a higher SNS mediated stress response (Appelhans & Luecken, 2006). In addition, low vmHRV has been associated with several psychological disorders including anxiety (Chalmers, Quintana, Abbott, & Kemp, 2014) and depression (Kemp et al., 2010) and crucially, patients with IBS and IBD have been shown to have a reduced vmHRV (Pellissier, Dantzer, Canini, Mathieu, & Bonaz, 2010). Recent studies showed that greater acceptance of emotions and self-compassion have been associated with higher vmHRV (Svendsen et al., 2016; Visted et al., 2017). Therefore, greater acceptance of negative emotions and thoughts, as practiced in mindfulness meditation, may lead to reduced IBS symptoms severity by increasing the relative influence of the PSNS at resting state and during stress. So far, there is little empirical work on the relationship between a self-judgemental-attitude and physiological reactions in patients with a chronic illness. However, some

support for this relationship comes from a study that found reductions in pain severity in patients with chronic pain, after a self-compassion based intervention (Chapin et al., 2014).

5.5 Linking Key Skills Learned in MBCT for IBS with the Hypothesized Mechanisms of Change

Based on the above examination of maintaining factors and treatment mechanisms, I adapted the MBCT for depression protocol to patients with IBS (MBCT for IBS). The MBCT for IBS treatment protocol is described in section 5.7 of this chapter. This current section will focus on how the cognitive skills taught in MBCT for IBS relate to the identified mechanisms of change (e.g., pain- and IBS-catastrophizing, visceral anxiety sensitivity, self-health discrepancy, and attentional control). This is thought to ultimately lead to a better understanding of change mechanisms (Michie & Prestwich, 2010; Onken et al., 2014). There are four key skills though to be developed through MBCT for IBS that are relevant for the identified cognitive maintaining factors of IBS. These are: 'Concentration', 'Decentring', 'Sensory, experiential processing' and 'Developing a friendly relationship towards the body'.

5.5.1 Concentration

In mindfulness courses, concentration is trained by meditation practices that involve focusing on one indented object of attention (e.g., the breath or sensations in the body), identifying deviations from present moment awareness (e.g., daydreaming, worrying), disengaging attention from these thoughts and returning (shifting) attention to the intended focus of present moment. Repeatedly practising mindfulness meditation may strengthen attentional control (Chiesa et al., 2011) as it involves active conflict monitoring and alertness. Indeed, previous studies have shown that different mindfulness programmes (Ainsworth et al., 2013; Becerra et al., 2017; Chapter 3; Tang et al., 2007), including an adaption of MBCT for students (Chapter 4), can increase attentional control. Therefore, it is predicted that MBCT can improve attentional control in patients with IBS. Meditation practices in MBCT that entail training in focused attention are the 'body scan' and the 'anchor of body and breath mediation' (explained in more detail in section 5.8.2.2.7 and 5.8.2.3.5). A sufficient degree of attention regulation ability is proposed to be necessary to

monitor, sustain and reinstate awareness of the present moment in order to stay engaged with meditation and the decentred perspective (Hölzel et al., 2011; Segal et al., 2013).

5.5.2 Decentring

Decentring is a multidimensional concept that involves *direct present moment experience*, *decoupling* and *non-judgemental awareness*. It is a type of meta-awareness with an observational attitude characterized by a non-judgemental relationship with physical sensations, thoughts and emotions. Decentring is characterized by a wider mental perspective in which thoughts, emotions and physical sensations are transient events that can be seen, distinguished and labelled as such (e.g., this is a self-critical thought).

Direct present moment experience is characterized by actively paying attention to the present moment, with an effort to bring physical experiences, emotions, thoughts, and environmental aspects (e.g., sounds) into awareness. During meditation the intention is to experience sensations as "raw" as possible, with an attitude of acceptance and non-striving whilst suspending evaluation of the experience as good or bad, pleasant or unpleasant. This includes meta-cognitively observing sensations without following the thoughts triggered by the sensations (e.g., memories about previous events when sensations such as symptoms have occurred). From this 'observer perspective' thoughts may feel less adhesive making it is easier to let go of them. The attitude of bringing attention to the present moment without wanting it to be different, and without reacting to thoughts, may be crucial for increasing non-judgemental awareness and reducing discrepancy-based processing. In addition, experiencing a moment to moment awareness creates opportunities to directly observe the connection between mind and body and the effect of thoughts and emotions on physiological functioning (e.g., an anxious thought might trigger a faster heartbeat or a sensation of tension in the chest). This would be associated with a more thorough personal understanding of the connection between thoughts, emotions and physiological sensations, enabling IBS patients to respond more wisely to symptoms.

Decoupling is the process of separating two or more mental concepts that were previously closely linked. In this context, it involves seeing clearly the difference between thoughts, emotions and physical sensations, seeing an event separate from the interpretation of the event and understanding that thoughts are not always factual. For example, when taking on a decentred perspective it may be possible to separate the thought "The pain is unbearable" from the physical sensation of pain. Making this distinction may help patients see that the thought may not have reflected the truth and actually contributed to worsening the situation.

I hypothesize that the decentred perspective can affect catastrophizing and visceral anxiety sensitivity through (1) recognizing maladaptive thought patterns, (2) recognizing the difference between symptoms and thoughts about symptoms (3) developing a new attitude towards the content of the thoughts (i.e., they may not be true), (4) developing a new relationship to having these thoughts (i.e., they are transient mental events that can be observed from a decentred perspective), and (5) not processing thoughts self-referentially (e.g., having these thoughts is not a sign of personal failure).

In patients with IBS, engaging in a decentred perspective may lead to a reduced implicit self-health discrepancy because the decentred mode of mind (also referred to as 'being mode' in (Williams, 2008)) is assumed to preclude discrepancy-based processing (Williams, 2008). The accepting, non-judgemental, sensory experience focused quality of the decentred perspective is fundamentally different from the indirect, conceptual, evaluative, abstract thinking and planning mode of mind (often referred to as the 'doing mode' (Williams, 2008)). Crucially, the 'doing mode' is also assumed to engage in monitoring of the differences between current and wanted experience (Williams, 2008) which is incompatible with an accepting, non-judgemental mode of mind. If, as Williams (2008) explained, discrepancy-based processing encompasses comparing ideas with a standard or "how things should be", then engaging in the decentred mode of mind should reduce comparisons between the perceived self and the ideal, healthy self. I hypothesise that this process will be reflected in reduced self-health discrepancy in patients with IBS. Some support for this hypothesis come from a study by Crane and colleagues (2008) showing associations

between improvements in self-ideal similarities (the perceived congruency between once perceived current self and ideal-self) and more adaptive self-guides (key characteristics of the ideal and ought selves) in recovered depressed patients, after the treatment with MBCT.

5.5.3 Sensory, experiential processing

Sensory experiential processing brings awareness to bodily sensations - sights, sounds, smells, tastes and physical sensations such as tingling or pain-, with an approach oriented, curious attitude. The aim of engaging in sensory experiential processing is to experience the body directly, rather than to think about it (e.g., thinking about one's foot is slightly more abstract that paying attention to the raw sensations in the foot). Farb and colleagues (2015) proposed that paying unbiased attention directly to the sensations in the body (i.e., without expecting to find certain sensations) would be linked to increased interoceptive awareness (i.e., awareness of stimuli arising within the body). The authors also suggested that this would update expectations (priors). Based on their model (Farb et al., 2015), I would assume that sensory experiential processing would broaden the range of expected bodily states in patients with IBS to include many non-illness related states. Based on this assumption, increased interoceptive awareness would reduce the felt discrepancy between the representation of the self and a desired healthy state. To this end, the 'body-scan', may be particularly therapeutic for IBS patients as it a) encourages engagement with all sensations of the body (also neutral and pleasant sensations) rather than mainly attending to the body when there is pain or discomfort and b) trains an engagement with painful or uncomfortable sensations that is characterized by a friendly and curious approach (often referred to as turning towards the difficult). Additionally, physical sensations that arise are explored in depth (e.g., a sensation might be fluctuating and have a clear edge signalling where the sensation stops and another one begins). Experiential sensory processing is therefore thought to lead to reduced self-health discrepancy by a) increasing interoceptive awareness, b) reintroducing health into awareness and c) processing pain or other IBS symptoms in an accepting rather than discrepancy focused mode.

Moreover, engaging with physical sensations directly may reduce the perceived threat value of physical sensations. For example, when physical sensations are approached whilst

suspending judgement about them, they may be perceived as temporary (rather than permanent), fluctuating (rather than stable) and more fine-grained (rather than a 'blob of pain'). Increased granularity and awareness of transience of interoceptive signals and may thus to reduce anxiety of gastrointestinal specific sensations (Garland et al., 2012).

Finally, because patients are instructed to explore sensations experientially, rather than to think about them, habitual tendencies to cognitively elaborate on unpleasant sensations may be short-circuited. For example, when engaging in the discrepancy-based mode of processing patients might attempt to 'solve' the pain using active inference: identifying the problem (e.g., discrepancies between current (pain) and desired experiences (pain-free)), thinking about how the current undesirable state came about in a self-referential way (e.g., my body is flawed) and comparing the current situation to similar situations in memory (e.g., the last time I felt this way I had to cancel all my plans). Alternatively, engaging with the sensory aspects of feared, unwanted or threat-laden sensations with acceptance and curiosity, might create a shift from the language based processing (e.g., worrying about the relentlessness of pain or situations in which symptoms would be embarrassing) to interoceptive recovery and greater self-regulation skills (Farb et al., 2015; Garland et al., 2012). Over time, practicing sensory experiential processing may thus be linked with reductions in catastrophizing.

5.5.4 Developing a friendly relationship towards the body

A friendly relationship towards the body is characterized an attitude of acceptance (e.g., the pain/discomfort/numbness/etc. is there and that is okay) and of working with the signals of the body. The aim of developing this relationship is to reduce or replace unhelpful coping strategies: Working against or despite the body (e.g., pushing towards exhaustion), engaging with negative self-relevant feelings (i.e., feeling ashamed and considering one's body as flawed) and avoidance (i.e., avoiding or ignoring physical sensations as a coping mechanisms). It is expected that attempting to engage with the physical body non-judgementally may bring to the fore habitual patterns of dealing with pain and symptoms. Some habitual ways of coping with IBS (e.g., pushing towards exhaustion) may have become automatic, and only by attempting to replace these reactions

may patients become aware of them (e.g., by trying to say that it is okay to have pain, a patient may notice that they hold the attitude that pain is a sign of weakness). In addition, this process may bring up resistance to change (e.g., resistance to take a break when feeling tired) which gives another opportunity to explore attitudes towards the illness and the self. This exploration may give participants direct insight into their habitual attempts of dealing with difficulty (including physical pain and discomfort) and the level of self-criticisms they may have employed when experiencing symptoms.

The MBCT for IBS course protocol contains modules to uncover unhelpful coping mechanisms and treatment techniques to help participants find alternative, adaptive idiosyncratic coping strategies. As behavioural coping strategies fall outside the scope of this thesis (they are not measured), they are not discussed in detail, however the techniques are mentioned in the course protocol.

5.6 Rationale for Structural Adaptations and Additional of Modules

Dimidjian and Segal (2015) clearly emphasize that extensions of MBIs to new conditions may require modifications of the original programmes to address the specific illness specific mechanisms). The structure, composition and content of the individual modules of the MBCT for IBS course were adapted specifically for IBS patients. The section below describes how changes to the course structure were made and which additional modules were added and why.

5.6.1 Adaptations to the structure of the MBCT programme

The aims of this project were to develop a treatment that is effective (in leading to IBS symptom improvement and increased quality of life, is efficient in using resources (i.e., time, financial) and has an acceptable time-commitment required by participants. Within this framework the minimum number of treatment sessions to convey the key skills and capacities was carefully devised to address the main mechanisms of change. The original programme was dismantled into individual modules and reassembled to address the key capacities in six weekly two-hour sessions

(+ daily 1 hour home practice). All modules and sessions build upon each other in a similar way as the original MBCT for depression course.

5.6.1.1 Evidence for the efficacy of shortened psychological programmes for IBS

Shortened psychological treatment programmes for IBS have previously been developed (i.e., group-based, minimal contact or internet versions of CBT) and evaluated (Hunt et al., 2009; Lackner et al., 2008; Vollmer & Blanchard, 1998). Reviewing these studies revealed encouraging evidence for shortened approaches. Firstly, carefully adapted, shortened versions of established treatment protocols for IBS can lead to symptom improvement and are comparable in effectiveness to full-length treatments (Lackner et al., 2008; Vollmer & Blanchard, 1998). Secondly they show that group-based treatments are suitable for IBS patients. Thirdly, they demonstrate that treatments that involve substantial time-commitments outside of the therapy sessions with the teachers are feasible for this patient group (e.g., Hunt et al., 2009).

5.6.1.2 Additions to the programme

In addition to changes to the length of the course, four modules that are not part of the MBCT for recurrent depression course were added to the MBCT for IBS programme. A rationale for adding these is explained below. In brief, these new modules are thought to help build a new relationship to pain and thoughts and to form a sense of social connection.

5.6.1.2.1 Psychoeducation: primary and secondary pain

This psychoeducation element was added to the course as it illustrates one of the main rationales for MBCT for IBS. It was considered paramount that participants learn about the difference between primary suffering (arising from illness/injury and unavoidable) and secondary (optional) suffering in response to primary suffering.

5.6.1.2.2 Ice cube exercise

IBS patients are dealing with physical pain and many unpleasant physical sensations. The ice cube exercises which intends to gives experiential knowledge about how different attitudes and approaches to pain can change the perception of painful experiences (i.e., the sensations of holding ice-cubes) was therefore added to the course.

5.6.1.2.3 Vicious flower

The vicious flower exercise illustrates how different coping mechanisms can ameliorate or exacerbate symptoms and suffering (e.g., how avoiding social situations could lead to social isolation may increase IBS-related suffering). It also demonstrates that various coping mechanisms (e.g., avoidance, pharmacological methods) are not universally good or bad, but that they need to be evaluated separately for each person and each situation.

5.6.1.2.4 Connection meditation

The MBCT for recurrent depression programme has an emphasis on treating oneself kindly, which is transmitted through all exercises and guided meditations. However, it does not have a meditation for the purpose of building social connections between people. It was considered important to add a meditation that fosters feelings of connectedness with others, as IBS patients often feel shame and a sense of isolation due to their condition (Drossman et al., 2009; Kristy Phillips, Wright, & Kent, 2013). The 'Connection meditation' from the Breathworks Pain Management Programme (Burch & Penman, 2013; Cusens, Duggan, Thorne, & Burch, 2010) was chosen to for this purpose.

5.6.1.3 Possible disadvantages of adapting and shortening the length of existing interventions

Despite the proven efficacy of shortened psychological interventions for IBS, it is important to consider the possible disadvantages of making major changes to the length and content of existing interventions when adapting a treatment to a specific patient group. These limitations pertain to reduced effects on the patient population and possible shortcomings during the implementation phase. The following limitations are relevant for adaptations that go beyond modifying the psychoeducational content.

Firstly, adapting an intervention to a patient group before the mechanisms of change are clearly understood may run the risk that important active ingredients of the intervention are left out when the treatment is shortened. In the interest of not losing important core elements, a safer strategy may be to first run the original intervention (in length and content). If shown to be

effective, running a dismantling or constructive trial (Kazdin, 2016) may be a suitable strategy to build an evidence base for the dose and content of the intervention that needs to be present in order for it to be effective for a particular patient group. Secondly, by shortening the intervention length while still attempting to cover critical content, there may be an overload of information and new practices for patients. This may lead to early drop-out or misunderstanding of content. It is thus important to carefully adapt the content, balancing the delivery of content with the pacing of the intervention. Thirdly, a carefully designed intervention may have several different types of modules to achieve a desired change in symptoms or mediating factors. This is because in group interventions, a particular module may effectuate change for one participant but not another and vice versa. Thus keeping several different types of modules in the intervention may be important, particularly for patient groups as diverse as IBS. The risk of taking out too many modules is that the intervention may become too specific and may be suitable for a small subgroup of patients only. Fourthly, care needs to be taken that additions to the intervention are within the general guiding principles of the intervention. For example, mindfulness is based on the premise of experiential learning, personal wisdom, kindness and curiosity rather than learning in a didactic fashion. If these principles are not attended to in the modification process, the intervention may become a different type of intervention (e.g., too many added didactic modules may render the adapted treatment a psychoeducation intervention). To reduce this risk, in the adaptation of MBCT for IBS, additional relevant modules were taken from existing mindfulness-based interventions only (e.g., Mindfulness-Based Cognitive Therapy for people at Risk of Suicide, Mindfulness for health (Burch & Penman, 2013; M. Williams, Fennell, Barnhofer, Crane, & Silvertion, 2015) and the adaptation was carefully done with clinical and research experts in MBCT.

Implementation issues may arise if the patients in the general community (for whom the intervention is intended) differ markedly from the sample of patients with whom the intervention was tested. For example, in general practice, a subgroup of patients may have a greater and more diverse number of psychological and physiological co-morbid illnesses. For patients with a greater psychological and physiological burden to carry, a longer intervention may be more appropriate.

This would allow more time to process the content and to practice aspects considered crucial (e.g., meditation in mindfulness based interventions). Therefore one risk of shortening an intervention is that it would be effective for a better functioning, less burdened subgroup of patients only. A shortened intervention may thus be effective in a clinical research setting but its efficacy remains to be tested in a clinical community setting. Finally, during the implementation phase it may become apparent that shorter interventions that cover a complex set of psychological skills may be deliverable by more experienced therapists only. However, in order to increase the availability of an effective intervention it is important that novice therapists can also learn to deliver it. Paradoxically there is thus a risk that by shortening an intervention (to make it more affordable for all patients) it becomes less accessible because only experienced therapists can deliver it effectively.

5.7 MBCT for IBS Treatment Outline and General Structure

The course consists of six two-hour sessions spread over a period of six weeks. The general structure, aims, hypothesised change mechanisms and capacities trained in MBCT for IBS are listed in Table 5.1. Each session consists of a review of home practice (except Session 1), meditation, inquiry following each meditation module, psychoeducation, instructions for home practice for the coming week (except for final session) and the distribution of handouts. Typically, home practice consists of 30-60 minutes of meditation and 5-15 minutes of psychoeducational exercises. The planned class size was 15-20 participants. Each participant is invited to a 45 minute orientation meeting with one of the teachers before the course begins.

Table 5.1. General structure, aims, hypothesised change mechanisms and capacities trained in MBCT for IBS.

Main Aims: Reduction in IBS symptom severity, increase in IBS quality of life
General Structure
Number of weeks: 6 Number of sessions: 6 + 1 orientation meeting (30-45 minutes) Duration of each session: 2 hours Daily suggested home practice duration: 45 - 60 minutes
Hypothesized mechanisms of change
1 Pain / IBS catastrophizing 2 Visceral anxiety sensitivity 3 Attentional control 4 Biased self-referential processing of illness and health 5 Non-judgemental awareness 6 Adaptive coping
Main skills that MBCT develops which are hypothesized to affect the mechanisms of change
1 Concentration 2 Decentring 3 Sensory, experiential processing 4 Friendly relationship towards the body

5.7.1 Guiding principles

The following guiding principles of MBCT are infused throughout the treatment and reflect the course's general approach to teaching and learning.

5.7.1.1 Experiential learning

The course is taught experientially, that is instead of learning *about* mindfulness for IBS, the course is designed to allow participants to experience mindfulness for themselves through direct practice. This guiding principle ensures that participants learn from the exercises and meditation practices, first through their own experience before making sense of the meaning and potential learning points with the teachers and the class (Segal et al., 2013).

5.7.1.2 Kindness, curiosity and non-judgement as attitudinal foundations

Bringing kindness, curiosity and a non-judgemental attitude to all experiences (e.g., negative, neutral and positive, emotional and physical) is a key theme running through the whole of the course. They are guiding principles woven through all instructions and essential qualities embodied by the teachers. Importantly, this principle emphasizes that the aim is not just about developing or sharpening attention, but about the quality or attitude that is brought along with the attention (kind, curious, non-critical, non-judgemental) (Segal et al., 2013).

5.7.1.3 Personal wisdom

The underlying assumption is that each participant knows their body and mind best, they are the experts (Segal et al., 2013). The teachers are there to guide participants to make best use of their existing personal knowledge. There is a continuous focus on home practice which places the responsibility for their own growth on the participants and builds routines for a practice that can be continued without weekly meetings with a teacher.

5.8 MBCT for IBS Treatment Protocol

Each session has a set of integrated modules. Table 5.2 lists the modules for each session, and a detailed description of each session and its content can be found below.

Table 5.2. Summary structure and content of Mindfulness-Based Cognitive Therapy (MBCT) for Irritable Bowel Syndrome (IBS).

Session Structure and Content		
Session Themes and Content	**Module Type**	**Time (in Minutes)**
Session 1 - Waking up to autopilot in IBS		
• Introduction of teachers	General	15
• Housekeeping and groups guidelines	General	
• Participant introduction	General	20
• Raisin meditation Practice and inquiry	Meditation	20
• Primary and secondary suffering	Psy.Ed.	15
• Body scan meditation • Practice and inquiry	Meditation	40
• Home practice and handouts Body scan (6 days) Routine activity (6 days)	General	10
• Poem		
Session 2 - Living in our heads and anchoring attention		
• Body scan meditation Practice and inquiry	Meditation	45
• Home practice review	General	20
• Walking down the street exercise	Psy.Ed.	15
• Anchor of the breath meditation Practice and inquiry	Meditation	20
• Home practice and handouts Body scan (6 days) Pleasant events diary Ten minutes attention to the breath meditation (6 days)	General	15
Session 3 - Beginning to befriend challenges and building capacity		
• Stretch and breath Practice and inquiry	Meditation	40
• Home practice review	General	20
• Ice cube exercise Practice and inquiry	Psy.Ed.	30
• Breathing space meditation Practice and inquiry	Meditation	15
• Home practice and handouts Breath and body (6 days)	General	10

Session Structure and Content

Session Themes and Content	Module Type	Time (in Minutes)
Mindful movement (3 days) Mindful yoga (3 days) Unpleasant events diary		
Session 4 - Allowing and letting be		
• Relating differently to thoughts Practice and inquiry	Meditation	40
• Home practice review	General	20
• Getting to know the territory of our minds	Psy.Ed.	20
• Relating differently to difficulty Practice and inquiry	Meditation	25
• Breathing space as a response to difficulty Practice and inquiry	Meditation	10
• Home practice and handouts Relating differently to thoughts (3 days) Relating differently to difficulty (3 days) Breathing space as a response to difficulty (if needed) Regular breathing space (6 Days)	General	5
Session 5 - Bringing friendliness to yourself and also to others		
• Relating differently to difficulty Practice and inquiry	Meditation	35
• Home practice review	General	15
• Vicious flower	Psy.Ed.	15
• Breathing space as a response to difficulty Practice and inquiry	Meditation	5
• Working wisely with IBS - Identifying triggers	Psy.Ed.	20
• Connection meditation Practice and Inquiry	Meditation	15
• Home practice and handouts Relating differently to difficulty (3 days) Connection meditation (3 days) Breathing space as a response to difficulty (if needed) (second week: make a selection of any of the practices) Working wisely with IBS - responding skilfully	General	5

Session Structure and Content		
Session Themes and Content	**Module Type**	**Time (in Minutes)**
Session 6 - Bringing what we learned into the future		
• Body scan meditation Practice and inquiry	Meditation	30
• Home practice review	General	25
• Review of the course	General	20
• Making plans for future practice	General	15
• Ending and well-wishing	General	15

In the following section, it will be highlighted how each module of the course is related to IBS and the overall aims of this course. The aim is to provide a clear understanding of the content and structure of the course. Differences between the MBCT course for recurrent depression and the MBCT course for IBS are mentioned where the aims, intentions or psychoeducational aspects of the components have been adapted.

5.8.1 General modules repeated throughout the sessions

5.8.1.1 Inquiry and home practice review

Two important aspects of integrating mindfulness into daily life are ‘Inquiring into practice’ and ‘Home practice review’. These are repeated in each session. The main difference between the two forms of inquiry is that the home practice review is a time in which participants can share their learning points and difficulty with the home practice. Inquiry into practice on the other hand takes place directly after a formal meditation practice in class. Both forms of inquiry are times for participants to describe, comment or reflect on their experience and for the teachers to use a mindful approach to explore the experience with the participant (Segal et al., 2013). Both ‘inquiry into practice’ and ‘home practice review’ are briefly described below and referred to in the description of each session.

5.8.1.1.1 Inquiry into practice

'Inquiry into practice' helps participants connect the meditation practices with what they have learned about themselves. It has several layers that focus on what the participant has noticed, on putting these experiences in a personal context and on linking them with the aim of MBCT (Segal et al., 2013).

5.8.1.1.2 Home practice review

'Home practice review is very similar to 'inquiry into practice', with the difference that the review covers a whole week of home practice. It therefore includes discussions of problems with regards to integrating the practice into daily life (e.g. finding time for it) and reflections on how the practice may have changed over the course of the week (e.g. concentration on the practice may improve).

5.8.1.2 Handouts

At each session, the participants are given a handout that summarizes the learning points of that session. Participants can read this to reflect upon what they have learned and to bring further understanding to the psychoeducational aspects of the class. In most cases, the handouts also include instructions for the formal meditation sessions (e.g., posture and attitude). All handouts were adapted from the handouts of the MBCT for depression course (Segal et al., 2013) to reflect the unique psychological understanding of IBS. The handouts can be seen in section 9.3.2 in the Appendices.

5.8.1.3 Home practice

All meditation practices assigned for home practice can be accessed with a cd or an online streaming service.

5.8.2 MBCT for IBS - Sessions 0-6

5.8.2.1 Session 0 - The orientation meeting

The MBCT for IBS programme starts with an individual orientation meeting between the teacher and each participant. In this session, the teacher develops an individual problem formulation with the participant, explains how MBCT might be helpful and describes what to

expect during the course (Segal et al., 2013; Surawy et al., 2014). It also sets the stage for the importance of home practice throughout the course.

5.8.2.2 Session 1 'Waking up to the autopilot in IBS'

5.8.2.2.1 Theme and intention

The first session, 'Waking up to the Autopilot in IBS' has three main elements. Participants are guided through (perhaps) their first formal experience of present moment awareness and sensory processing using a mindful approach (the 'raisin meditation'). This is in stark contrast to automatic processing of everyday experience which is often characterized by mindless (unaware) and thought based experience. Secondly, participants are taught about the difference between primary and secondary suffering. Links are made illustrating how mindfulness can help participants respond more skilfully to symptoms and thereby reduce avoidable (unnecessary) suffering and pain. This serves two aims: to initiate decoupling of physical sensations (including symptoms) from thoughts and feelings about symptoms, as well as providing a rationale for why mindfulness is relevant for patients with IBS. Thirdly, the body-scan is introduced as a way to bring approach oriented, non-judgemental awareness to the body. The body scan aims to develop a decentred perspective, practices sensory experiential processing to increase interoceptive awareness, trains sustained concentration and emphasizes a kind and friendly relationship towards the body. The flow of modules in this session is described below:

5.8.2.2.2 Introduction of teachers

The teachers welcome participants to the course, introduce themselves to the whole class and briefly touch upon the relevance of mindfulness for IBS.

5.8.2.2.3 Housekeeping and group guidelines

This module sets general guidelines for the class. The main guidelines are about confidentiality and privacy (things mentioned in the group stay in the group), taking breaks during class if needed (as there is no scheduled break), how and when to move during meditation, and listening respectfully to others and their experiences. Participants learn that they are not required to

speak up in the group, that difficult emotions may arise during class and that this is a normal part of the therapeutic process.

5.8.2.2.4 Participant introduction

Participants first introduce themselves in small groups of two to three people with their name and what they hope to learn from and take away from this course. Afterwards participants are asked to introduce themselves to the whole group.

5.8.2.2.5 Raisin meditation - practice and inquiry

The raisin meditation is a meditative exercise designed as an introduction to mindfulness (Segal et al., 2013). Participants are given a raisin and are asked to treat it like something they have never seen before. In this context participants are instructed to slowly explore the object, including its appearance (surface, and reflections of light), texture, weight, smell, sensations of the object in the mouth, including physical reactions to the raisin in the mouth and finally chewing and tasting it. Participants are asked to take note of any thoughts arising as part of the exercise and return their attention back to the intended purpose – exploring the object. The aim is to establish a sense of what present moment sensory experience can be like from a mindfulness perspective (a manifold of physical sensations, thoughts and emotions), how paying attention can change experience, to encourage participants to become aware of automatic thoughts which arise, and highlight the contrast between mindful and mindless (on auto-pilot) experiencing. The relevance of this in relation to IBS is discussed in the inquiry that follows this practice.

The concern that patients may develop an aversion towards the raisin exercise was discussed, as some patients are very concerned that certain food items exacerbate or trigger their IBS symptoms. However, as the raisin might bring up some automatic, habitual IBS-related thoughts it was felt that this could be an excellent first learning experience for participants to learn about automatic thoughts and automatic reactions to these thoughts. In addition, all meditation practices, including the raisin meditation are given as invitations. This means that participants can omit aspects of the practice (e.g., they did not have to eat the raisin if they did not want to).

5.8.2.2.6 Primary and secondary suffering

In this psychoeducation module, the teachers explain the difference between primary and secondary suffering and how mindfulness relates to it. Primary suffering is explained as the pain that arises from illness, injury or damage to the body's nervous system and other unavoidable difficulties (e.g., bereavement). Secondary suffering is the mind's reaction to the primary pain. That can include negative thoughts, emotions and action tendencies towards the physical pain (Burch & Penman, 2013), as well as resistance to and avoidance of these sensations and automatic tensing up around the pain, holding one's breath and irritability. It is then explained how practising mindfulness can help to reduce secondary suffering with IBS specific examples. Particularly, the awareness that is developed throughout the course helps participants to see the difference between their own primary pain and secondary suffering, to recognize their psychological reactions to their primary pain and to understand how their reactions might contribute to secondary suffering. This module serves two main aims: to initiate decoupling of physical sensations (symptoms) and thoughts and feelings about symptoms, as well as providing a rationale for why mindfulness is relevant for patients with IBS. Providing a clear rationale for the treatment is known to be an important ingredient for larger treatment effects (Kaptchuk et al., 2010). Later exercises (e.g. the vicious flower exercise) also build upon this framework.

5.8.2.2.7 Body scan – practice and inquiry

The 'body scan' is a meditation that is usually practised lying down but can also be practised sitting or standing. Participants are instructed to bring detailed awareness to bodily sensations by moving attention through all parts of the body starting with the toes. The awareness that is brought to the body in this exercise is characterized by gentleness and curiosity (Segal et al., 2013), meaning that there are no right or wrong sensations in the body and that participants bring a sense of friendly interest to what they find. As part of this practice, participants develop focused attention over a longer period of time (Segal et al., 2013), an appreciation of positive and neutral sensations in the body and an understanding that many bodily sensations are rather fleeting and less stable than assumed. It was also expected that some participants may have developed an

antagonistic relationship towards their body, based on having unexplained symptoms. This and other reactions to this practice were explored in the inquiry. The intention of this exercise is to encourage participants to develop a friendlier, kinder relationship with their bodies and to increase interoceptive awareness.

5.8.2.2.7.1 Differences between MBCT for recurrent depression and MBCT for IBS

One of the main aims of the body scan in MBCT for depression is to use the body as a way to understand emotion better and to anchor attention in the body rather than predominantly in thoughts (Segal et al., 2013, p.120). In MBCT for IBS the emphasis of this exercise is shifted slightly more on developing a kind and friendly relationship with the body, a careful exploration of the sensations within the body and allowing them to be as they are, rather than changing them. This is because rather than changing symptoms directly, the aim is to change the relationship that patients have with their symptoms and their body.

5.8.2.2.8 Home practice

Participants are given handouts. For home practice, participants are asked to practise the body scan on six out of seven days, using a cd or an online streaming version of the guided meditation track. In addition, participants were asked to bring moment-to-moment awareness to a routine activity (e.g. brushing teeth) each day. The poem "Walking Slowly" by Danna Foulds (Segal et al., 2013) is read at the end of the session (also see the participant handouts in section 9.3.2 of the Appendices).

5.8.2.3 Session 2 'Living in our heads and anchoring attention'

5.8.2.3.1 Theme and intention

Firstly, the second session begins with the 'body scan'. Secondly, the theme of decoupling continues, this time with an exercise to highlight the difference between events and interpretation of events and the effect that interpretations can have on mood (the Walking down the street exercise). Finally, the anchor of the breath meditation is introduced, which establishes the practice of focused attention. Holding attention on one object can be challenging and this meditation practice highlights the frequency of present moment absence, (e.g., mind-wandering, thinking and

worrying) as well as the content of mind-wandering (often repetitive themes can be noticed).The flow of modules in this session is described below:

5.8.2.3.2 Body scan – practice and inquiry

The body scan as described in session 1 is the first practice of this session. Continuing with the body scan emphasizes the importance of working with and through the body and of learning to develop a new relationship with it and the sensations within it. Experiences of this mediation were explored in the inquiry.

5.8.2.3.3 Home practice review

This first home practice review focuses on experiences and difficulties with home practice. Attitudes towards the practice, including uncertainties about 'doing it right', negative (e.g., boredom) and positive (e.g., relaxation) experiences and practical issues (e.g., not finding time) are brought into the review session and discussed.

5.8.2.3.4 Walking down the street

The Walking Down the Street psychoeducation module is a typical cognitive therapy exercise that teaches the role of interpretation of events in influencing subsequent mood (Segal et al., 2013). Participants are asked to imagine the following scenario: "You are walking down the street…, and on one side of the street you see somebody you know…. You smile and wave….The person just doesn't seem to notice and walks by…." (Segal et al., 2013, p.160). Participants are then asked to take note of how they feel, what they are thinking, what they feel like doing and which bodily sensations they experience. Participants are then encouraged to share what they thought and felt with the group. This module is aimed to let people explicitly experience the connection between thoughts and mood and to show that different people have many different idiosyncratic interpretations, thoughts and mood states as a response to the same scenario. It also undermines the belief that all thoughts are accurate.

5.8.2.3.4.1 Differences between MBCT for recurrent depression and MBCT for IBS

In MBCT for the depression, this exercise also highlights the importance of negative interpretations in the maintenance of depression and how interpretations can lower mood even

further. This link with depression is not drawn in this course. Rather the exercise is seen as an important precursor to later modules (e.g., 'relating differently to thought', 'getting to know the territory of our minds') that pick up the theme of 'thoughts and mood' and the idea that 'thoughts are not facts' in relation to IBS specific thoughts and fears.

5.8.2.3.5 Anchor of breath meditation – practice and inquiry

In the 'Anchor of Breath' meditation the teachers instruct participants to observe the breath. The practice involves bringing the attention back to the object of attention (the breath) when participants notice that their mind has wandered. Potential anchors for attention are the sound or physical movements of the breath. This exercise guides attention to a more sustained narrow focus rather than a moving focus as in the body scan (Segal et al., 2013). It is also a first step to recognize habits of the mind (typical thoughts and thought patterns) (Segal et al., 2013) and trains the ability to let go of 'thought trains' if one chooses to do so (e.g. by repeatedly disengaging from thoughts). The meditation is taught in a spirit of a kind attitude towards mind-wandering. The inquiry explores the reflections of participants with this new, more focused meditation practice. The teachers also emphasize that mind-wandering is not a sign of failing at the meditation or a time to be self-critical. Rather, each time participants notice that their mind has wandered is a moment when they are back in the present moment and an opportunity to return their attention to the intended point of focus.

5.8.2.3.6 Home practice

Participants are given the handouts and asked to practise the 'Body Scan' and 10 minutes of attention to the breath meditation on six out of seven days. In addition, participants are instructed to keep a diary of pleasant events (see participant handouts in section 9.3.2 of the Appendices).

5.8.2.3.6.1 Pleasant events diary

This module is given as a home practice assignment. Participants are asked to write down thoughts, feelings and physical sensations associated with pleasant events (Segal et al., 2013). The exercise is designed to help participants recognize the many pleasant experiences that are in their

lives and encourages them to take time to experience these. It also reiterates the emphasis on relating to these experiences more directly, through 'raw' physical sensations (sights, smells, temperature and sound) rather than through thoughts.

5.8.2.4 Session 3 'Beginning to befriend challenges and building capacity'

5.8.2.4.1 Theme and intention

The third session starts with a movement meditation designed to increase awareness to the attitudes participants hold towards their bodies and to develop a gentle, friendly approach to the body and its limitations. Importantly, options for working mindfully with physical discomfort are introduced. In line with this theme, new approaches to painful sensation in the body are explored with the 'Ice-cube exercise'. The module emphasizes that the type and quality of attention applied to physical discomfort and pain actively shapes the perceived experience of the sensations. This facilitates the decoupling of sensations from thoughts through demonstrating that (at least) two separate processes (the sensations registered by nociceptive receptors and the mental attitude brought to the sensations) contribute to the perceived experience. It also trains attentional control under more difficult circumstances (in the presence of pain). Finally, the breathing space, a short meditation that facilitates the integration of mindfulness into daily life, is introduced. All modules are within the general theme of building resources by increasing the options participants have when dealing with challenging situations as they arise. The flow of modules in this session is described below:

5.8.2.4.2 Stretch and breath meditation – practice and inquiry

The 'stretch and breath' meditation is a movement-based meditation. Crucially, movements are simple and performed slowly. Physical sensations as well as thoughts and attitudes are monitored. The intended attitude during this movement is characterised by curiosity, non-striving, and kindness to one-self and the body. The movements are simple and performed slowly (e.g., the arms are raised out to the side until they are parallel to the head and then lowered back down; this may take up to 5 minutes). Participants are encouraged to stop the movements at any time if they wish to do so. The instructions are to pay attention to the sensations of the muscles

engaging and stretching as well as to the sensations of relief when each movement comes to an end (Segal et al., 2013). During this module, participants are guided to become aware of the attitudes they hold towards their body. The aim of this exercise is to develop a direct experience of the body's sensations, a sense of honouring the limitations of the body, and developing a friendly attitude towards it. At the same time, the attitude is one of not forcing a stretch yet at the same time not disengaging as soon as discomfort is felt. This allows the exploration of physical discomfort whilst at the same time resisting habitual reactions to discomfort (e.g., pushing through it or avoiding it altogether). This also helps participants become aware of more typical attitudes such as 'striving', self-criticism or having unrealistic expectations (Segal et al., 2013) and provides another tool to move attention away from (unrelated) thoughts and into the present moment. More implicitly, participants learn to reduce discrepancy based processing by staying with the body and its sensations as they are, rather than trying to force the body to meet one's expectations (e.g., to be more flexible).

The movement in this practice is followed by a breath and body meditation which narrows the focus on the breath and later widens the focus on the body. This enables participants to explore patterns of sensations in the body and to explore options for working with difficult sensations – moving mindfully or exploring sensation. Participants are learning how to respond to their body more sensitively and wisely.

The attitudes participants are holding towards their body are also a key aspect to be picked up in the inquiry. For example, a tendency to push the body towards or past its limits to achieve goals is likely accomplished by ignoring the body's needs. This can unintentionally exacerbate symptoms and trigger negative reactions to symptoms (e.g. thinking that one is inadequate and unreliable due to the symptoms).

5.8.2.4.2.1 Differences between MBCT for recurrent depression and MBCT for IBS

The MBCT for depression course draws a more explicit parallel between difficult physical sensations and difficult emotions when working with this approach. This is done to a lesser extent in the MBCT for IBS course where the focus is on working with the body. Nevertheless, the

attitudes that participants hold towards their body are likely to be present in other aspects of their life and this is touched upon lightly in the inquiry.

5.8.2.4.3 Home practice review

Experiences and difficulty with the home practice are discussed. The topic of the review is mind-wandering, emotional reactions to mind-wandering (e.g. self-criticism) and how to deal with it during meditation. In addition, the recordings from the pleasant events diary are discussed with a focus on separating thoughts from feelings and sensations. This is thought to facilitate 'decentring' as it is easier to decentre from clearly labelled experiences, than an intertwined bundle of experiences (Segal et al., 2013).

5.8.2.4.4 Ice cube exercise – practice and inquiry

The 'Ice Cube' exercise is a psychoeducation module in which participants engage with pain using several different mental attitudes (Duncan et al., 2017). In this exercise participants are asked to hold an ice cube five times for one minute each, with breaks of one and a half minutes between holding the ice cube. The first time, participants hold the ice-cube for a minute and without specific instructions to engage a particular attitude. The second time of holding the ice-cube for a minute, participants are asked to bring their awareness to their breath while imagining to breathe into and out from the sensations. The third time, the instructions are to focus on the particular sensations, to label them, find the physical edge of the sensation (e.g., where the sensations of the ice-cube in the hand end and other sensations begin), the intensity of the sensations and how this might be changing. The fourth time, participants are instructed to move their awareness into their whole body and become aware of how much of their body is not in pain. The fifth time, participants are encouraged to be playful with the sensations, to do something that they have tried already or to try their own idea of dealing with the pain of the ice cube. In the break period (1.5 minutes) participants are instructed to rest their awareness on the breath, or to do a mini body scan. The aim of this module is to allow participants to experience different possible approaches of relating skilfully to intense sensations, to appreciate that different attitudes and approaches to pain result in different perceptions of the experience, to learn to decouple cognitions

from experience and to train attentional control under more difficult circumstances. The experiences of this exercise are shared and discussed in the inquiry.

5.8.2.4.5 Regular breathing space meditation

The breathing space is a short meditation with three main stages. In the first stage, participants are instructed to bring their awareness to body and mind and notice what sensations, thoughts and emotions are currently present. In the second stage, participants are asked to narrow their attention and focus on the sensations of the breath only. During the third stage participants are encouraged to widen their attention again to cover the whole body and the breath (Segal et al., 2013). This meditation has two aims. Firstly it can be completed in a very short period of time (three minutes or less) and therefore helps to integrate meditation into daily life. Secondly, it is designed to return attention to the body and the present moment. Engaging in a breathing space can therefore be a useful way to disengage from worrying thoughts about symptoms. Importantly, it is not a tool to fix a situation or to relax, but rather an intentional mindfulness based activity that can be implemented to step out of autopilot and reengage with the present moment more mindfully.

5.8.2.4.6 Home practice

Participants are given the handouts and instructed to practise the 'Anchor of Breath' Meditation on six of seven days, the 'Stretch and Breath' (mindful movement) mediation on three days and a 'Mindful Yoga' practice on three alternative days. Mindful yoga is very similar to mindful movements with the difference that simple yoga postures are introduced. In addition, participants are asked to complete a diary of unpleasant events.

5.8.2.4.6.1 Unpleasant events diary

This module is given as a home practice assignment. Participants are asked to write down thoughts, feelings and physical sensations associated with unpleasant events (Segal et al., 2013). This exercise is designed to help participants recognize unpleasant feelings and their reaction to them, even if they are very subtle (see participant handouts in section 9.3.2 of the Appendices).

5.8.2.5 Session 4 'Allowing and letting be'

5.8.2.5.1 Theme and intention

The fourth session starts with a practice which builds on the sitting practice in Session 3 and introduces relating to sounds and thoughts as mental events that arise and disappear. Developing a new relationship with thoughts as transient mental events is a key aspect of this practice. The corresponding psycho-education module teaches that thoughts are part of the territory of IBS and are not necessarily true but rather symptoms of anxiety, using the participant's own experiences. Both modules encourage decentring and decoupling of thoughts from the belief that they are true or that they define one's identity. The third aspect of this session introduces a new practice in which participants are guided to a new way of relating to difficult situations or mood states, by way of becoming aware of the physical manifestations of psychological states (Segal et al., 2013) (e.g., a tight chest in response to a worrying thought). This introduces an allowing of difficulty in the form of present moment sensory processing, rather than avoiding, supressing or cognitively elaborating on problem(s). Further, it illustrates the connection between thoughts, emotions and physical sensations, and underlines the mind-body connection which is highly relevant for IBS patients. Finally, participants are encouraged to use the breathing space in response to difficulty. The flow of modules in this session is described below:

5.8.2.5.2 Relating differently to thoughts – practice and inquiry

This meditation teaches a mindful approach to thoughts. This approach to thoughts has been practised more implicitly in previous practices and is introduced in a more direct way here. The aim is to learn about the temporary nature of thoughts and that they can be observed with a kind attitude without engaging with them (i.e., from a decentred perspective). This is particularly relevant for thoughts that might trigger worries or catastrophizing. It starts with a focus on the breath, moves to a wider focus on the body and then includes sounds into present moment awareness. The instructions are to become aware of sounds, loud and subtle, to become aware of labelling sounds, aversion and liking of sounds (e.g., this is a birds song, it is pleasant; this is a car driving by, it is unpleasant) and then to treat sounds as 'events' that arise, stay for a while and then

dissipate. Returning attention to listening to the soundscape when caught up with reactions to sounds (e.g., thoughts) is another important aspect of this practice. The next step is to move attention away from sound and onto thoughts, treating them in the same way as sounds – mental events that arise, stay and dissolve. Finally participants are guided to let go of any particular focus of mind and rather be aware of anything that arises in the body, mind or their environments (Segal et al., 2013). As with the other mindful meditations mentioned here, when participants notice their mind wandering, worrying or ruminating, the instructions are to gently bring attention back to the intended focus. The experiences of this approach of relating to thoughts and how this may be relevant to thoughts about IBS are the focus of the inquiry.

5.8.2.5.3 Home practice review

The home practice review covers the experience with the movement based meditations, reflections, insights and difficulties that it brought up. Importantly, the 'unpleasant events diary' is discussed. The central theme of this discussion is how both attachment and aversion are typically expressed: "needing things to be different from how they are right now" (Segal et al., 2013). The deeper meaning here is that that unpleasant emotions, thoughts and physical sensations (especially those related to IBS) can trigger reactions to symptoms such as catastrophizing thoughts or fear of worsening of symptoms. Importantly, once participants can see that symptoms and thoughts about symptoms are separate entities, they can choose to stay present with the symptoms - without cascading into negative thoughts - and then choose a helpful response if needed.

5.8.2.5.4 Getting to know the territory of our minds

This psychoeducation module about automatic thoughts was adapted from an MBCT for depression exercise (Segal et al., 2013) to cover specific automatic thoughts that are relevant for patients with IBS. Participants are asked to think about the thoughts they had at a time when their IBS had bothered them and to write them on a whiteboard. The teacher then reads the thoughts aloud. Items from the Gastrointestinal Cognitions Questionnaire (Hunt et al., 2014b) were also added if they sounded familiar to participants (e.g. "If people knew what my life was really like they would think I was crazy" (Hunt et al., 2014b)) . The group is then encouraged to discuss how

it feels to hear these and if there are times when they believe these thoughts more or less strongly. It is usually the case that participants tend not to believe in the thoughts during the session. However, the beliefs in the thoughts tend to be stronger when participants are feeling unwell or down. This module is designed to reinforce the message that thoughts are not facts and are often symptoms of the prevailing mood. It also reinforces a sense of 'common humanity' in a sense that participants are relieved to verbalise these thoughts and to find that they are not alone in having them.

5.8.2.5.5 Relating differently to difficulty – practice and inquiry

The focus of this meditation practice was to approach difficulty (e.g., thoughts, emotions) by exploring associated physical sensations with friendliness, interest and discernment as an alternative to avoiding or mentally elaborating (e.g., catastrophizing) the difficulty. The meditation has two stages. In the first stage, participants are asked to bring to awareness a current difficulty in their lives or something that has bothered them in the past or that feels unresolved. In the second stage attention is shifted to the concomitant sensations in the body, as the difficult experience is kept in mind. This is done with an attitude of allowing the experiences to be there (Segal et al., 2013) and with a sense of kindness. The instructions are to discern the extent to which this is possible and to anchor awareness on the breath if there is a sense of being overwhelmed. In this way a new approach to relating to difficulty is learned that is different from ruminating or worrying about difficulties. It may also constitute an extended period of mentally exposing oneself to difficulty, and thus experiencing that one is safe in the face of difficulty without the use of coping strategies like avoidance or rumination. This approach is a way to decentre from thoughts and emotions without suppressing them and at the same time without engaging with them through unhelpful thinking patterns. In addition, for IBS patients in particular it is also a way of seeing the connection between emotional states and the body's reaction to them. This new way of approaching difficulty is followed up in the inquiry with a focus on how participants related to distress and how they experienced working with the alternative approach (e.g., was this approach helpful, challenging or both?).

5.8.2.5.6 Breathing space in response to difficulty

The meditation is the same as the regular breathing space, with the addition, that participants are instructed to use it deliberately when they feel negative or unpleasant feelings or when they feel overwhelmed by these feelings. It is clarified, that practising the breathing space in response to difficulty is not seen as a way to avoid the negative feelings, but as a means of acknowledging them and a chance to step out of the current mode of thinking into a more accepting, experiential mode of mind (Segal et al., 2013).

5.8.2.5.7 Home practice

Participants are given handouts and asked to practise the 'relating differently to thoughts' meditation and the 'relating differently to difficulty' meditation on alternate days. In addition, participants are encouraged to practise the 'Regular Breathing Space' on each day and the 'Breathing space in Response to Difficulty' if needed.

5.8.2.6 Session 5 'Bringing friendliness to yourself and also to others'

5.8.2.6.1 Theme and intention

The fifth session continues the practice of relating to difficulty through the body ('relating differently to difficulty') before moving to a cognitive therapy exercise that illustrates the difference between maladaptive and adaptive responses to symptoms and distress (McManus, Muse, Surawy, Hackmann, & Williams, 2015; Surawy et al., 2014). It distinguishes responses (including behaviours) that perpetuate symptoms and distress from responses that may reduce symptoms. Perpetuating responses are well-intended, yet maladaptive reactions that maintain symptoms. Participants also identify IBS triggers and old mental habits (thought patterns) that are unhelpful in relieving distress or symptoms and crucially are prompted to recognize responses that relieve distress. These exercises serve to heighten the recognition of the importance of self-care and responding using the wisdom arising from the present moment. A second theme of this session is to foster the participant's feelings of social connectedness through a 'Loving-Kindness' meditation. This is a possible nourishing activity that has been shown to increase positive emotions

(Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). The flow of modules in this session is described below:

5.8.2.6.2 Relating differently to difficulty – practice and inquiry

The meditation practice of relating differently to difficulty is repeated at the beginning of the session. This includes a period of inquiry into the experience with the meditation similar to the accompanying inquiry of the previous session.

5.8.2.6.3 Home practice review

The home practice review centres on people's experiences and discoveries with the suggested practices. This includes a focus on moments when the home practice was perceived as helpful and situations when it was avoided and why. Participants learn to recognize their individual reactions (cognitive and behavioural) to aversion and to use these moments of recognition as an opportunity to choose alternative responses.

5.8.2.6.4 Vicious flower

This exercise aims to draw out how reactions to symptoms such as avoidance of social activities, worrying about symptoms and other coping strategies may inadvertently lead to an exacerbation of negative mood, anxiety and symptoms. In the second stage of this practice, it is explored how attending to symptoms and reactions to symptoms mindfully can help choose alternative responses that are aimed to lead to the participant's wellbeing (McManus et al., 2015; Surawy et al., 2014). This practice was adapted from an exercise in the manual "Mindfulness-Based Cognitive Therapy for people at Risk of Suicide" (Williams, Fennell, Barnhofer, Crane, & Silvertion, 2015).

5.8.2.6.5 Breathing space as a response to difficulty – practice and inquiry

The 'vicious flower' exercise can sometimes bring up negative feelings, relating to inadequacy or self-judgement in a response to realizing that attempts to alleviate symptoms have potentially made symptoms worse. The breathing space as a response to difficulty is entered here as a way to be with this difficulty, to allow these feelings to be there and to see them for what they are – a temporary emotional state that accompanies thoughts that may or may not be correct.

5.8.2.6.6 Working wisely with IBS – identifying triggers

The working wisely with IBS exercise consists of two forms to be completed by the participants. The first form asks people to identify triggers of their IBS symptoms, thoughts, emotions, bodily sensations and action tendencies that they notice in response, and to identify any old habits that keep them in a distressed state. The second form is covered as part of the home practice and concerns skilful responses to difficulty.

5.8.2.6.7 Connection meditation – practice and inquiry

The connection meditation is a meditation from the "Mindfulness for Health" self-help book by Vidyamala Burch (Burch & Penman, 2013). This meditation encourages participants to develop a sense of social connectedness and kindness towards others. It differs from the previous meditations, as its focus is outwards rather than inward: connecting with others, rather than paying attention to one's own thoughts and emotions or bodily sensations. The meditation was added, because having a chronic illness often limits one's ability to socialise (e.g., going to restaurants without worrying about symptoms), and patients with IBS often feel embarrassed to talk about symptoms (there can be a sense of shame in talking about diarrhoea and constipation) (Drossman et al., 2009). The meditation is structured in a way that it becomes clear that in a deeper sense there is little that separates one person from another (all people have their struggles and strive for happiness). It focuses on the things that people share rather than what separates them. 'Loving-Kindness' meditations such as the connection meditation have been shown to relate to a decrease in illness symptoms and an increase in positive emotions (Fredrickson et al., 2008). A period of inquiry follows the meditation.

5.8.2.6.8 Home practice

Participants are given the handouts and are asked to practise the 'relating differently to difficulty' meditation and the 'connection meditation' on alternate days of the week. They are also encouraged to use the 'breathing space as a response to difficulty' if needed. The second part of the 'working wisely with IBS' form is completed at home.

5.8.2.6.8.1 Working wisely with IBS – responding skilfully

The second form of the 'Working wisely with IBS' exercise asks participants to identify ways of 'skilfully' responding to stress or worries about IBS, including how they can best care for themselves when feeling distressed. This exercise aims to prepare participants to identify helpful strategies to lessen distress in response to IBS, particularly for the time after the course has finished.

5.8.2.7 Session 6 'Using what we have learned in the future'

5.8.2.7.1 Theme and intention

The sixth and final session begins with a body scan to reiterate the importance of present moment experience, sensory processing and developing a kind relationship with the body. It continues with a review of what participants have learned in the course. The final part of the session focuses on creating plans about continuing the practice after the course has finished. The general approach is that of taking things forward and that this is an opportunity to continue integrating mindfulness in daily life and benefit from the practice. The flow of modules in this session is described below:

5.8.2.7.2 Body scan

The body scan as described in session 1 and 2 is the first practice of this session. Beginning the last session with the body scan emphasizes the importance of working with and through the body and is intended to give a sense of 'coming full circle' (Segal et al., 2013). Experiences of this mediation are briefly explored in the inquiry.

5.8.2.7.3 Home practice review

At this point in the course the home practice inquiry is focused on the experience with the meditation practices over the past two weeks and a thorough examination of ways to respond skilfully to IBS and distress.

5.8.2.7.4 Review of the course

This module gives participants time to look back and reflect on what they experienced and learned throughout the course. Participants answer questions about their initial expectations, what obstacles they encountered and what strategies have helped them.

5.8.2.7.5 Making plans for future practice

This section focuses on making plans for the future to continue meditation practice if that is considered desirable.

5.8.2.7.6 Ending and well-wishing

Handouts of session six are given to participants. The final part of the last session ends with well-wishing for all participants of the course and information about where the practice can be continued (e.g., local mindfulness meditation groups) is distributed.

5.9 MBCT for IBS – linking mechanisms with intervention techniques

Based on Michie and Prestwich's (2010) recommendation, the final aim of this chapter was to link treatment techniques (modules) to intermediate treatment targets and hypothesised change mechanism. In their theory coding scheme (Michie & Prestwich, 2010), individual techniques can be linked directly to individual predictors or clusters of techniques can be linked to individual predictors or clusters of predictors. In this chapter, I previously linked skills that are hypothesised to be developed in MBCT with intermediate predictors of the outcome (e.g., decentring was linked to reduced catastrophizing). In this section I will list the clusters of modules that may be particularly relevant for each individual predictor. Whilst a complex, intricate interplay between modules is expected in a carefully designed multicomponent intervention such as MBCT and MBCT for IBS, there is also a lack of scientific knowledge about the effects of individual modules and their effects on each other. The hypothesised relationships between techniques, skills and predictors are therefore largely based on the description of the modules and their intended effects.

5.9.1 Attentional control

It is expected that modules, which train concentration will affect attentional control. Particularly, the first two MBCT for IBS sessions are concerned with developing sustained and focused attention.

5.9.1.1 Modules

Modules that may train attentional regulation in MBCT for IBS are the 'body scan', the 'anchor of breath meditation', the 'breathing spaces' and the 'ice cube' exercise.

5.9.2 Pain and IBS catastrophizing

Modules that practise decentring, and particularly those that encourage the decoupling of sensations from thoughts, reduce the belief that thoughts always represent the truth, help recognize thought patterns and automatic reactions to symptoms or potential symptom triggers, and those modules that teach participants about the role of thoughts and emotions for IBS are considered most relevant. In addition those modules that may increase attentional control (see above) are thought to aid the reduction of catastrophizing.

5.9.2.1 Modules

The relevant psychoeducation modules are 'primary and secondary suffering', 'ice cube', 'getting to know the territory of our minds', 'vicious flower' and 'working wisely with IBS'. The most relevant meditation module is 'relating differently to thoughts', in addition to the modules that increase attentional control.

5.9.3 Self-referential processing of Illness and health

MBCT for IBS modules aimed at developing a decentred perspective and sensory, experiential processing with a non-judgemental attitude are thought to affect biased self-referential processing of illness and health in IBS patients.

5.9.3.1 Modules

The 'body-scan' is hypothesised to be the most important meditation module in affecting biased self-referential processing of illness and health. In addition, the 'stretch and breath' and the

‘relating differently to thoughts’ meditations should further support reductions in self-health discrepancy..

5.9.4 Visceral anxiety sensitivity

Modules that focus on decentring and sensory experiential processing are thought to decrease visceral anxiety sensitivity. Particularly modules that increase interoceptive awareness and decrease the perceived threat value of visceral sensations are considered relevant. In addition modules that help recognize unhelpful cognitive states such as hypervigilance or symptom anxiety may be implicated in reducing visceral anxiety sensitivity.

5.9.4.1 Modules

The relevant modules are the ‘body scan’, ‘stretch and breath’, the ‘ice-cube’ exercise, ‘primary and secondary suffering’ and ‘relating differently to thoughts’.

5.9.5 Adaptive coping

Modules that encourage the recognition of unhelpful coping patterns and the importance of self-care, and those modules that build resources for alternative, less reactive coping mechanism are thought to improve adaptive coping behaviour.

5.9.5.1.1 Modules

The relevant meditation modules are ‘stretch and breath meditation’, ‘relating differently to difficulty’, and the ‘breathing space’. The relevant psychoeducation modules are ‘working wisely with IBS’ and ‘vicious flower’.

5.10 The stages of treatment development in this thesis - a critical assessment

The stages of the NIH Stage Model of Intervention Development (Onken et al., 2014) pertinent to the development of MBCT for IBS were: Stage 0 (Basic Science) and Stage 1A (activities related to the modification or adaptation of an existing intervention). Critical aspects of Stage 1A have been implemented and were described in this Chapter. The relevant steps involved were a) “identifying promising basic or clinical scientific findings relevant to the development or

refinement of an intervention", b) "formulating theories relevant to intervention development" and c) "defining and standardizing new or modified principle driven interventions" (Onken et al., 2014, p. 10). Using the available scientific literature, I identified maladaptive illness specific cognitive reactions to symptoms as maintaining factors of IBS. In addition, based on Chapters 2 and 3 of this thesis I hypothesised that attentional control and biased self-referential processing of illness and health could maintain the illness and predict response to treatment. I then applied existing cognitive theories (e.g., the DAH and the predictive coding model of mind body integration (Farb et al., 2015; Lau et al., 2004; Teasdale, 1988)) to the IBS population. Using these theories I linked the identified maintaining factors with a specific treatment (MBCT) that, when adapted to patients with IBS (i.e., MBCT for IBS) was hypothesised to reduce the symptoms of IBS. A treatment protocol and materials to deliver the intervention (e.g., participant handouts) were created. In addition, it is important to acknowledge the aspects of Stage 0 and of the transition from Stage 0 to Stage 1 that were not covered thoroughly in this thesis. One way to acknowledge this is by comparing this thesis to the development of other successful treatments and to consult additional treatment development guidelines. The development of treatments for anxiety disorders, PTSD and recurrent depression was based on the generation of basic clinical findings using a mixture of *qualitative and rigorous experimental research* as well as the *formation of testable theories* (Clark, 2004, 2013; Lau et al., 2004). In addition, guidelines for the integration of experimental research into intervention development have been published based on the example of anxiety (Clark, 2004). These involve a) "the use of clinical interviews and cognitive psychology paradigms to identify the core cognitive abnormality of anxiety", b) "constructing a theoretical account that explains why the abnormality does not self-correct" (e.g., the maintaining factors), c) "to test the hypothesised maintaining factors in experimental studies" and d) "to develop cognitive treatments which aim to reverse the maintenance mechanism" (Clark, 2004). In comparison to these guidelines, the majority of ideas on maintaining factors and mechanisms that were used in the development of MBCT for IBS were based on findings from the literature rather than my own experimental research. That is, the findings from the cross sectional study reported in Chapters 2 and 3 were

informative and supportive, but not decisive factors for the choice of MBCT as a treatment as well as the adaptations that were made to the original MBCT for depression protocol.

5.11 Summary and Conclusion

This Chapter explained the treatment rational for adapting MBCT for patients with IBS and described the new MBCT for IBS treatment protocol. Visceral anxiety sensitivity, catastrophizing, attentional control, self-referential processing of illness and health and non-judgemental awareness were identified as treatment targets and changes in these factors were hypothesised to lead to reductions in symptom severity. MBCT for IBS was hypothesised to affect these factors through several skills that MBCT for IBS is presumed to develop: A decentred perspective, concentration, sensory, experiential processing and a friendly relationship towards the body. Finally, the links between the course modules, core skills and the identified change mechanisms were outlined more explicitly.

