
Functional Gastrointestinal Disorders: Psychological Characteristics

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Statement of Candidate

I certify that the work in this thesis entitle “*Functional Gastrointestinal Disorders: Psychological Characteristics*” has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree to any other university or institution other than Macquarie University.

I also certify that the thesis is an original piece of research and has been conceptualized, implemented, analysed and written by me. Associate Professor Baillie provided statistical support and conceptual feedback while Professor Jones provided conceptual feedback. Any other help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

The research presented in this thesis was approved by the Macquarie University Human Research Ethics Committee, reference numbers: 5201000814 on 11 November 2010 & 5201100583 (D) on 9 August 2011, respectively.

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Thesis Summary

Despite the prevalence and disease burden of Functional Gastrointestinal Disorders (FGIDs), there are still several notable lacunae in the FGID research in terms of clearly classifying them by using a symptom-based approach, and the current psychological models of FGIDs. This thesis compared the patterns of psychological factors between two FGIDs. Additionally, an integrated psychological model of FGIDs was proposed and aspects of it were tested. Specifically, inter-relationships between FGID-specific psychological factors and a potential protective factor were tested. A series of analytical techniques were used.

This thesis is presented in the form of three manuscript style chapters, preceded by a general introduction and followed with a general discussion. The first paper compared the patterns of psychological factors in two FGIDs (Irritable Bowel Syndrome and Functional Constipation), with the intention of expanding scientific knowledge about Functional Constipation, which has received little study. The second paper examined the inter-relationships between FGID-related illness representations, visceral sensitivity and mindfulness skills, and their influence on FGID symptoms and reported symptom severity. The third paper used a case series to examine the dynamic relationships between irritable bowel syndrome symptoms, distress, visceral sensitivity, and negative emotions as a result of an eight-week mindfulness skills training program. This last paper also compared the relative influence of visceral sensitivity versus generic negative emotions on FGID-related distress to ascertain the importance of visceral sensitivity in FGIDs.

The findings from this thesis contribute to the field of FGID research by expanding our understanding of Functional Constipation, which has implications for the psychological treatment available for it. The results in this thesis also validate aspects of an integrated psychological model of FGIDs by increasing our understanding of the psychological factors specific to FGIDs, as well as considering the role of protective factors in FGIDs, which were hitherto unstudied.

Key words: Functional Gastrointestinal Disorders, Irritable Bowel Syndrome, Functional Constipation, Classification, Differentiation Psychological Model

CHAPTER 1.

THESIS INTRODUCTION

1.1 The Need to Understand FGIDs

Despite many research breakthroughs, functional gastrointestinal disorders (FGIDs) remain poorly understood. This is in part because many existing FGIDs have not received adequate scientific study. Additionally, the still gaps in existing models FGIDs, reduce their potential utility in helping us understand FGIDs.

FGIDs refer to a group of bowel syndromes characterized by the dysregulation of normal bowel functions (Jones, Crowell, Olden, & Creed, 2007) with no apparent pathophysiological causes such as bowel cancer, bowel trauma or inflammatory bowel diseases that the “architecture” of the gastrointestinal tract (Jones et. al., 2007). Examples of FGIDs include irritable bowel syndrome (IBS), functional constipation (FC), and functional dyspepsia (FD), among others (Talley, 2008).

While not life-threatening, FGIDs are very prevalent in both developing and developed communities (Talley, 2008). For instance, Talley (2008) reviewed research showing that 42% of the Minnesota populace reported one or more FGIDs over a 12year period. Additionally, 69% of American householders reported having at least one FGID. Further, Chang and Jones (2003) demonstrated that about 4 – 22% of the population met the criteria for IBS. Similarly, Selby and Corte (2010) found that the prevalence of chronic functional constipation ranged from 6 – 30%. While different diagnostic criteria contribute to the wide range of prevalence in these studies, it is undeniable that FGIDs are prevalent across the world.

The disease burden of FGIDs, including its direct and indirect cost, as well as quality of life compromise, is also very high (Talley, 2008). For instance, Talley highlighted a systematic review which indicated that people with IBS took 8.5 – 21.6 days off from work per annum, and this was associated with reduced productivity equivalent to having worked

less than 4 days a week (Talley, 2008). Additionally, the medical costs associated with FGID healthcare-seeking was around US\$8750 per person in 2002 (Talley, 2008). IBS and FD also affect the quality of life of sufferers, with research showing that these disorders impacted negatively on both the physical and mental well-being of sufferers (Talley, 2008). Taken together, the disease burden and prevalence of FGIDs signal the need to better manage these bowel syndromes. Better management follows from a better understanding of FGIDs.

This thesis aims to address two inter-related issues in FGIDs research:

1. The similarities and differences between functional constipation and irritable bowel syndrome in terms of psychological factors.
2. The gaps in current psychological models of FGIDs. These include the lack of consideration of FGID-specific psychological factors, the impact of generic emotional processes, and the lack of consideration of the role of protective factors. An integrated psychological conceptualization of FGIDs which accounts for some of these gaps will be proposed, and aspects of it tested.

1.2 Comparing Functional Constipation and Irritable Bowel Syndrome

Despite its prevalence and high disease burden, little is known about functional constipation (FC), in particular, its relationship with psychological factors. An area of lacuna involves the relationship between FC Psychological factors have been found to play important roles in the development, maintenance, complication of some other FGIDs (Deary, Chalder, & Sharpe, 2007; Jones et. al., 2007; Oudenhove et. al., 2007). Studies have also found that psychological factors can result from these FGIDs (O'Mahony et. al., 2009). However, studies investigating the role of psychological factors in FC are limited compared

to other FGIDs (Selby & Corte, 2010). Overall, little is understood about FC, limited psychological and medical treatment options for it.

This observation has been echoed by other researchers. For instance, Brook and colleagues' (2000) review indicated a very limited repertoire of non-medical treatment options for FC. A literature search also found that existing psychological interventions for constipation are only behavioural mainly take the form of biofeedback training (Wald, 2007) and behavioural modification (Dijk et. al., 2007). The evidence surrounding the effectiveness of these treatments in FC remains conflicted

biofeedback training for example, some studies argue that its effects are limited to those whose constipation is maintained by pelvic floor muscular dysfunction, which is an organic disorder (Chiarioni, Salandini & Whitehead, 2005). Others argued that it is effective for other types of constipation slow-transit constipation Emmanuel & Kamm, 2001). Likewise, while some have recommended behavioural modification techniques in the treatment of constipation (Dijk et. al, 2007), others that called into question its effectiveness (Dijk et. al, 2008; Emmanuel & Kamm, 2001). With regards to dietary, medical and pharmacological treatments available for chronic constipation, Selby and Corte (2010) suggested increasing fibre and water intake as a preliminary measure to improving bowel movement, but stated that these might not necessarily be effective. The next tier option recommended by them pharmacological agents such as bulking agents, Lactulose, Magnesium Sulfate, Sorbitol liquid, Sodium Phosphate, Sodium Picosulfate, stool softeners, stimulant laxatives, rectal laxatives and lubricants (Selby & Corte, 2010). However, the authors also highlighted the paucity of evidence surrounding the efficacy and tolerability of these pharmacological agents.

Conversely, other FGIDs have received considerable research in terms of their relationship with various psychological factors (Deary, Chalder, & Sharpe, 2007; Jones, Schettler, Olden & Crowell, 2004) and mental disorders (Drews & Hazlett-Stevens, 2008), as well as the types of treatment options available to them. IBS in particular, has received the greatest scientific and clinical attention. The repertoire of treatment options for IBS is also much wider. For instance, Brandt and colleagues (2009) provided a very thorough review of the effectiveness of a plethora of medical, psychological and alternative medicine approaches for IBS. Medical treatments include anti-spasmodics, bulking agents, laxatives, dietary fibre, anti-diarrhoeals, antibiotics, 5HT₃ receptor antagonists, amongst others. Psychological treatments include Cognitive Behavioural Therapy (Lackner et. al, 2004), hypnosis (Blanchard, 2001), relaxation training (Keefer & Blanchard, 2001), and so forth. Alternative medicine approaches include acupuncture and herbal therapies.

The psychological interventions for IBS, which are of particular interest in this thesis, have received fairly robust empirical support (Blanchard, 2001; Lackner et. al, 2004). The latest research findings also provide preliminary support for the effectiveness of mindfulness training with exposure therapy in improving IBS symptoms (Ljotsson, Andreewitch et. al, 2010; Ljotsson, Falk et. al, 2010). These researchers developed a three-phase protocol involving psycho-educating participants about their IBS, a brief 15-minute mindfulness practice period to be practiced daily as homework, and eventually interoceptive exposure to symptoms combined with mindfulness practice (Ljotsson, Andreewitch et. al, 2010). Thus, in terms of its association with psychological factors or its range of treatments, FC appears to be a much neglected FGID compared to IBS.

There is recent debate that FC and IBS are variants of the same syndrome (Wong et. al., 2010). Although this remains a contentious issue, a comparison of the psychological factors between IBS and FC would nonetheless be valuable in aiding the development of

treatment options for FC. Specifically, should these psychological factors be similar in both syndromes, this will imply that the psychological treatments effective for IBS can be applied to FC, thus expanding the treatment repertoire for FC. Thus, this thesis as an initial exploratory effort to understanding FC better.

1.3 Models of FGIDs

There have been many attempts at explaining how FGIDs develop and perpetuate from the psychological perspective (Deary, Chalder, & Sharpe, 2007; Jones et. al., 2007). Many studies have also examined the correlation between FGIDs and psychological factors (Drews & Hazlett-Stevens, 2008). Oftentimes, psychological models strive to tie together the various psychological factors associated with FGIDs, and to identify the core psychological process(es) amongst these factors which contribute significantly to the development, precipitation and maintenance of FGIDs (Lackner, Morley, Dowzer, Mesmer, & Hamilton, 2004; Westbrook, Kennerly, & Kirk, 2011). This section will review the prominent psychological theories and models of FGIDs, and the research support for these models, as well as their limitations. These models include:

1. The Bio-Psycho-Social (BPS) Model of FGIDs (Jones et. al., 2007; Tanaka, Kanazawa, Fukudo & Drossman, 2011)
2. The Cognitive Behavioural (CB) Model of FGIDs (Deary et. al., 2007)
3. The Dual Etiology Model (Wilhelmsen, 2005)

1.3.1 The Bio-Psycho-Social Model

There have been several Bio-Psycho-Social (BPS) models proposed to explain the functioning of FGIDs (Gaynes, & Drossman, 1999; Jones et. al., 2007). These models

attempt to integrate and/ or incorporate physiological elements with psychological and socio-cultural factors in explaining how FGID symptoms develop and are maintained (Jones, Koloski, Boyce, & Talley, 2011; Tanaka et. al., 2011). The predominant processes in FGIDs proposed by these models are nervous system changes resulting from complex interactions between psychological and social factors (Levy a al., 2006; Jones et. al, 2007).

A Bio-Psycho-Social model generally involves an elaboration of how genetic factors and childhood learning experiences such as exposure to stressors, social learning and social support combine to predispose the development of functional bowel abnormalities, for example, motility problems and nociceptive sensitization, and psychological distress (Gaynes & Drossman, 1999). Specifically, functional abnormalities are exacerbated by psychological distress (and/ or psychiatric disorders), maladaptive stress response (Gaynes, & Drossman, 1999; Tanaka et. al., 2011) and socio-contextual factors such as divorce, abuse, life changes, via the changes in gut-specific autonomic functioning (Levy a al., 2006). Overall, a key feature of BPS models is their focus on the way psychological and social factors interact mutually with and through biological pathways to produce FGID symptoms.

Recent research has proposed that the brain-gut axis, which involves a central nervous system-enteric nervous system link (Koloski et al., 2012; O'Mahoney et. al., 2009), is the central biological pathway through which all these psychological, social and other biological factors interact to produce FGID symptoms. The brain-gut axis consists of many mutually interacting biological micro-processes such as hormonal changes and altered immune responses, to name a few (O'Malley et. al., 2011). Activations of brain centers associated with emotional responding and stress will be channeled down the central nervous system to the enteric nervous system via these biological micro-processes. This will activate gastrointestinal changes. Likewise, changes in gastrointestinal functions are routed back up/communicated along the enteric nervous system to the brain via chemical pathways, as

well as psychological processes such as vigilance to visceral sensations (Craske et. al., 2011; Mayer, 2000). Figure 1.1 provides a summary of the BPS models.

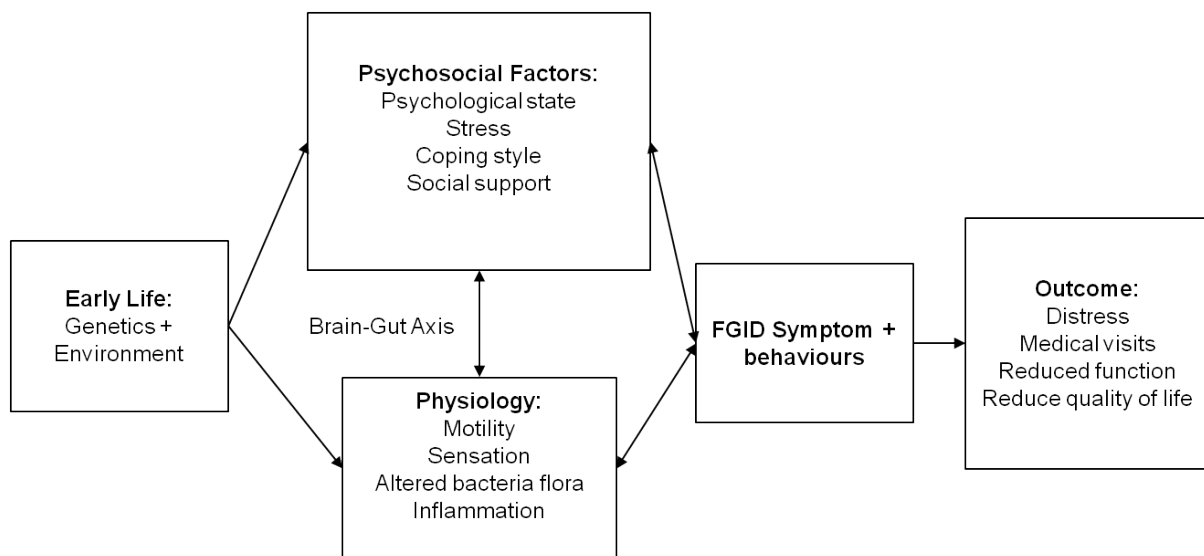


Figure. 1.1 The BioPsychoSocial model of FGIDs. Adapted from Tanaka et. al., (2011)

Evidence base

Aspects of the BPS models have received empirical support. In particular, research into the brain-gut axis has provided preliminary support for the biological pathways in the BPS models. For instance, O'Mahony and colleagues (2009, 2011) demonstrated that baby rats forcefully separated from their mothers- a highly distressing event, developed IBS-like symptoms. Autopsies also revealed changes in neurological pathways along the brain-gut axis.

While the specific biological processes within the brain-gut axis are still elusive, certain pathways have been proposed and empirically tested. For instance, Levy and colleagues (2006) reviewed research supporting the involvement of neuroendocrine pathways in the psychology-to-bowel symptom translation process (including changes in how corticotrophin-releasing factors, cortisol, norepinephrine and epinephrine are released) when an individual becomes affectively activated. Likewise, O'Malley and colleagues (2011)

provide a comprehensive review of studies investigating the biological micro-processes that are implicated in the brain-gut axis functioning. Their review indicated that stress-induced HPA dysregulation is associated with elevated cytokine levels, which result in inflammatory reactions in the gut. These results support the role of the brain-gut axis as a physiological mediating mechanism between psychological factors and symptoms.

In terms of the connection between psychological factors and the brain-gut axis, there is some research support for various proposed pathways. For instance, O'Malley, Quigley, Dinan, and Cryan's (2011) review of the research indicated that maladaptive stress responses play a part in activating or exacerbating IBS symptoms. Specifically, the studies they reviewed showed an association between stress and changes in immune responses, which in turn aggravated IBS symptoms. There is also evidence that hormonal changes due to stress, specifically, changes in corticotropin release factor, mediates changes gastrointestinal functions (O'Malley, Quigley, Dinan, & Cryan, 2011), which implicates the relationship between stressors and the brain-gut axis.

Likewise, Mayer's (2000, 2001) papers detailed the various empirically studied biological pathways through which long-term stress results in permanent changes in the brain-gut axis, which he termed "allostatic load". For instance, he reviewed research showing that stress-related changes in the autonomic (vagal) regulation of gut motility mediated changes in bowel functioning.

Perhaps more indirectly, Koloski and colleagues' (2012) study provided some support for the link between emotions and gastrointestinal symptoms across time. Their findings led the authors to conclude that the relationship between the nervous system, as reflected in emotions, and the gut, as reflected in IBS symptoms, is bidirectional. This provides some support for the mutual relationship between biological and psychological factors as conceptualized in the BPS models.

However, while animal model research has suggested that early life stressors result in the development of brain-gut axis abnormalities, the link between early traumatic experiences as proposed by some versions of the BPS model, and the development of FGID symptoms in humans, is less clear-cut. For example, Oudenhove and Aziz's (2009) review of prospective and retrospective studies on childhood abuse experiences and IBS symptoms produced mixed results. Some studies showed no association between a history of abuse and rectal sensitivity, while others demonstrated otherwise. Additionally, Oudenhove and Aziz (2009) found that sexual abuse, but not physical abuse, was related to gastric hypersensitivity in FD sufferers. Overall, these findings suggest that the role of early abuse in the development of FGID symptoms remains unclear.

Despite these uncertainties, the BPS models have their strengths. In particular, these models incorporate various physiological pathways that may explain the production of FGID symptoms, for example, the brain-gut axis, and acknowledge its interaction with psychological and social factors to produce or perpetuate FGID symptoms. However, the BPS model does not take into account potential protective factors that might mitigate the FGID symptoms, and how these protective factors might moderate the various psycho-social factors that contribute to FGID symptoms.

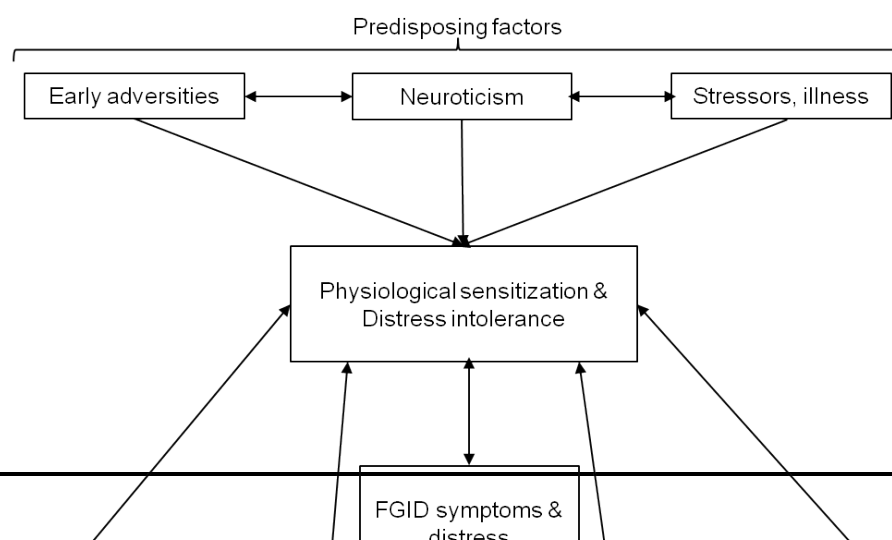
1.3.2 The Cognitive Behavioural model

The Cognitive-Behavioural (CB) models of FGID can be considered an expansion of the BPS model with a greater focus on, and wider inclusion of psychological factors, some of which are specific to FGIDs (Kennedy et. al., 2012). Like the BPS models, there are several variants of the CB model of FGIDs. The main foci of these models are negative cognitive processes such as negative cognitive appraisal (on bowel symptoms, stressors, the consequences of having and FGID, one's ability to cope, and so forth), pain catastrophization

and hypervigilance to abdominal sensations, and their effects on symptom-related anxiety. These in turn have a physiological effect on symptoms (Lackner et. al., 2004). Somatization is another psychological process involved in FGIDs (Kennedy et. al., 2012). Recently, researchers have drawn from medically unexplained syndrome (MUS) research to expand on the CB model of FGIDs. This effort is based on the assumption that FGIDs, like IBS, are also MUS (Deary et. al., 2007).

One often cited model is that proposed by Deary and colleagues (2007). This model expands on the CB model by including the roles of predisposing factors such as (the contentious contribution of) early abuse experiences (Oudenhove & Aziz, 2009), biological events (e.g., illness) and a neurotic personality trait, maladaptive behaviours such as avoidance behaviours, and “socio-cultural” influences such as the patient-doctor interaction. Most of these additional elements have received some empirical support validating their roles in MUS (Deary et. al., 2007). This will be elaborated below.

Adding to the standard CB models, some researchers have incorporated other psychological factors such as distress intolerance, coping style, illness behavior and social support (Deary et. al., 2007). For them, the symptoms of FGIDs are not maintained by a single bio-psycho-social element. Rather, the core (maintaining) psychological processes in the CB model are the multiple reciprocal feedback loops between all elements. This allows the FGID to be self-sustaining, a process they coined “autopoiesis” (Deary et. al., 2007). Figure 1.2 summarizes this expanded CB model.



Evidence base

There is a good evidence base for the role of various psychological factors proposed in the CB model. Some researchers highlight the importance of personality factors such as neuroticism and their contribution to the emotional aspects of FGIDs/ IBS (De Gucht et. al., 2004). For example, Jones, Schettler, Olden and Crowell (2004) showed that individuals scoring high on alexithymia (another personality trait) tended to over-report visceral symptoms (somato-sensory amplification).

Other researchers demonstrate the significance of psychological factors such as hypervigilance, somatization, and catastrophizing. For instance, Kennedy and colleagues (2012) reviewed several laboratory studies which consistently found that IBS sufferers tended to recall more bowel sensation words than healthy controls, when an ‘emotional word recall paradigm’ was used. This provided support for the presence of hypervigilance towards bowel sensations in IBS sufferers. Similarly, Tilburg, Palsson, and Whitehead (2013) found in their path analysis that somatization and catastrophization predicted IBS symptom severity.

Additionally, Drews and Hazlett-Stevens (2008) found that cognitive processes such as excessive worrying commonly found in generalized anxiety disorder was also present in sufferers of IBS. Further, the effectiveness of Cognitive-Behavioural treatments (CBT) for IBS provides indirect support for the role of the psychological factors it emphasizes (Jones, Koloski, Boyce, & Talley, 2011). For instance, Lackner and colleagues (2006) found that Cognitive Therapy which targets cognitive appraisals of bowel symptoms, stressors, perceived consequences of having IBS and perceived ability to cope with IBS, resulted in changes in limbic activity, anxiety levels and also gastrointestinal symptoms of IBS sufferers. Jones and colleagues (2011) found that a possible pathway through which CBT works, involves changes in emotions as a result of cognitive changes. Emotional changes lead to reduction in bowel symptoms. This pathway of change mimics one of the proposed CB model pathways. These studies implicate the role of psychological factors such as cognitive appraisals in FGIDs, providing support for the CB model.

Compared to the BPS models which highlight the role of physiological processes, the CB models tend to emphasize the role of psychological factors and processes in FGIDs. The strength of the CB model is that it encompasses the roles and inter-relationships of several psychological processes. This allows it to account for a variety of psychological presentations in the diverse FGID population.

However, the CB model argument that everything is inter-related and mutually influential reduces the unique contribution and centrality of specific psychological factors. In short, because everything is linked, removing some psychological factors from the equation would likely not affect the perpetuation of FGID symptoms. If important psychological processes such as cognitive appraisals can be removed without affected the overall FGID presentation, the extended CB model runs the risk of becoming too generic and might miss out specific psychological processes that are more influential in the maintenance of FGIDs.

1.3.3 The Dual-Etiology Model

Wilhelmsen (2005) hypothesized a model of Functional Somatic Syndromes such as FGIDs that attempted to explain the relative influences of biological factors as reflected in the Bio-Psycho-Social models and psychological factors as reflected in the CB models in symptom presentation and distress. The central argument in this model is that the FGID symptoms of some individuals are more influenced by biological factors whilst those of other individuals are more affected by psychological factors.

Wilhelmsen (2005) proposed that sensitization is the process by which biological or psychological processes work to increase symptoms. This process refers to the increased activation of the central nervous system involved in symptom production, which can be triggered by biological factors (as in visceral hyperalgesia) or amplified by psychological processes such as hyper-vigilance to bodily sensations. Based on his literature review and research which showed that individuals suffering from IBS with comorbid psychiatric, personality and adverse life experiences had more extra-intestinal symptoms, he further proposed that biological and psychological factors influenced each other in FGIDs (Wilhelmsen, 2005).

According to Wilhelmsen (2005), various psychological processes such as catastrophizing, taking on the sick role (illness behavior), the experience of life stressors, and obsessive scanning of normal visceral sensations can serve to amplify the biological sensitization involved in symptom production. This is consistent with what Jones and colleagues (2004) found – personality traits like alexithymia increased the tendency to engage in somato-sensory amplification in functional dyspepsia sufferers. Moreover, biologically sensitized symptoms are in themselves stressors, which would further exacerbate psychological amplification. Seen in this light, the Dual Etiology hypothesis combines the

BPS and CB models with sensitization in the CNS as a core process. Recent studies have supported the important role of the CNS in FGIDs, and the complex relationship it has with psychological processes (Oudenhove & Aziz, 2009).

Evidence base

Unfortunately, the Dual Etiology model has not received much empirical support. While some research supports the concept of sensitization (Jones et. al., 2004), the hypothesis that some FGID sufferers tend to be affected more by biological factors whilst others by psychological factors remains to be validated (Wilhelsem, 2005). Nonetheless, the strength of this model lies in its attempts to explain the link between biological and psychological processes, although this link remains somewhat vague. It is plausible that different psychological processes will have different relationships or pathways with different physiological processes. The complexity underlying these relationships has been reviewed by Oudenhove and Aziz (2009). In short, vagueness in this model reduces its explanatory power.

1.3.4 Overall Shortcomings of These Models

No single model can capture the full picture of how and why FGIDs occur. Each provides useful pieces of the puzzle, as demonstrated by the review of the three main models above. However, all these models have important limitations, namely:

1. They have not considered “newer” psychological processes that are specific to FGIDs, which might play a crucial role in the development or maintenance of symptoms.
2. They do not factor in the contribution of comorbid mental illness or generic emotions.

3. They do not consider protective factors that might mitigate FGID symptom severity.

Therefore, this thesis seeks to address these gaps. Notably, recent research has identified “new” psychological factors and processes specific to FGIDs. These have the potential to improve our understanding of the development and maintenance of FGID symptoms but have not been incorporated into the existing psychological models reviewed above. Examples of such psychological factors include visceral sensitivity (Labus, Mayer, Chang, Bolus, & Naliboff, 2007; Craske et. al., 2011) and illness representations focused on FGID (Rutter & Rutter, 2002; Riedl et. al., 2009). Recent work suggests that these factors might play important roles in maintaining or affecting FGID symptoms and distress (Craske et. al, 2011; Riedl et. al., 2009). However, the inter-relationships between these psychological factors and their contribution to FGID outcomes have yet to be studied. This is the aim of Chapter 3, which seeks to expand the existing psychological models of FGIDs by including the roles of visceral sensitivity and illness representations.

Following that, Chapter 4 explores the neglected role of comorbid mental illness and generic emotions in FGID symptomology. Existing models focus only on the psychological processes that produce FGID symptoms and neglect the additional influences of generic emotions and mental illnesses such as anxiety disorders. However, research indicates that these do play a part. For example, Wilhelmsen(2005) found that different mood states resulted in changes in colonic motility. Other researchers (e.g., Drews & Hazlett-Stevens, 2008) found that generalized anxiety disorder and psychological processes involved in anxiety disorders, for example worrying and experiential avoidance, were closely associated with the endorsement of ROME II criteria for IBS in a sample of undergraduate students. Similarly, Gros and colleagues (2009) found that IBS symptoms were significantly higher in

people who suffered from panic disorder, generalized anxiety disorder and depression, while those who suffered from obsessive-compulsive disorder and social anxiety reported frequency of IBS symptoms similar to non-anxious populations. Chang and Jones (2003) reported that depression and somatoform disorders occurred in a significant proportion of IBS sufferers.

Anxiety also seems to be associated with other FGIDs including Functional Dyspepsia. For instance, Oudenhove and colleagues (2007) found an inverse relationship between anxiety levels and pain and discomfort thresholds amongst sufferers of hypersensitive Functional Dyspepsia. In particular, higher levels of anxiety were associated with lowered pain and discomfort thresholds.

While existing psychological models of FGIDs acknowledge that generic emotional states and mental illness have a role in FGIDs, they do not consider how these psychological factors might interact with the FGID-specific psychological processes to moderate symptom production and the experience of distress. These models also do not consider the relative influence of generic emotional states or mental illnesses on FGID outcomes, compared with the FGID-specific psychological factors. Chapter 4 will explore these aspects in detail.

Lastly, as demonstrated in the current literature review, all the existing models are pathological explanations of FGIDs and fail to take into account protective factors in FGIDs. This is significant because certain psychological processes might increase resilience towards FGID symptoms, protect an individual from symptom development or exacerbation, improve FGID symptoms and reduce the associated distress. These impact on an individual's quality of life and should thus be taken into consideration.

This proposition is supported by clinicians and researchers who argue that distress or pain or symptom reduction does not necessarily equate to well-being/ functional *enhancement* – that is, correcting what is wrong might not equate to making things better,

only in making things neutral (Gable & Haidt, 2005). Indeed, the World Health Organization cautioned that health is not defined by a mere absence of disease or dysfunction (World Health Organization, 2011). This view questions the utility of focusing merely on symptom reduction, and lends greater weight to the importance of protective factors in the experience of FGIDs, and more importantly, the maintenance of health.

Similarly, the Positive Psychology literature argues that positive psychological processes might have prevention, speedy recovery and functional enhancement effects (Gable & Haidt, 2005). They refer to these psychological factors as “distal buffers to mental illness” (Gable & Haidt, 2005; p. 106). From a relapse prevention perspective, the literature indicates that mindfulness might serve to prevent relapse of depression in those suffering from chronic and recurrent depression (Segal, Williams & Teasdale, 2002). From a recovery perspective, studies show that experiencing more positive emotions results in speedier recovery from the effects of negative emotional experiences (Garland et. al., 2010). This suggests that positive emotions act as protective factors against the impact of negative experiences. Given that negative emotions are closely associated with, and contribute to, FGID symptoms (Wilhelmsen, 2005), it is important to consider factors that might aid in speedier recovery from FGIDs “flare-ups” by de-activating negative emotional processes.

In sum, existing psychological models of FGIDs, while providing important information about the mechanisms involved in symptom production and maintenance, have not focused on “new” psychological processes specific to FGIDs. Neither have they considered how generic emotions and co-morbid mental illnesses might complicate FGID symptoms, nor the role of protective factors in FGIDs. The current research addresses these limitations by proposing an integrated model that offers a more holistic perspective of FGIDs.

1.4 A Proposed Integrated Psychological Model

Based on the literature reviewed, a psychological model of FGIDs was proposed which will integrate the key elements in the existing models along with the “newer” FGID-specific psychological factors and a potential protective factor. This integrated model will expand the understanding of FGIDs and it is presented in Figure 1.1 below.