Chapter 6: Mindfulness-Based Cognitive Therapy Reduces the Severity of Irritable Bowel Syndrome (IBS): Results from a Randomised, Controlled Study

6.1 Abstract

6.1.1 Objectives

The aim of this randomised, waiting list controlled trial was to investigate the effects of Mindfulness-Based Cognitive Therapy for Irritable Bowel Syndrome (MBCT for IBS). MBCT for IBS aims to train concentration and decentring from physical sensations, thoughts and emotions. It aims to cultivate a kind, approach oriented relationship towards the body as well as a non-judgemental awareness of private events. It was hypothesized that MBCT for IBS is associated with reductions in IBS symptoms, depression, anxiety and stress as well as improvements in quality of life.

6.1.2 Design and methods

Sixty-seven female patients with IBS who met Rome III criteria and had a doctor's diagnosis of IBS were randomly allocated to an immediate treatment condition with six weekly sessions of MBCT for IBS or a waiting list control condition. Patients completed self-report measures of IBS symptom severity (GSRS-IBS), IBS quality of life (IBSQOL), depression, anxiety and stress (DASS) and mindfulness (FFMQ) at baseline, after two treatment sessions, post-treatment and at six-week follow-up. Treatment expectations and credibility was measured before participants started the course. Data were examined using Intention To Treat analysis (ITT; all patients who completed baseline assessment). In addition, Per-Protocol analysis (PP) was performed for IBS symptom severity, quality of life and treatment expectations / credibility.

6.1.3 Results

Both ITT and PP analyses showed that patients in the immediate treatment group had significant reductions in IBS symptom severity, depression, anxiety and stress, as well as improvements in quality of life and mindfulness at post-treatment and at follow-up (six weeks). Larger effect sizes were found at follow-up for IBS symptom severity, quality of life and mindfulness. Expectations of therapeutic gains were significantly correlated with reductions in changes in IBS symptoms, and stress and increases in IBS quality of life at follow-up.

6.1.4 Conclusion

MBCT for IBS may be an effective treatment to reduce IBS symptom severity, symptoms of depression, anxiety and stress and to increase quality of life. Setting positive expectations towards clinical treatments may increase therapeutic effects. Larger studies, with an active control group and longer-term follow-ups are needed to substantiate conclusions.

6.2 Introduction

The development of MBCT for IBS was explained in Chapter 5, along with a detailed description of the treatment protocol. MBCT for IBS was developed to reduce IBS symptom severity, and increase quality of life in patients with IBS. MBCT for IBS is hypothesised to affect the proposed maintaining factors of IBS: visceral anxiety sensitivity, catastrophizing, attentional control and biased self-referential processing of illness and health. The study described in this chapter was designed to evaluate the effects of MBCT for IBS and to investigate the mediating factors of MBCT for IBS (see Chapter 7). To assess the effects of this newly developed treatment, the following hypotheses were tested.

6.2.1 Hypotheses

6.2.1.1 Primary hypothesis

1. Compared to the waiting list (WL) group, the mindfulness group (MG, immediate treatment group) would have significant reductions in IBS symptom severity at post-treatment and follow-up.

6.2.1.2 Secondary hypothesis

2. Compared to the WL group, the MG would have significant increases in quality of life at post-treatment and follow-up.
3. Compared to the WL group, the MG would have significant reductions in levels of depression at post-treatment and follow-up.
4. Compared to the WL group, the MG would have significant reductions in levels of anxiety at post-treatment and follow-up.
5. Compared to the WL group, the MG would have significant reductions in levels of stress at post-treatment and follow-up.
6. Compared to the WL group, the MG would have significantly increased levels of mindfulness at post-treatment and follow-up.

6.2.1.3 Tertiary hypothesis

7. Within the MG higher levels of home practice (frequency and total amount of practice) would correlate with decreases in IBS symptom severity and increases in quality of life.

6.3 Methods

6.3.1 Design and general procedure

The study had a randomised, waiting list controlled design. Figure **6.1** illustrates the design and participant flow through the study. The study 'Mindfulness for IBS' (MIBS) was approved by the NHS Health Research Authority (National Research Ethics Service; REC. Reference Number 15/SC/0618). The study was registered with ClinicalTrials.gov as study number NCT02794376. Participants were required to personally sign and date the study's informed consent form before any study specific procedures were performed. The Participant Information Sheets (PIS) and the Consent Form (CF) of this study can be found in sections 9.4.1 (PIS for IBS patients) and 9.4.2 (CF) in the Appendices. Each participant had the right to withdraw from the study at any time.

6.3.1.1 Sample size calculation

This is a pilot study to determine if the adapted intervention improves IBS symptoms. MBCT for IBS in the current specialized and compact form has, to my knowledge, never been used in a study for IBS. A recent well designed mindfulness study had an effect size of $d = .59$ ($f = 0.29$, a medium effect size) on IBS symptoms (Gaylord et al., 2011) when comparing a mindfulness group to an active control group. In the current study, sample size has been determined taking into account limited resources (time and financial). A sensitivity analysis (which determines the required effect size) using the programme G* power (Faul et al., 2007) calculated that a medium effect size of $f = 0.29$ (J. Cohen, 1992) can be detected when using a repeated measures ANOVA (with two groups and four time points), with a sample size of n = 60, at a power of 0.8 and an alpha level of .05. Taking into account a possible maximum withdrawal rate of 25%, the required sample size for this study has been determined to be 80.

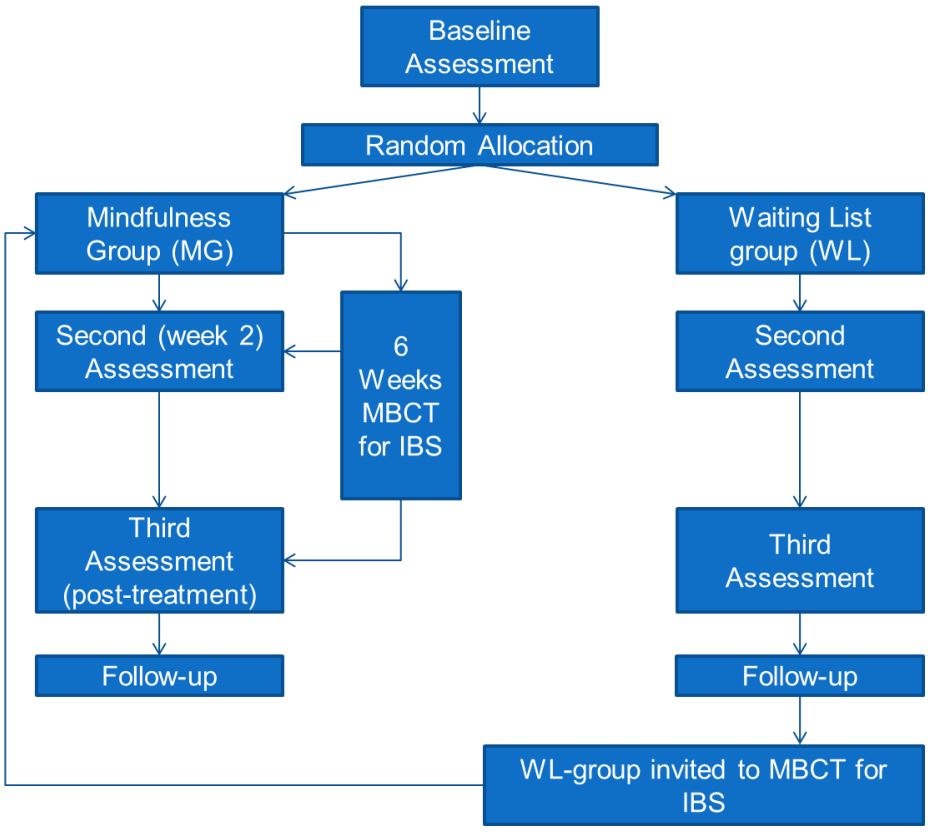


Figure 6.1**. Schematic representation of the design of the study "Mindfulness for Irritable Bowel Syndrome" (MIBS).**

6.3.2 Participants

Patients with IBS were recruited through gastroenterology clinics in Oxford, GP practices, Oxford University, and the general public. The study was advertised through the University's departments, colleges, libraries, newspapers, departmental websites, departmental participation recruitment schemes, social media and posters in public spaces and waiting rooms of GP practices.

6.3.2.1 Eligibility criteria

Eligibility for the study was assessed using an online screening questionnaire and eligibility was confirmed by the project coordinator (JH). The screening questionnaire can be found in section 9.4.3 of the Appendices.

6.3.2.1.1 Inclusion criteria

To be included in the study, participants had to be (a) willing and able to give informed consent for participation in the study; (b) female; (c) aged 18-65 years; (d) diagnosed with IBS by

a gastroenterologist or GP, meeting Rome III criteria for IBS with symptom onset at least 6 months prior to inclusion in this study and discomfort or pain at least 2-3 days per month (e) speaking English fluently; (f) having normal or corrected to normal vision.

6.3.2.1.2 Exclusion criteria

Participants were excluded if they met any of the study's exclusion criteria: (a) insufficient manual dexterity for the computerized tasks; (b) severe DSM Axis I or II psychiatric disorder (diagnosis of dementia, amnesia, delirium, a dissociative disorder, a personality disorder, schizophrenia or any other psychotic disorder, a substance-related or induced disorder (such as alcoholism), attention deficit hyperactivity disorder (ADHD), attention deficit disorder (ADD), a primary diagnosis of obsessive compulsive disorder (OCD), current suicidality, regular non-suicidal self-injury; (c) recent bereavement (within one year); (d) GI diagnosis other than IBS (e.g., inflammatory bowel disease (IBD), coeliac disease, another functional gastrointestinal disorder (FGID)); (e) pregnancy; (f) no access to the internet; (g) prior participation in an 8–week mindfulness course (MBSR, MBCT); (h) prior participation in any other structured mindfulness training including a Vipassana meditation course; (i) regular meditation practice (meditating more than once per month); (j) not able or unwilling to commit to the prescribed amount of practice (sessions and home practice); (k) participant is currently enrolled in another study assessing a pharmacological of psychological treatment for IBS.

6.3.3 Random assignment and flow of participants

The flow of participants through the study is depicted in Figure 6.2. One hundred and fifty-eight patients were assessed for eligibility. Of those 158, 93 were found to be eligible and invited for the first assessment visit. Twenty-six of the eligible participants declined to participate. Sixty-five were not eligible due to being male (n = 2), being under the age of 18 (n = 1), not having a formal diagnosis of IBS from either a GP or a Gastroenterologist (n = 15), a diagnosis of an IBD (n = 6), a diagnosis of a FGID (n = 5), impaired vision (n = 1), previous participation in an eight week MBCT or MBSR course (n = 10), previous participation in another structured mindfulness course (n = 5), a regular meditation practice (n = 3), having been bereaved within the last 12 months (n =

5), a psychiatric diagnosis (n = 4), suicidality (n = 2), self-injury (n = 1) or not meeting the Rome III criteria for IBS (n = 5).

Sixty-seven participants completed the 1st assessment (visit and online questionnaire) and were randomised to the MG (n = 36) or the WL group (n = 31). After the randomization, five participants in the MG withdrew from the study (reasons: unable to attend orientation session - 1, unable to attend the course due to competing commitments - 2, discontinued intervention after the first session due to competing commitments - 1, unknown / no response - 1) and six participants in the WL group withdrew from the study (reasons: logistical / unable to attend the course after the waiting period - 4, unrelated medical issue during waiting period - 1, unknown / no response - 1). Fifty six participants (of which MG = 31, and WL = 25) completed the 2nd assessment, however one of the participants in the MG completed the questionnaires only as she was unable to attend the 2nd assessment visit; she continued with the study and the treatment. After the 2nd assessment, six participants in the MG withdrew from the study (reasons: discontinued treatment due to not finding the treatment valuable after the third session - 1, discontinued due to competing commitments – 2, completed the treatment, but not available for further assessments - 2, discontinued due to study related logistics - 1) and two participants in the WL withdrew from the study (reasons: unknown / no response - 1, completed the third assessment visit and discontinued for unknown reasons before completing the questionnaires - 1). Forty eight participants completed the post-treatment (3rd) assessment (MG = 25, WL = 23). After the 3rd assessment, two participants in the MG withdrew from the study (reasons: unknown / no response - 2) and two participants in the WL group withdrew from the study (reasons: discontinued due to competing commitments - 1, unknown / no response - 1). Forty four participants completed the follow-up (4th) assessment (MG = 23, WL = 21). From baseline to follow-up, 34% of participants (n = 23) withdrew from the study. Between the 4th assessment and the start of the mindfulness course of the WL group, two participants withdrew from the study (reasons: logistical / moved away - 1, discontinued due to competing commitments - 1). Nineteen of the participants in the WL then started their course and three participants withdrew from the study before the 5th assessment took place (reasons: discontinued

due to competing commitments – 2, unrelated medical issue - 1). Sixteen participants completed the 5th mid-treatment assessment. After the 5th assessment three participants withdrew from the study (reasons: discontinued due to competing commitment - 1, unexpected life event / bereavement – 1, unknown / no response – 1). Thirteen participants completed the 6th (post-treatment) assessment. After the 6th assessment two participants withdrew from the study (reasons: unknown / no response – 2) and eleven participants completed the 7th (follow-up) assessment.

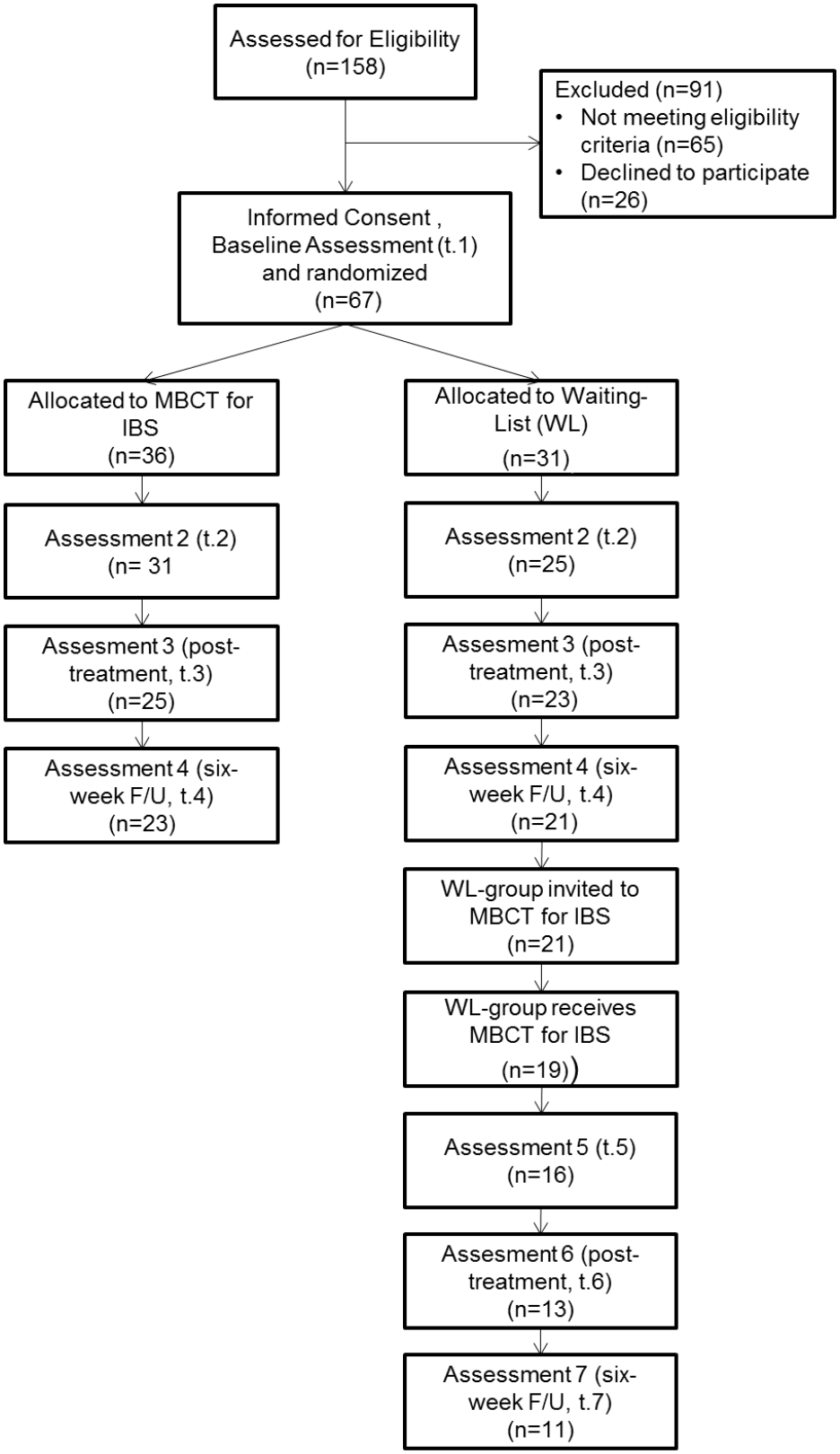


Figure 6.2. Study flow diagram of participants in the study "Mindfulness for Irritable Bowel Syndrome" (MIBS) that were allocated to immediate MBCT for IBS (MG) or the waiting list group (WL). Note. F/U is follow-up.

6.3.3.1 Randomization

To ensure that the MG and the WG were similar in age, randomisation to treatment conditions was stratified according to age. The study had two sets of participants, the first set was recruited in March and April 2016 and the second set was recruited between October 2016 and January 2017. The study coordinator (JH) generated the randomization sequence in four blocks of 40 (using the sequence generator on www.randomizer.org). The first two blocks were used for the randomization for the first set of participants; the second two blocks were used for the second set of participants. For each set, one block was used for participants between the age of 18-35, and the second block was used for participants between the ages of 36-65. The randomization codes had the numbers 1 and 2 in a random sequence of 40 numbers per block. After completion of all baseline assessment, the study coordinator allocated participants to the immediate treatment (MG) or the delayed treatment condition (WL) based on the obtained randomization codes in sequential order.

6.3.3.2 Masking

Due to the nature of the study, the participants and the mindfulness teachers could not be blinded to study assignment.

6.3.4 Intervention conditions

6.3.4.1 Treatment

Mindfulness-Based Cognitive Therapy for Irritable Bowel Syndrome (MBCT for IBS) (see Chapter 5) was specifically adapted for patients with IBS. Its content was designed to reduce pain-catastrophizing, visceral sensitivity anxiety, biased implicit self-referential processing of illness and health and to increase attention control. Changes in these factors as well as increases in non-judgemental awareness were hypothesized to lead to reductions in IBS symptom severity, and psychological distress as well as improvements in quality of life.

MBCT for IBS consists of six weekly two hour long group sessions over a period of six consecutive weeks. In this study, each course had a week long break after the fifth session due to teacher availability. Therefore, the total course length was seven weeks long. For each participant

the course was preceded by a one-to-one orientation meeting with one of the two teachers of the MBCT for IBS course. In this orientation meeting, the treatment rationale was explained and a personal problem formulation was developed collaboratively. In most cases the interview was carried out in person, however, in a few cases the interview was held over the phone due to lack of matching availability of teachers and participants. Please see the treatment description in Chapter 5 for more information. Each session of the MBCT for IBS course consists of one or more *meditations*, a period of *inquiry, a reflection on home practice (except for the first session)* and a period of *psycho-education*. *Meditation* sessions vary in time between 3 and 40 minutes and are suitable for individuals new to meditation. *Inquiry* involves an opportunity to reflect on the experience of practising meditation with the teacher and others in the group. *Reflection on home practice* is an opportunity to share experiences from the home practice. *Psychoeducation* involves the skilful communication of key illness-specific information from the biopsychosocial and cognitive model of IBS. Specifically, it focuses on mental and physical health using ideas from cognitive psychology. Crucially it contains exercises which shed light on the cognitive processes that maintain beliefs about illness severity and suggestions for how to work with these beliefs in a new way. Participants learn to develop a new relationship with symptoms, thoughts and emotions that is characterized by acceptance and curiosity. Additionally during sessions 1-5, participants were instructed to do *home practice*. *Home practice* was suggested for 6 days per week and includes guided meditation, reading, paying special attention to activities in daily life and written exercises. The course was taught by two experienced clinical psychologists trained in MBCT. For this study, each course also had a voluntary helper for each session to set up the class, distribute the handouts and collect home practice diaries. Each week, participants were given a CD with a recording of the led meditation for home practice and participants also had the option to stream the guided meditation online via a streaming service set up by the Oxford Mindfulness Centre. The session content and structure can be found in more detail in Chapter 5.

6.3.4.2 Waiting list

Participants assigned to the waiting list group were instructed to follow the testing schedule described below whilst waiting for their course to begin.

6.3.5 Testing schedule

Pre-treatment (t.1), intra-treatment (t.2) and post-treatment (t.3) assessments consisted of two parts: (a) an assessment visit during which several computerized tasks were administered (see section 9.4.4 in the Appendices) and (b) the assessment questionnaire which participants filled in online on their personal computer at a time convenient to them (see section 9.4.5 in the Appendices). The results of the computerized tasks will be presented in Chapter 7. For the baseline assessment, the assessment visit took place before the online questionnaire was made available. This was done to ensure that informed consent was obtained before any study related activities took place. Each assessment visit took approximately 40-60 minutes, each questionnaire assessment took approximately 20-30 minutes to complete. The follow-up (F/U) assessment (t.4) consisted of the online questionnaire only. For the WL group, t.4 was both the F/U assessment for comparison with the MG and pre-treatment assessment before their course started after the waiting period. The WL group completed assessments t.5 (intra-treatment$_{WL}$), t.6 post-treatment$_{WL}$ and t.7 (F/U$_{WL}$). Assessments t.5 – t.7 consisted of the online questionnaire only.

All eligible participants completed the baseline (t.1) assessment within three weeks prior to the scheduled start of the course. Participants were randomly allocated to the MG or the WL after the baseline assessment had been completed. Participants who were allocated to the MG then completed a treatment-credibility and expectations questionnaire after their orientation meeting and before the first session of the course.

T.2 assessments took place after the second session and before the third session of the MBCT for IBS course. All participants regardless of group allocation completed the t.2 assessment in the same week. T.3 assessments took place within two weeks after the completion of the MBCT for IBS course for all participants. T.4 assessments took place four weeks after t.3 had been completed (six weeks after treatment completion) and three weeks before the WL started their

MBCT for IBS course. The participants in the WL group then completed a treatment-credibility and expectations questionnaire after their orientation meeting and before the first session of their course. T.5 assessments took place after the second session and before the third session of the MBCT for IBS course for the WL group participants. T.6 assessments took place within two weeks after the completion of the MBCT for IBS course for WL group participants. T.7 assessments took place four weeks after the WL group had completed T.6. In addition to the study assessments, participants were asked to fill in a weekly diary sheet to record their frequency and duration of formal meditation practice during the duration of this course (see section 9.4.6 in the Appendices for an example of the weekly diary card).

The assessment visits were carried out at the Department of Experimental Psychology and the Department of Psychiatry (Oxford University). The assessment visits were organized in groups of up to five participants. Participants wore noise cancelling headphones during the assessment visit so they would not be distracted by possible sounds coming from the other participants. Stimulus presentation and data collection for the computerized tasks was carried out with E-Prime 2.0 (Psychology Software Tools, 2012). Questionnaire data and demographic information was obtained via the online platform LimeSurvey (LimeSurvey Project Team & Schmitz, 2015). As part of the MIBS study, participants completed several computerized tasks and questionnaires. The complete list of questionnaires and tasks can be seen in section 9.4.4 and section 9.4.5 of the appendices.

6.3.6 Outcome measures

Participant's age and level of education was recorded. Internal consistency for each self-report outcome measure was calculated at baseline with the intention to treat sample.

6.3.6.1 IBS symptom severity

IBS symptom severity was measured with the Gastrointestinal Symptom Rating Scale for IBS (GSRS-IBS) (Wiklund et al., 2003). The total score ranges between 13 and 91 with higher scores indicating higher symptom severity. A more detailed description of the scale can be found in

Chapters 2 and 3. In the current study, Cronbach's alpha for the total scale in the IBS groups was α. = .78.

6.3.6.2 IBS quality of life

Quality of life in IBS patients was assessed with the 34-item IBS quality of life instrument (IBS-QOL) (Patrick, Drossman, Frederick, DiCesare, & Puder, 1998). The IBS-QOL has eight subscales that assess IBS related dysphoria, interference with activity, body image, health worry, food avoidance, social reactions, sexual and relationship functioning. The response scale ranges from 1-5 (1 = not at all, 5 = extremely / a great deal) and scores are calculated so that 0 indicates minimum quality of life and 100 indicates maximum quality of life. The IBS-QOL has very good psychometric properties, with internal consistency of Cronbach's alpha = .95 and high reproducibility (Patrick et al., 1998). It has been shown to be responsive to treatments (Drossman et al., 2000). In the current study, Cronbach's alpha for the total scale in the IBS groups was α. = .95.

6.3.6.3 Depression, Anxiety and Stress

Symptoms of depression, anxiety and stress were measured with the short version of the Depression-Anxiety-Stress Scale (DASS-21) (Henry & Crawford, 2005; Lovibond & Lovibond, 1995). Scores of the subscales for depression (DASS-D), anxiety (DASS-A) and stress (DASS-S) range between 0 and 42, and higher scores indicate higher symptom severity. A more detailed description of the scale can be found in Chapters 2, 3 and 4. In the present study, Cronbach's alpha for depression was α. = .92, Cronbach's alpha for anxiety was α. = .80 and Cronbach's alpha for stress was α. = .84.

6.3.7 Process measures

6.3.7.1 Mindfulness

Mindfulness was assessed with the Five Facet Mindfulness Questionnaire Short Form (FFMQ – 24) (Baer et al., 2006; Bohlmeijer et al., 2011). The FFMQ – 24 uses 24 items to assess five aspects of mindfulness: observing, describing, acting with awareness, non-judging of inner experiences and non-reactivity to inner experience. Participants rate how well each item describes

them on a 1-5 point scale (1 = never or very rarely true, 5 = very often or always true). Gu and colleagues (2016) recently recommended assessing changes in mindfulness in intervention studies without the observing subscale, as the meaning of the subscale is different between non-meditators and meditators. This implies that changes in observing scores do not represent valid changes in mindfulness. A more thorough explanation for this phenomenon and the scale can be found in Chapter 4. Therefore the FFMQ total score without the observing scale (FFMQtotal-obs) was used in this study. The maximum score of the FFMQtotal-Obs is 100; the maximum score for each of the subscales is 25. In the present study, Cronbach's alphas for the total FFMQtotal-Obs score was α. = .85 (at baseline, using the ITT sample).

6.3.7.2 Credibility Expectations Questionnaire

Treatment credibility and expectations were measured with the six items Credibility Expectations Questionnaire (CEQ) (Borkovec & Nau, 1972; Devilly & Borkovec, 2000). The CEQ has two subscales that assess credibility (e.g., "At this point, how logical does the therapy offered to you seem?") and expectations (e.g., "At this point, how much do you really *feel* that therapy will help you to reduce your IBS symptoms") separately. As not all items are measured on the same scale (some items are assessed on a 1-9 Likert type scale, others use percentages from 0-100 in 10% steps), scores were standardized before subscales were calculated as recommended in Devilly (2000). Higher scores on each subscale indicate higher credibility and higher expectations. The questionnaire has good internal consistency (Cronbach's alpha) for the expectancy scale ($\alpha_{standardized}$ between .79 and .90) and the credibility scale ($\alpha_{standardized}$ between .81 and .86) (Devilly & Borkovec, 2000). The test-retest reliability is good at r = .82 for the expectancy factors and r = .75 for the credibility factor (Devilly & Borkovec, 2000).

6.3.7.3 Home practice log and attendance

Participants were asked to provide a weekly home practice log for the duration of the MBCT for IBS course. Participants were instructed to indicate the type of meditation they practised and the duration (in minutes) of each meditation for each day of the course. These home practice logs were collected on a weekly basis by the helpers in the course and passed on to the

course coordinator (JH). It was made clear to participants that these home practice diaries were for the study only and not for the teachers to control or evaluate engagement with home practice. The following formulae were used to calculate home practice scores:

Total minutes of home practice = minutes of weekly home practice week 1 + minutes of weekly home practice week 2 + …+ minutes of weekly home practice week 5

Total number of home practice sessions = weekly home practice sessions week 1 + weekly home practice sessions week 2 + …+ weekly home practice sessions week 5

Participants recorded their attendance at each session by signing-in on a sheet of paper before each session started. After the course, this sheet was passed on to the course coordinator (JH).

6.3.8 Statistical analyses

Statistical analyses were performed with IBM SPSS statistics Version 24 (IBM Corp., 2016). Intention to treat (ITT) analyses were performed with the Last Observation Carried Forward method (LOCF) for all participants that had completed baseline assessments and had been allocated to the groups. Per-protocol analysis was performed for all patients that had completed the minimum required treatment dose (four of the six sessions) and for whom the measurements of the endpoints (primary and secondary outcomes) were available. ITT and per protocol (PP) analyses were conducted for the primary outcome IBS symptom severity as well as quality of life. ITT analysis was conducted for secondary outcomes (depression, anxiety, stress, mindfulness).

For the purpose of sensitivity analysis, ITT analysis using multiple imputations (MI) was carried out in SPSS 24 for the primary outcome IBS symptom severity (GSRS-IBS) and the secondary outcome quality of life (IBSQOL). It was assumed that study drop-out was related to observed variables in the data and thus were considered data missing at random (MAR). The MI procedure used a fully conditional specifications (FCS) imputation procedure (van Buuren, 2007; Van Buuren, Brand, Groothuis-Oudshoorn, & Rubin, 2006) and five imputations. Missing data were then estimated and imputed using predictive mean matching (PMM). I incorporated the pre-

treatment and, where available the intra- and post-treatment scores of attentional control, biased self-referential processing of illness and health, GSRS-IBS, IBS-QOL, DASS, PCS, GI-C, VSI and the non-judgemental awareness subscale of the FFMQ as well as group allocation in modelling the imputed datasets. Finally, the statistical analysis of choice was performed on each complete dataset and pooled using Rubin's 1987 combination rules (Rubin, 1987) to provide an overall point estimate.

Data for treatment expectations /credibility and home practice was analysed using PP analysis. Separate mixed design 2 x 4 ANOVAs, with time as within group factor (pre-treatment, during treatment, post-treatment, follow-up) and group (MG, WL) as between groups factor were employed to assess group dependent changes in primary and secondary outcomes. The analyses of overall interaction effects were followed-up with simple contrasts to investigate interaction effects at each time-point compared with baseline. Additional mixed design 2 x 2 ANOVAS with time as within group factor (t.3 and t.4) and group (MG, WL) as between groups factor were employed to explore if additional changes in outcomes occurred between post-treatment and follow-up. SPSS 24 does not run repeated-measures ANOVAs on multiply imputed datasets. Therefore the method recommended by van Ginkel and Kroonenberg (2014), which involves reformulating the ANOVA model as a regression model, effect coding the predictors, and applying existing combination rules was applied. An SPSS macro (SPSS syntax) provided by van Ginkel (2017), which carries out this method, was employed to run mixed design ANOVAS for a sensitivity analysis. With a 2x4 design, this syntax allows the calculation of an overall effect, a main effect of time, a main effect of group and of an overall interaction. To follow up an overall interaction, two separate 2x2 ANOVAs using the macro by van Ginkel were run to calculate an interaction effect between group and time for post-treatment (t.1, t.3) and follow-up (t.1, t.4) of the measures for symptom severity and quality of life. Pooled means (m_{pooled}) and standard errors (SE_{pooled}) are reported to interpret these analyses.

Bivariate correlations were run to investigate the relationship between treatment credibility, treatment expectations, home practice and all primary and secondary outcomes. Effect

sizes were reported using the Partial Eta Squared index (ηp^2) and Cohen's *d*. Following Cohen (1988) and Olejnik and Algina (2000) for ηp^2 a small effect size = 0.01; medium effect size = 0.06; large effect size = 0.14, for Cohen's *d* a small effect size = 0.2; medium effect size = 0.5; large effect size = 0.8. Clinically significant and reliable change on the GSRS-IBS and IBSQOL were calculated according to the method outlined by Jacobson and Truax (1991).

6.4 Results

6.4.1 Participant characteristics at baseline

Participant characteristics at baseline are displayed for the participants included in the ITT analysis (Table 6.1) and in the per protocol analysis (Table 6.2) separately. 31% of participants allocated to the MG and 23% allocated to the WL withdrew from the study. This difference was not statistically significant ($\chi^2 = .539$, $p = .463$). Participants in the MG had significantly lower quality of life scores and significantly higher anxiety scores at baseline compared to the WL group.

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Table 6.1. Comparison of baseline characteristics of participants that were included in the intention to treat (ITT) analysis, split by group assignment.

	MG[1] (n = 36)		WL[2] (n = 31)		t-value/ χ^2 value
	Mean	(S.D.)	Mean	(S.D.)	
Age (years)	35.58	(13.73)	35.48	(14.71)	0.029
Highest Educational Level Reached	27.8% Up to and including A-levels[7]; 72.2% Tertiary Education[8];		16.1% Up to and including A-levels[7]; 83.9% Tertiary Education[8];		1.301
Length of Symptoms in months [years]	162.89 [13.57 years]	(155.71)	144.71 [12.06 years]	(136.52)	0.504
IBS Symptom Severity (GSRS-IBS[3])	45.89	(10.80)	42.42	(11.45)	1.275
IBS quality of life (IBS-QOL[4])	52.19	(21.12)	64.07	(17.50)	-2.517*[b]
Depression (DASS[5])	15.72	(11.30)	12.13	(10.26)	1.345
Anxiety (DASS[5])	14.78	(10.78)	10.13	(5.77)	2.241*[b]
Stress (DASS[5])	22.89	(9.70)	19.03	(8.45)	1.721
Mindfulness (FFMQ[6])	56.22	(10.39)	59.32	(9.45)	-1.269

*p < .05; **p < .01; ***p < .001; [a] Fisher's Exact test values were used; [b]Equal variances not assumed

[1] Mindfulness Group; [2] Waiting list Group; [3]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [4] Quality of Life measure for Irritable Bowel Syndrome; [5] Depression Anxiety Stress Scale; [6] Five Factor Mindfulness Questionnaire excluding the Observation Subscale; [7] no formal qualifications, GCSE, NVQ or vocational Qualification or at least 12 years of schooling; [8] University degree (Undergraduate, Masters, Post-Graduate)

Table 6.2. Comparison of baseline characteristics of the participants that were included in the Per-Protocol analysis (PP), split by group assignment.

	MG[1] (n = 23)		WL[2] (n = 21)		t-value/ $\chi 2$ value
	Mean	(S.D.)	Mean	(S.D.)	
Age (years)	35.48	(13.66)	36.1	(16.11)	-0.137
Highest Educational Level Reached	26.1% Up to and including A-levels[7]; 73.9% Tertiary Education[8];		9.5% Up to and including A-levels[7]; 90.5% Tertiary Education[8];		2.024[a]
Length of Symptoms in months [years]	151.000 [12.58 years]	(124.89)	134.62 [11.17 years]	(147.66)	0.398
IBS Symptom Severity (GSRS-IBS[3])	45.65	(11.30)	43.00	(12.60)	0.736
IBS quality of life (IBS-QOL[4])	51.31	(20.55)	61.84	(16.90)	-1.845
Depression (DASS[5])	16.34	(11.11)	12.47	(11.08)	1.156
Anxiety (DASS[5])	14.78	(10.18)	9.52	(5.40)	2.167*[b]
Stress (DASS[5])	22.61	(10.21)	19.43	(8.99)	1.092
Mindfulness (FFMQ[6])	56.04	(11.93)	59.67	(9.52)	-1.106

*p < .05; **p < .01; ***p < .001; [a] Fisher's Exact test values were used; [b]Equal variances not assumed

[1] Mindfulness Group; [2] Waiting list Group; [3]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [4] Quality of Life measure for Irritable Bowel Syndrome [5] Depression Anxiety Stress Scale; [6] Five Factor Mindfulness Questionnaire excluding the Observation Subscale; [7] no formal qualifications, GCSE, NVQ or vocational Qualification or at least 12 years of schooling; [8] University degree (Undergraduate, Masters, Post-Graduate)

6.4.2 Outcomes

Separate mixed design 2 x 4 ANOVAs, with time as within group factor (pre, during, post, follow-up) and group (MG, WL) as between groups factor were employed to assess group dependent changes in overall IBS severity (GSRS-IBS), quality of life (IBS-QOL), depression, anxiety, stress (DASS) and mindfulness (FFMQ).

6.4.2.1 Primary outcome – IBS Symptom Severity

6.4.2.1.1 ITT analysis

ITT analysis indicated a main effect of time ($F(3, 195) = 4.670$, $p = .004$, $\eta p^2 = .07$) and no main effect of group ($F(1, 65) = 0.306$, $p = .582$, $\eta p^2 = .01$) on the main outcome IBS symptom severity. There was a significant time x group interaction ($F(3, 195) = 5.330$, $p = .001$, $\eta p^2 = .08$), (see Table 6.3 for Means and SDs), indicating that overall participants in the MG experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 3.423$, $p = .069$, $\eta p^2 = .05$), indicating that there were no group dependent changes in IBS symptom severity between t.1 and t.2. The contrasts showed a significant group x time interaction from t.1 to t.3 ($F(1, 65) = 4.843$, $p = .031$, $\eta p^2 = .07$), indicating that at post treatment (t.3) participants in the MG experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL. In addition, the contrasts showed a significant group x time interaction from t.1 to t.4 ($F(1, 65) = 10.550$, $p = .002$, $\eta p^2 = .14$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in IBS symptom severity compared with baseline than did those in the WL (see Table 6.3 for Means and SDs, and Figure 6.3). Compared with baseline scores, overall IBS severity was reduced by 11% in the MG vs. -2% in the WG post-treatment and 20% (MG) vs. 1% (WL) at six-weeks follow-up.

The results based on the multiply imputed dataset were comparable. The pooled overall test of the 2x4 ANOVA was significant, $F(7, 168.54) = 5.936$, $p < .001$, there was a significant main effect of time, $F(3, 171.84) = 7.49$, $p < .001$ and the main effect of group was not significant $F(1, 62.80) = 1.034$, $p = .313$. The interaction of time and group was significant, $F(3, 154.36) =$

5.024, p = .002. To follow up the significant interaction, a 2x2 ANOVA with group (MG, WL) as between group factor and pre-treatment (t.1) and post-treatment (t.3) GSRS scores as within group factor was run. The results showed a significant interaction between group and time, $F(1, 61.30)$ = 7.372, p = .009. A second 2x2 ANOVA with group (MG, WL) as between group factor and pre-treatment (t.1) and follow-up (t.4) GSRS scores as within group factor showed a significant interaction between group and time, $F(1, 57.84)$ = 10.389, p = .002. These findings indicate that the participants in the mindfulness group experienced significantly greater reductions in IBS severity at post-treatment (m_{pooled} = 39.29, SE_{pooled} = 1.76) and follow- up (m_{pooled} = 34.84, SE_{pooled} = 1.94) compared with baseline (m_{pooled} = 45.89, SE_{pooled} = 1.80) than did those in the WL (Baseline m_{pooled} = 42.42, SE_{pooled} = 2.06; post-treatment m_{pooled} = 43.77, SE_{pooled} = 2.17; follow-up m_{pooled} = 41.59, SE_{pooled} = 1.67). Taking into account the results from the two different data imputation methods (LOCF and MI) and the per-protocol analysis reported below it can be concluded that the results of the effect on MBCT for IBS on symptom severity remain robust across different methods of handling missing data.

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction ($F(1, 65)$ = 2.088, p = .153, ηp^2 = .03), indicating that there were no significant additional group dependent changes in IBS symptom severity between t.3 and t.4. Planned simple effects contrasts showed that the MG improved significantly from t.3 to t.4 ($F(1, 65)$ = 6.041, .p = .017, ηp^2 = .09, *mean difference* -4.278, 95%CI [-7.754, -.802]), whereas the participants in the WG did not ($F(1, 65)$ = 0.096, p = .758, ηp^2 < .01, *mean difference* -0.581, 95%CI [-4.327, 3.165]).

The 2 x 4 mixed design ANOVA of treatment effects on IBS symptom severity between groups (MG, WL) over time (t.1, t.2, t.3, t.4) was then repeated with baseline quality of life and baseline anxiety as covariates, as the groups had differed in these variables at baseline. IBS-QOL scores did not significantly interact with time ($F(2.833, 189)$ = 0.790, p = .501, ηp^2 = .01) and neither did anxiety scores ($F(2.833, 189)$ = 0.088, p = .961, ηp^2 < .01). The overall time x group interaction was still significant when anxiety and quality of life were controlled for ($F(2.833, 189)$

= 3.386, p = .021, ηp^2 = .05). With the covariates in the analysis, simple contrasts showed that from t.1 to t.2 there was no group x time interaction (F(1, 63) = 2.482, p = .120, ηp^2 = .04), indicating that there were no group dependent changes in IBS symptom severity between t.1 and t.2. The group x time interaction from t.1 to t.3 was no longer significant when the covariates were included (F(1, 63) = 2.844, p = .097, ηp^2 = .04), indicating that controlling for baseline differences removed variance from the analysis, that previously (without the covariates) explained some of the differences in group dependent changes in IBS symptom severity. The group x time interaction from t.1 to t.4 remained significant when the covariates were included (F(1, 63) = 6.918, p = .011, ηp^2 = .10), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL regardless of baseline differences in anxiety and quality of life.

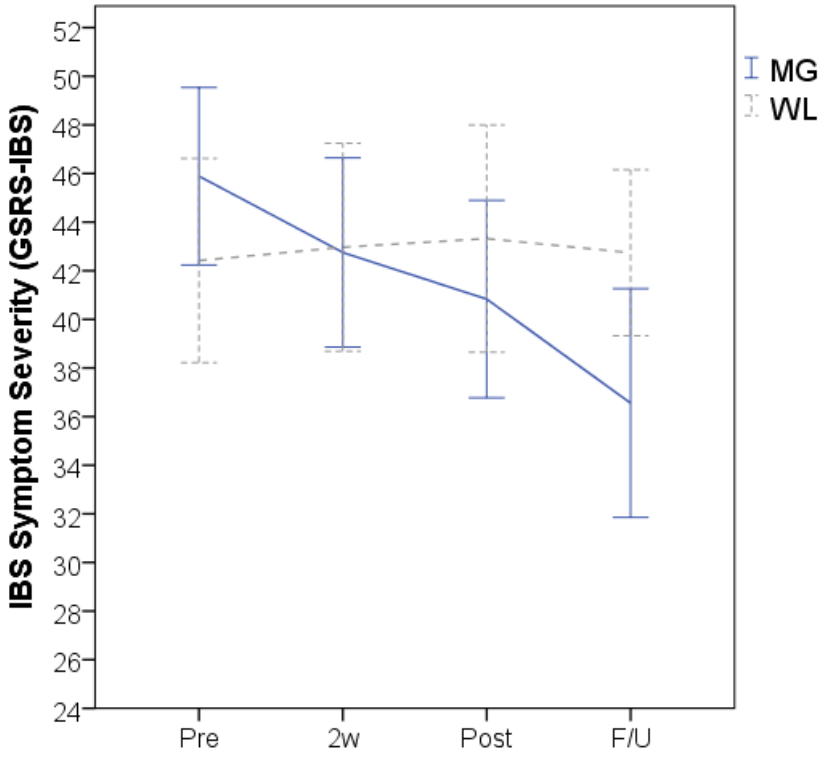


Figure 6.3. Comparison of IBS symptom severity scores (GSRS-IBS) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* This figure is based on Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.1.2 Per Protocol analysis

PP analysis indicated that there was a main effect of time ($F(3, 126) = 5.119$, $p = .002$, $\eta p^2 = .11$) and no main effect of group ($F(1, 42) = 1.279$, $p = .264$, $\eta p^2 = .03$). There was a significant time x group interaction ($F(3, 126) = 4.876$, $p = .003$, $\eta p^2 = .10$), see Table 6.4 for Means and SDs, indicating that overall participants in the MG experienced significantly greater reductions in IBS severity compared with baseline than did those in the WL. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 42) = 2.773$, $p = .103$, $\eta p^2 = .06$), indicating that there were no group dependent changes in IBS symptom severity between baseline and intra-treatment. The contrasts showed no group x time interaction between t.1 and t.3 ($F(1, 42) = 3.524$, $p = .067$, $\eta p^2 = .08$, indicating that there were no group dependent changes in IBS symptom severity between pre- and post-treatment. In addition, the contrasts showed a significant group x time interaction ($F(1, 42) = 10.281$, $p = .003$), $\eta p^2 = .20$, indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL (see Table 6.4 for Means and SDs, and Figure 6.4). Compared with baseline scores, overall IBS severity was reduced by 13% in the MG vs. -2% in the WG post-treatment and 28% (MG) vs. <1% (WL) at six week follow-up.

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction ($F(1, 42) = 2.342$, $p = .133$, $\eta p^2 = .05$), indicating that there were no significant additional group dependent changes in IBS symptom severity between t.3 and t.4. Planned simple effects contrasts showed that the MG improved significantly from t.3 to t.4 ($F(1, 42) = 6.453$, $p = .015$, $\eta p^2 = .13$, *mean difference* -6.696, 95%CI [-12.015, -1.376]), whereas the participants in the WG did not ($F(1, 42) = 0.097$, $p = .758$, $\eta p^2 < .01$, *mean difference* -0.857, 95%CI [-6.424, 4.710]).

As the per-protocol analysis that included t.4 (follow-up) contained 44 participants only, a mixed design repeated measures ANOVA was run with all participants that completed t.1 and t.3 assessments (n = 47). This analysis indicated that there was a main effect of time ($F(1, 45) = 2.348$, $p = .132$, $\eta p^2 = .05$) and no main effect of group ($F(1, 45) = 0.263$, $p = .610$, $\eta p^2 < .01$). There was

a significant time x group interaction ($F(1, 45) = 4.869$, $p = .032$, $\eta p^2 = .10$), indicating that at post treatment (t.3) participants in the MG ($M_{t.1} = 45.42$, $SD_{t.1} = 11.11$; $M_{t.3} = 38.67$, $SD_{t.3} = 12.48$) experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL ($M_{t.1} = 43.04$, $SD_{t.1} = 12.22$; $M_{t.3} = 44.26$, $SD_{t.3} = 13.73$).

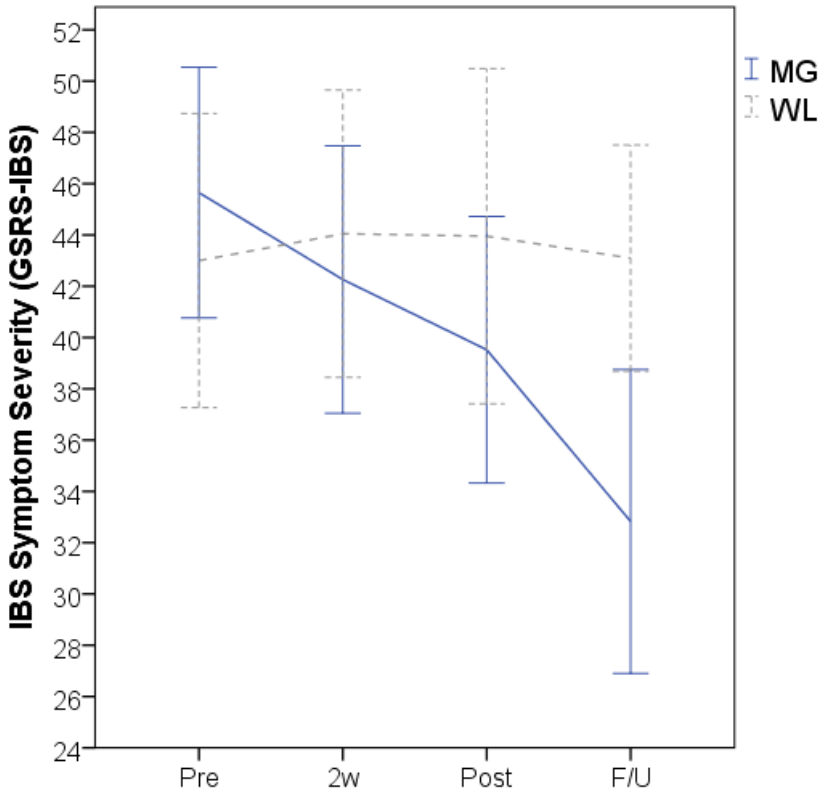


Figure 6.4. Comparison of IBS symptom severity scores (GSRS-IBS) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* This figure is based on the Per-protocol (PP) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.2 Secondary outcome – Quality of life

6.4.2.2.1 ITT analysis

ITT analysis indicated that there was a main effect of time ($F(2.395, 155.687) = 7.115$, $p = .001$, $\eta p^2 = .10$, Huynh-Feldt corrected) and no main effect of group ($F(1, 65) = 0.286$, $p = .286$, $\eta p^2 = .02$). There was a significant time x group interaction ($F(2.395, 155.687) = 7.974$, $p < .001$, $\eta p^2 = .11$, Huynh-Feldt corrected), see Table 6.3 for Means and SDs, indicating that overall participants in the MG experienced significantly greater improvements in IBS quality of life

compared with baseline than did those in the WL. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 1.797$, $p = .185$, $\eta p^2 = .03$), indicating that there were no group dependent changes in IBS quality of life between baseline and week 2. The contrasts showed a significant group x time interaction between t.1 and t.3 ($F(1, 65) = 8.244$, $p = .006$, $\eta p^2 = .11$), indicating that at post treatment (t.3) participants in the MG experienced significantly greater improvements in IBS quality of life compared with baseline than did those in the WL. In addition, the contrasts showed a significant group x time interaction from t.1 to t.4 ($F(1, 65) = 13.400$, $p = .001$, $\eta p^2 = .17$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in IBS severity compared with baseline than did those in the WL (see Table 6.3 for Means and SDs, and Figure 6.5).Compared with baseline scores, overall IBS quality of life improved by 21% in the MG vs. 2% in the WG post-treatment and 26% (MG) vs. -1% (WL) at six-weeks follow-up.

The results based on the multiply imputed dataset were comparable. The pooled overall test of the 2x4 ANOVA was significant, $F(7, 172.64) = 8.740$, p< .001, there was a significant main effect of time, $F(3, 183.03) = 8.593$, $p < .001$ and the main effect of group was not significant $F(1, 63.01) = 0.642$, $p = .426$. The interaction of time and group was significant, $F(3, 183.32) = 10.023$, $p < .001$. To follow up the significant interaction, a 2x2 ANOVA with Group (MG, WL) as between group factor and pre-treatment (t.1) and post-treatment (t.3) IBSQOL scores as within group factor was run. The results showed a significant interaction between group and time, $F(1, 62.60) = 11.700$, $p = .001$. A second 2x2 ANOVA with Group (MG, WL) as between group factor and pre-treatment (t.1) and follow-up (t.4) IBS-QOL scores as within group factor showed a significant interaction between group and time, $F(1, 59.92) = 14.166$, $p < .001$. These findings indicate that the participants in the mindfulness group experienced significantly greater improvements in IBS quality of life at post-treatment ($m_{pooled} = 67.70$, $SE_{pooled} = 2.80$) and follow-up ($m_{pooled} = 68.86$, $SE_{pooled} = 2.74$) compared with baseline ($m_{pooled} = 52.19$, $SE_{pooled} = 3.52$) than did those in the WL (Baseline $m_{pooled} = 64.07$, $SE_{pooled} = 3.14$; post-treatment $m_{pooled} = 64.90$, $SE_{pooled} = 3.28$; follow-up $m_{pooled} = 62.51$, $SE_{pooled} = 3.33$). Taking into account the results from the

two different data imputation methods (LOCF and MI) and the per-protocol analysis reported below it can be concluded that the results of the effect on MBCT for IBS on quality of life remain robust across different methods of handling missing data.

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction ($F(1, 65) = 2.163$, $p = .146$, $\eta p^2 = .03$), indicating that there were no significant additional group dependent changes in IBS symptom severity between t.3 and t.4. Planned simple effects contrasts showed no significant improvement in IBS quality of life from t.3 to t.4 for the MG ($F(1, 65) = 1.748$, $p = .191$, $\eta p^2 = .03$, *mean difference* 2.614, 95%CI [-1.336, 6.563]), or the WL group ($F(1, 65) = 0.607$, $p = .439$, $\eta p^2 < .01$, *mean difference* -1.660, 95%CI [-5.916, 2.595]).

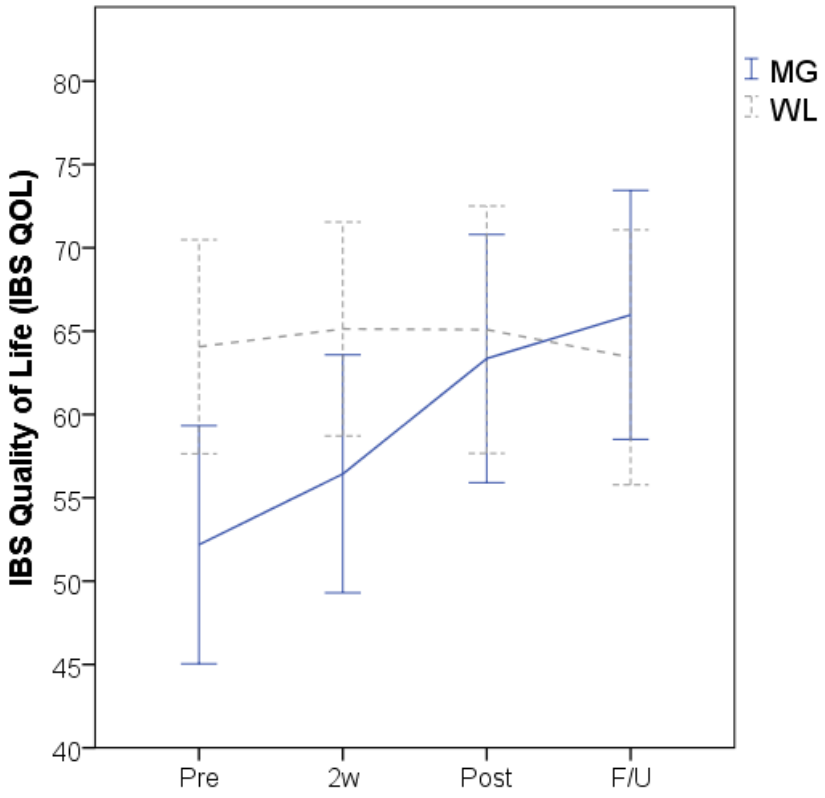


Figure 6.5. Comparison of quality of life scores (IBS-QOL) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* This figure is based on the Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.2.2 Per Protocol analysis

PP analysis indicated that there was a main effect of time ($F(2.612, 109.717) = 7.703$, $p < .001$, $\eta p^2 = .16$, Huynh-Feldt corrected) and no main effect of group ($F(1, 42) = 0.012$, $p = .913$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.612, 109.717) = 8.538$, $p < .001$, $\eta p^2 = .17$, Huynh-Feldt corrected), (see Table 6.4 for Means and SDs), indicating that overall participants in the MG experienced significantly greater improvements in IBS quality of life compared with baseline than did those in the WL. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 42) = 1.579$, $p = .216$, $\eta p^2 = .04$), indicating that there were no group dependent changes in IBS quality of life between t.1 and t.2. The contrasts showed a significant group x time interaction between t.1 and t.3 ($F(1, 42) = 8.859$, $p = .005$, $\eta p^2 = .17$), indicating that at post-treatment (t.3) participants in the MG experienced significantly greater improvements in IBS quality of life compared with baseline than did those in the WL. In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 42) = 15.489$, $p < .001$, $\eta p^2 = .27$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in IBS quality of life compared with baseline than did those in the WL (see Table 6.4 for Means and SDs, and Figure 6.6). Compared with baseline scores, overall IBS quality of life was improved by 32% in the MG vs. 3% in the WG post-treatment and 39% (MG) vs. -1% (WL) at six-weeks follow-up.

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction ($F(1, 42) = 2.201$, $p = .145$, $\eta p^2 = .05$), indicating that there were no additional group dependent changes in IBS quality of life between t.3 and t.4. Planned simple effects contrasts showed no significant improvement in IBS quality of life from t.3 to t.4 for the MG ($F(1, 42) = 1.804$, $p = .186$, $\eta p^2 = .04$, *mean difference* 4.092, 95%CI [-2.057, 10.241]), or the WL group ($F(1, 42) = 0.591$, $p = .446$, $\eta p^2 = .01$, *mean difference* -2.451, 95%CI [-8.886, 3.984]).

As the per-protocol analysis that included t.4 (follow-up) contained 44 participants only, a mixed design repeated measures ANOVA was run with all participants that completed t.1 and t.3 assessments (n = 47). This analysis indicated that there was a significant main effect of time ($F(1,$

45) = 12.900, p = .001, ηp^2 = .22) and no main effect of group (F(1, 45) = 0.535, p = .468, ηp^2 = .01). There was a significant time x group interaction (F(1, 45) = 10.181, p = .003, ηp^2 = .18), indicating that participants in the MG ($M_{t.1}$ = 52.42, $SD_{t.1}$ = 20.82; $M_{t.3}$ = 68.11, $SD_{t.3}$ = 20.14) experienced significantly greater improvements in IBS related quality of life compared with baseline than did those in the WL ($M_{t.1}$ = 63.68, $SD_{t.1}$ = 17.29; $M_{t.3}$ = 64.61, $SD_{t.3}$ = 20.87).

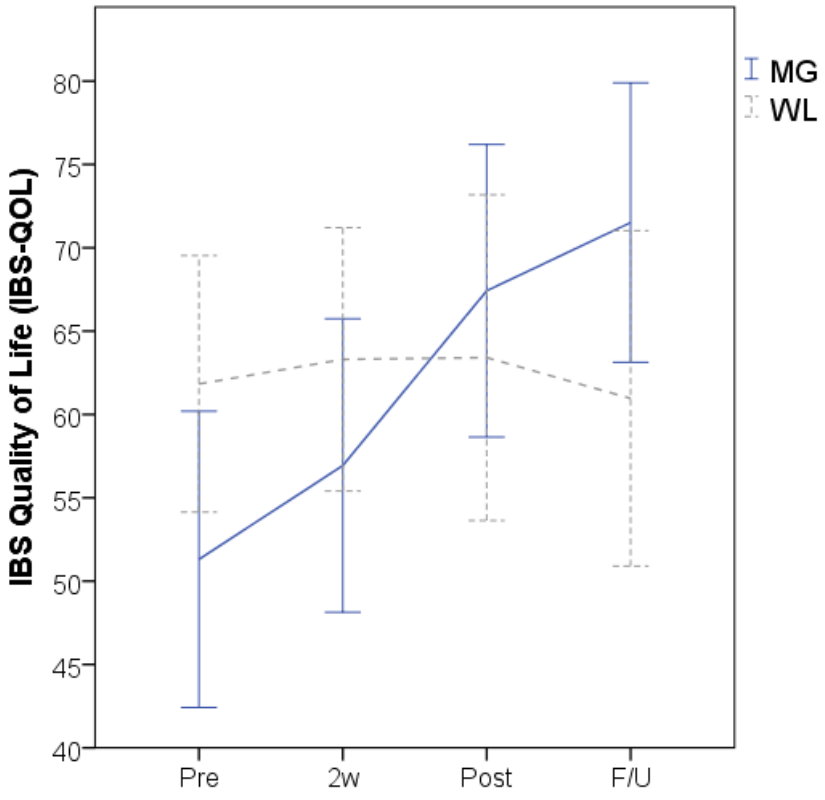


Figure 6.6. Comparison of quality of life scores (IBS-QOL) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* The figure is based on the Per-protocol (PP) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.3 Clinically significant change

The primary therapeutic targets for clinical change of this study were irritable bowel symptom changes as reported on the standardized measure GSRS-IBS and IBS related quality of life reported with the standardized measure IBS-QOL. Based on the approach described by Jacobson and Truax (1991) clinically significant change in symptom severity was considered to have occurred, if a) the participant's follow-up score was within the range of the functional

(healthy) population and b) the participant recorded a statistically reliable reduction in scores from baseline to six weeks after the intervention (follow-up) using the reliable change index (RCI). For criterion a), a cut-off score of 33.82 on the GSRS-IBS was established, based on the mean (18.66) and SD (7.58) of healthy control participants reported in Chapter 2 (Henrich, Gjelsvik, & Martin, 2018). In the per-protocol analysis of the mindfulness group (n = 23), fourteen participants (60.8%) displayed symptom scores in the functional range (below the cut-off) and seven (50.0%) of these displayed a reliable reduction in GSRS-IBS scores (RCI < -1.96). In the control group (n = 21), four participants (19.1%) had scores below the cut-off at follow-up and one (25.0%) of these displayed a reliable reduction in GSRS-IBS scores. Considering only the RCI, it is important to note that three participants (14.3%) in the WL group experienced a statistically reliable increase in symptom severity (GSRS-IBS scores), whilst zero (0%) participants in the MG displayed such an increase. In addition, one participant in the MG experienced a reliable decrease in symptoms (RCI = -3.39) but did not enter the functional range of scores. The ITT analysis based on multiply imputed data (MG = 36, WL = 31) revealed comparable findings, with the exception of the percentage of participants in the mindfulness group who entered the range of functional scores: 43.3%. Proportions of the other comparisons were similar. Of those participants in the MG who had entered the functional range of scores, 51.3% displayed a reliable reduction based on the RCI. In the control group, 16.7% had scores below the cut-off at follow-up and 34.6% of these displayed a reliable reduction in GSRS-IBS scores.