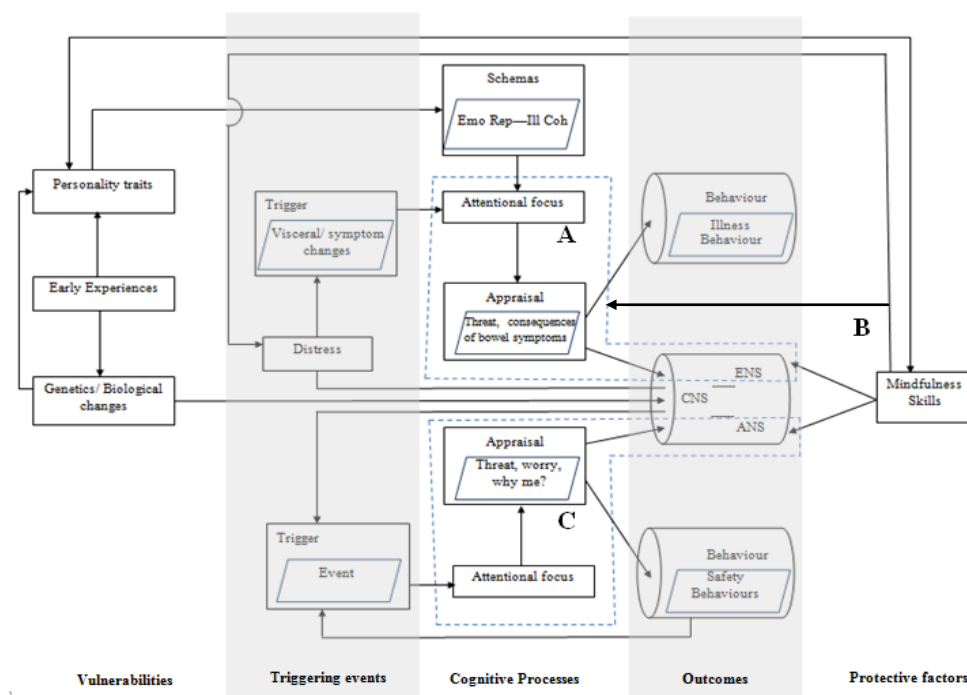


Figure 1.3 The proposed Integrated Psychological model of FGIDs. Part A refers to the psychological processes unique to FGIDs, including illness schemata and visceral sensitivity. Visceral sensitivity comprises of an attention, appraisal and central-enteric nervous system (CNS-ENS) arousal components – forming gut-specific anxiety. Part B refers to protective factors, in this case mindfulness skills, and possible paths of influence. Part C refers to the generic psychological processes in emotions and mental illnesses co-morbid with FGIDs. Similar to Part A, emotion comprises of attention, appraisal and central-autonomic nervous system (CNS-ANS) arousal components.

The aim of this integrated model is to expand on existing models of FGIDs by incorporating “new” psychological factors and a potential protective factor into current models. It is hoped that by closely examining this subset of psychological factors and their mutual interaction, their role in affecting FGID symptoms and distress can be clarified

Although ideal, it is beyond the scope of this thesis to provide an all-encompassing model that incorporates an exhaustive list of psychological factors. It is thus acknowledged that this integrated model is incomplete in itself, as it does not include other important psychological factors such as self-efficacy, coping styles, social support and stress (Deary et. al., 2007, Tanaka et. al., 2011). Instead, the current model focuses on psychological factors pertaining to more internal and “emotional” aspects of FGIDs. This is of particular interest because the relationships between these factors have not been studied previously, and thus warrants greater attention. Doing so provides a stepping stone for the future development of a more comprehensive model.

Within the integrated model, the physiological and psychological factors are classified as vulnerabilities, triggering factors, cognitive processes, outcomes (behavioural or physiological arousal), and protective factors depending on their role in FGIDs, as described in the existing models or in the literature. Based on the BPS models (Jones et. al., 2007), the nature of social support received by an individual, his early experiences including genetic influences and possible exposure to traumatic events such as child abuse, as well as social learning, all contribute to the development of personality factors such as neuroticism and resultant changes to the brain-gut axis. These vulnerability factors predispose the development of FGID symptoms and have been empirically tested in other models (Deary, et. al., 2007). It is proposed that personality traits might influence the development of core

beliefs. Within the context of FGIDs, neuroticism might facilitate the development of negative core illness schemas/ representations.

With regards to perpetuating psychological and physiological processes, the model proposes that the inter-relationships between triggers, cognitive processes such as schemas, attentional focus and appraisal, activation or sensitization of the nervous system, and the engagement in specific maladaptive behaviours would maintain or exacerbate the problem i.e., the original triggering event. One of the unique contributions of this model is the separation of perpetuating factors into FGID-specific (see Part A in Figure 1.1) and generic factors (see Part C in Figure 1.1). Referring to Part A of Figure 1.1, illness representations will likely influence visceral sensitivity (here broken down into attentional focus, cognitive appraisal, and physiological arousal processes), setting in motion a series of psychological events that exacerbate or perpetuate distress and FGID symptoms (the psychological amplification argument, Wilhelmsen, 2005). Part C of Figure 1.1 explains the contribution of generic emotional states and mental illnesses in FGIDs. It is proposed that generic negative emotional processes in Part C will influence FGID symptoms by activating the central – autonomic - enteric nervous system (based on research by Oudenhove & Aziz, 2009; Wilhelmsen, 2005).

Referring to Figure 1.1, it should be noted that both generic and FGID-specific processes (see Parts A & C of Figure 1.1) are similar but the contents differ i.e., generic negative mood content versus FGID related appraisal content. Importantly, visceral sensitivity is considered to comprise three dynamic processes - attentional focus, appraisal of bowel sensations, and the central and enteric nervous system arousal, in this model. However, these processes might not be captured in a cross-sectional measurement by a psychometric single instrument. These dynamic processes combine to form the subjective experience of gut-related anxiety (Jones et. al., 2007). Likewise for Part C of Figure 1.1, the

subjective experiences of attentional focus, appraisal and physiological arousal are considered to constitute general negative emotion states such as anxiety or depressed mood, along a continuum of severity from non-clinical to clinical levels.

Finally, protective factors (in this case mindfulness skills; see Part B Figure 1.1) are posited to work by regulating generic negative emotions, gut-related anxiety, symptom related distress and the influence of neuroticism on the cognitive processes. This mindful regulation would then positively impact FGID symptoms. Additional features in this integrated model include illness representations, visceral sensitivity, mindfulness skills and the relationships amongst them and other existing factors. These additional factors will be explored in depth in Chapters 3 and 4.

1.5 Chapter Road Map

The aims of this thesis are to compare the psychological factors between two similar FGIDs, and to validate aspects of the integrated psychological model presented above. A combination of cross-sectional and case study research designs are planned for this thesis. It is hoped that the cross-sectional design will provide a broad picture of the research questions while the case study design will provide a deeper and more nuanced perspective that is otherwise missed by a cross-sectional design.

This thesis will examine the relationship between psychological factors and FGIDs from three different angles, so as to answer three key questions:

Question 1: How similar or different are Irritable Bowel Syndrome and Functional Constipation psychologically?

Question 2: What are the roles of illness representations, visceral sensitivity and mindfulness skills in FGIDs (Parts A & B of Figure 1.1)?

Question 3: How do mindfulness skills, as a protective factor, work on FGIDs in actual clinical practice and how important is visceral sensitivity to FGIDs, compared to generic negative emotions (Parts A vs C and examining Part B of Figure 1.1)?

Each question will be addressed in a standalone paper presented in the form of a journal article manuscript. The first paper (Chapter 2) seeks to answer Question 1 by comparing the psychological factors associated with IBS and FC. The second paper (Chapter 3) will address Question 2 by proposing and examining the roles of FGID-specific psychological processes and their inter-relationships as outlined in the integrated model.

The third paper (Chapter 4) will use a case series to examine the dynamic relationships between psychological variables and symptoms, which cannot be achieved by using cross-sectional data. Specifically, it examines the dynamic psychological variables and symptoms across time as a result of mindfulness training conducted in a clinical setting. It seeks to answer Question 3.

Chapter 5 will provide an overall conclusion that summarizes all the findings. It will also identify and discuss the themes examined, including those that arise from the research in the foregoing chapters. Finally, recommendations for clinical practice will be made.

References

- Blanchard, E. B. (2001). Irritable Bowel Syndrome: Psychosocial Assessment and Treatment. Washington, DC: American Psychological Association.
- Brandt, L.J., Chey, W.D., Foxx-Orenstein, A.E., Schiller, L.R., Schoenfeld, P.S., Spiegel, B.M., Talley, N.J., Quigley, E.M.M., Moayyedi, P. (2009). An evidence-based systematic review on the management of irritable bowel syndrome American College of Gastroenterology Task Force on IBS. *Supplement to The American Journal of Gastroenterology*, 104 (Supplement 1), S1 – S35. DOI: 10.1038/ajg.2008.122.
- Brooks, R. C., Copen, R. M., Cox, D. J., Morris, J., Borowitz, S., & Sutphen, J. (2000). Review of the treatment literature for encopresis, functional constipation, and stool-

toileting refusal. *Annals of Behavioral Medicine*, 22(3), 260-267.

DOI: 10.1007/BF02895121

Chang, S.Y., & Jones, M.P. (2003). Consulters and nonconsulters in irritable bowel syndrome: What makes an IBS patient a patient? *Practical Gastroenterology*, 15 – 26. Retrieved from <http://practicalgastro.com/pdf/December03/ChangArticle.pdf>, on 11 September 2011.

Chiarioni, G., Salandini, L., & Whitehead, W. E. (2005). Biofeedback Benefits Only Patients With Outlet Dysfunction, Not Patients With Isolated Slow Transit Constipation. *Gastroenterology*, 129, 86–97. DOI: 10.1053/j.gastro.2005.05.015

Craske, M.G., Wolitzky-Taylor, K.B., Labus, J., Wu, S., Frese, M., Mayer, E.A., & Naliboff, B.D. (2011). A cognitive-behavioral treatment for irritable bowel syndrome using interoceptive exposure to visceral sensations. *Behaviour Research and Therapy*, 49, 413 – 421. DOI: 10.1016/j.brat.2011.04.001.

De Gucht, V., Fischler, B., & Heiser, W. (2004). Neuroticism, alexithymia, negative affect, and positive affect as determinants of medically unexplained symptoms. *Personality and Individual Differences*, 36(7), 1655-1667. DOI: 10.1016/j.paid.2003.06.012.

Deary, V., Chalder, T., & Sharpe, M. (2007). The cognitive behavioural model of medically unexplained symptoms: a theoretical and empirical review. *Clinical Psychology Review*, 27(7), 781 – 797. DOI: 10.1016/j.cpr.2007.07.002

Dijk, M. V., Benninga, M. A., Grootenhuis, M. A., Nieuwenhuizen, A. O., & Last, B. F. (2007). Chronic childhood constipation: A review of the literature and the introduction of a protocolized behavioral intervention program. *Patient Education and Counseling*, 67, 63–77. DOI: 10.1016/j.pec.2007.02.002

- Dijk, M. V., Bongers, M. E. J., Vries, G. D., Grootenhuis, M. A., Last, B. F., & Benninga, M. A. (2008). Behavioral therapy for childhood constipation: a randomized controlled trial. *Pediatrics*(121), 5. DOI: 10.1542/peds.2007-2402
- Drews, A., & Hazlett- Stevens, H. (2008). Relationships between irritable bowel syndrome, generalized anxiety disorder, and worry-related constructs. *International Journal of Clinical Health Psychology*, 8(2), 429- 436. Retrieved from <http://redalyc.uaemex.mx/pdf/337/33712001005.pdf>, on 15 June 2012.
- Drossman, D. A., Creed, F. H., Olden, K. W., Svedlund, J., Toner, B. B., & Whitehead, W. E. (1999). Psychosocial aspects of the functional gastrointestinal disorders. *Gut*, 45(Suppl II), II25–II30. DOI: 10.1053/j.gastro.2005.11.057
- Emmanuel, A. V., & Kamm, M. A. (2001). Response to a behavioural treatment, biofeedback, in constipated patients is associated with improved gut transit and autonomic innervation. *Gut*, 49, 214-219. DOI: 10.1136/gut.49.2.214
- Gable, S.L., & Haidt, J. (2005). What (and why) Is positive psychology? *Review of General Psychology*, 9(2), 103 – 110. DOI: 10.1037/1089-2680.9.2.103.
- Garland, E.L., Fredrickson, B., Kring, A.M., Johnson, D.P., Meyer, P.S., & Penn, D.L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review*, 30(7), 849 – 864. DOI: 10.1016/j.cpr.2010.03.002.
- Gaynes, B.N., & Drossman, D.A. (1999). The role of psychosocial factors in irritable bowel syndrome. *Balliere's Clinical Gastroenterology*, 13(3), 437 – 452. DOI: 10.1053/bega.1999.0038

- Gros, D.F., Antony, M.M., McCabe, R.E., & Swinson, R.P. (2009). Frequency and severity of the symptoms of irritable bowel syndrome across the anxiety disorders and depression. *Journal of Anxiety Disorders*, 23(2), 290 – 296. DOI: 10.1016/j.janxdis.2008.08.004.
- Jones, M., Koloski, N., Boyce, P., & Talley, N. J. (2011). Pathways connecting cognitive behavioral therapy and change in bowel symptoms of IBS. *Journal of Psychosomatic research*, 70(3), 278-85. Elsevier B.V. DOI:10.1016/j.jpsychores.2010.10.004
- Jones, M.P., Schettler, A., Olden, K., & Crowell, M.D. (2004). Alexithymia and Somatosensory Amplification in Functional Dyspepsia. *Psychosomatics*, 45, 508–516. DOI: doi:10.1176/appi.psy.45.6.508
- Keefer, L., & Blanchard, E. B. (2001). The effects of relaxation response meditation on the symptoms of irritable bowel syndrome: results of a controlled treatment study. *Behaviour Research and Therapy*, 39, 801–811. DOI: 10.1016/S0005-7967(00)00078-4
- Kennedy, P.J., Clarke, G., Quigley, E.M.M., Groeger, J.A., Dinan, T.G., & Cryan, J.A. (2012) Gut memories: Towards a cognitive neurobiology of irritable bowel syndrome. *Neuroscience and Biobehavioral Reviews*, 36, 310–340. DOI: 10.1016/j.neubiorev.2011.07.001.
- Koloski, N. A., Jones, M., Kalantar, J., Weltman, M., Zaguirre, J., & Talley, N.J. (2012). The brain-gut pathway in functional gastrointestinal disorders is bidirectional. *Gut*, 61(9), 1284-1290. DOI: 10.1136/gutjnl-2011-300474.
- Labus, J.S., Mayer, E.A., Chang, L., Bolus, R., & Naliboff, B.D. (2007). The central role of gastrointestinal-specific anxiety in irritable bowel syndrome: further validation of the

- visceral sensitivity index. *Psychosomatic Medicine*, 69(1), 89 – 98. DOI: 10.1097/PSY.0b013e31802e2f24
- Lackner, J. M., Coad, M.L., Mertz, H.R., Wack, D.S., Katz, L.A., Krasner, S.S., Firth, R., Mahl, T.C., & Lockwood, A.H. (2006). Cognitive therapy for irritable bowel syndrome is associated with reduced limbic activity, GI symptoms, and anxiety. *Behaviour research and therapy*, 44(5), 621 – 638. DOI: 10.1016/j.brat.2005.05.002
- Lackner, J. M., Morley, S., Dowzer, C., Mesmer, C., & Hamilton, S. (2004). Psychological Treatments for Irritable Bowel Syndrome: A Systematic Review and Meta-Analysis. *Journal of Consulting and Clinical Psychology*, 72(6), 1100–1113. DOI: 10.1037/0022-006X.72.6.1100.
- Levy, R.L., Olden, K.W., Naliboff, B.D., Bradley, L.A., Francisconi, C., Drossman, D.A., & Creed, F. (2006). Psychosocial aspects of the functional gastrointestinal disorders. *Gastroenterology*, 130, 1447 – 1458. DOI: 10.1053/j.gastro.2005.11.057
- Ljotsson, B., Andreevitch, S., Hedman, E., Ruck, C., Andersson, G., & Lindefors, N. (2010). Exposure and mindfulness based therapy for irritable bowel syndrome--an open pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, 41(3), 185 – 190. DOI: 10.1016/j.jbtep.2010.01.001
- Ljotsson, B., Falk, L., Vesterlund, A.W., Hedman, E., Lindfors, P., Ruck, C., Hursti, T., Andreevitch, S., Jansson, L., Lindefors, N., & Andersson, G. (2010). Internet-delivered exposure and mindfulness based therapy for irritable bowel syndrome--a randomized controlled trial. *Behaviour Research and Therapy*, 48(6), 531 - 539. DOI: 10.1016/j.brat.2010.03.003

- Mayer, E.A. (2000). The neurobiology of stress and gastrointestinal disease. *Gut*, 47, 861-869. DOI:10.1136/gut.47.6.861.
- Mayer, E. A., Naliboff, B. D., Chang, L., & Coutinho, S. V. (2001). Stress and the Gastrointestinal Tract V. Stress and irritable bowel syndrome. *American Journal of Physiology, Gastrointestinal and Liver Physiology*, 280, G519–G524.
- O’Mahony, S. M., Hyland, N.P., Dinan, T.G., & Cryan, J.F., (2011). Maternal separation as a model of brain–gut axis dysfunction. *Psychopharmacology*, 214, 71–88. DOI 10.1007/s00213-010-2010-9.
- O’Mahony, S.M., Marchesi, J.R., Scully, P., Codling, C., Ceolho, A., Quigley, E.M.M., Cryan, J.F., & Dinan, T.G. (2009). Early life stress alters behavior, immunity, and microbiota in rats: Implications for Irritable Bowel Syndrome and psychiatric illnesses. *Biological psychiatry*, 62(3), 263 – 267. DOI: 10.1016/j.biopsych.2008.06.026
- O’Malley, D., Quigley, E.M.M., Dinan, T.G., & Cryan, J.F., (2011). Do interactions between stress and immune responses lead to symptom exacerbations in irritable bowel syndrome? *Brain, Behavior, and Immunity*, 25, 1333–1341. DOI: 10.1016/j.bbi.2011.04.009.
- Oudenhove, L.V., & Aziz, Q. (2009). Recent insights on central processing and psychological processes in functional gastrointestinal disorders. *Digestive and Liver Disease*, 41(11), 781 – 787. DOI: 10.1016/j.dld.2009.07.004.
- Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health

Organization, no. 2, p. 100) and entered into force on 7 April 1948. Retrieved from <http://www.who.int/about/definition/en/print.html> on 23 Oct 2010, on 10 October 2012.

Riedl, A., Maass, J., Fliege, H., Stengel, A., Schmidtman, M., Klapp, B.F., & Monnikes, H. (2009). Subjective theories of illness and clinical and psychological outcomes in patients with irritable bowel syndrome. *Journal of Psychosomatic Research*, 67(5), 449 – 455. DOI: 10.1016/j.jpsychores.2009.02.001.

Rutter, C.L., & Rutter, D.R. (2002). Longitudinal analysis of the illness representation model in patients with irritable bowel syndrome (IBS). *Journal of Health Psychology*, 12(1), 141 - 148. DOI: 10.1177/1359105307071748.

Segal, Z.V., Williams, J.M.G., & Teasdale, J.D. (2002). *Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse*. New York: The Guilford Press.

Selby, W, & Corte, C. (2010). Managing constipation in adults. *Australian Prescriber*, 33(4), 116 – 119. Retrieved from <http://www.australianprescriber.com/magazine/33/4/116/9>, on 10 June 2012

Talley, N.J. (2008). Functional gastrointestinal disorders as a public health problem. *Neurogastroenterology & Motility*, 20(Suppl 1), 121 – 129. DOI: 10.1111/j.1365-2982.2008.01097.x

Tanaka, Y., Kanazawa, M., Fukudo, S., & Drossman, D.A., (2011). Biopsychosocial model of irritable bowel syndrome. *Journal of Neurogastroenterology and Motility*, 17(2), 131 – 139. DOI: 10.5056/jnm.2011.17.2.131.

- Tilburg, M.A.L.V., Palsson, O.S., & Whitehead, W.E. (2013). Which psychological factors exacerbate irritable bowel syndrome? Development of a comprehensive model. *Journal of Psychosomatic Research*, <http://dx.doi.org/10.1016/j.jpsychores.2013.03.004>.
- Wald, A. (2007). Chronic constipation: advances in management. *Neurogastroenterology and Motility*, 19, 4-10. DOI: 10.1111/j.1365-2982.2006.00835.x
- Westbrook, D., Kennerly, H, & Kirk, J. (2011). *An Introduction to Cognitive Behaviour Therapy: Skills and Applications (2e)*. London: SAGE Publications Ltd.
- Wilhelmsen, I. (2005). Biological sensitisation and psychological amplification: Gateways to subjective health complaints and somatoform disorders. *Psychoneuroendocrinology*, 30(10), 990 – 995. DOI: 10.1016/j.psyneuen.2005.01.011
- Wong, R.K., Palsson, O.S., Turner, M.J., Levy, R.L., Field, A.D., Korff, M.V., & Whitehead, W.E. (2010). Inability of the Rome III criteria to distinguish functional constipation from constipation-subtype irritable bowel syndrome. *The American Journal of Gastroenterology*, 105(10), 2228- 2234. DOI: 10.1038/ajg.2010.200

Running head: COMPARING IBS AND CONSTIPATION PSYCHOLOGICALLY

CHAPTER 2.

**IRRITABLE BOWEL SYNDROME AND FUNCTIONAL
CONSTIPATION: PSYCHOLOGICAL SIMILARITIES AND
DIFFERENCES.**

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ABSTRACT

Introduction: Functional chronic constipation (FC) is an overlooked functional gastrointestinal disorder (FGID) that carries a high disease burden. FC and irritable bowel syndrome (IBS) have been found to present with similar symptoms. An exploration of patterns of psychological factors between these syndromes has implications for the expansion of psychological treatment options for FC. **Method:** 144 participants from the Australian community were recruited to complete an anonymous online survey consisting of the ROME III Questionnaire, the International Personality Item Pool, the Visceral Sensitivity Index, the Toronto Alexithymia Scale, the Depression-Anxiety-Stress Scale, the Bowel Symptom Severity Scale, and the Revised Illness Perception Questionnaire. Binary logistic regression analyses were conducted to evaluate psychological differences between FC and IBS as defined by the ROME III criteria. **Results:** Only visceral sensitivity, neuroticism and negative emotions/ emotional distress differentiated chronic constipation and IBS. Specifically, higher levels of visceral sensitivity and neuroticism predicted inclusion into the IBS category while higher levels of emotional distress predicted inclusion into the chronic constipation category. All other psychological factors did not predict inclusion into either group. **Conclusion:** The results suggest that FC and IBS share very similar patterns of psychological factors. They differ mainly along emotional factors such as visceral sensitivity, neuroticism and emotional distress.

Key words: Irritable Bowel Syndrome, Functional Constipation, Neuroticism, Alexithymia, Visceral Sensitivity, Emotional Distress, Illness Representations

2.1 Irritable bowel syndrome and functional constipation: Psychological similarities and differences

Functional constipation (FC) is a functional gastrointestinal disorder (Guthrie & Thompson, 2002; Jones, Crowell, Olden, & Creed, 2007) that is prevalent in most communities. It also has significant personal and socio-economic impact. For instance, the prevalence rates of chronic (functional) constipation is 12 – 19% in the USA (Rao et. al, 2007), 1.9% - 27.2% in the North Americas (Leung, Riutta, Kotecha, & Rosser, 2011), 0.7% - 81% across European countries and an average of 15.3% in Oceanic countries (Peppas, Alexious, Mourtzoukou, & Falagas, 2008). In Australia, Selby and Corte (2010) found that the prevalence of chronic constipation ranged from 6 – 30%. The variability in range appeared to be dependent on the diagnostic criteria used. For instance, Higgins and Johanson's (2004) systematic review included articles using diverse methods of diagnosis ranging from ICD-10 reports, ROME I and ROME II criteria or patient self-report.

In addition to its high prevalence, chronic (functional) constipation impacts on multiple levels of living (Leung et. al., 2011). At the individual level, FC is distressing and interferes with daily living (Lee et. al., 2008). A review of the literature revealed that the impact of FC on quality of life is comparable to other chronic health conditions such as diabetes (Belsey, Greenfield, Candy, and Geraint, 2010). At the societal level, FC is a significant burden to the healthcare system. In the US, the annual amount spent on diagnostic tests per constipation sufferer averaged US\$3000 and the annual amount spent on medical care averaged around US\$4500 in 2002 (Leung et. al., 2011).

Despite the prevalence and consequences of FC however, there is considerable lack of research on this syndrome, compared to FGIDS such as Irritable Bowel Syndrome (IBS). As such, the psychological factors associated with FC remain unknown. In an effort to expand

the understanding of FC, this study aims to examine the similarities and differences between FC and IBS in terms of psychological factors.

Psychological factors have been found to play important roles in the development, maintenance, and complication of some functional gastrointestinal disorders (Deary, Chalder, & Sharpe, 2007). Some studies have also found that psychological factors can result from these FGIDs (Koloski et. al, 2012). As yet, it is unknown whether all FGIDs share similar psychological processes or different ones.

While there are studies about the mutually influential roles of psychological factors and some FGIDs, as well as comparisons of psychological factors *within* FGIDs (Muscatello et. al., 2010), FC has not been compared to other FGIDs in terms of psychological factors. Such a comparison is important as there are implications for the treatment of FC. As yet, the treatment options for FC, both psychological (Brooks et. al, 2000) and medical (Wald, 2007), are very limited. In the case of psychological treatments, existing interventions are mostly behavioural in nature, for example biofeedback (Wald, 2007) and behavioural modification (Dijk et. al, 2007). Biofeedback training involves training patients to control anal muscles by means of electrodes attached to the surface of the anus. Behavioural modification includes programmes involving stimulus control, contingency management and activity scheduling to establish healthier toileting habits (Dijk et. al, 2007).

The effectiveness of biofeedback is equivocal with some studies arguing that its effects are limited to those whose constipation are maintained by pelvic floor muscular dysfunction, which is an organic disorder (Chiarioni, Salandini & Whitehead, 2005). Others argue that it is also effective for other types of constipation such as slow-transit constipation (Emmanuel & Kamm, 2001). The research surrounding behavioural techniques face a similar problem. Some researchers recommend behavioural modification techniques in the treatment

of constipation (Dijk et. al, 2007) whilst others find its efficacy equivocal (Dijk et. al, 2008; Emmanuel & Kamm, 2001).

Given the lacunae in psychological interventions for FC, a comparison between FC and IBS in terms of psychological factors would be an important undertaking. Specifically, if FC and other more studied FGIDs are found to share similar psychological factors, this would imply that psychological treatments effective for other FGIDs can be applied to FC, thus expanding the treatment repertoire for FC. This is especially pertinent in light of recent contention that FC and IBS are very similar syndromes, or even variants of the same syndrome (Wong et. al., 2010). While this remains debatable issue, a comparison of FC against IBS in terms of psychological factors would help to inform psychological treatments for FC.

2.1.1 Functional Constipation and Irritable Bowel Syndrome as Very Similar Syndromes

Studies using the ROME III diagnostic criteria (Drossman & Dumitrascu, 2006; Drossman, 2006) have found that IBS and FC are very closely related and share many overlapping symptoms. Some even propose that these syndromes are variations of the same FGID (Wong et. al., 2010), suggesting that FC can be defined as a subtype of IBS. The following paragraphs illustrate this in greater detail.

In the case of IBS, an individual must report a moderate level of recurrent abdominal pain or discomfort for at least three days a month in the last three months, with at least two other symptoms involving changes in bowel functioning. These can consist of changes in the frequency of diarrhoea, constipation or reduction in pain with bowel movement, associated with abdominal pain. In addition, these symptoms must last for at least 6 months to be considered as IBS (Drossman & Dumitrascu, 2006). The subtypes of IBS include IBS-D

(diarrhoea predominant), IBS-C (constipation predominant) and IBS-A (alternating between diarrhoea and constipation). The ROME III criteria specifies that a person must endorse abdominal pain or discomfort along with two other symptoms (involving bowel function changes) for at least 25% of the time, in the absence of inflammatory, anatomic, or metabolic causes so as to meet the criteria for IBS (Drossman & Dumitrascu, 2006).

FC or chronic constipation is characterised by difficulty moving the bowels in the absence of any apparent organic causes (Bassotti & Villanacci, 2006). The ROME III diagnostic criteria for FC require a person to have 12 weeks of constipation within the last 12 months (Bassotti & Villanacci, 2006). FC symptoms include at least two of the following for more than 25% of bowel movements: 1) straining during bowel movement, 2) hard stools, 3) sensation of incomplete bowel clearing, 4) sensation of blockage in the rectum, 5) the use of manual manoeuvres to facilitate bowel movement, and 6) less than 3 bowel movements per week (Bassotti & Villanacci, 2006). Additionally, there are no loose stools and the sufferer does not meet the criteria for IBS (Bassotti & Villanacci, 2006). There are several subtypes of FC, including normal transit constipation where constipation persists despite normal intestinal movements, slow transit constipation and pelvic floor dyssnergia- bowel movement problems due to dysfunction of the pelvic floor muscles around the rectum (Emmanuel & Kamm, 2001). Indeed, the ROME III criteria for both syndromes are fairly similar.

There are several findings from studies comparing symptom profiles of FC and IBS that have led to the suggestion that these are variants of the same syndrome. For instance, Wong and colleagues (2010) found that a significant portion of their sample switched ROME III diagnostic categories between IBS-C and FC across time. Specifically, they found that those with diagnoses of IBS-C and FC switched diagnoses at a twelve month follow-up – a third had switched from an IBS-C diagnosis to a FC diagnosis and a third of FC sufferers had switched to either an IBS or IBS-C diagnosis (Wong et. al., 2010). Other researchers (Mearin

et. al., 2003) have suggested that FGID symptoms are fluid and that symptom change is a natural disease progression (Alpers, 2008), more a norm rather than the exception. This is also supported by longitudinal research showing that a high proportion of patients switched symptoms between IBS and functional dyspepsia (Halder et. Al., 2007). This pattern of change between FGIDs such as FC and IBS might in part be situation-dependent. Indeed, research has shown that FGIDs are prone to contextual influences such as lifestyle changes and exam stress (Chang et. al., 2006). Additionally, there is consistent research indicating that overlaps between FGIDs are common. Locke and colleagues (2005) noted considerable symptom overlap between dyspepsia, IBS and constipation. In their study, most of their sample reported additional symptoms that fell within some other diagnostic category. These findings are similar to those of Jung and colleagues (2007), who found that IBS and gastro-oesophageal reflux disease overlapped regularly in their community sample, above and beyond chance occurrence. They also found that greater tendency towards somatisation predicted this overlap.

These patterns of findings have led some researchers (Wong et. al, 2010) to contend that FC could be a subset of IBS-C, and that FC and IBS lies along a spectrum of severity with IBS on the more severe end and FC on the less severe end. Likewise, Locke and colleagues (2005) have made a similar proposition that these common overlaps between the syndromes challenge the current agreement that FGIDs are discrete syndromes. However, these suggestions cannot be conclusive as the underlying patho-physiological mechanisms for both syndromes remain elusive (Oudenhove, Demyttenaere, Tack, & Aziz., 2004).

In sum, whether FC and IBS are indeed variants of the same syndrome remains to be clarified. What is certain is that they are very similar syndromes, and it is likely that they might share similar psychological factors.

2.1.2 Functional Gastrointestinal Disorders and Psychological Factors

There are close associations between FGIDs and many psychological factors. For instance, a personality trait such as neuroticism, defined as a tendency to experience negative mood states (De Gucht, Fischler & Heiser, 2004), has been found to be associated with more severe IBS presentations (Ormel, Rosmalen & Farmer, 2004). Farnam, Somi, Sarami, and Farhang (2008) also found that in comparison with non-sufferers, sufferers of IBS reported higher levels of neuroticism and, in addition, conscientiousness.

Psychological Factors Associated with IBS

Recently, some researchers (De Gucht et. al., 2004) found that a personality trait such as alexithymia - the inability to differentiate emotions from physical sensations predicts medically unexplained syndromes. Alexithymia is also implicated in IBS (Deary, Chalder, & Sharpe, 2007). Additionally, Porcelli and colleagues (2003) found that individuals suffering from FGIDs who reported higher levels of alexithymia had more pronounced bowel symptoms following treatment compared to those with lower levels of alexithymia. These personality traits are assumed to predispose the other psychological factors and influence the way IBS symptoms are experienced (Farnam et. al., 2008). For instance, Porcelli and colleagues (2003) suggest that individuals high in alexithymia might have an increased tendency to misinterpret somatic sensations that accompany emotional states as FGID symptoms.

Additionally, negative mood states including depression and anxiety have been shown to be closely associated with IBS (Gros, Antony, McCabe, & Swinson, 2009), with many pathways of influence between anxiety, depression and IBS proposed. For instance, some

researchers argue that negative mood states result in aggravated IBS symptoms and symptom-related distress (De Gucht et. al., 2004; Myers & Meerveld, 2009), while others suggest that these are a result of the psychological distress associated with the debilitating experiencing of IBS symptoms (Mayer, Naliboff, Chang, & Coutinho, 2001; Muscatello et. al., 2010). Still, other researchers have found that depression and anxiety are conditions that are co-morbid with IBS, suggesting a common underlying psychological cause or mechanism (Gros et. al., 2009).