Clinically significant changes in IBS quality of life was considered to have occurred if a) the participant's follow-up score was closer to the mean of the functional than the dysfunctional population and b) the participant recorded a statistically reliable reduction in scores from baseline to six weeks after the intervention (follow-up) using the RCI (Jacobson & Truax, 1991). For criterion a), a cut-off score of 78.16 on the IBS-QOL was established based on the formula $c = (S_0M_1 + S_1M_0) / (S_0+S_1)$ in Jacobson and Truax (1991, p. 13). The decision for this criterion was made, because the functional and dysfunctional population largely overlap: the mean found in treatment seeking IBS patients, m = 65.84, (Drossman et al., 2000) falls within the range of two

standard deviations below the mean found in healthy participants (M = 88.80, SD = 17.20; Mean-2SD = 54.40) (Hunt et al., 2014b). A criterion that requires the patient to score within two SDs of the healthy population would thus be too lenient. Similarly, requiring the participant to score outside of the mean and two standard deviations of the patient population would ask the treated patient to score higher than the mean of the healthy population. This criterion would be too stringent. In the per-protocol analysis of the mindfulness group (n = 23), nine participants (39.1%) displayed IBSQOL scores closer to the functional than the dysfunctional mean and five (55.6%) of these displayed reliable improvements in IBSQOL scores (RCI > 1.96). In addition, four participants displayed reliable improvements in quality of life (RCI > 1.96) but did not pass the threshold that would put them closer to the functional mean. In the control group (n = 21), four participants (12.9%) had scores closer to the mean of the functional group and none (0%) of these were indicated by reliable improvements in IBSQOL scores. Considering only the RCI, two participants (9.5%) in the WL group experienced a statistically reliable worsening in quality of life (IBSQOL scores), whilst zero participants in the MG displayed such a decrease. The ITT analysis based on multiply imputed data (MG = 36, WL = 31) showed that 25.0% of the participants in the mindfulness group had scores closer to the mean of the functional population at follow-up. Of these, 55.6% displayed a reliable improvement based on the RCI. When considering only the RCI, 41.7% of participants in the MG experienced reliable improvements in quality of life. In the control group, 12.9% had scores above the cut-off score and 0.0% of these displayed a reliable reduction in IBSQOL scores. In summary, MBCT for IBS was superior to the waiting list control condition in effectuating clinically significant and reliable changes in both IBS symptom severity and IBS related quality of life.

6.4.2.4 Secondary outcome – Depression, ITT analysis

ITT analysis showed no main effect of time ($F(2.717, 176.595) = 1.581$, $p = .200$, $\eta p^2 = .02$) and no main effect of group ($F(1, 65) = 0.188$, $p = .666$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.717, 176.595) = 3.162$, $p = .030$, $\eta p^2 = .05$), (see Table 6.3 for Means and SDs and Figure 6.7), indicating that overall participants in the MG showed significantly

greater decreases in depression than did those in the WL (all degrees of freedom (dfs) and alphas reported using Huynh-Feldt). Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 0.002$, $p = .968$, $\eta p^2 < .01$), indicating that there were no group dependent changes in DASS depression scores between t.1 and t.2. The contrasts showed a significant group x time interaction ($F(1, 65) = 4.152$, $p = .046$, $\eta p^2 = .06$), between t.1 and t.3, indicating that participants in the MG showed greater reductions than those in the WL during this time period. In addition, the contrasts showed no group x time interaction ($F(1, 65) = 3.439$, $p = .068$, $\eta p^2 = .05$), between t.1 and t.4. Planned pairwise comparisons showed that the MG showed significant decreases in DASS depression scores from t.1 to t.3 (*mean difference = 4.778*, $p = .010$ [1.162, 8.393]) and from t.1 to t.4 (*mean difference = 4.722*, $p = .010$ [1.169, 8.276]) whereas the WL did not (t.1 to t.3 *mean difference = -0.645*, $p = .742$ [-4.541, 3.251]; from t.1. to t.4 (*mean difference* = -0.129, $p = .947$ [-3.959, 3.700]).

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction $F(1, 65) = 0.110$, $p = .742$, $\eta p^2 < .01$. Planned simple effects pairwise comparisons showed that neither the MG nor the WL group improved from t.3 to t.4 (MG: $F(1, 65) = 0.002$, $p = .962$, $\eta p^2 < .01$, *mean difference* -0.056, 95%CI [-2.401, 2.290]; WL: $F(1, 65) = 0.166$, $p = .685$, $\eta p^2 < .01$, *mean difference* -0.516, 95%CI [-3.044, 2.011]).

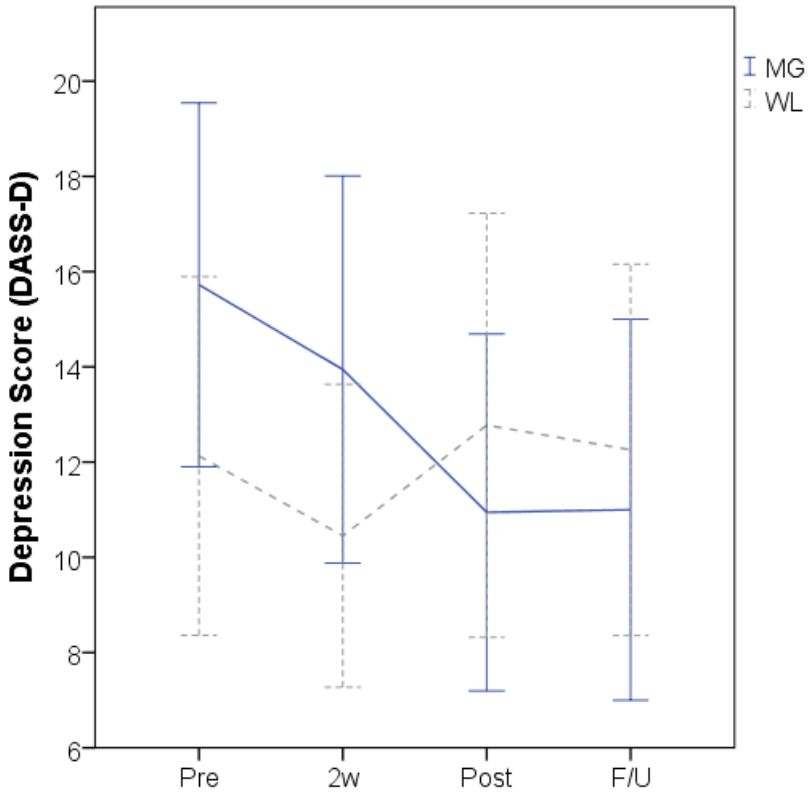


Figure 6.7. Comparison of depression scores (DASS-D) in the mindfulness group (MG) and the waiting-list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* This figure is based on the Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.5 Secondary Outcome – Anxiety. ITT analysis

ITT analysis showed no main effect of time ($F(2.101, 136.552) = 2.473$, $p = .085$, $\eta p^2 = .04$) and no main effect of group ($F(1, 65) = 0.943$, $p = .335$, $\eta p^2 = .01$). There was a significant time x group interaction ($F(2.101, 136.552= 3.981$, $p = .019$, $\eta p^2 = .06$), (see Table 6.3 for Means and SDs and Figure 6.8), indicating that overall participants in the MG showed significantly greater decreases in anxiety than did those in the WL (all dfs and alphas reported using Greenhouse-Geisser). Planned contrasts (simple) showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 1.447$, $p = .233$, $\eta p^2 = .02$), indicating that there were no group dependent changes in DASS anxiety scores between t.1 and t.2. The contrasts showed a significant group x time interaction ($F(1, 65) = 6.697$, $p = .012$, $\eta p^2 = .09$), between t.1 and t.3, indicating that the participants in the MG had decreased significantly more in anxiety scores than the participants

in the WL did. In addition, the contrasts showed a significant group x time interaction ($F(1, 65) = 4.460$, $p = .039$, $\eta p^2 = .06$), between t.1 and t.4.

Planned pairwise comparisons showed that the MG showed significant decreases in DASS anxiety scores from t.1 to t.3 (*mean difference = 4.444*, $p = .001$ [1.773, 7.116]) and from t.1 to t.4 (*mean difference = 4.167*, $p = .005$ [1.320, 7.013]) whereas the WL did not (t.1 to t.3 *mean difference = -0.645*, $p = .656$ [-3.534, 2.234]; t.1. to t.4 (*mean difference* = -0.258, $p = .867$ [-3.325, 2.809]).

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction $F(1, 65) = 0.411$, $p = .524$, $\eta p^2 = .01$. Planned simple effects pairwise comparisons showed that neither the MG nor the WL improved from t.3 to t.4 (MG: $F(1, 65) = 0.155$, $p = .695$, $\eta p^2 < .01$, *mean difference* -0.278, 95%CI [-1.687, 1.131]; WL: $F(1, 65) = 0.259$, $p = .612$, $\eta p^2 < .01$, *mean difference* -0.387, 95%CI [-1.905, 1.131]).

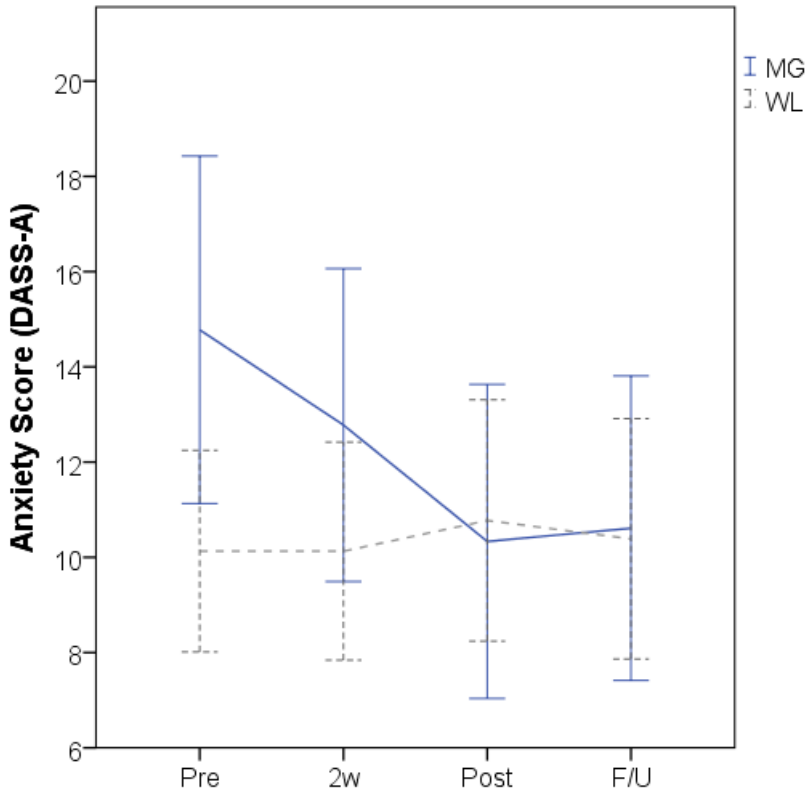


Figure 6.8. Comparison of anxiety scores (DASS-A) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and

follow-up (F/U) assessments. *Note.* Figure 6.4 is based on the Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.6 Secondary Outcome – Stress, ITT analysis

ITT analysis showed a main effect of time ($F(2.156, 140.143) = 3.856$, $p = .021$, $\eta p^2 = .06$) and no main effect of group ($F(1, 65) = 0.243$, $p = .624$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.156, 140.143) = 4.911$, $p = .016$, $\eta p^2 = .06$), (see Table 6.3 for Means and SDs and Figure 6.9), indicating that overall participants in the MG showed significantly greater decreases in stress scores than did those in the WL (all dfs and alphas reported using Greenhouse-Geisser). Planned contrasts (simple) showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 0.274$, $p = .603$, $\eta p^2 < .01$), indicating that there were no group dependent changes in stress scores between t.1 and t.2. The contrasts showed a significant group x time interaction ($F(1, 65) = 6.325$, $p = .014$, $\eta p^2 = .09$), between t.1 and t.3, indicating that the MG had decreased significantly more on scores of DASS stress than the WL during that time period. In addition, the contrasts showed a significant group x time interaction ($F(1, 65) = 4.137$, $p = .046$, $\eta p^2 = .06$), between t.1 and t.4 indicating that the MG had decreased significantly more on scores of DASS stress than the WL during that time period. Planned pairwise comparisons showed that the MG showed significant decreases in DASS stress scores from t.1 to t.3 (*mean difference = 5.278*, $p = .001$ [2.113, 8.442]) and from t.1 to t.4 (*mean difference = 4.944*, $p = .004$ [1.685, 8.204]) whereas the WL did not (t.1 to t.3 *mean difference = -0.581*, $p = .735$ [-3.991, 2.829]; t.1. to t.4 (*mean difference* = 0.065, $p = .971$ [-3.448, 3.577]).

Additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction $F(1, 65) = 0.609$, $p = .438$, $\eta p^2 = .01$. Planned simple effects pairwise comparisons showed that neither the MG nor the WL group improved from t.3 to t.4 (MG: $F(1, 65) = 0.153$, $p = .697$, $\eta p^2 < .01$, *mean difference* -0.333, 95%CI [-2.037, 1.370]; WL: $F(1, 65) = 0.492$, $p = .485$, $\eta p^2 = .01$, *mean difference* 0.645, 95%CI [-1.191, 2.481]).

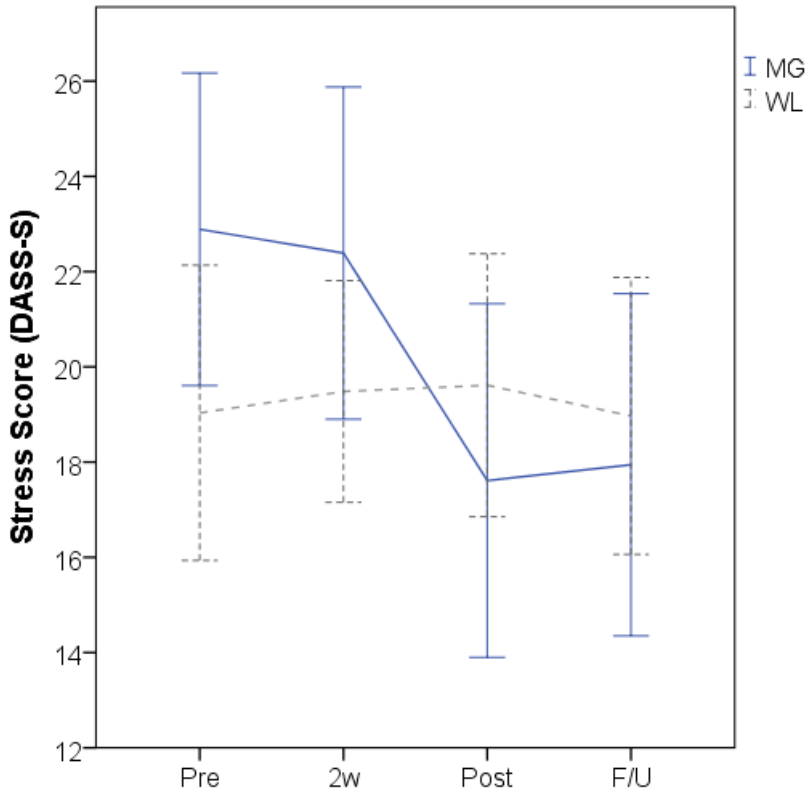


Figure 6.9. Comparison of stress scores (DASS-S) in the mindfulness group (MG) and the waiting list control group (WL) from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. *Note.* This figure is based on the Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

Table 6.3. Means and standard deviations (SD) of IBS symptom severity, IBS quality of life, depression, anxiety, stress and mindfulness at baseline (t.1), week 2 (t.2), post-treatment (t.3) and six-week follow-up (t.4) for the mindfulness group (MG, n = 36) and the waiting list group (WL, n = 31) in the Intention to Treat (ITT) analysis.

	Group	t.1		t.2		t.3		t.4		Overall interaction effects
	MG (n=36) WL (n=31)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	F
IBS Symptom Severity (GSRS-IBS[1])	MG	45.89	(10.80)	42.75	(11.59)	40.83	(12.00)	36.56	(13.90)	5.330**[a]
	WG	42.42	(11.45)	42.97	(11.66)	43.32	(12.74)	42.74	(9.31)	
Time x group interaction with t.1 (F)				3.423		4.843*		10.55**		
IBS quality of life (IBS-QOL[2])	MG	52.19	(21.12)	56.43	(21.09)	63.36	(22.00)	65.97	(22.07)	7.974***[a]
	WG	64.07	(17.50)	65.13	(17.49)	65.09	(20.23)	63.43	(20.85)	
Time x group interaction with t.1 (F)				1.797		8.244**		13.400**		
Depression (DASS[3])	MG	15.72	(11.30)	13.94	(12.01)	10.94	(11.07)	11.00	(11.83)	3.162*[a]
	WG	12.13	(10.26)	10.45	(8.67)	12.77	(12.14)	12.26	(10.63)	
Time x group interaction with t.1 (F)				0.002		4.152*		3.439		
Anxiety (DASS[3])	MG	14.78	(10.78)	12.78	(9.71)	10.33	(9.75)	10.61	(9.45)	3.981*[b]
	WG	10.13	(5.77)	10.13	(6.24)	10.77	(6.90)	10.39	(6.88)	
Time x group interaction with t.1 (F)				1.447		6.697*		4.460*		

	Group	t.1		t.2		t.3		t.4		Overall interaction effects
	MG (n=36) WL (n=31)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	F
Stress (DASS[3])	MG	22.89	(9.70)	22.39	(10.31)	17.61	(10.97)	17.94	(10.62)	4.105*[b]
	WG	19.03	(8.45)	19.48	(6.35)	19.61	(7.53)	18.97	(7.93)	
Time x group interaction with t.1 (F)				0.274		6.325*		4.137*		
Mindfulness (FFMQ[4])	MG	56.22	(10.39)	54.67	(11.09)	58.50	(11.02)	60.31	(10.68)	7.299**[b]
	WG	59.32	(9.45)	58.06	(11.51)	57.10	(9.91)	57.26	(10.93)	
Time x group interaction with t.1 (F)				0.041		6.900*		9.751**		

*p < .05; **p < .01; ***p < .001; [a] Huynh-Feldt corrected; [b]Greenhouse-Geisser corrected

[1]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [2]Quality of Life measure for Irritable Bowel Syndrome
[3] Depression Anxiety Stress Scale; [4]Five Factor Mindfulness Questionnaire excluding the Observation Subscale

Table 6.4. Means and standard deviations (SD) of IBS symptom severity and IBS quality of life at baseline (t.1), week 2 (t.2), post-treatment (t.3) and six-week follow-up (t.4) for the mindfulness group (MG, n = 23) and the waiting list group (WL, n = 21) in the Per-Protocol (PP) analysis.

	Group	t.1		t.2		t.3		t.4		Overall interaction effects
	MG (n=23) WL(n=21)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	F
IBS Symptom Severity (GSRS-IBS[1])	MG	45.65	(11.30)	42.26	(12.05)	39.52	(12.02)	32.83	(13.70)	4.876**[a]
	WG	43.00	(12.60)	44.05	(12.30)	43.95	(14.36)	43.10	(9.69)	
Time x group interaction with t.1 (F)				2.773		3.524		10.281**		
IBS quality of life (IBS-QOL[2])	MG	51.31	(20.55)	56.94	(20.36)	67.42	(20.31)	71.52	(19.38)	8.538***[a]
	WG	61.83	(16.90)	63.31	(17.35)	63.41	(21.48)	60.96	(22.10)	
Time x group interaction with t.1 (F)				1.579		8.859**		15.489***		

*p < .05; **p < .01; ***p < .001; [a] Huynh-Feldt corrected;

[1]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [2]Quality of Life measure for Irritable Bowel Syndrome

6.4.2.7 Process measure – Mindfulness, ITT analysis

ITT analysis showed no main effect of time ($F(2.213, 143.845) = 2.779$, $p = .061$, $\eta p^2 = .04$) and no main effect of group ($F(1, 65) = 0.046$, $p = .832$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.213, 143.845) = 7.299$, $p = .001$, $\eta p^2 = .10$), (see Table 6.3 for Means and SDs and Figure 6.10), indicating that overall participants in the MG showed significantly greater increases in mindfulness than did those in the WL (all dfs and alpha reported using Greenhouse-Geisser). Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 65) = 0.041$, $p = .841$, $\eta p^2 < .01$), indicating that there were no group dependent changes in FFMQ scores between baseline and intra-treatment measures. The contrasts showed a significant group x time interaction between t.1 and t.3 ($F(1, 65) = 6.900$ $p = .011$, $\eta p^2 = .10$), indicating that the MG increased significantly more in FFMQ scores than the WL between baseline and post-treatment. In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 65) = 9.751$, $p = .003$, $\eta p^2 = .13$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in FFMQ scores compared to baseline than did those in the WL.

An additional planned repeated measures ANOVA with t.3 and t.4 showed no group x time interaction ($F(1, 65) = 2.115$, $p = .151$, $\eta p^2 = .03$). Planned simple effect contrasts showed that the MG improved significantly from t.3 to t.4 ($F(1, 65) = 5.513$, $p = .022$, $\eta p^2 = .08$, *mean difference* 1.806, 95%CI [0.270, 3.341]), whereas the participants in the WL group did not ($F(1, 65) = 0.038$, $p = .846$, $\eta p^2 < .01$, *mean difference* 0.161, 95%CI [-1.494, 1.816]).

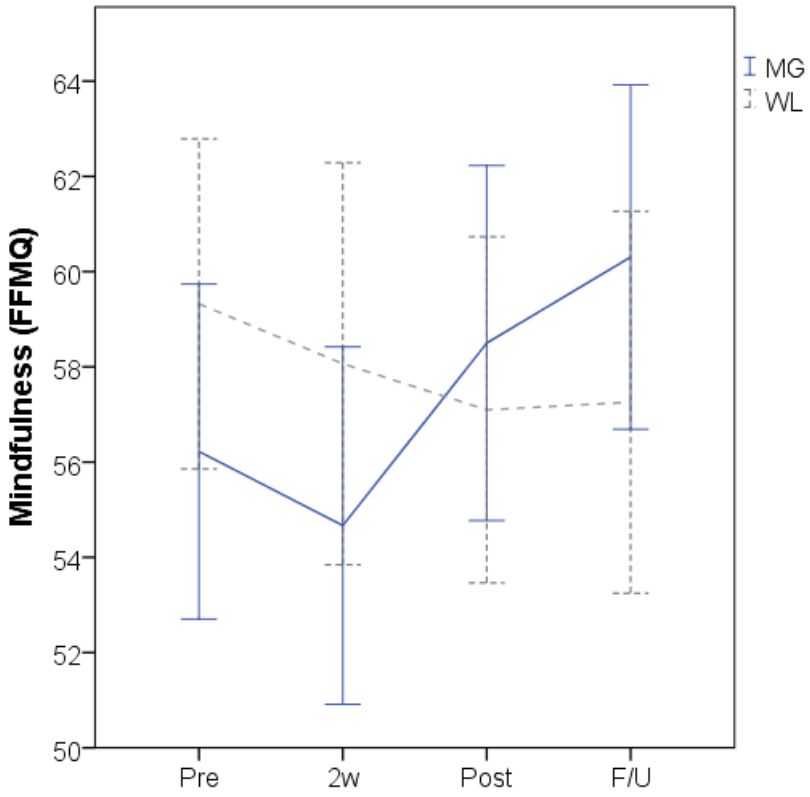


Figure 6.10. Comparison of mindfulness scores (total FFMQ scores without the observation subscale) in the mindfulness group (MG) and the waiting list (WL) control group from pre-treatment (Pre), two weeks into the course (2w), post-treatment (post) and follow-up (F/U) assessments. The figure is based on the Intention to Treat (ITT) Analysis of Variance (ANOVA); Error bars represent 95% Confidence Intervals (95% CI).

6.4.2.8 Treatment expectations and treatment credibility

Analyses of treatment expectations, credibility and home-work were performed with the PP sample. Treatment expectations and credibility were measured in the timeframe between the orientation meeting and the start of the course. This was done with the participants of the MG and the WL group (i.e., after the waiting period and before the WL attended their course). The analysis of treatment expectations was thus run with both groups combined from baseline to post-treatment and baseline to follow-up (n = 37 at post-treatment, n = 34 at F/U).

Bivariate correlations were calculated with treatment credibility and treatment expectations separately to investigate if credibility and expectations were correlated with change scores of the outcomes of IBS Symptom Severity (GSRS-IBS), IBS quality of life (IBSQOL), depression (DASS-depression), anxiety (DASS-anxiety), stress (DASS-stress), and mindfulness (FFMQ)

scales. Change scores of GSRS, IBS-QOL, and anxiety were not normally distributed and thus Spearman's rho is reported for all outcomes.

The scores for treatment credibility correlated with change scores from pre-treatment to follow-up in DASS-stress (*rho* = -.440, *p* = .009), indicating that that higher treatment credibility was associated with larger reductions in DASS-stress scores from pre-treatment to follow-up. Treatment credibility did not correlate with change scores of any other outcome measures from pre- to post-treatment or pre-treatment to follow-up (all *rho*s < .32, all *p*s >.05).

The scores for treatment expectations correlated with change scores from pre- to post-treatment in IBS-GSRS (*rho* = -.435, *p* = .007) and IBS QOL (*rho* = .415, *p* = .011), indicating that that higher treatment expectations were associated with larger reductions in IBS severity scores and larger increases in IBS QOL scores from pre- to post-treatment. Treatment expectation scores were also significantly correlated with change scores from pre-treatment to follow-up in IBS-GSRS (*rho* = -.339, *p* = .050), IBSQOL (*rho* = .404, *p* = .018), and DASS-Stress (*rho* = -.368, p = .032). Treatment expectation scores were not correlated with any other outcome measure (all *rho*s < .290 all *p*s > .05).

To follow-up findings on expectations and change scores in the primary outcome variable IBS symptom severity, a simple linear regression with bootstrapped confidence intervals for the regression coefficients was run to test if pre-treatment expectations predicted changes in IBS symptom severity from t.1 to t.3. The model was significant, and expectations significantly predicted changes in self-reported IBS symptom severity from pre- to post- treatment. Table 6.5 displays the model parameters.

Table 6.5. Linear model of treatment expectations[1] at pre-treatment as predictor for changes in IBS symptom severity[2] from pre- to post-treatment (t.3 - t.1).

	b [95% CI]	*SE B*	*ß*	*t*	*p*
Constant	-6.423 [-8.948, -4.132]	1.402		-4.508	<0.001
Treatment Expectations	-1.447 [-2.532, -0.345]	0.539	-0.418	-2.724	0.01

Note. R^2= .18, F(1, 35) = 7.419, *p* = .010
[1]Measured with the Credibility/Expectancy Scale (CES) [2]measured with the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS)

6.4.2.9 Home practice

Correlational analysis with home practice (total minutes of home practice, and total number of home practice sessions was run, across both groups, in order to explore the relationship between home practice and changes in outcomes (GSRS-IBS, IBS-QOL, DASS-anxiety, DASS-depression, DASS-stress, FFMQ) from pre- to post-treatment and from pre-treatment to follow-up. This analysis was run with participants that had recorded and handed in their home practice sheets and whose data was available for the specific time-points (n = 37 at post-treatment and n = 34 at F/U).

Total minutes of home practice was not related to change scores in any of the outcomes at post-treatment (all *rho*s < ±.190, all *p*s> .05). The total number of home practice sessions was also not related to changes in any of the outcome measures at post treatment (all *rho*s < ±.12, all *p*s> .05). In addition, it was found that the total minutes of home practice was not related to changes in any outcomes at follow-up (all *rho*s < ±.19, all *p*s> .05). Total number of home practice sessions was also not related to changes in any of the outcomes at follow-up (all *rho*s < ±.14, all *p*s> .05).

It was planned to run independent sample t-test on changes in all outcomes at post-treatment and follow-up between participants who practised less than three times per week and participants who practised more than three times per week. This analysis was planned as a previous trial found a difference in outcomes (odds of relapse into depression) between these two sub-groups (Crane et al., 2014). After investigation of the data, this was deemed not feasible, as only three participants practised on average less than three times per week.

6.4.3 Differences between participants who withdrew after group allocation and participants who continued with the study

Independent sample *t*-tests were run to investigate differences in baseline variables (Age, GSRS-IBS, IBS-QOL, DASS-depression, DASS-anxiety, DASS-stress, FFMQ-obs) between participants who continued with the study after allocation (n = 49) until post-treatment assessment and those that withdrew after group allocation (n = 18). It was found that participants who withdrew were not significantly different on any of the baseline variables from those that continued (all *t*s < 1.016, all *p*s >.05).

Thirteen participants withdrew from the study before their ratings of treatment credibility and expectations were assessed. The following analysis is based on participants for whom credibility and expectations were measured. Rating of treatment credibility and treatment expectations were not significantly different between those that continued (n = 49) and those that withdrew from the study (n = 5) (Credibility $t(48) = .628$, $p = .533$; Expectations $t(48) = .300$, $p = .766$).

6.4.4 Graphical illustrations of treatment trajectories for the MG and the WL

Changes in outcome trajectories per group are depicted in Figure 6.11 through to Figure 6.16. The figures are based on the participants who attended at least four out of six sessions and each time-point includes all participants that had done the assessment at the time, regardless of whether they had done any of the assessments later on. The number of participants per time point were t.1 = 48 (n_{MG} = 24, n_{WL} = 24), t.2 = 48 (n_{MG} = 24, n_{WL} = 24), t.3 = 47 (n_{MG} = 24, n_{WL} = 23), t.4 = 44 (n_{MG} = 23, n_{WL} = 21), t.5 = 16 (n_{WL} = 16), t.6 = 13 (n_{WL} = 13), t.7 = 11 (n_{WL} = 11). The symbol n_{MG} indicates the number of participants in the mindfulness group (MG); the symbol n_{WL} indicated the number of participants in the waiting list group (WL) for the time specified time-points.

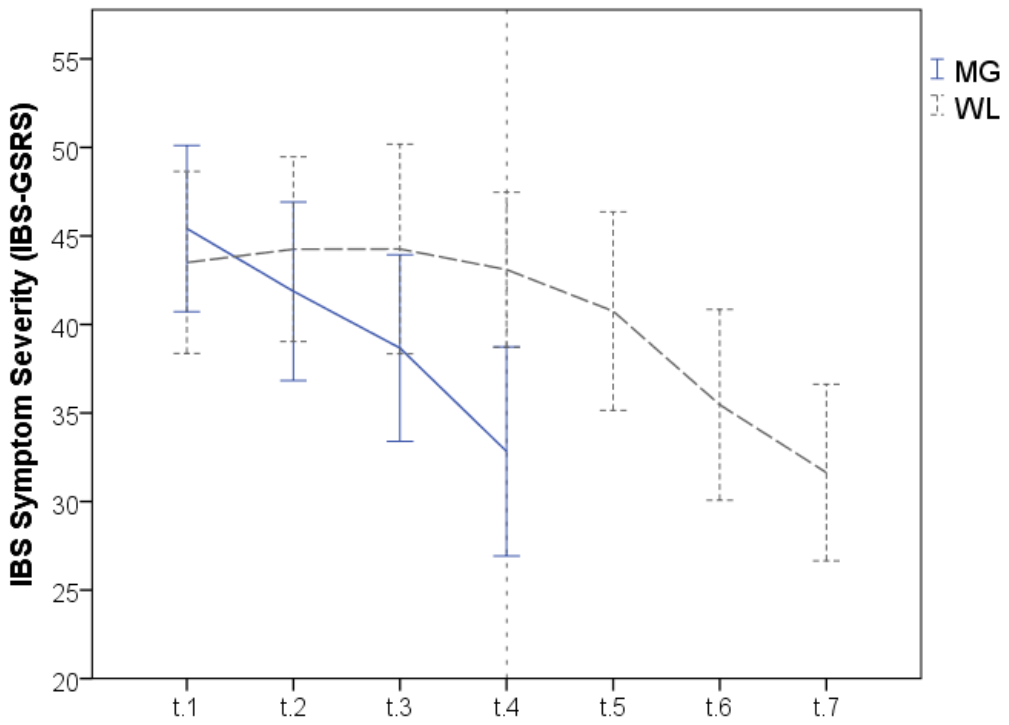


Figure 6.11. Scores of IBS symptom severity for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

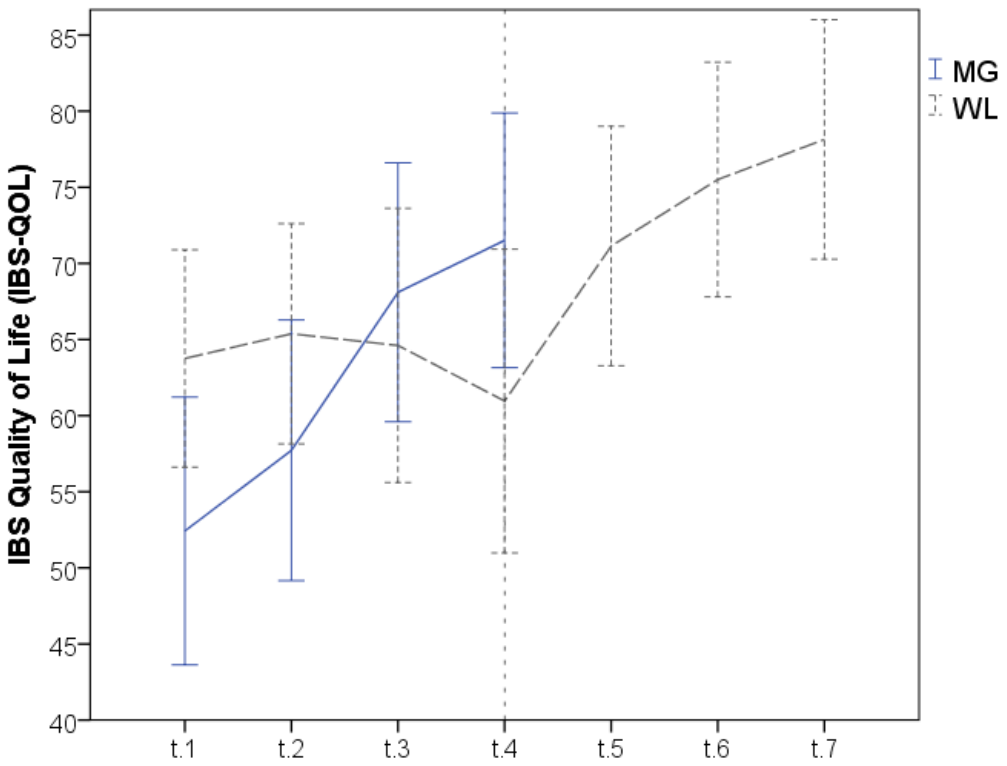


Figure 6.12. Scores of IBS quality of life for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

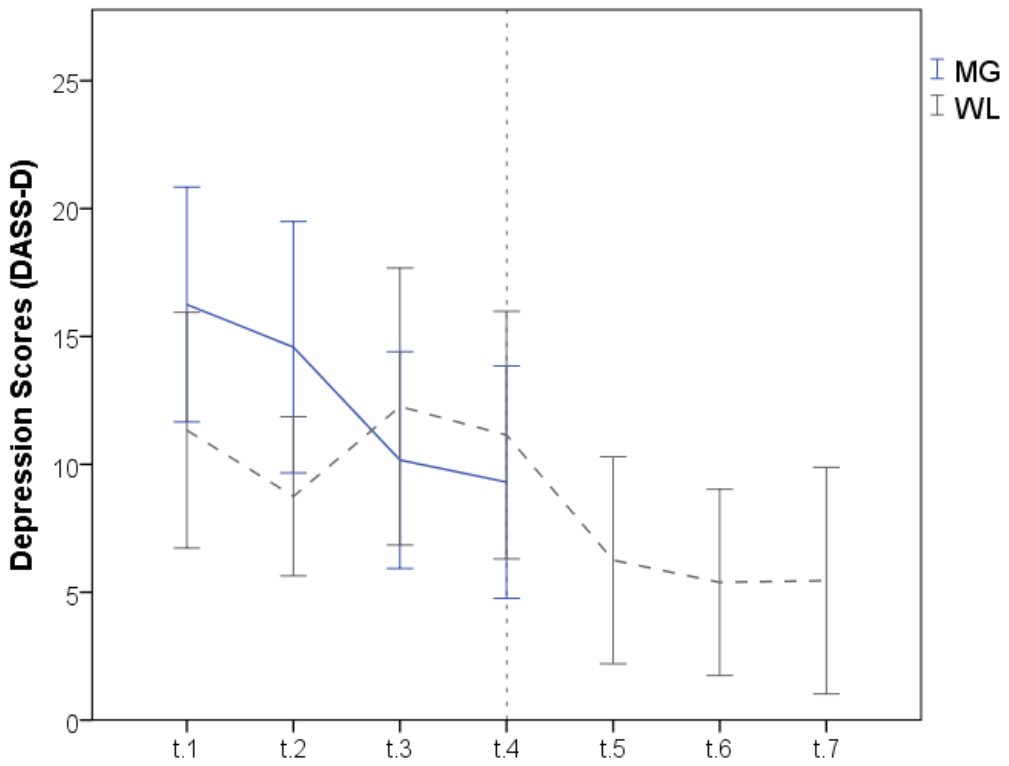


Figure 6.13. Scores of depression for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

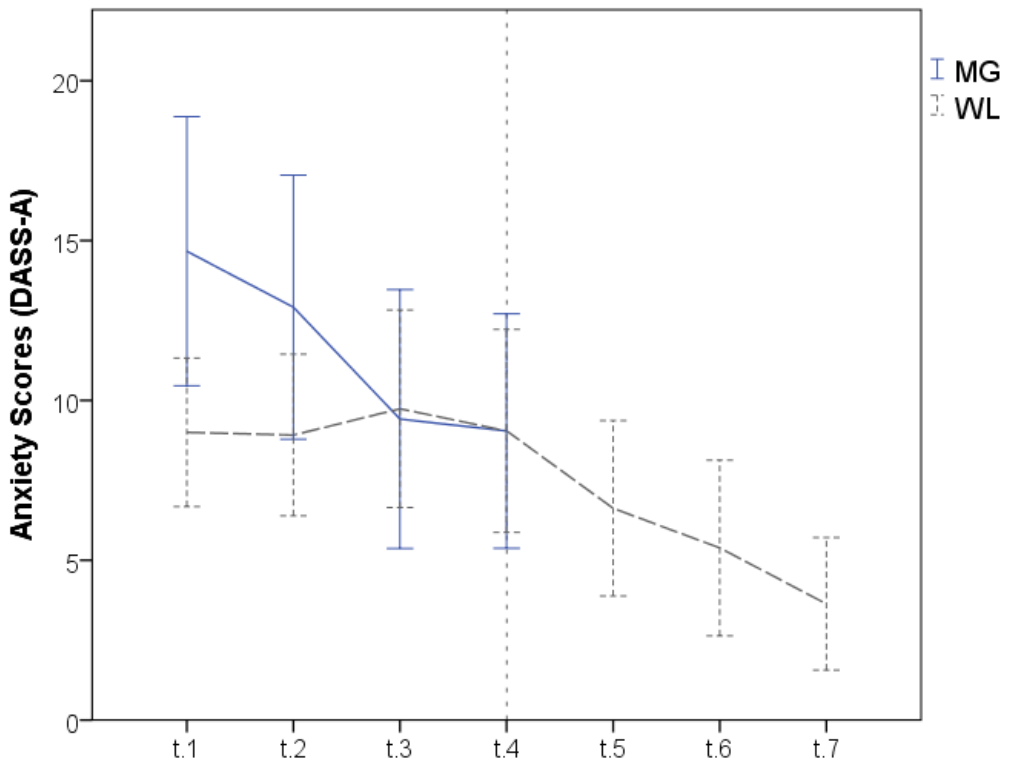


Figure 6.14. Scores of anxiety for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

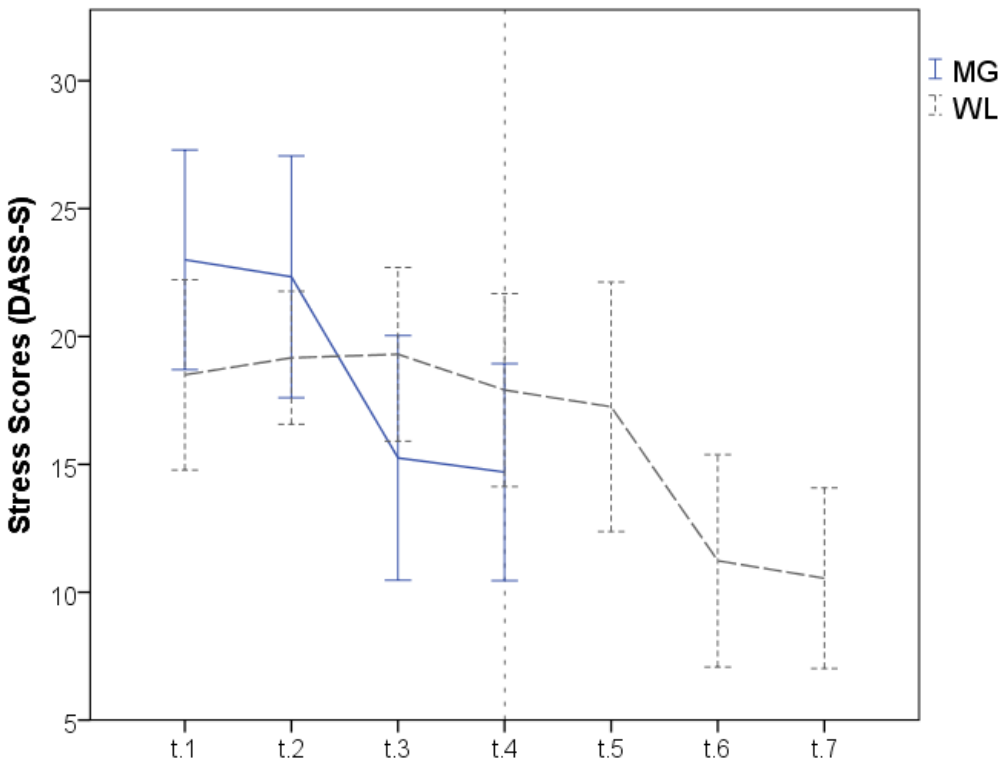


Figure 6.15. Scores of stress for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. ***Note.*** **Error bars represent 95% Confidence Intervals (95% CI).**

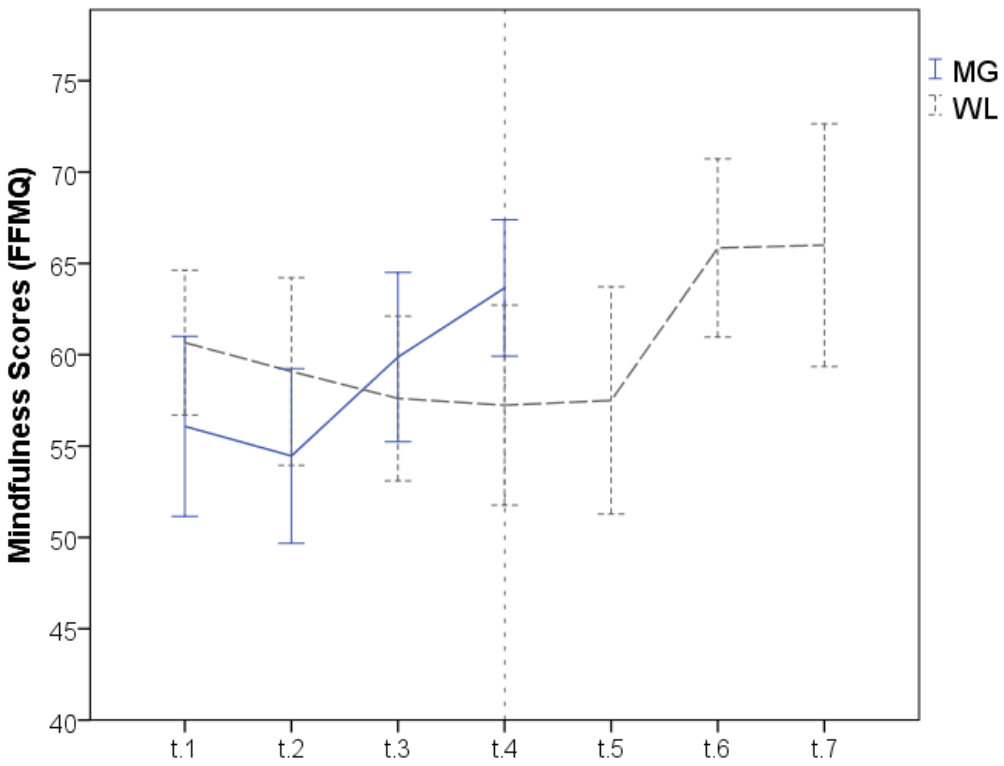


Figure 6.16. Scores of mindfulness for the mindfulness group (MG) and the waiting list group (WL) from t.1 to t.7. The dotted vertical line represents the time after which the participants in the WL started their MBCT for IBS course. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

6.5 Discussion

Several previous studies have shown that mindfulness programmes can lead to symptom reductions in patients with IBS (Gaylord et al., 2011; Zernicke et al., 2013). However, this is the first study that has demonstrated that an adapted MBCT course for IBS can significantly reduce IBS symptom severity. Benefits were shown to last up to six weeks after the intervention. The conservative intention to treat (ITT) analysis showed that IBS symptoms were reduced by 11% after the intervention and by 20% at follow-up. Analyses of the data of participants who completed the course and the study (per protocol analysis) showed that symptoms were reduced by 13% after the course and by 28% at follow-up. These findings indicate that compared to the waiting list control condition, MBCT for IBS leads to a significant reduction in symptom severity, as indicated by the large effect size observed at follow-up ($\eta p^2 = .20$). MBCT for IBS also led to significant improvements in quality of life and mindfulness and significant reductions in depression, anxiety and stress at post-treatment and follow-up, compared to the waiting list, indicating that MBCT for IBS acts on both physical and psychological outcomes relevant to IBS patients.

The clinical significance of these findings is also supported by the changes in IBS symptom severity, quality of life and psychological distress that were observed in the control group after starting their MBCT for IBS course. Figure 6.11 through to Figure 6.16 show that participants in the delayed treatment group (WL) showed a change trajectory once their treatment commenced that is similar to that of the MG during their treatment phase. This was observed regardless of the level of psychological wellbeing when the course began. For example, participants in the WL had higher baseline quality of life scores than participants in the MG, changed minimally over the first four assessments and, once their treatment started, their change trajectory was similar to that in the MG during their treatment phase.

This study broadens the current literature of mindfulness-based treatments for IBS. This was the first study to report the results of an MBCT protocol specifically adapted for patients with IBS and the first small to medium study on any MBCT treatment for IBS. In the context of the emphasis on translational science put forward by Onken (2014) this study adds a Stage 2 clinical

trial where there are none for adapted MBCT courses in the IBS population (Dimidjian & Segal, 2015). It is thus an important first study that explores the applicability of MBCT for IBS and widens the range of MBIs that could be therapeutic for IBS patients. Chapter 7 will examine the mechanisms within the treatment to deepen the knowledge of how MBCT for IBS works for patients with IBS.

From a translational perspective, it is important to note the differences between the hypothesised treatment models of MBCT for depression and MBCT for IBS. MBCT for depression was developed for patients with recurrent depression in remission. As such, MBCT aims to reduce the hypothesised risk factor for recurrence – cognitive reactivity – by reducing self-referential discrepancy-based processing of private experiences, including thoughts, emotions and physical sensations (Lau et al., 2004; Segal et al., 2013). In MBCT for IBS, the aim was to reduce the maintaining factors rather than the risk factors, because IBS is a chronic, rather than episodic illness. Therefore, the aim was to break a vicious cycle of symptoms and cognitive reactions to symptoms that are posited to maintain and exacerbate IBS. It was hypothesised that MBCT for IBS would affect the maintaining factors of IBS by changing how IBS patients relate to their symptoms as well as their thoughts about and emotional reactions to symptoms. Specifically, it was suggested that the decentred perspective and interoceptive awareness that MBCT for IBS aims to develop would help patients to shift away from discrepancy-based, self-referential processing of the illness and illness specific thoughts and fears towards sensory, present-moment focused and accepting processing of these stimuli. As such, although there are differences in treatment models and change trajectories of depression and IBS the aim of both treatments was to change the *processing* of thoughts, emotions and sensations. That is, similarities exist in the hypothesised role of self-referential and language based processing of illness-related stimuli. For example, even though the content of thoughts related to depression is different from the content of thoughts related to IBS (e.g., low self-worth in depression, the meaning of pain in IBS), a commonality of both treatments is the aim to change how these thoughts are processed. Comparing treatment models of IBS and

depression also highlights importance of adapting mindfulness-based interventions to specific illness groups as advocated by Dimidjian and Segal (2015).

Comparing the post-treatment and follow-up effects sizes of three randomised controlled studies on MBIs for IBS (i.e., MBSR (Zernicke et al., 2013), MBSR adapted for IBS (Gaylord et al., 2011) and MBCT adapted for IBS (the current study)) shows that different types of MBIs may differ in their effects on various outcomes. In terms of IBS illness severity and quality of life, the adapted MBSR for IBS course reported by Gaylord and colleagues (2009, 2011) appears to have more lasting therapeutic effects (at six and twelve months follow-up) (Faurot et al., 2014) than the more generic (i.e., not specifically adapted to IBS) MBSR course reported by Zernicke and colleagues (2013). This indicates that a mindfulness treatment that is specifically adapted to IBS patients may be more effective than a generic course in the long-term. A long-term evaluation (e.g., one year or longer follow-up) of the current MBCT for IBS treatment is thus needed to determine if it shows lasting therapeutic effects on symptom severity and quality of life. Compared to the current study, the MBSR for IBS course had a larger effect on symptom reduction than the MBCT for IBS course in the intention to treat analysis: symptom reduction at post treatment was 11% in MBCT for IBS and 26% in MBSR for IBS; symptom reduction at follow-up was 20% in MBCT for IBS and 38% in MBSR for IBS. Thus, when purely comparing changes in IBS symptom severity, MBSR for IBS might be a better choice, than MBCT for IBS. However, when also taking into account quality of life, and psychological distress, MBCT for IBS seems to have larger effects in IBS patients. For example, the increase in quality of life at post-treatment was 21% in MBCT for IBS and 15% in MBSR for IBS and the increase in quality of life at follow-up was 26% in MBCT for IBS and 18% in MBSR for IBS in the ITT sample. In addition, the MBSR for IBS study showed no significant changes in symptoms of depression after the course whereas the MBCT for IBS course did (ITT analysis; albeit a small to medium effect size). When interpreting these effects it should be noted that MBCT for IBS was compared to a waiting list control condition, whereas MBSR for IBS was compared to an active control condition, so comparatively larger effect sized would be expected in the MBCT for IBS study. A simple recommendation as to

which treatment (MBCT or MBSR for IBS) is better is not advisable at this point. The choice of treatment may also depend on patient profiles (e.g., levels of symptom severity, quality of life and psychological distress) and individual preferences.

To determine the clinical efficacy of MBCT for IBS, it would be necessary to directly compare MBCT for IBS to the currently recommended psychological treatments for IBS (e.g., CBT (National Institute for Health and Care Excellence [NICE], 2008, updated 2017)). A good example of comparing MBCT with currently recommended treatments is the PREVENT trial (Kuyken et al., 2015; Kuyken, Byford, et al., 2010a, 2010b). If MBCT for IBS were found to be similarly efficacious as CBT in reducing the symptom of IBS, then adding the course to the collection of available treatment options would broaden the choices available for patients with IBS. In addition, compared to CBT and interpersonal psychotherapy, the current MBCT for IBS course is less resource-intensive. This is because MBCT for IBS is a group-based treatment which can be taught in small to medium sized groups (up to 20 participants), whereas conventional psychological therapies are typically conducted in one-to-one settings. Accessibility and availability of psychological treatments could therefore be improved as more patients can be helped with fewer resources. However, despite these advantages, the implementation of MBCT for recurrent depression into UK NHS services has met barriers (e.g., human resources, financial, institutional culture) and equal accessibility across the UK remains a long-term project (Crane & Kuyken, 2013; Rycroft-Malone et al., 2017).

Despite MBCT's emphasis on home practice of meditation in patients with recurrent depression (Segal et al., 2013), the predicted relationship between levels of home practice engagement and changes in outcome measures was not found. Specifically, none of the changes in patient reported physical or psychological outcome measures were related to either the frequency or the total amount of home practice. A recent meta-analysis found a small but significant correlation between the amount of home practice and improvements in outcomes across MBSR and MBCT studies ($r = 0.26$), with no differences between psychological or physiological outcomes (Parsons, Crane, Parsons, Fjorback, & Kuyken, 2017), which contrasts the findings of

the current study. One reason for the null-findings in the current study may be that the home practice records were incomplete. Only 55% of participants had complete home practice records and 74% had handed in at least two thirds (4/6) of the home practice logs. Therefore the incompleteness of home practice records prevents drawing firm conclusions about the role of home practice. Digital data acquisition methods using smartphones may help improve the number and accuracy of home practice records in future studies. For example, Day (2013) used an online diary to record participants daily meditation practice and Gross (2011) employed an electronic logger device to record minutes of home practice.

The study had a number of noteworthy strengths. Firstly, participant's baseline measures were taken before randomization took place, reducing the likelihood that any potential differences at baseline were due to non-random factors. Comparing the two groups at their first assessment showed that the MG had significantly lower quality of life and significantly higher anxiety scores. To confirm that differences at baseline did not interfere with improvements in the primary outcome variable (i.e., IBS symptom severity), the ITT analysis of changes in treatment outcomes between groups was repeated with baseline scores of quality of life and anxiety as covariates. The analysis showed that the interaction at post-treatment was no longer significant but the MG had still significantly higher symptom reductions at follow-up. Secondly, results were reported given intention to treat (ITT) and per protocol analysis for the primary outcome IBS symptom severity and the secondary outcome IBS quality of life. ITT analysis gives an unbiased comparison of treatment groups that may occur if attrition between groups is unequal. The current study had approximately equal withdrawal rates across groups. ITT analysis also mirrors actual clinical practice (Gupta, 2011; "National Institute for Health and Care Excellence," 2017), when not all patients adhere to the treatment regimen. It is a more conservative estimate of treatment efficacy particularly in small studies when results of treatment effects may be overestimated due to lower precision (Sterne & Egger, 2001). The per-protocol (PP) analysis has the advantage that it gives a more accurate estimation of the effects when participants actually complete the treatment rather than a diluted effect due to inclusion of non-compliant subjects (Gupta, 2011). This means that by

using PP analysis more can be learned about the actual treatment and its effects. For example, the treatment as defined in the protocol can be assessed and improved upon and responders and non-responders can be identified. Not surprisingly, in this study differences in outcomes were larger in the PP analysis compared to the ITT analysis.

6.5.1 Limitations

The study has several limitations that need to be taken into account when interpreting the findings, and which should be addressed in future studies. Firstly, the sample size of this study is small and a possible selection bias may have been introduced by recruiting participants through advertisements. Study advertisements can introduce a systematic difference between those patients that self-select to participate and those that do not, thus limiting the generalizability of the findings (Kazdin, 2016). For example, only patients that had previously noticed an association between situations that they experienced as stressful and their symptom severity may have opted to try a psychological intervention. The selection bias is particularly relevant as the IBS patient population is relatively heterogeneous – with a complex interplay of psychological, social and biological factors contributing to the illness (Enck et al., 2016). Therefore MBCT for IBS may be effective for a particular subgroup of patients only – those whose symptom manifestation is influenced to a larger degree by psychological factors. The intervention may be less effective for IBS patients whose symptom severity is influenced to a larger degree by dietary factors. Additionally, the study was run with female participants only, to reduce heterogeneity in this small-scale study. As men and women often react differentially to pharmacological agents (Fillingim, King, Ribeiro-Dasilva, Rahim-Williams, & Riley, 2009; Keers & Aitchison, 2010), the possibility that men and women react differently to the active ingredients of MBCT for IBS was the main reason to recruit women only. Given the small scale of this study, subgroup analysis based on gender would have been underpowered and the validity of the results may have been jeopardized. IBS is more common in women than men (patients are 60-70% female) and the findings may therefore still be generalizable to a large subgroup of patients. However, the results have to be considered as preliminary and a replication with a larger, more representative sample is needed.

Secondly, a small sample size decreases the power to detect small effects and therefore increases chances of making type 2 errors (i.e., not detecting genuine effects). Given the small sample size and the estimated small effect between home practice and outcomes that was previously detected in MBCT and MBSR trials (Parsons et al., 2017), insufficient power in this study may have reduced our chances of finding an effect if it was there.

A third limitations is that the control group in the study did not undergo any interventional components and was therefore an inactive control group (Kazdin, 2010). Therefore, changes in outcome measures may not be a result of MBCT for IBS per se but could instead be due to non-specific treatment factors such as therapist contact, social bonding with people who have similar problems and treatment expectations. Indeed, it was found that treatment expectations before the course started predicted improvements in IBS symptom severity. On one side, this suggests that response biases could be implicated in the self-reported symptom reduction. Alternatively, this points to the biopsychological nature of IBS and the 'power' of expectations (Elsenbruch & Enck, 2015). Specifically, the link between expectations and treatment outcomes in IBS patients signals that psychological factors can impact physiological functioning. For example, brain imaging studies have demonstrated neurobiological and psychobiological correlates of placebo-responses along the brain-gut axis showing that placebo effects go beyond response biases (Elsenbruch & Enck, 2015). Finally, previous studies have established that expectations play a large part in the placebo effect on IBS symptom severity, pain, visceral pain and nausea (Benedetti, 2005; Elsenbruch & Enck, 2015; Kaptchuk et al., 2010; Koyama, McHaffie, Laurienti, & Coghill, 2005), pointing to the need to control for treatment expectations with active control groups in future studies evaluating this programme.

6.5.2 Conclusion

Patients with IBS who participated in MBCT for IBS experienced significant reductions in IBS severity, decreases in symptoms of depression, anxiety and stress and improvements in quality of life and mindfulness. Treatment expectations predicted improvements in symptoms, highlighting the importance of setting realistic yet positive expectations in clinical treatment settings. This wait-

list controlled trial explored the therapeutic effects of MBCT for IBS and found promising results. To determine treatment efficacy and generalizability of the treatment, a larger scale study with a longer-term follow-up that also includes men with IBS would be needed.

Chapter 7: Mechanisms of Change in Mindfulness-Based Cognitive Therapy (MBCT) for Irritable Bowel Syndrome (IBS)

7.1 Abstract

7.1.1 Background and objectives

Chapter 6 provided preliminary evidence that Mindfulness-Based Cognitive Therapy for patients with Irritable Bowel Syndrome (MBCT for IBS) can reduce the symptoms of IBS and improve IBS related quality of life. In this Chapter, I investigate if MBCT for IBS, which promotes accepting present moment awareness, decentring, interoceptive awareness, and control over attention, targets the underlying maintaining factors of IBS, including maladaptive illness specific cognitions, biased self-referential and self-judgemental processing and deficits in attentional control in patients with IBS.

7.1.2 Design and methods

Data from the randomized waiting list control trial described in Chapter 6 were examined using per protocol analysis (n = 44). At four time-points (pre-treatment, 2 Weeks intra-treatment, post-treatment and at six weeks follow-up) IBS patients in the mindfulness group (MG) and the waiting list (WL) group were assessed on self-reported pain-catastrophizing, IBS-catastrophizing, visceral anxiety sensitivity, non-judgemental awareness as well as reaction time based attentional control and implicit self-referential processing of illness and health. Mixed-design ANOVAs were used to assess the effect of MBCT for IBS on each hypothesised mediator before regression-based mediation analyses were performed to examine through which mediators MBCT exerts its effect on symptom severity and quality of life.

7.1.3 Results

Mediation analyses showed that MBCT induced changes in visceral anxiety sensitivity, pain-catastrophizing, IBS-catastrophizing, and non-judgemental awareness mediated reductions in IBS symptom severity. Reductions in biased self-referential processing of illness and health after two weeks of MBCT for IBS predicted changes in non-judgemental awareness at post-treatment. The treatment did not affect attentional control. Improvements in quality of live were driven by reductions pain catastrophizing, visceral anxiety sensitivity and increases in non-judgemental awareness. Changes in symptom severity predicted, but did not mediate changes in quality of life.

7.1.4 Conclusion

MBCT for IBS may reduce IBS symptoms and quality of life through reducing gastrointestinal-specific anxiety and catastrophic magnifications of the threat value of symptoms paired with a shift towards self-referential processing of health related information and more accepting, non-judgemental processing of emotions and thoughts. Further investigations linking specific intervention techniques with cognitive and biological change mechanisms are needed in order to develop a maximally potent psychological intervention for IBS.

7.2 Introduction

How does Mindfulness-Based Cognitive Therapy adapted for patients with IBS (MBCT for IBS) reduce the symptoms of IBS? Gaining a deeper understanding of the mechanisms through which effective psychological treatments reduce symptoms is integral to improving treatments of disorders of the brain-gut interaction such as IBS. MBCT for IBS has been shown to significantly reduce IBS symptom severity (Chapter 6). In line with the National Institute of Health (NIH) stage model of intervention design (Onken et al., 2014), the aim of the current study was to examine the specific therapeutic mechanisms through which MBCT for IBS may exert its influence on IBS symptom severity.

The combination of mindfulness mediation and psychoeducation provided through MBCT for IBS aims to cultivate a *decentred perspective*, characterized by paying meta-cognitive, non-judgemental attention to the thoughts, emotions and sensations of the present moment (Crane et al., 2016; Segal et al., 2013), *interoceptive awareness*, an approach oriented, accepting awareness of physical sensations (Crane et al., 2016; Farb et al., 2015) and *attention regulation abilities* (Crane et al., 2016; Hölzel et al., 2011; Tang et al., 2015). Based on the postulated working mechanisms of MBCT (Crane et al., 2016; Segal et al., 2013) and mindfulness meditation in general (Farb et al., 2015; Hölzel et al., 2011; Tang et al., 2015) as well as empirical findings of the effect of mindfulness on IBS (Garland et al., 2012), several mechanisms of change have been suggested during the development of MBCT for IBS (Chapter 5).

Firstly, decentring involves an observer perspective in which thoughts are observed as mental events (Segal et al., 2013; Williams, 2008), rather than facts about oneself or one's illness. This is hypothesised to short-circuit the maladaptive thinking involved in maintaining IBS symptomatology. Specifically, decentring may attenuate illness specific catastrophizing and visceral anxiety sensitivity, two well-known maintaining factors of IBS illness severity (Windgassen et al., 2017). Visceral anxiety sensitivity is characterized by attentional pre-occupation with symptom-related thoughts (e.g., "I often worry about problems in my belly") coupled with anxiety of gastrointestinal symptoms and hypervigilance of sensations in the

abdomen (Labus et al., 2004). Catastrophizing involves cognitive elaborations that perseverate on negative predictions about symptom progression (e.g., "When I feel pain I become afraid that the pain will get worse") and the impact of the illness on one's live (e.g., "As soon as I feel abdominal discomfort I begin to worry and feel anxious") (Sullivan et al., 1995). Indeed, a recent study suggests that mindfulness mediation can affect these cognitive maintaining factors of IBS (Garland et al., 2012).

Secondly, through practicing detailed awareness of bodily sensations with a non-judgemental attitude, mindfulness is hypothesised to increase both interoceptive awareness (i.e., awareness of stimuli originating inside the body) and the use of perceptual inference (i.e., adjusting expectations of bodily sensations based on actual sensations) (Farb et al., 2015). These processes are hypothesised to be implicated in interoceptive recovery, which is an intentional shift of attention away from thought-based, emotional aspects of an experience and towards to the sensory aspects of the experience (Farb et al., 2010; Garland et al., 2012). This is thought to prevent the perpetuation of aversive emotional and physiological disturbances of cognitive elaboration (Farb et al., 2010; Garland et al., 2012). In MBCT for IBS interoceptive recovery processes are hypothesised to reduce the heightened threat appraisal and hypervigilance implicated in visceral anxiety sensitivity.

Thirdly, MBCT for IBS may be therapeutic for IBS patients because mindfulness may change the way emotional as well as illness and health related information are attended to and processed (Garland et al., 2012). For example, mindfulness has been associated with more objective, self-detached processing of sensory events (Farb et al., 2007). As such, by practicing accepting interoceptive awareness from a decentred perspective, MBCT for IBS may reduce biased self-referential processing of illness and health, which was recently found in patients with IBS (Chapter 2). Based on the assumptions that a sense of self and embodiment arises from the perception of interoceptive signals (Farb et al., 2015; Hölzel et al., 2011; Tang et al., 2015) and that engaging in perceptual inference relaxes appraisal tendencies of bodily states (Farb et al., 2015), increasing interoceptive awareness should be reflected in a shift in self-processing (Farb et

al., 2015) and hence reduced self-health discrepancy. In addition, repeated mindfulness practice is assumed to promote a non-judgemental attitude (Baer et al., 2006), which I hypothesised to be a possible therapeutic mechanism of MBCT for IBS (Chapter 5). I suggested that the shift away from self-appraisal towards more accepting processing of distressing emotions and thoughts (Baer et al., 2008, 2006) would reduce the potential impact of negative emotions and thoughts on IBS symptoms. Specifically, adopting a non-judgemental and accepting attitude may prevent the physiological concomitants of stress and perseverative cognition (e.g., worry) (Ottaviani et al., 2015; Thayer et al., 2012) that may trigger symptoms in the abdominal tract (Bhatia & Tandon, 2005). Clinical studies have shown that changes in implicit biases occur prior to and predict later self-observed clinical changes (Harmer, O'Sullivan, et al., 2009; Harmer et al., 2011; Harmer, Goodwin, et al., 2009; Murphy et al., 2008; Reinecke, Waldenmaier, et al., 2013). For example, based on clinical research on CBT for anxiety disorders it has been suggested that over time, early "changes in cognitive biases will translate into global therapeutic effects" (Reinecke, Waldenmaier, et al., 2013, p. 1068). In this context, I aim to investigate if changes in implicit self-referential processing of illness and heath are early markers of changes in non-judgemental awareness. Both, reductions in biased processing of illness and health and increases in non-judgemental awareness indicate a relaxation in appraisal tendencies in relation to the self. In addition, patients in the MBCT for IBS group are taught to engage in perceptual inference at first with physical sensations before applying it to thoughts and emotions. Therefore, it was predicted that changes in implicit self-referential processing of illness and health, driven by reductions in self-health discrepancy, would precede and predict increases in explicit non-judgemental awareness in IBS patients.

Mindfulness meditation practice is hypothesised to lead to changes in mindfulness and some qualities of mindfulness may be more readily associated with changes in self-referential, accepting processing than others. The most comprehensive scale of mindfulness, the five factor mindfulness questionnaire (FFMQ) measures five aspects (in subscales) that are thought to represent the qualities of mindfulness (Baer et al., 2006). Of all the subscales of the FFMQ, the

non-judgemental awareness subscale seems to best capture the qualities of acceptance and (non-) self-referential processing. It measures a tendency to be self-critical and to appraise one's private experiences in relation to one's sense of self. An example would be to disapprove of oneself for having certain emotions or thoughts. As such, increases in scores on the non-judgemental awareness subscale may resemble a shift in self-processing. As explained above, this shift may be predicted by an early, implicit shift in self-processing in the treatment of MBCT for IBS: reductions in biased self-referential processing of illness and health. The other subscales of the FFMQ, non-reactivity, observing, describing and acting with awareness do not capture acceptance *and* self-referential processing to the same extent. For example, the non-reactivity scale measures how well people can allow and let go of thoughts and feelings without having to immediately react to them. This subscale appears to capture many of the qualities ascribed to a decentred awareness. However, even though non-reactivity requires a level of detachment from private experiences, it does not entail the reduction of self-appraising tendencies represented by non-judgemental awareness. The observing subscale measures how much people notice internal (e.g., warmth) and external (e.g., a bird chirping) experiences, and is therefore more closely related to attentional functions. Similarly, the acting with awareness subscale measures to what extent people attend to their present moment activities (e.g., if a person is aware that they are driving or if their mind has wandered off). The last subscale, 'describing', refers to how accurate people can describe their emotions, beliefs and experiences in words, which seems to refer to a shift in accurate perception of emotions and a willingness to communicate these rather than a shift in self-referential processing.

Finally, Mindfulness-Based Interventions are theorized to support the development of greater attentional regulation such as attentional control (Crane et al., 2016; Hölzel et al., 2011; Jha et al., 2007; Tang et al., 2015). Indeed, several studies have shown that the practice of mindfulness can improve attentional control (Ainsworth et al., 2013; Becerra et al., 2017; Tang et al., 2007) and that an adapted MBCT course (for students) can affect attentional control after two course sessions (Chapter 4). Low attentional control in IBS patients has been linked with higher levels of

catastrophizing (Henrich & Martin, 2018 (Chapter 3)) and improvements in attentional control have previously been associated with improvements in negative intrusive thoughts (Fox et al., 2015). It was therefore hypothesised, that patients in the MBCT for IBS group would show increased attentional control after two weeks of MBCT for IBS and that this change in attentional control would be associated with reductions in catastrophizing thoughts about IBS.

The therapeutic benefit of MBCT for IBS has also been evident in improvements in quality of life (see Chapter 6). IBS is typically characterized by mild to severe reductions in healthy activities (e.g., movement, eating), social, interpersonal (e.g., relationships, sexual encounters) and intrapersonal (e.g., health worries) functioning (Drossman et al., 2000; Patrick et al., 1998). Across a range of previous psychological interventions for IBS, therapeutic effects on quality of life were shown to arise as a function of changes in symptoms as well as maladaptive gastrointestinal specific cognitions (Windgassen et al., 2017). Whilst the main aim of this Chapter was to elucidate the psychological mechanisms of change of that link the practice of MBCT to reductions in symptom severity, I will also explore potential mediating factors of IBS related quality of life as this is an important patient centred outcome.

To conclude, it was hypothesised that MBCT for IBS may attenuate maladaptive illness-specific cognitions in order to relieve IBS symptoms (Garland et al., 2012). Secondly, mindfulness practice is expected to increase attentional control (Ainsworth et al., 2013; Hölzel et al., 2011; Tang et al., 2015), and this increase is hypothesised to aid the reduction of IBS-specific catastrophizing. Thirdly, it is predicted that participating in MBCT changes the processing of experiences (Crane et al., 2016; Farb et al., 2015) – that is patients will learn to relate non-judgementally to illness and health related information as well as emotions and thoughts. The switch in the processing of experiences is predicted to be directly related to symptom relief.

7.2.1 Hypotheses

The current study aimed to test the following hypotheses:

1) MBCT for IBS is associated with reductions in visceral anxiety sensitivity, pain-catastrophizing and IBS-catastrophizing at post-treatment and at follow-up compared to the control group.
2) MBCT for IBS is associated with increases in non-judgemental awareness at post-treatment and at follow-up compared to the control group.
3) MBCT for IBS is associated with improvements in attentional control after two weeks of the treatment compared to the control group.
4) MBCT for IBS is associated with changes in implicit self-referential processing of illness and health, driven by reductions in self-health discrepancy after two weeks of the treatment compared to the control group.
5) In the treatment of irritable bowel syndrome with MBCT for IBS, changes in visceral anxiety sensitivity, pain-catastrophizing, IBS catastrophizing and non-judgemental awareness at post-treatment mediate changes in IBS symptom severity at follow-up.
6) In the treatment of irritable bowel syndrome with MBCT for IBS, changes in implicit self-referential processing of illness and health at Week 2 of MBCT for IBS predict increases in non-judgemental awareness at post-treatment which in turn mediates changes in IBS symptom severity at follow-up.
7) In the treatment of irritable bowel syndrome with MBCT for IBS, improvements in attentional control at Week 2 of MBCT for IBS predict reductions in IBS-catastrophizing at post-treatment which in turn mediates changes in IBS symptom severity at follow-up.

7.3 Methods

7.3.1 Design and general procedure

A detailed description of the study's procedures can be found in Chapter 6. The study 'Mindfulness for IBS (MIBS) was approved by the NHS Health Research Authority (National

Research Ethics Service) (Reference Number 15/SC/0618). The study had a randomized waiting list controlled design.

7.3.1.1 Participants

Sixty-seven (67) eligible women (for eligibility criteria please see Chapter 6) with IBS completed the first assessment and were randomized to the Mindfulness Group (n = 36) or the Waiting list group (n = 31). Fifty-six participants completed the second (intra-treatment) assessment (MG = 31, WL = 25), 48 participants completed the post-treatment assessment (MG = 25, WL = 23) and 44 participants completed the follow-up assessment (MG = 23, WL = 21).

7.3.1.2 Intervention and control groups

Briefly, MBCT for IBS is a six weeks mindfulness-based programme specifically designed for patients with IBS. It consists of six weekly two-hour sessions, as well as six to seven hours of homework between sessions. The course was taught by two clinical psychologists experienced in delivering MBCT. During the course participants learn key illness-specific information from the biopsychosocial and cognitive model of IBS. Crucially it contains exercises which shed light on the cognitive processes that maintain illness severity and suggestions for how to work with these in a mindful way. The aim of the programme is to teach a different way of relating to thoughts, emotions and physical sensations (i.e., a decentred perspective) and to increase sensory experiential processing via CT based psychoeducation and mindfulness meditation practices. This is hypothesised to lead to reductions in pain- and IBS-catastrophizing, visceral sensitivity anxiety and biased processing of illness and health. Meditation practices that focus on the accepting observation of private events are hypothesised to lead to increased non-judgemental awareness. Meditation practices which are thought to increase concentration such as the body-scan and the anchor of the breath meditation are hypothesised to increase attention control. The session content and structure can be found in more detail in Chapters 5 and 6. All participants (i.e., those assigned to the immediate treatment group and those assigned to the waiting list group) were instructed to follow the testing schedule described in Chapter 6.

7.3.2 Self-report outcome measures

Internal consistency is reported using Cronbach's alpha (α) using all participants that completed baselines assessments.

7.3.2.1 IBS symptom severity

IBS symptom severity was recorded with the Gastrointestinal Symptoms Rating Scale for IBS (GSRS-IBS) (Wiklund et al., 2003). The GSRS-IBS has 13 items which are rated a 1 to 7 point scale that ranges from 'no discomfort at all' to 'very severe discomfort'. The maximum score (worst symptom severity) is 91. More details about the scale and the internal reliability in in this study's sample can be found in Chapter 6.

7.3.2.2 IBS quality of life

Quality of life was assessed with the 34-item IBS quality of life instrument (IBS-QOL) (Patrick et al., 1998) which measures IBS related dysphoria, interference with activity, body image, health worry, food avoidance, social reactions, sexual and relationship functioning. More details about this scale can be found in Chapter 6.

7.3.2.3 Visceral Anxiety Sensitivity

Gastrointestinal specific anxiety was assessed with a 15-item Visceral Sensitivity Index (VSI) (Labus et al., 2004). Items relate to anticipatory anxiety about and hypervigilance for sensations in the abdominal region (e.g., "I am constantly aware of the feelings I have in my belly"). The level of agreement with the item's content is reported on a 1 (strongly agree) - 6 (strongly disagree) scale. Items were reverse-scored and higher scores reflect higher visceral anxiety sensitivity. Cronbach's alpha in the current sample was .91. More information about this scale can be found in Chapter 3.

7.3.2.4 Pain Catastrophizing

The level of believe in catastrophizing thoughts about pain is measured with the 13-item Pain-Catastrophizing Scale (PCS) (Sullivan, 2009; Sullivan et al., 1995). The degree of belief in the thoughts represented by each item is assessed with a 5-point scale (0 = not at all, 4 = all the time). The PCS has three subscales which assess rumination (four items; e.g., "I keep thinking

about how much it hurts"), magnification (three items; e.g., "I wonder whether something serious may happen") and helplessness (six items; e.g., "I feel I can't go on"). A cut-off score of 30 or higher on the PCS is considered clinically relevant and it represents the 75th percentile from normative data (Sullivan, 2009). The PCS has very good internal consistency (Cronbach's alpha for the total PCS = .87) (Sullivan et al., 1995). In the current study, Cronbach's alpha was .95 at t.1.

7.3.2.5 IBS-Catastrophizing

The Gastrointestinal Cognitions Questionnaire (GI-Cognitions) is a 16-item questionnaire that measures the extent to which participants believe in catastrophic cognitions about their IBS symptoms on a 5-point scale (0 = not at all, 4 = very much) (Hunt et al., 2014b). The range of catastrophic cognitions covers the topics of life-interference, disgust and negative social consequences. In the current study, Cronbach's alpha was .88. More information about this scale can be found in Chapter 3.

7.3.2.6 Non-judgemental awareness

Non-judgemental awareness of inner experiences was assessed with the 'nonjudge' subscale of the short form of the Five-Factor Mindfulness Scale (FFMQ-24) (Baer et al., 2006; Bohlmeijer et al., 2011). The subscale consists of five items that measure how much people judge themselves negatively and evaluate their thoughts and emotions (e.g., "I tell myself that I shouldn't be thinking the way I'm thinking" or "I think some of my emotions are bad or inappropriate and I shouldn't feel them"). The 'nonjudge' subscale has been shown to have good internal consistency (Cronbach's α = .86) and it is highly sensitivity to change (Bohlmeijer et al., 2011). Cronbach's alpha in the current sample was .86.

7.3.3 Reaction-time based outcome measures

7.3.3.1 Attentional control

Attentional control was measured with the brief reaction-time based Attention Network Task (ANT) (Fan et al., 2002; Hou et al., 2014). The task, data preparation and the formula for

calculating the conflict score (i.e., the index of attentional control) in this study was identical to the ANT described in Chapter 3. Please note that higher conflict scores reflect poorer attentional control.

7.3.3.2 Self-referential processing of illness and health

Self-health discrepancy and identification with illness (self-referential processing of illness and health) was measured with the Implicit Association Task (IAT) (Greenwald et al., 1998; Teachman et al., 2008). This task is identical to the task used in Chapter 2, and more information about the task design, its stimuli, and the data preparation can be found there. Briefly, data from this task were prepared using the same procedure as described in Chapter 2 (using the D6 algorithm developed by Greenwald, Nosek and Banaji (2003)). The index of implicit self-referential processing of illness and health is called the IAT-D score. A positive IAT-D score reflects relatively faster RTs for self-illness associations and negative score reflects relatively faster RTs for self-health associations.

7.3.4 Statistical analyses

Per-Protocol (PP) analysis was conducted for all outcomes. Statistical analyses were performed with IBM SPSS statistics, Version 24 (IBM Corp., 2016) and mediation analyses were conducted with the PROCESS Macro for SPSS (Hayes, 2012, 2013). Firstly, the effect of the intervention on the predicted mediators was assessed separately using mixed design ANOVAs for each outcome. Individual mediation effects of visceral anxiety sensitivity and pain-catastrophizing were analysed using simple mediation models (PROCESS model 4) and 5,000 bootstrap samples. The PROCESS programme employs regression-based analysis, bootstrapping and confidence intervals to assess effects and their significance. Within the PROCESS model, indirect effects of a predictor (X) on an outcome (Y) are considered mediation effects (see Figure 7.1). These indirect effects are calculated as interaction effects by multiplying the effect of the predictor on the proposed mediator (path (a)) by the effect of the mediator on the outcome (path (b)) (indirect effect = a*b) (see Figure 7.1). The significance of direct and indirect effects is denoted using unstandardized regression coefficients (*b*) with 95% Confidence Intervals (95% CIs). CIs that do

not cross zero are considered genuine effects at the 0.05 significance level (when CIs cross zero the chance that the effect is not present is greater than 5%). The advantage of using bootstrapped CIs is that they do not rely on the assumption that the data are normally distributed. For example, bootstrapped CIs are more powerful than the Sobel test of significance in smaller samples (Hayes & Rockwood, 2016; Preacher & Hayes, 2004). A serial mediation model (model 6) was used to test mediation via two sequential mediators (self-referential processing of illness and health at t.2 and non-judgemental awareness at t.3; attentional control at t.2 and IBS-catastrophizing at t.3).

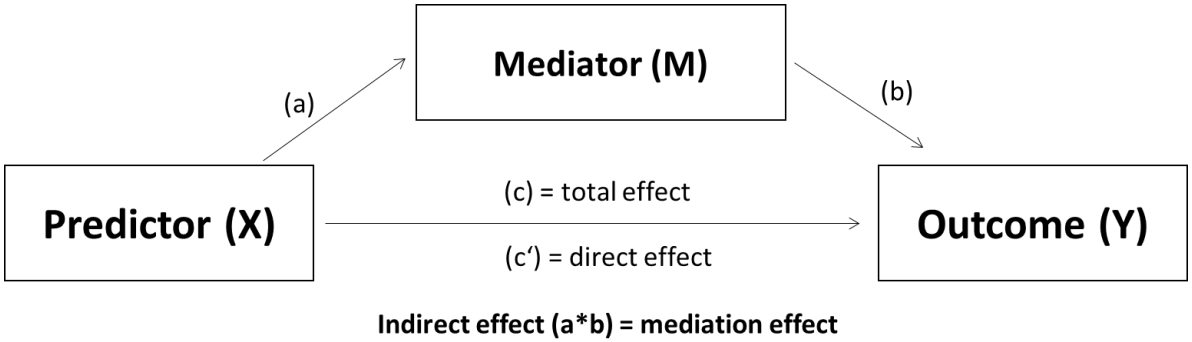


Figure 7.1. Simple mediation model using PROCESS. ***Note.*** **(a) Denotes the effect of the predictor on the mediator, (b) denotes the effect of the mediator on the outcome, (c) denotes the effect of the predictor on the outcome and (c') denotes the effect of the predictor on the outcome when the mediator is accounted for. (a*b) is the indirect effect of the predictor on the outcome via the mediator (the mediation effect).**

7.4 Results

7.4.1 Participant characteristics

The characteristics of the participants in each group can be seen in Table 7.1. Participants in the MG and WL group had similar baseline scores of IBS symptom severity, depression, non-judgemental awareness, pain-catastrophizing, IBS-catastrophizing, self-referential processing of illness and health and attentional control. However, participants in the MG had significantly higher scores of visceral anxiety sensitivity than those in the WL group. The demographic characteristics of the groups can be seen in Chapter 6, Table 6.1.

Table 7.1. Comparison of baseline characteristics of the participants that were included in the per-protocol analysis, split by group assignment.

	MG[1] (n = 23)		WL[2] (n = 21)		
	Mean	(SD)	Mean	(SD)	t-value
IBS Symptom Severity (GSRS-IBS[3])	45.65	(11.30)	43.00	(12.60)	0.736
Non-judgemental awareness (FFMQ[5])	12.39	(5.10)	13.76	(3.35)	-1.063[a]
Visceral Anxiety Sensitivity (VSI[6])	64.43	(13.43)	54.57	(11.59)	2.596*
Pain-Catastrophizing (PCS[7])	22.74	(12.26)	15.67	(10.92)	2.013[b]
IBS-Catastrophizing (GI-C[8])	29.78	(12.64)	27.29	(12.51)	0.658
Self-referential processing of illness and health (IAT[9])	-0.45	(0.45)	-0.58	(0.43)	1.005
Attentional control (conflict score of the ANT[10])	70.20	(40.91)	71.98	(23.46)	-.168[c]

*p < .05; **p < .01; ***p < .001; [a] Equal variances not assumed; [b] Trending towards significance at p = .051; [c] n in the WL group was 19, as 2 participants had error rates > 3SD above the mean error rate

[1]Mindfulness group; [2]Waiting list group; [3]Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome; [4]Five Factor Mindfulness Questionnaire non-judge subscale; [5]Visceral Sensitivity Index; [6]Pain-Catastrophizing Scale; [7]Gastrointestinal-Cognitions Questionnaire; [8]Implicit Association task; [9]Attention Network Task

7.4.2 Between groups analysis

Firstly, the effect of MBCT for IBS on each of the predicted mediators (visceral anxiety sensitivity, pain and IBS catastrophizing, non-judgemental awareness, self-referential processing of illness and health and attentional control) was assessed separately using mixed design ANOVAs for each outcome.

7.4.2.1 Visceral Anxiety Sensitivity

PP analysis indicated that there was a main effect of time $F(2.196, 92.229) = 9.288$, $p < .001$, $\eta p^2 = .18$) and no main effect of group ($F(1, 42) = 0.276$, $p = .602$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.196, 92.229) = 8.179$, $p < .001$, $\eta p^2 = .16$), (see Table 7.2 for means and SDs; where applicable Greenhouse-Geisser corrected degrees of freedom and p-values are reported), indicating that overall participants in the MG experienced significantly greater reductions in visceral anxiety sensitivity compared to baseline than did participants in the WL group. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction ($F(1, 42) = .960$, $p = .333$, $\eta p^2 = .02$), indicating that there were no group dependent changes in visceral anxiety sensitivity between t.1 and t.2. The contrasts showed a significant group x time interaction between t.1 and t. 3 ($F(1, 42) = 12.959$, $p = .001$, $\eta p^2 = .24$), indicating that the MG decreased significantly more in visceral anxiety sensitivity than the WL group (please see Table 7.2 for means and SDs, and Figure 7.2). In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 42) = 8.430$, $p = .006$, $\eta p^2 = .17$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in visceral anxiety sensitivity compared to baseline than did those in the WL group (see Table 7.2 for means and SDs, and Figure 7.2).

Additional planned simple effect contrasts showed that the participants in the MG did not decrease significantly in visceral anxiety sensitivity from t.1 to t.2 (*mean difference* -2.392, $p = .244$, 95%CI [-6.47, 1.69]). However, participants in the MG decreased significantly in visceral anxiety sensitivity between t.1 and t.3 (*mean difference* -14.913, $p < .000$, 95%CI [-20.80, -9.03]) and between t.1 and t.4 (*mean difference* -14.391, $p < .000$, 95%CI [-20.71, -7.87]). The

participants in the WL group did not decrease significantly in visceral anxiety sensitivity from t.1 to t.2 (*mean difference* -0.476, p = .823, 95%CI [-3.79, 4.75]), from t.1 to t.3 (*mean difference* .286, p = .926, 95%CI [-5.87, 6.45]) or from t.1 and t.4 (*mean difference* -.810, p = .812, 95%CI [-7.64, 6.02]).

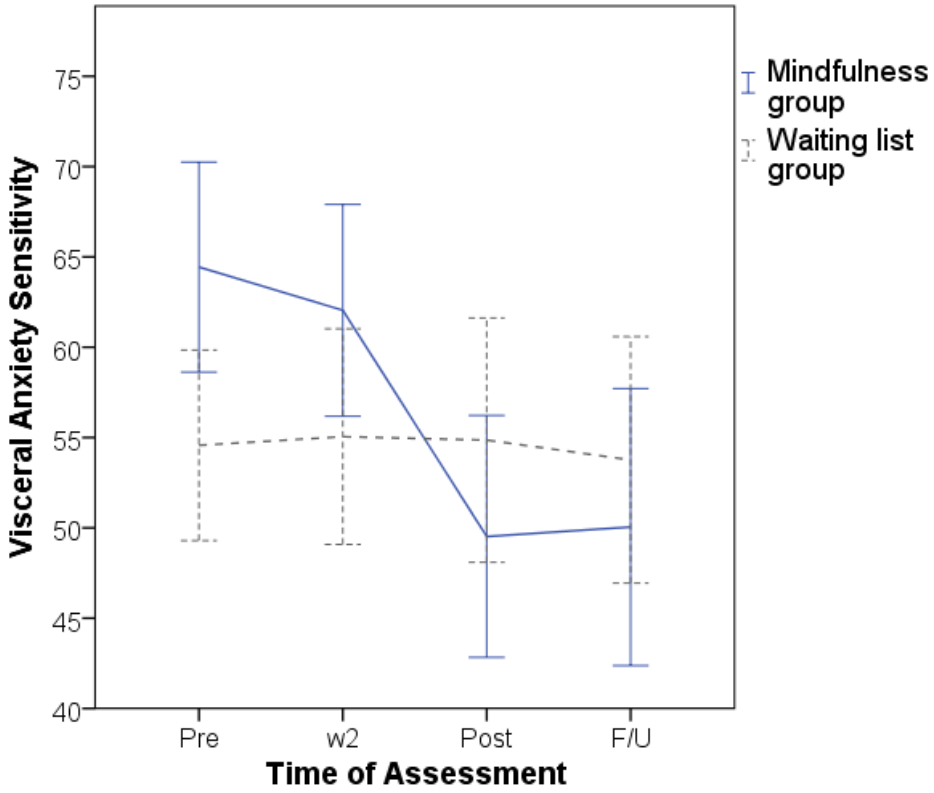


Figure 7.2. Levels of visceral anxiety sensitivity at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2), post-treatment (Post) and Follow-up (F/U) for the mindfulness group and the waiting list control group. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

7.4.2.2 Pain-Catastrophizing

PP analysis indicated that there was a main effect of time (F(3, 126) = 5.267, p = .002, ηp^2 = .11) and no main effect of group (F(1, 42) = 0.489, p = .488, ηp^2 = .01). There was a significant time x group interaction (F(3, 126) = 4.674, p = .004, ηp^2 = .10), (see Table 7.2 for means and SDs), indicating that overall participants in the MG experienced significantly greater decreases in pain-catastrophizing compared to baseline than did participants in the WL group. Planned simple contrasts showed that from t.1 to t.2 there was no group x time interaction (F(1, 42) = 1.396, p = .244, ηp^2 = .03), indicating that there were no group dependent changes in pain-catastrophizing

between t.1 and t.2. The contrasts showed a significant group x time interaction between t.1 and t. 3 ($F(1, 42) = 4.190$, $p = .047$, $\eta p^2 = .09$), indicating that the MG decreased more in pain-catastrophizing than the WL group (please see Table 7.2 for means and SDs and Figure 7.3). In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 42) = 11.088$, $p = .002$, $\eta p^2 = .21$), indicating that at follow-up (t.4) participants in the MG experienced significantly greater improvements in pain-catastrophizing compared to baseline than those in the WL group (see Table 7.2 for means and SDs, and Figure 7.3).

Additional planned simple effect contrasts showed that the participants in the MG did not decrease significantly in pain-catastrophizing from t.1 to t.2 (*mean difference* -1.304, $p = .515$, 95%CI [-5.32, 2.701]). However, participants in the MG did decrease significantly in pain-catastrophizing between t.1 and t.3 (*mean difference* -7.696, $p = .002$, 95%CI [-12.39, -3.01]) and between t.1 and t.4 (*mean difference* -7.913, $p < .001$, 95%CI [-12.04, -3.78]). The participants in the WL group did not decrease significantly in pain-catastrophizing from t.1 to t.2 (*mean difference* 2.095, $p = .320$, 95%CI [-2.10, 6.29]), from t.1 to t.3 (*mean difference* -.810, $p = .741$, 95%CI [-5.72, 4.10]) or from t.1 and t.4 (*mean difference* 1.957, $p = .367$, 95%CI [-2.37, 6.28]).

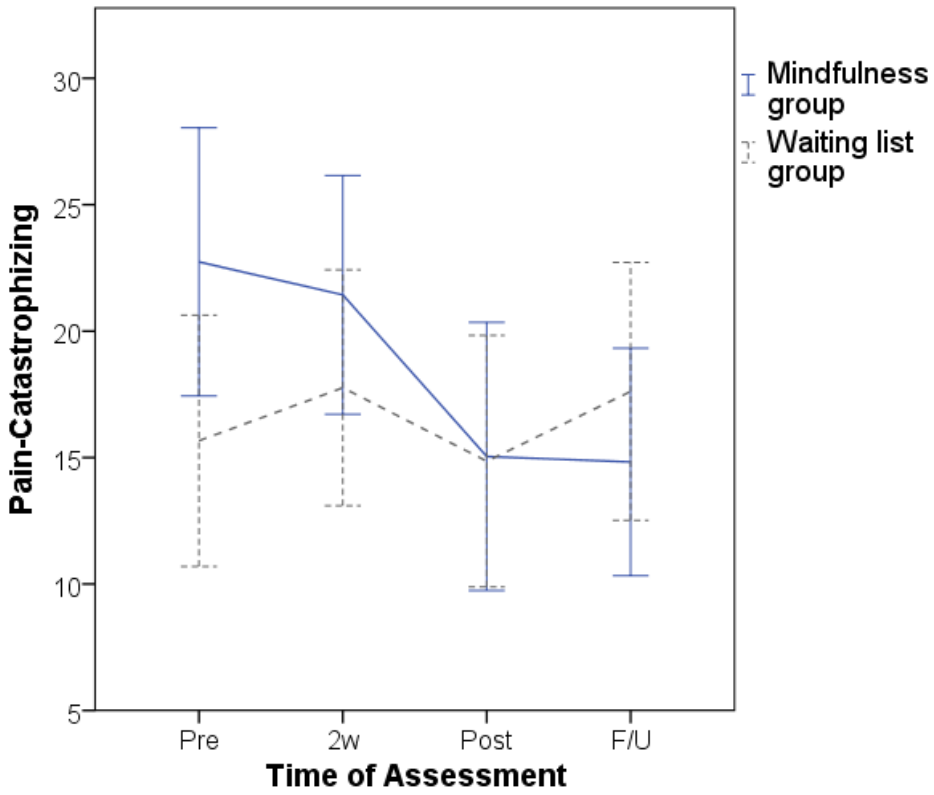


Figure 7.3. Levels of pain-catastrophizing at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2), post-treatment (Post) and Follow-up (F/U) for the mindfulness group and the waiting list group. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

7.4.2.3 IBS-Catastrophizing

The PP analysis indicated that there was a main effect of time ($F(2.291, 96.218) = 13.415$, $p > .001$, $\eta p^2 = .24$) and no main effect of group ($F(1, 42) = 0.142$, $p = .708$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.291, 96.218) = 3.814$, $p = .021$, $\eta p^2 = .08$), (see Table 7.2 for means and SDs), indicating that overall participants in the MG experienced greater reductions in IBS-catastrophizing compared to baseline than did participants in the WL group. Planned simple contrasts found no group x time interaction between t.1 and t.2 ($F(1, 42) = 0.227$, $p = .636$, $\eta p^2 < .05$) or between t.1 and t.3 ($F(1, 42) = 3.835$, $p = .057$, $\eta p^2 = .08$), indicating that there were no group dependent changes in IBS-catastrophizing between baseline, t.2 and post-treatment. In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 42) = 5.562$, $p = .023$, $\eta p^2 = .12$), indicating that at follow-up (t.4) participants in the MG

experienced greater improvements in IBS-catastrophizing compared to baseline than did those in the WL group (see Table 7.2 for means and SDs, and Figure 7.4).

Additional planned simple effect contrasts showed that the participants in the MG did not decrease significantly in IBS-catastrophizing from t.1 to t.2 (*mean difference* -3.043, $p = .084$, 95%CI [-6.51, 0.47]). However, participant in the MG did decrease significantly in IBS-catastrophizing between t.1 and t.3 (*mean difference* -10.043, $p < .001$, 95%CI [-14.38, -5.71]) and between t.1 and t.4 (*mean difference* -11.826, $p < .001$, 95%CI [-16.71, -6.95]). The participants in the WL group did not decrease significantly in IBS-catastrophizing from t.1 to t.2 (*mean difference* -1.857, $p = .308$, 95%CI [-5.49, 1.77]), from t.1 to t.3 (*mean difference* -3.950, $p = .086$, 95%CI [-8.49, 0.59]) or from t.1 and t.4 (*mean difference* -3.571, $p = .166$, 95%CI [-8.68, 1.54]).

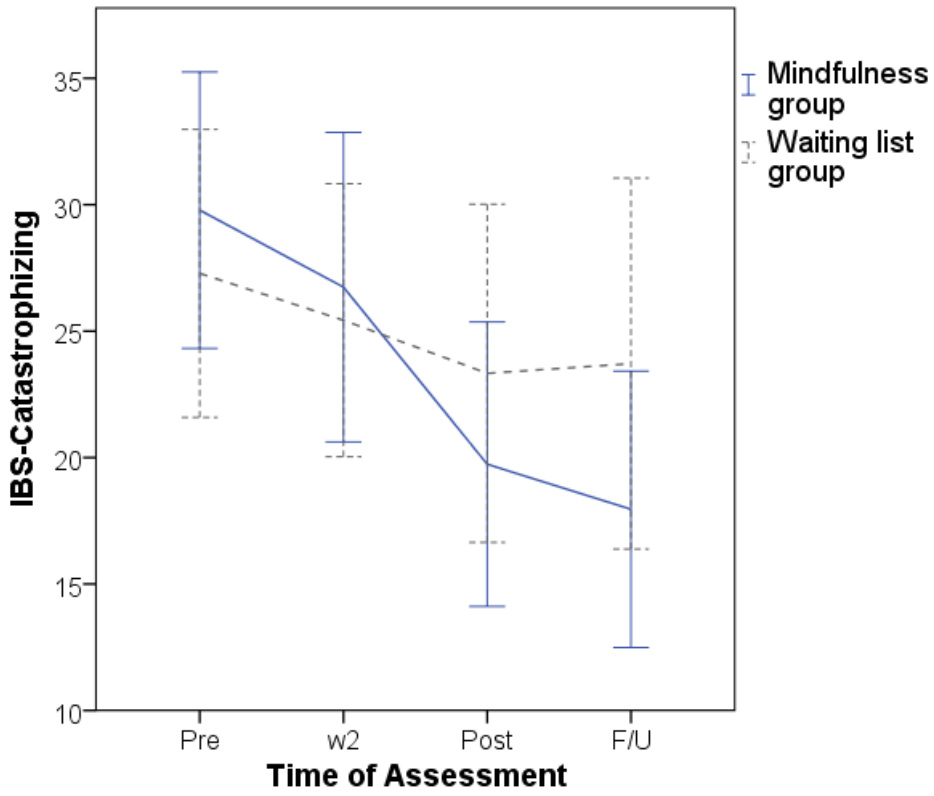


Figure 7.4. Levels of IBS-catastrophizing at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2), post-treatment (Post) and Follow-up (F/U) for the mindfulness group and the waiting list control group. *Note.* Error bars represent 95% CI).

7.4.2.4 Non-judgemental awareness

PP analysis indicated that there was a main effect of time $F(2.517, 105.725) = 4.122$, $p = .012$, $\eta p^2 = .09$) and no main effect of group ($F(1, 42) = 0.101$, $p = .752$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2.517, 105.725) = 12.985$, $p < .001$, $\eta p^2 = .24$), (see Table 7.2 for means and SDs), indicating that overall participants in the MG experienced significantly greater increases in non-judgemental awareness compared to baseline than did participants in the WL group. Planned simple contrasts showed that from t.1 to t.2 there was no significant group x time interaction ($F(1, 42) = 0.827$, $p = .368$, $\eta p^2 = .02$), indicating that there were no group dependent changes in non-judgemental awareness from baseline to t.2. The contrasts showed a significant group x time interaction between t.1 and t. 3 ($F(1, 42) = 13.202$, $p = .001$, $\eta p^2 = .24$), indicating that the MG increased significantly more in non-judgemental awareness than the WL group (please see Table 7.2 for means and SDs, and Figure 7.5). In addition, the contrasts showed a significant group x time interaction between t.1 and t.4 ($F(1, 42) = 14.407$, $p < .001$, $\eta p^2 = .26$), indicating that at follow-up (t.4) participants in the MG experienced greater improvements in non-judgemental awareness compared to baseline than did those in the WL group (see Table 7.2 for means and SDs, and Figure 7.5).

Additional planned simple effect contrasts showed that the participants in the MG did not increase significantly in non-judgemental awareness from t.1 to t.2 (*mean difference* -0.565, $p = .412$, 95%CI [-1.94, 0.81]). However, participant in the MG did increase significantly in non-judgemental awareness between t.1 and t.3 (*mean difference* 2.913, $p < .001$, 95%CI [1.50, 4.32]) and between t.1 and t.4 (*mean difference* 3.391, $p < .001$, 95%CI [1.85, 4.93]). The participants in the WL group did not decrease significantly in non-judgemental awareness from t.1 to t.2 (*mean difference* 0.333, $p = .643$, 95%CI [-1.11, 1.28]), from t.1 to t.3 (*mean difference* -.762, $p = .303$, 95%CI [-2.24, 0.71]) or from t.1 and t.4 (*mean difference* -0.810, $p = .317$, 95%CI [-2.42, 0.81]).

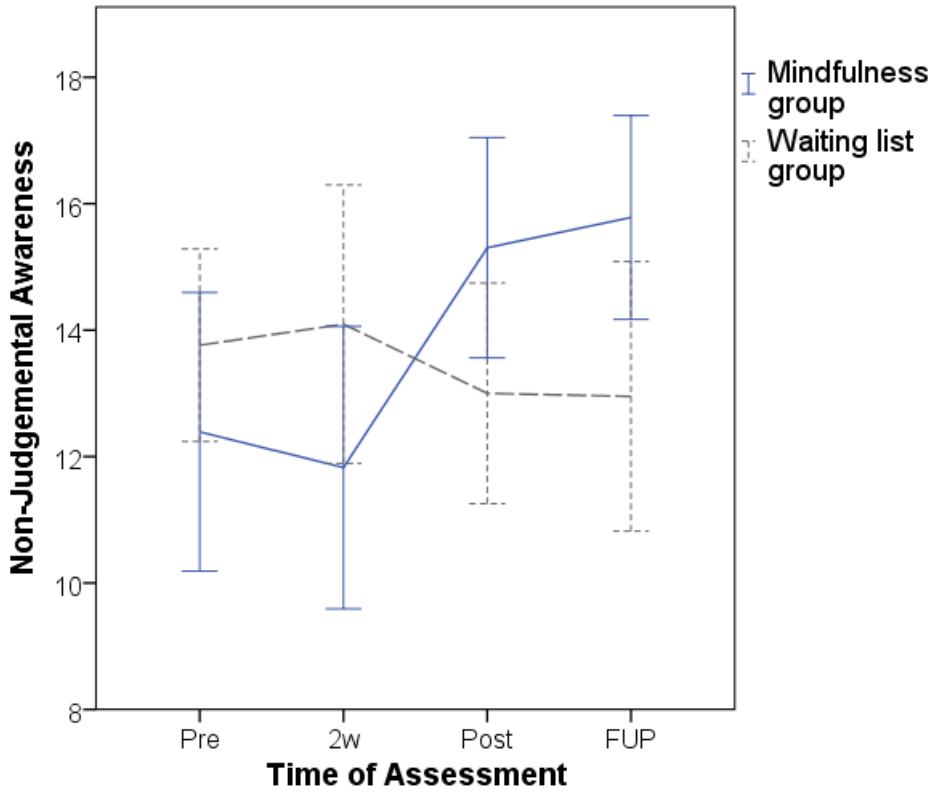


Figure 7.5. Levels of non-judgemental awareness at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2), post-treatment (Post) and follow-up (F/U) for the mindfulness group and the waiting list control group. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

Table 7.2. Means and standard deviations (SD) of IBS symptom severity, visceral anxiety sensitivity, pain-catastrophizing, IBS-catastrophizing, and non-judgemental awareness at t.1 (Baseline), t.2 (intra-treatment at two weeks), t.3 (post-treatment) and t.4 (follow-up) for the mindfulness group (MG, n = 23) and the waiting list group (WL, n = 21).

	Group (n)	t.1		t.2		t.3		t.4	
		Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
IBS symptom severity (GSRS-IBS[1])	MG	45.65	(11.30)	42.26	(12.05)	39.52	(12.02)	32.83	(13.70)
	WG	43.00	(12.60)	44.05	(12.30)	43.95	(14.37)	43.10	(9.69)
Non-judgemental Awareness (FFMQ[2])	MG	12.39	(5.10)	11.83	(5.17)	15.30	(4.03)	15.78	(3.73)
	WG	13.76	(3.35)	14.10	(4.84)	13.00	(3.83)	12.95	(4.68)
Visceral Anxiety Sensitivity (VSI[3])	MG	64.43	(13.43)	62.04	(13.56)	49.52	(15.49)	50.04	(17.72)
	WG	54.57	(11.59)	55.05	(13.12)	54.86	(14.85)	53.76	(15.00)
Pain catastrophizing (PCS[4])	MG	22.74	(12.26)	21.43	(10.91)	15.04	(12.26)	14.83	(10.41)
	WG	15.67	(10.92)	17.76	(10.25)	14.86	(10.92)	17.62	(11.21)
IBS-Catastrophizing (GI-C[5])	MG	29.78	(12.64)	26.74	(14.15)	19.74	(13.00)	17.96	(12.64)
	WG	27.29	(12.51)	25.43	(11.86)	23.33	(14.69)	23.71	(16.11)

[1]Gastrointestinal symptom rating scale for IBS, [2]Nonjudge subscale of the Five-Factor Mindfulness Questionnaire-24; [3]Visceral Sensitivity Index; [4]Pain Catastrophizing Scale; [5]Gastrointestinal Cognitions Scale

7.4.2.5 Self-referential processing of illness and health (IAT-D score)

The next section shows the analysis of changes on the IAT-D score (self-referential processing of illness and health) between groups over the course of treatment (t.1, t.2 and t.3). Across groups, 98.8% (at t.1), 99.9% (at t.2) and 99.9% (at t.3) of the Implicit Association Test (IAT) experimental trials were included in the analysis. The mean percentage of incorrect responses at t.1 was 3.47% in the MG and 5.34% in the WL group, at t.2 it was 5.03% in the MG and 5.12% in the WL group, at t.3 it was 6.64% in the MG and 5.84% in the WL group.

A 2 x 3 mixed design ANOVA, with time as a within-group factor (pre, intra, post) and group (MG, WL) as between-groups factor was employed to assess group dependent changes on the IAT-D score. Participants were included if they had an error rate of < 30%. Based on this criterion, no participant was excluded from the analysis.

PP analysis indicated no main effect of time ($F(2, 90) = 0.274$, $p = .761$, $\eta p^2 = .01$) and no main effect of group ($F(1, 45) = 2.517$, $p = .120$, $\eta p^2 = .05$). There was a significant time x group interaction ($F(2, 90) = 4.758$, $p = .011$, $\eta p^2 = .10$), (see Table 7.3 for means and SDs), indicating that relative to the WL group, the MG experienced a decrease on the IAT-D score. Planned repeated contrasts showed that from t.1 to t.2 there was a significant group x time interaction ($F(1, 45) = 6.815$, $p = .012$, $\eta p^2 = .13$), indicating that between t.1 and t.2 the MG experienced a decrease on the IAT-D score relative to the WL group (please see Table 7.3). Planned simple effect contrasts showed that reductions on the IAT-D score in MG were trending towards significance between t.1 and t.2 (*mean difference* -0.16, $p = .093$, 95%CI [-0.34, 0.03]). A trend in increases in IAT-D scores was recorded for participants in the WL group between t.1 and t.2 (*mean difference* 0.18, $p = .054$, 95%CI [< -0.01, 0.36]). Additional simple effects group contrasts showed that at t.1 the groups did not differ in the IAT-D score ($F(1, 45) = 0.102$, $p = .751$, $\eta p^2 < .01$, *mean difference* = -.043, 95% CI [-0.31, 0.23]). However, at t.2 the MG had significantly lower scores on the IAT-D index than the WL group ($F(1, 45) = 6.328$, $p = .016$, $\eta p^2 = .12$, *mean difference* =.293, 95% CI [0.06, 0.53]). The repeated contrasts showed no group x time interaction between t.2 and t.3 ($F(1, 45) = 0.814$, $p = .706$, $\eta p^2 < .01$), indicating no additional group dependent changes on the IAT-D

score between Week 2 and post-treatment. Figure 7.6 displays the changes in implicit self-referential processing of illness and health over time.

7.4.2.5.1 IAT versions

Twenty-three participants received version 'A' and 24 participants received version 'B' of the IAT at each time-point. We ran a group (healthy, IBS) x Version (A, B) x time mixed-measure ANOVA to check if these two versions of the IAT produced different results between groups over time. Results indicated no main effect of time ($F(2, 86) = 0.396$, $p = .674$), no two-way interaction between time and version ($F(2, 86) = 1.228$, $p = .298$) and no three-way interaction between time, group and version ($F(2, 86) = 1.962$, $p = .147$). The interaction between time and group was still significant when 'version' was included in the analysis ($F(2, 86) = 4.445$, $p = .015$). There was a main effect of version, ($F(1, 43) = 16.622$, $p < .001$), indicating that overall participants with Version A had higher IAT scores than participants with Version B (*Mean difference* = -.378, p < .001, 95%CI [-0.56, -0.19]). As the different versions of the task did not influence the interaction between time and group, it was considered appropriate to use the data collected from both versions in the same analysis

Table 7.3 Means and Standard Deviations (SD) of the IAT-D score (self-referential processing of illness and health), and reaction times in the congruent (identification with illness) and incongruent (identification with health) condition as measured with the Implicit Association Test (IAT) at t.1 (Baseline), t.2 (intra-treatment) and t.3 (post-treatment) for the mindfulness group (MG, n = 23) and the waiting list group (WL, n = 24).

	Group	t.1		t.2		t.3	
		Mean	SD	Mean	SD	Mean	SD
IAT-D score (self-referential processing of illness and health)	MG	-0.46	(0.46)	-0.62	(0.43)	-0.65	(0.42)
	WL	-0.51	(0.46)	-0.33	(0.36)	-0.39	(0.46)
RT congruent condition (identification with illness)	MG	903.82	(222.50)	878.99	(195.06)	912.39	(269.48)
	WL	950.20	(238.70)	854.50	(170.07)	823.08	(177.46)
RT incongruent condition (identification with health)	MG	782.15	(179.06)	704.47	(186.61)	721.03	(229.55)
	WL	787.62	(207.31)	769.99	(194.86)	746.50	(245.51)

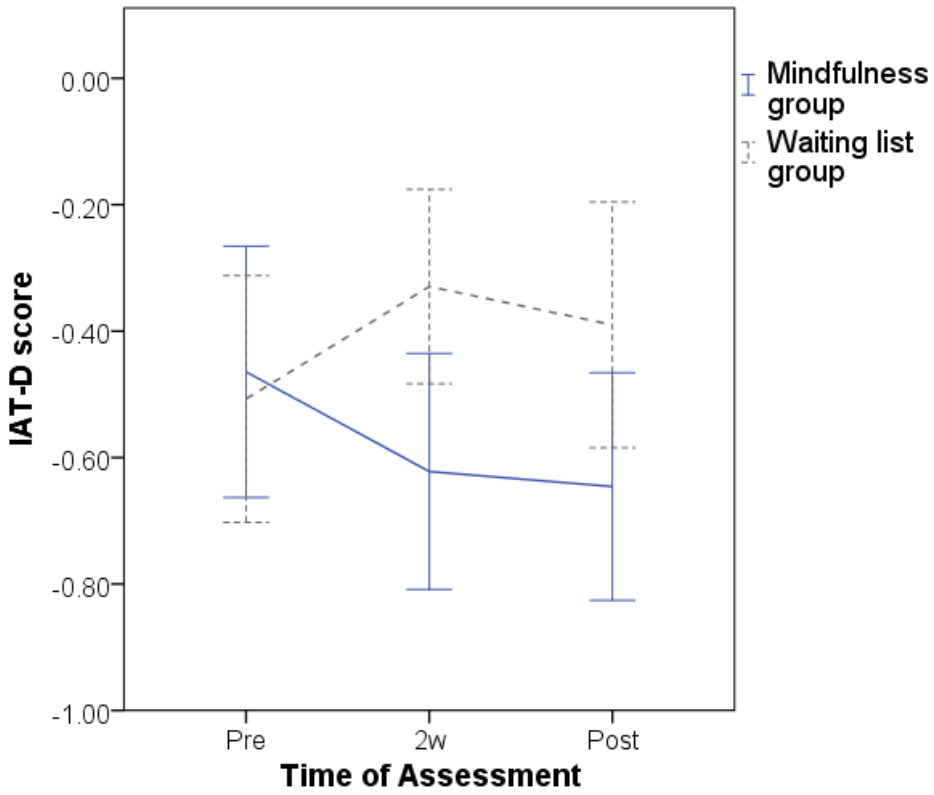


Figure 7.6. Self-referential processing of illness and health (IAT-D score) at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2) and post-treatment (Post) for the mindfulness group and the waiting list group. *Note.* Error bars represent 95% Confidence Intervals (95% CI).

7.4.2.5.2 RT differences between groups in the incongruent and the congruent condition of the IAT

To disentangle whether changes in the IAT-D score reflect changes in the congruent condition (illness-identity) or the incongruent condition (identification with health/self-health discrepancy) of the task (or both conditions), two additional mixed-design 2 x 3 ANOVAs were run separately for each condition. Each ANOVA had group as between group factor (MG, WL) and the raw reaction time scores of each time point (t.1, t.2, t.3) as within group factor.

In the congruent condition (identification with illness) the analysis indicated a main effect of time ($F(2, 90) = 4.469$, $p = .014$, $\eta p^2 = .09$) and no main effect of group ($F(1, 45) = 0.157$, $p = .694$, $\eta p^2 < .01$). There was a significant time x group interaction ($F(2, 90) = 4.320$, $p = .016$, $\eta p^2 = .09$), (see Table 7.3 for means and SDs), indicating that overall, participants in the WL group decreased their reaction time in the congruent condition (RTs became faster on identification with

illness) compared to baseline, whereas participants in the MG showed no such changes. The repeated contrasts from t.1 to t.2 and from t.1 to t.3 were not significant (all *F*s < 2.312, all *p*s > .135). However, simple effect contrasts showed that participants in the WL group significantly increased their RT from t.1 to t.2 (*mean difference* -95.70, *p* = .005, 95%CI [-161.37, -30.03]) and from t.1 to t.3 (*mean difference* -127.17, *p* = .001, 95%CI [-195.59, -58.64]) in the absence of significant changes in the MG from t.1 to t.2 (*mean difference* -24.83, *p* = .460, 95%CI [-91.92, 42.26]) and from t.1 to t.3 (*mean difference* -8.57, *p* = .806, 95%CI [-61.38, 78.52]).

In the incongruent condition (identification with health/ self-health discrepancy) the analysis indicated no main effect of time ($F(2, 90) = 3.440$, $p = .058$, $\eta p^2 = .07$, Greenhouse-Geisser corrected) and no main effect of group ($F(1, 45) = 0.336$, $p = .565$, $\eta p^2 < .01$). The interaction between time x group was not significant ($F(2, 90) = 0.985$, $p = .347$, $\eta p^2 = .02$), (see Table 7.3.for means and SDs). The repeated contrasts from t.1 to t.2 and from t.1 to t.3 were not significant (all *F*s < 2.155, all *p*s > .149). However, simple effect contrasts showed that participants in the MG significantly increased their RT from t.1 to t.2 (*mean difference* -77.68, *p* = .011, 95%CI [-136.55, -18.81]) but RT changes were not significant between t.1 to t.3 (*mean difference* -61.12, *p* = .137, 95%CI [-142.44, 20.21]). There were no significant changes is RT in the WL group between t.1 and t.2 (*mean difference* -17.64, *p* = .541, 95%CI [-75.27, 39.99]) or t.1 and t.3 (*mean difference* -41.12, *p* = .304, 95%CI [-120.73, 38.49]).

7.4.2.6 Attentional control

The next section is concerned with the analysis of changes in attentional control between groups over the course of treatment (t.1, t.2 and t.3). At baseline, the groups did not differ significantly in task accuracy (MG: $M = 93.19$, $SD = 7.14$; WL: $M = 91.35$, $SD = 11.19$, $t(65) = 0.814$, $p = .419$) and overall reaction time (MG: $M = 593.68$, $SD = 129.79$; WL: $M = 619.68$, $SD = 144.32$, $t(65) = -0.776$, $p = .440$). Accuracy and reaction time was calculated with all participants that completed baseline assessments.

For the main analysis on conflict scores (attentional control), participants were included in the analysis if their error rate was below three SDs of the mean error rate for the particular time

point. Mean error rates and SDs (in parentheses) for each time point were: t.1 = 3.73 (9.49); t.2 = 1.64 (2.35); t.3 = 1.73 (2.15). Thus, error rate cut-off scores (mean + 3SD) were 32.19 (t.1), 8.68 (t.2) and 8.19 (t.3). The number of participants that did not meet the weekly error rate inclusion criteria was t.1 = 2 (MG:0, WL:2), t.2 = 1 (MG:0, WL:1) and t.3 = 1 (MG:1, WL:0). After these participants were excluded from the analysis, an independent samples t-test was conducted to test for baseline differences in attentional control. It was found that the MG (M = 62.61; SD = 28.97) and the WL (M = 75.91; SD = 27.07) did not score differently in attentional control ($t(41) = -1.552$, $p = .128$) at baseline.

A 2 x 3 mixed design ANOVA, with time as within group factor (pre, intra, and post) and group (MG, WL) as between groups factor was employed to assess change in attentional control. Overall task accuracy was recorded at each time point. Mean error rates across groups were 3.73% at t.1, 1.64% at t.2 and 1.72% at t.3. The analysis indicated a main effect of time ($F(2, 82) = 5.420$, $p = .006$, $\eta p^2 = .12$) and no main effect of group ($F(1, 41) = 0.364$, $p = .549$, $\eta p^2 < .01$). The time x group interaction was trending towards significance ($F(2, 82) = 2.919$, $p = .060$, $\eta p^2 = .07$), (see Table 7.4 for means and SDs). Planned repeated contrasts showed that from t.1 to t.2 there was a significant group x time interaction ($F(1, 41) = 4.401$, $p = .042$, $\eta p^2 = .10$). The contrasts showed no group x time interaction $F(1, 41) = 0.133$, $p = .717$, $\eta p^2 < .01$, from t.2 to t.3.

Planned simple effect contrasts showed that the MG did not change in attentional control between t.1 and t.2 (*mean difference* -2.56, $p = .610$, 95%CI [-12.64, 7.52]). However, the WL group did show a significant increase in attentional control between t.1 and t.2 (*mean difference* 12.42, $p = .02$, 95%CI [2.10, 22.73]). Figure 7.7 displays the changes in attentional control over time.

Table 7.4. Means and Standard Deviations (SD) of the conflict score (attentional control) as measured with the Attention Network Task (ANT) at t.1 (baseline), t.2 (intra-treatment at two weeks) and t.3 (post-treatment) for the mindfulness group (MG) and the waiting list group (WL).

		t.1		t.2		t.3	
	Group (n)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Conflict score	MG (22)	62.62	(28.98)	65.18	(25.01)	57.95	(17.90)
	WL (21)	75.91	(27.07)	63.49	(28.85)	58.70	(24.57)

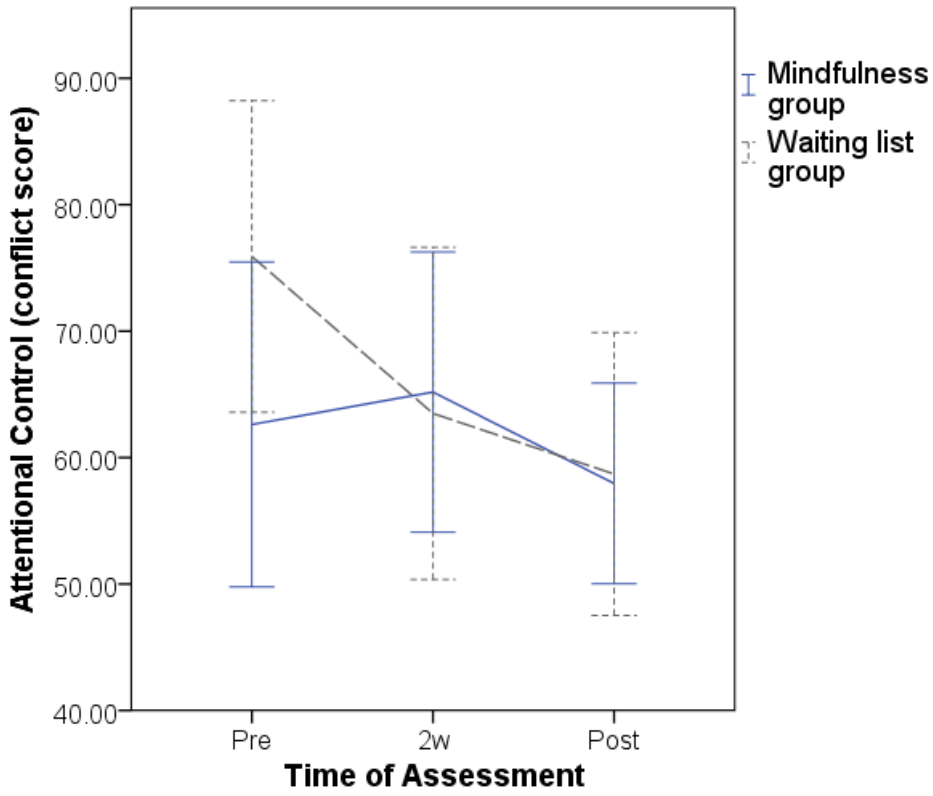


Figure 7.7. Levels of attentional control at pre-treatment (Pre), intra-treatment after two MBCT for IBS sessions (w2) and post-treatment (Post) for the mindfulness group and the waiting list control group. ***Note.*** **Error Bars represent 95% Confidence Intervals (95% CI).**

7.4.3 Simple mediation analyses: IBS symptom severity

Simple mediation analyses were run with PROCESS model 4 for each hypothesised simple mediation relationship (visceral anxiety sensitivity, pain catastrophizing). For each simple mediation analysis, a corresponding figure and a table is provided, showing the results of the regression analysis including the unstandardized bootstrapped estimates of the direct and indirect

effects with bias corrected bootstrapped 95% confidence intervals (95% CI) and the partially standardized indirect effect. All mediation analyses use the respective change scores for the mediator (e.g., t.2-t.1 or t.3-t.1) and the outcome (e.g. t.3-t.1 or t.4-t.1).

7.4.3.1 Visceral anxiety sensitivity as a mediator of symptom severity

The mediation analysis showed that there was a significant indirect effect of MBCT on IBS symptom severity (change score t.4-t.1) through visceral anxiety sensitivity (change score t.3-t.1), b = 6.46, 95% CI [2.03, 13.36], indicating that visceral anxiety sensitivity mediates the effect of MBCT on IBS symptoms. The regression model with group (MG or WL) and visceral anxiety sensitivity as predictors explained 35.58% of the variance in IBS symptom severity. MBCT was positively related to visceral anxiety sensitivity, and visceral anxiety sensitivity predicted IBS symptom severity. Please see Figure 7.8 and Table 7.5 for the full results of the individual regression models.