Psychological Factors Associated with FC

Rao and colleagues (2007) found that those suffering from constipation characterised by dyssynergic defecation were significantly more likely to be depressed and anxious, had higher scores on obsessive-compulsiveness, hostility, paranoid ideation, and somatisation, as compared to healthy controls and those with slow transit constipation. Likewise, Chan and colleagues (2005) found that sufferers of chronic constipation reported higher levels of anxiety and depression than normal controls. These findings were replicated by Zhou, Lin, Lin, Wang and Zhang (2010) who found that individuals suffering from FC symptoms reported higher levels of depression and anxiety compared to healthy controls. These researchers also found that depressive mood and anxiety were associated with decreased rectal sensitivity, leading them to conclude that anxiety and depression are important contributors to FC. Overall, the research shows that psychological factors are often associated with FC.

Patterns of Psychological Factors in FGIDs

There is some research comparing psychological factors between subtypes of a single FGID. For instance, Muscatello and colleagues (2010) found differences in the psychological factors between individuals suffering from IBS-C and IBS-D. Specifically, individuals suffering from IBS-C had higher levels of depression and anxiety compared to individuals suffering from IBS-D. Complementing and adding to this research, Nagisa and Shinobu (2008) found that anxiety was associated with cognitive appraisals in those with IBS-D, but not IBS-C. They also found associations between abdominal pain and cognitive appraisals in these two groups (Nagisa & Shinobu, 2008).

Muscatello and colleagues (2010) also found that individuals suffering from IBS-C scored higher on state anger and angry reaction (dispositional hypersensitivity to perceived criticism) as compared to individuals suffering from IBS-D. Additionally, Eriksson Andrén, Eriksson, and Kurlberg (2008) found that individuals suffering from IBS-D had lower levels of body awareness, reported less psychological symptoms such as anxiety and depression, and had a higher sense of coherence - a representation of coping ability, compared to individuals suffering from IBS-C and IBS-A subtypes. They also found that individuals suffering from IBS-A subtype reported higher levels of anxiety, depression, and poorer quality of life. These findings suggest nuanced variations amongst the psychological factors within a single FGID, which leads to the question of whether such variations also exist *between* FGIDs.

However, it should be noted that some of the psychological factors such as anxiety, depression, cognitive appraisals, neuroticism, and alexithymia reviewed above have received more empirical support than others, for example, psychoticism, angry reactions, obsessive-compulsiveness (Rao et. al., 2007). Less empirically supported psychological factors tended to be assessed using generic instead of factor-specific measures. For instance, Rao et. al.'s

(2007) study used the Revised 90-item Symptom Checklist to assess obsessive-compulsive, angry reactions and so forth, which brings into question the validity of using these psychological factors to differentiate between FGIDs.

In conclusion, FGIDs are often closely associated with psychological factors. While there are comparisons of psychological factors within a single FGID, as yet, there are no comparisons between different FGIDs.

2.1.3 Including Psychological Factors Specific to FGIDs

Recent research has identified additional psychological factors that are specific to FGIDs, which demands further investigation. These psychological factors are important when comparing FC with IBS as they potentially contribute to the maintenance of FGID symptoms. For instance, visceral sensitivity - the negative cognitive appraisal of, hyper-vigilance and emotional reaction to abdominal symptoms (Labus, Mayer, Chang, Bolus, & Naliboff, 2007), has been hypothesized to perpetuate IBS symptoms by increasing sensitivity to abdominal pain. This in effect sensitizes a person to physiological sensations.

IBS sufferers have also been found to catastrophize (similar to the negative cognitive appraisal in visceral sensitivity) the severity of their symptoms (Hunt, Milonova and Moshier, 2009). These catastrophic appraisals increase attention focus on benign abdominal sensations and autonomic arousal, which in turn activates bowel symptoms (Craske et. al., 2011). Additionally, visceral sensitivity has been found to mediate the relationship between state anxiety and symptom severity in persons with IBS (Labus et. al., 2007). These findings suggest the possible role of visceral sensitivity as a psychological mechanism involved in activating IBS symptoms. .

Another set of psychological factors that has received attention recently are the illness representations of IBS (Rutter & Rutter, 2002; Rutter & Rutter, 2007). Illness representations are personal beliefs about the causes of one's illness, its consequences, the sense of control one feels one has over it, the nature of cure suitable for it, the sense of understanding (coherence) one has of it, the chronicity of one's illness, and the emotions associated with it (Rutter & Rutter, 2002). These core illness beliefs affect the cognitive appraisal of symptoms, psychological factors like anxiety- both gut-specific and general, the experience of distress over bowel symptoms, and illness behaviours. To illustrate, a persistent belief that one's IBS symptoms are indicative of severe damage increases catastrophic appraisal of the slightest abdominal sensations. This in turn increases anxiety, physiological arousal and triggers abdominal discomfort. As a result, the individual becomes very distressed, which serves to further perpetuate catastrophic interpretation of the triggered abdominal discomfort. Indeed, Cheng, Chan, Hui and Lam (2003) found that individuals with chronic constipation who believed that they had no personal control over their symptoms sought medical help more often as compared to those who did not endorse this belief.

In conclusion, visceral sensitivity and illness representations are important psychological factors to consider when clarifying the differences and similarities between IBS and FC, along with other more well-studied psychological factors such as personality traits and emotional distress. As they are more specific to FGIDs, visceral sensitivity and illness representations might therefore contribute as additional psychological mechanisms in the maintenance of FGID distress and symptoms.

2.1.4 Aims and Hypotheses

This paper aims to compare the patterns of psychological factors of FC and IBS. Based on Wong and colleagues' (2010) study, it is predicted that there will be no difference between FC and IBS in terms of Neuroticism, Alexithymia, Emotional Distress, Visceral Sensitivity, and Illness Perception (Personal Control, Illness Coherence, Emotional Representation, Psychological Attribution, Risk Factor Attribution, Chance Attribution and Altered Immunity Attribution).

2.2 METHOD

2.2.1 Sample

144 ($N_{\text{male}} = 27$, $N_{\text{females}} = 117$) participants were recruited from several sources: 1) from the community in response to advertisements placed on newspapers, and various online social media webpages such as Facebook and Gumtree, 2) patient populations at the John Hunter Hospital NSW, and 3) from an undergraduate psychology student pool at Macquarie University, Sydney. The inclusion criteria for participation were: 1) 18 years of age or older, 2) indication of some FGID symptoms such as constipation or diarrhoea, abdominal pain, abdominal discomfort, and bloating regularly for a period of time (e.g., 3 months). 14.8% of male participants fell within the 25 – 30 year old range, and 11.1% fell within each of the 18 – 24 and 56 – 60 year old ranges. The remainder fell within the other age ranges. 18.8% of female participants fell within the 18 -24 year old range, while the remainder were distributed across the other age ranges (each consisting of less than 10% of the female participants).

2.2.2 Data Collection

Participants were logged on to a secure website to complete an online survey via the Qualtrics survey platform. On the survey website, participants were informed that their participation was voluntary - they could withdraw at any time without any penalties simply by exiting the website; and that their responses were anonymous. Upon completion of the survey, participants could register for an AUD60 prize draw. They could also download some free stress management material developed by the researchers. This study received ethical approval from the Macquarie University Human Research Ethics Committee.

2.2.3 Measures

ROME III questionnaire (Drossman & Dumitrascu, 2006). The ROME III is an 18-question self-report diagnostic criteria of Irritable Bowel Syndrome and Functional Constipation. This questionnaire is the composite of the Irritable Bowel Syndrome and Functional Constipation modules of the ROME questionnaires. The questions ask participants about the frequency and duration of specific symptoms as well as changes in their bowel functioning in relation to these symptoms. Different questions were rated in different ways (e.g., on a 5-point scale, on a 7-point scale and so forth). A sample item would be “In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?” The scoring method for this questionnaire is based on a decision tree method where certain key symptoms must be endorsed along with a minimal number of other symptoms before the criteria for IBS or FC is met. For this study, the Cronbach’s alpha of the ROME-III was $\alpha = .62$. Participants who reported two or more key FC symptoms were considered to have chronic constipation (CC).

Bowel Symptom Severity Scale (BSSS) (Boyce, Gilchrist, Talley & Rose, 2000). The BSSS is a 24-question measure of eight bowel symptoms, their perceived severity and perceived interference over the past week. It is rated along a 5-point scale for symptom frequency (1 = Not at all, 5 = More than once a day), and another 5-point scale for perceived severity and interference (1 = Not at all, 5 = Extremely). An example of an item is “Over the past week on how many occasions did you have hard or lumpy stools when you had a bowel motion?” Three scores (one each for symptom frequency, perceived severity and perceived interference) are calculated by summing up the scores for eight corresponding items in each subscale. All three scores would achieve a maximum score of 40 and a minimum of 8, with higher scores indicating respectively, greater symptom frequency, greater perceived severity of symptoms and greater perceived interference by the symptoms. For this study, the Cronbach’s alpha of the three subscales were Symptom Frequency $\alpha = .67$, Symptom Severity $\alpha = .82$, and Interference $\alpha = .86$ respectively.

International Personality Item Pool (the IPIP; Goldberg et. al., 2006). The IPIP provides a 10-item (self-statement) non-clinical measure of neuroticism (the tendency to experience low moods). It has good convergent validity with the NEO-PI-R ($r = .82$; http://ipip.ori.org/newNEO_DomainsTable.htm). It is rated along a 5-point scale (1 = Very inaccurate, 5 = Very accurate as a description of you) where participants are asked to rate how accurately these items described them presently. An example of an item is “Am often down in the dumps.” A single score is calculated by summing up responses to all 10 items following reverse-scoring. The final score ranges from 10 to 50, with higher scores indicating greater visceral sensitivity. For this study, the Cronbach’s alpha of the NEO-10 was $\alpha = .85$, indicating good internal consistency.

Toronto Alexithymia Scale – 20 (TAS – 20; Bagby, Parker & Taylor, 1994). The TAS – 20 is a 20-item (self-statement) measure of Alexithymia which is rated along a 5-point scale (1 = Strongly disagree, 5 = Strongly agree). Participants are asked to rate how much each item agreed with their personal experiences. An example of an item is “It is difficult for me to find the right words for my feelings.” The total score of the TAS-20 is calculated by adding the ratings for all the items. This total score ranges from 20 to 100, with higher scores indicating greater tendencies toward alexithymia. For this study, the Cronbach’s alpha of the TAS-20 was $\alpha = .83$, indicating good internal consistency.

Illness Perception Questionnaire - Revised (IPQ-R; Moss-Morris et. al., 2002). The IPQ-R is a multi-component questionnaire assessing various personal beliefs about an illness adapted to IBS and FC. For the purposes of the present study, only the illness coherence, emotional representation, control/ cure, and causal attribution subscales (psychological, risk factor, altered immunity, and chance factors) were used. Altogether, the IPQ-R consists of 70 items made up of declarative statements and a list of physical symptoms. These subscales are rated along a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). For this study, the Cronbach’s alpha of the seven subscales were Illness Coherence $\alpha = .93$ (total score range from 5 to 25), Emotional Representation $\alpha = .87$ (total score range from 6 to 30), Personal Control $\alpha = .89$ (total score range from 6 to 30), Psychological causal attribution $\alpha = .79$ (total score range from 5 to 25), Risk factor causal attribution $\alpha = .50$ (total score range from 7 to 35), Altered immunity causal attribution $\alpha = .58$ (total score range from 3 to 15), and Chance causal attribution $\alpha = .22$ (total score range from 2 to 10), respectively. Higher total scores indicate greater illness coherence, emotional reaction to the illness, sense of person control, and endorsement of each causal belief, respectively.

Visceral Sensitivity Index (VSI; Labus et. al., 2004). The VSI is a 15-item (self-statement) measure of visceral sensitivity which is rated along a 6-point scale (1 = Strongly agree, 6 = Strongly Disagree). Participants are asked to rate how much each statement agrees with their personal experience. An example of an item is “I often worry about problems in my belly.” A single total score is calculated by summing up the scores for all 15 items. Total scores range from 15 to 90, with higher scores indicating greater visceral sensitivity levels. For this study, the Cronbach’s alpha of the VSI was $\alpha = .91$ indicating that it has good internal consistency.

Depression Anxiety and Stress Scale – 21 (DASS – 21; Henry & Crawford, 2005; Lovibond & Lovibond, 1995). The DASS – 21 is a 21-item self-statement measure of depression, anxiety and stress states over the past week, which is rated along a 4-point scale (0 = did not apply to me at all, 1 = Applied to me to some degree, 2 = Applied to me to a considerable degree, 3 = Applied to me very much). An example of an item is “I found it very hard to wind down.” For the purpose of this study, a total score is calculated by summing up all the items, and then multiplying this sum by two. Total scores range from 0 to 126, with higher scores indicating greater emotional distress. For this study, the Cronbach’s alpha of the DASS-21 was $\alpha = .94$, indicating that it has good internal consistency.

2.2.4 Data Management & Data Analysis Strategy

Of the 144 participants, 12 did not meet ROME criteria for any diagnosis based on their ROME III questionnaire answers, leaving 132 participants [N(Constipation_{Functional} Constipation+Chronic Constipation) = 31, N(IBS) = 101]. With regards to missing data (overall 12.5% missing), Little’s Missing Completely At Random (MCAR) test (1988) revealed that data was

missing at random, $\chi^2 = 430.01$, $df = 1394$, $p = 1.00$. Missing data was imputed using the mean substitution method.

The data was analysed in the following steps:

1. Descriptive statistics – Bivariate correlation analyses.
2. *Mann-Whitney U* tests to ascertain if IBS-C and IBS-Others were similar on all measures to be combined as a single group, and also to test if FC and CC were similar to be combined as a single group. The purpose of this step was to determine if it was viable to form two groups for logistic regression analyses. This decision was based on the small sample size, as well as recommendations of some researchers such as Selby and Corte (2010) who suggested that individuals with subclinical FC symptoms (i.e., CC) be considered for the FC diagnosis as well. Their rationale was that most people who reported disability resulting from bowel symptoms did not meet all the criteria of the ROME III categories (Selby & Corte, 2010; Wong et. al., 2010). Specifically, they found that most people who reported symptoms of chronic constipation did not meet the full criteria for FC because they did not endorse the sufficient number of symptoms (Selby & Corte, 2010). *Mann-Whitney U* tests were used because the diagnosis groups were not interval or ratio data.
3. Logistic regression analyses of two groups (FC and IBS) with all measures as covariates. Effect sizes for the psychological factors were calculated (Cohen's d) and post-hoc power analyses were also conducted. The power analysis was conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). Results indicated that there was an 80% ($1 - \beta = .80$) chance of detecting medium effect size (Cohen's $d = .50$) on a simple two sample t-test. However, the sample in this study was slightly under-powered to detect small effects (i.e., Cohen's $d = .20$) in multivariate analyses.

2.3 RESULTS

2.3.1 Descriptive Statistics

Bivariate correlations were used to assess the relationship between the various variables in this study. The correlation coefficients are presented in Table 2.1.

2.3.2 Are IBS-C and IBS-Others similar enough to be combined as group, and are FC and CC similar enough to be combined as a group?

Prior to data analysis, Mann-Whitney *U* tests were conducted to compare BSSS interference subscale, Neuroticism, TAS-20 total, DASS-21 total, VSI, Personal Control, Illness Coherence, Emotional Representation, Psychological causal attribution, Altered immunity causal attribution, Risk factor causal attribution and Chance causal attribution scores between FC and CC. The same procedure was used to compare these scores between IBS-C and the other IBS cases. This procedure was done to ascertain the suitability of grouping FC and CC together as a distinct group, and the IBS subtypes together as another distinct group, resulting in two comparison groups.

Results for the comparisons between FC and CC are summarized in Table 2.2. Results for the comparisons between IBS-C and other IBS cases are also summarized in Table 2.2, Overall, the Mann-Whitney *U* tests indicated that the FC and CC groups were comparable in terms of all psychological and symptom variables. Hence, it was decided to combine these two groups into a unitary Constipation group.

The same pattern emerged for IBS-C and other IBS cases, save for psychological causal attribution which was significantly different between IBS-C (*Mean Rank* = 47.64, *n* = 81) and IBS-Other (*Mean Rank* = 64.60, *n* = 20), *U* = 538, *z* = -2.37, *p* < .05, two-tailed.

This suggested that other IBS cases tended to endorse greater beliefs in psychological causes for their symptoms than IBS-C sufferers. Nonetheless, as most of the other variables were comparable for IBS-C and other IBS cases, and the mean rank difference for psychological causal attribution was not very large, IBS-C and IBS-Other were also combined to form a unitary IBS group. Constipation and IBS were defined as two levels of the variable – diagnosis group.

Table 2.1

Bivariate Correlations between Neuroticism, Emotional Distress, Alexithymia, Visceral Sensitivity and Illness Representations

Variables	Cohen's d	1	2	3	4	5	6	7	8	9	10
1.Neuroticism	.27										
2.Emotional Distress	-.28	.68**									
3.Alexithymia	-.36	.28**	.50**								
4.Visceral Sensitivity	.71	.34**	.26**	.11							
5.Personal Control	.12	-.12	-.16	-.11	-.25**						
6.Illness Coherence	.14	-.11	-.09	-.15	-.32**	.37**					
7.Emotional Representation	.52	.45**	.47**	.13	.66**	-.32**	-.37**				
8.Psychological Causes	.26	.40**	.39**	.17	.24**	-.11	-.09	.34**			
9.Risk Factor Causes	-.08	.15	.23**	.23**	-.09	.22*	.14	.06	.30**		
10.Altered Immunity Causes	.26	.1	.17	.07	.04	.18*	-.12	.14	.04	.36**	
11.Chance Causes	.04	.08	.22*	.18*	-.003	-.13	-.13	.25**	.12	.30**	.41**

*correlation is significant at the $p=.05$ level (2 tailed)**correlation is significant at the $p = .01$ level (2 tailed)

2.3.3 Are Constipation and IBS Different Psychologically?

A binary logistic regression was used to identify the psychological variables that uniquely discriminated between the Constipation and IBS groups. The diagnosis group (with Constipation and IBS as two levels of this group) was the DV and psychological variables (FGID Interference, Neuroticism, Emotional Distress, Alexithymia, Gut-specific Anxiety, and Illness Representation) were covariates, with a 95% confidence interval, and significance set at $p < .05$.

FGID interference was entered into the model first to ascertain that the two diagnosis groups were not different in this variable. Neuroticism and Emotional Distress were next entered as established psychological factors and generic processes. The two are variables commonly associated with IBS in the literature. They were entered before the other variables to control for their effects in predicting differences between IBS and FC.

The other psychological factors (i.e., Alexithymia, Visceral Sensitivity, Illness Coherence, Emotional Representation, Personal Control, Psychological Causal Attribution, Altered Immunity Causal Attribution, Risk Factors Causal Attribution and Chance Causal Attribution) were considered FGID-specific or new psychological factors and processes. These were entered separately in the third step. The aim was to ascertain if these variables uniquely differentiated between the two diagnosis groups.

Table 2.2

Comparison of mean psychological and symptom variables between FC and CC, and IBS-C and IBS-Other

Variables	FC Mean Rank (N)	CC Mean Rank (N)	<i>U</i>	<i>z</i>	<i>p</i>	Variables	IBS-C Mean Rank (N)	IBS- Other Mean Rank (N)	<i>U</i>	<i>z</i>	<i>p</i>
Neuroticism	16.06 (8)	15.98 (23)	91.5	-.02	.98	Neuroticism	50.07 (81)	54.75 (20)	735	-.64	.52
Alexithymia	14.25 (8)	16.61 (23)	78	-.63	.53	Alexithymia	53.78 (81)	39.73 (20)	584.5	-1.92	.05
Emotional Distress	13.5 (8)	16.87 (23)	72	-.90	.37	Emotional Distress	51.59 (81)	48.63 (20)	762.5	-.41	.69
Visceral Sensitivity	14.56 (8)	16.5 (23)	80.5	-.52	.60	Visceral Sensitivity	50.81 (81)	51.78 (20)	794.5	-.13	.87
Personal Control	19.19 (8)	14.89 (23)	66.5	-1.15	.25	Personal Control	50.31 (81)	53.78 (20)	754.5	-.48	.64
Illness Coherence	11.63 (8)	17.53 (23)	57	-1.59	.11	Illness Coherence	48.18 (81)	62.43 (20)	581.5	-1.96	.05
Emotional Representation	14.69 (8)	16.46 (23)	81.5	-.48	.64	Emotional Representation	50.84 (81)	51.65 (20)	797	-.11	.91

* $p < .05$, two-tailed.

Table 2.2 (Cont'd) Comparison of mean psychological and symptom variables between FC and CC, and IBS-C and IBS-Other

Variables	FC Mean Rank (N)	CC Mean Rank (N)	<i>U</i>	<i>z</i>	<i>p</i>	Variables	IBS-C Mean Rank (N)	IBS- Other Mean Rank (N)	<i>U</i>	<i>z</i>	<i>p</i>
Psychological Causal attribution	15.56 (8)	16.15 (23)	88.5	-.16	.88	Psychological Causal attribution	47.64 (81)	64.6 (20)	538	-2.33*	0.02
Risk factor causal attribution	11.31 (8)	17.63 (23)	54.5	-1.71	.09	Risk factor causal attribution	52.59 (81)	44.58 (20)	681.5	-1.10	.271
Altered immunity causal attribution	18.69 (8)	15.07 (23)	70.5	-.98	.34	Altered immunity causal attribution	51.56 (81)	48.73 (20)	764.5	-.39	.70
Chance causal attribution	19.19 (8)	14.89 (23)	66.5	-1.17	.26	Chance causal attribution	52.54 (81)	44.75 (20)	685	-1.08	0.28
FGID Interference	17.13 (8)	15.61 (23)	83	-.41	.71	FGID Interference	53.18 (81)	42.18 (20)	633.4	-1.51	.13

* $p < .05$, two-tailed.

A total of 132 cases were analysed and the final model was significantly reliable ($\chi^2 = 36.46$, $df = 12$, $p < .05$). This model accounted for 24.1% to 36.4% of the variance in diagnosis group categorization, with 93.1% of the diagnosis of IBS successfully predicted. 38.7% of the diagnosis of Constipation was successfully predicted. Overall, there was an 80.3% correct allocation to either diagnosis groups in the final model. Table 2.3 summarizes the coefficients, Wald statistic, associated degrees of freedom and probability values for each of the predictor variables. This shows that the total DASS-21 score, IPIP (neuroticism) score and the VSI score reliably predicted differences in categorization of IBS and Constipation. The values of the coefficients revealed that a one-point change in total DASS-21 score was associated with a decrease in the chances of falling within the IBS group (and falling within the Constipation group instead) by a factor of .95. Conversely, a one-point change in VSI score was associated with 1.08 times chance of falling within the IBS group. Additionally, a one-point change in IPIP score is associated with 1.10 times chance of falling within the IBS group.

Table 2.3

Logistic Regression Analysis of 132 IBS and Constipation sufferers

Predictors	β	$SE\ \beta$	Wald's χ^2	df	p	$e\beta$ (Odds Ratio)	95% C.I. for $e\beta$	
							Lower	Upper
Block 0								
constant	1.18	.21	33.09	1.00	.00	3.26	-	-
Block 1 = comparing interference levels between two groups								
constant	.78	.61	1.64	1.00	.20	2.19		
Interference	.02	.04	.47	1.00	.49	1.03	.95	1.10
Block 2 = known psychological variables								
Interference	.02	.04	.23	1.00	.63	1.02	.94	1.10
Neuroticism	.10	.04	7.21	1.00	.01*	1.11	1.03	1.19
Emotional Distress	- .03	.01	7.73	1.00	.01*	.97	.95	.99
Block 3 (Final Model) = new psychological effects								
Interference	- .09	.05	2.68	1.00	.10	.92	.82	1.02
Neuroticism	.09	.04	4.45	1.00	.03*	1.10	1.01	1.20
Emotional Distress	- .05	.02	8.62	1.00	.00*	.95	.92	.98
Alexithymia	- .02	.03	.41	1.00	.52	.98	.93	1.04
Visceral Sensitivity	.07	.03	7.57	1.00	.01*	1.08	1.02	1.13
Personal Control	.02	.07	.12	1.00	.73	1.02	.89	1.17
Illness Coherence	.09	.06	1.75	1.00	.19	1.09	.96	1.24
Emotional Representation	.13	.08	2.64	1.00	.10	1.14	.97	1.33

* $p < .05$ **Notes:** Bold numbers indicate significant Odds Ratios

Table 2.3

(Cont'd) Logistic Regression Analysis of 132 IBS and Constipation sufferers

Predictors	β	$SE\ \beta$	Wald's χ^2	df	p	$e\beta$ (Odds Ratio)	95% C.I. for $e\beta$	
							Lower	Upper
Psychological Causal Attribution	.06	.07	.80	1.00	.37	1.07	.93	1.23
Risk Factor Causal Attribution	- .07	.09	.63	1.00	.43	.93	.78	1.11
Altered Immunity Causal Attribution	.22	.15	2.23	1.00	.14	1.25	.93	1.67
Chance Causal Attribution	.04	.22	.03	1.00	.86	1.04	.68	1.60
Test of Model								
Overall (Final) model evaluation			χ^2	df	p			
Model χ^2			36.46	12.00	.00			
Goodness-of-fit test								
Hosmer & Lemeshow			10.29	8.00	.25			

**p* < .05

2.4 DISCUSSION

This study seeks to compare psychological factors between IBS and FC. The hypothesis that individuals with FC will have similar levels of psychological factors as those with IBS in terms of personality features such as neuroticism and alexithymia, emotional distress, and cognitive features such as visceral sensitivity and illness representation, was partially supported.

It was found that emotional distress, neuroticism and visceral sensitivity significantly predicted the different categorization of IBS and constipation. Specifically, those reporting higher levels of emotional distress were more likely to have constipation than IBS. Conversely, those endorsing higher levels of visceral sensitivity and neuroticism were more likely to meet the ROME III criteria for IBS. In other words, individuals with constipation tended to present with higher levels of general emotional distress as characterized by the DASS-21 score, while IBS sufferers tended to present with higher levels of visceral sensitivity as characterized by the VSI score, and neuroticism as characterized by the IPIP score.

Apart from these psychological factors, it was found that the two groups had similar levels of illness representations, alexithymia, and neuroticism. Specifically, scores on the illness representation subscales (personal control, illness coherence, emotional representation, psychological, altered immune system, risk factor and chance attributions), and alexithymia were similar between those endorsing the IBS criteria versus those endorsing the symptoms of constipation.

This pattern of findings indicate that constipation might share similar illness representations and levels of alexithymia to IBS, giving some support to the argument that FC is very similar to IBS (Locke et. al., 2005; Wong et. al, 2010). These results also indicate that psychological factors and processes like neuroticism, emotional distress, visceral sensitivity, alexithymia and illness representations play a role in FC.

Additionally, it can be argued that IBS and FC can be differentiated by their relative patterns of emotional distress, neuroticism and visceral sensitivity. The finding that individuals with constipation might present with higher levels of emotional distress is consistent with the findings of Rao and colleagues (2007) and Chan and colleagues (2005). These researchers found

that compared to those without constipation, those with various types of constipation tended to be more depressed or anxious (i.e., emotionally distressed). However, the reason for this observation is unclear, especially since research shows that those with IBS also tended to suffer from co-morbid anxiety or depression (Gros et. al., 2009). A possible explanation could be that the experience of prolonged constipation, while not as acutely distressing as the abdominal pain that characterizes IBS, is emotionally distressing. Although pain is distressing and leads to a very specific anxiety (Jones et. al., 2007), chronic constipation might be more frustrating because bowel movement does not improve. Frustration with an intractable condition might result in emotional distress. Indeed, some studies have shown that having a chronic illness that shows no improvement is often associated with depression (e.g., Kivirvuusu et. al., 2007).

Conversely, it is understandable that higher levels of visceral sensitivity are associated with IBS compared to constipation. This is because chronic recurring bouts of abdominal pain and/ or unpredictable changes in bowel function, as is often the case in IBS Diarrhea and mixed/ alternating subtypes, can result in negative appraisal of, and hypervigilance to bowel functions. Indeed, a meta-analysis by Schoth, Nunes, and Liossi (2012) found that chronic pain sufferers displayed significantly higher pain-related information processing bias as compared to those who did not suffer from chronic pain. This suggests that chronic and recurrent abdominal pain might be associated with similar pain-related information processing bias such as visceral sensitivity.

As mentioned, abdominal pain in IBS is likely a powerful focus on visceral sensitivity (Labus et; al., 2007), exacerbating anxiety much like focusing on somatic sensations in panic disorders exacerbates a panic attack (Craske et. al., 2011). In contrast, abdominal pain is not present or less intense in constipation as compared to IBS (Wong et. al., 2010). Thus, constipation less likely to be negatively appraised. Rather, the inability to move one's bowels is

a greater source of concern. Hence, visceral sensitivity is more salient to IBS as compared to FC because of more severe abdominal pain. This can also explain the difference in emotional distress levels between IBS and FC in the current sample. Specifically, visceral sensitivity might be more salient than generic emotional distress in IBS, as it is more specifically focused on abdominal sensations relevant to IBS (Labus et. al., 2007; Craske et. al., 2011).

Another plausible explanation for this result could be methodological biases. Specifically, the Visceral Sensitivity Index (VSI) items seem to be geared towards measuring diarrhoea more than constipation (Labus et. al., 2007), making it more likely to be associated with the IBS-D subgroup within the sample. Hence, how visceral sensitivity is operationalized by the VSI might be problematic. Further research into the construct validity of the VSI, as well as other methods of assessing this construct will be very informative.

Finally, the finding that individuals who reported higher levels of neuroticism tended to endorse the ROME III criteria for IBS is consistent with existing research about the relationship between neuroticism and IBS (e.g., Deary et. al., 2007; Farnam et. al., 2008). It is likely that neuroticism plays a role in predisposing the development of IBS symptoms. However, it is unclear why those who reported higher levels of neuroticism tended not to endorse constipation symptoms, and the current body of literature offers no explanation as yet. As demonstrated by the comprehensive literature review earlier on, there is no research about neuroticism in FC. Perhaps neuroticism also predisposes the development of FC, but to a lesser degree than IBS. Indeed, Deary and colleagues (2007) proposed that neuroticism is one common predisposing factor in medically unexplained syndromes, which include FGIDs. Taken together, this would then suggest that neuroticism might predispose the *severity* of bowel symptoms along a

continuum from IBS on the severe end, and FC on the less severe end (Wong et. al., 2010).

However, more research is required to clarify the relationship between neuroticism and FC.

While the results are illuminating, this study is not without its limitations. Firstly, the diagnoses for this sample were only preliminary as they were based on self-reported measures as opposed to a full medical review. Secondly, the sample used in this study was self-selected and small, which might limit its representativeness. Additionally, there is no way of ascertaining if participants in this sample have undergone any medical tests to rule out other similar conditions, for example, Crohn's disease. This lack of representativeness might reduce the generalisability of current findings. It would hence be helpful to replicate this study with a larger and clinically identified sample.

Thirdly, power limitations due to a small sample size might obscure otherwise significant differences in the other psychological factors compared. Specifically, it might be that the DASS-21, IPIP and VSI scores showed big effects despite power limitations but that the other psychological factors might have small effects which are not apparent due to power limitations (i.e., Type II error). This is a possibility given the small effect sizes (Cohen's *d*) of most of the measured psychological variables. Fourthly, these findings could be due to chance effects and this cannot be totally discounted (Type I Error). Hence, it is advisable to interpret the findings of the present study with caution.

A final limitation of this study was the high attrition rate for demographic information such as intake source, ethnicity, socio-economic and status among respondents due to a technical error in the online survey. Unfortunately, this meant that any differences in the variables measured between demographic groups, and how potential differences might affect the pattern of results was unknown. Additionally, while gender information was available, no analyses were

undertaken to determine difference in the variables between genders as the gender was unevenly distributed (i.e., much more female respondents than male). This means that any comparisons between genders would not be meaningful. Future studies should attempt to include demographic information and recruit a sample which has a more even distribution of males and females.

However, from another angle, that DASS-21, IPIP and VSI scores stood out as indicators of difference between constipation and IBS despite these limitations reflected the salience of these psychological (emotional) variables in FGIDs in general, and the differences in terms of these emotional psychological factors between FC and IBS. Indeed, the medium-to-large effect size of the VSI indicates that FC and IBS sufferers do indeed have different levels of visceral sensitivity.