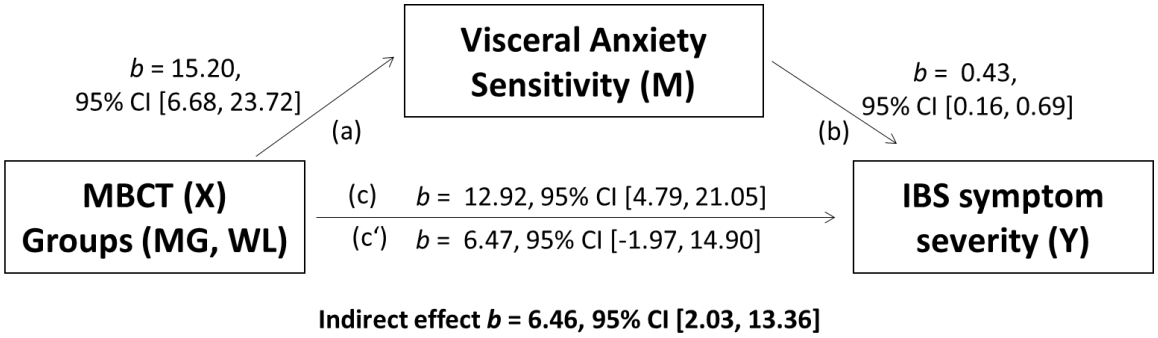


Figure 7.8. Graphical representation of MBCT as predictor of IBS symptom severity (at t.4) mediated by changes in visceral anxiety sensitivity (at t.3). The figure shows the total (c), direct (c') and indirect effects (mediation effect) of MBCT on IBS symptom severity.

Table 7.5. Results of regression-based mediation analysis with changes in visceral anxiety sensitivity from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS symptom severity (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to Visceral Anxiety Sensitivity[2] (M)[3]; Direct effect (a)[4]	15.2	4.22	6.68	23.72	0.236	12.960 (1, 42)	< .001
Visceral Anxiety Sensitivity (M) to IBS symptom severity[5] (Y)[6]; Direct effect (b)[7]	0.43	0.13	0.16	0.69	0.36	11.321 (2, 41)	< .001
Group (X) to IBS symptom severity (Y) Direct effect (c')[8]	6.45	4.18	-1.97	14.9			
Group (X) to IBS symptom severity (Y) Total effect (c)[9]	12.92	4.03	4.79	21.05	0.20	10.281 (1, 42)	0.003
*Indirect Effect of Group on IBS symptom severity (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	6.46	2.88	2.03	13.36			
Partially Standardized Indirect Effect	0.44	0.17	0.15	0.81			

[1] Predictor; [2] measured with the Visceral Sensitivity Index (VSI); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

7.4.3.2 Pain-catastrophizing as a mediator for symptom severity

The mediation analysis showed that there was a significant indirect effect of MBCT on IBS symptom severity (change score t.4-t1) through pain-catastrophizing (change score t.3-t1), *b* = 3.73, 95%CI [0.12, 10.66], indicating that pain-catastrophizing mediates the effect of MBCT on IBS symptoms. The regression model with group (MG or WL) and pain catastrophizing as predictors explained 36.13% of the variance in IBS symptom severity at follow-up. MBCT was positively related to reductions in pain-catastrophizing, and changes in pain-catastrophizing predicted IBS symptom severity. Please see Figure 7.9 and Table 7.6 for the full results of the regression analysis.

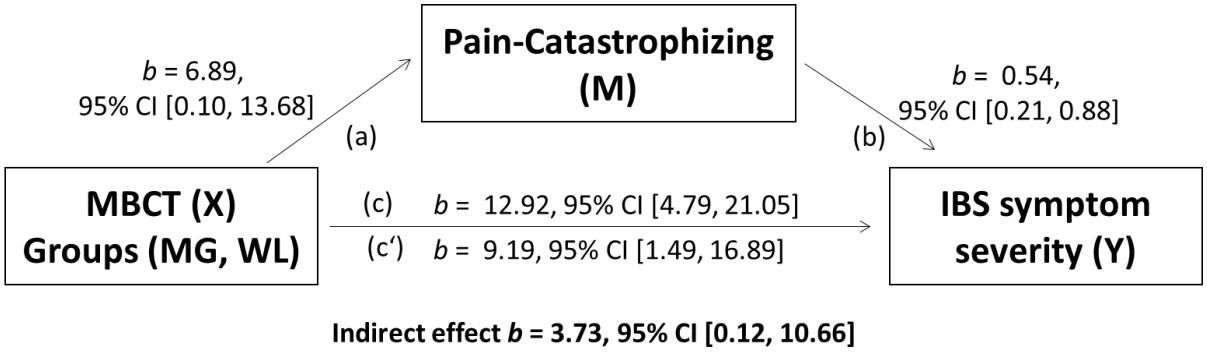


Figure 7.9. Graphical representation of MBCT as predictor of IBS symptom severity (at t.4) mediated by changes in pain catastrophizing (at t.3). The figure shows the total (c), direct (c') and indirect effects (mediation effect) of MBCT on IBS symptom severity.

Table 7.6. Results of regression-based mediation analysis with changes in pain-catastrophizing from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS symptom severity (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to pain-catastrophizing[2] (M)[3]; Direct effect (a)[4]	6.88	3.36	0.10	13.68	0.09	4.190 (1, 42)	0.047
Pain-catastrophizing (M) to IBS symptom severity[5] (Y)[6]; Direct effect (b)[7]	0.54	0.17	0.21	0.88	0.36	11.595 (2, 41)	< .001
Group (X) to IBS symptom severity (Y) Direct effect (c')[8]	9.19	3.81	1.48	16.89			
Group (X) to IBS symptom severity (Y) Total effect (c)[9]	12.92	4.03	4.79	21.05	0.20	10.281 (1, 42)	0.003
*Indirect Effect of Group on IBS symptom severity (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	3.74	2.64	0.12	10.66			
Partially Standardized Indirect Effect	0.25	0.17	0.01	0.66			

[1] Predictor; [2] measured with the Pain Catastrophizing Scale (PCS); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

7.4.4 Serial mediation analysis

7.4.4.1 Serial mediation analysis with self-health discrepancy and non-judgemental awareness

Serial mediation analysis showed a significant indirect effect of MBCT on IBS symptom severity through serial changes in implicit self-referential processing of illness and health (t.2-t.1) and non-judgemental awareness (t.3-t.1), *b* = 1.37, BCa CI [0.19, 4.49]. Patients who were allocated to the MBCT for IBS course showed reductions in the IAT-D score compared to participants who were allocated to the waiting-condition (path (d), *b* = 0.4, 95%CI [0.24, 0.65]). Those participants who experienced greater reductions in the IAT-D showed larger increases in scores in the non-judge scale (path (e), *b* = -2.64, 95%CI [-5.14, -0.13]). Patients with greater increases in scores on the non-judge scale showed greater reductions in scores on the GSRS-IBS scale (path (f), *b* = -1.32, 95%CI [-2.61, -0.04]). These results indicate that changes in implicit self-referential processing of illness and health affect changes in non-judgemental awareness and that combined, these factors mediate the effect of MBCT on IBS symptoms. The results also show that MBCT does not influence IBS symptom severity independent of its effect on self-health discrepancy and non-judgemental awareness (path (c'), *b* = 8.54, 95%CI [-1.05, 18.13]). The regression model with group (MG, WL), the IAT-D score and the non-judge scale as predictors explained 28.49% of the variance in GSRS-IBS scores. Please see Figure 7.10 and Table 7.7 for the full results of the regression analysis and the paths between variables.

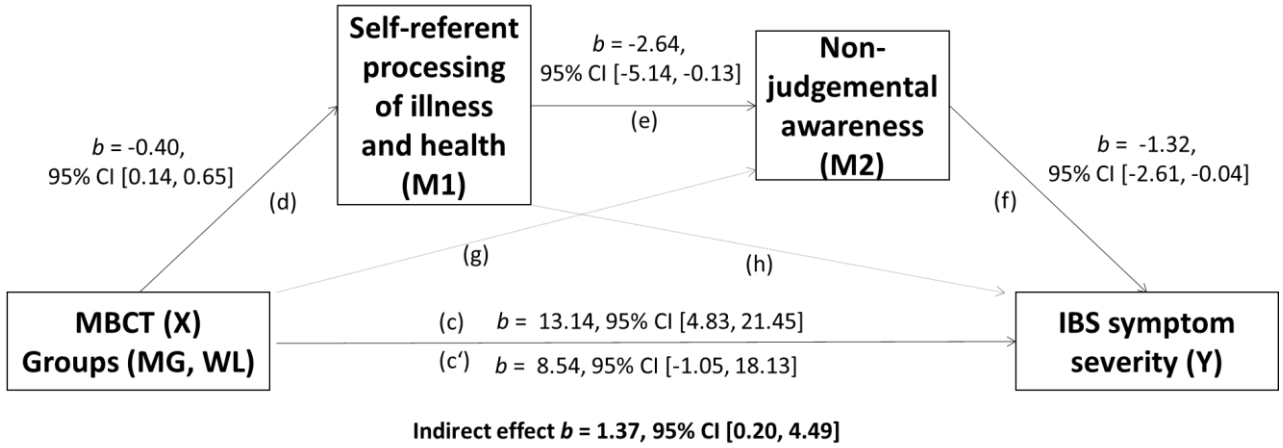


Figure 7.10. Graphical representation of MBCT as predictor of IBS symptom severity (at t.4) mediated by serial changes in self-health discrepancy (t.2) and non-judgemental awareness (at t.3). The figure shows the total (c), direct (c') and indirect effects (mediation effect) of MBCT on IBS symptom severity as well as paths between the predictor and the mediators (paths (d), (g)) between mediators (path (e)) and between mediators and outcomes (paths (h), (f)).

Table 7.7. Results of regression-based serial mediation analysis with changes in implicit self-referential processing of illness and health from baseline (t.1) to Week 2 (t.2) and changes in non-judgemental awareness from baseline (t.1) to post-treatment (t.3) as serial mediators of changes in IBS symptom severity (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[17]		Regression model parameters		
	B	SE	LL[18]	UL[19]	R^2	F (df)	p
Group (X)[1] to self-referential processing of illness and health [2] (M1)[3]; Direct effect (d)[4]	0.4	13	0.24	0.65	0.3	9.97 (1, 41)	0.003
Self-referential processing of illness and health (M1) to non-judgemental awareness[5] (M2)[6]; Direct effect (e)[7]	-2.64	1.24	-5.14	-0.13	0.31	8.94 (2, 40)	< .001
Group (X) to non-judgemental awareness (M2); Direct effect (g)[8]	-2.59	1.11	-4.82	-0.35			
Self-referential processing of illness and health (M1) to IBS symptom severity[9] (Y)[10]; Direct effect (h)[11]	-0.48	5.26	-11.22	10.15	0.28	5.18 (3, 39)	0.004
Non-judgemental awareness (M2) to IBS symptom severity (Y); Direct effect (f)[12]	-1.32	0.64	-2.61	-0.04			
Group (X) to IBS symptom severity (Y); Direct effect (c')[12]	8.54	4.74	-1.05	18.13			
Group (X) to IBS symptom severity (Y) Total effect (c)[13]	13.14	4.12	4.83	21.45	0.2	10.19 (1, 41)	0.003
Indirect effect of group on IBS symptom severity (Mediation);							
Indirect Effect via self-referential processing of illness and health (unstandardized)[14]	-0.19	2.39	-5.15	4.60	-	-	-
Partially standardized indirect effect	-0.01	0.17	-0.34	34	-	-	-

			95% CI[17]		Regression model parameters		
	B	SE	LL[18]	UL[19]	R^2	F (df)	p
Indirect effect via self-referential processing of illness and health and non-judgemental awareness (unstandardized) [15]	1.38	0.94	0.20	4.49	-	-	-
Partially standardized indirect effect	0.09	0.06	0.01	0.29	-	-	-
Indirect effect via non-judgemental awareness (unstandardized)[16]	3.42	2.36	0.29	10.08	-	-	-
Partially standardized indirect effect	0.23	0.15	0.02	0.63	-	-	-

[1] Predictor; [2] measured with the Implicit Association Task (IAT); [3] first mediator; [4] Direct effect of the predictor on the first mediator; [5] measured with the Nonjudge subscale or the Five-Factor Mindfulness Scale-24 (FFMQ-24); [6] Second mediator; [7] Direct effect of the first mediator on the second mediator; [8] Direct effect of the predictor on the second mediator; [9] measured with the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS); [10] Outcome; [11] Direct effect of the first mediator on the outcome; [12] Direct effect of the second mediator on the outcome; [13] Direct effect of the predictor on the outcome when the first and second mediators are included in the model; [14] the interaction effect of d*h is considered the mediation effect of the first mediator; [15] the interaction effect of d*e*f is considered the serial mediation effect via the first and the second mediator; [16] the interaction effect of g*f is considered the mediation effect of the second mediator; [17] 95% Confidence Intervals; [18] Lower limit; [19] Upper limit

7.4.4.2 Serial mediation analysis with attentional control and IBS catastrophizing

Serial mediation analysis showed a significant indirect effect of MBCT on IBS symptom severity through changes in IBS catastrophizing from baseline to post-treatment (*b* = 3.88, 95%CI [0.52, 10.32]), indicating that IBS catastrophizing is mediating the effect of MBCT on IBS symptom severity. There was no indirect effect through both attentional control and IBS catastrophizing (*b* = -0.03, 95%CI [-1.41, 0.44]) or through attentional control alone (*b* = 0.48, 95%CI [-1.21, 4.32]) indicating that attentional control is not mediating the effect of MBCT on symptom severity. In addition, no evidence was found for an association between changes in attentional control and changes in IBS-catastrophizing (*b* = 0.01, 95%CI [-0.09, 0.11]). Please see Table 7.8 for the full results of the regression analysis and the paths between variables.

Table 7.8. Results of regression-based serial mediation analysis with changes in attentional control from baseline (t.1) to Week 2 (t.2) and changes in IBS-catastrophizing from baseline (t.1) to post-treatment (t.3) as serial mediators of changes in IBS symptom severity (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[17]		Regression Model parameters		
	B	SE	LL[18]	UL[19]	R^2	F (df)	p
Group (X)[1] to attentional control[2] (M1)[3]; Direct effect (d)[4]	-5.22	10.37	-26.19	15.74	0.01	0.254 (1, 39)	0.62
Attentional control (M1) to IBS-catastrophizing[5] (M2)[6]; Direct effect (e)[7]	0.01	0.05	-0.09	0.11	0.11	2.298 (2, 38)	0.11
Group (X) to IBS-catastrophizing (M2); Direct effect (g)[8]	7.03	3.28	0.39	13.67			
Attentional control (M1) to IBS symptom severity[9] (Y)[10]; Direct effect (h)[11]	-0.09	0.06	-0.21	0.03	0.37	7.33 (3, 37)	< .001
IBS-catastrophizing (M2) to IBS symptom severity (Y); Direct effect (f)[12]	0.55	0.19	0.16	0.94			
Group (X) to IBS symptom severity (Y); Direct effect (c')[12]	9.03	4.14	0.65	17.41			
Group (X) to IBS symptom severity (Y) Total effect (c)[13]	13.36	4.28	4.70	22.02	0.2	9.74 (1, 39)	0.003
Indirect effect of group on IBS symptom severity (Mediation);							
Indirect effect via attentional control (unstandardized)[14]	-0.48	1.26	-1.21	4.32	-	-	-
Partially standardized indirect effect	0.03	0.08	-0.09	0.27	-	-	-

			95% CI[17]		Regression Model parameters		
	B	SE	LL[18]	UL[19]	R^2	F (df)	p
Indirect effect via attentional control and IBS-catastrophizing (unstandardized) [15]	-0.03	0.51	-1.41	0.44	-	-	-
Partially standardized indirect effect	< -0.01	0.03	-0.09	0.03	-	-	-
Indirect effect via IBS-catastrophizing (unstandardized)[16]	3.88	2.47	0.52	10.32	-	-	-
Partially standardized indirect effect	0.26	0.15	0.04	0.62	-	-	-

[1] Predictor; [2] measured with the Attention Network Task (ANT); [3] first mediator; [4] Direct effect of the predictor on the first mediator; [5] measured with the Gastrointestinal Cognitions Questionnaire (GI-C); [6] Second mediator; [7] Direct effect of the first mediator on the second mediator; [8] Direct effect of the predictor on the second mediator; [9] measured with the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS); [10] Outcome; [11] Direct effect of the first mediator on the outcome; [12] Direct effect of the second mediator on the outcome; [13] Direct effect of the predictor on the outcome when the first and second mediators are included in the model; [14] the interaction effect of d*h is considered the mediation effect of the first mediator; [15] the interaction effect of d*e*f is considered the serial mediation effect via the first and the second mediator; [16] the interaction effect of g*f is considered the mediation effect of the second mediator; [17] 95% Confidence Intervals; [18] Lower limit; [19] Upper limit

7.4.5 Simple mediation analysis: Quality of Life

Additional simple mediation analyses was run with group as predictor, changes in quality of life between t.1 and t.4 as outcome and changes in maladaptive illness specific cognitions, non-judgemental awareness and IBS symptom severity between t.1 and t.3 as mediator. The analyses showed that there was an indirect effect of MBCT on IBS quality of life (change score t.4-t.1) trough visceral anxiety sensitivity (change score t.3-t.1) *b* = -11.08, 95% CI [-19.99, -4.68], pain-catastrophizing (change score t.3-t.1) *b* = -4.49, 95% CI [-12.46, -0.16], and non-judgemental awareness (change score t.3-t.1) *b* = -9.65, 95% CI [-17.97, -4.31]. The analysis of IBS symptom severity (change score t.3-t.1) as a mediator of IBS quality of life was not significant, *b* = -3.95, 95% CI [-10.65, 0.02]. The regression model with Group (MG or WL) and visceral anxiety sensitivity as predictor explained 51.08% of the variance in IBS quality of life. The regression model with Group (MG or WL) and pain catastrophizing as predictor explained 39.20% of the variance in IBS quality of life. The regression model with Group (MG or WL) and non-judgemental awareness as predictor explained 44.92 % of the variance in IBS quality of life. The regression model with Group (MG or WL) and IBS symptom severity as predictor explained 38.24% of the variance in IBS quality of life. Please see Table 7.9 (visceral anxiety sensitivity as a mediator), Table 7.10 (pain catastrophizing as a mediator), Table 7.11 (non-judgemental awareness as a mediator) and Table 7.12 (IBS symptom severity as mediator) for the full results of the individual regression models.

Table 7.9. Results of regression-based mediation analysis with changes in visceral anxiety sensitivity from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS quality of life (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to Visceral Anxiety Sensitivity[2] (M)[3]; Direct effect (a)[4]	15.20	4.22	6.68	23.72	0.236	12.960 (1, 42)	< .001
Visceral Anxiety Sensitivity (M) to IBS quality of life[5] (Y)[6]; Direct effect (b)[7]	-0.73	0.16	-1.06	-0.40	0.51	21.408 (2, 41)	< .001
Group (X) to IBS quality of life (Y) Direct effect (c')[8]	-10.00	5.07	-20.24	0.25			
Group (X) to IBS quality of life (Y) Total effect (c)[9]	21.08	5.36	-31.89	-10.27	0.27	15.489 (1, 42)	< .001
*Indirect Effect of Group on IBS quality of life (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	-11.08	3.85	-19.99	-4.68			
Partially Standardized Indirect Effect	-0.54	0.16	-0.86	-0.24			

[1] Predictor; [2] measured with the Visceral Sensitivity Index (VSI); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the IBS Quality of Life instrument (IBS-QOL); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

Table 7.10. Results of regression-based mediation analysis with changes in pain-catastrophizing from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS quality of life (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to pain-catastrophizing[2] (M)[3]; Direct effect (a)[4]	6.88	3.36	0.10	13.68	0.09	4.190 (1, 42)	0.047
Pain-catastrophizing (M) to IBS quality of life[5] (Y)[6]; Direct effect (b)[7]	-0.65	0.22	-1.11	-0.19	0.39	13.216 (2, 41)	< .001
Group (X) to IBS quality of life (Y) Direct effect (c')[8]	-16.59	5.19	-27.06	-6.12			
Group (X) to IBS quality of life (Y) Total effect (c)[9]	-21.08	5.36	-31.89	-10.27	0.27	15.489 (1, 42)	< .001
*Indirect Effect of Group on IBS quality of life (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	-4.49	3.02	-12.46	-0.16			
Partially Standardized Indirect Effect	-0.22	0.16	-0.59	-0.002			

[1] Predictor; [2] measured with the Pain Catastrophizing Scale (PCS); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the with the IBS Quality of Life instrument (IBS-QOL); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

Table 7.11. Results of regression-based mediation analysis with changes in non-judgemental awareness from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS quality of life (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to non-judgemental awareness[2] (M)[3]; Direct effect (a)[4]	-3.68	1.01	-5.72	-1.63	0.24	13.202 (1, 42)	< .001
Non-judgemental awareness (M) to IBS quality of life[5] (Y)[6]; Direct effect (b)[7]	2.63	0.72	1.18	4.08	0.45	16.717 (2, 41)	< .001
Group (X) to IBS quality of life (Y) Direct effect (c')[8]	-11.43	5.40	-22.33	-0.53			
Group (X) to IBS quality of life (Y) Total effect (c)[9]	-21.08	5.36	-31.89	-10.27	0.27	15.489 (1, 42)	< .001
*Indirect Effect of Group on IBS quality of life (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	-9.65	3.31	-17.97	-4.31			
Partially Standardized Indirect Effect	-0.47	0.15	-0.82	-0.22			

[1] Predictor; [2] measured with the Nonjudge subscale or the Five-Factor Mindfulness Scale-24 (FFMQ-24); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the IBS Quality of Life instrument (IBS-QOL); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

Table 7.12. Results of regression-based mediation analysis with changes in IBS symptom severity from baseline (t.1) to post-treatment (t.3) as mediator of changes in IBS quality of life (outcome) from baseline (t.1) to follow-up (t.4).

			95% CI[11]		Regression Model parameters		
	B	SE	LL[12]	UL[13]	R^2	F (df)	p
Group (X)[1] to IBS symptom severity[2] (M)[3]; Direct effect (a)[4]	7.08	3.77	-0.53	14.70	0.08	3.524 (1, 42)	.067
IBS symptom severity (M) to IBS quality of life[5] (Y)[6]; Direct effect (b)[7]	-0.56	0.20	-0.97	-0.15	0.38	12.694 (2, 41)	< .001
Group (X) to IBS quality of life (Y) Direct effect (c')[8]	-17.13	5.19	-27.61	-6.65			
Group (X) to IBS quality of life (Y) Total effect (c)[9]	21.08	5.36	-31.89	-10.27	0.27	15.489 (1, 42)	< .001
*Indirect Effect of Group on IBS quality of life (Mediation); (a*b)[10]*							
Indirect Effect (unstandardized)	-3.95	2.65	-10.65	0.02			
Partially Standardized Indirect Effect	-0.19	0.13	-0.51	0.01			

[1] Predictor; [2] measured the Gastrointestinal Symptom Rating Scale for Irritable Bowel Syndrome (GSRS-IBS); [3] Mediator; [4] Direct effect of the predictor on the mediator; [5] measured with the IBS Quality of Life instrument (IBS-QOL); [6] Outcome; [7] Direct effect of the mediator on the outcome; [8] Direct effect of the Predictor on the Outcome when the Mediator is included in the model; [9] Total effect of the predictor on the outcome when the mediator is not included in the model; [10] the interaction effect of a*b is considered the mediation effect; [11] 95% Confidence Intervals; [12] Lower limit; [13] Upper limit

7.5 Discussion

The findings show that MBCT for IBS reduces the symptoms of IBS and improves quality of life through a range of cognitive mechanisms. Mediation analyses showed that pain-catastrophizing, IBS-catastrophizing and visceral anxiety sensitivity at the end of treatment directly mediated attenuations in IBS symptom severity at six weeks follow-up. Decreases in IBS symptom severity at follow-up were also mediated through serial reductions in biased implicit self-referential processing of illness and health after only two weeks of mindfulness training and increases in non-judgemental awareness at the end of treatment. Changes in pain-catastrophizing, visceral anxiety sensitivity and non-judgemental awareness at post-treatment also mediated the gains in quality of life at follow-up. Reductions in symptom severity predicted but did not mediate improvements in quality of life. In combination with the results from Chapter 6 which showed that MBCT for IBS significantly reduces IBS symptom severity and ameliorates impairments in quality of life, it can be concluded, that MBCT may be a suitable treatment for patients with IBS that attenuates the known cognitive maintaining factors of IBS.

The mediators of IBS symptom severity and quality of life in this study are partially in line with findings from the only other study looking at mechanisms of change in mindfulness-based treatments for patients with IBS (Garland et al., 2012). Similar to the currently study, their study found that Mindfulness-Based Stress Reduction (MBSR) for IBS led to reductions in pain catastrophizing and visceral anxiety sensitivity (Garland et al., 2012). In both studies, pain-catastrophizing mediated quality of life and visceral anxiety sensitivity mediated IBS symptom severity and quality of life. In contrast to the current study, pain catastrophizing did not mediate symptom severity in the MBSR study (Garland et al., 2012). The study on MBSR for IBS measured cognitive mechanisms and outcomes simultaneously, leaving uncertainty about the sequential order of changes between symptoms and cognitions. To some degree this uncertainty is also present in the current study, as both symptoms and cognitions had changed directly post MBCT for IBS. However, the current study also extends these findings by showing that changes in the hypothesised mechanisms (illness specific cognitions) at post-treatment predict and mediate

later changes in symptoms and quality of life (at follow-up). Thus, there is partial evidence that mechanisms precede additional changes in outcomes. Crucially, both studies show that changes in the *processing* of cognition mediate symptom severity and quality of life. For example, in the MBSR for IBS course non-reactivity to thoughts, emotions and physical sensations was associated with changes in both pain catastrophizing and visceral anxiety sensitivity (Garland et al., 2012). In addition, changes in the reinterpretation of pain (e.g., interpreting pain as another form of sensory experience, such as numbness or temperature) directly mediated symptom severity (Garland et al., 2012). Similarly, in the MBCT for IBS course, changes in non-judgemental awareness and biased self-referential processing of illness and health predicted reduction of IBS symptoms. Hence, private sensations including thoughts, emotions and physical sensations may be processed more directly, rather than though self-referential cognitive and emotional evaluations of these experiences (Farb et al., 2007; Tang et al., 2015). These findings align with predictions from the updated predictive coding model for mind-body integration (Farb et al., 2015) when applied to patients with IBS. Based on this model, mindfulness induced increases in interoceptive awareness and shifts towards accepting (i.e., perceptual inference) rather than discrepancy-focused processing (i.e., active inference) of physical sensations could underlie symptom reduction. Interestingly, whilst reductions in threat processing of physical sensations and a non-critical stance towards private emotions and thoughts mediated improvements in quality of life, changes in symptom severity did not. This was an unexpected finding as the reduction in IBS related quality of life in patients with IBS is thought to be a function of how much the symptoms interfere with life (Drossman et al., 2000; Halpert & Drossman, 2005; Patrick et al., 1998). One interpretation of these findings is that there are crucial psychological factors that may maintain and exacerbate deviations in activity, social, interpersonal and intrapersonal functioning. These cognitive factors may maintain reductions in quality of life independently of symptom severity and they can be targeted in psychological treatments to improve quality of life.

Overall, visceral anxiety sensitivity and pain catastrophizing have been found to be mediators of IBS symptom improvement across different treatment types (e.g., CBT, MBSR)

(Garland et al., 2012; Hunt, Ertel, Coello, & Rodriguez, 2014a; Ljotsson et al., 2013; Wolitzky-Taylor et al., 2012). This suggests that these factors are robust mediators and key mechanisms in the treatment of IBS and that different treatment types may target maladaptive illness cognitions with different processes. For example, CBT based treatments for IBS may change the content of these thoughts (e.g., through cognitive restructuring), whereas MBI's may change the way they are processed (Fennell & Segal, 2011; Garland et al., 2012). This change in processing may be a result of the decentred perspective that MBIs are hypothesised to develop (Crane et al., 2016; Segal et al., 2013). For example, from the decentred perspective negative thoughts may not be perceived as factual or truthful, but rather as temporary mental events that arise and pass away (Williams, 2008). The reduced verisimilitude of thoughts and the story they tell (e.g., If I don't monitor the sensations in my abdomen constantly I may be caught off guard with bowel symptoms) may reduce their capacity to contribute to IBS symptom severity. This hypothesis aligns with the suggested working mechanisms of MBCT for recurrent depression: MBCT promotes the development of a decentred perspective to reduce the risk that the content and processing of depressionogenic thinking leads to depressive relapse (Lau et al., 2004; Teasdale et al., 2002). Based on the findings of the current study, MBCT for IBS appears to be a suitable treatment to affect the two best known maintaining factors of IBS: visceral anxiety sensitivity and catastrophizing. If future studies provide sufficient evidence for the efficacy of MBCT for IBS, adding the protocol to the NICE recommended psychological treatments for IBS could lead to greater treatment choices for both patients and clinicians.

Data from the IAT relating to changes in self-referential processing could provide information to clinicians and researchers about intervention techniques that trigger a therapeutic response. It was shown that two weeks of MBCT for IBS can reduce the implicitly perceived discrepancy between the self and the health-concepts in patients with IBS resulting in an adaptive identification with health. The first two sessions of MBCT for IBS were designed to develop interoceptive awareness, a decentred perspective and a non-judgemental relationship with the body. To this end, the body scan had been chosen as the main meditation practice during the course

sessions and for daily home practice. Thus the findings suggest that practicing the body scan brings about reductions in biased self-referential processing of illness and health in patients with IBS. However, given that the body scan was provided in conjunction with psychoeducation, further research which directly links the body scan with changes in self-health discrepancy in IBS patients is needed. For example, a study that compares the effect of the body scan with the effect of psychoeducation on self-referential processing of illness and health could provide data that pin the effect on one of the two intervention techniques.

Surprisingly, it was also found that participants in the waiting list group showed greater implicit identification with illness when they were tested the second time. One possible explanation is that patients in the waiting list condition may have been explicitly confronted with their illness through the study, without receiving treatment right away. This may have implicitly increased the association between their self and illness schema.

The findings which link non-judgemental awareness directly to reductions in IBS symptom severity are novel. They demonstrate that non-judgemental awareness does not only play a role for mental health (Van Dam, Sheppard, Forsyth, & Earleywine, 2011) but also physical health. Specifically, the findings indicate that a tendency to accept rather than critically evaluate internal events (e.g., thoughts, emotions, physical sensations) may have cascading effects on the functioning of the brain-gut axis in patients with IBS. Potential biopsychological mechanisms could pertain to the functioning of the autonomic nervous system (ANS) (see Chapter 5 for more detail). For example, recent studies showed that greater acceptance of emotions and self-compassion has been associated with higher vagally mediated Heart Rate Variability (vmHRV) (Svendsen et al., 2016; Visted et al., 2017), a proxy measure of the activity of the parasympathetic nervous system (PSNS). The PSNS is responsible for calming the body and can influence the functioning of the digestive tract (Bonaz et al., 2018). Therefore, greater MBCT induced acceptance of negative emotions and thoughts may have led to reduced IBS symptom severity by increasing the relative influence of the PSNS, when experiencing difficult emotions. Future studies involving MBCT for IBS should aim to establish links between cognitive and biological

mechanisms in order to trace the psycho-biological effect of mindfulness meditation on gut functioning (i.e., IBS symptom severity).

The current study found no evidence that MBCT for IBS increases attentional control in IBS patients. This is a puzzling finding as previous studies have shown that mindfulness courses can increase attentional control (Ainsworth et al., 2013; Becerra et al., 2017) even after just two sessions (the Finding Peace course, see Chapter 4). One explanation for the lack of change in attentional control in the mindfulness group is that the treatment modules in the first two MBCT for IBS sessions were different from those in the MBCT for students course (i.e., the "Finding Peace Course") and those in the study by Ainsworth and colleagues (2013). Both the Finding Peace course (see Chapter 4) and the Ainsworth et al. (2013) study contained focused meditation techniques (e.g., the "Anchor of Body and Breath" meditation) in the first two sessions, whereas the emphasis in the MBCT for IBS course was on the "Body Scan" meditation. Because both practices (Anchor of Body and Breath and the Body Scan) encourage a focus on physical sensations and disengagement from distracting thoughts, it was expected that these two practices would have similar effects on attentional control. However, the 'Body Scan' in MBCT for IBS has a particular emphasis on developing friendly curiosity towards the sensations in the body (i.e., sensory experiential processing), which may have resulted in the cultivation of interoceptive awareness (Farb et al., 2015) rather than training in conflict monitoring and inhibition (two important aspect of attentional control) (Eysenck & Derakshan, 2011). Future studies should investigate the specific cognitive effects of individual mindfulness meditation techniques, so that these can be used more strategically to produce desired effects in multicomponent interventions.

Unexpectedly, patients in the WL group improved significantly in attentional control from baseline to two weeks in the absence of the same effect in the MG. The improvement in attentional control in the WL group could be explained by a repetition effect (i.e., performance on the task was improved as a function of simply repeating the task). The corresponding lack of improvements in the MG may have been observed due to a possible ceiling effect: The MG had higher attentional control at baseline than the WL group (although the differences were not significant), and they may

have already performed at their maximum capacity, which meant that task repetition alone could not improve performance.

Finally, changes in IBS-catastrophizing were observed in the absence of changes in attentional control. This suggests that reductions in catastrophizing can occur independently of improvements in attentional control. This study's hypothesis that improvements in attentional control would predict reductions in catastrophizing was thus not supported. An experimental study that induces improvements in attentional control and subsequently measures catastrophizing would be necessary to confirm or disconfirm the hypothesis.

7.5.1 Strengths and limitations

This study has several strengths. Both well-known and novel mediators of change in IBS symptom severity were evaluated in this study. This approach allowed the investigation into whether MBCT affects well known mediators of symptom improvement in IBS and an exploration of new mechanisms through which MBCT was hypothesised to improve symptoms. Predicted mediators were measured before changes in outcomes, supporting the hypothesis, that the mechanisms of change have a causal effect on the outcomes. This approach is in line with the NIH stage model of intervention design and implementation (Onken et al., 2014) which argues that understanding change mechanisms is crucial for developing effective interventions.

This study also has several limitations. Firstly, the control group was not active, leaving some doubt as to whether the active ingredients of MBCT (i.e., meditation in combination with cognitive psychoeducation) or other non-specific treatment factors led to the changes in mediators and outcomes. Secondly, causal pathways between predictors, mediators and outcomes were not estimated simultaneously in the same model (i.e., a single model that simultaneously analyses all mediators of symptom severity). As such, possible relationships between mediators were not accounted for. Given that the individual mediation models account for more than 100% of the variance in IBS symptom severity and quality of life, when the variances (R^2) of the models are added together, inter-correlations between mediators seems likely. Inter-correlations between

mediators in a multiple mediator model can change the relationship between a mediator and an outcome (Hayes, 2013) that was observed in single mediation models and these differences may change the interpretation of mechanisms. Multiple mediator models were not run in this study due to the small sample size and reduced power to detect significant effects in regression-based models with several mediators. Therefore, the study should be repeated with a larger number of patients, which facilitate the evaluation of mechanisms with multiple mediation models.

7.5.2 Conclusion

As part of a broader programme of work exploring cognitive mechanisms related to IBS symptom improvement and quality of life, this study contributes novel findings pertaining to the working mechanisms of MBCT. These mechanisms represent reductions in maladaptive cognitions in response to symptom (i.e., visceral anxiety sensitivity, pain and IBS catastrophizing), increased non-judgemental awareness of internal events and increased implicit associations between the self and the health concept. It was shown that changes in implicit processing of illness and health can be measured after two weeks of MBCT for IBS. Thus, implicit self-health and self-illness associations as measured with the IAT could be used as potential early markers of treatment efficacy. MBCT for IBS appears to be a promising treatment for patients with IBS. A larger study, with an active control group and a longer-term follow-up (e.g., up to one year) would be necessary to corroborate and substantiate this conclusion.

Chapter 8: General Discussion and Conclusion

8.1 Abstract

In this doctoral thesis I used a translational model, spanning from basic cognitive research through to intervention design, to develop and evaluate Mindfulness Based-Cognitive Therapy for patients with Irritable Bowel Syndrome (MBCT for IBS). I will summarise the aims, research processes and findings from this thesis and place them into context of current knowledge, theoretical frameworks and advances in the field. I will then discuss the strengths and limitations of this thesis before I outline suggestions for future research. Finally, a brief conclusion of this thesis will be presented.

8.2 Summary

8.2.1 Background and aims

Irritable bowel syndrome is a common chronic disorder of brain-gut interaction with insufficient treatment options. Given limited knowledge of the psychological maintenance factors of IBS I used a systematic translational approach to develop a new treatment for patients with IBS. This approach was based on the NIH stage model of intervention development (Onken et al., 2014). The model provides a clear framework for all crucial stages of intervention development and implementation. It emphasises the integration of theory-based basic science investigations about mechanisms of change into each research stage. Using this approach, my first aim was to identify underlying psychological processes involved in the maintenance of IBS symptom severity. Secondly, my aim was to use this information to inform the identification, modification and evaluation of a new psychological treatment for patients with IBS.

8.2.2 Summary of translational steps

Suitable explicit and implicit treatment targets were selected in a two-step process: First I selected meaningful maintaining factors based on a review of the literature (Chapters 1 and 5); second, I conducted an experimental, cross sectional study to explore potential implicit cognitive maintaining factors of IBS (Chapter 2 and 3). Using several theoretical frameworks to examine the findings, I concluded that adapting the original Mindfulness-Based Cognitive Therapy course for depression (MBCT) to patients with IBS (MBCT for IBS) could address the identified psychological factors (Chapter 5). The identified treatment targets informed the specific modifications that were made to the original MBCT protocol (Chapters 5). Based on studies that showed that changes in implicit biases occur prior to and predict later self-observed clinical changes (Harmer, O'Sullivan, et al., 2009; Harmer et al., 2011; Harmer, Goodwin, et al., 2009; Murphy et al., 2008; Reinecke, Waldenmaier, et al., 2013), I predicted that MBCT for IBS would affect the identified implicit maintaining factors before explicit self-reported clinical changes would be detected. The timing of when these implicit changes could best be tested was determined in a quasi-experimental proof-of-concept study with an MBCT for students course (the Finding

Peace course; Chapter 4). Finally, MBCT for IBS was evaluated in a randomized controlled clinical trial (Chapter 6). The hypothesised mechanisms of change were investigated (Chapter 7) with an embedded study of mediators of treatment effects.

8.2.3 Summary of findings

Firstly, by applying the Differential Activation Hypothesis (DAH) (Lau et al., 2004; Teasdale, 1988) and the Schema Enmeshment Model of Pain (Pincus & Morley, 2001) to the IBS population, I predicted, that biased implicit self-referential processing of illness and health would be a vulnerability and maintaining factor of IBS symptom severity (Chapter 2). In addition, based on Attentional Control Theory (ACT) (Eysenck & Derakshan, 2011; Eysenck et al., 2007) I predicted that patients with IBS would have lower attentional control than healthy people without IBS. It was hypothesized that higher levels of anxiety and higher visceral anxiety sensitivity in IBS patients would correlate with levels of attentional control. Based on previous of findings (Fox et al., 2015) I also predicted, that those patients with the lowest levels of attentional control would be those who catastrophize more about their illness. These hypotheses were tested with a cross sectional study with 42 IBS patients and 41 healthy participants. The study showed that compared to healthy participants, patients with IBS implicitly de-identified from health and thus showed an implicit discrepancy between their self-concept and their health-concept. Counter to our hypothesis patients did not clearly over-identify with their illness concept and the implicit associations with illness and health where not related to IBS symptom severity. In addition, it was found that patients with IBS had lower attentional control than healthy participants and that those patients with the lowest attentional control also had higher levels of catastrophizing thoughts about IBS symptoms (Chapter 3). The hypothesis that levels of anxiety would related to levels of attentional control was not supported.

A quasi-experimental study with 31 student participants showed that the Finding Peace Course, an MBCT course adapted for students, increased attentional control in healthy participants. Improvements in attentional control were detectable after two weeks of the course. These early changes in implicitly measured attentional control were predictive of later changes in attentional

focus. This shows that changes in implicit measures have predictive value over changes in related explicit measures. In addition, a significant increase in self-reported attentional focus after two weeks predicted reductions in anxiety after the course, pointing to the role of attentional processes in treating anxiety in students.

A review of the literature indicated that visceral anxiety sensitivity (fear of and hypervigilance for sensations in the abdomen) and pain/IBS catastrophizing (magnifying the meaning and consequences of IBS symptoms and pain) were reliable mediators of symptom reduction across treatment types (CBT for IBS and MBSR for IBS) (Chapter 1 and 5). This conclusion was supported by a recently published review of psychological mechanisms of treatment effect in IBS (Windgassen et al., 2017). Furthermore, although anxiety and depression were common targets of psychological treatments for IBS, improvements in IBS symptoms did not reliably dependent on improvements in psychological distress.

Based on the conclusions drawn from the literature review, the empirical findings from Chapters 2 and 3 and theory-based predictions about the mechanisms of mindfulness (Farb et al., 2015; Hölzel et al., 2011; Tang et al., 2015) and MBCT in particular (Lau et al., 2004; Segal et al., 2013; Teasdale, 1988), I adapted MBCT for patients with IBS. MBCT for IBS aims to change how bodily sensations, thoughts and emotions are processed - rather than changing the content of sensations, cognition and affect (Crane et al., 2016; Fennell & Segal, 2011, Chapter 5; Segal et al., 2013). Specifically, developing a decentred perspective, increased interoceptive awareness and improved attentional regulation were hypothesised to reduce visceral anxiety sensitivity and catastrophizing. In addition, I hypothesised that MBCT for IBS would reduce biased self-referential processing of illness and health and self-critical appraisal tendencies, and that these changes would mediate changes in IBS symptom severity.

MBCT for IBS was evaluated in a randomized wait-list controlled clinical study with 67 patients with IBS (the intention-to-treat (ITT) sample) (see Chapter 6). The study had a withdrawal rate of 34%; 47 participants completed post-treatment and 44 participants completed follow-up

assessments. These withdrawal rates are comparable to the other randomized controlled studies on mindfulness for IBS, where attrition rates were 37% (Gaylord et al., 2011) and 33% (Zernicke et al., 2013). To trace treatment effects over the course of treatment and beyond, study participation entailed baseline, intra-treatment (after 2 weeks), post-treatment and six-week follow-up assessments. This study was the first to show that MBCT can significantly reduce the symptoms of IBS and improve the patient's quality of life. Specifically, for the main outcome IBS symptoms severity, participants in the mindfulness group showed an 11% reduction at post-treatment and a 20% reduction at six weeks follow-up compared to baseline (in the ITT sample). The therapeutic effect was even greater in those patients who completed the course: 13% symptom reduction at post-treatment and 28% symptom reduction at follow-up. Improvements in IBS quality of life in the mindfulness group were similarly encouraging: in the ITT group, there was a 15% improvement at post-treatment and a 19% improvement at follow-up compared to baseline. Among treatment completers, there was a 21% improvement at post-treatment and a 27% improvement at follow-up.

To gain insights into the underlying mechanisms that led to symptom improvement in the treatment of IBS with MBCT for IBS, several mediation analyses were run and reported in Chapter 7. Firstly, I found that changes in anxiety of gastrointestinal specific symptoms, as well as catastrophic interpretations of pain and IBS symptoms at post- treatment mediated changes in IBS symptom severity at follow-up. This indicates that mindfulness induced reductions in threat related appraisals of symptoms changed the perceived severity of symptoms. Secondly, serial mediation analysis showed that reductions in self-health discrepancy after two weeks of MBCT together with an increase in non-judgemental awareness after the course mediated reductions in IBS symptom severity at follow-up. Reductions in self-health discrepancy also directly predicted increases in non-judgemental awareness. The findings indicate that reductions in biased self-referential and self-critical processing of internal events could be implicated in IBS symptom severity. Thirdly, the hypothesis that MBCT for IBS would lower IBS-catastrophizing via increasing attentional

control was not supported. Specifically, although MBCT for IBS lead to reductions in IBS-catastrophizing, this was observed in the absence of changes in attentional control.

8.3 Discussion of Findings

In this section I will discuss the findings from this thesis within the context of current knowledge and advances in the field. Theoretical implications will be explored and avenues for future studies will be highlighted.

8.3.1 Biased self-referential processing of illness and health – cognitive marker of changes in self-related processing

This thesis is one of three studies that found biased self-referential processing with regards to illness, pain and health stimuli in patients with a chronic health condition (IBS, somatoform disorders, chronic pain) when compared to healthy participants (Riebel et al., 2013; Van Ryckeghem et al., 2013). Therefore, implicit self-referential processing of illness and health could be a cognitive marker that can be found in patient groups where psychological factors play a role in symptom maintenance. To contextualise, a biomarker is a physiological index of health that predicts symptoms or the risk of developing a disease (for example an abnormal lipid profile is a biomarker of arterial vulnerability in cardiovascular disease (Vasan, 2006)). Similarly, a cognitive marker would be based on valid psychological measures and, if reliable, could improve accuracy of IBS diagnosis, prognosis, treatment choice and response to the treatment. In support of this suggestion, a self-health IAT similar to the IAT used in this thesis has recently been shown to be a reliable and valid measure of the implicit self-health concept (Werntz, Green, & Teachman, 2017). In addition, the self-illness - self-health IAT from this thesis seems to respond sensitively to the treatment with MBCT for IBS: In my analysis of change mechanisms (Chapter 7), it was an early marker of changes in non-judgemental awareness, a direct mediator of changes in IBS symptom severity. These findings support Farb's (2015) prediction that mindfulness practice would promote shifts in self-processing. Particularly the body scan, which engages in increased precision weighing of sensory experiences might instil a greater sense of embodiment and therefore affect a person's self-representation (Farb et al., 2015). The findings are also in line with Williams (2008)

assumption that decentred, non-judgemental processing, as is hypothesised to be practiced in MBCT, would reduce a focus on discrepancies between current and desired states.

When weaker associations between the self-concept and the health concept are defined as a discrepancy between current and desired (ideal-self) experiences, and when the discrepancy is considered an emotional vulnerability, akin to Higgins self-discrepancy theory (Higgins, 1987), then the findings of this thesis are coherent with the principles of the mindfulness tradition. Within the origins of mindfulness, the Buddhist teachings, craving for a particular state, particularly the "desire to be or become particular selves" (Teasdale & Chaskalson, 2011a, p. 96), is seen as one of the fundamental origins of suffering (Teasdale & Chaskalson, 2011a). Letting go of craving for a state is posited to reduce the suffering (Teasdale & Chaskalson, 2011a). In the case of patients with IBS, the desired state of the self is the healthy state. Weaker associations between the self-concept and the health-concept would represent the felt discrepancy between the actual self and the desired self. By attending to experiences with a non-judgemental, non-evaluative, approach oriented, present moment focus, as is practiced in mindfulness mediation, (Crane et al., 2016; Teasdale & Chaskalson, 2011b), experiences can be accepted as they are, without concurrently desiring or craving for these experiences to be different. That is, without wishing or craving that an experience was different from what it is (i.e., "without wishing that a chicken was a duck" (Cullen, 2016)), the suffering created by craving for a different self-state is thought to be reduced (Teasdale & Chaskalson, 2011a). Within MBCT for IBS, practicing non-judgemental observation of bodily states may have reduced the implicit discrepancy between the self and the healthy state, possibly signifying a more adaptive processing of bodily states, including pain and IBS symptoms. Thus paradoxically, by observing bodily sensations non-judgementally, without comparing actual sensations to the idea of a healthy state, IBS patients may have reduced the discrepancy between actual and desired self-states – as evidenced by closer associations between the self and the health concept. However, this interpretations needs to be considered within the limitations of the Implicit Association Task (the measure that was used to assess biased implicit processing of illness and health), and the comparison groups. Firstly, there are no established cut-off points for reaction-time

latencies or IAT-scores that denote differences between adaptive and-non-adaptive processing of health and illness related stimuli. Comparisons were made between IBS patients and healthy participants, with the assumption that healthy participants would express adaptive processing of illness and health. However, evidence for this assumption still needs to be provided. In addition, the IAT measures reactions to linguistic stimuli and it is not yet known if changes in the processing of linguistic stimuli represent changes in the processing of physical sensations. Imaging studies (e.g., fMRI) that observe self-referential processing in response to physical stimuli, such as heat or pain, may provide useful information.

8.3.2 Attentional control

Based on Eysenck's Attentional Control Theory (ACT) (Eysenck & Derakshan, 2011; Eysenck et al., 2007), which theorizes that anxiety impairs executive attentional functions such as attentional control, I predicted to find a positive correlation between levels of anxiety, visceral anxiety sensitivity and attentional control in patients with IBS. However, the results in Chapter 3 showed no such correlation. As discussed in Chapter 3, one explanation for the lack of correlation would be that the effects of anxiety and visceral anxiety sensitivity on attentional control may only be observable when a feared threat is present, for example during the emotional (or IBS related) Stroop Task (Bar-Haim et al., 2007; Derakshan & Eysenck, 2009). A second explanation would be that there may be a certain threshold of anxiety that needs to be reached in order for anxiety to affect attentional control. For example, Mogg and colleagues (2000) showed that threat needs to exceed a certain threshold to capture attention in low anxious individuals. Similarly anxiety may need to go above a certain threshold in order to affect executive attentional resources. The mild to moderate anxiety that was recorded in IBS patients in my study (Chapter 3) was perhaps below this threshold.

This still leaves the question of why patients with IBS in our study may have had lowered attentional control when compared to healthy participants. One possibility is that low attentional control in IBS patients is a result of worries. For example, on study found that high worriers showed reduced working memory capacity when worrying about a negative topic, but not when

thinking about a positive topic (Hayes, Hirsch, & Mathews, 2008). Working memory is an executive function closely related to attentional control (Course-Choi et al., 2017; Shipstead et al., 2014). Their findings also supported the hypothesis that the worry component of anxiety rather than mood reduces working memory capacity (Hayes et al., 2008). IBS patients have been shown to engage in more worry than healthy participants (Hazlett-Stevens, Craske, Mayer, Chang, & Naliboff, 2003) and it is conceivable that participation in a study about IBS may have triggered worries about symptoms. Therefore IBS patients may have shown reduced attentional control as a result of worrying during the assessment of attentional functions. An alternative explanation is the hypothesis that functioning of the attentional networks may be a trait characteristic (Posner & Rothbart, 2007). Having low trait attentional control may leave IBS patients vulnerable to develop worries and catastrophic thoughts about symptoms when they appear. This interpretation would align with the Cognitive Model of Pathological Worry (Hirsch & Mathews, 2012), which theorises that insufficient top-down attentional control may be a risk factor for developing pathological worries. In conclusion, the lack of correlation between anxiety and attentional control in patients with IBS does not support ACT. ACT may not be applicable to IBS patients with mild to moderate anxiety or when attentional control is tested without presenting threatening material (e.g., the word diarrhoea) during the arrow and flanker display of the Attention Network Task (ANT). Therefore, it remains to be tested if the predicted correlation would be found in IBS patients with severe anxiety or when attentional control is tested with a different task, such as the emotional Stroop task or a flanker task with additional threat related distractors. An experiment that measures attentional functioning with the ANT under three conditions, after a worry induction, after an induction to think about a positive or neutral topic, and without any induction, may shed light on the potential effect of worrying and attentional control in IBS patients. Currently, the findings are more supportive of the suggestion that low attentional control may be a trait characteristic (Posner & Rothbart, 2007). The results suggest that attentional control may be a vulnerability factor of catastrophizing in patients with IBS, but that it may not be a necessary component of the therapeutic process to reduce catastrophizing. Therefore, in the case of IBS, theories that treat low

attentional control as a plastic vulnerability factor that interacts with worry, anxiety and attentional biases, such as the Cognitive Model of pathological worry (Hirsch & Mathews, 2012) may be more applicable.

8.3.2.1 The role of attentional control for the reduction of negative, repetitive thoughts

Taking together the finding that MBCT can reduce catastrophizing without increasing attentional control (Chapter 7) and the findings of studies in which improvements in executive functions (i.e., attentional control and working memory) were linked to reductions in worries (Course-Choi et al., 2017; Fox et al., 2015; Grol et al., 2018) suggests that executive attention may be *one of several factors* that can contribute to the reduction of negative, repetitive and catastrophic thoughts. Along this line, the cognitive model of pathological worry (Hirsch & Mathews, 2012) proposes that, next to attentional control, cognitive biases that facilitate the automatic processing of threat related material play a role in the instigation and maintenance of worry. In addition, the theory specifies that attentional control may be useful in reducing the impact of non- verbalized pre-conscious distractions. However, once internally verbalised, negative thoughts tend to occupy and consume executive resources, making it more difficult to ignore worries and catastrophic thoughts. The authors (Hirsch & Mathews, 2012) also suggest that positive beliefs about worry may be a maintaining factor of worry. Applying this premise to the current finding would imply that mindfulness – and by this token the decentred perspective - may have reduced catastrophizing by changing beliefs about verbalized catastrophizing thoughts. In the context of treatment, adding an effective training of working memory or attentional control to an already existing mindfulness intervention might increase the effectiveness of this intervention. This combination training would be hypothesised to act on the non-verbalized pre-conscious as well as the verbalized thought based form of negative thoughts. Indeed, it has been shown that the combination of computerized working-memory training and mindfulness training was more effective at reducing worry than either training alone (Course-Choi et al., 2017). In addition, examining the link between cognitive biases in IBS patients such as hypervigilance for threat (Afzal et al., 2006; Chapman & Martin,

2011; Kristy Phillips et al., 2014; Tkalcic et al., 2014) and catastrophizing thoughts would help clarify the link between pre-conscious and verbalized worries in IBS patients.

8.3.2.2 The varying effects of mindfulness on attentional control

Based on the results from Chapter 4, showing that two weeks of MBCT for students (the Finding peace course) can increase attentional control in students, I had predicted that two weeks of MBCT for IBS would increase attentional control in patients with IBS. The predominant meditation of the first two weeks of the Finding Peace course (MBCT for students) is a focused attention meditation ("Mindfulness of body and breath") and the main meditation of the first two weeks of MBCT for IBS is the "Body Scan". Both mindfulness mediations (mindfulness of body and breath; the body scan) were expected to lead to increases in attentional control due to the instructions that invite participants to sustain attention on the breath or the sensations in the body, and to return attention to the intended point of focus if the mind has wandered off. However, MBCT for IBS appeared to have no significant effects on attentional control in IBS patients. One explanation for these unexpected findings is that the effects of an intervention on one population (e.g., students) may not translate to another (e.g., IBS patients). However, more importantly, the combination of these findings highlights the need to investigate the specific effects of specific intervention techniques even within interventions that have the same treatment label (e.g., MBCT) (Henrich et al., 2015). This has also been the aim of the "Behaviour Change Techniques and Theory" project (Michie et al., 2011) which emphasises the importance of linking specific intervention techniques to intermediate targets of treatments (i.e., the hypothesised mechanisms) (Michie & Prestwich, 2010). Knowledge of the specific effects of treatment modules allows researchers in intervention design to be more deliberate in the choice of treatment modules to reach desired effects. For example, motivation is considered to be a determinant of physical activity and behaviour change techniques such as 'behavioural goal setting' and 'self-monitoring of behaviour' have been associated with beneficial changes in motivation (Knittle et al., 2018). Thus researchers that design interventions to increase physical activity by targeting motivation could deliberately choose these techniques as modules in their intervention. Along this line, in Chapter 4, it was

shown that increasing attentional focus predicts reductions in anxiety in students. Therefore, those designing an intervention to reduce anxiety in students may wish to choose treatment modules that are known to reliably improve attentional focus.

8.3.3 Mindfulness-based interventions for IBS

The thesis demonstrates the potential benefits of MBCT for IBS. The treatment had a medium effect size for reducing symptom severity at post-treatment (ITT: $\eta p^2 = .07$ converts to $d = 0.55$; PP: $\eta p^2 = .10$ converts to $d = 0.67$). This effect is comparable to the cumulative effect size reported in a meta-analysis of psychological treatments for IBS ($g = .64$ across CBT, CT, hypnotherapy, MBIs and relaxation courses) (Henrich et al., 2015). This indicates that MBCT for IBS may be a promising treatment that is on par with previously established psychological treatments. Unfortunately, comparable data for follow-up effect sizes are currently not available. I will now discuss this findings in the context of the only other study that reported results on an adapted mindfulness-based intervention for patients with IBS (Gaylord et al., 2011). In contrast to Gaylord and colleagues' (2011) randomized, actively controlled study on mindfulness-based stress and pain-management for patients with IBS (MBSR for IBS), the current MBCT for IBS course shows a smaller effect size on the primary outcome of IBS symptom severity. This difference could be explained by variations in intervention length and course content. For example, the course length of the MBSR for IBS course was eight weeks (and a one-day retreat), compared to the 6-week MBCT for IBS course. The additional dose of treatment in the MBSR for IBS course could have had an additional therapeutic effect. However a review by Carmody and Baer (2009) found no correlation between the length of the course and reductions in psychological distress in MBSR. Therefore, it is more likely that differences in content rather than length may have contributed to differences in effect size. This conclusion is supported by studies showing that shortened CBT for IBS programmes have similar effects as full length programmes (Lackner et al., 2008; Vollmer & Blanchard, 1998). Nevertheless, it would be worthwhile exploring if an eight week MBCT for IBS protocol would have larger and longer lasting effects than the current six-week MBCT for IBS programme.

Although largely similar in terms of treatment content, MBSR and MBCT were developed for different populations and with different rationales. MBSR was developed as a stress reduction programme to train self-regulation skills for patients with chronic pain (Kabat-Zinn, 1982) with promising results at the time (Kabat-Zinn et al., 1985). Therefore, the MBSR for IBS course (Gaylord et al., 2009, 2011) may have had a qualitatively different emphasis than the MBCT for IBS course. After examining the rationale and treatment content for the MBSR for IBS course (Gaylord et al., 2009) and comparing it with the MBCT for IBS course, it became apparent that the MBSR for IBS course has a greater focus on the subjectivity of interpretation, reinterpretation of pain, the role of mindfulness for stress in every-day life and training in emotional intelligence relating to working with difficult emotions and communicating these effectively. The MBCT for IBS course has a greater emphasis on working with and processing maladaptive cognitions and recognizing habitual patterns of the mind, next to strengthening interoceptive awareness, self-care and working with difficult emotions. It is thus conceivable that differences in the emphasis on specific topics (e.g., on stress and emotional intelligence in MBSR for IBS; recognizing and processing maladaptive cognitions) may have contributed to differences in effect size in IBS symptom severity between treatments. This different emphasis may have also been reflected in differential changes in quality of life and psychological distress between the two courses, where the MBCT course seemed to have a larger and more immediate effect. In addition, the MBSR course protocol (Gaylord et al., 2009) had some specific intervention techniques that were not covered in the MBCT for IBS protocol: practising diaphragmatic breathing, walking meditation and "choiceless awareness". Particularly diaphragmatic breathing may have given participants a new skill in responding calmly to difficult situations. Indeed, it has been shown that training in diaphragmatic breathing can bring about lowered cortisol levels in response to stress (Ma et al., 2017), indicating that this breathing technique can modify important physiological markers of the HPA axis, a system involved in brain-gut interaction. Adjusting the MBCT for IBS protocol by adding new modules, such as diaphragmatic breathing, and introducing additional topics such as emotional intelligence and mindful coping with stress, and subsequently comparing the

effectiveness of the original and the adjusted MBCT for IBS protocol would help refine the treatment with the aim to enhance its effects.

Moreover, the results from this study and the Gaylord study (2011) showed that larger treatment effects on IBS symptom severity and quality of life often appear at follow-up (at least six weeks after the intervention) rather than directly post-treatment. This suggests a delayed effect of mindfulness practice on IBS related outcomes and shows the importance of measuring symptom changes in the medium and long-term (as significant changes might occur long after course completion). In contrast to IBS symptom severity, in the current study, this delayed effect was not observed for psychological distress (depression, anxiety and stress), visceral anxiety sensitivity and catastrophizing. For these variables, reductions of scores were greatest directly after the treatment and then stayed stable until follow-up. This could point to a differential response between psychological and biological (albeit self-reported) outcomes to mindfulness-based treatments. In other words, there might be a greater response lag in physiological variables compared to psychological variables in response to MBCT.

Finally, the analysis of process measures showed expectations of improvement significantly correlated with actual symptom improvements. This points to a placebo response to the treatment and highlights the importance of comparing MBCT for IBS to an active, credible control group to assess the internal validity of the effects. Additionally, further studies with longer follow-up periods are necessary to assess longer term effects of the treatment. Given the promising results, the study on MBCT for IBS reported in this thesis created a platform for future studies that aim to compare MBCT for IBS to an active control group including current recommended treatment options.

8.3.4 Mechanisms of change of MBCT for IBS

8.3.4.1 Maladaptive, illness specific reactions to symptoms

The findings that causally link visceral anxiety sensitivity and catastrophizing to IBS symptom severity provide additional support for the biopsychological model of IBS. They show

that reductions in threat-based appraisals of symptoms are implicated in symptom amelioration. The next section will focus specifically on recent findings from three relevant studies that may help explain the role of fear of visceral sensations in relation to IBS and MBCT for IBS. Briefly, visceral anxiety sensitivity describes a fear of abdominal symptoms, both when they are present and when they are absent. Firstly, in a large study involving 1,144 patients with either IBS or functional dyspepsia, levels of visceral sensitivity (measured using sensitivity to rectal balloon distension) were directly associated with increases GI symptom severity (Simrén et al., 2017), suggesting sensitivity to sensations in the viscera as a potential treatment target. Secondly, a recent experimental study has shown that fear of visceral pain in combination with pain intensity affects pain-unpleasantness (also in response to rectal balloon distension) in healthy individuals (Koenen et al., 2017). These findings reflect the contribution of fear of visceral pain in the perception of visceral pain stimuli (Koenen et al., 2017). Thirdly, a recent treatment study showed that CBT led to reductions in anxiety of visceral sensations and IBS symptom severity in the absence of reductions of visceral sensitivity (Edebol-Carlman et al., 2017). Taken together, these studies suggest a bi-directional brain gut interaction: Along the afferent gut-to-brain pathways, sensitivity to visceral sensations contributes to symptom perception. In addition, fear of these sensations may modulate their perceived unpleasantness (in addition to pain intensity). Crucially, psychological treatments may lead to symptom reduction without affecting the sensitivity of the viscera but rather by affecting the relationship patients hold towards these sensations (i.e., a reduction in anxiety or fear of these sensations). Thus fearful interoceptive anticipation of symptoms may alter either the perception of symptoms or gut functions unrelated to gut sensitivity via efferent brain-gut pathways. These may be two of several routes through which MBCT (and CBT) affect IBS symptom severity. To conclude, MBCT for IBS may have affected how thoughts about symptoms are processed, but more importantly, it may have attenuated biased threat-laden processing of visceral sensations, including IBS symptoms.

8.3.4.2 Non-judgemental awareness

I introduced non-judgemental awareness as a potentially important psychological variable that may be related to IBS symptom severity via its presumed effect on the autonomic nervous system (a crucial part of the brain-gut axis, see Chapters 5 and 7). Similarly, several authors have suggested a model in which greater acceptance of IBS and pain could be linked to reduced IBS symptom severity and increased quality of life via reduced experiential avoidance (Dindo & Lackner, 2017; Ferreira, Gillanders, Morris, & Eugenicos, 2017; Naliboff et al., 2008). Experiential avoidance is the reluctance to stay in contact with painful private experiences (e.g., negative thoughts, emotions or physical sensations) and taking action to avoid or alter these experiences (Chawla & Ostafin, 2007). In this model, experiential avoidance is considered a maladaptive avoidant coping strategy hypothesised to be linked to IBS symptoms and IBS related suffering (Dindo & Lackner, 2017; Ferreira et al., 2017). Greater acceptance of private painful events is thought to reduce experiential avoidance, which is hypothesised to be linked with reductions in IBS symptom severity and increases quality of life (Dindo & Lackner, 2017; Ferreira et al., 2017). The findings that link non-judgemental awareness to symptom severity also indicate that other psychological treatments that promote acceptance may have potential benefits for patients with IBS. One such treatment is Acceptance and Commitment Therapy (ACT). ACT is built upon Relational Frame Theory, and just as MBCT aims to affect the processing of thoughts rather than their content (Hayes et al., 2006). In ACT the contextual events that alter cognition and its impact (e.g., if a thought is taken literally) are the focus of treatment with the aim to increase psychological flexibility (Hayes et al., 2006). ACT combines mindfulness and acceptance with a personal values-based approach. Indeed, a research group in Edinburgh, UK, ran two uncontrolled pilot studies investigating an ACT self-help intervention with 45 and 56 IBS patients per study (Ferreira et al., 2017; Gillanders, Ferreira, Angioni, Carvalho, & Eugenicos, 2016). The intervention was associated with improved IBS severity and greater acceptance of IBS, however it was not associated with reductions in experiential avoidance (Gillanders et al., 2016). Furthermore, changes in acceptance predicted changes in symptom severity (Ferreira et al., 2017). These studies further corroborate the hypothesis that learning to be more accepting towards internal events may

be therapeutic for IBS patients. Future studies should investigate the relationship between non-judgemental awareness, acceptance, experiential avoidance and IBS symptoms and clarify if IBS-specific acceptance or more general acceptance of private events aids symptom amelioration in psychological treatments for IBS. Studies that investigate the specific psychobiological mechanisms that link non-judgemental awareness to biological markers of IBS symptom reduction are needed to establish clear brain-gut mechanisms.

8.4 Strengths

This doctoral programme of research has several notable strengths. Firstly, it was based on a translational approach which integrated previous findings from the literature and experimental research into the development of a new intervention to reduce IBS symptom severity. To this end, I systematically investigated cognitive maintaining factors of IBS, based on the recommendations of the NIH stage model of intervention development (Onken et al., 2014). This led to the development of Mindfulness-Based Cognitive Therapy for patients with IBS (MBCT for IBS).This thesis crosses stages 0, 1A, 1B and 2 of the NIH stage model and care was taken to examine mechanisms related to symptom improvement in IBS patients. This was in line with recommendations from Dimidjian and Segal (2015) who pointed out that it was crucial to understand the mechanisms of change in mindfulness based interventions in order to advance the healthcare of those patient groups for whom MBIs are developed. The focus on investigating mechanisms in this thesis also led to the discovery that MBCT for IBS decreased IBS symptoms by reducing gastrointestinal specific anxiety, catastrophizing about symptoms and biased implicit processing of health and illness as well as increasing in non-judgemental awareness.

Secondly, MBCT for IBS meets the requirements for adaptations of MBI's set by Crane and Colleagues (2016): The intervention benefits from a theoretically grounded analysis of empirically validated vulnerability and maintaining factors of patients with IBS. It is based within the biopsychological model of irritable bowel syndrome and efforts were taken to tailor MBCT for IBS to affect specific hypothesised mechanisms whilst upholding the core curriculum elements (Crane et al., 2016). Following recommendations by Michie and Prestwich (2010), care was taken

to link specific intervention techniques and their presumed effects to specific intermediate outcomes. This also meant that modules of MBCT that were deemed irrelevant for IBS patients were not included, leading to a shorter, more concise intervention.

Thirdly, throughout this thesis, previously validated, implicit, more objective reaction-time based measures were used (e.g., the implicit association task and the attention network task) in addition to more traditional self-report measures. These reaction-time tasks are considered to be more objective, because they are less sensitive to response biases than self-report measures. As a result, the effects that were measured with these tasks are more likely reflect actual differences in cognitive functions, rather than subjectively perceived differences.

Fourthly, the clinical trial evaluating MBCT for IBS had a randomized, waiting-list controlled design, which goes beyond the initial pilot testing (stage 1b) set forth by the NIH stage model. Because random allocation avoids systematic differences that could confound the interpretation of the results (Sibbald & Roland, 1998), causal inferences about the effect of the intervention can be made.

Finally, the development of the intervention was not naive to possible resource implications. Therefore the aim was to create an effective yet minimally resource-intensive intervention that could reliably affect the hypothesised change mechanisms. MBCT for IBS has the potential to be integrated into existing care structures, if proven efficacious in subsequent clinical trials. Many psychologists in the UK are trained in delivering MBCT for depression through the national health care service. With additional training in the theoretical principles that underpin MBCT for IBS (Crane et al., 2016) trained psychologists should be able to deliver MBCT for IBS to interested patients.

8.5 Limitations

Despite its applicability and translational approach, this programme of research has several limitations. The cross-sectional study reported in Chapters 2 and 3 compared IBS patients to a control group of healthy participants on biased self-referential processing of illness and health and

attentional control. Given, that the stimuli words in the implicit association task (IAT) for illness/health identification were not IBS-specific, it cannot be ascertained that biased self-referential processing of illness and health is an IBS specific phenomenon. It is possible that other patients groups with a chronic illness would also have weaker associations with health-related words. Using illness-specific stimuli words (e.g., bloating) would have made the associations more specific to gastroenterological illnesses rather than any chronic illness. However, as mentioned in Chapter 2, IBS patients also have a range of other somatic complaints (e.g., fatigue) that led me to choose more general illness and health related stimuli. Finally, a second control group with patients that have a chronic gastroenterological illness with biological markers (e.g., inflammatory bowel disease) would have helped to clarify the specificity of the results.

The proof-of-concept, quasi-experimental study reported in Chapter 4 aimed to determine the dose of mindfulness meditation necessary to produce changes in attentional control over and above a training effect on the attention network task (ANT) and to assess changes in psychological variables relevant for students. However, during the implementation phase, it became clear that the intended control group (i.e., students on the waiting list for the Finding Peace course) was not available. Therefore an age and gender matched control group was recruited to control for training effects on the ANT and pre-post course differences on self-reported measures were examined using the mindfulness group only. This uncontrolled design bears uncertainty about the causes of observed changes from pre-to post intervention. For example, reductions in psychological distress and improvements in satisfaction with life may have been a result of response biases, placebo effects (e.g., expectations) or reflected the normal progression of student's psychological well-being throughout their term. Hence causality between the Finding Peace course and improvements in psychological wellbeing was not established. In addition, the study sample was slightly smaller than the a-priori determined sample size, which resulted in a reduction of power to detect genuine effects.

The randomized controlled trial that evaluated the effect of MBCT for IBS on symptom severity, quality of life, anxiety, depression and stress as well as the intervention's change

mechanisms has a number of issues that limit the internal and ecological validity of its findings. Firstly, this intervention study included women only, and it was a one-centre study with an above average number of highly educated participants. This limits the generalizability of the findings to female, more highly educated patients. However, with approximately two thirds of IBS patients being female, findings may still apply to a majority of patients. Secondly, as is the case with most psychological interventions that are compared to a waiting list control group, it was not possible to blind participants or therapists to treatment allocation. This heightens the chance of response biases to have played a role in the observed improvements in the outcome measures. Thirdly, whilst the findings from this study are novel, they are based on a comparison to a waiting-list, rather than an active control group. I chose this control group because it was important to have preliminary evidence of a positive treatment effect of MBCT for IBS, before spending financial resources on the development and implementation of a comparable active control group. Future studies should compare MBCT to an active treatment condition to determine its relative efficacy. Finally, the study was underpowered to detect changes in primary and secondary outcomes as well as the mediation analysis. A replication study with a higher number of participants would be necessary to confirm findings.

8.6 Looking ahead

8.6.1 Implementation

Subject to definitive positive outcomes of MBCT for IBS in larger, actively controlled trials, including non-inferiority trials, it is worthwhile thinking ahead of possible issues that may arise when implementing MBCT for IBS into the wider healthcare system. Preparing for potential issues is expected to smooth the implementation process which may result in better patient care. Based on an examination of the facilitators and barriers of MBCT for recurrent depression in the UK (Crane & Kuyken, 2013), it is possible to forecast issues for the implementation of MBCT for IBS. These issues can be broadly summarized as ‘top-down support’, ‘official guidelines’, ‘champions’ and ‘building networks / referrals’.

On the level of individual health care organisations, having the implementation of MBCT integrated into the strategic plan of the organisation was a key facilitator. Strategic support helped to make MBCT more widely available, in ensuring appropriate training for therapist and in increasing an organisation-wide understanding how MBCT works (Crane & Kuyken, 2013). A lack of strategic oversight and prioritisation often resulted in training needs of therapists not being met, protected time to deliver classes not being provided and in a lack of understanding of the core elements of MBCT within the organisation. To overcome these barriers to implementation it is thus crucial to generate top-down structural and organisational support for a new intervention in order to ensure it becomes widely accessible. In countries where MBCT has been made more widely available, and outcome based studies show its acceptability and efficacy for patients with recurrent depression, the implementation of MBCT for IBS may be easier. Here, additional training needs would revolve around the adaptation of the course to the specific patient group rather than teaching a new type of treatment. In contrast, in countries where MBCT is not yet widely available or where it is not customary to prescribe psychological treatments for IBS, additional resources may need to be employed to develop strategic support and patient acceptability. Secondly, implementation was also facilitated by having clinical guidelines that recommend the use of the treatment, such as the guidelines by the National Institute of Health Care Excellence (NICE) in the UK (Crane & Kuyken, 2013; National Institute for Health and Care Excellence [NICE], 2008). Given sufficient evidence for MBCT for IBS, it would therefore be crucial to add the treatment to the clinical guidelines before implementation is attempted. Providing help in interpreting the available scientific evidence and tools that aid the communication to service managers have also been identified as facilitators for change (Crane & Kuyken, 2013). For example, good practice guidelines that specify in simple terms how MBCT might be helpful for patients with IBS and why implementing it is in line with organisational goals may aid generating strategic support. A third factor that has been recognized was the identification of "champions" (passionate and committed individuals) that drive the implementation of MBCT within their organisation (Crane & Kuyken, 2013). These champions may self-designate to start bottom-up movements within the organisation

or they can be identified once top-down support has been secured. Intra organisational, long-term outcome-based research on the effect of MBCT for patients and its acceptability help to drive initiatives and provide an additional evidence base for its continued provision. The fourth factor can be broadly categorized as a strong network across organisations that are involved in research, training, diagnosis and implementation. For example, strong associations among health care organisations, universities and training centres would help meet the training needs of therapists, links between care organisations and clinicians (i.e., both GPs and specialists in tertiary care) would help generate appropriate referrals, and informal and formal communication channels can disseminate best practices.

To put it briefly, knowledge of the implementation issues of MBCT identified by Crane and Kuyken (2013) can be used to prepare for the possible implementation of MBCT for IBS. However, there are also country and discipline specific issues that need to be considered. For example, due to different backgrounds and training, communication about the value of MBCT for IBS between medically trained professionals and psychologists may need to be approached carefully. For instance, one difference between members of each discipline lies in the communication of clinical effects. Medical journals often report odds ratios whereas psychological journals report effect sizes using Cohen's d. As such, medical specialists may want to know the effect of MBCT phrased in terms of odds ratios whereas psychologists are accustomed to communicate the same information using different effect size statistics. This may lead to ineffective communication of the effects of a clinical trial evaluating MBCT for IBS. This example illustrates just one small difference in communication styles, however there are likely to be additional knowledge and communication gaps among psychologists, gastroenterologists, GPs and health care unit managers. Therefore to create a mutual understanding of the interaction of biological and psychological factors in IBS, the value of psychological therapies for patients, the clinical reality of busy tertiary care clinics and potential time-points to offer the intervention to patients, specific task forces or focus groups may need to be created.

In conclusion, before implementing MBCT for IBS in a specific country, a map of the countries' individual health care system needs to be drawn, to identify those who would be delivering the intervention, those who would refer patients to the intervention and those who would make decisions about strategic plans and budgets. Clinical guidelines would need to recommend MBCT as a suitable treatment for IBS. In addition, clear practice guidelines would need to be drawn that explain the therapeutic rationale of MBCT for IBS and provide economic information that helps to make a good business case for each organisation considering implementing MBCT for IBS. Finally, it may be helpful to run a pilot implementation study in an interested clinic to document country and discipline specific facilitators and barriers which could inform a full-scale implementation.

8.6.2 Staging MBCT for IBS among other therapeutic interventions

Next to considering the possible implementation of MBCT for IBS, it may also be useful to reflect upon where MBCT would fit among the staging of available therapeutic interventions. Currently the NICE (National Institute for Health and Care Excellence [NICE], 2008) recommended care management stages for IBS start with general lifestyle, physical activity (for patients with low levels of physical activity) and dietary advice. If symptoms persist following general lifestyle advice the FODMAP diet (see Chapter 1) is the next option. In addition, clinicians can prescribe first line pharmacological treatments (e.g., laxatives, antispasmodic and antimotility agents). If patients do not respond to first line pharmacological treatments, second line pharmacological treatments may be offered (e.g., stronger laxatives, tricyclic antidepressants, selective serotonin uptake inhibitors). Third line pharmacological treatment (e.g., eluxadoline, a mu-opioid receptor agonists with more serious side effects that can be addictive) is available for patients with diarrhoea only, if their IBS has not responded to first or second line treatment or if there are contraindications or intolerances for these treatments. Finally, the NICE guidelines recommend that psychological therapies should be offered if the patient does not respond after 12 months of pharmacological treatment. Given this set of guidelines, MBCT for IBS could simply be added to the list of psychological treatments (e.g., CBT, hypnotherapy) that are offered to

refractory patients. Alternatively, given reliable findings showing that psychological maintaining factors of IBS can be ameliorated using psychological therapies, emerging evidence for disordered brain-gut interactions as well as reports that link co-morbid psychological disorders to increased symptom burden, it may be warranted to consider offering MBCT for IBS at earlier stages in care management.

What might be possible advantages of offering MBCT for IBS as a first or second line treatment? Firstly, the cultivation of mindfulness may facilitate self-care behaviours. For example, patients may be less critical of themselves if they fail to follow a new diet or exercise plan 100% of the time and they may therefore continue with implementing it, rather than give up due to frustration. Mindfulness may therefore support the adaptation of particular diets, physical exercise and healthy lifestyle choices that reduce stress. In addition, MBCT for IBS encourages patients to recognise factors in their life that may exacerbate symptoms and symptom burden. As such mindfulness practices may support the patient in identifying idiosyncratic triggers and maintaining factors of IBS. MBCT for IBS may thus be suited to be offered alongside of advice about life-style or dietary changes.

Secondly, if IBS symptoms were improved to a healthy level of functioning through MBCT for IBS or other psychological interventions, then prescribing pharmacological agents may no longer be necessary. This may be particularly important for patients who wish to avoid pharmacological treatments due to potential side effects or the need to take these over long periods of time. However, it should be noted that mindfulness-based treatments may also carry potential side effects. Unfortunately adverse effects in meditation are not well monitored and therefore often go unnoticed. A recent critical evaluation of mindfulness cautioned researchers and clinicians to become aware of the possibility of unwanted meditation induced effects (Van Dam et al., 2018). The authors based their recommendation on accumulated information from case reports and observational studies that reported serious adverse effects such as depersonalisation and panic as well as an observed lack of methodical research into unintended effects (Van Dam et al., 2018). It is thus important to increase research activities into both serious and more benign (e.g., crying

during sessions) unintended effects of mindfulness treatments so that patients and doctors can make informed choices.

Thirdly, one important objective of health care interventions should be to reduce symptom burden. As outlined in Chapter 1, co-morbid psychological disorders adversely affect symptom burden and prognosis of patients with a chronic medical condition (Dindo & Lackner, 2017; Löwe et al., 2008). Therefore psychological interventions such as MBCT for IBS or CBT that have been shown to reduce symptoms of depression and anxiety should be first-line treatments, particularly for patients with co-morbid psychological distress.

Finally, MBCT for IBS can be delivered in groups and may therefore be less costly than one-on-one psychological therapies. Subject to future evidence of its effectiveness, it may therefore be a cost-effective treatment for patients whose symptoms are maintained by psychological factors along the brain-gut axis.

To conclude, MBCT for IBS could be added to the NICE guideline's list of psychological treatments that are offered to refractory patients. In addition, it would be worthwhile considering MBCT for IBS and other psychological interventions as a first line treatment to all patients, in order to reduce symptom burden and support making healthy lifestyle changes. In order to improve transparency of treatment effects, it is crucial to research possible adverse and unintended side effects of MBCT for IBS. Most importantly, the patients' needs and preferences need to be taken into account when considering and choosing treatments options.

8.7 Future research perspectives

Although IBS is increasingly recognized as a brain-gut disorder and several psychological treatments have been developed to treat the illness, the care for patients with IBS and the understanding of the illness is still sub-par. As Onken and colleagues (2014) have suggested, in order to improve the impact of interventions, it is equally important to engage in basic research and applied treatment studies in combination with investigations into the mechanisms of change. This will further the understanding of the underlying (psycho-) pathological factors that contribute to

the illness and improve treatment outcomes and ultimately the life of the patients. The next section therefore focuses on future perspectives and proposals for investigations into the cognitive mechanisms and the long-term evaluations of psychological treatments for patients with IBS.

8.7.1 Suggested research proposals within the NIH stage model

Based on the results of this thesis, it would be worthwhile to a) further examine the role of attentional control and biased self-referential processing of illness and health in IBS patients (stage 0 research) b) to further refine MBCT for IBS and to compare the updated intervention with active control groups (stage 1), and c) to include investigations into the hypothesised bio-psychological mechanisms at each step. If shown to be effective MBCT for IBS could then be evaluated in in a stage III efficacy trial in community rather than research settings whilst comparing it to a psychological treatment recommended by the current NICE guidelines.

8.7.1.1 Stage 0

In particular, based on the findings of Chapter 2, showing that biased self-referential processing of illness and health in general was related to more general symptomatic complaints it would be worthwhile investigating if patients with IBS show biased self-referential processing of IBS and abdominal health and if this bias would be directly related to IBS symptoms (Chapter 2). The next step would then be to test if this IBS specific bias would also be sensitive to changes in response to treatment, and if changes in this bias would be directly related to symptom improvement. This would render an IBS/abdominal health specific bias a potential early indicator of symptom reduction and treatment efficacy. In addition, in Chapter 3 the hypothesis that levels of anxiety would be related to levels of attentional control was not supported. Because attentional control is an important aspect of emotional and self-regulation (Diamond, 2013) it would be worthwhile to investigate reasons for lower attentional control in IBS patients. This might illuminate alternative ways to increase attentional control in these patients. For example, examining if worry (temporarily) erodes attentional control would point to an intervention that reduces worry, in order to improve attentional control.

8.7.1.2 Stage 1

8.7.1.2.1 Training attentional control and reducing catastrophizing

Given that computerized training methods have previously been shown to lead to improvements in attentional control (Sari et al., 2015), it might be worthwhile exploring if such a method would be effective in leading to increased attentional control in IBS patients and if this would in turn be related to outcomes relevant for IBS patients (e.g., better emotion regulation, reduced catastrophizing). In addition, given results that show that the combination of mindfulness and working memory training was more effective at reducing worry than either training alone, (Course-Choi et al., 2017) a similar combination may also be more effective at reducing catastrophizing in IBS patients than mindfulness training alone.

8.7.1.2.2 Specificity of effects

The results from this thesis showed that MBCT for IBS can lead to reductions in self-health discrepancy and that the Finding Peace course can increase attentional control. However, it is not yet clear which specific modules of the programme led to these changes. Studies that explore the specific effects of specific mediation techniques for specific target groups (e.g., the effect of the 'body scan' on self-health discrepancy in IBS patients) would help the development of future interventions. Researchers in intervention development could then pick a particular technique for its known effects on a target group, when developing or refining a treatment. For example knowing if the diaphragmatic breathing technique that was used in MBSR for IBS (Gaylord et al., 2009, 2011) has effects on emotion regulation or regulation of the HPA axis in IBS patients would make it a prime module to be included in future interventions. Looking ahead, knowing which elements and modules of a treatment are absolutely crucial to affect the mechanisms of change of IBS symptom severity, would be invaluable in the later implementation stages of the NIH stage model, where treatment shown to be effective in research settings are often shortened or adjusted to meet a particular budget (Onken et al., 2014).

8.7.1.2.3 Cognitive markers

In a comprehensive review on IBS, Enck and colleagues (2016) recommended the importance of developing techniques to screen for reliable biomarkers and to use these to stratify patients to treatment types to enhance trial efficacy. Similarly, Dimidjian and Segal (2015) found that only a few studies on MBIs had explored candidate moderators of treatment efficacy. They therefore recommended examining "for whom" a specific MBI works. This strategy could be expanded to using cognitive markers in IBS patients to select appropriate psychological treatments based on the assumed underlying mechanisms. A first step in this direction would be to investigate treatment responders of MBCT for IBS. For example it may be that patients with high self-health discrepancy or high visceral anxiety sensitivity respond particularly well to MBCT whereas patients with avoidant coping strategies may benefit more from exposure-based CBT. Moderator analysis that examines treatment responders based on cognitive markers for treatment selection could ensure that more patients receive the care that is best suited to their individual needs, in a timely manner. Alternatively, there are several positive treatment implications if further analysis reveals no moderating factors. For example, if treatment effects are not moderated by underlying psychological or biological differences, then one conclusion would be that the treatment is effective for the majority of IBS patients. This would simplify treatment choice and increase treatment accessibility. In such a case the need for complicated treatment allocation algorithms would be reduced. In addition several clinical therapists could deliver a treatment rather than few specialised therapists.

8.7.1.3 Stages 1 / 2

8.7.1.3.1 Choosing and refining existing interventions

Before any efficacy or effectiveness trials in the community (i.e., stages 3 and 4) can be considered, more information about the long-term effects of MBCT for IBS, the most effective modes of delivery (e.g., eight weeks or six weeks) and the treatment's effect compared to an active control group needs to be gathered. In addition, the MBSR for IBS course seemed to have been more effective at reducing symptoms, whereas the MBCT for IBS course appeared to be more

effective at improving quality of life and reducing symptoms of depression. To improve the transparency of information given to patients who may wish to choose one or the other course based on time-commitments and the outcomes they are most interested in improving, it appears to be worthwhile to directly compare two versions of MBCT for IBS (a six and an eight week version) with the eight week MBSR for IBS course. This potential trial should measure the effects in the longer term (at least 12-month) and also include a cost-effectiveness evaluation. In addition to measuring endpoints that are important for funding agencies and health care institutions, such as symptom severity, general functioning and cost effectiveness, it would be worthwhile to expand the breadths of measures to patient-centred outcomes. As IBS is a chronic illness in which full recovery is improbable, an expansion of measures that take into account the reduction in illness burden on the patient's life, irrespective of symptom severity, seems desirable. Examples of such outcomes are pain-suffering, general well-being, life-satisfaction and quality of life. Improvements in well-being and reductions in suffering would also more closely map onto the theoretical framework of MBCT. Particularly, MBCT for IBS aims to change the patient's relationship to symptoms, rather than the symptoms themselves. Broadly speaking, the aim of the course is to develop an awareness of one's reactions to symptoms (i.e., cognitive, emotional and behavioural) and to cultivate a non-judgemental non-critical awareness of experiences, including difficult situations (e.g., symptoms; see Chapter 5). Although the aim of this thesis was to understand the effect of MBCT for IBS on symptom severity (see Chapter 6), and it was shown that changes in the relationship to symptoms (i.e., maladaptive symptom specific cognitions) lead to symptom improvement (see Chapter 7), mindfulness practices do not explicitly strive for symptom reduction. Rather the aim is to understand and reduce the suffering that is created around the illness. Lackner and Quigley (2005) found that pain suffering (i.e., the emotional meaning of pain) is influenced by worrying and pain catastrophizing. Pain-suffering may thus be one of the patient centred outcomes that MBCT for IBS would be hypothesised to reduce. The initial pain created by abdominal cramps would be considered "primary pain", whereas pain-suffering would be considered "secondary, avoidable pain" (see section 5.8.2.2 Session 1 'Waking up to the autopilot in IBS' and section 9.3.2

MBCT for IBS – Handouts for participants, session 1). I would hypothesise that a reduction in pain suffering is linked with increased quality of life and social and emotional functioning. This concept was also illustrated in a recent randomised controlled trial that evaluated MBCT training for patients with medically unexplained symptoms in comparison to enhanced usual care (van Ravesteijn, Lucassen, Bor, van Weel, & Speckens, 2013): the mindfulness training was found to improve vitality and social functioning, whereas the patient's general health status and physical functioning did not change (van Ravesteijn et al., 2013). Therefore, broadening research activities to quality of life, well-being, life-satisfaction and pain-suffering would not only cover important areas of the patient's life that may be affected by the illness, it may also be better suited to capture the range of changes that would be expected from mindfulness-based treatments.

In conclusion, the results of a study that evaluates the costs as well as the long-term effects on symptoms, quality of life and life-satisfaction would aid in deciding if a broader implementation into the health-care system should be recommended and if MBCT for IBS affects patient centred outcomes in line with the theoretical underpinnings of the treatment. Any future trials should embed process studies to obtain scientific knowledge of the processes that lead to changes in IBS related outcomes (e.g., IBS symptom severity, quality of life), moderators of treatment efficacy (e.g., dosage and content) and patient responsiveness to treatment (Onken et al., 2014).

8.7.2 Interdisciplinary research groups

Studies that investigate the links among psychological change mechanisms (e.g., non-judgemental awareness, visceral anxiety sensitivity) to neurological changes and biological markers of IBS symptom reduction are sorely needed to establish clear brain-gut mechanisms. To this end I recommend the formation of interdisciplinary research groups and alliances that pool resources from biomedical, neuroscientific and psychological disciplines. Multidisciplinary alliances could help close the gap between basic and applied science in IBS, more precisely trace biopsychological treatment mechanisms, point to new treatment targets and develop therapeutic, multicomponent interventions.

8.8 Conclusion

Using the translational model of treatment development, this doctoral programme integrated existing knowledge relating to the maintaining factors of IBS, basic research on implicit cognitive functioning and principles of intervention design to develop a new treatment for patients with IBS. Maladaptive illness specific reactions to symptoms (i.e., anxiety of gastrointestinal specific sensations, catastrophizing about symptoms), cognitive biases and altered executive functioning were identified as potential treatment targets. To address these factors, I adapted MBCT for patients with IBS, tested its effectiveness and investigated therapeutic mechanisms. MBCT for IBS was effective in reducing IBS symptoms and increasing quality of life in the short-term (up to six weeks after treatment). Long-term studies with active control groups and larger sample sized are needed to substantiate these findings. The investigation of change mechanisms revealed that MBCT for IBS exerts its influence on IBS symptom severity by reducing maladaptive illness-specific cognitions coupled with a shift towards self-referential processing of health related information and more accepting, non-judgemental processing of emotions and thoughts. Given the promising results, this thesis created a platform for future investigations into the mechanisms and efficacy of MBCT for IBS. Moreover, several unexpected findings stimulated ideas for future studies. For example, an interesting avenue would be to explore the causes of low attentional control in patients with IBS as well as effective techniques to enhance it. In addition, improved knowledge about the specific effects of specific mindfulness meditation techniques could help intervention designers to make more informed and deliberate choices of treatment modules. The findings of this thesis may stimulate multidisciplinary research into the therapeutic mechanisms of mindfulness along the brain-gut axis which may ultimately lead to improved care for IBS patients.

Chapter 9: Appendices

9.1 Appendices Chapter 2 and Chapter 3

9.1.1 Participant Information Sheet for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH): patients with IBS

COGNITIVE AND EMOTIONAL FACTORS IN ILLNESS AND HEALTH

Information Sheet for Participants with Irritable Bowel Syndrome

As a member of the **'Cognition and Health'** research group under the supervision of Prof. Maryanne Martin, I am investigating the connection between mind and body. To do this, I study the similarities and differences in thought patterns among healthy individuals and people with a chronic illness. We understand that both our health and illness are driven by many complex factors. Some are more physical (e.g. pain) and others are more mental or a combination of both (e.g. stress).

We would like to invite you to take part in this research project. This project will help us understand and learn about the connection between thinking, emotion and irritable bowel syndrome. This understanding will help us in the development of effective treatment for irritable bowel syndrome.

If you decide to be a volunteer for this study, you can change your mind later at any time even if you have already started study procedures.

Before you decide, please read carefully through the information provided here and do ask questions about anything that may be unclear. You can ask the researcher any questions you may have about this study. If you are happy to participate you will be provided with a consent form to join the study.

Thank you for reading this. Without your help this research would not be possible!

Kind regards,

Julia Henrich

What is the purpose of the study?

Mind and body constantly exchange information on a neurocognitive basis (including communication between the nervous system and the brain) and thus influence each other. Chronic illnesses can impact one's quality of life, thoughts and emotions. In turn emotions and thoughts might also have an impact on the experience of pain and other symptoms. We do not have a good understanding of how such factors may influence the experience of irritable bowel syndrome. This study will explore a range of thought patterns as well as emotional and personality factors that play a role in irritable bowel syndrome. We will compare how these factors differ among asthma, irritable bowel syndrome and healthy people. This knowledge will help us to improve our understanding and the treatment for such chronic illnesses.

Why have I been invited?

You have been asked to take part because we want to find out how thoughts, emotion and personality are related to chronic illness, and you have expressed an interest in participating in this study. We are looking for participants diagnosed with irritable bowel syndrome, or asthma or are healthy individuals.

Do I have to take part?

It is up to you to decide whether or not you participate. If you do decide to take part you will be given this information sheet to keep and you will be asked to sign a form agreeing to take part. If you decide to take part, you can still change your mind and withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision to not take part, will not affect you in any way. If you are a student at Oxford University, there are no adverse academic consequences if you decide not to take part in this study or if you withdraw at any point after you have already started study procedures.
Please inform the researcher of your decision.

What will happen to me if I decide to take part?

Before filling out the study questionnaires or taking part in any tests you will be asked to fill out an on-line screening questionnaire.

This study has two parts. The first part is an online questionnaire and the second part consists of a series of computerized games.

We will send you a link to the online questionnaire, which includes an online consent form. You will be asked to fill out this questionnaire prior to the testing session. Filling out the questionnaire will take between 30 and 45 minutes and you can do this at a time and a place that is convenient for you.

You will also be required to sign a consent form before any testing takes place. The testing with the computerized games will take place at your gastroenterology clinic at Addenbrooke's Hospital, the Department of Experimental Psychology, University of Oxford, or St. Edmund Hall.

The testing session will take around 1.5 hours. During this time you will be asked to complete a range of interesting, simple and fun computer based tasks and games.

The data you provide will be handled confidentially.

Information about the questionnaires

The questionnaire will ask some general information, and questions to find out about your health, stress, thoughts, feelings and personality. Any information you give will be treated with strict confidentiality, unless in the rare circumstance that you or someone else is at risk of serious harm. In this circumstance, the research team will disclose only information directly relating to the emergency to emergency services.

Information about the computerized tests

Like computer games, all of the computerized tasks involve pressing buttons on a keyboard or a mouse as a response to the choices that you make. Some tasks require you to identify the location of a target on a computer screen, others will ask you to judge facial expressions or make choices about the appeal of items and words.

Financial compensation

Everyone who takes part in the study will receive £20 to compensate them for their time and travel. In addition you will have the chance to win up to £5 during one of the games.

What are the possible benefits of taking part?

There is no direct medical benefit to you if you take part in this study, but we hope that the information we get from this study may help us to understand more about the underlying cognitive factors in irritable bowel syndrome.

Will my taking part in this study be kept confidential?

We will replace your name on each data file with a unique ID number. The results from all individuals will be gathered together and the data analysed over the group. It will not be possible to identify you in any report or publication. Responsible members of the University of Oxford or the local NHS Trust may be given access to data for monitoring and/or audit of the study to ensure we are complying with regulations.

Storage of data

All information that is collected about you during the course of the research will be kept strictly confidential. You will be assigned a unique ID number and the file that allows us to match each ID number with a specific name will be stored on a password protected computer, with access only available to the primary researchers. Questionnaires and the results of the computer task will be identified by using the unique ID numbers and your data will thus be anonymous. All data on hard copies will be kept in a locked file cabinet to which only the primary researchers have access. If any results of these experiments are published or reported, it will not be possible to identify you from the reports.

Are there any risks involved in taking part?

Participating in this study carries no risks.

What if there is a problem?

The University of Oxford, as a Sponsor, has appropriate insurance in place in the highly unlikely event that you suffer any harm as a direct consequence of your participation in

this study. If you have a concern about any aspect of this project, please speak to Julia Henrich (Tel. **01865 271338**) or Prof. Maryanne Martin [tel.**01865 271313**). We will do our best to answer your query. If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact Julia Henrich (emails: Julia.Henrich@seh.ox.ac.uk, Tel: 01865 271338) or you may contact the University of Oxford Clinical Trials and Research Governance (CTRG) office on 01865 572224 or the head of CTRG, email ctrg.admin.ox.ac.uk.

What will happen if I don't want to carry on with the study?

If you decide that you do not want to carry on with the study, please inform the researcher of your decision. We will then discontinue with the study procedures. The information that we have already collected up until your withdrawal will be retained and used in the study. Data will be anonymized and it will not be possible to identify you in any published material.

What will happen to the results of the research study?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

If you agree to participate in this project, the research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published with open access.

We also hope to publish the results of this study in a scientific journal. We may also present the results at a scientific conference or a seminar in a university, or during talks to the general public. We may also publish results on our website. It will *not* be possible to identify you in any report or publication.

Who is funding this study?

Stiftung Oskar Helene Heim is funding this study.

Who has reviewed the study?

This project has been reviewed by, and received ethics clearance through, *NRES Committee North West - Greater Manchester West.* Maintenance of confidentiality of information is subject to normal legal requirements.

Contact for Further Information

For further information please contact Julia Henrich, by email, julia.henrich@seh.ox.ac.uk.

9.1.2 Participant Information Sheet for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH): healthy participants

COGNITIVE AND EMOTIONAL FACTORS IN ILLNESS AND HEALTH

Information Sheet for Healthy Volunteers

As a member of the **'Cognition and Health'** research group under the supervision of Prof. Maryanne Martin, I am investigating the connection between mind and body. To do this, I study the similarities and differences in thought patterns among healthy individuals and people with a chronic illness. We understand that both our health and illness are driven by many complex factors. Some are more physical (e.g. pain) and others are more mental or a combination of both (e.g. stress).

We would like to invite you to take part in this research project. This project will help us understand and learn about the connection between thinking, emotion and health. This understanding will help us in the development of effective treatment for chronic illnesses.

If you decide to be a volunteer for this study, you can change your mind later at any time even if you have already started study procedures

Before you decide, please read carefully through the information provided here and do ask questions about anything that may be unclear. You can ask the researcher any questions you may have about this study. If you are happy to participate you will be provided with a consent form to join the study.

Thank you for reading this. Without your help this research would not be possible!

Kind regards,

Julia Henrich

What is the purpose of the study?

Mind and body constantly exchange information on a neurocognitive basis (including communication between the nervous system and the brain) and thus influence each other. Chronic illnesses can impact one's quality of life, thoughts and emotions. In turn emotions and thoughts might also have an impact on the experience of pain and other symptoms. We do not have a good understanding of how such factors may impact illness and or lead to better health. This study will explore a range of thought patterns as well as emotional and personality factors that play a role in health and illness. We will compare how these factors differ among asthma, irritable bowel syndrome and healthy people. This knowledge will help us to improve our understanding and the treatment for such chronic illnesses.

Why have I been invited?

You have been asked to take part because we want to find out how thoughts, emotion and personality are related to chronic illness, and you have expressed an interest in participating in this study. We are looking for healthy participants or participants diagnosed with asthma or with irritable bowel syndrome.

Do I have to take part?

It is up to you to decide whether or not you participate. If you do decide to take part you will be given this information sheet to keep and you will be asked to sign a form agreeing to take part. If you decide to take part, you can still change your mind and withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision to not take part, will not affect you in any way. If you are a student at Oxford University, there are no adverse academic consequences if you decide not to take part in this study or if you withdraw at any point after you have already started study procedures.
Please inform the researcher of your decision.

What will happen to me if I decide to take part?

Before filling out the study questionnaires or taking part in any tests you will be asked to fill out an on-line screening questionnaire.

This study has two parts. The first part is an online questionnaire and the second part consists of a series of computerized games.

We will send you a link to the online questionnaire, which includes an online consent form. You will be asked to fill out this questionnaire prior to the testing session. Filling out the questionnaire will take between 30 and 45 minutes and you can do this at a time and a place that is convenient for you.

You will also be required to sign a consent form before any testing takes place. The testing with the computerized games will take place at the Department of Experimental Psychology, University of Oxford, or St. Edmund Hall.

The testing session will take around 1.5 hours. During this time you will be asked to complete a range of interesting, simple and fun computer based tasks and games.

The data you provide will be handled confidentially.

Information about the questionnaires

The questionnaire will ask some general information, and questions to find out about your health, stress, thoughts, feelings and personality. Any information you give will be treated with strict confidentiality, unless in the rare circumstance that you or someone else is at risk of serious harm. In this circumstance, the research team will disclose only information directly relating to the emergency to emergency services.

Information about the computerized tests

Like computer games, all of the computerized tasks involve pressing buttons on a keyboard or a mouse as a response to the choices that you make. Some tasks require you to identify the location of a target on a computer screen, others will ask you to judge facial expressions or make choices about the appeal of items and words.

Financial compensation

Everyone who takes part in the study will receive £20 to compensate them for their time and travel. In addition you will have the chance to win up to £5 during one of the games.

What are the possible benefits of taking part?

There is no direct medical benefit to you if you take part in this study, but we hope that the information we get from this study may help us to understand more about the underlying cognitive factors to chronic illnesses and health.

Will my taking part in this study be kept confidential?

We will replace your name on each data file with a unique ID number. The results from all individuals will be gathered together and the data analysed over the group. It will not be possible to identify you in any report or publication. Responsible members of the University of Oxford or the Oxford University Hospitals NHS Trust may be given access to data for monitoring and/or audit of the study to ensure we are complying with regulations.

Storage of data

All information that is collected about you during the course of the research will be kept strictly confidential. You will be assigned a unique ID number and the file that allows us to match each ID number with a specific name will be stored on a password protected computer, with access only available to the primary researchers. Questionnaires and the results of the computer task will be identified by using the unique ID numbers and your data will thus be anonymous. All data on hard copies will be kept in a locked file cabinet to which only the primary researchers have access. If any results of these experiments are published or reported, it will not be possible to identify you from the reports.

Are there any risks involved in taking part?

Participating in this study carries no risks.

What if there is a problem?

The University of Oxford, as a Sponsor, has appropriate insurance in place in the highly unlikely event that you suffer any harm as a direct consequence of your participation in

this study. If you have a concern about any aspect of this project, please speak to Julia Henrich (Tel. **01865 271338**) or Prof. Maryanne Martin [tel.**01865 271313**). We will do our best to answer your query. If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact Julia Henrich (emails: Julia.Henrich@seh.ox.ac.uk, Tel: 01865 271338) or you may contact the University of Oxford Clinical Trials and Research Governance (CTRG) office on 01865 572224 or the head of CTRG, email ctrg.admin.ox.ac.uk.

What will happen if I don't want to carry on with the study?

If you decide that you do not want to carry on with the study, please inform the researcher of your decision. We will then discontinue with the study procedures. The information that we have already collected up until your withdrawal will be retained and used in the study. Data will be anonymized and it will not be possible to identify you in any published material.

What will happen to the results of the research study?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

If you agree to participate in this project, the research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published with open access.

We also hope to publish the results of this study in a scientific journal. We may also present the results at a scientific conference or a seminar in a university, or during talks to the general public. We may also publish results on our website. It will *not* be possible to identify you in any report or publication.

Who is funding this study?

Stiftung Oskar Helene Heim is funding this study.

Who has reviewed the study?

This project has been reviewed by, and received ethics clearance through, *NRES Committee North West - Greater Manchester West.* Maintenance of confidentiality of information is subject to normal legal requirements.

Contact for Further Information

For further information please contact Julia Henrich, by email, julia.henrich@seh.ox.ac.uk.

9.1.3 Consent Form for the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH)

Cognitive and Emotional Factors in Illness and Health
Consent Form – IBS and Healthy Participants

Thank you for volunteering to take part in this study.
We are investigating the connection between neurocognition, emotion, illness and health.
Names of Researchers: Prof. Maryanne Martin, Julia Henrich (doctoral student).

Please read the information below and initial the boxes if you agree with the statements.

Name:_____(block capitals)

I confirm that I have read and understood the information sheet 'Cognitive and Emotional Factors in Illness and Health' (***Version Date: 25.11.2014, Version Number: 3.0*****)** for the above study and have had the opportunity to ask questions, and have had these satisfactorily answered. ☐

I understand that I may withdraw from the study without penalty at any time by advising the researchers of this decision or by exiting the on-line survey. ☐

I understand that this project has been reviewed by, and received ethics clearance through the *NRES Committee North West - Greater Manchester West*. ☐

I understand that data collected during the study may be looked at by the researchers of this study, authorized individuals from the University of Oxford or the OUH NHS Trust where it is relevant to my taking part in this research. I permit these individuals access to my research records. I understand how the data will be stored, and what will happen to the data at the end of the project. ☐

I understand that if I withdraw from the study any data that have already been collected from me will be used in the study and analysed**,** but no further data will be collected. ☐

I understand that the research may be written up as a student's thesis, and I understand how data included in that thesis will be published and stored. ☐

I am aware that all personal information will be treated with full confidentiality, except in the rare circumstance that I or somebody else is at risk of serious harm. In this case only information necessary to an emergency will be revealed to emergency services. I give permission for this disclosure. ☐

I understand how to raise a concern and make a complaint. ☐

I agree to take part in this study. ☐

Please turn the page to sign

OPTIONAL:
I would like to be informed of the results of the study and give my consent for my details to be retained so that I may be contacted with these results. ☐

I am happy to be contacted about future research projects, and for my contact details to be stored for this purpose. ☐

Name Participant: ……..Signed: …… Date:……..

Name of person taking consent:……..Signed:……. Date: …….

If you have any questions please contact Julia Henrich, on 01865 271338 or at julia.henrich@seh.ox.ac.uk.

Thank-you!

9.1.4 Screening Questionnaire for the study "Cognitive and Emotional Factors in Illness and Healthy" (CEFIH)

Screening Questionnaire

Please take a few minutes to fill out this questionnaire about your health and other factors we need to know before you can participate in the research project 'Cognitive and Emotional Factors in Health and Illness'. Please answer all questions.

The information that you provide will be treated with full confidentiality.

About You

1. **Which participant group do you belong to?**
   ☐ Healthy ☐ Irritable Bowel Syndrome ☐ Asthma

2. **What is your Gender:**
   ☐ Male ☐ Female ☐ Other:……..

3. **What is your age (years):**……

4. **Do you speak English fluently, or at a native level?**
   ☐ No ☐ Yes

5. **Do you have:**
   ☐ Normal vision?
   ☐ Corrected to normal vision? (e.g. if you wear glasses)
   ☐ Impaired vision/problems with your vision?

6. **Are you currently diagnosed with Irritable Bowel Syndrome (IBS) by your GP or Gastroenterologist?**
   ☐ No ☐ Yes

7. **Are you diagnosed with another gastrointestinal disorder (for example: Crohn's disease, ulcerative colitis, coeliac disease, inflammatory bowel disease etc.)?**
   ☐ No ☐ Yes, please specify _____

8. **Are you currently diagnosed with Asthma by your GP or Asthma specialist?**
   ☐ No ☐ Yes

9. **Are you currently diagnosed with a chronic physical condition other than IBS or Asthma?**
   ☐ No ☐ Yes, please specify _____

10. **In the past, have you ever suffered from a chronic physical condition?**
    ☐ No ☐ Yes, please specify _____

11. Have you ever been diagnosed with any of the following:

i. A cognitive disorder (such as dementia or amnesia)?
ii. A dissociative disorder (such as dissociative amnesia)?
iii. An eating disorder (such as anorexia nervosa and bulimia nervosa)?
iv. A personality disorder (such as borderline personality disorder)?
v. Schizophrenia or any other psychotic disorder?
vi. A substance-related (or induced) disorder (such as alcoholism)?

☐ No ☐ Yes

Information about your bowel and abdomen

The questions below ask about your bowel movements and abdominal pain **in general and over a longer period of time.**

12. In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?

0	Never
1	Less than one day a month
2	One day a month
3	Two to three days a month
4	One day a week
5	More than one day a week
6	Everyday

13. Have you had this discomfort or pain 6 months or longer?

0	Not applicable
1	No
2	Yes

14. Did this discomfort or pain occur only during your menstrual bleeding and not at other times?

0	Not applicable because I have had no discomfort or pain; because I have had menopause or because I am a male
1	No
2	Yes

15. How often did this discomfort or pain get better or stop after you had a bowel movement?

0	Not applicable
1	Never or rarely
2	Sometimes
3	Often
4	Most of the time
5	Always

16. When this discomfort or pain started, did you have more frequent bowel movements?

0	Not applicable
1	Never or rarely
2	Sometimes
3	Often
4	Most of the time
5	Always

17. When this discomfort or pain started, did you have less frequent bowel movements?

0	Not applicable
1	Never or rarely
2	Sometimes
3	Often
4	Most of the time
5	Always

18. When this discomfort or pain started, were your stools (bowel movements) looser?

0		Not applicable
1		Never or rarely
2		Sometimes
3		Often
4		Most of the time
5		Always

19. When this discomfort or pain started, how often did you have harder stools?

0		Not applicable
1		Never or rarely
2		Sometimes
3		Often
4		Most of the time
5		Always

20. In the last 3 months, how often did you have hard or lumpy stools?

0		Never or rarely
1		Sometimes
2		Often
3		Most of the time
4		Always

21. In the last 3 months, how often did you have loose, mushy or watery stools?

0		Never or rarely
1		Sometimes
2		Often
3		Most of the time
4		Always

The Study

This study has two parts: an online questionnaire (45-60 minutes) to fill out at a time and place convenient to you, and a computerised testing part (approximately 1.5-2 hours) in one of our testing locations.

22. Do you think you will have time to commit to filling out the questionnaire and completing the computerised testing?

☐ No ☐ Yes

Personal Information

The information we ask you to provide below will be kept strictly confidential. It is collected so that we can contact your further participation in this study. This information will be accessible only to researchers involved the study.

First Name _____ **Last Name** _____

City _____ **Post Code** _____

Email _____ **Phone** _____

9.1.5 Overview of Questionnaires in the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH)

Table 9.1. Overview of questionnaires per group.

	Group	
Questionnaire	IBS	Healthy
Gastrointestinal Symptom Rating Scale IBS (GSRS IBS) (Wiklund et al., 2003)	✓	✓
Asthma Symptom Checklist (ASC) (Brooks et al., 1989; Kinsman et al., 1973)	✓	✓
IBS Quality of Life (IBSQOL) (Drossman et al., 2000)	✓	
Positive and Negative Affect Schedule (PANAS) (Crawford & Henry, 2004; Watson et al., 1988)	✓	✓
Depression Anxiety Stress Scale (DASS-21) (Henry & Crawford, 2005)	✓	✓
Social Anxiety (SIAS, SPS) (Kupper & Denollet, 2012; Mattick & Clarke, 1998)	✓	✓
Pain Catastrophizing Questionnaire (PCS) (Sullivan et al., 1995)	✓	✓
GI Cognitions Questionnaire (GI-C) (Hunt et al., 2014b)	✓	✓
Somatosensory Amplification Scale (SSAS) (Barsky & Wyshak, 1990)	✓	✓
Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2006)	✓	✓
Visceral Sensitivity Index (VSI) (Labus et al., 2004)	✓	✓
Perceived Stress Scale (PSS) (S. Cohen, Kamarck, & Mermelstein, 1983)	✓	✓
Toronto Alexithymia Scale (TAS) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parkers, 1994)	✓	✓
Beliefs about Medication Questionnaire (BMQ) (Horne, Weinman, & Hankins, 1999)	✓	✓
Satisfaction with Life Scale (SWLS) (Diener et al., 1985)	✓	✓

9.1.6 Overview and sequence of cognitive computerized tasks in the study "Cognitive and Emotional Factors in Illness and Health" (CEFIH)

Table 9.2. Overview and sequence of cognitive computerized tasks.

Cognitive Task	Time to complete (in minutes)
Dot-Probe Task (Asmundson, Wright, & Hadjistavropoulos, 2005; Keogh, Ellery, Hunt, & Hannent, 2001; MacLeod & Mathews, 1988)	15-20
Self-referential encoding and incidental recall task (SRET) (Fritzsche et al., 2010; Harmer, O'Sullivan, et al., 2009)	5
Attention Network Task (ANT) (Fan et al., 2002; Hou et al., 2014)	5
Implicit Association Test (IAT) (Greenwald et al., 1998; Teachman et al., 2008)	10-15
Break	5-10
Facial recognition task (Harmer, O'Sullivan, et al., 2009)	10-15
Extrinsic Affective Simon Task (EAST) (Reinecke, Rinck, Becker, & Hoyer, 2013)	20
Ultimatum Game (Güth, Schmittberger, & Schwarze, 1983)	20

9.2 Appendices Chapter 4

9.2.1 Participant Information Sheet for the study "Time Course of Cognitive Changes" (TCCC): Participants in the mindfulness group

TIME COURSE OF COGNITIVE CHANGES

Participant Information Sheet
For Participants of a Mindfulness Course

We would like to invite you to take part in this research project. Before you decide whether or not to take part, it is important that you understand the background of this study. This information sheet describes the aims and procedures of the current study.

We contact you as you have signed up for an 8 week mindfulness class. Individuals who take part in mindfulness programmes often report feeling more positive emotions, less stress and a better ability to concentrate after having completed the programme. With this research project we investigate when in the programme these changes take place for people who take part in mindfulness training.

This project will help us understand and learn about the connection between mindfulness training, thinking, emotion and concentration. This understanding will help us in the continuous improvement of mindfulness programmes.

If you decide to be a volunteer for this study, you can change your mind later at any time even if you have already started study procedures.

Before you decide, please read through the information provided here carefully. If you have any questions please feel free to get in touch. You can ask the researcher any questions you may have about this study. If you are happy to participate you will be asked for your consent to take part in this study.

Thank you for reading this. Without your help this research would not be possible!

Kind regards,

Julia Henrich

WHAT IS THE PURPOSE OF THE STUDY?

Mindfulness training is a very structured programme that often leads to improvements in mood and concentration as well as lower stress level. We are very keen to find out how these changes develop over time and if the changes are related to the amount of mindfulness practice. Knowing this will aid the development of mindfulness courses to improve mood, concentration, stress and pain.

WHY HAVE I BEEN INVITED?

You have been invited because you are taking part in a mindfulness course or you have indicated that you might be interested in taking part in this study. We are looking for individuals with little or no previous experience in mindfulness, who are interested in taking part in this study.

DO I HAVE TO TAKE PART?

It is up to you to decide whether or not you participate. If you do decide to take part you will be given this information sheet to keep and you will be asked to give your consent to take part digitally. If you decide to take part, you can still change your mind and withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision to not take part, will not affect you in any way. If you are a student at Oxford University, there are no adverse academic consequences if you decide not to take part in this study or if you withdraw at any point after you have already started study procedures.

Please inform the researcher of your decision.

WHAT WILL HAPPEN TO ME IF I DECIDE TO TAKE PART?

Before enrolling in this study you will be asked to fill out an on-line screening questionnaire.

Over the course of nine consecutive weeks, you will be asked to fill out weekly online questionnaires and complete weekly computerized tasks. You will be asked to complete the first week's questionnaire and task in the week before the start of the mindfulness course. The remaining eight weeks of this study will then be taking place during the eight weeks of the mindfulness course.

Each week, you will be sent instructions via email detailing how you can complete this week's questionnaire and task. In the first and last week the questionnaire and the task will take approximately 30 minutes. In weeks two to eight completing the questionnaires and tasks will take approximately 20 minutes.

The questionnaires and tasks can be completed online on a computer and you can complete the tasks at a time and place convenient for you. It is important to complete each week's questionnaire and task before the next week's mindfulness class. We may send you reminders to complete the questionnaire and tasks on time.

In order to complete the weekly computerized tasks you will need to download software onto your computer. The software works on both Mac and Windows. This software is not harmful to your computer and you can de-install it after completing the study. We will send you information on how to install the software onto your computer.

The information you provide will not be shared with the teachers of the mindfulness courses.

INFORMATION ABOUT THE QUESTIONNAIRES

The questionnaires will ask some general information about you, your thoughts, feelings and stress. Each week, we will also ask you if you have attended that week's session and the amount of home practice you have done. Any information you give will be treated with strict confidentiality, unless in the rare circumstance that you or someone else is at risk of serious harm. In this circumstance, the research team will disclose only information directly relating to the emergency to emergency services.

INFORMATION ABOUT THE COMPUTERIZED TESTS

Like computer games, the computerized tasks involve pressing buttons on a keyboard or a mouse as a response to the choices that you make.

FINANCIAL COMPENSATION

Everyone who completes the study will receive a compensation of £25. Partial completion of the study will not be compensated.

WHAT ARE THE POSSIBLE BENEFITS OF TAKING PART?

There is no direct benefit to you if you take part in this study. We hope that the information we get from this study may help us to understand more about the timing of changes in thoughts, concentration and emotion during mindfulness training.

WILL MY TAKING PART IN THIS STUDY BE KEPT CONFIDENTIAL?

We will replace your name on each data file with a unique ID number. The results from all individuals will be gathered together and the data analysed over the group. It will not be possible to identify you in any report or publication. Responsible members of the University of Oxford may be given access to data for monitoring and/or audit of the study to ensure we are complying with regulations.

STORAGE OF DATA

All information that is collected about you during the course of the research will be kept strictly confidential. You will be assigned a unique ID number and the file that allows us to match each ID number with a specific name will be stored on a password protected computer, with access only available to research team. Questionnaires and the results of the computer task will be identifiable up until the point we receive them, when we will replace any identifiable details with your unique ID number. All data on hard copies will be kept in a locked file cabinet to which only the researcher team has access. If any results of these experiments are published or reported, it will not be possible to identify you from the reports.

ARE THERE ANY RISKS INVOLVED IN TAKING PART?

Participating in this study carries no risks.

WHAT IF THERE IS A PROBLEM?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. If you have a concern about any aspect of this project, please speak to Julia Henrich (Tel. **01865 271338**), Prof. Maryanne Martin [Tel. **01865 271313**) or Dr. Bergljot Gjelsvik (Tel. **01865 61 31 55)**. We will do our best to answer your query. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford (Chair, Medical Sciences Inter-Divisional Research Ethics Committee; Email: ethics@medsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD). The chair will seek to resolve the matter in a reasonably expeditious manner.

WHAT WILL HAPPEN IF I DON'T WANT TO CARRY ON WITH THE STUDY?

If you decide that you do not want to carry on with the study, please inform the researcher of your decision. We will then discontinue with the study procedures. The information that we have already collected up until your withdrawal will be retained and used in the study. Data will be anonymized and it will not be possible to identify you in any published material.

WHAT WILL HAPPEN TO THE RESULTS OF THE RESEARCH STUDY?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

If you agree to participate in this project, the research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published with open access.

We also hope to publish the results of this study in a scientific journal. We may also present the results at a scientific conference or a seminar in a university, or during talks to the general public. We may also publish results on our website. It will *not* be possible to identify you in any report or publication.

WHO IS FUNDING THIS STUDY

Stiftung Oskar Helene Heim [and insert additional funding body] are funding this study.

WHO HAS REVIEWED THE STUDY?

This project has been reviewed by, and received ethics clearance through the University of Oxford Central University Research Ethics Committee. Maintenance of confidentiality of information is subject to normal legal requirements.

CONTACT FOR FURTHER INFORMATION

For further information please contact Julia Henrich, by email, julia.henrich@psy.ox.ac.uk

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9.2.2 Participant Information Sheet for the study "Time Course of Cognitive Changes" (TCCC): Participants in the control group

TIME COURSE OF COGNITIVE CHANGES

Participant Information Sheet

We would like to invite you to take part in this research project. Before you decide whether or not to take part, it is important that you understand the background of this study. This information sheet describes the aims and procedures of the current study.

This project will help us understand and learn about the connection between thinking, emotion and concentration over time.

If you decide to volunteer for this study, you can change your mind later at any time even if you have already enrolled in the study.

Before you decide, please read through the information provided here carefully. If you have any questions please feel free to get in touch. You can ask the researcher any questions you may have about this study. If you are happy to participate you will be asked for your consent to take part in this study.

Thank you for reading this. Without your help this research would not be possible!

Kind regards,

Julia Henrich

WHAT IS THE PURPOSE OF THE STUDY?

Concentration, mood and thoughts fluctuate over the course of a day, a week and a month. We are very keen to find out how these changes develop over time and if they change together or separately. We are also investigating how mindfulness affects concentration and mood. To do this we will compare a group of people who are participating in a mindfulness course to a group of people who have little experience with mindfulness. This will help us understand the link between mood, thinking and concentration. Knowing this will aid the development of mindfulness courses to improve mood, concentration, stress and pain.

WHY HAVE I BEEN INVITED?

You have been invited because you are on a waiting list for a mindfulness course, you are waiting for your mindfulness course to start or you have indicated that you might be interested in taking part in this study. We are looking for individuals with little or no previous experience in mindfulness, who are interested in taking part in this study.

DO I HAVE TO TAKE PART?

It is up to you to decide whether or not you participate. If you do decide to take part you will be given this information sheet to keep and you will be asked to give your consent to take part digitally. If you decide to take part, you can still change your mind and withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision to not take part, will not affect you in any way. If you are a student at Oxford University, there are no adverse academic consequences if you decide not to take part in this study or if you withdraw at any point after you have already started study procedures.

Please inform the researcher of your decision.

WHAT WILL HAPPEN TO ME IF I DECIDE TO TAKE PART?

Before enrolling in this study you will be asked to fill out an on-line screening questionnaire.

Over the course of nine consecutive weeks, you will be asked to fill out weekly online questionnaires and complete weekly computerized tasks. Each week, you will be sent instructions via email detailing how you can complete this week's questionnaire and task. In the first and last week the questionnaire and the task will take approximately 30 minutes. In weeks two to eight completing the questionnaires and tasks will take approximately 20 minutes.

The questionnaires and tasks can be completed online on a computer and you can complete the tasks at a time and place convenient for you. It is important to complete each week's questionnaire and task before your receive the next week's instructions. We may send you reminders to complete the questionnaire and tasks on time.

In order to complete the weekly computerized tasks you will need to download software onto your computer. The software works on both Mac and Windows. This software is not harmful to your computer and you can de-install it after completing the study. We will send you information on how to install the software onto your computer.

INFORMATION ABOUT THE QUESTIONNAIRES

The questionnaires will ask some general information about you, your thoughts, feelings and stress. Any information you give will be treated with strict confidentiality, unless in the rare circumstance that you or someone else is at risk of serious harm. In this circumstance, the research team will disclose only information directly relating to the emergency to emergency services.

INFORMATION ABOUT THE COMPUTERIZED TESTS

Like computer games, the computerized tasks involve pressing buttons on a keyboard or a mouse as a response to the choices that you make.

FINANCIAL COMPENSATION

Everyone who completes the study will receive a compensation of [£25 or 12 CREDITS for students]. Partial completion of the study will not be compensated.

WHAT ARE THE POSSIBLE BENEFITS OF TAKING PART?

There is no direct benefit to you if you take part in this study. We hope that the information we get from this study may help us to understand more about the timing of changes in thoughts, concentration and emotion.

WILL MY TAKING PART IN THIS STUDY BE KEPT CONFIDENTIAL?

We will replace your name on each data file with a unique ID number. The results from all individuals will be gathered together and the data analysed over the group. It will not be possible to identify you in any report or publication. Responsible members of the University of Oxford may be given access to data for monitoring and/or audit of the study to ensure we are complying with regulations.