Additionally, this is the first study of its kind to compare the psychological factors between two distinct but closely related FGIDs. Although the patterns of psychological factors associated with each syndrome are very similar, they were shown to differ on emotional factors. These findings contribute to the understanding of constipation, and its relationship to IBS. Additionally, this study underscores the importance of psychological factors in FC and implicates the different roles of emotional factors in FGIDs. Furthermore, many other less studied psychological factors such as visceral sensitivity, alexithymia and illness representation were investigated within this study, further expanding their scope of relevance beyond IBS to that of other FGIDs such as FC.

Future research can take several directions. These include replication of the present study with a larger FC sample that meets the full ROME III FC criteria, and with clinically diagnosed IBS and FC. Other research can also examine in-depth lesser known but FGID-specific

psychological variables and their relative patterns between FC and IBS. Further, this research design can be used to compare between other FGIDs such as Functional Dyspepsia and IBS. Such research may help to clarify the differences between these FGIDs, as suggested by Alpers (2008). This will have significant implications for treatment. Finally, this study can be replicated with more robust statistical analysis techniques such as cluster analysis using a larger sample size.

In sum, FC and IBS appear to be very similar on many important psychological factors associated with FGIDs. However, they differ in terms of emotional distress, neuroticism and visceral sensitivity levels, which might indicate the differing roles and salience of these emotional factors in FC and IBS.

References

- Alpers, D.H. (2008). Multidimensionality of symptom complexes in irritable bowel syndrome and other functional gastrointestinal disorders. *Journal of Psychosomatic Research*, 64(6), 567 – 572. DOI: 10.1016/j.jpsychores.2008.02.023.
- Bagby, R.M., Parker, J.D.A., & Taylor, G.J. (1994). The twenty-item Toronto Alexithymia Scale – I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, 38(1), 23 – 32. DOI: 10.1016/0022-3999(94)90005-1
- Bassotti, G., & Villanacci, V. (2006). Slow transit constipation: a functional disorder becomes an enteric neuropathy. *World Journal of Gastroenterology*, 12(29), 4609 - 4613.
Retrieved from <http://www.wjnet.com/1007-9327/12/4609.asp>, on 15 September 2012.
- Belsey, J., Greenfield, S., Candy, D., & Geraint. M. (2010). Systematic review: impact of constipation on quality of life in adults and children. *Alimentary Pharmacology & Therapeutics*, 31(9), 938 – 949. DOI: 10.1111/j.1365-2036.2010.04273.x
- Boyce, P., Gilchrist, J., Talley, N.J., & Rose, D. (2000). Cognitive–behaviour therapy as a treatment for irritable bowel syndrome: a pilot study. *Australian and New Zealand Journal of Psychiatry*, 34, 300–309. DOI: 10.1046/j.1440-1614.2000.00731.x
- Brooks, R. C., Copen, R. M., Cox, D. J., Morris, J., Borowitz, S., & Sutphen, J. (2000). Review of the treatment literature for encopresis, functional constipation, and stool-toileting refusal. *Annals of Behavioral Medicine*, 22(3), 260-267. DOI: 10.1007/BF02895121

- Chan, A. O. O., Cheng, C., Hui, W. M., Hu, W. H. C., Wong, N. Y. H., Lam, K. F., Wong, W.M, Lai, K.C, Lam, S.K., & Wong, B.C.Y. (2005). Differing coping mechanisms, stress level and anorectal physiology in patients with functional constipation. *World Journal of Gastroenterology*, 11(34), 5362-5366. Retrieved from <http://www.wignet.com/1007-9327/11/5362.asp>, on 12 September 2012.
- Chang, L., Toner, B.B., Fukudo, S., Guthrie, E., Locke, G.R., Norton, N.J., & Sperber, A.D. (2006). Gender, age, society, culture, and the patient's perspective in the Functional Gastrointestinal Disorders. *Gastroenterology*, 130(5), 1435 – 1446. DOI: 10.1053/j.gastro.2005.09.071.
- Cheng, C., Chan, O. O., Hui, W. M., & Lam, S. K. (2003). Coping strategies, illness perception, anxiety and depression of patients with idiopathic constipation: a population-based study. *Alimentary Pharmacology and Therapeutics*, 18(3), 319-326. doi:10.1046/j.1365-2036.2003.01663.x
- Chiarioni, G., Salandini, L., & Whitehead, W. E. (2005). Biofeedback Benefits Only Patients With Outlet Dysfunction, Not Patients With Isolated Slow Transit Constipation. *Gastroenterology*, 129, 86–97. DOI: 10.1053/j.gastro.2005.05.015
- Craske, M.G., Wolitzky-Taylor, K.B., Labus, J., Wu, S., Frese, M., Mayer, E.A., & Naliboff, B.D. (2011). A cognitive-behavioral treatment for irritable bowel syndrome using interoceptive exposure to visceral sensations. *Behaviour Research and Therapy*, 49, 413 – 421. DOI: 10.1016/j.brat.2011.04.001.

- Deary, V. Chalder, T., & Sharpe, M. (2007). The cognitive behavioural model of medically unexplained symptoms: A theoretical and empirical review. *Clinical Psychology Review*, 27, 781 – 797. DOI: 10.1016/j.cpr.2007.07.002
- De Gucht, V., Fischler, B., & Heiser, W. (2004). Neuroticism, alexithymia, negative affect, and positive affect as determinants of medically unexplained symptoms. *Personality and Individual Differences*, 36(7), 1655-1667. DOI: 10.1016/j.paid.2003.06.012
- Dijk, M. V., Benninga, M. A., Grootenhuis, M. A., Nieuwenhuizen, A. O., & Last, B. F. (2007). Chronic childhood constipation: A review of the literature and the introduction of a protocolized behavioral intervention program. *Patient Education and Counseling*, 67, 63–77. DOI: 10.1016/j.pec.2007.02.002
- Dijk, M. V., Bongers, M. E. J., Vries, G. D., Grootenhuis, M. A., Last, B. F., & Benninga, M. A. (2008). Behavioral therapy for childhood constipation: a randomized controlled trial. *Pediatrics*(121), 5. DOI: 10.1542/peds.2007-2402.
- Drossman, D. A., & Dumitrascu, D. L. (2006). Rome III: New Standard for Functional Gastrointestinal Disorders. *Journal of Gastrointestinal and Liver Disorders*, 15(3), 237-241. DOI: 10.1053/j.gastro.2006.03.008
- Emmanuel, A.V., & Kamm, M.A. (2001). Response to a behavioural treatment, biofeedback, in constipated patients is associated with improved gut transit and autonomic innervations. *Gut*, 49, 214 – 219. DOI: 10.1136/gut.49.2.214
- Eriksson, E.M., Andrén, K.I., Eriksson, H.T., & Kurlberg, G.K. (2008). Irritable bowel syndrome subtypes differ in body awareness, psychological symptoms and biochemical

stress markers. *World Journal of Gastroenterology*, 14(31), 4889 – 4896. DOI: 10.3748/wjg.14.4889

Farnam, A., Somi, M.H., Sarami, F., & Farhang, S. (2008). Five personality dimensions in patients with irritable bowel syndrome. *Neuropsychiatric Disease and Treatment*, 4(5), 959 – 962. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19183786>, on 15 April, 2012.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41, 1149-1160. DOI: 10.3758/BRM.41.4.1149

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. C. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality*, 40, 84 - 96. DOI: 10.1016/j.jrp.2005.08.007

Gros, D.F., Antony, M.M., McCabe, R.E., & Swinson, R.P. (2009). Frequency and severity of the symptoms of irritable bowel syndrome across the anxiety disorders and depression. *Journal of Anxiety Disorders*, 23(2), 290 – 296. DOI: 10.1016/j.janxdis.2008.08.004

Guthrie, E., & Thompson, D. (2002). ABC of psychological medicine: Abdominal pain and functional gastrointestinal disorders. *British Medical Journal*, 325, 701-703. DOI: 10.1136/bmj.325.7366.701

Halder, S.L.S, Locke III, G.R., Schleck, C.D., Zinsmeister, A.R., Melton, L.J., & Talley, N.J.. (2007). Natural history of functional gastrointestinal disorders: A 12-year longitudinal

- population-based study. *Gastroenterology*, 133, 799 – 807. DOI: 10.1053/j.gastro.2007.06.010.
- Henry, J.D., & Crawford, J.R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, 44, 227–239. DOI: 10.1348/014466505X29657
- Higgins, P. D. R., & Johanson, J. F. (2004). Epidemiology of constipation in North America: a systematic review. *The American journal of gastroenterology*, 99(4), 750-9. DOI:10.1111/j.1572-0241.2004.04114.x
- Hunt, M.G., Milonova, M., & Moshier, S. (2009). Catastrophizing the Consequences of Gastrointestinal Symptoms in Irritable Bowel Syndrome. *Journal of Cognitive Psychotherapy*, 23(2), 160 – 173. DOI: 10.1891/0889-8391.23.2.160
- Jones, M.P., Crowell, M.D., Olden, K.W., & Creed, F. (2007). Functional gastrointestinal disorders: an update for the psychiatrist. *Psychosomatics*, 48(2), 93 – 102. DOI: 10.1176/appi.psy.48.2.93
- Jung, H.K., Halder, S., McNally, M., Locke III, G.R., Schleck, C.D., Zinsmeister, A.R., & Talley, N.J. (2007). Overlap of gastro-oesophageal reflux disease and irritable bowel syndrome: prevalence and risk factors in the general population. *Alimentary Pharmacology & Therapeutics*, 26, 453 – 461. DOI: 10.111/j.1365-2036.2007.03366.x.
- Kiviruusu, O., Huurre, T., & Aro, H. (2007). Psychosocial resources and depression among chronically ill young adults: Are males more vulnerable? *Social Science & Medicine*, 65(2), 173 – 186. DOI: 10.1016/j.socscimed.2007.02.030.

- Koloski, N. A., Jones, M., Kalantar, J., Weltman, M., Zaguirre, J., & Talley, N.J. (2012). The brain-gut pathway in functional gastrointestinal disorders is bidirectional. *Gut*, 61(9), 1284-1290. DOI: 10.1136/gutjnl-2011-300474.
- Labus, J.S., Bolus, R., Chang, L., Wiklund, I., Naesdal, J., Mayer, E.A., & Naliboff, B.D. (2004). The Visceral Sensitivity Index: development and validation of a gastrointestinal symptom-specific anxiety scale. *Alimentary Pharmacology & Therapeutics*, 20, 89–97. DOI: 10.1111/j.1365-2036.2004.02007.x
- Labus, J.S., Mayer, E.A., Chang, L., Bolus, R., & Naliboff, B.D. (2007). The central role of gastrointestinal-specific anxiety in irritable bowel syndrome: further validation of the visceral sensitivity index. *Psychosomatic Medicine*, 69(1), 89 – 98. DOI: 10.1097/PSY.0b013e31802e2f24
- Lee, V., Guthrie, E., Robinson, A., Kennedy, A., Tomenson, B., Rogers, A., & Thompson, D. (2008). Functional bowel disorders in primary care: factors associated with health-related quality of life and doctor consultation. *Journal of Psychosomatic Research*, 64(2), 129 – 138. DOI: 10.1016/j.jpsychores.2007.09.004
- Little, R.J.A (1988). A test of missing completely at random for multivariate data with missing values. *Journal of The American Statistical Association*, 83 (404), 1198 – 1202. DOI: 10.1080/01621459.1988.10478722
- Leung, L., Riutta, T., Kotecha, J., & Rosser, W. (2011). Chronic constipation: An evidence-based review. *Journal of the American Board of Family Medicine: JABFM*, 24(4), 436 – 451. DOI: 10.3122/jabfm.2011.04.100272

- Locke III, G.R., Zinsmeister, A.R., Fett, S.L., Melton, L.J., & Talley, N.J. (2005). Overlap of gastrointestinal symptom complexes in a US community. *Neurogastroenterology and Motility*, 17, 29 – 34. DOI: 10.1111/j.1365-2982.2004.00581.x.
- Lovibond, P.F. & Lovibond, S.H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33, 335-343. DOI: 0.1016/0005-7967(94)00075-U
- Mayer, E.A., Naliboff, B.D., Chang, L., & Coutinho, S.V. (2001). Stress and irritable bowel syndrome. *American Journal of Physiology, Gastrointestinal and Liver Physiology*, 280, 519-524. Retrieved from <http://ajpgi.physiology.org/content/280/4/G519.full.pdf+html>, on 10 June 2012.
- Mearin, F., Baro, E., Roset, M., Badia, X., Zarate, N., & Perez, I. (2003). Clinical patterns over time in irritable bowel syndrome: Symptom instability and severity variability. *American Journal of Gastroenterology*, 99, 113 – 121. DOI: 10.1046/j.1572-0241.2003.04023.x
- Myers, B., & Meerveld, B.G. (2009). Role of anxiety in the pathophysiology of irritable bowel syndrome: importance of the amygdale. *Frontiers in Enteric Neuroscience*, 1, 1 – 10. DOI: 10.3389/neuro.21.002.2009
- Moss-Morris, R., Weinman, J., Petrie, K.J., Horne, R., Cameron, L.D., & Buick, D. (2002). The revised Illness Perception Questionnaire (IPQ-R). *Psychology and Health*, 17(1), 1 – 16. DOI: 10.1080/08870440290001494

- Muscatello, M.R.A., Bruno, A., Pandolfo, G., Mico, U., Stilo, S., Scaffidi, M., Consolo, P., Tortora, A., Pallio, S., Giacobbe, G., Familiari, L., & Zoccali, R. (2010). Depression, anxiety and anger in subtypes of Irritable Bowel Syndrome patients. *Journal of Clinical Psychology in Medical Settings*, 17, 64–70. DOI: 10.1007/s10880-009-9182-7
- Nagisa, S. & Shinobu, N. (2008). Relationship between cognitive appraisals of symptoms and negative mood for subtypes of irritable bowel syndrome. *BioPsychoSocial Medicine*, 2(9), 1- 6. DOI: 10.1186/1751-0759-2-9.
- Ormel, J., Rosmalen, J., & Farmer, A. (2004). Neuroticism: a non-informative marker of vulnerability to psychopathology. *Social Psychiatry and Psychiatric Epidemiology*, 39(11), 906 – 912. DOI: 10.1007/s00127-004-0873-y
- Oudenhove, L.V., Demyttenaere, K., Tack, J., & Aziz, Q. (2004). Central nervous system involvement in functional gastrointestinal disorders. *Best Practice & Research Clinical Gastroenterology*, 18(4), 663–680. DOI: 10.1016/j.bpg.2004.04.010
- Peppas, G., Alexiou, V.G., Mourtzoukou, E., & Falagas, M.E. (2008). Epidemiology of constipation in Europe and Oceania: a systematic review. *BMC gastroenterology*, 8(5). DOI: 10.1186/1471-230X-8-5
- Porcelli, P., Bagby, R.M., Taylor, G.J., Carne, M.D., Leandro, G., Todarello, O. (2003). Alexithymia as Predictor of Treatment Outcome in Patients with Functional Gastrointestinal Disorders. *Psychosomatic Medicine*, 65(5), 911 - 918. DOI:10.1097/01.PSY.0000089064.13681.3B

- Rao, S. S. C., Seaton, K., Miller, M. J., Schulze, K., Brown, C. K., Paulson, J., & Zimmerman, B. (2007). Psychological profiles and quality of life differ between patients with dyssynergia and those with slow transit constipation. *Journal of Psychosomatic Research*, 63, 441– 449. DOI: 10.1016/j.jpsychores.2007.05.016
- Rutter, C.L., & Rutter, D.R. (2002). Illness representation, coping and outcome in irritable bowel syndrome (IBS). *British Journal of Health Psychology*, 7(4), 377 – 391. DOI: 10.1348/135910702320645372
- Rutter, C.L., & Rutter, D.R. (2007). Longitudinal analysis of the illness representation model in patients with irritable bowel syndrome (IBS). *Journal of Health Psychology*, 12(1), 141 - 148. DOI: 10.1177/1359105307071748
- Schoth, D.E., Nunes, V.D., & Liossi, C. (2012). Attentional bias towards pain-related information in chronic pain; a meta-analysis of visual-probe investigations. *Clinical Psychology Review*, 32, 13 – 25. DOI: 10.1016/j.cpr.2011.09.004.
- Selby, W, & Corte, C. (2010). Managing constipation in adults. *Australian Prescriber*, 33(4), 116 – 119. Retrieved from <http://www.australianprescriber.com/magazine/33/4/116/9>, on 10 June 2012.
- Talley, N.J. (2008). Functional gastrointestinal disorders as a public health problem. *Neurogastroenterology & Motility*, 20(Suppl 1), 121 – 129. DOI: 10.1111/j.1365-2982.2008.01097.x
- Wald, A. (2007). Chronic constipation: advances in management. *Neurogastroenterology and Motility*, 19, 4-10. DOI: 10.1111/j.1365-2982.2006.00835.x

- Wong, R.K., Palsson, O.S., Turner, M.J., Levy, R.L., Field, A.D., Korff, M.V., & Whitehead, W.E. (2010). Inability of the Rome III criteria to distinguish functional constipation from constipation-subtype irritable bowel syndrome. *The American Journal of Gastroenterology*, 105(10), 2228- 2234. DOI: 10.1038/ajg.2010.200
- Zhou, L., Lin, Z., Lin, L., Wang, M., & Zhang, H. (2010). Functional constipation: implications for nursing interventions. *Journal of clinical nursing*, 19(13-14), 1838-43.
DOI:10.1111/j.1365-2702.2010.03246.x
- A Comparison between the 5 broad domains in Costa and McCrae's NEO Personality Inventory (NEO-PI-R) and the corresponding preliminary IPIP Scales measuring similar constructs.* (n.d.).
Retrieved from ipip.ori.org/newNEO_DomainsTable.htm, on 30 November 2012.

CHAPTER 3.

**ILLNESS SPECIFIC AND PROTECTIVE PSYCHOLOGICAL
FACTORS IN FUNCTIONAL GASTROINTESTINAL
DISORDERS**

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ABSTRACT

Introduction: While current psychological models of functional gastrointestinal disorders (FGIDs) suggest possible mechanisms maintaining these bowel syndromes, they have not included newly conceptualized psychological factors, and the influence of protective factors on FGID outcomes. This study examined the inter-relationship between psychological variables specific to FGIDs (FGID-related illness representations and visceral sensitivity) and mindfulness skills as a protective factor. **Method:** 144 participants from the Australian community were recruited to complete an anonymous online survey consisting of the ROME III Questionnaire, the International Personality Item Pool, the Visceral Sensitivity Index, the Five Facet Mindfulness Questionnaire, the Depression-Anxiety-Stress Scale, the Bowel Symptom Severity Scale, and the Revised Illness Perception Questionnaire. Path analysis was conducted. **Results:** Illness representations (illness coherence and emotional representation) and visceral sensitivity predicted significant additional variance in symptom severity and frequency above that predicted by neuroticism, depression, stress and anxiety. Path modelling revealed that emotional representation and visceral sensitivity fully mediated the relationship between neuroticism and symptom severity (distress) and frequency. Illness coherence independently and inversely predicted symptom severity and frequency. Mindfulness skills were found to inversely predict neuroticism. **Conclusion:** The results support the role of illness representations and visceral sensitivity in the maintenance of FGID symptoms and distress. They also suggest that mindfulness skills and illness coherence are potential protective factors in FGIDs.

Key words: Functional Gastrointestinal Disorders, Integrated Psychological Model, Illness Coherence, Emotional Representation, Mindfulness Skills, Visceral Sensitivity

3.1 Specific and Protective Psychological Factors in Functional Gastrointestinal Disorders

While many psychological models such as the biopsychosocial models and the cognitive behavioural models have been proposed to explain how FGIDs develop and are maintained (e.g. Deary, Chalder, & Sharpe, 2007; Wilhelmsen, 2005), none have included the role of “newer” psychological factors such as visceral sensitivity (Craske et. al., 2011) and illness representations (Rutter & Rutter, 2007) in FGIDs. Current models also do not consider the influence of potential protective factors on FGID symptoms and FGID-related distress. However, recent studies suggest that mindfulness might have important protective properties for FGIDs like irritable bowel syndrome (IBS)(Baer, 2003; Garland et. al., 2011). This paper thus aims to examine the roles and inter-relationships of these psychological factors in influencing FGID symptom frequency and symptom severity. These psychological factors are part of a proposed integrated psychological model of FGIDs consisting of FGID-specific and protective psychological factors, as well as the influence of more generic emotional processes (See Figure 3.1).

3.1.1 Visceral Sensitivity, Illness Representations and Their Relationship

Visceral Sensitivity involved in the perpetuation of FGID outcomes

One crucial element that is implied in all explanatory models of FGIDs, whether psychological or patho-physiological, is what perpetuates the bowel symptoms. Research into FGIDs like IBS has highlighted many inter-related patho-physiological and psychological factors involved in symptom perpetuation. Yet, many remain unknown (Oudenhove & Aziz, 2009). The existing psychological models have contributed to explaining FGIDs from a psychological

certain elements such as what contributes to gut-related anxiety and how does it lead to symptom activation, remain unknown.

Recent research findings have suggested that visceral sensitivity might play an important role in FGIDs. Visceral sensitivity is defined as the negative appraisal of and hyper-vigilance to abdominal sensations, and the resultant emotional reaction (Labus, et. al., 2007). Compared to other types of cognitive appraisals that focus on the consequences, severity or controllability of their symptoms (Jones, Koloski, Boyce, & Talley, 2011; Garland et. al., 2011; Martin & Crane, 2003), visceral sensitivity is a very specific process involving specific appraisals of abdominal sensations. Some studies have found that visceral sensitivity predicts bowel symptom severity (Labus, Mayer, Change, Bolus, & Naliboff, 2007). In addition, treatment research by Craske and colleagues (2011) found that interoceptive exposure focusing on visceral sensations and aiming to reduce catastrophic mis-appraisals of these sensations (i.e., visceral sensitivity) was more effective than attentional control, and equally effective to stress management training in improving IBS symptom measures and pain vigilance. These findings suggest that visceral sensitivity is an important psychological factor to target in treatment, and implicates its role in FGIDs.

Specifically, Craske and colleagues (2011) have proposed that visceral sensitivity might mediate between neuroticism and bowel symptom severity, and also functions like catastrophic appraisal of, and hypervigilance to bodily cues in panic disorder (i.e., the same cognitive process with a different content). Based on this model, visceral sensitivity seemed to have some overlaps with catastrophic interpretations of bowel sensations (Hunt, Milonova & Moshier, 2009), and it was proposed that such an interpretation can result in increased arousal, and hence distress, in IBS (Craske et. al., 2011). Whether this is true remains to be tested.

Other studies have also found (Wolitzky-Taylor, Craske, Labus, Mayer, & Naliboff, 2012) that changes in visceral sensitivity mediated changes in all IBS outcomes, regardless of any of the three treatment conditions participants were in. These findings are consistent with Labus and colleagues' (2004) research which showed that visceral sensitivity score predicted symptom severity. It is also possible that visceral sensitivity serves to increase or activate FGID symptoms by sensitizing the central and enteric nervous systems (Wilhelmsen, 2005), and by increasing perception of symptom severity. Increased symptom frequency might then contribute to increased visceral sensitivity.

Based on these research findings, visceral sensitivity is very likely one mediator in the sequence of psychological events (Jones et. al., 2007) that might activate and perpetuate FGID symptoms. It is also reasonable to expect that emotional experience of visceral sensitivity, as comprising of attentional focus, cognitive appraisal of symptoms and autonomic sensitization, to be similar to gut-related anxiety (Jones et. al., 2007). This argument has its basis in Cognitive-Behavioural models of anxiety disorders, which conceptualize anxiety as consisting of the dynamic interplay between cognitive appraisals and bodily arousal (Crane & Martin, 2003; Garland et. al., 2011). Indeed, the studies by Craske and colleagues (2011) and Wolitzky-Taylor and colleagues (2012) showed that visceral sensitivity and gut-related anxiety are closely related.

However, Craske and colleagues' (2011) argument that visceral sensitivity and IBS symptoms have the same relationship as sensitivity to bodily cues and panic attacks has only received indirect support in their study. Specifically, their conclusions were based on the results of comparing Cognitive Behavioural Therapy focused on visceral sensitivity versus focused on general stress management. No studies have directly ascertained if visceral sensitivity has the same relationship with IBS symptoms as sensitivity to bodily cues does to panic attacks.

Whether visceral sensitivity does indeed function in the way proposed by Craske and colleagues (2011) remains to be further validated. It is also notable that all the abovementioned studies use the Visceral Sensitivity Index (VSI) as a means of assessing the construct of visceral sensitivity. While the VSI has sound psychometric properties (Labus et. al, 2004), the use of a single measure might not adequately capture the dynamic nature of visceral sensitivity.

Illness Coherence and Emotional Representation: Influencing Visceral Sensitivity

Another unknown is what predisposes an individual to engage in the process of appraisal and hyper-vigilance that characterizes visceral sensitivity. Similarly, what contributes to the “content” (e.g., abdominal sensations are bad) of the “process” in visceral sensitivity is unclear. Put simply, visceral sensitivity does not just happen “out-of-the-blue”. A review of illness representation studies and the Cognitive Behavioural model of FGIDs suggest that illness representation might be one set of psychological factors that influences visceral sensitivity. Specifically, illness representations of FGIDs could influence how a person interprets (appraises) abdominal sensations and focuses his or her attention excessively on minute sensations (hyper-vigilance). Consistent with the “Beckian” model of Cognitive Therapy (Westbrook, Kennerley, & Kirk, 2011), illness representations are illness-specific core beliefs (Hagger & Orbell, 2003) and like other core beliefs, will drive assumptions on how to function around a situation, in this case, one’s FGID, which in turn guides negative automatic thoughts (i.e., mis-interpretations) and day-to-day bowel changes. Together, these result in distress and bowel-related anxiety.

Illness representations are structured core beliefs and theories about an illness (Hagger & Orbell, 2003). They include an individual’s beliefs about what the illness is, what causes it, what

can cure it, how long it lasts, how much sense it makes to the person, and also the emotional reaction to the illness (Hagger & Orbell, 2003). There has been research suggesting that illness representations have significant impact on IBS-related outcomes. For instance, Rutter and Rutter (2002) found that IBS sufferers who endorsed beliefs that bowel symptoms had negative consequences, as well as possessed poor personal control over their IBS, reported lower quality of life and higher depression and anxiety scores. They also found that believing in psychological causes of IBS was positively correlated with anxiety and depression. Additionally, coping styles mediated the relationship between these illness representations and outcomes such as anxiety, depression and quality of life (Rutter & Rutter, 2002).

In a later study, they also found that these illness representations remained constant across time in IBS sufferers (Rutter & Rutter, 2007). Further, Riedl and colleagues (2009) found that individuals with IBS who espoused somatic theories as to the cause of their IBS reported higher levels of bowel symptoms, while those who believed that their symptoms were related to their emotional state reported poorer mental quality of life. Overall, these findings are consistent with studies in related Functional Somatic Syndromes (FSSs) such as chronic pain (Page et. al., 2004) and chronic fatigue syndrome (Gray & Rutter, 2007; Knoop, Prins, Moss-Morris, & Bleijenberg., 2010). Specifically, these studies all found that illness representations predicted illness outcomes such as quality of life and functioning.

However, Rutter and Rutter (2002, 2007) have not studied other illness representations such as Illness Coherence and Emotional Representation. Respectively, these refer to how much an individual makes sense of his or her illness (Gray & Rutter, 2007; Jopson & Moss-Morris, 2003; Rees et. al., 2004) and the emotional reactions that have come to be associated with their illness, that is, their emotional schema (Gray & Rutter, 2007; Chaboyer, Lee, Wallis, Gillespie,

& Jones, 2010). Research into these two illness representations suggests that they play important roles in illness experience. For instance, Paddison, Alpass, & Stephens (2010) found that illness coherence is positively associated with quality of life and inversely related to distress in diabetes sufferers. Likewise, Chaboyer and colleagues (2010) found that emotional representation predicted psychological health-related quality of life of Taiwanese students – the stronger the emotional representation, the worse their reported quality of life.

Illness representations might have an influence on visceral sensitivity as well. Specifically, emotional representations might influence visceral sensitivity in the same way as emotions affect reasoning and cognitive interpretations (Muris, Merckelbach, Schepers & Meesters, 2003). Emotional representations such as anxiety or frustration might affect how an individual appraises his bowel symptoms. It may also influence the tendency to engage in the process of negative appraisal. Indeed, Labus and colleagues (2004) found that visceral sensitivity mediated generic emotions and psychological factors like anxiety and neuroticism, and IBS symptoms. It is hence reasonable to expect that visceral sensitivity would mediate between emotional representations and FGID outcomes as well.

Conversely, research has shown that making sense of one's illness such as chronic pain helps to alleviate the distress it causes (Graham, Lobel, Glass, & Lokshina, 2008). A study found that a writing intervention designed to help chronic pain patients make sense of their condition significantly and independently improved their depression (Graham, et. al., 2008). Furthermore, illness coherence positively predicts how much an individual focuses on bowel symptoms (Gray and Rutter, 2007). This suggests that the more sense or understanding an individual has about his or her IBS, the less likely he or she would mis-appraise benign

abdominal sensations. Drawing from these findings, it can be argued that an increased understanding of one's FGIDs would change the *content* of negative gut appraisals.

In sum, illness representations predispose and influence visceral sensitivity. Emotional representations predispose the tendency to have visceral sensitivity while greater illness coherence decreases visceral sensitivity.

3.1.2 Neuroticism and Emotional Representation: An Emotional Vulnerability

Many have suggested that neuroticism is a generic risk factor that *indirectly* affects the development of many mental disorders and some medical conditions (De Gucht, Fischler & Heiser, 2004; Ormel, Rosmalen & Farmer, 2004; Farnam et. al., 2008). With regards to its association with IBS, Farnam and colleagues (2008) found that persons with IBS-C (constipation subtype) tended to score higher on the NEO-FFI compared to other IBS subtypes. Tayama and colleagues (2012) found a similar pattern. Specifically, they discovered that young adults with IBS-C (Diarrhoea subtype) tended to score higher on a neuroticism measure such as the Maudsely Personality Inventory, as compared to IBS-C sufferers, while IBS-C sufferers themselves reported higher levels of neuroticism as compared to healthy controls.

Likewise, Tanum and Malt (2001) found that people who suffered from FGID, including IBS, tended to score higher on neuroticism as measured by the NEO-PI, as compared to healthy controls. Further, Naliboff and colleagues (2008) found that in women with IBS, higher levels of neuroticism were associated with greater degrees of startle response to threat. They suggested that their results supported the hypothesis that IBS sufferers tended to be hyper-sensitive to

visceral sensations, which in turn activates bowel symptoms. Overall, these studies highlight the association between FGIDs and neuroticism.

These researchers have argued that neuroticism makes a person vulnerable to developing negative emotional states (Farnam et. al., 2008; Tayama, 2012). This implies that neuroticism would also influence emotional representations in FGIDs, which are negative emotional reactions with an FGID content. Tayama and colleagues (2012) hypothesized that high levels of neuroticism worsens negative emotions such as depression, which activate the hypothalamic-pituitary-adrenocortical (HPA) axis. This in turn aggravates the brain-gut axis, resulting in IBS symptoms. Similarly, Naliboff and colleagues' (2008) findings suggest that neuroticism might play a role in potentiating fearful threat responses in IBS sufferers, which then activates IBS symptoms. Hence, it is argued that neuroticism, emotional representations and visceral sensitivity form an emotional pathway, from generic emotional tendencies (neuroticism) to more specific contents (emotional representation) and processes (visceral sensitivity).

3.1.3 Mindfulness Skills as Protective Factors

According to psychological research, mindfulness - the capacity to focus one's attention in the present moment (Feltman, Robinson & Ode, in press) in a receptive (Khong, 2009), non-judgemental (Giluk, 2009) and open way (Bishop et al., 2004; Brown, Ryan & Creswell, 2007), seems to have protective functions. It has received empirical support in terms of its beneficial effects on various psychological and physical conditions. For instance, Feltman, Robinson and Ode (in press) found that mindfulness moderated the predictive effects of neuroticism on negative mood states such as depression and trait anger – possibly through the re-direction of attention.