STORAGE OF DATA

All information that is collected about you during the course of the research will be kept strictly confidential. You will be assigned a unique ID number and the file that allows us to match each ID number with a specific name will be stored on a password protected computer, with access only available to research team. Questionnaires and the results of the computer task will be identifiable up until the point we receive them, when we will replace any identifiable details with your unique ID number. All data on hard copies will be kept in a locked file cabinet to which only the researcher team has access. If any results of these experiments are published or reported, it will not be possible to identify you from the reports.

ARE THERE ANY RISKS INVOLVED IN TAKING PART?

Participating in this study carries no risks.

WHAT IF THERE IS A PROBLEM?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. If you have a concern about any aspect of this project, please speak to Julia Henrich (Tel. **01865 271338**), Prof. Maryanne Martin [Tel. **01865 271313**) or Dr. Bergljot Gjelsvik (Tel. **01865 61 31 55)**. We will do our best to answer your query. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford (Chair, Medical Sciences Inter-Divisional Research Ethics Committee; Email: ethics@medsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD). The chair will seek to resolve the matter in a reasonably expeditious manner.

WHAT WILL HAPPEN IF I DON'T WANT TO CARRY ON WITH THE STUDY?

If you decide that you do not want to carry on with the study, please inform the researcher of your decision. We will then discontinue with the study procedures. The information that we have already collected up until your withdrawal will be retained and used in the study. Data will be anonymized and it will not be possible to identify you in any published material.

WHAT WILL HAPPEN TO THE RESULTS OF THE RESEARCH STUDY?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

If you agree to participate in this project, the research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published with open access.

We also hope to publish the results of this study in a scientific journal. We may also present the results at a scientific conference or a seminar in a university, or during talks to the general public. We may also publish results on our website. It will *not* be possible to identify you in any report or publication.

WHO IS FUNDING THIS STUDY

Stiftung Oskar Helene Heim [and insert additional funding body] are funding this study.

WHO HAS REVIEWED THE STUDY?

This project has been reviewed by, and received ethics clearance through the University of Oxford Central University Research Ethics Committee. Maintenance of confidentiality of information is subject to normal legal requirements.

CONTACT FOR FURTHER INFORMATION

For further information please contact Julia Henrich, by email, julia.henrich@psy.ox.ac.uk.

9.2.3 Online Consent Form for the study "Time Course of Cognitive Changes" (TCCC): Participants in the control group

Time course of cognitive changes

On-line Consent Form

Thank you for expressing an interest in this study.
We are investigating the relationship between changes in thoughts, concentration and emotion in people who do and do not take part in mindfulness training.

The study is carried out by Julia Henrich (doctoral student) under the supervision of Prof. Maryanne Martin, Dr. Bergljot Gjelsvik.

Please read the information below, tick each box if you agree with the statement to the left of it and tick 'yes' if you agree to take part in this study.

I confirm that I have read and understood the information sheet '**Time course of cognitive changes**' (*Version Date: 27.09.2015, Version Number: 2.0*) for the above study and have had the opportunity to ask questions, and have had these satisfactorily answered. ☐

I understand that I may withdraw from the study without penalty at any time by advising the researchers of this decision or by exiting the on-line survey or task. ☐

I understand that this project has been reviewed by, and received ethics clearance through the *University of Oxford Central University Research Ethics Committee*.

I understand that data collected during the study may be looked at by the researchers of this study, authorized individuals from the University of Oxford. I permit these individuals access to my research records. I understand how the data will be stored, and what will happen to the data at the end of the project. ☐

I understand that if I withdraw from the study any data that have already been collected from me will be used in the study and analysed**,** but no further data will be collected. ☐

I understand that the research may be written up as a student's thesis, and I understand how data included in that thesis will be published and stored. ☐

I am aware that all personal information will be treated with full confidentiality, except in the rare circumstance that I or somebody else is at risk of serious harm. In this case only information necessary to an emergency will be revealed to emergency services. I give permission for this disclosure. ☐

I understand how to raise a concern and make a complaint. ☐

I agree to take part in this study.

☐Yes ☐No
If you have any questions please contact Julia Henrich, on 01865 271338 or at julia.henrich@seh.ox.ac.uk.

Thank-you!

9.2.4 Participant Flowchart of the Time Course of Cognitive Changes Study

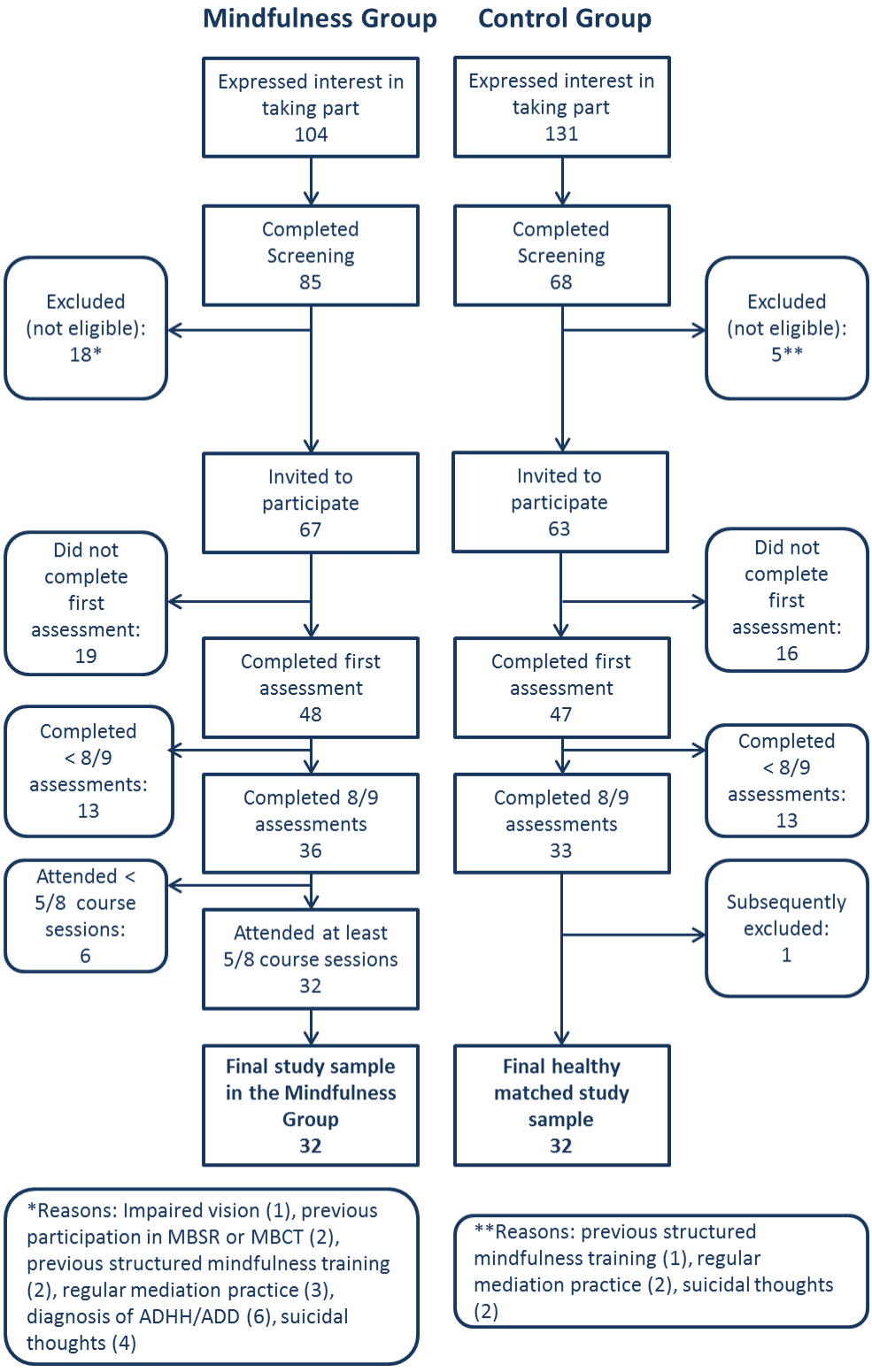


Figure 9.1. Participant Flowchart of the Time Course of Cognitive Changes Study.

9.2.5 Summary of the course structure of the "Finding Peace in a Frantic World" Course

Table 9.3. MINDFULNESS: A PRACTICAL PATH OF FINDING PEACE IN A FRANTIC WORLD – COURSE SUMMARY.

# 1 Waking up to the Autopilot [Ch 5] AUTOPILOT ▪ Introductions ▪ Presentation introducing Mindfulness ▪ Raisin Exercise ▪ Mindfulness of Breath & Body ▪ Setting Home Practice ▪ Closing Practice Home practice: ▪ Body & Breath (track 1) 08:08 X2 ▪ Mindfulness of a routine activity ▪ One Mindful Snack	**# 2 Keeping the Body in Mind** [Ch 6] SENSING/BODY ▪ Body Scan ▪ Home Practice review ▪ Keeping body in mind when listening & speaking ▪ Appreciation / Gratitude here & now ▪ Setting Home Practice ▪ Closing Practice Home practice: ▪ Body Scan (track 2) 14:45 X2 ▪ Ten Finger Gratitude / Appreciation here & now ▪ Keeping Body in Mind when Speaking & Listening
# 3 The Mouse in the Maze [Ch 7] MFN IN DAILY LIFE ▪ Breathing Space introduction ▪ Home Practice review ▪ Mindful Standing, Stretching, Walking ▪ Breath & Body Meditation ▪ Setting Home Practice ▪ Closing Practice Home practice: ▪ Mindful Movement and Breath & Body (3 & 4) 8:57/08:18 X2 ▪ Breathing Spaces twice a day at set times ▪ Corridor / Commuting Walking Practice	**# 4 Moving Beyond the Rumour Mill** [Ch 8] THOUGHTS ▪ Arrival Practice: Standing, Stretching, Breathing Space ▪ Home Practice review ▪ Exploration: Relating Differently to Thoughts & Worries including Thoughts & Feelings Exercise ▪ Sounds & Thoughts Meditation ▪ Setting Home Practice ▪ Closing Practice Home practice: ▪ Breath & Body and Sounds & Thoughts (4 & 5) 8:57/ 8:03 X2 ▪ Breathing Space twice a day at set times and when needed

# 5 Turning Towards Difficulties [Ch 9] DIFFICULTY ▪ Opening Practice & Breathing Space ▪ Home Practice Review ▪ Exploration: Turning towards difficulties – from Reacting to Responding ▪ Exploring Difficulty Meditation ▪ Guest House poem discussion ▪ Breathing Space development to include the difficult ▪ Setting Home Practice ▪ Closing Practice Home practice: ▪ Body & Breath, Sounds & Thoughts and Exploring Difficulty (4, 5 & 6) 8:18/8:03/10:13 X1 ▪ Breathing Space twice a day and to befriend difficult	**# 6 Trapped in the Past..?** [Ch 10] PRACTISING KINDNESS ▪ Opening Meditation: Body, Breath, Sounds, Thoughts, Exploring Difficulty ▪ Home Practice Review ▪ Exploring: from harshness to kindness & compassion ▪ Recognising self-critical habits & patterns – scenarios exercise ▪ Practising Kindness: Befriending Meditation ▪ Setting Home Practice ▪ Making the most of last two weeks ▪ Closing Practice Home practice: ▪ Breath & Body / Silence and Befriending (4 & 7) 8:18/ 9:37 ▪ Developed Breathing Space twice a day ▪ Random Acts of Kindness
# 7 When did you stop dancing? [Ch 11] ACTIVITY ▪ Opening Breathing Space ▪ Home Practice Review ▪ Exploring: Developing Balance [Nourishing / Depleting/ Rebalancing exercises] ▪ Breathing Space + Action Step ['The List'] ▪ Guided Meditation: Exploring Difficulty or Befriending ▪ Setting Home Practice & intentions for final week ▪ Closing Practice Home practice: ▪ Twenty Minute Sitting meditation ▪ Breathing Space twice a day + action step ▪ Putting Rebalancing intentions into practice	**# 8 Your Wild and Precious Life** [Ch 12] INTENTIONS ▪ Opening Breathing Space ▪ Home Practice Review ▪ Course Review including reflective exercise in pairs ▪ Writing 'Letter to Self' & Practice Plan ▪ Open Discussion ▪ Closing Practice & poem [Love after Love] Home practice: ▪ Complete and follow Practice Plan

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9.2.6 Course and Assessment Schedule

Mindfulness group (MG) only:

Mindfulness Couse Sessions	S1	S2	S3	S4	S5	S6	S7	S8

Mindfulness group (MG) and Control group (CG):

Weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Assessments									
ANT[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓
ACS[2]	✓	✓	✓	✓	✓	✓	✓	✓	✓
PANAS[3]	✓	✓	✓	✓	✓	✓	✓	✓	✓
DASS[4]	✓	✓	✓	✓	✓	✓	✓	✓	✓
FFMQ[5]	✓								✓
SWLS[6]	✓								✓

[1]Attention Network Task; [2]Attentional Control Scale; [3]Positive Affect Negative Affect Schedule; [4]Depression Anxiety Stress Schedule; [5]Five Factor Mindfulness Questionnaire-24; [6]Satisfaction with Life Scale

9.3 Appendices for Chapter 5

9.3.1 Item Similarities between the Cognitive Scale for Functional Bowel Disorders (CSFBD) and the Gastrointestinal (GI) - Cognitions Questionnaire.

Table 9.4. Item Similarities between the Cognitive Scale for Functional Bowel Disorders (CSFBD) and the Gastrointestinal (GI) - Cognitions Questionnaire.

CSFBD	GI-Cognitions
"symptoms are too much too handle", "Bowel symptoms are agony"	"When I feel my GI symptoms acting up, I'm afraid the pain will be excruciating and intolerable"
"I worry about passing gas in public"	"If I fart, people around me will be disgusted"
"I worry about not finding a bathroom when I need one", "I worry about losing control of bowels in public"	"If I feel the urge to defecate and cannot find a bathroom right away I won't be able to hold it and I'll be incontinent", "The thought of fecal incontinence is terrifying. If it happened, it would be awful"
"With frequent bathroom visits, others think something is wrong"	"If I have to get up and leave an event, meeting or social gathering to go to the bathroom people will think there's something wrong with me"
"I worry about my bowel symptoms on a trip"	"If I have stop or leave to find a bathroom during an outing or trip my friends and family will be frustrated and annoyed with me"
"I worry about not take advantage of opportunities due to bowel problems"	"When my gut acts up, I have to cancel my plans and miss out on important parts of Life"

9.3.2 MBCT for IBS – Handouts for participants

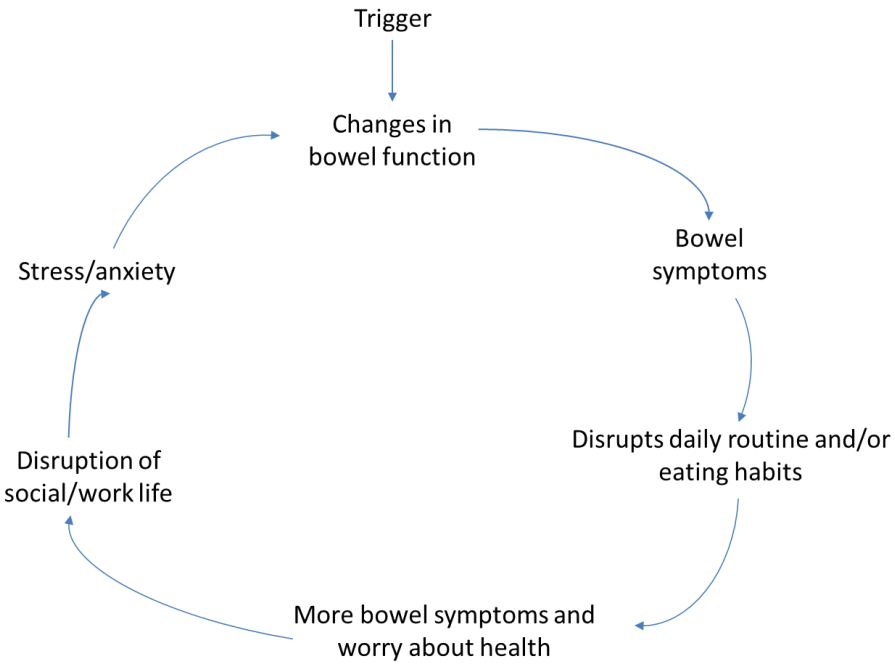
Session 1 - Handouts

Waking up to autopilot

When you are experiencing ill health which has gone on for some time, or perhaps has taken you by surprise and has resulted in a change in the way you live your life, it is easy to get disheartened. Reactions to a physical condition like IBS can take many forms, particularly when your symptoms are worse or you are tired.

For example, you may feel concern or anxiety about the meaning of symptoms; you may feel upset that your life has changed in this way or that others don't seem to understand; you may feel hopeless, uncertain or frustrated about the future; you may find that you are critical of yourself, or think that you are different or have less value than other people, or are a burden to them. There may be an effect on your daily routine, eating habits and wider life. It might be that you end up withdrawing from activities, become preoccupied with pain or negative thoughts, or change your routines in an effort to manage symptoms. Such reactions can easily take hold and become the story of your life: it might seem like your life is a continual battle with your body and mind. It is very easy to lose perspective and lose touch with the richness of the life that is possible.

The cycle below shows how living with IBS might affect people.



Mindfulness enables us to be sensitive to the way we react to what appears in our lives moment by moment. We can begin to become aware of the way in which we tend to get caught up in trying to escape or avoid what we don't like and hang on to pleasant experiences. Of course it is natural to want to do this, but it does mean that most of the time we are not conscious of how quickly and habitually we react to our experience, sometimes in ways that are unhelpful. We can train ourselves to develop an accurate awareness of what our experience *actually is*, rather than the story that pops into our mind immediately. This can give us the space to choose how we would like to respond rather than be pulled into an automatic stream of reactions. With awareness and mindfulness many more of our moments, and much more of our lives, can be imbued with possibility and confidence.

Mindfulness can teach us to:

- Become aware of the workings of our mind
- Learn to recognise patterns
- Learn to stay steady and stand back a little
- See that we have choices rather than slipping back into old patterns
- Learn to take a kinder and gentler attitude towards ourselves
- Learn to recognize warning signals and take helpful action
- Learn how to put less effort into fixing things
- Learn how to focus on the here and now.

Summary of Session 1 – Automatic Pilot

In a car we can sometimes drive for miles "on automatic pilot," without really being aware of what we are doing. In the same way, we may not be really "present", moment-by-moment, for much of our lives: we can often be "miles away" without knowing it.

On automatic pilot, we are more likely to have our "buttons pressed": events around us, and thoughts, feelings and sensations in the mind and body (of which we may be only dimly aware) can trigger old habits of thinking and reacting that are often unhelpful, and may lead on to worsening mood or increased physical symptoms. In other words, our attention is very easily hi-jacked without us knowing it.

By becoming more aware of our thoughts, feelings, and body sensations, from moment to moment, we give ourselves the possibility of greater freedom and choice; we do not have to go down the same "mental ruts" that may be unhelpful.

The aim of this programme is to increase awareness so that we can respond to situations with choice, rather than react automatically. We do that by practising becoming more aware of where our attention is, and bringing it back to our chosen focus over and over again.

To begin with, we used attention to eating the raisin to explore how to step out of automatic pilot. We then began to practice exploring the body in a *new way* – through sensations. We used attention to these sensations as a focus to anchor our awareness in the here and now, noticing how the mind can quickly move off into thoughts and emotions *about* the sensations and take us far away from the present. Through practising the body scan regularly, we can learn to gently re-focus the mind when it wanders, cultivating a sense of kindness towards ourselves. By moving attention systematically through the body we are also learning the skill of choosing different places to direct our attention and awareness.

The body scan forms the main homework exercise this week. Sometimes it can be a challenging practice and may bring up difficult thoughts and emotions. It might also seem to be in conflict with how you have managed difficulties in the past. But being honest about what is happening in our bodies in a non-judgmental way can have a profound impact on our mental and emotional states as well as on the levels of physical tension or pain we might experience through living with chronic illness. The class and teacher are here to support you each week. It might be helpful to remember that what can seem difficult can often turn out to be our most abiding and helpful teacher.

A Definition of Mindfulness

Mindfulness means

the awareness that emerges when we learn to pay attention in a particular way:

on purpose,

in the present moment,

and

non-judgmentally

to things as they are.

Jon Kabat-Zinn

Primary and Secondary Suffering

Primary suffering is the actual unpleasant sensations felt in your body in any given moment; secondary suffering is the additional pain that arises when you resist and react against this.

Many people describe ‘battling’ or ‘fighting’ their pain or discomfort, sometimes getting caught up in a cycle of worry. Other coping strategies including ignoring or pushing through. People can feel overwhelmed or exhausted by unpleasant sensations. These are all examples of the secondary suffering which may arise as a *reaction* to discomfort, pain or difficulties.

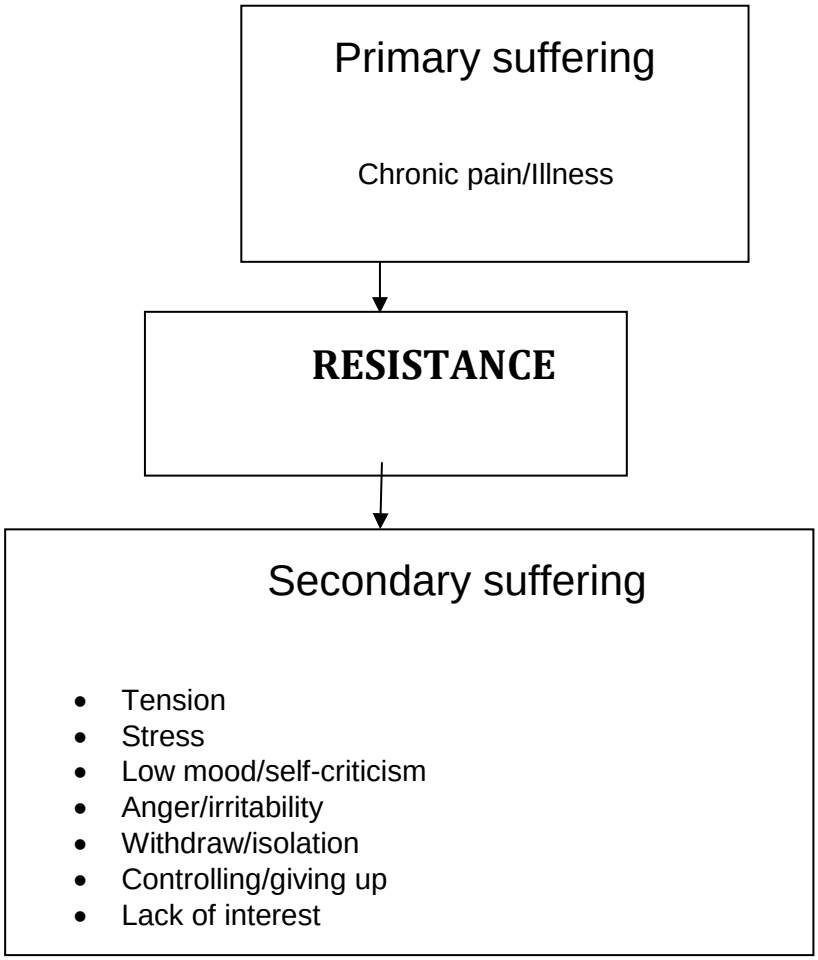


Diagram adapted from Burch (2013).

Secondary suffering can often become as much, if not more, of a problem than primary suffering. Pain (primary suffering) is an inevitable part of the human experience, but secondary suffering is perhaps not so inevitable.

Awareness and self-compassion, which are cultivated through mindfulness practice, may help you to see more clearly your own reactions to primary suffering and the additional difficulties which may arise from these (secondary suffering). Mindfulness can help us to respond ‘wisely’ to the difficulties life presents us with, enabling us to live with greater ease and put aside unnecessary secondary suffering.

A Participant's Report: practicing the body scan

"For the first ten days it was like a burden. I kept "wandering off" and then I would worry about whether I was doing it right. For example I kept having flights of fantasy. My mind was all over the place. I tried too hard to stop it, I think.

Another problem at the start was the message about accepting things as they are now. I thought that was totally unreasonable. I thought to myself "I can't do that".

Eventually, I just put the CD on and expected to go off into a realm of thoughts. I didn't worry if concerns came in. Gradually the forty minutes passed without me losing track and from then on, the next time was more effective.

After ten days I relaxed more, I stopped worrying if I was thinking about anything else. When I stopped worrying about it then I actually stopped the flights of fancy. If I did think of something else, I picked up the instructions again when I stopped thinking. Gradually the flights of fantasy reduced. I was happy to listen to the CD and then I started to get some value from it.

Soon I had developed it so that I could actually feel the breath going down to the base of my foot. Sometimes I didn't feel anything, but then I thought "If there's no feeling then I can be satisfied with the fact there is no feeling".

It's not something you can do half a dozen times. It's got to be a daily thing. It becomes more real the more that you try it. I began to look forward to it.

If people have got to structure the time for the forty five minutes for their CD, it may be easier to structure other things in their life as well. The CD in itself would prove an impetus.

Body Scan Meditation

1. Lie down, making yourself comfortable, lying on your back on a mat or rug, on the floor or on your bed, in a place where you will be warm and undisturbed. Allow your eyes to close gently. If your body experiences pain lying down, then find a position that is more comfortable to begin the practice e.g. sitting, or propped up with pillows. This can also be useful when you are sleepy, as can opening your eyes.

2. Take a few moments to get in touch with the movement of your breath and the sensations in the body. When you are ready, bring your awareness to the physical sensations in your body, especially to the sensations of touch or pressure where your body makes contact with the floor or bed. On each out-breath, allow yourself to let go, to sink a little deeper into the mat or bed.

3. Remind yourself of the intention of this practice. Its aim is not to feel any different, relaxed, or calm; this may happen or it may not. Instead, the intention of the practice is, as best you can, to bring awareness to any sensations you detect, as you focus your attention on each part of the body in turn.

4. Now bring your awareness to the physical sensations in the lower abdomen, becoming aware of the changing patterns of sensations in the abdominal wall as you breathe in, and as you breathe out. Take a few minutes to feel the sensations as you breathe in and as you breathe out.

5. Having connected with the sensations in the abdomen, bring the focus or "spotlight" of your awareness down the left leg, into the left foot, and out to the toes of the left foot. Focus on each of the toes of the left foot in turn, bringing a gentle curiosity to investigate the quality of the sensations you find, perhaps noticing the sense of contact between the toes, a sense of tingling, warmth, or no particular sensation.

6. When you are ready, on an in-breath, feel or imagine the breath entering the lungs, and then passing down into the abdomen, into the left leg, the left foot, and out to the toes of the left foot. Then, on the out-breath, feel or imagine the breath coming all the way back up, out of the foot, into the leg, up through the abdomen, chest, and out through the nose. As best you can, continue this for a few breaths, breathing down into the toes, and back out from the toes. It may be difficult to get the hang of this – just practice this "breathing into" as best you can, approaching it playfully.

7. Now, when you are ready, on an out-breath, let go of awareness of the toes, and bring your awareness to the sensations on the bottom of your left foot – bringing a gentle, investigative awareness to the sole of the foot, the instep, the heel (noticing, for example, the sensations where the heel makes contact with the mat or bed). Experiment with "breathing with" the sensations – being aware of the breath in the background, as, in the foreground, you explore the sensations of the lower foot.

8. Now allow the awareness to expand into the rest of the foot – to the ankle, the top of the foot, and right into the bones and joints. Then, taking a slightly deeper breath, directing it down into the whole of the left foot and, as the breath lets go on the out-breath, let go of the left foot completely, allowing the focus of awareness to move into the lower left leg – the calf, shin, knee, etc., in turn.

9. Continue to bring awareness, and a gentle curiosity, to the physical sensations in each part of the rest of the body in turn – to the upper left leg, the right toes, right foot, right leg, pelvic area, back, abdomen, chest, fingers, hands, arms, shoulders, neck, head and face. In each area, as best you can, bring the same detailed level of awareness and gentle curiosity to the bodily sensations present. As you leave each major area, "breathe in" to it on the in-breath, and let go of that region on the out-breath.

10. When you become aware of tension, or of other intense sensations in a particular part of the body, you can "breathe in" to them – using the in-breath to gently bring awareness right into the sensations, and, as best you can, have a sense of their letting go, or releasing, on the out-breath.

11. The mind will inevitably wander away from the breath and the body from time to time. That is entirely normal. It is what minds do. When you notice it, gently acknowledge it, noticing where the mind has gone off to, and then gently return your attention to the part of the body you intended to focus on.

12. After you have "scanned" the whole body in this way, spend a few minutes being aware of a sense of the body as a whole, and of the breath flowing freely in and out of the body.

If you find yourself falling asleep, you might find it helpful to prop your head up with a pillow, open your eyes, or do the practice sitting up rather than lying down.

Home Practice for Week 1

1. Body Scan CD

Do the Body Scan CD six times. Record on the Home Practice Record Sheet each time you do it, and make a note of anything that comes up so that we can talk about it at the next meeting.

Don't expect to feel anything in particular from listening to the CD. Approach it each time with an open mind and let your experience be your experience, whatever it is.

2. Awareness of a Routine Activity

Choose one routine activity that you do every day and make a deliberate effort to bring moment-to-moment awareness to that activity each time you do it, just as we did in the raisin exercise. Be mindful of the same activity each day.

Possibilities include:

- waking up in the morning,
- brushing your teeth
- showering
- drying your body
- getting dressed
- eating
- driving, taking out the rubbish
- shopping
- etc. etc.

Name:_____

Home Practice Record – Week 1

Record on the Homework Record each time you practice. Also, note anything that comes up in the homework so we can talk about it at the next meeting.

Day/Date	**Practice**	***** **Comments**
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity❒	
	CD ❒ Routine Activity ❒	

Walk Slowly

It only takes a reminder to breathe,
a moment to be still, and just like that,
something in me settles, softens, makes
space for imperfection. The harsh voice
of judgment drops to a whisper and I
remember again that life isn't a relay
race; that we will all cross the finish
line; that waking up to life is what we
were born for. As many times as I
forget, catch myself charging forward
without even knowing where I'm going,
that many times I can make the choice
to stop, to breathe, and be, and walk
slowly into the mystery.

Danna Faulds

Session 2 - Handouts

Summary of Session 2: 'Living in our Heads and Anchoring our Attention'

Our aim in this program is to be more aware more often. In other words, to be aware of our direct, actual experience as it happens.

When you have a condition such as IBS, it is usual to worry about symptoms. Powerful thoughts and images about the future or the past can feel very real. What can happen is that you lose awareness of the moment, and also lose the freedom to choose how to respond and what, if any, action needs to be taken. For example, we might be very aware of physical sensations but in a particular way - it might be that our minds very quickly head off into judgments, fear or worry, ruminative thinking and efforts to make things better. We might also end up in a state of being very watchful of our bodies, in case a symptom shows up that we think we need to do something about.

We lose touch with the *direct experience* of the body and perhaps also with the wisdom to respond wisely and kindly to it.

Sometimes it can also be that other experiences, for example memories of a difficult social interaction or a feeling of shame or embarrassment loss or blame, can lead us into familiar ways of reacting. Even our wandering minds can lead to us travelling the road of self criticism long before we are aware of it. Our automatic tendency to *judge* our experience as being not quite right in some way (it is not what should be happening, or not what we expected or wanted), is a powerful influence taking us away from being "fully present" in each moment. These judgements can lead to sequences of thoughts about what might happen, what could be different, or what needs to be changed. Often, thoughts such as these will take us, quite automatically, down some well-worn paths in our minds

We can regain our freedom if, as a first step, we simply acknowledge the *actuality* of our experience as it is, without being immediately hooked into automatic tendencies to judge, fix, or want things to be other than they are. The body scan exercise provides an opportunity to practise simply bringing an interested and friendly awareness to the way things are in each moment, *without having to do anything to change anything* – even those very powerful thoughts or images. There is no goal to be achieved, other than to bring awareness to different parts of the body as the instructions suggest. Specifically, achieving some special state of relaxation is <u>not</u> a goal to aim for in the exercise.

If physical discomfort is present, the body scan can help us to experiment with gently breathing into the actual sensations that are present, approaching them. We can also begin to observe our usual *reactions* to intensity, and seeing more clearly when they are helpful and when they are less so. Can we start to discern when moving to ease discomfort is the wisest course of action, and when choosing to explore sensations or taking our attention elsewhere is what is needed?

Tips for the Body Scan

1. Regardless of what happens (e.g. if you fall asleep, lose concentration, keep thinking of other things, keep focusing on the wrong bit of body, not feeling anything) persist with it!. These are your experiences in the moment, See if it's possible to be aware of them just as they are.

2. If your mind is wandering a lot, simply note the thoughts (as passing events) and then bring the mind gently back to the Body Scan.

3. Let go of ideas of "success", "failure", "doing it really well", or "trying to purify the body". This is not a competition. It is not a skill you need to strive for. The only discipline involved is regular and frequent practice. Just do it with an attitude of openness and curiosity, then allow the rest to take care of itself.

4. Let go of any expectations about what the Body Scan will do for you: Imagine it as a seed you have planted. The more you poke around and interfere, the less it will be able to develop. So with the Body Scan, just give it the right conditions - peace and quiet, regular and frequent practice - that is all. The more you try and influence what it will do for you, the less it will do.

5. Try approaching your experience in each moment with the attitude: "OK, that's just the way things are right now". If you try to fight off unpleasant thoughts, feelings, or body sensations, they will only distract you from doing anything else. Be aware, be non-striving, be in the moment, accept things as they are.

The Breath

This week we practiced focussing on the body and the breath. As we noticed, our mind is often scattered, pulled or lost in thought, prediction and memory. This is because it is often working away in the background trying to manage difficulties, complete unfinished tasks from the past or strive for goals in the future. So at the moment, we need to find a way of coming back to the here and now. The breath and body offer an ever present focus with which we can reconnect with a mindful presence, gather and settle the mind and ease ourselves into being.

Focussing on the breath brings us back into this very moment – the HERE AND NOW

Breath is always available as an ANCHOR AND HAVEN no matter where we are.

It can actually change our experience by connecting us with a wider space and broader perspective from which to view things

**

'Breath is life. You could think of the breath as being like a thread or a chain that links and connects all the events of your life from birth, the beginning, to death, the end. The breath is always there every moment, moving by itself like a river.

Have you ever noticed how the breath changes with our moods -- short and shallow when we're tense or angry, faster when we're excited, slow and full when we're happy, and almost disappearing when we're afraid. It's there with us all the time. It can be used as a tool, like an anchor, to bring stability to the body and mind when we deliberately choose to become aware of it. We can tune into it at any moment during everyday life.

Mostly, we're not in touch with our breathing -- it's just there, forgotten. So one of the first things we do in mindfulness-based stress reduction [or MBCT] is to get in touch with it. We notice how the breath changes with our moods, our thoughts, our body movements. We don't have to control the breath. Just notice it and get to know it, like a friend. All that is necessary is to observe, watch, and feel the breath with a sense of interest in a relaxed manner.

With practice, we become more aware of our breathing. We can use it to direct our awareness to different aspects of our lives. For example, to relax tense muscles, or focus on a situation that requires attention. Breath can also be used to help deal with pain, anger, relationships or the stress of daily life. During this program, we will be exploring this in great detail'.

Karen Ryder

Mindfulness of the Breath

The Basics of Sitting to Meditate

It helps to adopt an erect and dignified posture, with the head, neck, and back aligned vertically - this is the physical counterpart of the inner attitudes of self-reliance, self-acceptance, patience, and alert attention that we are cultivating. For some of us it can be difficult to hold a posture for too long. For some of us, restlessness is an issue. It can be interesting to explore whether discomfort comes from wishing our sensations were more pleasant or different, or from a pain that would benefit from changing posture. So experiment. Should you need to stand or lie down, see if you can weave this into your meditation practice?

Practise on a chair or on the floor. If you use a chair, choose one that has a straight back and that allows your feet to be flat on the floor. If at all possible, sit away from the back of the chair so that your spine is self-supporting (see Figure A on p.15). Or you can place a cushion or rolled up yoga mat at the base of your spine for support.

If you choose to sit on the floor, do so on a firm, thick cushion (or pillow folded over once or twice) which raises your buttocks off the floor three to six inches. Sit in one of the positions shown in the Figure on p. 15. Figure B involves drawing one heel in close to the body and draping the other leg in front of it; Figure C involves kneeling with the cushion between the feet.

Guidance for Sitting Meditation

1. Settle into a comfortable sitting position, either on a straight-backed chair or on a soft surface on the floor, with your buttocks supported by cushions or a low stool. If you use a chair, it is very helpful to sit away from the back of the chair, so that your spine is self-supporting. If you sit on the floor, it is helpful if your knees can actually touch the floor; experiment with the height of the cushions or stool until you feel comfortably and firmly supported.

2. Allow the back to adopt an erect, dignified, and comfortable posture. This is the physical counterpart of the inner attitudes of self-reliance, self-acceptance, patience, and alert attention that we are cultivating. If sitting on a chair, have the feet flat on the floor with the legs uncrossed. Gently close the eyes.

3. Bring your awareness to the level of physical sensations by focusing your attention on the sensations of touch, contact, and pressure in your body where it makes contact with the floor and with whatever you are sitting on. Spend a minute or two exploring these sensations, just as in the body scan.

4. Now bring your awareness to the changing patterns of physical sensations in the abdomen as the breath moves in and out of the body. (When you first try this practice, it may be helpful to place your hand on the abdomen and to become aware of the changing pattern of sensations where the hand makes contact with the abdomen. Having "tuned in" to the physical sensations in this area in this way, you can remove the hand and continue to focus on the sensations in the abdominal wall.)

5. Focus your awareness on the sensations of slight stretching as the abdominal wall rises with each in-breath, and on the sensations of gentle deflation as the abdominal wall falls with each out breath. As best you can, follow with your awareness the changing physical sensations down in the lower abdomen, all the way through as the breath enters the body on the in-breath and all the way through as the breath leaves the body on the out breath, perhaps noticing the slight pauses between one in-breath and the following out-breath, and between one out-breath and the following in-breath.

6. There is no need to try to control the breathing in any way - simply let the breath breathe itself. As best you can, also bring this attitude of allowing to the rest of your experience - there is nothing to be fixed, no particular state to be achieved - as best you can, simply allow your experience to be your experience without needing it to be other than it is.

7. Sooner or later (usually sooner), the mind will wander away from the focus on the breath in the lower abdomen to thoughts, planning, daydreams, drifting along – whatever. This is perfectly OK - it's simply what minds do - it is not a mistake or a failure. When you notice that your awareness is no longer on the breath, gently congratulate yourself - you have come back and are once more aware of your experience! You may like to briefly acknowledge where the mind has been ("ah, there's thinking"). Then, gently escort the awareness back to a focus on the changing pattern of physical sensations in the lower abdomen, renewing the intention to pay attention to the ongoing in-breath or the ongoing out-breath, whichever you find.

8. However often you notice that the mind has wandered (and this will quite likely happen over and over and over again), each time, as best you can, congratulate yourself on reconnecting with your experience in the moment, gently escort the attention back to the breath,

and simply resume following in awareness the changing pattern of physical sensations that come with each in-breath, with each out-breath.

9. As best you can, bring a quality of kindliness to your awareness, perhaps seeing the repeated wanderings of the mind as opportunities to bring patience and gentle curiosity to your experience.

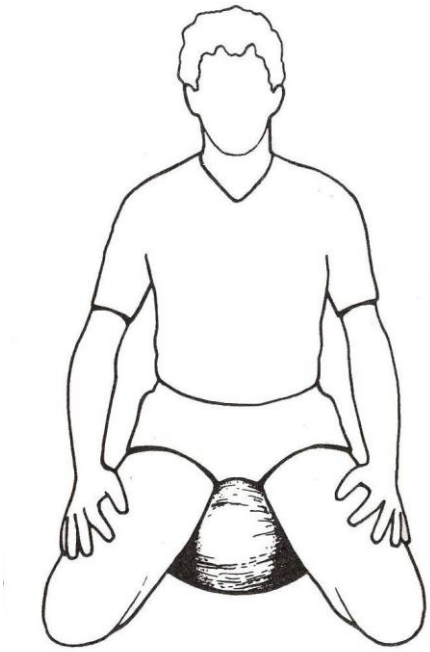
10. Continue with the practice for 10-15 minutes, or longer if you wish, perhaps reminding yourself from time to time that the intention is simply to be aware of your experience in each moment, as best you can, using the breath as an anchor to gently reconnect with the here and now each time that you notice that the mind has wandered and is no longer down in the abdomen, following the breath.

Postures for the Sitting Meditation



A





B C

Home Practice for Week 2

1. Body Scan CD

Use the Body Scan CD on 6 days and record your reactions on the Home Practice Record Sheet.

2. Mindfulness of Breathing

Also on 6 days, but at another time in the day, practise 10-15 minutes' mindfulness of breathing. Being with your breath in this way each day provides an opportunity to become aware of what it feels like to be connected and present in the moment without having to do anything.

3. Pleasant Experiences Diary

Each day record one entry on the Pleasant Experiences Diary. This is an opportunity to become more fully aware of the thoughts, feelings and body sensations that come with pleasant experiences. Record the experience as soon as possible after it has happened, in detail (e.g. write down your thoughts word for word, describe any images in your mind's eye, note the precise nature and location of bodily sensations).

4. Awareness of a Routine Activity

Choose a new routine activity to be especially mindful of on a daily basis – once again, the same activity each day (e.g. brushing teeth, washing dishes, taking a shower, taking out rubbish, reading to kids, shopping, eating).

Name:_____

Home Practice Record – Week 2

Record on the Home Practice Record each time you practise. Also, note anything that comes up in the home practice so we can talk about it at the next meeting.

Day/Date	**Practice**	**Comments**
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	
	CD ❒ Breath ❒ Routine Activity ❒	

Name:_____

Pleasant Experiences

Each day, be aware of a pleasant experience <u>at the time it is happening</u>. These do not have to be major events – small things count. Use the questions to focus your awareness on the details of the experience. Write it down later.

What was the experience?	How did your body feel, in detail, during this experience?	What thoughts or images accompanied this experience? (Write thoughts in words; describe images)	What moods, feelings and emotions accompanied this experience?	What thoughts are in your mind now as you write this down?
e.g. Heading home at the end of my shift – stopping and hearing a bird sing	Lightness across the face, aware of shoulders dropping, uplift of corners of mouth	"That's good", "How lovely (the bird), "It's so nice to be outside"	Relief, pleasure	It was such a small thing but I'm glad I noticed it
Day/Date:				
Day/Date:				
Day/Date				

Each day, be aware of a pleasant experience <u>at the time it is happening</u>. These do not have to be major events – small things count. Use the questions to focus your awareness on the details of the experience. Write it down later.

Day/Date:				
Day/Date				
Day/Date:				
Day/Date:				
Day/Date				

Barriers to Noticing Pleasant Moments

Especially when we are on automatic pilot and when we are anxious, it can be surprisingly difficult to tune into pleasant experiences – or even to allow them to be part of the picture. We need do nothing to change the patterns – our task is simply to become aware of their presence.

Here are some examples of common patterns.

Comparisons

Minds are quick to make comparisons between how things are and how they "should" be. We may find ourselves comparing how we feel now with times when we felt better, or comparing ourselves with other people who seem to be feeling better than we are, or comparing how we are feeling with how we want to feel. All of these comparisons undermine our capacity to be fully present with pleasant moments. Seeing them more clearly, we can choose to give them less weight.

Lost in our thoughts

As we practice meditation, we notice how quickly our minds turn to the past (memories, action-replays of things that have happened) and the future (worrying, anticipating). This wandering from the present moment can mean that we rush past experiences that might have been pleasant without even noticing them. It also means that we lose perspective – we only see ourselves in terms of the IBS, rather than this being part of a much bigger picture which is our life.

Being too busy

When we are under pressure, it is all too easy to forget to take time to replenish our resources and do things that give us pleasure. When life is busy, we may feel we simply don't have the time.

The busier our lives are, the more we need moments to refresh ourselves, moments when we come alive to the pleasure in small things. Pleasure does not have to be a major event – small things can make all the difference (e.g. noticing the scent of our shampoo or shower gel, savouring a cup of coffee instead of hardly noticing we are drinking it, pausing to look around us as we walk from the car to the front door).

Not believing we deserve pleasure

High standards can get in the way of pleasure – for example, we have to complete all our tasks before we can take a moment to ourselves, or we have to look after everyone else before we can attend to our own needs.

In fact, if taking care of ourselves is always bottom of the list, it may actually be harder to meet the demands of our busy lives and can make us miserable. We need to balance attention to others with kindness to ourselves.

Session 3 – Handouts

Summary of Session 3: Beginning to Befriend Challenges and Building Capacity

This week we practiced resting awareness on the breath and body in movement. The mindful movement practice provides an opportunity to:

- Build on the foundation of the body scan in learning how we can bring awareness to and 'inhabit' bodily experience/sensation
- See old habitual patterns of the mind: the 'attitudes' we bring to our body and experience
- Learn new ways of relating to ourselves/our bodies – developing a greater sense of self-compassion and care
- Work with physical boundaries and intensity and learn acceptance of our limits

The *attitude* which we bring to ourselves in our practice is so important. Through our practice, we may see old habits of relating to ourselves playing out more clearly. Bringing awareness to this, and deliberately taking a compassionate, friendly stance towards ourselves (as best we are able) in our mindfulness practice supports us in understanding how best to care for ourselves.

The ice cube exercise, which we did in the session today, links with many of the themes above. It particularly allowed us to explore the two-way links between the patterns and reactions of the mind and our experience of discomfort. Often our automatic reactions to discomfort are fear and aversion – we try to 'fight' or escape. However, sometimes this may prove futile and it may contribute to other difficulties such as exhaustion, frustration and hopelessness. By opening up to discomfort – seeing it as it actually is and seeing our reaction to it, we may notice the pain is different or more tolerable than we had expected, that emotions do not spiral so quickly or we may become aware of other (more helpful) ways of responding. We explored how the breath/body can be a helpful anchor and enable us to gently build our capacity for responding to discomfort.

Mindfulness of the Body in Movement

If our experience has been too unpleasant too often, it is a very natural reaction to tune out of body sensations and the thoughts and feelings it brings up (about ourselves, the future, fear, disappointment, frustration). But in the long run, this doesn't really work as ultimately we run the risk of doing less and less with our body, and losing our trust and confidence in it, in what it can do, and in ourselves. If we are disconnected from painful feelings and body sensations, then we cannot respond to them effectively. Our ability to feel anything at all – positive or negative – may become muted, so that we lose touch with the full experience of being alive. There is also evidence that the less we do, the more our mind can become very sensitive to all kinds of physical sensations, and interpret them as threatening, which leads naturally to a sense of wanting to protect ourselves, but which can just make things worse. So how can we learn to tune back in to our experience without being overwhelmed?

We need an effective way of allowing ourselves to experience ourselves *just as we are.* Mindful stretching and yoga offers us the opportunity to be with our minds and bodies in the spirit of curiosity, kindness and openness. These are attitudes which we began to cultivate in practicing the body scan and may be very different from our usual, habitual reactions to ourselves and our bodies. It involves seeing clearly and gently letting go of the screen of any fear laden or driven thinking and expectations that might be present.

Let's imagine that we have our hands above our heads and we begin to feel discomfort in the shoulders or back. One way we can react is to back off as soon as we feel any discomfort, lowering our arms and turning our attention to some other part of the body or out of the body altogether. Another possibility is to grit our teeth, tell ourselves we just have to put up with increasing pain and discomfort and not make a fuss. We might then put even more effort into pushing ourselves to stretch further. Here too we might numb out, removing our awareness from those regions of the body experiencing discomfort.

But there is a 3rd option that strikes a balance between withdrawing at the first sign of discomfort and forcing ourselves to meet some self imposed standard of endurance. The challenge of mindfulness is to approach the experience in a spirit of gentle nurturing. We direct the attention into the area of discomfort, using the breath to bring a friendly awareness into the region, as in the body scan. We can then explore what we find there - physical sensations coming and going and changing; noticing thoughts, feelings and impulses arising, and allowing them to come and go in awareness. We can play with intensity by varying the stretch and seeing how the body actually responds to every tiny change we introduce. This can give us some sense of being able to modulate the intensity of unpleasant sensations and learn how to relate to them, *and our bodies as a whole,* in a more playful and experimental way.

In this way, we are much more likely to develop a more positive relationship with the body and have a sense of contributing to its well being. We are also nurturing the qualities of kindness and compassion and goodwill towards ourselves, and weakening our tendency to avoid unwanted experiences and emotions.

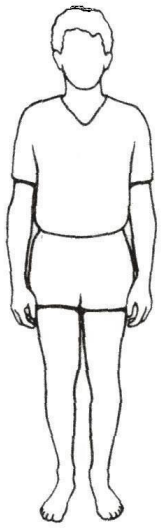
The practice of mindful stretching is that of being with the body in each moment in a spirit of gentleness and self acceptance. The idea is to explore your limits with respect and without judgment. It helps not to try to break through your limits and push yourself unreasonably, and as best you can, pay careful attention if you have this tendency.

At the same time, it is helpful to stay in a posture long enough to allow yourself to really experience any sensations which are present. When discomfort occurs, see if you can use the breath to "let go" into the discomfort, particularly if you find yourself struggling or fighting with it, or rapidly moving away from the sensations.

Practice observing and exploring the boundary between what your body can do and where it says stop for now. It is helpful to keep an open mind each time you practice about how it will be today. If you let go of expectations or goals and approach each moment of practice with curiosity and openness, you are more likely to learn to trust what you experience and know better how to work with your body. The only discipline involved is regular and frequent practice.

Mindfulness of the Body in Movement

Standing Postures



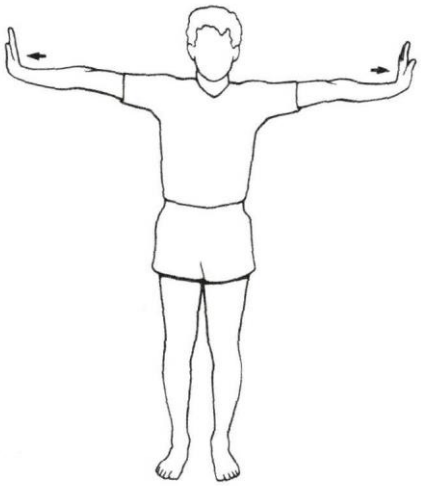


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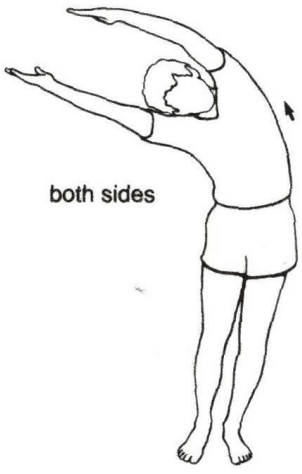


Figure b

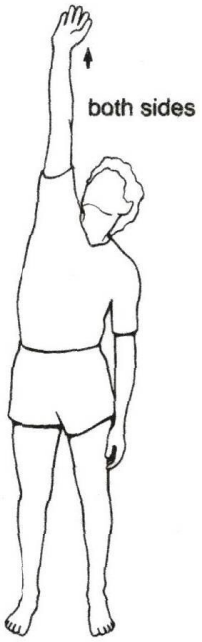


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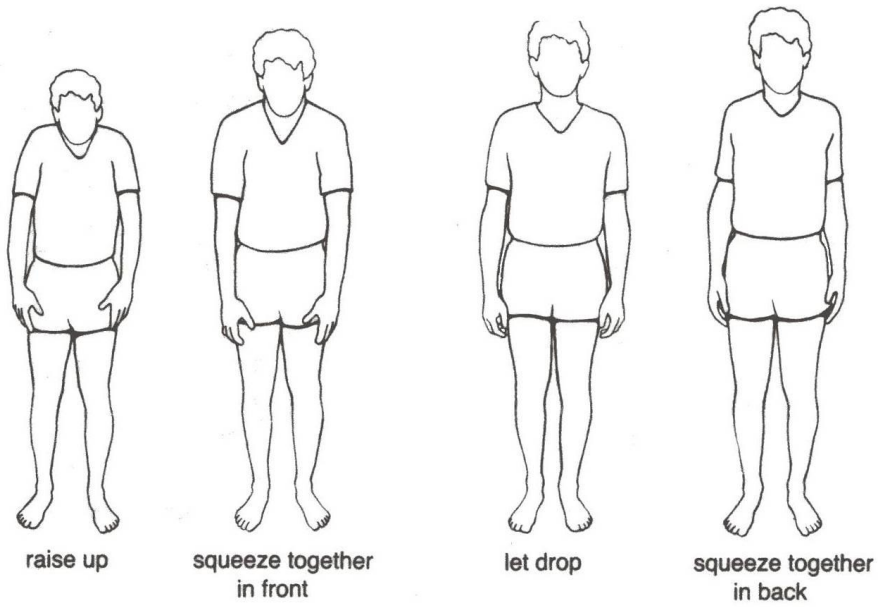


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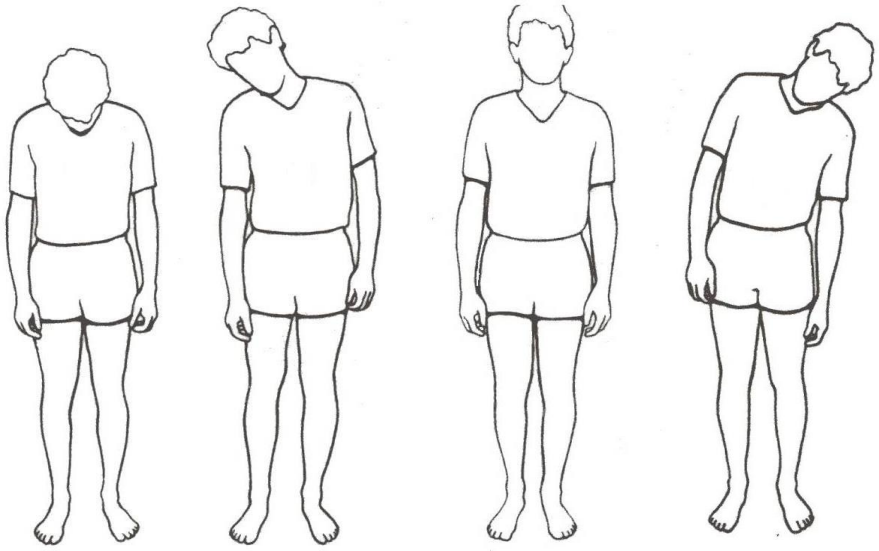


Figure e

Mindfulness of the Body in Movement:

Lying Down Postures

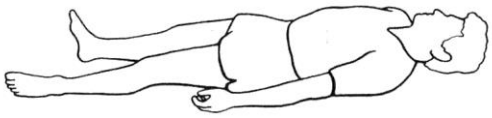


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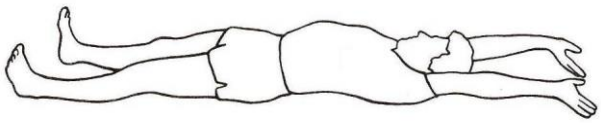


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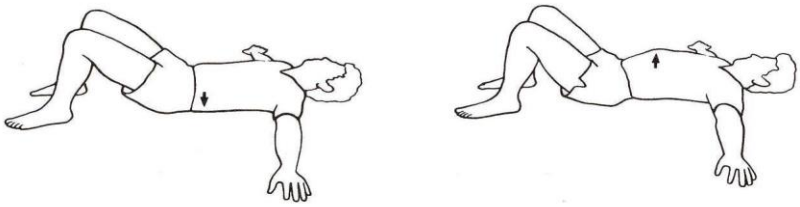


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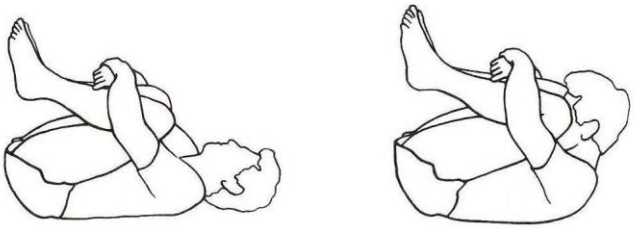


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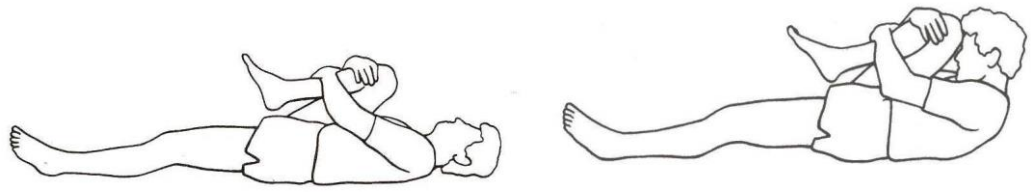


Figure 5



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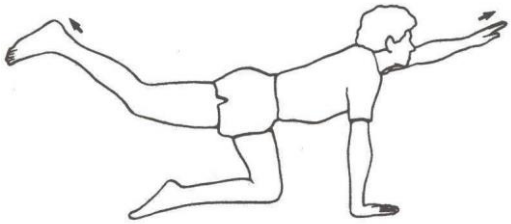


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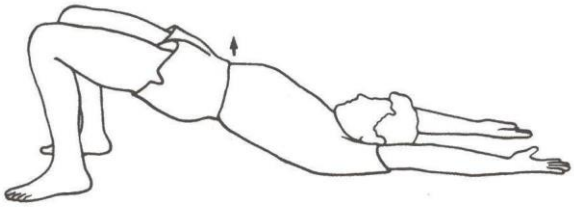


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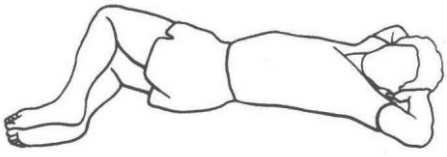


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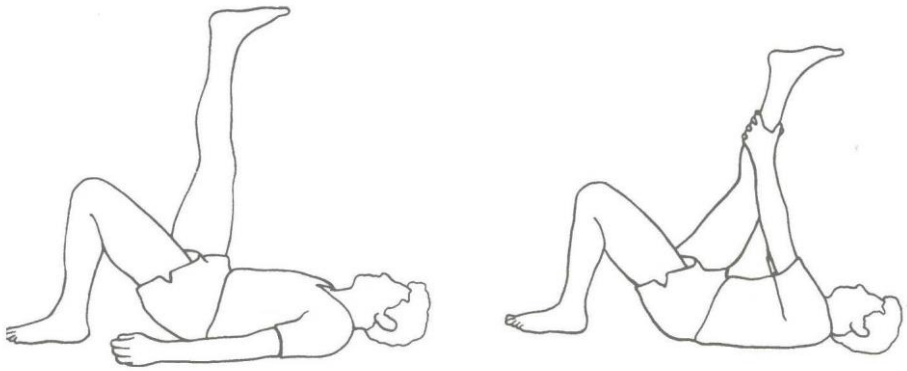


Figure 10.

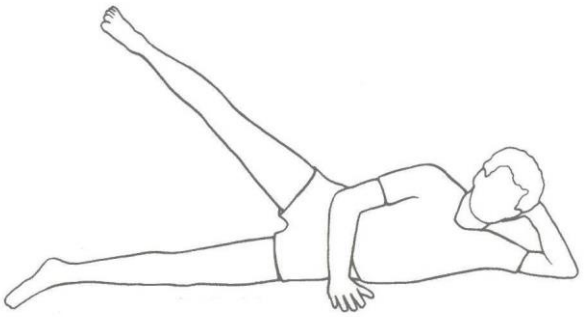


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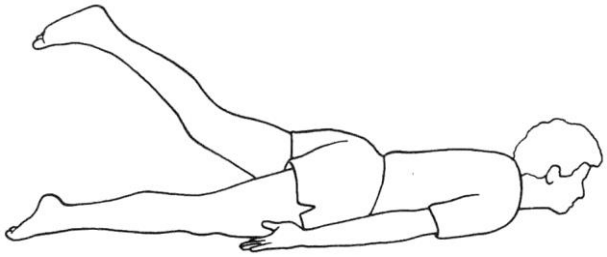


Figure 12.



Figure 13.



Figure 14.

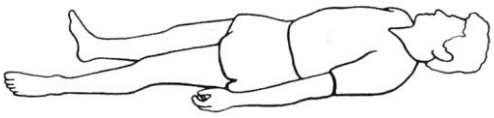


Figure 15.

The Three Minute Breathing Space: Instructions

1. Becoming Aware

Become more aware of how things are in this moment by deliberately adopting a dignified posture whether sitting or standing. If possible, close your eyes. Then bringing your awareness to your inner experience and acknowledging it, ask:

"What THOUGHTS are going through the mind?' As best you can acknowledge thoughts as mental events, perhaps putting them into words.

'What FEELINGS are here?' Turn towards any discomfort or unpleasant feelings, acknowledging them.

'What BODY SENSATIONS are here now?' Perhaps quickly scan the body to pick up any sensations of tightness or bracing, acknowledging the sensations.

2. Gathering

Then gently redirect full attention to breathing. Move in close to the sense of breath in the abdomen…feeling the sensations of the abdomen wall expanding as the in breath comes in….. and falling back as the breath goes out. Follow the breath all the way in and all the way out, using the breath to anchor yourself in the present.

3. Expanding

Now expand the field of your awareness around your breathing so that it includes a sense of the body as a whole, your posture and facial expression. If you become aware of any sensations of discomfort or tension or resistance, take your awareness there by breathing into them on the in breath. Then breathe out from them, softening and opening on the out breath.