Importantly, Ljotsson and colleagues (2011) found that mindfulness training combined with standard exposure therapy helped IBS sufferers reduce their symptoms and their distress associated with bowel symptoms, as well as increased their subjective experience of well-being. These researchers suggested that mindfulness might enhance the distress tolerance capacity of IBS sufferers, which is one postulated mechanism of its maintenance. Even more encouragingly, Garland and colleagues (2011) further found that mindfulness training improved IBS symptom severity/ distress. Non-reactivity, a mindfulness skill, was particularly important in reducing IBS symptom severity. These findings highlight the significance of mindfulness skills in FGIDs.

Moreover, the various processes underlying mindfulness skills might mitigate various processes involved in FGIDs. For instance, the emotional regulatory (Garland et. al., 2011) and attention control (Feltman, Robinson & Ode, in press) properties of mindfulness skills mitigate the distress that arises from both generic negative emotions as well as visceral sensitivity, which perpetuate or complicate bowel symptoms. In a similar vein, researchers (e.g, Kerr, Josyula, & Littenberg, 2011) have also found that mindfulness processes such as non-reacting, non-judging and intimacy with experience (similar to acting with awareness; Baer, 2003), are key skills in helping participants relate to their distress in a more constructive way. Additionally, findings from Garland and colleagues (2011) suggest that one facet of mindfulness (non-reacting) directly predicted changes in visceral sensitivity, suggesting the influence of mindfulness in changing visceral sensitivity.

Further based on Ljotsson and colleagues' (2011) proposition regarding the increased ability to tolerate distress (i.e., perceived symptom severity) bestowed by the practice of mindfulness skills, mindfulness skills in this case might reduce distress associated with experiencing symptoms, which in turn mitigates the arousal of the central nervous system-enteric

nervous systems. This will also discontinue the perpetuation of FGID symptoms. Finally, research has shown that mindfulness skills have an inverse relationship to neuroticism (Giluk, 2009). The pathway from neuroticism to emotional representation followed by visceral sensitivity might be yet another avenue through which mindfulness skills mitigate FGID outcomes.

In sum, mindfulness skills are potentially an important protective factor in mitigating FGID symptoms and distress. Existing research suggests that they might influence FGID outcomes through regulating emotions involved directly and indirectly in FGIDs, increasing distress tolerance, via the neuroticism – visceral sensitivity pathway.

3.1.4 Overall Summary: The Inter-relationships between Illness Representations, Visceral Sensitivity and Mindfulness Skills

Based on the research reviewed above and the proposed integrated model in Chapter 1, illness representations are posited to influence or predispose visceral sensitivity. Visceral sensitivity in turn will result in increased distress, which will then lead to greater symptom frequency, which itself feeds back onto visceral sensitivity. Emotional representation will be influenced by neuroticism. Mindfulness skills will mitigate FGID symptoms by influencing distress and visceral sensitivity directly, by way of its relationship with neuroticism.

3.1.5 Aims & Hypotheses

This study aims to examine the relationships between illness representations, visceral sensitivity, mindfulness and neuroticism as new elements in the integrated psychological model of FGIDs. Based on the research reviewed above, it was hypothesized that:

- Emotional representation and visceral sensitivity will completely mediate the relationship between neuroticism and symptom severity.
- Visceral sensitivity will form a feedback cycle with symptom severity (distress) and symptom frequency.
- Illness coherence will negatively predict visceral sensitivity and have a negative relationship with Emotional Representation.
- Mindfulness will negatively predict neuroticism, visceral sensitivity and symptom severity.

Figure 3.2 summarizes the hypothesized inter-relationships between these factors.

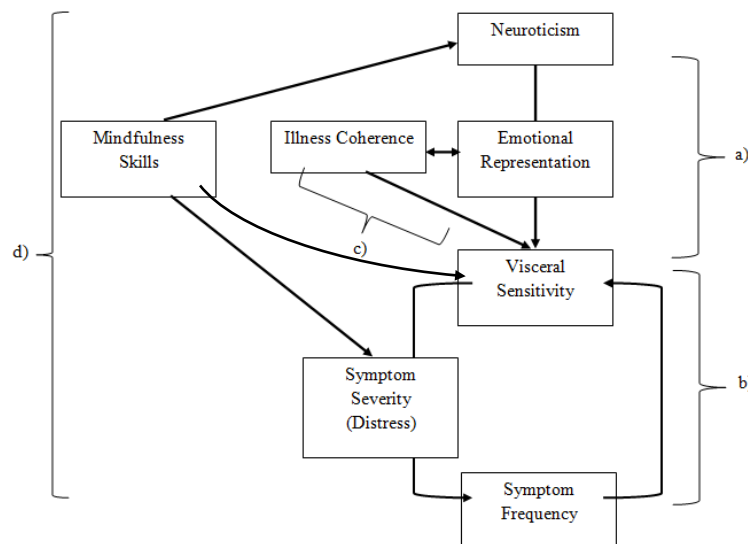


Figure 3.2 The hypothesized relationships between illness representations, visceral sensitivity, neuroticism and mindfulness skills

3.2 METHOD

3.2.1 Participants

144 ($N_{\text{male}} = 27$, $N_{\text{females}} = 117$) participants were recruited from several sources: 1) from the community (in response to advertisements placed on newspapers, and various online social media webpages such as Facebook and Gumtree), 2) patient populations at the John Hunter Hospital NSW, and 3) from an undergraduate psychology student pool at Macquarie University, Sydney. The inclusion criteria for participation were: 1) 18 years of age or older, 2) indication of some FGID symptoms (constipation or diarrhea, abdominal pain, abdominal discomfort, bloating) regularly for a period of time (e.g., 3 months). 14.8% of male participants fell within the 25 – 30 year old range, and 11.1% fell within each of the 18 – 24 and 56 – 60 year old ranges. The remainder fell within the other age ranges. 18.8% of female participants fell within the 18 -24 year old range, while the remainder were distributed across the other age ranges (each consisting of less than 10% of the female participants). 56% of the sample met criteria for IBS-C (constipation subtype), 14% met criteria for other IBS subtypes, 21% for chronic constipation. 9% did not meet any ROME III criteria.

3.2.2. Procedure

Participants completed an anonymous online survey using Qualtrics. Upon completion of the survey, participants could choose to register for a AUD60 prize draw. They could also download some free stress management material. This study was approved by the Macquarie University Human Research Ethics Committee.

3.2.3 Measures

International Personality Item Pool (IPIP; Goldberg et. al., 2006). The 10 self-statement IPIP items selected assess non-clinical neuroticism (the tendency to experience low moods). Items are rated along a 5-point scale (1 = Very inaccurate, 5 = Very accurate as a description of you), where participants are asked to rate how accurately these items described them presently. An example of an item is “Am often down in the dumps.” Items 2, 3, 6, 7, and 9 are reverse-scored. After reverse scoring, a single score is calculated by summing up responses to all 10 items. For this study, the Cronbach’s alpha for the IPIP was $\alpha = .85$ indicating good internal consistency.

Five Facet Mindfulness Questionnaire (FFMQ; Baer et. al., 2008). The FFMQ is a 39-item (self-statement) measure of dispositional mindfulness. It is rated along a 5-point scale (1 = Never or Very rarely true, 5 = Very often or Always true). Participants are asked to rate how true each statement was in describing their experience. An example of an item is “When I take a shower or bath, I stay alert to the sensations of water on my body.” Items 3, 5, 8, 10, 12, 13, 14, 16, 17, 18, 22, 23, 25, 28, 34, 35, 38, and 39 are reverse-scored. Five scores (one each for the subscales corresponding to the different facet of mindfulness – Observe, Describe, Acting with Awareness, Non-judging and Non-reacting) are calculated by summing up the scores for the corresponding items for each subscale. For this study, Cronbach’s alpha for the five subscales were Observe $\alpha = .76$, Describe $\alpha = .89$, Acting with Awareness $\alpha = .88$, Non-judging $\alpha = .76$, and Non-reacting $\alpha = .77$ respectively.

ROME III questionnaire (Drossman & Dumitrascu, 2006). The ROME III is an 18-question screening measure of Irritable Bowel Syndrome and Functional Constipation. This questionnaire

is the composite of the Irritable Bowel Syndrome and Functional Constipation modules of the ROME foundation questionnaires (<http://www.romecriteria.org/>). The questions ask participants about the frequency and duration of specific symptoms as well as changes in bowel functioning in relation to these symptoms. The scoring method for this questionnaire is based on a decision tree method where certain key symptoms must be endorsed along with a minimal number of other symptoms before the criteria for Irritable Bowel Syndrome or Functional Constipation is met. For this study, the Cronbach's alpha for the ROME-III was $\alpha = .62$ indicating that it approaches good internal consistency.

Bowel Symptom Severity Scale (BSSS; Boyce, Gilchrist, Talley & Rose, 2000). The BSSS is a 24-question self-report measure of eight bowel symptoms, their perceived severity and perceived interference over the past week. It is rated along a 5-point scale for symptom frequency (1 = Not at all, 5 = More than once a day), and another 5 point scale for perceived severity and interference (1 = Not at all, 5 = Extremely). An example of an item is "Over the past week on how many occasions did you have hard or lumpy stools when you had a bowel motion?" Three scores (one each for symptom frequency, perceived severity and perceived interference) are calculated by summing up the scores for eight corresponding items for each subscale. For this study, the Cronbach's alpha for the three subscales were Symptom Frequency $\alpha = .67$, Symptom Severity $\alpha = .82$, and Interference $\alpha = .86$ respectively.

Illness Perception Questionnaire - Revised (IPQ-R; Moss-Morris et. al., 2002). The IPQ-R is a multi-component questionnaire assessing various personal beliefs about an illness. Altogether,

the IPQ-R consists of 70 items made up of declarative statements and a list of physical symptoms. For the purposes of the present study, only the Illness Coherence and Emotional Representation subscales were used. The items of these subscales are rated along a 5- point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Scores for these subscales are obtained by summing up items relevant to them to form two scores. For this study, the Cronbach's alpha for the two subscales were Illness Coherence $\alpha = .93$ and Emotional Representation $\alpha = .87$, reflecting good internal consistency.

Visceral Sensitivity Index (VSI; Labus et. al., 2004). The VSI is a 15-item (self-statement) measure of visceral sensitivity which is rated along a 6-point scale (1 = Strongly agree, 6 = Strongly Disagree). Participants are asked to rate how much each statement agreed with their personal experience. An example of an item is "I often worry about problems in my belly." A single total score is calculated by summing up the scores for all 15 items. For this study, the Cronbach's alpha for the VSI was $\alpha = .91$ indicating that it has good internal consistency.

3.2.4 Data Analysis Strategy

Data analysis was undertaken using AMOS 20. The following steps were taken:

1. Data Management

Overall there was 12.5% of data missing. Little's Missing Completely At Random (MCAR) test (Little, 1988) was first conducted to ascertain the nature of the missing data. Results indicated

that data was missing completely at random – MCAR: $X^2 = 923.175$, $df = 2982$, $p = 1.000$.

Missing data was imputed by mean substitution.

2. Assumption Testing

Prior to analysis, assumptions were tested. Score on the IPIP, DASS-21 subscales, and BSSS-Symptom Severity subscale were normally distributed after Square Root Transformation. There were no problems with both univariate outliers. Likewise, there were no problems multivariate outliers - Mahalanobis distance analyses indicated that 4 cases fell outside the critical χ^2 for $df = 16$ (at $\alpha = 0.05$) of 28.85. As path analysis results without these four outliers were not significantly different from path analysis results with all cases included, it was decided to retain these four outliers. The sample size of $N = 144$ met the recommended 5:1 case-to-parameter ratio (actual $N/q > 4.50$; Bentler & Chou, 1987). Analysis of multi-collinearity indicated that there were no problems in this area (Tolerance > 0 ; VIF < 5).

3. Bivariate Correlations, Means and Standard Deviations

Table 3.1 presents the bivariate correlations between psychological factors, as well as their respective means and standard deviations.

4. Hypothesis testing

Path analysis using AMOS 20 was conducted to test the hypotheses. Path analysis was chosen as it allowed for the simultaneous analysis of various mediated and moderated pathways predicted in the psychological model, which could not otherwise be assessed using standard multiple regression models. Based on the standards recommended by Byrne (2010; $N = 5$ for

each specific path), the sample size for this study was adequate for path analysis. Additionally, each of the measures used had previously been factor analysed and evidenced factor structures that matched with their scoring (Boyce, Gilchrist, Talley & Rose, 2000; Baer et. al., 2008; Goldberg et. al., 2006; Labus et. al., 2004; Moss-Morris et. al., 2002), allowing for path analysis.

Three categories of fit indices (i.e., absolute fit indices, parsimony corrected indices and comparative fit indices) were examined to ascertain if the hypothesized relationships between the psychological factors fit the sampled data. The absolute fit indices – the chi-squared goodness of fit (χ^2) and the Standardized Root Mean Square (SRMR) ascertained if the sample covariance-variance matrices coincided with the predicted covariance-variance matrices. The parsimony corrected indices – the Root Mean Squared Error of Approximation (RMSEA) is the gold standard – indicate poor parsimony in the hypothesized model. The comparative fit indices compared the hypothesized model to other possible models. Commonly used indices for this purpose include Comparative Fit Index (CFI) and the Non-Normed Fitted Index (NNFI; Harrington, 2009). Models were considered to have acceptable fit with the sample data when χ^2 was non-significant, $SRMR < .08$, $RMSEA < .08$, $P\text{-}Close > .05$; $CFI > .9$, and $NNFI > .9$ (Schreiber, Stage, King, Nora & Barlow, 2006).

Based on recommendations for data analysis (Byrne, 2010) the overall pattern of these fit indices was observed to ascertain if the hypothesized model was supported. Models were re-specified and goodness-of-fit indices were re-examined (Byrne, 2010).

Table 3.1
Bivariate correlations, means and standard deviations of study variables

Variables (N = 144)	Means (SD)	1	2	3	4	5	6	7	8	9	10	11
1. Neuroticism	30.86 (8.03)		.34**	-.10	.42**	.16	-.15	-.42**	-.50**	-.4**	.26**	.14
2. Visceral Sensitivity	56.21 (15.48)			-.30**	.63**	.18*	-.02	.05	-.18*	-.20*	.54**	.37**
3. Illness Coherence	14.56 (5.14)				-.37**	-.01	.10	-.07	.04	.08	-.36**	-.36**
4. Emotional Representation	19.24 (4.70)					.20*	.01	-.09	-.26**	-.19*	.48**	.25**
5. Observe	3.20 (.68)						.27**	-.02	-.25**	.22**	.15	.18*
6. Describe	3.40 (.76)							.36**	.27**	.16	.00	.24**
7. Act with awareness	3.09 (.75)								.51**	.30**	-.05	.08
8. Non-judging	3.06 (.85)									.26**	-.10	.03
9. Non-reacting	2.83 (.66)										-.18*	-.04
10. Symptom Severity	17.79 (5.81)											.63**
11. Symptom Frequency	18.79 (4.57)											

* <.05 ** < .01

3.3 RESULTS

3.3.1 Diagnostic groups & Bivariate Correlations

Based on the ROME III criteria, 81 participants met the criteria for IBS-C, 20 participants met the criteria for other IBS diagnoses (IBS-D and IBS-A), eight participants met the full criteria for FC while 23 participants endorsed two or more functional constipation symptoms. 12 participants did not meet criteria for any ROME III categories.

Overall, the correlations in Table 3.1 showed that the direction of the variable relationships were largely consistent with theoretical propositions and the hypotheses in this paper. For instance, illness coherence was reasonably negatively correlated ($r > .05$) with visceral sensitivity, emotional representation, symptom severity and symptom frequency. Additionally, visceral sensitivity was strongly correlated with emotional representation ($r = .63$) and symptom severity ($r = .54$). Further, emotional variables like emotional representation and neuroticism correlated with symptom severity in the expected direction. However, the direction of correlation between two mindfulness skills (observe and describe) and visceral sensitivity, emotional representation, symptom severity and symptom frequency was positive instead of negative. This indicates that simple awareness (reflected by observe and describe) without the contribution of the other mindfulness skills might result in greater distress. In support of this argument, the other mindfulness skills were indeed negatively correlated, albeit at a smaller magnitude than expected to these psychological variables, as indicated by the literature.

3.3.2 Validating the Hypothesized Model of Neuroticism, Mindfulness, Illness

Representations and Visceral Sensitivity

Based on the literature on mindfulness (Garland et. al., 2011; Kerr et. al., 2011) and the pattern of correlation of between mindfulness skills and the other psychological factors, only three mindfulness skills were included in the hypothesized model. These were “acting with awareness”, “non-judging” and “non-reacting”. Additionally, the covariances between these three skills were included into the model as research indicates that they are highly correlated (Baer et. al., 2008). Further, the covariance between illness coherence and emotional representation was included in the model as illness coherence has been found to be inversely related to emotional distress, represented in this instance by emotional representations (Paddison, Alpass, & Stephens, 2010). The initial model is represented in Figure 3.3. Fit indices results for the initial hypothesised model indicated overall poor model fit where $\chi^2 = 38.46$ ($df = 19$, $N = 144$), $p = .01$ and $SRMR$ was .75; poor parsimony, where the $RMSEA$ was .09 ($P\text{-close} = .07$); despite acceptable comparative fit indices where the CFI was .95; and the $NNFI$ was .90.

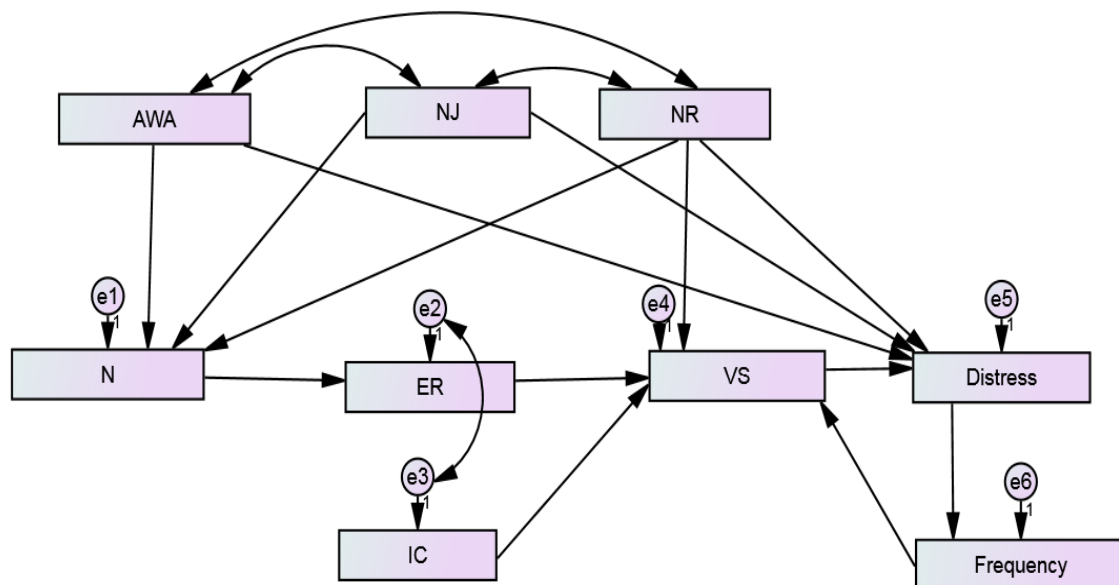


Figure. 3.3 Initial hypothesized model of the inter-relationship between neuroticism (N), emotional representation (ER), illness coherence (IC), visceral sensitivity (VS), mindfulness skills (AWA, NJ, NR), symptom severity (Distress) and symptom frequency (Frequency).

Analyses of the paths between psychological factors for this hypothesised model indicated that the mindfulness skills- acting with awareness, non-reacting and non-judging were unrelated to symptom severity ($p > .05$), which was consistent with the largely non-significant correlations between these variables. Similarly, illness coherence and symptom frequency did not significantly predict visceral sensitivity. These mis-specified models are summarized in Table 3.2 below. Overall, these results indicated some misspecifications in the initial model.

Following examination of modification indices and significance of specified paths, and where suggested by theory, a simplified model was re-specified and tested. This model included a direct chain of influence from neuroticism, to emotional representation, the visceral sensitivity, to symptom severity, which finally influences symptom frequency. The three mindfulness skills only predicted Neuroticism. This relationship was also found by Giluk (2009) and is consistent with the strong negative correlations between neuroticism and these mindfulness skills.

Illness coherence was specified to directly predict both symptom severity and symptom frequency without mediation by visceral sensitivity. This was based on research indicating the direct relationship between coherence and illness outcomes (Graham et. al., 2008). The fit indices for the initial hypothesised model, the modified models and the final model are presented in Table 3.2 below.

Table 3.2*Fit indices for original hypothesised model, modified models and final model*

Model	χ^2	<i>p</i>	<i>SRMR</i>	<i>RMSEA</i>	<i>P-Close</i>	<i>CFI</i>	<i>NNFI</i>
1. Original hypothesised model	38.64	.01	.75	.08	.07	.95	.91
2. Non-significant paths removed:	43.62	.01	.08	.07	.15	.95	.93
NJ → Distress Frequency → VS NR → Distress AWA → Distress IC → VS N → VS							
3. Illness Coherence as predictor (final model)							
IC → Distress	35.39	.06	.06	.06	.35	.97	.96
IC → Freq	30.18	.13	.06	.05	.51	.98	.97

Fit indices results for the final model indicated a better overall fit with the data, where $\chi^2 = 30.18$ ($df = 23$, $N = 144$), $p = .13$ and *SRMR* was .06; good parsimony with *RMSEA* at .05 ($P\text{-close} = .51$); and good comparative fit, with *CFI* at .98; and the *NNFI* at .97. The final model is represented by Figure 3.4 which also includes the standardized regression weights for each path. Table 3.3 summarized the parameter estimates for both re-specified (final) model.

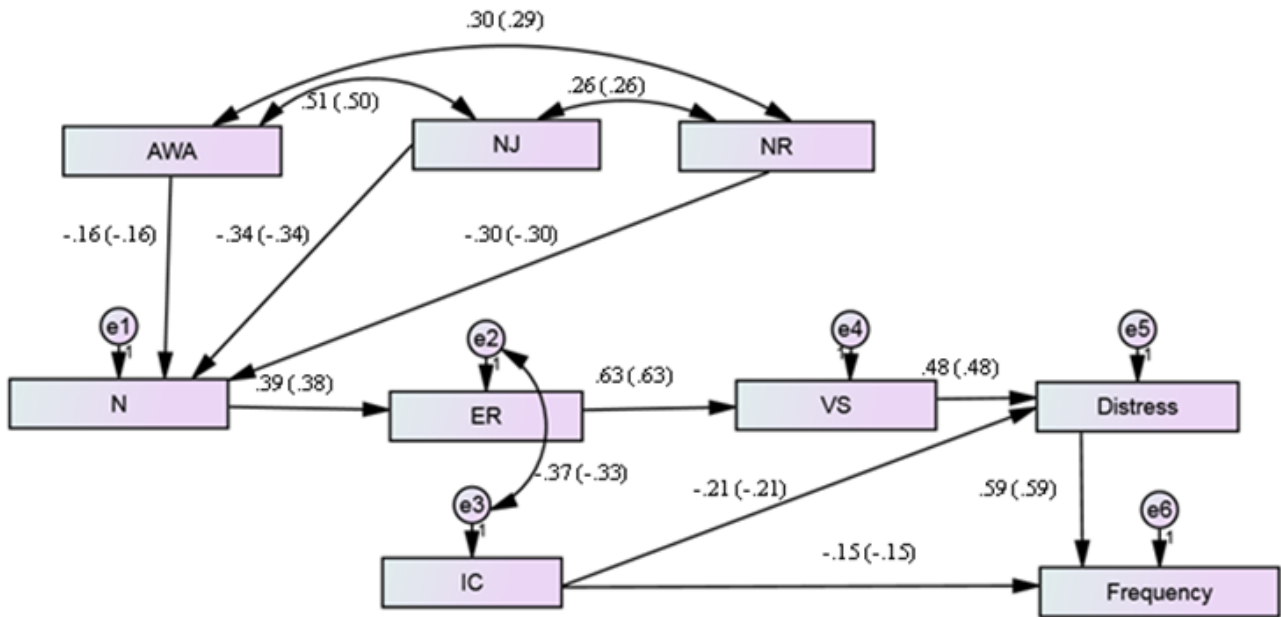


Figure. 3.4 The final (re-specified) model of the inter-relationship between neuroticism (N), emotional representation (ER), illness coherence (IC), visceral sensitivity (VS), mindfulness skills (AWA, NJ, NR), symptom severity (Distress) and symptom frequency (Frequency); with regression weights and standardized regression weights (brackets) for each path.

Table 3.3

Unstandardized and Standardized Regression Weights for the final model

Parameters	Unstandardized Estimate (Standard Error)	Standardized Estimate	p
AWA → Neo	-.16 (.08)	-.16	.04
NR → Neo	-.30 (.07)	-.30	***
NJ → Neo	-.34 (.08)	-.35	***
Neo → ER	.39 (.07)	.38	***
ER → VS	.63 (.07)	.63	***
VS → Distress	.48 (.07)	.48	***
IC → Distress	-.21 (.07)	-.21	.00
Distress → Freq	.59 (.07)	.59	***
IC → Freq	-.15 (.07)	-.15	.02

The standardized indirect and direct (i.e., the combined effect of mediated pathways between two variables) effects of neuroticism, illness coherence, emotional representation, visceral sensitivity and symptom severity on symptom frequency are presented in Table 3.4

below. These estimates reflect the effect size of direct and mediated pathways between variables.

Table 3.4

Standardized Direct and Indirect Effects of Neuroticism, Illness Representations, Visceral Sensitivity, and Mindfulness on Symptom Severity and Frequency

Relationships Between Variables	Direct Effects	Indirect Effects
Neuroticism → Emotional Representation	.39	NA
Neuroticism → Visceral Sensitivity	NA	.25
Neuroticism → Symptom Severity	NA	.12
Neuroticism → Symptom Frequency	NA	.07
Emotional Representation → Visceral Sensitivity	.63	NA
Emotional Representation → Symptom Severity	NA	.30
Emotional Representation → Symptom Frequency	NA	.17
Visceral Sensitivity → Symptom Severity	.48	NA
Visceral Sensitivity → Symptom Frequency	NA	.27
Illness Coherence → Symptom Severity	-.22	NA
Illness Coherence → Symptom Frequency	-.15	-.12
Acting with Awareness → Neuroticism	-.16	NA
Acting With Awareness → Emotional Representation	NA	-.06

Table 3.4 (Cont'd)

Standardized Direct and Indirect Effects of Neuroticism, Illness Representations, Visceral Sensitivity, and Mindfulness on Symptom Severity and Frequency

Relationships Between Variables	Direct Effects	Indirect Effects
Acting With Awareness → Visceral Sensitivity	NA	-.04
Acting With Awareness → Symptom Severity	NA	-.02
Acting With Awareness → Symptom Frequency	NA	-.01
Non-reacting → Neuroticism	-.30	NA
Non-reacting → Emotional Representation	NA	-.12
Non-reacting → Visceral Sensitivity	NA	-.07
Non-reacting → Symptom Severity	NA	-.04
Non-reacting → Symptom Frequency	NA	-.02
Non-judging → Neuroticism	-.34	NA
Non-judging → Emotional Representation	NA	-.13
Non-judging → Visceral Sensitivity	NA	-.08
Non-judging → Symptom Severity	NA	-.04
Non-judging → Symptom Frequency	NA	-.02

The endogenous psychological factors in the re-specified model yielded the following squared multiple correlations: $r^2_{\text{neuroticism}} = .37$, $r^2_{\text{emotional representation}} = .15$, $r^2_{\text{visceral sensitivity}} = .40$, $r^2_{\text{symptom severity}} = .32$ and $r^2_{\text{symptom frequency}} = .41$. This suggested that 40.7% of the variance was accounted for by neuroticism, emotional representation, illness coherence, visceral sensitivity and symptom severity. This also indicated that 31.8% of variance in symptom severity was accounted for by neuroticism, emotional representation, and visceral sensitivity. Mindfulness skills accounted for 73.4% of variance in neuroticism, which itself accounted for 15.2% of variance in emotional representation. Emotional representation accounted for 39.6% of variance in visceral sensitivity.

In sum, the evidence for model fit was mixed and implied misspecifications for the initial hypothesised model. The differences between the RMSEA indices for the initial and final models suggested that the model specified in Figure 3.4 was more parsimonious. The model suggested that the relationship between neuroticism and symptom frequency was fully mediated by emotional representation, visceral sensitivity and symptom severity. Additionally, illness coherence directly and inversely predicted symptom severity and symptom frequency. Finally, the relationship between the three mindfulness skills symptom severity was fully mediated through neuroticism alone.

3.4 DISCUSSION

This study examined the relationships between illness representations, visceral sensitivity, mindfulness, neuroticism and their influence on FGID symptom severity and symptom frequency. These relationships are new elements in a larger integrated psychological model that was proposed. This is the first study examining the relationship

between predisposing factors for visceral sensitivity, as well as the contributions of mindfulness skills as a potential protective factor in FGIDs.

Overall, the hypothesized model was partially supported by the results. That is, the hypothesis that emotional representation and visceral sensitivity will completely mediate the relationship between Neuroticism and Distress was fully supported. This study further supported the role of neuroticism (Ormel, et. al., 2004; Farnam et. al., 2008) in FGIDs but found that it worked by influencing illness representations and appraisal (visceral sensitivity). This result also supported a cognitive-behavioural type relationship between schemata and appraisal, as well as personality and schemata (Westbrook, et. al., 2011). The findings also highlighted the role of visceral sensitivity as a mediator between emotional representation and the acute experience of distress (perception of symptom severity) that stems from FGID symptom activation.

The hypothesis that visceral sensitivity will form a feedback cycle with symptom severity and FGID symptoms was only partially supported. That is, symptom severity completely mediated the relationship between visceral sensitivity and symptom frequency. However, symptom frequency did not predict or influence visceral sensitivity, meaning that there was no reciprocal relationship between these two factors. This is consistent with Labus and colleagues' (2007) proposition that visceral sensitivity does predict symptom severity, only in this case, mediated by the acute distress (subjective perception of symptom severity). Specifically, visceral sensitivity predicted the perception of symptom severity, which in turn predicted symptom frequency. The results however contradict Craske and colleagues' (2011) argument of the panic disorder model of visceral sensitivity in that it does not seem to function in the way hyper-vigilance and negative appraisal to bodily cues in panic disorders would. It is likely that there are other intervening variables in between visceral sensitivity and symptom frequency, as it is reasonable to consider that appraisal (visceral sensitivity)

will be affected by how frequently an individual experiences symptoms (i.e., some form of confirmation bias of the visceral sensitivity). Another possibility for the lack of cyclical relationship between visceral sensitivity, symptom severity and symptom frequency might be methodological. Specifically, the results might be limited by the way visceral sensitivity was measured, in this case using only the VSI in a cross-sectional design. These limitations do not allow for the validation of the dynamic relationships between visceral sensitivity, symptom severity and symptom frequency.

What this result does suggest nonetheless, is that emotional representation, mediated by visceral sensitivity and symptom severity, can influence and possibly exacerbate symptom frequency/ occurrence. This finding is consistent with research on illness representations, showing that more negative illness representations tended to be associated with poorer symptom outcomes (Rutter & Rutter, 2002).

The hypothesis that illness coherence will negatively predict visceral sensitivity and have a negative relationship with emotional representation was only partially supported. This hypothesis was based on the argument that the less a person understood their illness, the more distressing they will find it. The assumption is that uncertainty regarding the nature of illness is stressful (Lee & McCormick, 2002). Illness coherence did not predict visceral sensitivity at all. Consistent with existing research on the inter-relationship between illness representations (Moss-Morris, 2002), illness coherence had an inverse relationship with emotional representation.

Additionally, illness coherence directly and inversely predicted symptom severity and symptom frequency, which contradicted the hypothesized model where the relationship between illness coherence and FGID outcomes will be mediated by visceral sensitivity. In fact, the relationship between symptom severity, symptom frequency and illness coherence as the degree of personal understanding of FGIDs was partially mediated by the emotional

representation-visceral sensitivity link. This suggests that illness coherence mitigates symptom frequency and distress partially by regulating emotions, and partially via other possible mechanisms.

That illness coherence mitigates emotional reactions to FGID highlights the salutary effects of meaning-making and understanding. Indeed, this finding is expected because FGIDs sufferers often receive social messages that contradict their own experience. For example, they are told that nothing is wrong with them despite their often severe symptoms. This can be confusing (Lee & McCormick, 2002). Presumably the less confused one is, the less distressing it is, which in turn reduces the central sensitization (Oudenhove & Aziz, 2009) and symptom activation. What is surprising is that illness coherence as a schema did not influence the cognitive appraisal involved in visceral sensitivity directly. It is unclear at this point why this is so. Further research into the nature of visceral sensitivity and illness coherence would elucidate this point. Overall, the finding for this hypothesis suggested that illness coherence can act as another protective factor in FGID. It also explained in part how cognitive-behavioural therapy works (Lackner et. al., 2006) on FGIDs like IBS. Specifically, cognitive and behavioural experimental interventions (Westbrook, et. al., 2011) aim to increase or help individual develop a more realistic and coherent understanding of their illness, which would then serve to reduce unrealistic and anxiety-provoking appraisals.

Finally, the hypothesis that mindfulness will negatively predict neuroticism, visceral sensitivity and symptom severity was partially supported. Specifically, only three aspects of mindfulness (acting with awareness, non-react and non-judging) negatively predicted neuroticism. They did not predict FGID symptom severity at all, which contradicted the argument that mindfulness skills regulate distress (Ljotsson and colleagues, 2011). Indeed, taken together with the fact that these mindfulness skills were significantly correlated with symptom severity, this result suggests that mindfulness skills possibly influenced FGID

outcomes (symptom severity and frequency) indirectly through the central emotional processes as represented by neuroticism, emotional representation and visceral sensitivity. It is also interesting to note that the results did not replicate Garland and colleagues' (2011) findings that non-reacting directly predicted visceral sensitivity. A possible explanation for this indirect effect could be that mindfulness is a generic skill that does not specifically focus on FGID-specific appraisal or distress (symptom severity). Conversely, as demonstrated by Ljotsson and colleagues' (2011) study, mindfulness that is targeted to tolerating distress over FGID symptoms does have a direct effect on this distress.

The relationship between mindfulness and neuroticism is consistent with findings by other researchers (Giluk, 2009). Further, the fact that only three out of five of the mindfulness aspects had significant effect in the processing of FGIDs might attest to the particular importance of these aspects in regulating emotions (Baer et. al., 2008). In fact, a study of the correlations indicated that merely being aware (i.e., observing) was positively related to symptom frequency. In other words, the greater one observes one's symptoms, the more one experiences them. This suggests that this aspect *alone* might in fact *worsen* FGID symptom presentation. Overall, the results support the importance of protective factors in FGIDs and the potential of mindfulness skills in mitigating the FGID experience.

The findings of this study support the importance of visceral sensitivity, illness representation, and protective factors in FGIDs. This model is also a more useful case formulation heuristic for psychologists working with clients suffering from FGIDs. Moreover, it has explanatory value in that it posits several pathways through which psychological treatments might work in FGIDs. Furthermore, these results provide some explanation as to how mindfulness training might work in FGIDs like IBS (Ljotsson et al., 2010).

Finally, the findings support the use of meaning-making interventions in psychological treatments of FGIDs as they may improve illness coherence and mitigate FGID symptom frequency and severity. This is often absent in traditional cognitive-behavioural treatments of FGIDs like IBS (Blanchard, 2001), which focuses more on challenging negative appraisals associated with IBS and exposure to aversive bowel symptoms (Ljotsson et. al., 2010). Incorporating Pennebaker's writing paradigm (Halpert, Rybin, & Doros, 2010) in psychological treatments might be beneficial for FGID sufferers. Indeed, a pilot study doing just this found that expressive writing as a way of helping IBS sufferers express their distress and also develop a better understanding of their IBS significantly improved symptom severity reports and cognitive appraisals (Halpert et. al., 2010).

This study has limitations, as with every study. Firstly, the cross-sectional nature of the study and the use of path analysis techniques does not allow for causality to be inferred. It is only predictive, but does support the causal relationships that have been conceptualized. Secondly, the participants in the study were a self-selected, predominantly non-clinical sample. While the majority met ROME III criteria for FGIDs on a self-report measure, diagnosis involves negative results from a battery of medical tests to rule out other gastrointestinal disorders like IBS and Crohn's Disease. As this was not carried out, the potential presence of non-FGIDs will reduce the generalizability of the psychological model. Thirdly, the sample size for this study, while adequate for path analysis purposes (Byrne, 2010), was still small. A larger sample would ensure greater power in terms of path analysis, and might result in a different final model.

Hence, it is important for future research to replicate and expand this model with a clinical sample. It is also important to replicate this modelling study with a more diverse and much larger sample of FGIDs to ascertain its generalizability, and more importantly, whether different FGIDs have different unique psychological processes, much as different anxiety

disorders have different key processes. (Turk, Heimberg, & Magee, 2008). It would also be ideal to employ a longitudinal design to flesh out the specific causal directions in this model. Further, it would be advisable to study other FGID-specific and protective factors in FGIDs. In fact, illness coherence and the factors that promote it could be protective factors worth studying. An examination of some of the positive psychological literature (Gable & Haidt, 2005) might provide further avenues of study.

In conclusion, this study provides preliminary support for the role of newly conceptualized FGID-specific psychological factors and protective factors in FGIDs. Future studies could further clarify and elaborate upon this aspect of the model.

References

- Baer, R.A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Psychological Science*, *10*(2), 125-143. DOI: 10.1093/clipsy/bpg015
- Baer, R.A., Smith, G.T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J.M.G. (2008). Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment*, *15*(3), 329 – 342. DOI: 10.1177/1073191107313003
- Bentler, P. M., & Chou, C.P. (1987). Practical issues in structural modeling. *Sociological Methods and Research*, *16*(1), 78-117. DOI: 10.1177/0049124187016001004
- Bishop, S.R., Lau, M., Shapiro, S., Carlson L., Anderson, N.D., Carmody, J., Segal, Z.V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology Science and Practice*, *11*, 230 – 241. DOI: 10.1093/clipsy/bph077
- Blanchard, E. B. (2001). Irritable Bowel Syndrome: Psychosocial Assessment and Treatment. Washington, DC: American Psychological Association.
- Boyce, P., Gilchrist, J., Talley, N.J., & Rose, D. (2000). Cognitive–behaviour therapy as a treatment for irritable bowel syndrome: a pilot study. *Australian and New Zealand Journal of Psychiatry*, *34*, 300–309. DOI: 10.1046/j.1440-1614.2000.00731.x
- Byrne, B.M. (2010). *Structural Equation Modeling with AMOS: Basic Concepts, Applications and Programming (2e)*. New York: Routledge.

- Brown, K.W., Ryan, R.M., & Creswell, J.D. (2007). Mindfulness : Theoretical Foundations and Evidence for its Salutory Effects. *Psychological Inquiry*, 18(4), 211 – 237. DOI: 10.1080/10478400701598298
- Chaboyer, W., Lee, B.-O., Wallis, M., Gillespie, B., & Jones, C. (2010). Illness representations predict health-related quality of life 6 months after hospital discharge in individuals with injury: a predictive survey. *Journal of Advanced Nursing*, 66(12), 2743-50. DOI:10.1111/j.1365-2648.2010.05431.x
- Craske, M.G., Wolitzky-Taylor, K.B., Labus, J., Wu, S., Frese, M., Mayer, E.A., & Naliboff, B.D. (2011). A cognitive-behavioral treatment for irritable bowel syndrome using interoceptive exposure to visceral sensations. *Behaviour Research and Therapy*, 49, 413 – 421. DOI: 10.1016/j.brat.2011.04.001.
- De Gucht, V., Fischler, B., & Heiser, W. (2004). Neuroticism, alexithymia, negative affect, and positive affect as determinants of medically unexplained symptoms. *Personality and Individual Differences*, 36(7), 1655-1667. DOI: 10.1016/j.paid.2003.06.012
- Deary, V., Chalder, T., & Sharpe, M. (2007). The cognitive behavioural model of medically unexplained symptoms: a theoretical and empirical review. *Clinical Psychology Review*, 27(7), 781 – 797. DOI: 10.1016/j.cpr.2007.07.002
- Drossman, D. A., & Dumitrascu, D. L. (2006). Rome III: New Standard for Functional Gastrointestinal Disorders. *Journal of Gastrointestinal and Liver Disorders*, 15(3), 237-241. DOI: 10.1053/j.gastro.2006.03.008
- Farnam, A., Somi, M.H., Sarami, F., & Farhang, S. (2008). Five personality dimensions in patients with irritable bowel syndrome. *Neuropsychiatric Disease and Treatment*,

4(5), 959 – 962. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19183786>,
on 15 April, 2012.

Feltman, R., Robinson, M.D., & Ode, S. (in press). Mindfulness as a moderator of
neuroticism-outcome relations: A self-regulation perspective. *Journal of Research in
Personality*. DOI: 10.1016/j.jrp.2009.08.009.

Gable, S.L., & Haidt, J. (2005). What (and why) Is positive psychology? *Review of
General Psychology*, 9(2), 103 – 110. DOI: 10.1037/1089-2680.9.2.103.

Garland, E.L., Gaylord, S.A., Palsson, O., Faurot, K., Mann, J.D., & Whitehead, W.E.
(2011). Therapeutic mechanisms of a mindfulness-based treatment for IBS: effects on
visceral sensitivity, catastrophizing, and affective processing of pain sensations.
Journal of Behavioral Medicine, 35(6), 591-602. DOI: 10.1007/s10865-011-9391-z

Giluk, T. L. (2009). Mindfulness, Big Five personality, and affect: A meta-analysis.
Personality and Individual Differences, 47(8), 805 – 811. DOI:
10.1016/j.paid.2009.06.026

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., &
Gough, H. C. (2006). The International Personality Item Pool and the future of public-
domain personality measures. *Journal of Research in Personality*, 40, 84 - 96. DOI:
10.1016/j.jrp.2005.08.007

Graham, J.E., Lobel, M., Glass, P., & Lokshina, I. (2008). Effects of written anger
expression in chronic pain patients: Making meaning from pain. *Journal of
Behavioural Medicine*, 31, 201 – 212. DOI 10.1007/s10865-008-9149-4.

Gray, S. E., & Rutter, D. R. (2007). Illness representations in young people with Chronic Fatigue Syndrome. *Psychology & Health*, 22(2), 159-174.

DOI:10.1080/14768320600774595

Hagger, M. S., & Orbell, S. (2003). A meta-analytic review of the common-sense model of illness representations. *Psychology*, 18(2), 141-184. DOI:

10.1080/088704403100081321

Halpert, A., Rybin, D., & Doros, G. (2010). Expressive writing is a promising therapeutic modality for the management of IBS: A pilot study. *American Journal of*

Gastroenterology, 105, 2440–2448. DOI: 10.1038/ajg.2010.246.

Harrington, D. (2009). Confirmatory Factor Analysis. NY: Oxford University Press.

Hunt, M.G., Milonova, M., & Moshier, S. (2009). Catastrophizing the Consequences of Gastrointestinal Symptoms in Irritable Bowel Syndrome. *Journal of Cognitive*

Psychotherapy, 23(2), 160 – 173. DOI: 10.1891/0889-8391.23.2.160

International Personality Item Pool: A Scientific Collaboratory for the Development of Advanced Measures of Personality Traits and Other Individual Differences

(<http://ipip.ori.org/>). Internet Web Site. Retrieved from

<http://ipip.ori.org/newNEOKey.htm#Neuroticism>, on 10 June 2012.

Jones, M.P., Crowell, M.D., Olden, K.W., & Creed, F. (2007). Functional gastrointestinal disorders: an update for the psychiatrist. *Psychosomatics*, 48(2), 93 – 102. DOI:

10.1176/appi.psy.48.2.93

Jones, M., Koloski, N., Boyce, P., & Talley, N. J. (2011). Pathways connecting cognitive behavioral therapy and change in bowel symptoms of IBS. *Journal of psychosomatic*

research, 70(3), 278-85. Elsevier B.V. DOI:10.1016/j.jpsychores.2010.10.004

- Jopson, N. M., & Moss-Morris, R. (2003). The role of illness severity and illness representations in adjusting to multiple sclerosis. *Journal of Psychosomatic Research*, 54(6), 503-511. DOI:10.1016/S0022-3999(02)00455-5
- Kerr, C.E., Josyula, K., & Littenberg, R. (2011). Developing an observing attitude: An analysis of meditation diaries in an MBSR clinical trial. *Clinical Psychology and Psychotherapy*, 18, 80 – 93. DOI: 10.1002/cpp.700
- Khong, B.S.L. (2009). Expanding the understanding of Mindfulness: Seeing the tree and the forest. *The Humanistic Psychologist*, 37(2), 117 – 136. DOI: 10.1080/08873260902892006
- Knoop, H., Prins, J. B., Moss-Morris, R., & Bleijenberg, G. (2010). The central role of cognitive processes in the perpetuation of chronic fatigue syndrome. *Journal of psychosomatic research*, 68(5), 489 - 94. DOI:10.1016/j.jpsychores.2010.01.022
- Labus, J.S., Bolus, R., Chang, L., Wiklund, I., Naesdal, J., Mayer, E.A., & Naliboff, B.D. (2004). The Visceral Sensitivity Index: development and validation of a gastrointestinal symptom-specific anxiety scale. *Alimentary Pharmacology & Therapeutics*, 20, 89–97. DOI: 10.1111/j.1365-2036.2004.02007.x
- Labus, J.S., Mayer, E.A., Chang, L., Bolus, R., & Naliboff, B.D. (2007). The central role of gastrointestinal-specific anxiety in irritable bowel syndrome: further validation of the visceral sensitivity index. *Psychosomatic Medicine*, 69(1), 89 – 98. DOI: 10.1097/PSY.0b013e31802e2f24
- Lackner, J. M., Coad, M.L., Mertz, H.R., Wack, D.S., Katz, L.A., Krasner, S.S., Firth, R., Mahl, T.C., & Lockwood, A.H. (2006). Cognitive therapy for irritable bowel

syndrome is associated with reduced limbic activity, GI symptoms, and anxiety.

Behaviour research and therapy, 44(5), 621 – 638. DOI: 10.1016/j.brat.2005.05.002

Lee, Y., & McCormick, B.P. (2002). Sense making process in defining health for people with chronic illnesses and disabilities. *Therapeutic Recreation Journal*, 36(3), 235 – 246. Retrieved on, <http://www.calvin.edu/~yl33/research.html>, on 15 September 2012.

Little, R.J.A (1988). A test of missing completely at random for multivariate data with missing values. *Journal of The American Statistical Association*, 83 (404), 1198 – 1202. DOI: 10.1080/01621459.1988.10478722

Ljotsson, B., Andreevitch, S., Hedman, E., Ruck, C., Andersson, G., & Lindefors, N. (2010). Exposure and mindfulness based therapy for irritable bowel syndrome--an open pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, 41(3), 185 – 190. DOI: 10.1016/j.jbtep.2010.01.001

Ljotsson, B., Hedman, E., Lindfors, P., Hursti, T., Lindefors, N., Andersson, G., Ruck, C. (2011). Long-term follow-up of internet-delivered exposure and mindfulness based treatment for irritable bowel syndrome. . *Behaviour Research and Therapy*, 49(1), 58 - 61. DOI: 10.1016/j.brat.2010.10.006

Martin, M., & Crane, C. (2003). Cognitions and the body: Somatic attributions in irritable bowel syndrome. *Behavioural and Cognitive Psychotherapy*, 31(1), 13 – 31. DOI: 10.1017/S1352465803001036

Moss-Morris, R., Weinman, J., Petrie, K.J., Horne, R., Cameron, L.D., & Buick, D. (2002). The revised Illness Perception Questionnaire (IPQ-R). *Psychology and Health*, 17(1), 1 – 16. DOI: 10.1080/08870440290001494

- Muris, P., Merckelbach, H., Schepers, S., & Meesters, C. (2003). Anxiety, threat perception abnormalities, and emotional reasoning in nonclinical Dutch children. *Journal of Clinical, Child and Adolescent Psychology*, 32(3), 453 – 459. DOI: 10.1207/S15374424JCCP3203_13
- Naliboff, B.D., Waters, A.M., Labus, J.S., Kilpatrick, L., Craske, M.G., Negoro, H., & Ibrahimovic, H. (2008). Increased acoustic startle responses in IBS patients during abdominal and nonabdominal threat. *Psychosomatic Medicine*, 70, 920–927. DOI: 10.1097/PSY.0b013e318186d858.
- Ormel, J., Rosmalen, J., & Farmer, A. (2004). Neuroticism: a non-informative marker of vulnerability to psychopathology. *Social Psychiatry and Psychiatric Epidemiology*, 39(11), 906 – 912. DOI: 10.1007/s00127-004-0873-y
- Oudenhove, L.V., & Aziz, Q. (2009). Recent insights on central processing and psychological processes in functional gastrointestinal disorders. *Digestive and Liver Disease*, 41(11), 781 – 787. DOI: 10.1016/j.dld.2009.07.004.
- Paddison, C. A. M., Alpass, F. M., & Stephens, C. V. (2010). Using the Common Sense Model of illness self- regulation to understand diabetes-related distress□: The importance of being able to “make sense ” of diabetes. *New Zealand Journal of Psychology*, 39(1), 45 – 50. Retrieved from, http://www.psychology.org.nz/cms_show_download.php?id=525, on 15 September 2012.
- Page, L., Howard, L. M., Husain, K., Tong, J., Dowson, J., Weinman, J., & Wessely, S. C. (2004). Psychiatric morbidity and cognitive representations of illness in chronic daily

headache. *Journal of psychosomatic research*, 57(6), 549-55.

DOI:10.1016/j.jpsychores.2004.04.371

Rees, G., Fry, A., Cull, A., & Sutton, S. (2004). Illness perceptions and distress in women at increased risk of breast cancer. *Psychology and Health*, 19(6), 749 – 765. DOI: 10.1080/08870440412331279764

Riedl, A., Maass, J., Fliege, H., Stengel, A., Schmidtman, M., Klapp, B.F., & Monnikes, H. (2009). Subjective theories of illness and clinical and psychological outcomes in patients with irritable bowel syndrome. *Journal of Psychosomatic Research*, 67(5), 449 – 455. DOI: 10.1016/j.jpsychores.2009.02.001.

Rutter, C.L., & Rutter, D.R. (2002). Illness representation, coping and outcome in irritable bowel syndrome (IBS). *British Journal of Health Psychology*, 7(4), 377 – 391. DOI: 10.1348/135910702320645372

Rutter, C.L., & Rutter, D.R. (2007). Longitudinal analysis of the illness representation model in patients with irritable bowel syndrome (IBS). *Journal of Health Psychology*, 12(1), 141 - 148. DOI: 10.1177/1359105307071748

Schreiber, J.B., Stage, F.K., King, J., Nora, A., & Barlow, E.A. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, 99(6), 323 – 337. Retrieved from <http://search.proquest.com.ezproxy.library.uq.edu.au/docview/204202199?accountid=14723>

Tanum L., & Malt U.F. (2001). Personality and physical symptoms in nonpsychiatric patients with functional gastrointestinal disorder. *Journal of Psychosomatic Research*, 50(3), 139–146. DOI: [http://dx.doi.org/10.1016/S0022-3999\(00\)00219-1](http://dx.doi.org/10.1016/S0022-3999(00)00219-1)

- Tayama, J., Nakaya, N., Hamaguchi, T., Tomiie, T., Shinozaki, M., Saigo¹, T., Shirabe¹, S., & Fukudo, S. (2012). Effects of personality traits on the manifestations of irritable bowel syndrome. *BioPsychoSocial Medicine*, 6(20), 1 - 8. DOI: 10.1186/1751-0759-6-20.
- Turk, C.L., Heimberg, R.G., & Magee, L. (2008). Social Anxiety Disorder. In Barlow, D.H. (Ed.) *Clinical Handbook of Psychological Disorders, Fourth Edition: A Step-by-Step Treatment Manual* NY: The Guilford Press.
- Westbrook, D., Kennerley, H., & Kirk, J. (2011). *An Introduction to Cognitive Behaviour Therapy: Skills and Applications* (2e). London: SAGE.
- Wilhelmsen, I. (2005). Biological sensitisation and psychological amplification: Gateways to subjective health complaints and somatoform disorders. *Psychoneuroendocrinology*, 30(10), 990 – 995. DOI: 10.1016/j.psyneuen.2005.01.011
- Wolitzky-Taylor, K., Craske, M.G., Labus, J.S., Mayer, E.A., & Naliboff, B.D. (2012). Visceral sensitivity as mediator of outcome in treatment of irritable bowel syndrome. *Behaviour Research and Therapy*, 50, 647 – 650. DOI: 10.1016/j.brat.2012.05.010

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CHAPTER 4.
**A CASE SERIES EXPLORATION OF A PSYCHOLOGICAL
MODEL OF IRRITABLE BOWEL SYNDROME**

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ABSTRACT

Introduction: Many psychological models have been proposed to explain irritable bowel syndrome (IBS). However, most of these are based on cross-sectional data which do not allow researchers to validate the dynamic relationships between psychological factors and how these relationships affect IBS symptoms and distress. This study aims to examine the dynamic relationship between visceral sensitivity, negative emotions, mindfulness skills, IBS symptoms and distress using a case series. The relative influence of visceral sensitivity and negative emotions on distress following mindfulness skill training is also explored. **Method:** Six participants from the Australian community were recruited to participate in an eight-week mindfulness skills training program. They were required to complete a series of questionnaires and a daily diary measuring symptoms, distress and various psychological variables. Analyses included reliable and clinically significant change calculations, visual analysis of daily diary plots, cross-correlation function analyses and random effects regression modeling. **Results:** While mindfulness skills training did not result in clinically significant or reliable change symptoms, distress, visceral sensitivity or negative emotions, visual analysis of diary plots indicated that there was a trend towards change in these variables. It was found that changes in visceral sensitivity predicted changes in distress to a more consistently and to greater degree than negative emotions, following mindfulness skills training. **Conclusion:** The results provide some support for the role of mindfulness skills as a protective factor and also highlighted the uniqueness and centrality of visceral sensitivity over generic negative emotions in IBS.

Key words: Irritable Bowel Syndrome, Visceral Sensitivity, Negative Emotions, Mindfulness Skills, Case Series

4.1 A Case Series Exploration of a Psychological Model of Irritable Bowel Syndrome

Psychological models of irritable bowel syndrome (IBS) attempt to explain the role of the dynamic relationships between various psychological factors in the development, maintenance and exacerbation of bowel symptoms and the distress associated with them. However, much of the literature regarding IBS and psychological models of this syndrome are based on cross-sectional data, which does not allow researchers to validate these dynamic relationships. Additionally, cross-sectional data does not consider individual differences in psychological factors and IBS outcomes and how these vary across time, nor do they allow for the influence of extra-model psychological factors.

A new integrated psychological model for functional gastrointestinal disorders (FGIDs) was proposed. This model delineates the roles of FGID-specific psychological factors (FGID-related illness representations and visceral sensitivity), generic emotional processes, and protective factors (mindfulness skills) in FGID symptoms and distress. The roles of visceral sensitivity, illness representation and mindfulness were tested in a previous study (Chapter 3) and were supported or partially supported. However, the results of the previous study had the same methodological limitations as those of other studies of psychological models using cross-sectional data. This study aims to explore the effects of mindfulness skills training on the dynamic relationship between psychological factors in the integrated psychological model by using a case series.

4.1.1 The integrated Psychological Model: Specific and Generic Emotional Processing and Protective Factors

The illness-specific psychological processes can be considered central and specific to FGIDs. They consist of emotional representations (Moss-Morris et al., 2002; Rees, Fry, Cull, & Sutton, 2004) about FGIDs and their contribution to visceral sensitivity, that is, the anxious appraisal and hyper-vigilance of abdominal sensations (Labus et. al., 2004). These in turn increases the experiences of distress which exacerbates bowel symptoms. Research into visceral sensitivity has also proposed that visceral sensitivity, distress and symptoms form a self-perpetuating chain analogous to the negative appraisal, anxiety, arousal chain in the panic disorder cycle (Craske et. al., 2011).

In contrast, the generic psychological processes involve neuroticism, which refers to the general tendency to experience negative emotions, (Ormel, Rosmalen, & Farmer, 2004) and its contribution to the development of general negative emotions of anxiety, depressed mood, and stress reaction. Stress reaction refers to chronic but non-specific physiological arousal, and falls along the continuum from “normal” to clinical in terms of severity. (Lackner & Quigley, 2005). These generic psychological processes are reciprocally influential on FGID-related distress by activating the central nervous system-enteric nervous system connection (Wilhelmsen, 2005). Together, they are considered a peripheral pathway in FGIDs as they do not involve FGID-specific psychological factors.

It was further proposed that mindfulness skills would have protective functions by mitigating the emotional processes involved in the central and peripheral pathways, as the emotional regulatory properties of mindfulness skills have received empirical support (e.g., Vøllestad, Nielsen, & Nielsen, 2012). Recent studies have also supported the contribution of mindfulness interventions in improving distress tolerance in irritable bowel syndrome (Ljotsson and colleagues, 2010, 2011; Garland and colleagues, 2011).

Results of a previous study (Chapter 3) supported parts of this integrated psychological model. Specifically, the central pathway was tested using path analysis and demonstrated good model fit. It was found that the link between neuroticism and symptom frequency was fully mediated by emotional representations, visceral sensitivity, and distress in this order. Importantly, visceral sensitivity seemed to be a crucial mediating variable between illness beliefs and FGID outcomes. This provided some support for the unique contribution of these variables in FGIDs. However, the self-perpetuating cyclical relationship between visceral sensitivity, distress and symptoms was not supported. This could be due to the presence of additional mediating factors, or methodological limitations of the previous study (i.e., using Visceral Sensitivity Index as the online measure of visceral sensitivity, in a cross-sectional research design).

It was further found that three mindfulness skills - acting with awareness, non-reactance and non-judgment negatively predicted neuroticism but did not predict distress directly. Additionally, illness coherence – the personal sense an individual has of their FGID (Rees et. al., 2004), was found to directly and negatively predict both FGID-symptom frequency and distress, suggesting the salutary effects of increased illness coherence.

Overall, the findings of this study highlighted the importance of emotional processes, both central and peripheral, in the maintenance of FGID distress and symptoms. They also provided some impetus for the notion that emotional regulation plays an important role in FGIDs.

4.2.2 Further Questions

There are still many questions about the model that remain, three of which will be considered in this study. Firstly, mindfulness seemed to have a very indirect and tenuous

influence on a series of psychological factors that could be one of the central pathways in FGIDs. It is still uncertain if and how much mindfulness skills will affect elements in the central and peripheral pathways in actual clinical practice.

Secondly, the model proposed that central processes such as visceral sensitivity and peripheral processes characterised by general negative emotions influence distress and FGID symptoms. However, because of the cross-sectional nature of the previous study's design, this proposed direction of influence remains to be validated.

Thirdly, while two emotional pathways have been proposed in the integrated model – the FGID-specific (with visceral sensitivity as the key element) and the generic or non-specific (characterised by negative emotions), there has been no comparison between how much and how consistently each influences FGID outcomes.

How strong are Mindfulness Skills as a protective factor?

With regards to the first question, several possibilities exist. While the inverse relationship between mindfulness skills and negative emotions have received empirical and theoretical support (Arch & Craske, 2010; Vøllestad, Nielsen & Nielsen, 2012), this was not examined in the previous study. Additionally, contrary to findings by Garland and colleagues (2011) that visceral sensitivity mediated the relationship between non-reactivity and symptom severity, the previous study did not find a direct relationship between mindfulness skills and any of elements of the central pathway (i.e., emotional representation, visceral sensitivity, symptom severity). In short, it is unclear if mindfulness skills will actually have an impact on visceral sensitivity.

The findings in the previous study seemingly contradicted with Ljotsson's and colleagues' (2010, 2011) finding that mindfulness and Cognitive Behavioural therapy interventions improved visceral sensitivity among other outcome measures. However, it is unclear whether this improvement stemmed from the cognitive behavioural aspect of the treatment or the mindfulness aspect. Indeed, it could be that the Cognitive Behavioural treatment aspect predominantly contributed to the change in visceral sensitivity. In effect, Cognitive Behavioural therapy might help an individual become less reactive to information received from the bowels, that is, subjective feelings of symptom severity, by actively reducing negative appraisals of this information.

This proposition is tenable as visceral sensitivity, defined and measured with the Visceral Sensitivity Index (Labus et. al., 2004);) has a cognitive appraisal (of bowel symptom) component, and may benefit from cognitive restructuring interventions (Westbroek, Kennerley, & Kirk, 2011; Jones, Koloski, Boyce, & Talley, 2011). Indeed, Ljotsson and colleagues (2010) themselves suggested that the treatment could have worked by using exposure as an additional means of helping participants change their appraisals of symptoms, with mindfulness training as an adjunct in enhancing the exposure intervention.

However, some theorists have argued that mindfulness skills can exert a direct impact on cognitions. For instance, Feltman, Robinson and Ode (in press) suggested that the self-monitoring and attention-switching properties of being mindfully present derails the downward spiral of habitual negative cognitions and ruminations which typically result in negative mood states. Further, Shapiro, Carlson, Astin, and Freedman (2006) suggested that cognitive changes can happen as a result of applying mindfulness skills to one's experiences. Garland and colleagues (2011) also found that mindfulness training predicted reductions in visceral sensitivity and pain catastrophizing in sufferers of IBS.

In sum, whether changes in mindfulness skills will actually correspond to changes in central elements like visceral sensitivity and peripheral elements like negative emotions remains to be examined with more powerful and direct tests. If changes in mindfulness skills do not correspond to changes in central or peripheral emotional elements, then it is a poor set of protective factors. This might then point to the need for more specific or salient protective factors in IBS, such as illness coherence for instance.

The Dynamic Relationships: What is the direction of influence amongst these variables?

The order of influence of the various factors in the FGID-specific and non-specific/generic emotional pathways has not been tested, particularly in actual clinical practice. This is due to the cross-sectional nature of the design employed in the previous study, which does not allow for validation of the “causal” direction between the elements in the pathways (Borckardt et. al., 2008). It is possible that in clinical practice, the order of influence might be very different to those proposed in the psychological model. One possible outcome for instance, is that all factors change simultaneously, as proposed by some theorists (Deary, Chalder, & Sharpe, 2007). Another set of outcomes could be that psychological factors such as visceral sensitivity and negative emotions will precede IBS symptoms and distress. For instance, researchers such as Garland and colleagues (2011) validated models where visceral sensitivity predicted IBS symptom severity. The precedence of visceral sensitivity was also found in the previous study. Similarly, some researchers found that negative emotions such as anxiety influence IBS symptoms (Myers and Greenwood-Van Meerveld, 2009). Examining the order of change between psychological and symptom factors across time would provide further indication of causal directions between these factors, highlighting the precedence and hence importance, of certain psychological factors over others. Such information would extend the psychological model of FGIDs.

How important is visceral sensitivity compared to negative emotions in IBS?

While the proposed structure of the central pathway has received some empirical support in Chapter 3, it is still uncertain as to how important visceral sensitivity is compared to general negative emotions in influencing IBS outcomes. To elaborate, the question remains if visceral sensitivity is a sufficiently important variable - is it one of the key psychological processes that predicts IBS-related distress (Berger, 1998; Sim, Gwee & Bateman, 2005), compared to negative emotions? This is because there has been no comparison of the relative effects of the visceral sensitivity and negative emotions in predicting FGID outcomes such as distress.

While the Bio-Psycho-Social models of IBS have suggested that certain negative emotions such as anxiety help to perpetuate symptoms and distress (Jones et. al., 2011), research has indicated that their influence on IBS outcomes is inconsistent. For instance, some researchers have found that emotions such as anxiety, anger and worrying do not present consistently in some FGIDs (Muscatello et. al., 2010), while others have found negative emotions like anxiety do play an important part in the patho-physiology of IBS (Myers & Greenwood-Van Meerveld, 2009). These mixed results reflect the differential influence of generic emotional processes in FGID outcomes for different people. It is also likely that gut-related anxiety or visceral sensitivity (Labus et. al., 2004; Jones et. al., 2007) might play a greater role in predicting the patho-physiology of IBS than generic anxiety. More importantly, these studies suggest that negative emotions are important, but not necessarily crucial processes in FGIDs, supporting their role as peripheral influences.