As best you can, bring this expanded awareness to the next moments of the day.

The breathing space provides a way to step out of Automatic Pilot mode and reconnect with the present moment.

The key skill in using Mindfulness-based Cognitive Therapy is to maintain awareness in the moment.

Nothing else.

Home Practice for Week 3

1. Practising with CDs

This week we are going to use two different CDs:

- On Days 1, 3, and 5, use the Stretch and Breath CD. This combines a few minutes of gentle stretching exercises with instructions for mindfulness of the breath and body. Record your reactions on the Record Sheet.
- On Days 2, 4 and 6, use the Yoga CD. Again, record your reactions on the Record Sheet.

Both of these practices provide an opportunity to tune into sensations in the body in movement, as opposed to in stillness.

N.B.: *If you have any back problems or other health difficulties that may make it difficult for you to practise with these CDs, make your own decision as to which (if any) of the exercises you do. Gently explore sensations in your body and listen to what your body tells.*

2. Regular Breathing Spaces

Practise using the Breathing Space three times a day at set times that you have decided in advance. Record each time by ticking a box on the record sheet.

3. Unpleasant Experiences Diary

Each day record one entry in the Unpleasant Experiences Diary. This is an opportunity to become more fully aware of the thoughts, feelings and body sensations that come with the unpleasant experiences that pull you off centre, no matter how big or small. Record the experience as soon as possible after it has happened, in detail (e.g. write down your thoughts word for word, describe any images in your mind's eye, note the precise nature and location of bodily sensations).

Name:_____

Home Practice Record – Week 3

Record on the Home Practice Record each time you practise. Also, note anything that comes up in the home practice so we can talk about it at the next meeting.

Day/Date	**Practice**	**Comments**
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒	

Unpleasant Experiences

Each day, be aware of an unpleasant experience <u>at the time it is happening</u>. Use the questions to focus your awareness on the details of the experience. Write it down later.

What was the experience?	How did your body feel, in detail, during this experience?	What thoughts or images accompanied this experience? (Write thoughts in words; describe images)	What moods, feelings and emotions accompanied this experience?	What thoughts are in your mind now as you write this down?
e.g. Waiting for the repair man to come and fix the washing machine. Realise I am missing an important meeting at work	Stomach pain, tightness in my neck and shoulders, pacing up and down	"Is this what they mean by service? They don't care. This is one meeting I don't want to miss. What will everyone think of me?"	Angry, helpless.	"I hope I don't have to go through that again."
Day/Date:	❑	❑	❑	❑
Day/Date:	❑	❑	❑	❑
❑ **Day/Date:**	❑	❑	❑	❑

❑ **Day/Date:**	❑	❑	❑	❑
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❑ **Day/Date:**	❑	❑	❑	❑
❑ **Day/Date:**	❑	❑	❑	❑

Session 4 – Handouts

Summary of Session 4:

Allowing and Letting Be

The easiest way to relax is, first, to let go of trying to make things different. Allowing experience means simply allowing space for whatever is going on, rather than trying to create some other state.

Whenever we encounter a situation - whether it is pleasant, unpleasant or neutral – our bodies and minds react to it.

Pleasant Experiences: If an experience is pleasant, our bodies react in one way – perhaps relaxing, or feeling a sense of expansion or energy. However, we may wish it would go on for ever, or that it would happen again soon, or find ourselves trying to hang on to it for as long as possible.

Unpleasant Experiences: If an experience is unpleasant, our bodies react in another way – perhaps with tension, or a sense of contraction, or withdrawal. Here the tendency is to turn away from the experience, and if possible to avoid it or get away from it as soon as we can.

Neutral Experiences: and if an experience is neutral, our bodies may not react very much at all, and we may find ourselves feeling bored, spacing out and switching off.

These reactions are often automatic and immediate, and sometimes they are obvious and easy to notice. But at other times they are subtle (e.g. a slight change in body sensations), and can happen without our awareness. Whether obvious or subtle, a problem is that we may not be fully aware of how they are influencing us. This includes reactions not just to what is happening around us, but to *our own thoughts and feelings*. These automatic reactions can then narrow our options down, just when we need to be most mindful and most skilful in our responses.

Often when discomfort, pain or other unpleasant experiences are around, we move into

'avoidant mode' (wanting to distance ourselves), which restricts our capacity to respond flexibly and creatively. And we lose touch with *'approach mode'* (engaging with the unpleasant state with some friendliness), which would allow us to remain more flexible and creative, and to take best care of ourselves at this difficult time.

Through allowing we settle back into awareness of what is present. We let it be - we simply notice and observe whatever is already here. This is the way to relate to experiences that have a strong pull on our attention, however powerful and seductive they seem – even intense emotions like helplessness and frustration. When we see them clearly, it helps prevent us from getting pulled into ruminating about them, or trying to suppress or avoid them. We begin the process of freeing ourselves from them. We open up the possibility of responding skilfully and with compassion, rather than reacting, in knee jerk fashion, by automatically running off old (often unhelpful) strategies.

This week we introduced two new practices in the session, both of which allowed us to explore/see more clearly our usual reactions and to experiment with staying open and compassionate in the face of difficulty: allowing our experience to be as it is.

1. Guided sitting practice – exploring thoughts

Regularly practising Sitting Meditation gives us many opportunities to notice when we have drifted away from awareness of the moment, to note with a friendly interest what drew our attention, and to gently and firmly bring our awareness back to our intended focus, reconnecting with moment-by-moment awareness. This week we particularly focused on sounds and thoughts. It can be immensely liberating to see that our thoughts are just like sounds –events in the mind which can come and go. Also, we may have discovered that thoughts have an impact on the body, especially if they are linked to the reactions of fear or aversion.

2. Turning towards the difficult

In the class today, we also explored together a new way of approaching the difficult. If we noticed that our attention kept being pulled away from the breath (or another focus) to painful thoughts, emotions or feelings, the first step was to become mindfully aware of any physical sensations in the body that were occurring alongside the thought or emotion; we then deliberately moved the focus of awareness to the part of the body where those sensations were strongest. We explored how the breath could provide a useful vehicle to do this - just as we practised in the Body Scan, we can take a gentle and friendly awareness to that part of the body by 'breathing into' it on the in-breath, and 'breathing out' from it on the out-breath.

Once our attention had moved to the bodily sensations and they were in the field of awareness, the guidance was to say to ourselves *"It's okay. Whatever it is, it's okay to allow myself to be open to it"*. Then just to stay with the awareness of these bodily sensations and our relationship to them, breathing with them, allowing them, letting them be. It may be helpful to repeat "It's okay. Whatever it is, it's okay. Let me be open to it", using each out breath to be open to the sensations. Allowing is *not* resignation – it allows us, as a vital first step, to become fully aware of difficulties and to respond to them skilfully.

Relating differently to thoughts

Our thoughts can have very powerful effects on how we feel and what we do. Often thoughts arise automatically without us noticing the thought itself, the trigger for the thought or the consequences of it.

Examples of some of the thoughts which are common for people living with IBS and pain or discomfort are:

- This is embarrassing
- I'm afraid the pain will be excruciating and intolerable
- I miss out on important parts of my life
- Other people will think I am disgusting or weak if something happens in public
- People don't understand what it is like for me
- I frustrate and irritate others because I have to cancel things or find a bathroom when I am out with others
- People will think there is something wrong with me because I have to leave events/meetings/social gatherings to find a bathroom
- I can't enjoy or pay attention to anything when I feel bad

By becoming aware, over and over again, of the thoughts and images passing through the mind, and bringing friendliness to them as best we can, it is possible to get some distance and perspective on them. This can allow us to see that there may be other ways to think about situations, freeing us from the tyranny of the old thought patterns that automatically "pop into the mind". With time, we may come to see out thoughts differently and realize that:

- ***All thoughts are only mental events*** *(including the thoughts that say they are not)*
- ***There is a wider perspective***
- ***We are not our thoughts***

Ways of seeing thoughts differently

Here are some things you can do with your thoughts:

1. Watch them come and go without feeling you have to follow them
2. See if there is a particular mood that is around that has given rise to the thoughts
3. View your thought as a mental event, just like a sound. It is up to you how you want to respond to it.
4. Write your thoughts down on paper. This lets you see them in a way that is less overwhelming and allows you to pause which can be helpful.
5. For particularly difficult thoughts, it can be helpful to intentionally take a look at them as part of your sitting practice. Perhaps bringing a sense of curiosity to them, perhaps labelling the feeling which gives rise to them. Notice how your thoughts express themselves in your body and see if it is possible to bring a friendly interest to the sensations.

The key attitude to take towards your thoughts is one of gentleness and curiosity.

Breathing Space: Extra Guidance

You have been practising the Breathing Space, regularly three times a day and whenever you need it. Now we suggest that **whenever** you feel troubled in body or mind, the first step is always to take a breathing space. Here is some extra guidance that may help at these times.

1. Awareness

We have already practised observing - bringing the focus of awareness to our inner experience and noticing what is happening in our thoughts, feelings, and bodily sensations

In addition, you may like to experiment with describing, acknowledging, identifying - putting experiences into words, e.g. say in your mind "A feeling of anger is arising" or...."Self-critical thoughts are here"

2. Redirecting Attention

We have already practised gently *redirecting* your full attention to the breath; following the breath all the way in and all the way out

In addition: Try noting 'at the back of your mind': "Breathing in... Breathing out" or counting: "Inhaling, one...Exhaling, one; Inhaling, two...etc."

3. *Expanding Attention*

We have already practised allowing the attention to expand to the whole body. Now extend the attention to include any sense of discomfort, tension, or resistance. If these sensations are there, take your awareness to them by "breathing in to them" on the in-breath. Then, "breathe out from the sensations", softening and opening with the out-breath. Say to yourself on the out-breath, "It's okay. Whatever it is, it's okay to allow myself to be open to it". Become aware of and adjust posture and facial expression.

As best you can, bring this expanded awareness to the next moments

of your day.

Wild Geese

You do not have to be good.
You do not have to walk on your knees
for a hundred miles through the desert, repenting.
You only have to let the soft animal of your body
love what it loves.
Tell me about despair, yours, and I will tell you about mine.
Meanwhile the world goes on.
Meanwhile the sun and the clear pebbles of the rain
are moving across the landscapes,
over the prairies and the deep trees,
the mountains and the rivers.
Meanwhile the wild geese, high in the clear blue air,
are heading home again.
Whoever you are, no matter how lonely,
the world offers itself to your imagination,
calls to you like the wild geese, harsh and exciting -
over and over announcing your place
in the family of things.

By: Mary Oliver *Dream Work* Beacon Press, Boston

Home Practice for Week 4

1. Guided Sitting Practice and Befriending the Difficult

On one day, practice the Guided sitting CD, on the next day practice the Befriending the difficult Meditation CD – alternating between the two. Record your reactions on the Record Sheet. Indicate which you have used on the Home Practice Record.

2. Regular Breathing Spaces

Practise the Breathing Space *regularly*, three times a day, at times that you have decided in advance. Record each time you do it by ticking a box on the appropriate day on the Home Practice Record Sheet. Note any comments/difficulties.

3. Additional Breathing Spaces

In addition, practise using the Breathing Space when you notice unpleasant feelings and body sensations. Record each time you do it by ticking a box on the Record Sheet. Note any comments/difficulties.

Name:_____

Home Practice Record – Week 4

Record on the Home Practice Record each time you practise. Also, note anything that comes up in the home practice so we can talk about it at the next meeting.

Day/Date	**Practice**	**Comments**
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	
	CD ❒ Regular BS ❒❒❒ Additional BS ❒❒❒	

Session 5- Handouts

Summary of Session 5: Bringing Friendliness to yourself and also to others

Up till now we have been developing our capacity to approach our difficult experiences with kindness, especially through cultivating a tender awareness of the body and its sensations. We have also been learning that our thoughts can be very powerful in capturing our attention so that we 'live' as if they were our only reality. The practices can support our intention to turn towards *all* our experiences and reactions with a gentleness and sense of allowing. In doing this, we are cultivating compassion to ourselves and our experiences, and breaking the hold that IBS has on our sense of who we are.

We also know that social connection has a positive impact on our bodies and sense of well-being through our hormones and nervous system. The hormone oxytocin is released when we stroke a beloved pet or touch someone we care for and contributes to feelings of safety and warmth. But connection is difficult if we feel vulnerable and unsure and our bodies and minds tend to tense up rather than being open and flexible. When we deliberately practice kindness towards ourselves, it opens up the possibility of feeling empathy towards others and increases our sense of connection and well-being. It's as if we can begin to see that other people are like us all, stumbling through life trying to find happiness.

This week we also have the opportunity of extending the practice of kindness to ourselves and deliberately widening the circle of compassion to others who share our life, and possibly even to others who we may not even know. No matter how isolated you might feel, this practice will gradually help you to feel more connected. It may be that you find this meditation a little difficult at times, but remember, no-one is expecting you to suddenly love the entire world and everyone in it! It can be difficult to extend warmth to others when you are feeling stressed. But as with all the practices, there is no 'right' way to feel and no rush. Just follow the guidance as best you can and see what unfolds. Remember, you don't have to feel anything special, just listen out for what comes up as you practice and see if you can bring friendliness to that. We are just beginning this process of gently 'turning our minds' in the direction of friendliness and kindness to whatever comes, and this is enough.

The Connection Meditation

1. To begin with establish your meditation posture. It helps to position your body so you will be as comfortable as possible yet relaxed and alert for the next ten minutes. Allow your body to settle down towards the chair, the bed or the floor. And allow gravity to support your whole body.

2. Let your awareness rest inside the movements and sensations of the breath and the whole body. Feel the breath in the front, the back and the sides of the body, the inside of the body and the surface of the body. Allow the breath to be saturated with kindliness and tenderness towards yourself. Can you allow all the unpleasant and pleasant aspects of your experience in each moment to arise and pass away within a broad and open field of awareness, neither pushing away the unpleasant nor clinging onto the pleasant, but resting back within a broad stable kindly field of awareness that contains everything with a quality of fluidity and receptivity?

3. And now bring to mind a friend, someone for whom you have existing feelings of liking or friendliness. Choose someone quickly as representative of all the people you like in your life. Imagine inviting them into your field of awareness, either as an image, a feeling or any other way that works for you. Staying grounded in your own experience, expanding your awareness to include your friend and sitting quietly with them in your imagination, gently breathing together.

4. Now reflect on all that you share with your friend. Although you look different and the details in your lives are different, you are both breathing in and out in exactly the same way, and beneath the superficial differences you are so alike. Your friend will have unpleasant experiences they tend to resist and push away or get overwhelmed by, and pleasant experiences they tend to cling on to, in pretty much the same way that you do. See if you can imagine reaching over the sense of difference and separation that we usually feel towards others and focus instead on a sense of common humanity with your friend.

5. Now include a sense of kindliness towards your friend. On the in-breath breathing in as strong a sense of connection with your friend as you can manage and on the out-breath breathing out kindliness and well-wishing towards your friend. Everything that you wish for yourself: compassion, contentment, fulfilment, perhaps you can now wish for your friend. Imagine them being bathed in these qualities with each outbreath.

6. And now broaden your awareness still further to include other people. Expand your awareness so it radiates out from the centre of your body to include yourself, your friend and bring to mind other people around you. Maybe there are other people in the house with you or in your neighbourhood. Bringing these people to life in your imagination. Each one of them is a living breathing human being. Just like you. Everything that you experience in your own life they experience in their lives in their own way. They are breathing in and out at every moment, just like you. They have unpleasant experiences they tend to dislike and push away or get overwhelmed by, just like you. They also have pleasant experiences, enjoyable experiences that they can delight in, but so soften crush with the tight fist of clinging, just like you. So just resting for a few moments with the sense of commonality with all these other people.

7. Now broaden out your awareness still more to include more and more people, and seeing if you can expand the sense of awareness and empathy with humanity. Instead of feeling isolated by your experience, can you empathise with other human beings as you realize how alike

we all are deep down? To the extent that we know ourselves honestly and authentically we know humanity. To extend we acknowledge our own suffering we know what it is like for others to suffer. To the extent that we know our own openness of heart, joy and happiness we know what it is like for others to have joy and happiness and we can delight in this.

8. And now including kindliness and well-wishing with the breath as we spend this time reflecting on all that we share with others. On the in-breath, breathing in empathy for all humanity and on the outbreath breathing out kindliness and well-wishing towards all humanity. Instead of focusing on differences, we focus on commonality. Instead of focusing on isolation, we focus on connectedness. Breathing in a sense of interest and connection with humanity and breathing out kindliness and well-wishing towards all humanity. And allowing your breath of well-wishing to flow equally towards everybody without preference. People we like, people we don't like, people we know, people we don't know. People who are awake and people are asleep. People who are nearby, people who are far away. People living in peaceful places and people living in warzones. They are all human beings. We are all so similar. None of us likes to suffer and we all want to be happy.

9. So resting back within a broad and open field of awareness, remaining centred and grounded in your own experience. And expanding your awareness on and on to include all life everywhere. Resting inside the movements and sensations of the breath in your own body and having a sense of the whole world breathing. Expanding and subsiding, expanding and subsiding. A ceaseless gentle movement and flow. Allowing the whole world to be bathed and saturated in a kindly, loving breath.

10. Now very gently beginning to bring the meditation to a close. Maintaining a sense of openness towards oneself and towards others with a sense of softness in the body and the breath. Gently opening your eyes and moving the body and seeing if you can take this quality of connectedness with common humanity with you as you reengage with the activities of your day. Taking time as you make the transition from the meditation space to your daily life.

Connection Meditation from Vidyamala Burch.

The Guest House

This being human is a guest house.
Every morning a new arrival.

A joy, a depression, a meanness,
some momentary awareness comes
as an unexpected visitor.

Welcome and entertain them all!
Even if they are a crowd of sorrows,
who violently sweep your house
empty of its furniture,
still, treat each guest honorably.
He may be clearing you out
for some new delight.

The dark thought, the shame, the malice.
meet them at the door laughing and invite them in.

Be grateful for whatever comes.
because each has been sent
as a guide from beyond.

Rumi,

translation by Coleman Barks

Kindness

Before you know what kindness really is
you must lose things,
feel the future dissolve in a moment
like salt in a weakened broth.
What you held in your hand,
what you counted and carefully saved,
all this must go so you know
how desolate the landscape can be
between the regions of kindness.
How you ride and ride
thinking the bus will never stop,
the passengers eating maize and chicken
will stare out the window forever.

Before you learn the tender gravity of kindness,
you must travel where the Indian in a white poncho
lies dead by the side of the road.
You must see how this could be you,
how he too was someone
who journeyed through the night with plans
and the simple breath that kept him alive.

Before you know kindness as the deepest thing inside,
you must know sorrow as the other deepest thing.
You must wake up with sorrow.
You must speak to it till your voice
catches the thread of all sorrows
and you see the size of the cloth.

Then it is only kindness that makes sense anymore,
only kindness that ties your shoes
and sends you out into the day to mail letters and
purchase bread,
only kindness that raises its head
from the crowd of the world to say
it is I you have been looking for,
and then goes with you everywhere
like a shadow or a friend.

Naomi Shihab Nye
from The Words Under the Words: Selected Poems

Home Practice for the Two Weeks Following Session 5

1. Sitting Meditation

Practice the Befriending meditation CD on days 1, 3 and 5 and Working with the difficult meditation CD on days 2, 4 and 6 OR Sitting in silence

Record your reactions on the Home Practice Record Sheet.

2. Regular Breathing Spaces

Practise the Three-Minute Breathing Space *regularly*, three times a day, at times that you have decided in advance. Record each time you do it by ticking a box on the appropriate day on the Home Practice Record Sheet. Note any comments/difficulties.

3. Additional Breathing Spaces

Practise additional Breathing Spaces *WHENEVER YOU NOTICE UNPLEASANT FEELINGS*, using the Extra Guidance if you wish. Record each time you do it by ticking a box on the Record Sheet. Note any comments/difficulties.

4. Action plan for the Future

Carry on using the worksheets we began in class to help you reflect on how to best to respond skilfully to symptoms of IBS.

Name:_____

Home Practice Record – Week 5

Record on the Home Practice Record each time you practise. Also, note anything that comes up in the home practice so we can talk about it at the next meeting.

Day/Date	**Practice**	**Comments**
	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	
	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	
	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	
	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	
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	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	
	CD/Silence ❒ Regular BS ❒❒❒ Additional BS ❒❒❒❒❒	

Session 6 - Handouts

The advantages of awareness, acceptance, and mindfully **responding** to situations rather than immediately running off pre-programmed "automatic" **reactions** has been a recurring theme throughout this course.

We have learnt that bringing a friendly awareness to our experience (thoughts, feelings, body sensations) at times of distress can act as a springboard for responding in ways that relieve our distress. How can we best take care of ourselves in these moments? We can sometimes **do something** that is caring and kind towards ourselves or that is different from our usual reaction. There are also times when the situation or feeling is very difficult or impossible to change and action is *not* the most skilful response. We would only end up running away, or worrying in an attempt to 'solve' the problem which can have a powerful physiological effect and keep us stuck in a vicious circle. At these times, **you can still retain some sense of dignity and control by making a conscious, mindful decision not to attempt to exert control and to accept the situation as it is, if possible, with a kindly attitude both to the situation and to your reactions to it.**

The so-called "Serenity Prayer" asks for:

"grace to accept with serenity the things that cannot be changed, courage to change the things which should be changed, and the wisdom to distinguish the one from the other".

Where do we find this grace, this courage, this wisdom? At some level, we **already** have all of these qualities - our task is to realise them (make them real), and our way is none other than moment-by-moment mindful awareness.

The future

It is not always obvious what regular practice of meditation is doing for us. It's like learning a new language: a few phrases can keep the learning alive. So a manageable amount each day is better than long gaps. We encourage you to carve out time in your busy lives to do some kind of formal meditation practice every day, even if its only 5 minutes. It does not matter how long we give to the practice so much as we make an attempt to pause within all the busyness, however brief it is by the clock. So even brief moments, if we are really present for them with awareness, are re-orienting and healing.

Regular practice of mindfulness meditation is rather like weaving a parachute. It is better to weave it every day, rather than leaving it to the time you have to jump from the plane!

Ask yourself:

What is it that I want for myself that this practice can help me with?

Decide, right now, what your regular pattern of practice will be in the future, and stick to it as best you can.

Also, remember the Breathing Space - regular practice provides a way of "checking in with yourself" a few times a day. Let it also be your first response at times of anxiety, stress, or low mood - KEEP BREATHING!

DAILY MINDFULNESS

- When you first wake up in the morning, before you get out of bed, bring your attention to your breathing. Observe 5 mindful breaths.
- Notice changes in your posture. Be aware of how your body and mind feel when you move from lying down to sitting, to standing, to walking. Notice each time you make a transition from one posture to the next.
- Whenever you hear a phone ring, a bird sing, a train pass by, laughter, a car horn, the wind, the sound of a door closing - use any sound like the bell of mindfulness. Really listen, being present and awake.
- Throughout the day, take a few moments to bring your attention to your breathing. Observe 5 mindful breaths.
- Whenever you eat or drink something, take a minute and breathe. Look at your food and realize that the food was connected to something which nourished its growth. Can you see the sunlight, the rain, the earth, the farmer, the trucker in your food? Pay attention as you eat, consciously consuming this food for your physical health. Bring awareness to seeing your food, smelling your food, tasting your food, chewing your food, and swallowing your food.
- Notice your body while walking or standing. Take a moment to notice your posture. Pay attention to the contact of the ground under your feet. Feel the air on your face, arms, legs as you walk. Are you rushing?
- Bring awareness to listening and talking. When listening can you listen without agreeing or disagreeing, liking or disliking, or planning what you will say when it is your turn? When talking can you just say what you need to say without overstating or understating? Can you notice how your mind and body feel?
- Whenever you are waiting in a line, use this time to notice standing and breathing. Feel the contact of your feet on the floor and how your body feels. Bring attention to the rising and falling of your abdomen. Are you feeling impatient?
- Be aware of any points of tightness in your body throughout the day. See if you can breathe into them and, as you exhale, let go of excess tension. Is there tension stored anywhere in your body? For example - your neck, shoulders, stomach, jaw, or lower back. If possible stretch or do yoga once a day.
- Focus attention on your daily activities - such as brushing your teeth, brushing your hair, washing up, putting on your shoes, doing your job. Bring mindfulness to each activity.
- Before you go to sleep at night, take a few minutes and bring your attention to your breathing. Observe 5 mindful breaths.

Whenever you feel you have ‘lost it’, when life feels really hard, or when your practice has been hard to sustain; remember that you can always come back to the breath. No matter how long you’ve been away, you can always start over again, in this moment, right here, right now.

Adapted from: Mady Kline, Stress Reduction Clinic

BEING PRESENT IN THE MOMENT

"… live in the moment. … We do not own the past, with its grief and sin … we do not own the future. We own only a rag of time, this moment named the present … it is not necessary to expand the present with false imaginings and with peevishness, and the frenzy of our lives … Time is like a meal – each mouthful is separate and glorious"

Thomas Keneally (2002)

The Office of Innocence

Hodder & Stoughton

(p.241)

WORKING WISELY WITH IBS (1)

SEEING CLEARLY (noticing the first signs of stress)

This worksheet offers an opportunity to increase your awareness of what happens for you when you feel stressed or ***worried about your IBS***. The aim is, carefully and with curiosity, to investigate the thoughts, feelings, body sensations and patterns of behaviour that tell you that your stress level is mounting.

What triggers distress for you?

- Triggers can be external (things that happen to you), or internal (e.g. sensations, thoughts, feelings, memories,).
- Look out for small triggers as well as large ones – sometimes something that appears quite trivial can spark anxiety

What sort of thoughts run through your mind when you first feel your concerns mounting?

What emotions arise?

What happens in your body?

What do you do, or feel like doing?

Are there any old habits of thinking or behaviour that might unwittingly keep you stuck in distress and worry (e.g. going over and over things in your mind, trying to suppress or turn away from painful thoughts and feelings, planning how to escape)?

WORKING WISELY WITH IBS (2)

RESPONDING WISELY (caring for yourself and choosing wise options when you notice the first signs of distress)

This sheet gives you an opportunity to consider how you might ***skilfully*** respond when you find yourself under stress and worried about your IBS. Don't forget to include anything you have learned over these few weeks.

In the past, what have you noticed that helped when you were becoming concerned?

What might be a skilful response to distress? How could you *respond* without making it worse (include anything you feel might be useful from these few weeks together)?

How can you best care for yourself when you find yourself feeling distressed (e.g. things that would soothe you, activities that might nourish you, small things you could do to reduce the pressure you are experiencing)?

9.4 Appendices for Chapter 6

9.4.1 Participant Information Sheet for the Study "Mindfulness for Irritable Bowel Syndrome" (MIBS)

INFORMATION FOR PARTICIPANTS

Invitation

We would like to invite you to take part in this research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. *Part 1 of this information sheet tells you about the purpose of this study and what will happen to you if you take part. Part 2 gives you more detailed information about the conduct of the study.* Take time to decide whether or not you wish to take part. Thank you for reading this.

[There is an additional brain imaging component to the study which you may wish to participate in. Information about this is marked with brackets.]

What is the purpose of the study?

Many people in the United Kingdom suffer from Irritable Bowel Syndrome (IBS). People with irritable bowel syndrome often have abdominal pain, diarrhoea, constipation, cramps and bloating, but the current treatment options have helped little to reduce symptoms. Researchers and clinicians are just beginning to understand the complex physical and mental factors that may contribute to the symptoms. One of the routes that seems very promising is the 'brain-gut axis', which looks at the relationship between the brain and the guts. Research in this area has shown that training in mindfulness can help to reduce the symptoms of IBS and improve well-being. However, exactly how training in mindfulness reduces the symptoms of IBS remains unclear.

Researchers at the University of Oxford have developed a mindfulness training specifically for people with irritable bowel syndrome. We are interested in finding out if this training is effective at reducing the symptoms of IBS and how the training achieves its effects. What we learn from this study will be used to improve the care of patients with IBS in the future.

Why have I been chosen?

We are asking women to take part who have a diagnosis of Irritable Bowel Syndrome, with moderate to severe symptoms. We are also asking clinicians to mention this study to any patients they think might be interested in finding out more. We are contacting people directly through posters, adverts, social media, IBS support groups and the internet. We hope that about 80 people will take part in this study.

Do I have to take part?

It is up to you to decide whether or not you participate. If you do decide to take part you will be given this information sheet to keep and you will be asked to sign a form agreeing to take part. If you decide to take part, you can still change your mind and withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision to not take part, will not affect you in any way. If you are a student at Oxford University, there are no adverse academic consequences if you decide not to take part in this study or if you withdraw at any point after you have already started study procedures.

The Design of the study

We are investigating whether Mindfulness-based Cognitive Therapy for IBS (MBCT for IBS) can help people with IBS to reduce their symptoms and improve their quality of life. We are also interested in understanding the effect of mindfulness on psychological and physiological factors over the course of the treatment. To see whether the treatment is helpful we need to compare people in the treatment group with a group of people who are not receiving treatment at the moment. Everyone joining the study will be chosen at random by a computer program to receive either MBCT or to wait for treatment (delayed treatment). The delayed treatment group will be offered MBCT within 12 months of signing up for the study. To see if mindfulness brings about any changes during the treatment, we need to make assessments before, during and after treatment and compare the data we have gathered at the three time points. The delayed treatment group will be doing the assessments before the beginning of their treatment and an additional set of 4 online questionnaires before, during and after receiving MBCT for IBS.

[For participants who are interested in participating, there is an optional brain imaging component to the study. This will involve 2 additional visits where you will have some MRI brain scans, and will complete some additional questionnaires. The visits would take place before and after receiving MBCT.]

What is Mindfulness-based Cognitive Therapy (MBCT) for IBS?

MBCT for IBS is a pilot treatment. It combines mindfulness meditation with cognitive therapy techniques specifically for people with IBS. Previous research has shown that training in mindfulness can reduce the symptoms of IBS and help to increase general well-being. People taking part in MBCT for IBS will be invited to join six weekly 2 hour classes given by an experienced teacher to small groups of about 15-20 people. There they will learn the practice of mindfulness meditation. MBCT includes breathing exercises and homework activities to help you become more aware of the present moment, including getting in touch with moment-to-moment changes in the mind and the body. It also includes basic education about IBS, the relationship between mind and body, and several exercises from cognitive therapy that show the links between thinking, feeling and IBS. It will also teach you how best to look after yourself when your symptoms flare up or if you are stressed.

Please be aware that the treatment involves homework assignments. In particular meditation homework practices in MBCT can take up to an hour per day. From previous studies we know that the amount of mindfulness practice at home is related to more positive outcomes. You can look at it like learning to play an instrument: the more regularly you practice the more you improve. It can be difficult to make time for this, so you must think carefully about whether you are able to make this commitment, before agreeing to take part.

What is the delayed treatment group

The delayed treatment group will also receive MBCT for IBS after those that have been assigned to immediate treatment have finished their course. Whilst waiting, the people in the delayed treatment group will do the same assessments as those on the treatment group within the same timeframe.

What will happen to me if I take part?

Screening*:* Before filling out the study questionnaires or taking part in any tests you will be asked to fill out a screening questionnaire with a member of the research team or online.

If you meet our inclusion criteria and you decide to take part you will be asked to follow the following procedure.

***Initial Assessment (first assessment*)**: The initial assessment has two parts: The first part is an online questionnaire and the second part consists of a series of computerized games with the research team. The online questionnaire will take approximately 45 minutes and the assessment visit will take up to 1.5 hours. Both parts will take place within 21 days before the course MBCT for IBS starts.

Allocation to MBCT or to wait for treatment: After completing the initial assessment you will be randomly allocated to one of the two groups. If you are in the MBCT group you will meet the teacher running your class to discuss the course in more detail. If you are in the *delayed treatment* group you will be invited to talk about the waiting period with a researcher from the team.

Introductory session: Before the beginning of the treatment, you will be invited to have a meeting with one of the mindfulness teachers. The teacher will introduce mindfulness to you and explain what will happen over the six weeks of treatment. The teacher will also ask you some questions about you and your reasons to join the course. This meeting will take place at the Oxford Mindfulness centre and will be approximately 1 hour long.

Brief session about the waiting period: Each participant in the delayed treatment group will have a brief meeting or phone conversation with a member of the research team about the waiting period.

Treatment period: You will be asked to attend six weekly 2 hour sessions of MBCT for IBS over the course of 6-7 consecutive weeks (there may be a one week break). Between the sessions you will be asked to practice at home for up to 1 hour per day.

Second assessment: Everyone will be asked to complete a second assessment. For people in the treatment group, this assessment will take place during the first few weeks of the treatment period. For people in the waiting condition, this assessment will take place within 1-7 weeks after their initial assessment. The second assessment is very similar to the first assessment and has two parts:

The first part is an online questionnaire and the second part consists of a series of computerized tasks with the research team. The online questionnaire will take approximately 30 minutes to complete and the assessment visit will take up to 1.5 hours.

Third assessment: People in the treatment group will be asked to come back for a further research assessment within two weeks of completing the treatment. The people waiting for treatment will be asked to do the third assessment between 7 and 11 weeks after their first assessment. The third assessment is similar to the first and second assessment, and has two parts: The first part is an online questionnaire and the second part consists of a series of computerized tasks with the research team. The online questionnaire will take approximately 30 minutes and the assessment visit will take up to 1.5 hours.

Follow-up: Approximately 1 month after completing the third assessment, everyone will be asked to do a follow up assessment. You can complete this follow up assessment online at a time and place convenient for you.

Extra assessments for those in the delayed treatment group: When the people who were waiting for treatment start their MBCT course, they will be asked to complete a series on online questionnaires. These will be the same questionnaires as you will have been asked to complete during the waiting phase. You will be asked to complete these online just prior to treatment, during treatment, within two weeks after treatment and 1 month after treatment. Each time the online questionnaires will take approximately 30 minutes.

[Optional Brain imaging visits
If you are participating in the brain imaging component of the study you will be asked to attend for one imaging visit prior to starting MBCT and a second imaging visit after completing the treatment. Prior to taking part in this part of the study, a member of the research team would ask you some safety questions to ensure that it is safe for you to enter an MRI scanner. During each of the visits, you would complete an MRI scanning session lasting up to 1.5 hours. For most of the scanning you would be asked to lie still. During the scan you may be asked to respond to specific stimuli (for example, something presented on a screen, or a physical stimulus such as heat or a blunt needle placed on the skin).

All of the potentially painful sensations that we elicit are experimentally induced in a safe, controlled and temporary manner. During the stimulation sessions we will ask whether the stimulus feels painful, and if so ask you to rate the intensity of the pain. Most people find that they are able to tolerate it well, but if you find it too uncomfortable then you would be able to ask not to continue.

During each of the brain imaging visits you will be asked to complete some paper questionnaires about your pain, and things that may affect it or be affected by it. These should take no more than 30 minutes.]

Information about the online questionnaires

For each online assessment, we will send you a link to the online questionnaire, which includes an online consent form. Filling out the questionnaire will take 30-45 minutes and you can do this at a time and a place that is convenient for you.

The questionnaire will include some general questions as well as some questions about your health, stress, thoughts and feelings.

Information about the computerized tests

For each computerized testing session, you will be asked to come to a testing location at the University of Oxford. Like computer games, all of the computerized tasks involve pressing buttons on a keyboard or a mouse as a response to the choices that you make. Some tasks require you to identify the location of a target on a computer screen, others will ask you make choices about the appeal of items and words.

Compensation

As a compensation for your time, the 6-week course (which usually costs £350) will be entirely free for you.

For assessment visits, we can provide reimbursement of reasonable travel costs on production of receipts to a maximum of £5 per assessment visit. No other reimbursement will be given.

[If you take part in the imaging component of the study, you will be reimbursed £20 for each of the 2 visits in order to compensate you for your time and expenses. No other reimbursement will be given for this component of the study]

My responsibility

It is important that you complete the assessments on time and that you follow the instructions of the teacher. If you fail to attend the assessment sessions or to complete the online questionnaires, or if you are absent from the weekly sessions you may be excluded from participating in the course.

If I agree to take part, what am I agreeing to do? – A summary

If you agree to take part in the study you must complete both parts of the initial assessment before you are randomly allocated to the treatment group or the delayed treatment group. After group allocation, everyone will be asked to complete a total of 3 further assessments over the course of 5 months. Those who complete treatment after the waiting period (delayed treatment group) will be asked to complete 4 additional online questionnaires during and after their MBCT for IBS course. You will be asked to attend an initial meeting with a teacher, followed by six weekly sessions, each of about two hours, and to complete activities between the classes at home (up to one hour per day). You will be asked return a completed diary card to the teacher each week about your mindfulness practice at home. The class teacher may be videotaped each week to check that the treatments are being delivered effectively to everyone. It is important that you think carefully about whether or not you are willing to make the considerable commitment of time needed for both treatment and research assessments.

It is also important to remember that although you are agreeing to take part in the study -

- You can decide to stop any interview at any point.
- Anything you tell us will be absolutely confidential. Your name will be removed from the information and it will not be possible to identify anyone from our reports on the study.
- Audiotapes of research assessments and videotapes of treatment sessions taken during this study will be stored securely (with ***no*** identifying information to ensure confidentiality). They will be erased at the end of the study.
- *A flow-diagram showing the study outline is attached at the back of this information sheet to help make this information clearer.*

PART 2

This section describes in more detail how the research will be conducted.

Risks

You will be asked questions about your mood and thoughts in relation to your mental wellbeing and physical health (IBS). Occasionally these questions may upset you temporarily as negative thoughts and feelings might come to your mind when answering the questions. Also, part of MBCT for IBS involves facing past and current difficulties which can sometimes bring up negative feelings. These difficulties are often part of the therapeutic process and the trained therapists will be available to offer advice on overcoming these difficulties during the treatment period.

[Risks specific to the MRI scanning component (optional)

MRI is safe and non-invasive and does not involve any ionizing radiation (x-rays). However, because it uses a large magnet to work, MRI scans are not suitable for everybody. Because of this, you will be asked pre-screening safety questions to help determine if you are able to take part. For example, if you suffer from claustrophobia, you could not be scanned. Normally, MRI scanning for research purposes would not be performed without further investigation if you have a heart pacemaker, mechanical heart valve, mechanical implant such as an aneurysm clip, hip replacement, or if you carry other pieces of metal that have accidentally entered your body. While there is no evidence to suggest that MRI is harmful to unborn babies, as a precaution, the Department of Health advises against scanning pregnant women unless there is a clinical benefit. We do not test for pregnancy as routine so if you think you may be pregnant you should not take part in this study. As some of the scans are noisy, we would give you earplugs, head padding or headphones to make this quieter for you. It is important that these are fitted correctly as they are designed to protect your ears. In preparation for your scan and for your comfort and safety we may ask you to change into pocketless and metal free "pyjama-style" top and trousers, which are available in a range of sizes. You may keep your underwear and socks on but we would ask ladies to remove underwired bras, if you have a suitable sports type bra you may wear this instead. Please avoid any fabrics that contain metallic threads or have been silver impregnated (often marketed as anti-microbial/bacterial or anti-odor/stink).

Metal jewellery including body piercing must also be removed. Eye shadow and mascara must also be avoided, since some types contain materials that can interact with the magnetic field. If you wish to wear eye makeup to your scan we can provide makeup removal wipes but you are advised to bring your own makeup to reapply. Lockers are provided to secure your personal belongings and clothing.

Some people scanned in MRI scanners may experience a mild dizzy sensation as they are moved into the scanner. This is normal and the sensation starts to go away as soon as you are in the scanner.

It is important to note that we do not carry out scans for diagnostic purposes, and therefore these scans are not a substitute for a doctor’s appointment. Our scans are not routinely looked at by a doctor, rather our scans are intended for research purposes only. Occasionally a possible abnormality may be detected. In this case, we would have the scan checked by a doctor, who may communicate with your GP. If the doctor felt that the abnormality was medically important, you

would be contacted directly and recommended to have a hospital (NHS) diagnostic scan arranged. All information about you is kept strictly confidential.

Some of the stimuli used to elicit a painful sensation can produce temporary redness lasting about 20-30 minutes over the skin where they are applied.]

Benefits

Everyone taking part in the research will have the opportunity to receive a new treatment designed to reduce symptoms of IBS. We hope that, by carrying out this research, we can get a better understanding of treatment options for IBS.

What will happen if I don't want to carry on with the study?

If you decide that you do not want to carry on with the study, please inform the researcher of your decision. If you withdraw from the research assessments before treatment begins, we cannot offer you treatment, as your place will have to be made available for another person who can complete the research assessments. However, if you begin treatment but then decide that the treatment is not right for you and stop attending classes we would still like you to complete the remaining research assessments. This is important so that we can find out which groups of people they help. However you do not have to do so if you do not want to.

The information that we have already collected up until your withdrawal will be retained and used in the study. Data will be anonymized and it will not be possible to identify you in any published material.

What if there is a problem?

The University of Oxford, as a Sponsor, has appropriate insurance in place in the highly unlikely event that you suffer any harm as a direct consequence of your participation in this study. If you have a concern about any aspect of this project, please speak to Julia Henrich (Tel. 01865 271338), Prof. Maryanne Martin (tel.01865 271313) or Dr. Bergljot Gjelsvik (01865 613155). We will do our best to answer your query. If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact Julia Henrich (emails: Julia.Henrich@seh.ox.ac.uk, Tel: 01865 271338) or you may contact the University of Oxford Clinical Trials and Research Governance (CTRG) office on 01865 572224 or the head of CTRG, email ctrg.admin.ox.ac.uk.

Will my taking part in this study be kept confidential?

We will replace your name on each data file with a unique ID number. The results from all individuals will be gathered together and the data analysed over the group. It will not be possible to identify you in any report or publication. Responsible members of the University of Oxford or the local NHS Trust may be given access to data for monitoring and/or audit of the study to ensure we are complying with regulations.

Any information you give will be treated with strict confidentiality, unless in the rare circumstance that you or someone else is at risk of serious harm. In this circumstance, the research team will disclose only information directly relating to the emergency to emergency services.

Storage of data

All information that is collected about you during the course of the research will be kept strictly confidential. You will be assigned a unique ID number and the file that allows us to match each ID number with a specific name will be stored on a password protected computer, with access only available to the primary researchers. All data on hard copies will be kept in a locked file cabinet to which only the primary researchers have access.

What will happen to the results of the research study?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

The research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be published with open access.

We also hope to publish the results of this study in a scientific journal. We may also present the results at a scientific conference or a seminar in a university, or during talks to the general public. We may also publish results on our website. It will not be possible to identify you in any report or publication.

Who is funding this study

Stiftung Oskar Helene Heim is funding this study.

The imaging component is funded by Abide Therapeutics and the National Institute for Health Oxford Biomedical Research Centre

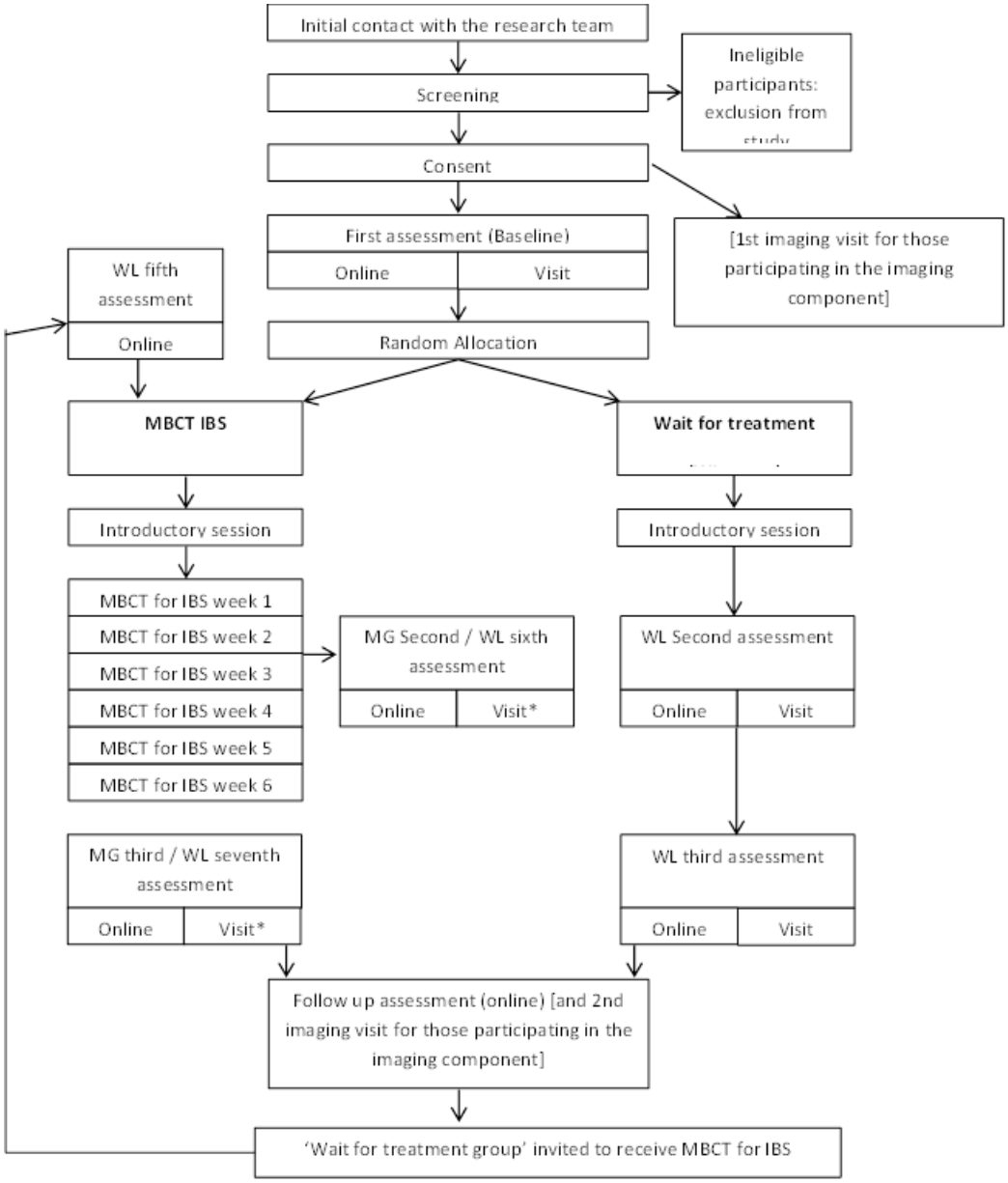
Who has reviewed the study?

This project has been reviewed by, and received ethics clearance through, South Central – Oxford A.

Contact for Further Information

If you have any further questions about this research, please feel free to speak to Julia Henrich on 01865 271338, or e-mail Julia.Henrich@psy.ox.ac.uk.

Study Flowchart



*MG group only. The DT group will complete the online assessments but not the assessment visit during their MBCT course.

THANK YOU FOR TAKING THE TIME TO READ THIS INFORMATION SHEET AND CONSIDERING WHETHER TO TAKE PART IN THIS RESEARCH.

9.4.2 Consent form for the study "Mindfulness for Irritable Bowel Syndrome" (MIBS)

Mindfulness for Irritable Bowel Syndrome (MIBS)

Consent Form

Thank you for volunteering to take part in this study.

We are investigating the effectiveness of Mindfulness-based Cognitive Therapy for the treatment of IBS.

Please read the information below and initial the boxes if you agree with the statements.

Name:_____(block capitals)

I confirm that I have read and understood the information sheet 'Mindfulness for Irritable Bowel Syndrome' (*Version Date: 18.04.2016, Version Number: 3.0*) for the above study and have had the opportunity to ask questions, and have had these satisfactorily answered. ☐

I understand that I may withdraw from the study without penalty at any time by advising the researchers of this decision. ☐

I understand that this project has been reviewed by, and received ethics clearance through the *Research Ethics Committee South Central – Oxford A*. ☐

I understand that data collected during the study may be looked at by the researchers of this study, authorized individuals from the University of Oxford or the OUH NHS Trust where it is relevant to my taking part in this research. I permit these individuals access to my research records. I understand how the data will be stored, and what will happen to the data at the end of the project. ☐

I agree that the researchers may take audio and video recordings of the mindfulness sessions which I attend. ☐

I understand that if I withdraw from the study any data that have already been collected from me will be used in the study and analysed**,** but no further data will be collected. ☐

I understand that the research may be written up as a student's thesis, and I understand how data included in that thesis will be published and stored. ☐

I am aware that all personal information will be treated with full confidentiality, except in the rare circumstance that I or somebody else is at risk of serious harm. In this case only information necessary to an emergency will be revealed to emergency services. I give permission for this disclosure. ***Please turn the page to sign*** ☐

I understand how to raise a concern and make a complaint. ☐

I understand that taking part in this study requires attending 6 weekly mindfulness sessions (2 hours per session), mindfulness practice of up to 1 hour per day on 6 out of 7 days during each week of the MBCT course, completing 4-8 online questionnaires and 3 assessment visits. ☐

I understand that I may be excluded from the study and the treatment if I do not complete the assessments and/or do not attend the sessions. ☐

I agree to take part in this study. ☐

OPTIONAL:

I would like to participate in the MRI brain imaging component of this study. I understand that these are research scans that are not useful for medical diagnosis, and that scans are not routinely looked at by a doctor. If a concern is raised about a possible abnormality on my scan it may be discussed with specialist doctors, and I will be informed if a doctor thinks it is medically important. With my permission, my GP may also be informed. ☐

I would like to be informed of the results of the study and give my consent for my details to be retained so that I may be contacted with these results. ☐

I am happy to be contacted about future research projects, and for my contact details to be stored for this purpose. ☐

Name Participant:

……..Signed:…….…….Date:……..

Name of person obtaining consent:
…….Signed:……Date:..……...

If you have any questions please contact Julia Henrich, on 01865 271338 or at julia.henrich@psy.ox.ac.uk.

Thank-you!

9.4.3 Screening Questionnaire of the study Mindfulness for Irritable Bowel Syndrome (MIBS)

Mindfulness for Irritable Bowel Syndrome: Screening Questionnaire

Welcome!

Please take a few minutes to fill out this questionnaire. Your answers to these questions will help us determine if you can participate in this study: Mindfulness for Irritable Bowel Syndrome (MIBS).

Please answer all questions.

The information that you provide will be treated with full confidentiality.

About You

23. What is your Gender?

☐	Female	☐	Male	☐	I identify as: (please fill in the box)

24. [only show if answer to 1 is Female] What is your age (in years)? ……

25. [only show if answer to 2 is >18 and < 65] Have you been diagnosed with Irritable Bowel Syndrome (IBS) by your gastroenterologist or GP?

☐	No, I do not have a formal diagnosis of IBS	☐	Yes, I was diagnosed by my GP	☐	Yes, I was diagnosed by a Gastroenterologist	☐	Yes, I was diagnosed by a Gastroenterologist and GP

26. **[only show if answer to 3 is yes] Have you been diagnosed with an Inflammatory Bowel Disease (IBD) (such as ulcerative colitis or Crohn's disease) or with coeliac disease?**

☐ No ☐ Yes

27. **[only show if answer to 4 is no] Have you been diagnosed with any other functional gastrointestinal disorders (FGIDs) (such as functional or non-ulcer dyspepsia, functional constipation, or gastrointestinal reflux disease (GERD))?**

☐ No ☐ Yes

28. **[only show if answer to 5 is no] Are you a native English speaker?**

☐ No ☐ Yes

29. **[If answer to 6 is no] Do you speak English fluently?**

☐ No ☐ Yes

30. **[only show if answer to 6 is yes OR if answer to 6 is no and answer to 7 is yes] Do you have:**

☐ Normal vision?

☐ Vision corrected to normal? (e.g. if you wear glasses or contact lenses)

☐ Impaired vision or problems with your vision?

31. **[only show if answer to 8 is normal or corrected to normal]Are you pregnant?**

☐ No ☐ Yes

32. **[If answer to 9 is no] Are you currently participating or enrolled in any other research study for the treatment or management of IBS? This could be a pharmacological or a psychological study.**

☐ No ☐ Yes

33. **[only show if answer to 10 is no] Have you previously participated in an 8-week mindfulness course (such as MBSR or MBCT)?**

☐ No ☐ Yes

34. **[only show if answer to 11 is no] Have you ever been involved in any other kind of structured mindfulness training?**

☐ No ☐ Yes

35. **[only show if answer to 12 is no] Have you ever taken part in a Vipassana meditation course?**

☐ No ☐ Yes

36. [only show if answer to 13 is no] Do you have a regular meditation practice, in which you would meditate at least once a month?

☐ No ☐ Yes

37. [only show if answer to 14 is no] Have you been bereaved within the past year?

☐ No ☐ Yes

38. [only show if answer to 15 is no] Have you ever been diagnosed with any of the following:

vii. A cognitive disorder (such as dementia or amnesia or delirium)?

viii. A dissociative disorder (such as dissociative amnesia)?

ix. A personality disorder (such as borderline personality disorder)?

x. Schizophrenia or any other psychotic disorder?

☐ No ☐ Yes

39. [only show if answer to 16 is no] Have you ever been diagnosed with any of the following:

xi. Attention Deficit Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD)?

xii. Obsessive Compulsive Disorder (OCD) as a primary diagnosis?

xiii. A substance-related (or induced) disorder (such as alcoholism)?

☐ No ☐ Yes

40. [only show if answer to 17 is no] Do you experience suicidal thoughts or behaviours?

☐ No ☐ Yes

41. [only show if answer to 18 is no] Do you engage in regular self-injury?

☐ No ☐ Yes

Your Gastrointestinal Health

The questions below ask about your bowel movements and abdominal pain **in general and over a longer period of time.**

42. [only show if answer to 19 is no]In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?

- ☐ Never
- ☐ Less than one day a month
- ☐ One day a month
- ☐ Two to three days a month
- ☐ One day a week
- ☐ More than one day a week
- ☐ Everyday

43. [only show if answer to 20 is 2-3 days a month or more]Have you had this discomfort or pain 6 months or longer?

☐ No ☐ Yes

44. [only show if answer to 21 is yes]Does this discomfort or pain occur only during your menstrual bleeding and not at other times?

	Not applicable because I have had no discomfort or pain; because I have had menopause
	No
	Yes

45. [only show if answer to 22 not applicable or no]How often does this discomfort or pain get better or stop after you have a bowel movement?

	Never or rarely
	Sometimes
	Often
	Most of the time
	Always

46. When this discomfort or pain starts, do you have more frequent bowel movements?

	Never or rarely
	Sometimes
	Often
	Most of the time
	Always

47. When this discomfort or pain starts, do you have less frequent bowel movements?

	Never or rarely
	Sometimes
	Often
	Most of the time
	Always

48. When this discomfort or pain starts, are your stools (bowel movements) looser?

	Never or rarely
	Sometimes
	Often
	Most of the time
	Always

49. When this discomfort or pain starts, how often do you have harder stools?

☐	Never or rarely
☐	Sometimes
☐	Often
☐	Most of the time
☐	Always

50. In the last 3 months, how often did you have hard or lumpy stools?

☐	Never or rarely
☐	Sometimes
☐	Often
☐	Most of the time
☐	Always

51. In the last 3 months, how often did you have loose, mushy or watery stools?

☐	Never or rarely
☐	Sometimes
☐	Often
☐	Most of the time
☐	Always

The Study

Everyone in this study will get the chance to receive mindfulness training for Irritable Bowel Syndrome (MBCT for IBS). Some participants will be randomly assigned to immediate treatment and others to delayed treatment. The Mindfulness training will involve 6 x 2 hour sessions of mindfulness training. In addition to attending the sessions, home practice of about one hour per day during the six weeks of training is a vital part of MBCT for IBS. Each participant (immediate and delayed treatment) will be expected to attend 3 assessment sessions and to fill in 4 online questionnaires at specific times.

52. Will you be able to commit to attending your sequence of six mindfulness sessions?

☐ No ☐ Yes

53. [only show if answer to 30 is yes] Are you willing to make some time each week (up to one hour per day, on six out of 7 days) to engage in mindfulness practice at home, as suggested by your mindfulness instructor?

☐ No ☐ Yes

54. [only show if answer to 31 is yes] Are you happy to commit to completing some computerised questionnaires and other tasks on four separate occasions, before, during and after your mindfulness course?

☐ No ☐ Yes

55. **[only show if answer to 32 is yes] Is it going to be possible for you to routinely access the internet on a computer over the course of the study?**

☐ No ☐ Yes

56. **[only show if answer to 33 is yes] Will you be able to use a keyboard and mouse to complete the tasks?**

☐ No ☐ Yes

57. **[only show if answer to 34 is yes] Do you agree to being contacted by the research team about taking part in this study?**

☐ No ☐ Yes

Personal Information

The information we ask you to provide below will be kept strictly confidential. It is collected so that we can contact you about your further participation in this study. This information will be accessible only to researchers involved in the study. Please type your answers into the boxes provided.

First Name	**Last Name**
Email	**Phone**

City

Thank you! We will be in touch with you shortly.

9.4.4 Overview and sequence of cognitive computerized tasks in the Study "Mindfulness for Irritable Bowel Syndrome (MIBS).

Table 9.5. Overview and sequence of cognitive computerized tasks in the Study "Mindfulness for Irritable Bowel Syndrome (MIBS).

Cognitive Task	**Time to complete**	**Assessment time point**		
	(in minutes)	**1**	**2**	**3**
Attention Network Task (ANT) (Fan et al., 2002; Hou et al., 2014)	5	✓	✓	✓
Implicit Association Task (IAT) Theme: Illness/health (Greenwald et al., 1998; Teachman et al., 2008)	10-15	✓	✓	✓
Dot-Probe Task (Asmundson et al., 2005; Keogh et al., 2001; MacLeod & Mathews, 1988)	15-20	✓	✓	✓
Implicit Association Task (IAT) Theme: Shame/Pride (Greenwald et al., 1998; Teachman et al., 2008)	10-15	✓	✓	✓
Self-referential encoding and incidental recall task (SRET) (Fritzsche et al., 2010; Harmer, O'Sullivan, et al., 2009)	5			✓

9.4.5 List of validated questionnaires and assessment points in the study "Mindfulness for Irritable Bowel Syndrome" (MIBS).

Table 9.6. List of validated questionnaires and assessment points in the study "Mindfulness for Irritable Bowel Syndrome" (MIBS). ***Note.*** **Mindfulness Group is MG and Waiting-list Group is WL.**

Questionnaires	Assessment time points				Assessment time points		
Groups	MG and WL				WL only		
Questionnaire	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IBS Symptom severity Gastrointestinal Symptom Rating Scale IBS (GSRS IBS) (Wiklund et al., 2003)	✓	✓	✓	✓	✓	✓	✓
Quality of life IBS Quality of Life - IBSQOL (Drossman et al., 2000)	✓	✓	✓	✓	✓	✓	✓
Psychological distress Depression Anxiety Stress Scale (DASS-21) (Henry & Crawford, 2005)	✓	✓	✓	✓	✓	✓	✓
Pain-Catastrophizing Pain Catastrophizing Questionnaire (PCS) (Sullivan et al., 1995)	✓	✓	✓	✓	✓	✓	✓
IBS-Catastrophizing Gastrointestinal Cognitions Questionnaire (Hunt et al., 2014b)	✓	✓	✓	✓	✓	✓	✓
Visceral Anxiety Sensitivity Visceral Sensitivity Index (VSI) (Labus et al., 2004)	✓	✓	✓	✓	✓	✓	✓
Mindfulness Five Facet Mindfulness Questionnaire Short Form (FFMQ-S) (Baer et al., 2006; Bohlmeijer et al., 2011)	✓	✓	✓	✓	✓	✓	✓
Somatosensory Amplification Somatosensory Amplification Scale (Barsky, Wyshak, & Klerman, 1991)	✓						
Social Anxiety Social Interaction Anxiety Scale 6 (SIAS-6) Social Phobia Scale – 6 (SPS-6) (Mattick & Clarke, 1998; Peters, Sunderland, Andrews, Rapee, & Mattick, 2012)	✓						
Alexithymia Toronto Alexithymia Scale(TAS) (Bagby et al., 1994)	✓						
Mood Positive and Negative Affect Schedule (PANAS) (Crawford & Henry, 2004; Watson et al., 1988)	✓	✓	✓	✓	✓	✓	✓
Rumination	✓						

Questionnaires	Assessment time points				Assessment time points		
Groups	MG and WL				WL only		
Questionnaire	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Ruminative Response Scale (RRS) (Treynor, Gonzalez, & Nolen-Hoeksema, 2003)							
Suppression White Bear Suppression Inventory (WBSI) (Wegner & Zanakos, 1994)	✓						
Credibility of Treatment Credibility/ Expectancy Questionnaire (CEQ) (Devilly & Borkovec, 2000)	✓						

9.4.6 Diary Card for the study "Mindfulness for Irritable Bowel Syndrome"

MIBS	Participant ID	Week	Diary Card

DEPARTMENT OF EXPERIMENTAL PSYCHOLOGY
Tinbergen Building, 9 South Parks Road, Oxford, OX1 3UD



Please do not hesitate to contact us if you have any questions.

Julia Henrich, **01865 271338;** Alternatively if your query is not urgent you can email ****Julia.Henrich@psy.ox.ac.uk**.**

Dear Study Participant, please complete the diary card each day during MBCT for IBS.
Please write down the date and the type of formal (guided) meditation that you practiced on each day (e.g. Body Scan, Breath and Body, Breathing Space). In the next column please record the time spent on each meditation in minutes. If you did not practise any meditation on a given day please write N/A. Please return this diary card to your mindfulness teacher.

Day	Date	Type of formal meditation practised	Minutes of practice per meditation	Notes
0 (class)				
1				
2				
3				
4				
5				
6				

Chapter 10: References

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