In contrast, the inconsistency of negative emotions in IBS also points to the presence of more central emotional processes in the perpetuation and presentation of FGID symptoms and distress. Research and clinician observations (Reme et. al., 2011; Lackner & Quigley, 2005) have shown that symptom appraisals and catastrophizing, which contribute to

emotional reactions towards symptoms, are consistently present in sufferers of IBS. Visceral sensitivity falls under this class of illness-specific appraisals-arousal (Craske et. al., 2011), making it a good candidate as a central process. Indeed, research by Garland and colleagues (2011) suggested that visceral sensitivity, which mediates mindfulness training and symptom severity, is an important element in psychological treatment. A comparison of the patterns and degrees of association of visceral sensitivity against negative emotions with IBS outcomes will give an indication of whether visceral sensitivity is indeed a crucial psychological process (Berger, 1998) in FGIDs.

4.1.3 Research Design, Aims & Hypotheses

A case series design was chosen as the best approach to answer the questions in this study (Moskowitz, Russell, Sadikaj, & Sutton, 2009). It is also a quasi-experiment where an element of the psychological model such as mindfulness skills is manipulated in order to discover changes in other elements. This design was chosen because the standard cross-sectional or pre-post intervention studies (Blanchard, 2001; Ljotsson, Falk et. al, 2010) miss out much valuable information regarding changes that happen during the course of intervention and from assessing each individual intensively (Kennedy, 2005).

Conversely, a longitudinal and case series design, where participants are measured repeatedly over time, would provide in-depth findings of the processes that happen during intervention, as well as the idiosyncrasies of each individual (Moskowitz et. al, 2009). This allows for observations of nuanced temporal associations between changes in mindfulness skills and IBS outcome by observing relative developmental trajectories across time (Kennedy, 2005, Borckardt et. al., 2008). In doing so, the underlying psychological mechanisms of FGIDs might be revealed. In addition, this design strives to ensure that the

conditions needed to make causal inferences (Horner et. al., 2005; Moskowitz et. al.; Onghena & Edgington, 2005) are met as much as practically possible given the constraints of the clinical setting.

This study uses a case series to test a mindfulness skills training program for IBS and explore the relative importance of visceral sensitivity and negative emotions over the course of mindfulness skills training. It was hypothesized that:

1. Mindfulness skills training will result in improvements in mindfulness skills, symptoms of FGIDs and related GI distress, visceral sensitivity and negative emotions.
2. Based on the integrated psychological model proposed, mindfulness training will result in changes in visceral sensitivity and negative emotions, which in turn precede changes in FGID symptoms and distress.
3. Mindfulness skills training will have its effect on distress more through changes in visceral sensitivity than changes in negative emotions.

4.2 METHOD

4.2.1 Participants

Six participants, one male and five female, were recruited from announcements on web pages to participate in a mindfulness skills training program. Seven interested individuals underwent a brief telephone screen interview to assess if they met FGID criteria according to the ROME III (Drossman & Dumitrascu, 2006) criteria; as well as to assess for major medical or psychological issues and suicidal ideation, intention, plans and history. One person who reported significant psychological problems that were thought to be better treated

with other modalities was referred to relevant healthcare providers. Specifically, this individual was already seeking psychological treatment for her OCD and clinical depression, and reported acute suicidal thoughts. It was determined that the mindfulness skills training program would not be the best treatment option for her as they did not target her more urgent depression and suicidality. The inclusion criteria were – age 18 years and older with a medical diagnosis of IBS following negative results from investigations such as (endoscopy, sigmoidoscopy, allergy tests, occult stool blood tests, barium enema. To maintain confidentiality, participants were assigned pseudonyms. Informed consent to participate was sought prior to commencement of the study. This study received approval from the Macquarie University Human Research Ethics Committee.

4.2.2 Measures

Five Facet Mindfulness Questionnaire (FFMQ; Baer et. al., 2008). The FFMQ is a 39-item self-statement measure of dispositional mindfulness. It is rated along a 5-point scale (1 = Never or Very rarely true, 5 = Very often or Always true). Participants are asked to rate how true each statement is in describing their experience. An example of an item is “When I take a shower or bath, I stay alert to the sensations of water on my body.” Items 3, 5, 8, 10, 12, 13, 14, 16, 17, 18, 22, 23, 25, 28, 34, 35, 38, and 39 are reverse-scored. For the purposes of this study and based on findings from the previous study, three scores (one each for the subscales corresponding to the different facet of mindfulness –Acting with Awareness, Non-judging and Non-reacting) are calculated by summing up the scores for the corresponding items for each subscale to produce five separate scores. The Acting with awareness, Non-judging and Non-reacting subscales were all found to have good internal consistency in the previous study (Cronbach’s $\alpha = .88$, $\alpha = .76$, $\alpha = .77$ respectively) and the overall questionnaire was found by Baer and colleagues (2008) to have good construct validity.

ROME III questionnaire (Drossman & Dumitrascu, 2006). The ROME III is an 18-question screening measure of Irritable Bowel Syndrome and Functional Constipation. This questionnaire is the composite of the Irritable Bowel Syndrome and Functional Constipation modules of the ROME foundation questionnaires. The questions ask participants about the frequency and duration of specific symptoms as well as changes in bowel functioning in relation to these symptoms. Different questions were rated in different ways – on a 5 point scale (0 = Never or rarely, 4 = Always), on a 7-point scale (0 = Never, 7 = Everyday), on a 3 point scale (0 = No, 1 = Yes, 2 = Does not apply because I have had the change in life (menopaus) or I am a male) and a 2 point dichotomous scale (0 = No, 1 = Yes). A sample item is “In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?” The scoring method for this questionnaire is based on a decision tree method where certain key symptoms must be endorsed along with a minimal number of other symptoms before the criteria for Irritable Bowel Syndrome or Functional Constipation is met. For the purpose of this study, an SPSS syntax was written based on the Rome Foundation scoring instructions of these questionnaires.

Bowel Symptom Severity Scale (BSSS) (Boyce, Gilchrist, Talley & Rose, 2000). The BSSS is a 24-question measure of eight bowel symptoms, their perceived severity and perceived interference over the past week. It is rated along a 5-point scale for symptom frequency (1 = Not at all, 5 = More than once a day), and another 5-point scale for perceived severity and interference (1 = Not at all, 5 = Extremely). An example of an item is “Over the past week on how many occasions did you have hard or lumpy stools when you had a bowel motion?” Three scores (one each for symptom frequency, perceived severity and perceived

interference) are calculated by summing up the scores for eight corresponding items for each subscale. Boyce and colleagues (2000) found that the BSSS has good internal consistency (Cronbach's $\alpha = .88$) and good face validity.

Depression Anxiety and Stress Scale – 21 (DASS – 21; Henry & Crawford, 2005; Lovibond & Lovibond, 1995). The DASS – 21 is a 21-item (self-reported) measure of depression, anxiety and stress states over the past week which is rated along a 4-point scale (0 = did not apply to me at all, 1 = Applied to me to some degree, 2 = Applied to me to a considerable degree, 3 = Applied to me very much). An example of an item is “I found it very hard to wind down.” A total score is obtained by summing up all items, and then multiplying this sum by two. The DASS-21 was found to have good internal consistency (Cronbach's $\alpha = .84$ to .91 depending on subscales) and good convergent validity with the BDI and BAI (Lovibond & Lovibond; 1995).

Visceral Sensitivity Index (VSI; Labus et. al., 2004). The VSI is a 15-item (self-statement) measure of bowel symptom related anxiety which is rated along a 6-point scale (1 = Strongly agree, 6 = Strongly Disagree). Participants are asked to rate how much each statement agreed with their personal experience. An example of an item is “I often worry about problems in my belly.” A single total score is calculated by summing up the scores for all 15 items. The VSI was found by Labus and colleagues (2004) to have good internal consistency (Cronbach's $\alpha = .93$) and good convergent and divergent validity.

Daily Diary. A Daily Diary was created for the purposes of this study and is contained in Appendix B. The items comprising this diary were based on the constructs measured in the questionnaires listed above. Where appropriate, items were phrased to capture the gist of the items in the questionnaire. For example, if depression was measured by the DASS-21, items in the diary would ask about depressed mood, anxiety and stress reaction. A diary was used with shortened items instead of the original questionnaires to ensure facility of daily completion by participants. It was anticipated that completing a full battery for the data collection needs of this study (i.e., daily collection) would be impractical for the participants, and would result in a greater attrition rate in terms of data returns. Participants are required to spend a few minutes each day recording their symptoms, the subjective distress and functional interference caused by the symptoms on that day, and subjective experiences (including mood states, level of self-perceived mindfulness, worries pertaining to their symptoms, and personal beliefs about their IBS). Most items were rated on a 9-point scale (0 – not at all, 8 = completely/ extremely). Examples of items for visceral sensitivity include - “You worry about sensations in you abdomen”, “How much the sensations in your abdomen frighten you”, “How much you keep focusing on the sensations in your abdomen at the expense of what’s happening around you”, and “How sensitive you are to changes in your abdomen”. The items in the diary were explained to participants by the therapist after the clinical interview, and any doubts were clarified.

For the purposes of this study, visceral sensitivity was calculated by taking the average of these items (i.e., VS1, VS2, VS3, & VS4). As an indication of item total correlation, standardized estimates from a random effects regression of each of four items individually against the sum of the other three for the 100 days of the study were respectively, .71, .99, .71, and .66. While not strictly on the same scale as an item total correlation, all were above a typical criterion for item total correlations, which supported the

averaging of these items. The first baseline visceral sensitivity diary scores had a moderate level of correlation with the pre-intervention VSI scores, ($r = .55$, $n = 6$). General negative emotions were measured by summing up ratings on anxiety, depression and stress items.

Clinical Interview. A comprehensive assessment of the participants' IBS history and presentation, mental health history using the semi-structured Anxiety Disorders Interview Schedule for Diagnostic and Statistical Manual-IV (ADIS-IV; Brown, DiNardo, & Barlow, 1994), medical history and relevant psychosocial history. The first author (WCT) is a graduate student with extensive training in the use of the ADIS-IV. He also received ongoing supervision from the second author (AB) during the course of the study in the use of the ADIS-IV. A working Cognitive-Behavioural case formulation was developed from this interview and was further refined during the course of the program. This served to identify the target for mindfulness practice, for example, ruminations, body sensations, and stress reaction.

4.2.3 Procedure

Prior to commencing the program, interested participants were telephoned and briefly interviewed by the investigator. Those who met the criteria for the program were scheduled for the clinical interview. Participants started completing their daily diary from the day of the clinical interview and were required to complete it for a waiting period of two weeks. This formed the baseline phase. Participants also completed the questionnaires on the day of commencement.

Following this two-week wait, they commenced the mindfulness skills training program for eight consecutive weeks and continued filling in the daily diary during this period. These eight weeks formed the intervention phase. Participants were administered the questionnaires at the last session of the program.

4.2.4 Treatment

An eight-week mindfulness skills training program was developed and delivered on a one-to-one basis at the Emotional Health Clinic, Macquarie University. This programme was developed based on work by Segal, Williams and Teasdale (2002), Siegel, Germer, & Olendzki (2008), Stahl and Goldstein (2010) and Westbrook, Kennerley and Kirk (2011).

The program included: 1) a psycho-education component, where the case formulation was discussed with each participant to determine the focus of mindfulness treatment; 2) A mindfulness skills training component comprising six of the eight sessions, with each session focusing on one aspect or component skill of mindfulness. Examples of mindfulness skills included taking a pause, watching experiences, being curious about experiences, and accepting experiences; and 3) a skills transfer and skills maintenance component which took place in the last two sessions. In these session, the participants and therapist discussed how to generalize the mindfulness skills into daily activities such as walking, eating, carrying out chores, and create a plan to maintain mindfulness practice post-treatment. Depending on the needs of each participant, the program was applied flexibly with different component skills emphasized for different participants.

A participant program workbook and an accompanying book teaching general mindfulness skills (Stahl & Goldstein, 2010) were given to each participant at the start of the program. At the end of the program, participants were remunerated AUD80 for their time.

The first author (WCT), a graduate student in clinical psychology with professional training in mindfulness skills applied in psychotherapy was the therapist for this study. Clinical supervision was provided by the second author (AB) who has had 20 years' experience as a clinical psychologist.

4.2.5 Client Backgrounds

Client backgrounds and case formulations of their IBS from a psychological perspective are presented in this section. Relevant participant background information, the case formulations and baseline scores of questionnaires completed by the participants are summarized in Table 4.1. All participants met the ROME III criteria for IBS.

Table 4.1 Participant backgrounds, case formulations and baseline measures

Participant	Relevant Information	Case formulation	Baseline scores	
			Measure	Scores
Miss C	18 year old university student	General negative emotions trigger bowel symptoms.	VSI	37
	Daily abdominal pain & occasional bouts of nausea and diarrhea	Symptoms maintained by hyper-vigilance to symptoms,	DASS-21	68
	Symptoms for at least 4 years	illness behaviours, and avoidance coping.	BSSS - Frequency	24
	Onset: severe gastric attack during a high school trip		BSSS - Severity	20
	Diagnosed with IBS by GP, diagnosed with <i>Giardia</i> two years ago		BSSS - Interference	18
	Triggers: irregular eating & stressful situations (e.g., family conflicts)		FFMQ - Acting with Awareness	3.13
	Coping: avoid eating & walking away from stressful situations		FFMQ - Nonreact	3.43
	No dysfunction in terms of her work and only missed classes infrequently		FFMQ - Nonjudge	3.88
	ADIS-IV: No comorbid mental illness			
Mrs P	49 year old self-employed	Generalized anxiety triggers bowel symptoms, which are	VSI	35
	Married without children	maintained by hyper-vigilance to symptoms, and <i>a</i>	DASS-21	70
	Severe abdominal pain & occasional diarrhea	<i>Posteriori</i> appraisal of symptoms (i.e., lucky not to have	BSSS - Frequency	17
	Symptoms for at least 20 years	had an accident)	BSSS - Severity	15
	Onset: high school period, no specific triggers		BSSS - Interference	8
	Diagnosed with IBS from GP 20 years ago		FFMQ - Acting with Awareness	3.13
	Symptoms worsen when she is rushing or hurried		FFMQ - Nonreact	3
	Coping: over-the-counter medications		FFMQ - Nonjudge	3
	ADIS-IV: sub-syndromal for generalized anxiety (self-described "fussiness", "need to do things", "always planning")			
	Family hx: father had chronic constipation & sister has IBS			

Maximum score for measures

VSI: 90 DASS-21: 126 BSSS-Frequency: 40 BSSS-Severity: 40 BSSS-Interference: 40 FFMQ-Acting with Awareness: 5

FFMQ-Nonreact: 5.71 FFMQ-Nonjudge: 5

Table 4.1 (cont'd) Participant backgrounds, case formulations and baseline measures

Participant	Relevant Information	Case formulation	Baseline scores	
			Measure	Scores
Mr K	48 year old professional male. Indian descent.	Pre-existing bowel symptoms due to dietary habits exacerbated by maladaptive coping of grief and Dysthymia.	VSI	44
	Vegetarian all his life		DASS-21	100
	Pre-deceased by wife (6 years ago). Has no children.		BSSS - Frequency	17
	Chronic constipation and abdominal discomfort		BSSS - Severity	15
	Had symptoms since a child		BSSS - Interference	15
	Onset: could not recall any triggering events		FFMQ - Acting with Awareness	2.13
	Underwent multiple medical test with negative results		FFMQ - Nonreact	4
	ADIS-IV: Dysthymia (duration of 8 years) - due to 1) sense of not fitting in with his community, & 2) loss of wife		FFMQ - Nonjudge	2.38
	Coping with mood: eating "junk food", social isolation/ avoidance			
Mrs W	65 year old retiree. Formerly part-time teacher	Excessive worrying (GAD) triggers and exacerbates pre-existing bowel problems, which are maintained by hyper-vigilance, negative appraisal of symptoms and illness behaviours.	VSI	47
	Married with two adult children		DASS-21	76
	Frequent diarrhea		BSSS - Frequency	20
	Has had symptoms for "very long time"		BSSS - Severity	21
	Diagnosed with IBS on March 2012 by gastroenterologist		BSSS - Interference	20
	Diagnosed with <i>Giardia</i> in her 50's		FFMQ - Acting with Awareness	3.38
	Symptom worsened following hemarroid operation in early 2012		FFMQ - Nonreact	2.43
	Triggers: during stressful periods		FFMQ - Nonjudge	2.63
	Coping: emptying bowels before leaving home			
	ADIS-IV: GAD (excessive worries about many aspects of her family)			
	Many recent changes in her family which are stressful (e.g., husband's retirement, daughter's pregnancy, aunt's diagnosis with cancer)			

Maximum score for measures

VSI: 90 DASS-21: 126 BSSS-Frequency: 40 BSSS-Severity: 40 BSSS-Interference: 40 FFMQ-Acting with Awareness: 5

FFMQ-Nonreact: 5.71 FFMQ-Nonjudge: 5

Table 4.1 (cont'd) Participant backgrounds, case formulations and baseline measures

Participant	Relevant Information	Case formulation	Baseline scores	
			Measure	Scores
Miss G	20 year old university student Severe abdominal pain Onset: 3 years ago during her HSC Diagnosed with IBS by her gastroenterologist in April 2011 Hyper-vigilance of symptoms & pre-occupied with finding out why she worries Symptoms worsen when stressed (e.g., preparing for assignments, family conflicts) & following irregular eating Copes by taking prescription medication and very selective eating ADIS-IV: sub-syndromal generalized anxiety (frequent "what -if" thinking) & specific (bird) phobia	Excessive worrying triggers bowel symptoms, which are maintained by hyper-vigilance to symptoms, worrying about symptoms and illness behaviours.	VSI	60
			DASS-21	54
			BSSS - Frequency	19
			BSSS - Severity	17
			BSSS - Interference	14
			FFMQ - Acting with Awareness	3.38
			FFMQ - Nonreact	3
			FFMQ - Nonjudge	2.38
MS Q	31 year old married woman. Has no children. Abdominal pain with history of abdominal cramps and diarrhea Onset: 21 years old following ingestion of milk Course: worsened by severe food poisoning at 25 years old Symptoms triggered by: stress (e.g., work) Coping by using over-the-counter medications & talking with her husband ADIS-IV: GAD (worrying about work & not having a routine over weekends) & social phobia. Hx: Tensed relationship with divorced parents. Had series of traumatic life changes (e.g., sudden move to Czech Republic, sudden return to Australia for HSC)	Excessive worrying (GAD) triggers bowel symptoms, which are predisposed by early traumatic experiences. symptoms are maintained by hyper-vigilance and illness behaviours.	VSI	52
			DASS-21	74
			BSSS - Frequency	22
			BSSS - Severity	18
			BSSS - Interference	19
			FFMQ - Acting with Awareness	2.38
			FFMQ - Nonreact	2.14
			FFMQ - Nonjudge	4

Maximum score for measures

VSI: 90 DASS-21: 126 BSSS-Frequency: 40 BSSS-Severity: 40 BSSS-Interference: 40 FFMQ-Acting with Awareness: 5
 FFMQ-Nonreact: 5.71 FFMQ-Nonjudge: 5

4.2.6 Data Analysis Strategy

Firstly, to investigate whether mindfulness skills training resulted in improvements in mindfulness skills, symptoms of FGIDs and related GI distress, visceral sensitivity and negative emotions, clinically significant and reliable change indices (Jacobson & Truax, 1991) across all questionnaires were calculated. For the clinically significant and reliable change analyses, norms in terms of means and standard deviations pertaining to each of the questionnaires were obtained from literature using the same measures and similar populations. Clinically significant change refers to the concept that any change is large enough to be clinically meaningful. Evans, Margison and Barkham (2012) stated that a cut-off or threshold known as Criterion C, beyond which a person would be considered to have attained clinically meaningful change, can be calculated¹. Reliable change refers to the concept that change is significant if its magnitude exceeds that expected by random measurement error alone (Evans, et. al, 2012). The threshold/ cut-off beyond which change is considered bigger than chance due to measurement error is the reliable change index (Evans et al, 2012.).

Next, graphical presentations of relevant diary variables were plotted to further assess how symptoms of FGIDs and related GI distress, visceral sensitivity and negative emotions changed across time and phases. Patterns of these scores at the baseline phase were

¹ Norms & test-retest reliability coefficients for the various measures used in reliable & clinically significant change calculations

<i>Source</i>	<i>Measure</i>	<i>Subscales</i>	<i>Mean</i>	<i>SD</i>	<i>Test-retest reliability rxx</i>
Ljotsson et. al (2010)	VSI	-	47.7	18.3	.68
Crawford et. al., (2011)	DASS-21	-	8.3	9.83	.56
Jones et. al., (2011)	BSSS	Frequency	20.8	4.5	.37
		Severity	17	5.1	-.40
		Interference	15.5	5.7	.36
Baer et. al. (2008)	FFMQ	Acting with Awareness	24.57	6.57	-.11
		Nonjudge	23.85	7.33	.65
		Nonreact	19.53	4.88	.20

compared to those during the intervention phase. The patterns of change between questionnaire and diary scores were compared to identify possible nuances. Principles of visual analyses of time series graphs were followed to compare level and trend changes between the baseline and intervention phases (Franklin, Allison, & Gorman, 1996).

Change in Level referred to the general height of the plot points at each phase and generally, a lower level in the treatment phase reflected an improvement in symptoms and negative psychological states (Franklin, et. al., 1996). *Trend* referred to the slope of the plot points at each phase. This reflected the rate and direction of change (Franklin, et. al, 1996), and was observed by studying the line-of-best-fit. In this case, a downward pointing slope indicated improvement and a steeper slope angle indicated a faster rate of improvement in symptom and negative psychological variables.

To explore the relative importance of visceral sensitivity and negative emotions in the relationship between mindfulness skills training and distress, Autoregressive Integrated Moving Averages (ARIMA) modelling of the time series data was used to pre-whiten the data (McCain, & McCleary, 1979). ARIMA modelling is an essential model-fitting step in time-series analysis as it serves to specify models that control for stationarity (the fact that ratings across times change at different rates), auto-regression (the fact that each rating predicts and hence influences the next rating because all ratings are made by the same person, which results in inflated and spurious cross-correlations) and stochastics (the fact that systematic error in participant ratings can affect prediction). For a detailed treatment of ARIMA models, refer to McCain, & McCleary, (1979).

To identify the best model fit, the Expert Modeller Program in SPSS 20 was applied for each participant. Stationary R-squared estimates moving towards the absolute value of 1 and a Ljung-Box Q statistic that is not statistically significant indicates good model fit

(McCain, & McCleary, 1979). Prior to running ARIMA models for each participant, missing data was imputed with the series mean of each item, and assumptions pertaining to normality and outliers were assessed for each of the participants (McCain, & McCleary, 1979). In this case, none of the data for each of the participants violated these assumptions and hence no transformations were required.

The Expert Modeller Program for all six participants indicated specific models (usually ARIMA(1,0,0), Holt, Brown or Simple models) for the diary ratings. The Box-Ljung Q statistics for all variables across all participants were not statistically significant, indicating adequate model fit to the actual data. The proposed models and the predicted values for all variables were accepted for use in calculating residuals.

After pre-whitening of the data, Cross-correlation function (CCFs) plots (cross-correlograms) were made for each of the six participants between the pre-whitened variable pairs, specifically visceral sensitivity and distress, negative emotions and distress, and visceral sensitivity and negative emotions. The CCF plots determined any lagged effects and the order of change in these variables. Cross-correlation reflected the relationship between the time points of two variables across lags, in this case specified as 7 days back and 7 days forward. They also reflected how such as distress the target variable, occurred in relationship to such as visceral sensitivity the reference variable.

A significant positive lag (e.g., lag +1) indicates that the target changes a day after reference variable (lag forward), while a significant negative lag (e.g., lag -1) indicates that the target changes a day before the reference variable (lag backwards). Bars that point up indicate a positive correlation while those that point down indicate a negative correlation. For the purposes of this study, only a +/- lag 1 (one day before and after) was considered during the analysis.

Finally, random effects regression models were conducted using the SPSS 20.0 MIXED procedure to integrate the six cases into a single analysis. Here, the relative importance of changes in visceral sensitivity and negative emotions were compared to ascertain how much these changes predicted changes in distress. A series of planned mixed effects regression models, with daily changes in Distress as the dependent variable, were compared. Each model consisted of different covariates including main effects such as changes in visceral sensitivity alone, and interaction effects such as the level of negative emotions x day – representing the time-varying change of the level of negative emotions.

These models factored individual variations in levels of dependent variable and covariates, as well as rates of change over time into their calculations. The estimates of interest were the -2 Log Likelihood ratios (-2LL), the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC) of each model and the deviance Chi-square (χ^2) (i.e., difference between pairs of -2 Log Likelihood ratios). Smaller -2LL ratios, AIC and BIC indicate better fit and a statistically significant Chi-square deviance indicated that models differed significantly. Apart from model comparisons, parameter estimates for each model were considered to find out the degree of influence of each covariate in that model.

4.3 RESULTS

4.3.1 Did Mindfulness Training lead to Improvements?

Did Mindfulness Skills Training Lead to Improvement in Mindfulness Skills?

Analyses revealed that mindfulness skills training did not result in reliable or clinically significant changes in mindfulness skills (Table 4.2). Specifically, the pre-intervention and post-intervention scores on the FFMQ subscales (acting with awareness,

non-reacting and non-judging) were not sufficiently large to meet the various reliable change indices or fall within the various clinically significant (Criterion C) cut-off ranges. Five participants (Miss C, Mrs P, Mr K, Mrs W and Miss G) reported small decrease in their ability to act with awareness, not react to adverse experiences and/ or not judge these experiences. Ms Q alone reported slight improvements in these three mindfulness skills.

Did Mindfulness Skills Training Lead to Improvement in IBS Symptoms and Distress?

Analyses revealed that mindfulness skills training did not result in reliable or clinically significant changes in IBS symptoms or distress for the six participants. With regards to the symptom measures (the BSSS subscales), five participants except Mrs P reported a slight decrease in symptom frequency. Three participants reported slightly lowered symptom severity (distress) scores while the other three (Miss G, Mr K and Ms Q) reported slight increases in symptom severity. Four participants reported a slight decrease in the amount their symptoms interfered in their daily lives but Mrs W reported no change in interference while Mr K reported a slight increase in interference. None of these changes met the reliable change criteria or fell within the clinically significant range for change.

Nonetheless, visual analyses of symptom and distress graphs plotted from diary ratings over time showed that there were slight improvements for five participants except Miss G (see Figures 4.1, 4.2 and 4.3). For instance, Miss C and Miss G showed slight downward trends in their daily symptom and distress scores. Additionally, symptom and distress graphs for Mr K, Mrs P and Mrs W evidenced a decrease in the fluctuations of these scores, suggesting a stabilization effect.

Did Mindfulness Skills Training Lead to Improvement in Visceral Sensitivity and Negative Emotions?

In terms of visceral sensitivity and negative emotions, it was found that whilst mindfulness skills training did result in some increase in the VSI and decrease in the DASS-21 ratings for all participants, these changes were not sufficient to meet the various reliable change indices or fall within the various clinically significant cut-off ranges.

Specifically, these results indicated that whilst half the participants reported small improvements in visceral sensitivity as measured by lower VSI ratings, one (Mr K) reported no improvement and two participants (Miss C and Mrs P) reported very slight worsening in visceral sensitivity. It is noteworthy to observe that Ms Q showed the greatest improvement in visceral sensitivity, almost achieving the reliable change standard, while Mrs W and Miss G also reported small improvements in visceral sensitivity.

However, visual analyses revealed slight improvement in the day-to-day visceral sensitivity scores for four participants, except for Miss G and Mrs W. Specifically, Miss C and Mrs P showed a slight downward trend in their visceral sensitivity scores at the intervention phase, which contradicted their post-intervention VSI scores. Ms Q evidenced a slight level change (lowering) of her visceral sensitivity scores and Mr K evidenced a decrease in the fluctuation of his scores at the intervention phase. There were no changes in the fluctuation of visceral sensitivity scores for Miss G and Mrs W.

Likewise, three participants (Ms Q, Miss C and Mrs W) reported slight improvements in their negative emotions scores as measured by lower DASS-21 ratings, while Mrs P, Mr K and Miss G reported deteriorations, specifically, elevated DASS-21 ratings. Mr K's post-intervention DASS-21 were concerning as they reflected an increase in negative emotions after training, compared to at baseline.

In contrast, visual analyses of negative emotion scores (Figures 4.1 to 4.3) revealed that Ms Q, Miss C and Mrs W did not evidence any changes in terms of trend, level or fluctuations in their scores. Also in contrast to their post-intervention scores, Mrs P and Miss G did not show any changes in their daily negative emotion scores across time and phases. However, Mr K's graph indicated that there was a notable reduction in the *fluctuation* of his negative emotions scores towards the end of the intervention phase, albeit also showing a slightly increasing trend. This upward trend was consistent with his post-intervention DASS-21 scores but the reductions in fluctuations reflected stabilization in his negative emotions.

In sum, it appears that mindfulness skills training resulted in some change in terms of IBS symptoms, distress, visceral sensitivity and negative emotions but that these changes were not sufficiently large to cross clinically significant or reliable change thresholds. There were also individual variations in these results.

Table 4.2.
Reliable and Clinically Significant Change on Mindfulness Measures

Participant	Measure	Subscales	Before Intervention (Pre)	After Intervention (Post)	Pre-Post Difference (Post - Pre)	Participant	Measure	Subscales	Before Intervention (Pre)	After Intervention (Post)	Pre-Post Difference (Post - Pre)
Miss C	FFMQ	Acting with Awareness	3.13	3.13	0	Mrs W	FFMQ	Acting with Awareness	3.38	2.38	-1
Miss C	FFMQ	Nonreact	3.43	3.57	.14	Mrs W	FFMQ	Nonreact	2.43	3.14	.71
Miss C	FFMQ	Nonjudge	3.88	3.5	-.38	Mrs W	FFMQ	Nonjudge	2.63	3.13	.5
Mrs P	FFMQ	Acting with Awareness	3.13	3.13	0	Miss G	FFMQ	Acting with Awareness	3.38	2.38	-1
Mrs P	FFMQ	Nonreact	3	2.43	-.57	Miss G	FFMQ	Nonreact	3	2.71	-.29
Mrs P	FFMQ	Nonjudge	3	2.38	-.62	Miss G	FFMQ	Nonjudge	2.38	1.75	-.63
Mr K	FFMQ	Acting with Awareness	2.13	2.38	.25	Ms Q	FFMQ	Acting with Awareness	2.38	3.25	.87
Mr K	FFMQ	Nonreact	4	3.29	-.71	Ms Q	FFMQ	Nonreact	2.14	3.14	1
Mr K	FFMQ	Nonjudge	2.38	2.88	.5	Ms Q	FFMQ	Nonjudge	4	4.13	.13
			Reliable Change Criteria ®	Clinically Significant Change Cutoff (Criterion C)©							
Measures		Subscales									
FFMQ	Acting with Awareness		1.56	4.55							
FFMQ	Nonreact		1.66	5.00							
FFMQ	Nonjudge		1.20	4.93							

Note: The reliable change criteria is the cut-off score indicating that the difference between post- and pre-intervention scores is greater than measurement error. The clinical significant change criteria is the cut-off score indicating that the post-intervention score fell within the non-symptomatic group.

Table 4.2.

(Cont'd) Reliable and Clinically Significant Change on Symptom and Psychological Measures

Participant	Measure	Subscales	Before Intervention (Pre)	After Intervention (Post)	Pre-Post Difference (Post - Pre)	Participant	Measure	Subscales	Before Intervention (Pre)	After Intervention (Post)	Pre-Post Difference (Post - Pre)
Miss C	VSI	-	37	40	3	Mrs W	VSI	-	47	39	-8
Miss C	DASS-21	-	68	66	-2	Mrs W	DASS-21	-	76	52	-24
Miss C	BSSS	Frequency	24	20	-4	Mrs W	BSSS	Frequency	20	12	-8
Miss C	BSSS	Severity	20	14	-6	Mrs W	BSSS	Severity	21	14	-7
Miss C	BSSS	Interference	18	16	-2	Mrs W	BSSS	Interference	20	11	-9
Mrs P	VSI	-	35	36	1	Miss G	VSI	-	60	55	-5
Mrs P	DASS-21	-	70	82	12	Miss G	DASS-21	-	54	66	12
Mrs P	BSSS	Frequency	17	18	1	Miss G	BSSS	Frequency	19	16	-3
Mrs P	BSSS	Severity	15	14	-1	Miss G	BSSS	Severity	17	18	1
Mrs P	BSSS	Interference	8	8	0	Miss G	BSSS	Interference	14	12	-2
Mr K	VSI	-	44	44	0	Ms Q	VSI	-	52	41	-11
Mr K	DASS-21	-	100	104	4	Ms Q	DASS-21	-	74	68	-6
Mr K	BSSS	Frequency	17	15	-2	Ms Q	BSSS	Frequency	22	18	-4
Mr K	BSSS	Severity	15	21	6	Ms Q	BSSS	Severity	18	20	2
Mr K	BSSS	Interference	15	22	7	Ms Q	BSSS	Interference	19	18	-1
Reliable Change Criteria			Clinically Significant Change Cutoff (Criterion C)©	Clinically Significant Change Cutoff (Criterion C)©			Reliable Change Criteria			Clinically Significant Change Cutoff (Criterion C)©	
Measures			Reliable Change Criteria ®	Measures			Measures			Reliable Change Criteria ®	
VSI			14.75	BSSS			BSSS			8.20	
DASS-21			27.58	BSSS			BSSS			9.78	
BSSS			6.12	BSSS			BSSS			17.45	
										15.59	

Note: The reliable change criteria is the cut-off score indicating that the difference between post- and pre-intervention scores is greater than measurement error. The clinical significant change criteria is the cut-off score indicating that the post-intervention score fell within the non-symptomatic group.

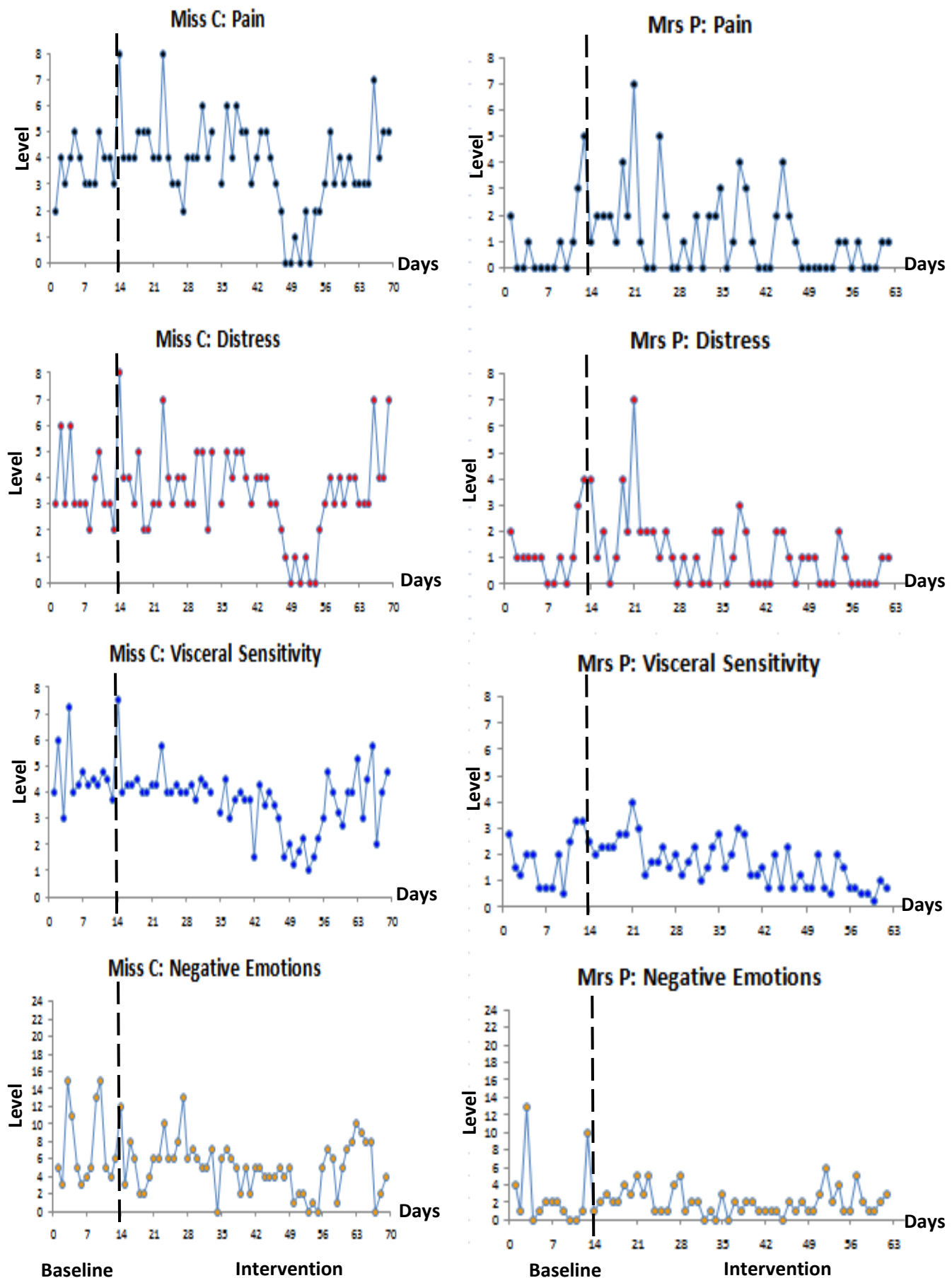


Figure 4.1 Symptom, Distress, Visceral Sensitivity and Negative Emotion levels at Baseline and Intervention Phases for Miss C and Mrs P

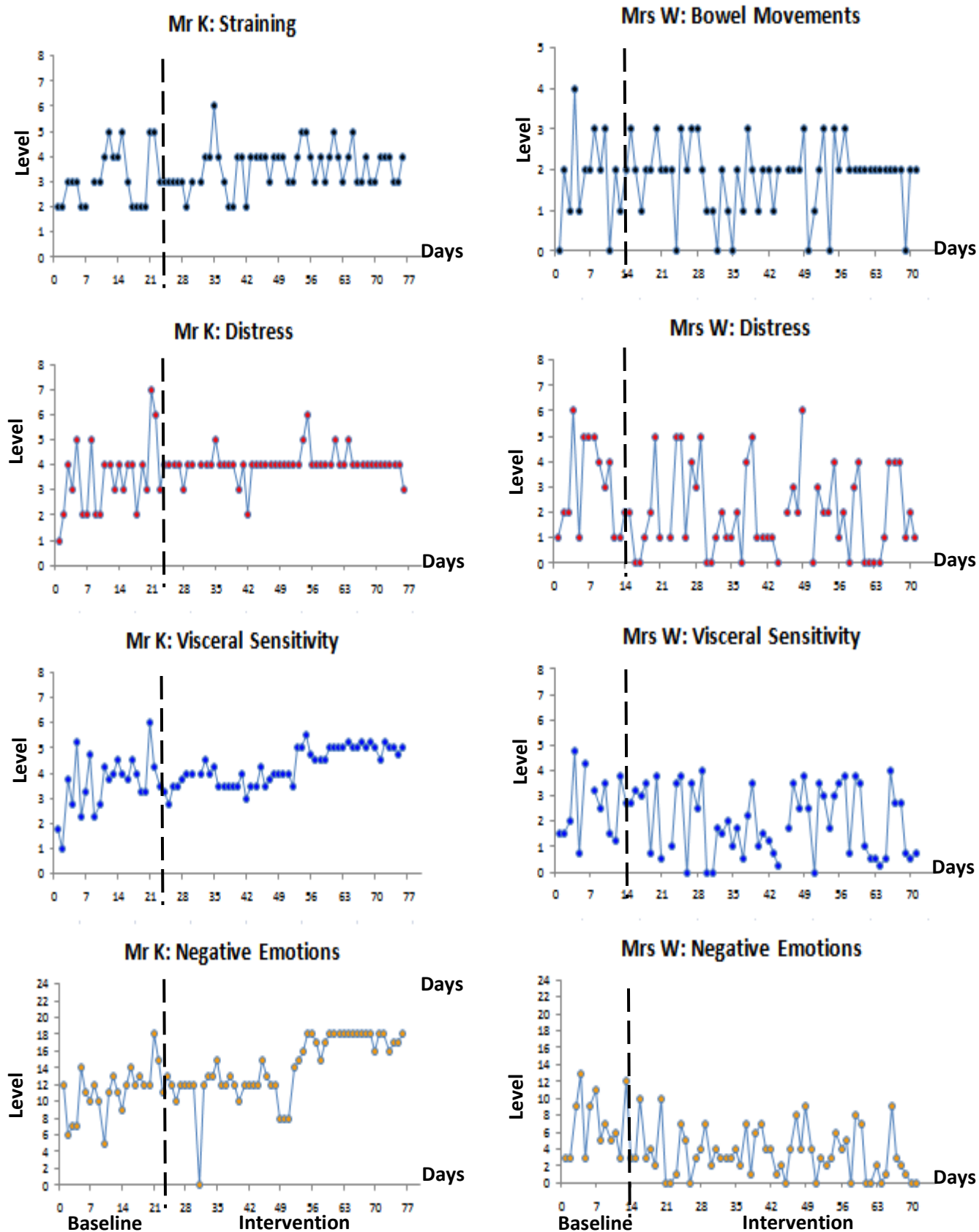


Figure 4.2 Symptom, Distress, Visceral Sensitivity and Negative Emotion levels at Baseline and Intervention Phases for Mr K and Mrs W

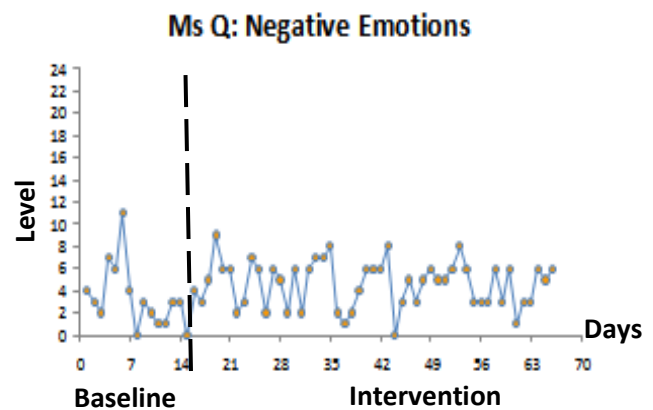
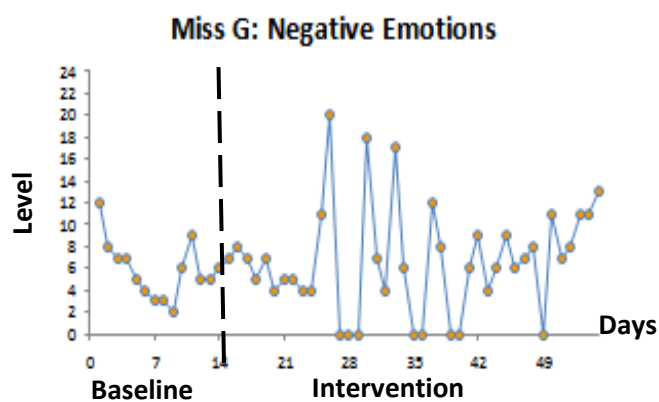
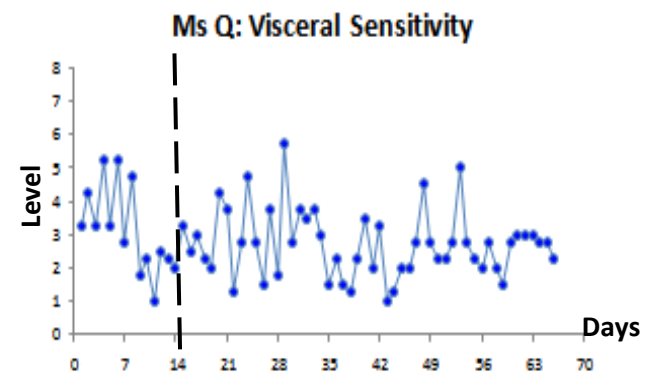
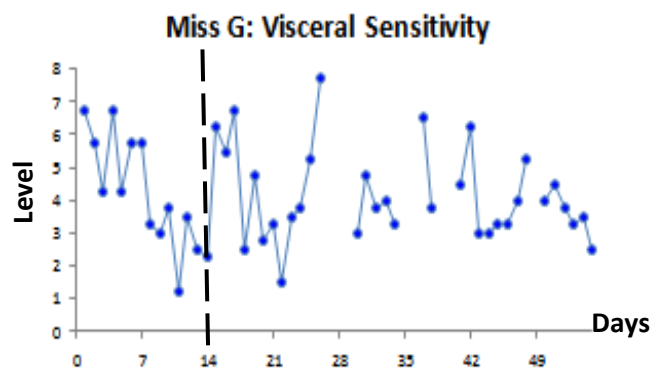
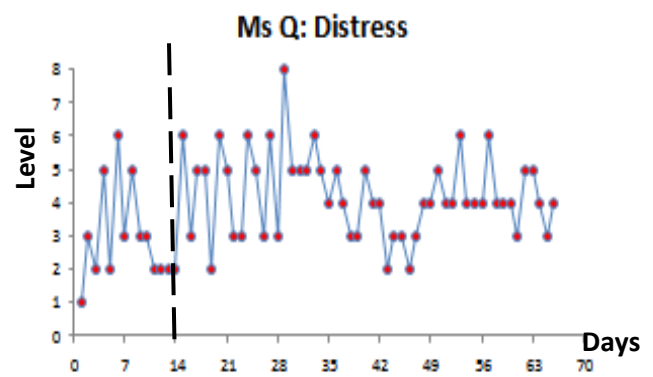
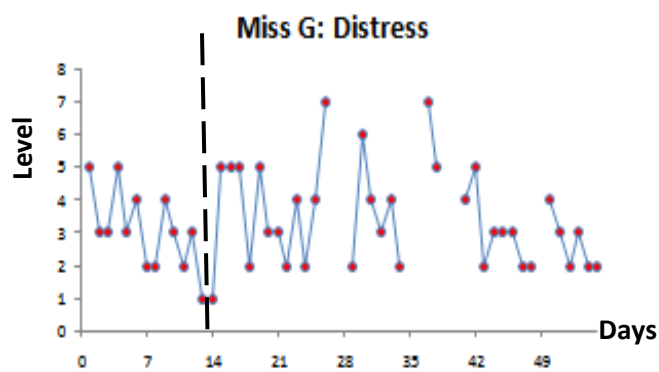
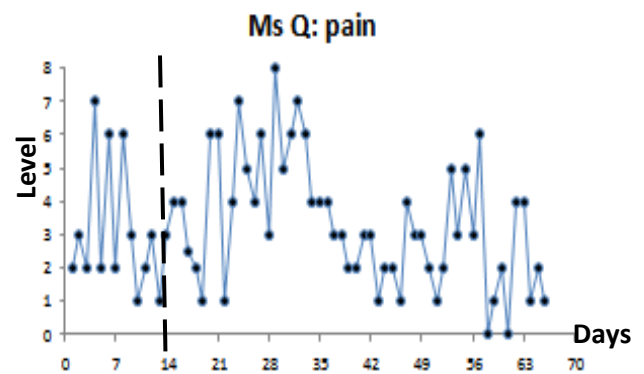
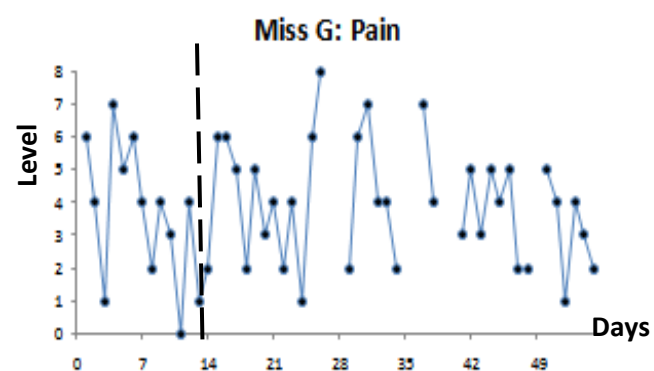


Figure 4.3 Symptom, Distress, Visceral Sensitivity and Negative Emotion levels at Baseline and Intervention Phases for Miss G and Ms Q

4.3.2 Will Changes in Visceral Sensitivity Changes and Negative Emotion Changes Precede Changes in Distress, Following Mindfulness Skills Training?

After Pre-whitening to remove auto-correlation, cross-correlograms were examined for evidence of significant correlations at lags -1 and + 1 which could indicate if one variable precedes another. Results showed that visceral sensitivity was significantly correlated with distress at lag 0 (see Figure. 4.4 for an example) for all participants, which indicated that these variables occurred on the same day.

However, the cross-correlations between distress and negative emotions varied between participants. For instance, while Miss C, Mr K and Ms Q evidenced significant cross-correlations at lag 0 only (e.g., see Figure. 4.5), the others evidenced either no significant cross-correlations (e.g., Mrs W and Mrs P), or significant cross-correlations at lag +1 only (negative emotion occurs a day after experiencing distress; e.g., Miss G). These patterns indicated that the negative emotions-distress association was weaker compared to the visceral sensitivity-distress association.

Likewise, the cross-correlations between visceral sensitivity and negative emotions were varied, and differed between participants. For instance, Miss C, Mr K and Mrs W showed significant cross-correlations at lag 0 only, indicating that both occurred on the same day (e.g., see Figure. 4.6). However, Mrs W, Miss G and Ms Q evidenced no significant cross-correlations between visceral sensitivity and negative emotions. These patterns indicated that visceral sensitivity was not as strongly related to negative emotions for some individuals, while negative emotions did not occur “causally” prior to visceral sensitivity. Cross-correlograms for the relationships between visceral sensitivity and distress, negative emotions and distress, and visceral sensitivity and negative emotions, for all participants are attached in Appendix C.

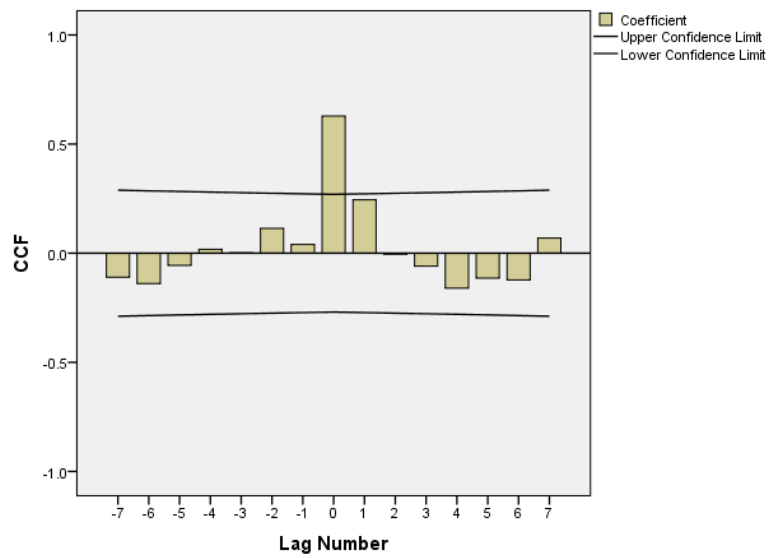


Figure. 4.4 Visceral sensitivity and distress correlated on the same day (tallest bar at Lag 0) for Miss C.

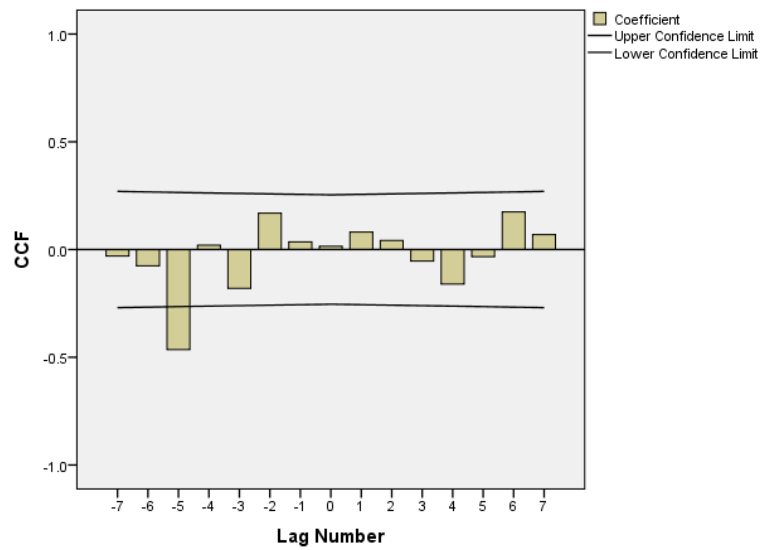


Figure. 4.5 Negative emotions and distress are not consistently correlated for Mrs P.

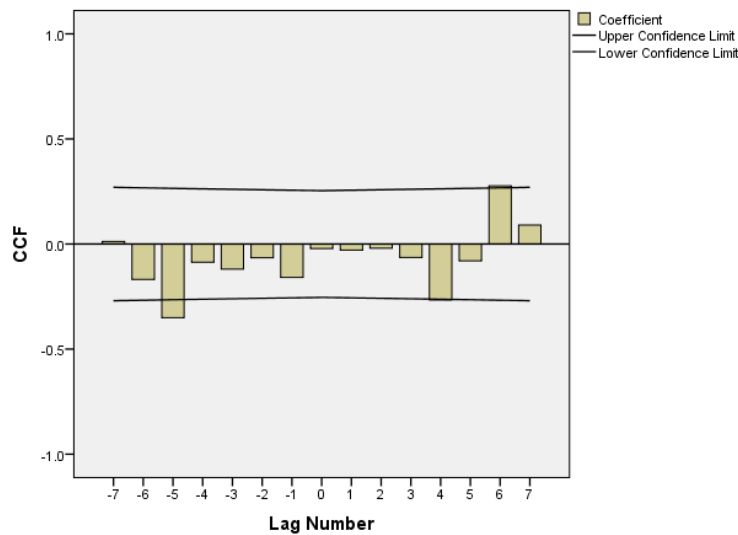


Figure. 4.6 Visceral sensitivity and negative emotions are not consistently correlated for Mrs P.

4.3.3 Will Mindfulness Skills Training have Its Effect on Distress More Through Visceral Sensitivity Changes than Negative Emotion Changes?

Random effects regression was used to test for the relative importance of negative emotions and visceral sensitivity using 60 – 100 diary recordings for each of the six participants. There were 798 data points on average per participant of which 1.98% of data points were missing from the total dataset. A model fitting approach was used where the variance in distress accounted for by random effects (random intercepts and random slopes) was first tested. It was found that both intercept and slope terms were non-significant. Subsequently, four models without random effects were specified, including:

1. Time (i.e., day) alone as covariate model (**Time alone**).

2. Time, Visceral sensitivity (level - vsstat, and daily fluctuations – vsdyn), and negative emotions (level – nestat, and daily fluctuations – nedyn) as covariates model (**Both covariates**).
3. Visceral sensitivity alone as covariate model (**Visceral Sensitivity alone**).
4. Negative emotions alone as covariate model (**Negative Emotions alone**).

The deviance Chi-square (χ^2) were calculated for the different between these models (i.e., both covariates – Time alone, both covariates – visceral sensitivity alone, both covariates – negative emotions alone). Results indicated that the model incorporating both visceral sensitivity and negative emotions was the best fitting model compared to the others ($AIC = 1198.36$, $BIC = 1537.42$, $df = 6$, $p < .01$). Importantly, while the visceral sensitivity and negative emotions model had a better fit than the negative emotions only model, it had a poorer fit than the visceral sensitivity alone model, ($AIC = 1178.91$, $BIC = 1210.82$, $df = 3$, $p < .01$). This indicated that a model with visceral sensitivity was superior to one with both visceral sensitivity and negative emotions as covariates (see Table 4.3).

Analyses of parameter estimates for the visceral sensitivity alone model indicated that for every .8 change in daily visceral sensitivity fluctuations, there will be a 1 unit change in distress ($t = 15.72$, $p < .01$). Additionally in the model including visceral sensitivity and negative emotions, for every .76 unit change in daily visceral sensitivity fluctuations, there will be a 1 unit change in distress ($t = 14.76$, $p < .01$). Additionally, for every .08 unit change in daily negative emotion fluctuations, there will be a 1 unit change in distress ($t = 3.12$, $p < .01$). Further, for every .06 unit of change in the time-varying levels of negative emotions, there will be a 1 unit change in distress ($t = 2.34$, $p < .05$). It is interesting to note that the parameter estimate for visceral sensitivity in the visceral sensitivity only model is almost identical to that in the model

incorporating both visceral sensitivity and negative emotions. It is also interesting to observe that the larger parameter estimate for negative emotions in the negative emotions only model became much smaller in the model incorporating both visceral sensitivity and negative emotions, when visceral sensitivity was added to the model. This pattern of results suggested that changes in visceral sensitivity contributed to a significant portion of the change in distress that was originally accounted for by changes in negative emotions. Table 4.4 summarizes the parameter estimates of the models.

Table 4.3

Comparison of Models to ascertain the model of Best Fit.

Models	Predictors	No. Of parameters	-2 Log Likelihood	AIC	BIC	Compare models	Deviance (X2)	df	p
1.Time only	no random effects (time only)	3	1357.43	1363.43	1375.4				
2.Both Covariates	add both covariates visceral sensitivity, negative emotions and time	9	1148.16	1198.36	1537.42	with 1	209.27	6	<.0001
3.Visceral Sensitivity only	only visceral sensitivity and time	6	1164.01	1178.91	1210.82	with 2	15.85	3	<.001
4. Negative Emotions only	only negative emotions and time	6	1327.02	1343.02	1374.93	with 2	178.85	3	<.0001

* $P < .05$, ** $p < .01$

Table 4.4

Estimates of Random Effects for Models 2, 3, and 4.

Parameter	Estimate	SE	df	t	p
<i>Both visceral sensitivity (Vis Sens) and Negative Emotions (Neg Emo) model</i>					
Intercept	-.37	.26	399	-1.40	.16
day	.01	.01	399	2.15	.03
Daily Vis Sen	.76**	.05	399	14.76	.00
Vis Sen level	.17	2.57	399	.07	.95
Daily neg emo	.08**	.03	399	3.12	.01
Neg emo levels	-1.19	1.03	399	-1.16	.2
day * Vis Sen level	.03	.07	399	.39	.70
day * Neg emo levels	.06*	.03	399	2.34	.02
<i>visceral sensitivity only model</i>					
Intercept	-.12	.12	399	-.94	.35
day	.00	.00	399	.34	.73
Daily Vis Sen	.80**	.05	399	15.72	.00
Vis Sen level	1.64	2.42	399	.68	.50
day * Vis Sen level	-.05	.06	399	-.76	.45
<i>negative emotions only model</i>					
Intercept	-.39	.27	399	-1.45	.15
day	.01	.01	399	1.96	.05
Daily neg emo	.17**	.03	399	5.28	.00
Neg emo levels	-1.56	1.19	399	-1.31	.19
day * Neg emo levels	.07*	.03	399	2.28	.02

* $P < .05$, ** $p < .01$

4.4 DISCUSSION

This study aimed to examine the dynamic relationship between visceral sensitivity, negative emotions, mindfulness skills, IBS symptoms and distress using a case series. It was hypothesized that mindfulness skills training will result in changes in symptoms, distress, visceral sensitivity and negative emotions. It was also predicted that change in visceral sensitivity will better predict changes in distress as compared to changes in negative emotions, following mindfulness skills training.

The first hypothesis was partially supported. While mindfulness skills training did result in some changes in key IBS symptoms, distress, visceral sensitivity and negative emotions, these changes were not large enough to be considered reliable (in that they exceeded changes that would be expected by measurement error alone) nor clinically (in that participants showed post-intervention scores expected of a non-symptomatic group). However, visual analyses showed that there were generally improving trends for most participants during the intervention phase, compared to the baseline phase. Improvements included slight lowering in trend, level and also a decrease in fluctuation of variable ratings, all signifying improvement. Notably, based on visual analysis of the intervention phases of the diary graphs, mindfulness skills training seemed to lead to changes in visceral sensitivity. This was consistent with Garland and colleagues' (2011) finding that mindfulness training resulted in significant changes in Visceral Sensitivity Index scores.

The overall results indicated that there was a general move towards improvement (or change) in the variables that make up the psychological model, following changes in mindfulness skills. This provides some support for mindfulness skills as a viable protective factor in IBS.

The findings also illustrated the potential emotional regulatory properties of mindfulness skills (Chambers, Gullone, & Allen, 2009; Kerr, Josyula, & Littenberg, 2011). They further suggest that mindfulness skills have an effect on the cognitive appraisal process in visceral sensitivity. This accord with Bennett-Levy and colleague's (2004) contention that mindfulness skills do result in changes in cognitive appraisals, which validates part of the central pathway proposed in the previous study.

The second hypothesis that visceral sensitivity and negative emotions will precede changes in distress following mindfulness skills training was not supported by the results. Specifically, the findings did not indicate any temporal order of change in terms of negative emotions, visceral sensitivity and distress. Examination of the cross-correlograms indicated that visceral sensitivity, and to a limited extent, negative emotions, changed at lag-0 with distress for all six participants.

The third hypothesis that changes in visceral sensitivity will predict changes in distress more than changes in negative emotions will do so, was supported by the results. That is, random effects regression indicated that visceral sensitivity alone predicted change in distress greater than negative emotions alone, negative emotions, and visceral sensitivity together. Similarly, cross-correlogram analyses indicated that visceral sensitivity was better able to predict changes in distress compared to negative emotions. Additionally, cross-correlograms revealed that visceral sensitivity presented across all participants while negative emotions only presented in some of the participants.

With regards to the pattern of results for the first hypothesis, there are several possibilities that can explain the small changes in outcomes following mindfulness skills

training. For example, it is possible that while mindfulness skills are a potential protective factor in IBS, they may not be strong protective factors. However, this explanation is unlikely as the results indicate that mindfulness-skills training is associated with changes in distal factors such as visceral sensitivity and IBS distress. Likewise, Garland and colleagues (2011) have found that mindfulness training do result in direct improvements in visceral sensitivity and IBS symptom severity. Further, it would be difficult to make this judgment because of the second explanation. That is, there is a possibility that the participants in this study did not have sufficient training in mindfulness skills to bring about sufficiently large changes. It might be the case that more intense training might result in more powerful changes. Indeed, participants' non-significant post intervention FFMQ results, both clinically and reliably indicated that they did not make enough improvements, supporting this second explanation.

Most mindfulness-based training such as the Mindfulness-Based Stress Reduction program (MBSR) require participants to practice very intensively for 45 minutes every day, with a half-day mindfulness retreat (Baer, Carmody, & Hunsinger, 2012; Kerr, et. al., 2011) to achieve significant effects. Diary ratings for this study's participants showed that they practiced on average 15 minutes daily, reflecting a much smaller amount of practice. Most of the participants reported struggling to maintain even this 15-minute practice throughout the program.

A third possibility is the presence of co-morbid mental disorders such as generalized anxiety disorder and dysthymia that might reduce the power of mindfulness skills alone. Co-morbid conditions such as anxiety or mood disorders are prevalent in IBS sufferers (Drews & Hazlett-Stevens, 2008). Indeed, most of the participants in the present study showed that co-morbid mental disorders complicated IBS outcomes and reduced the strength of mindfulness skills training. For instance, two of the participants met the ADIS-IV criteria for sub-syndromal

generalized anxiety, another two met the criteria for generalized anxiety disorder, and a third met the criteria for dysthymia. They all reported that these mental disorders and sub-syndromal generalized anxiety contributed or triggered their IBS symptoms. The effects of mindfulness-skills training will be undone by these behaviours. As Hauke puts it, “mindfulness alone does not replace qualified therapeutic interventions” (2006, p. 50). These complicating and nuanced factors need to be factored in, but are often overlooked in large scale cross-sectional studies (Borckardt et. al., 2008).

Consistent with the need to target anxiety processes in IBS, a fourth explanation could be that this particular sample had a higher presentation of pathological worrying and might have benefited more from cognitive behavioural treatments that focused on worrying (Lackner et. al. 2006). In other words, mindfulness might have not been the most appropriate treatment approach here. A fifth reason could be that the FGID symptoms of this sample were already well managed, and therefore there were no treatment effects because pre-treatment functioning was already good. A final contention as to the limited effects on mindfulness skills training could be the fact that mindfulness as a sole intervention is not effective in managing IBS symptoms. Indeed, studies by other researchers such as Kearney, McDermott, Martinez, and Simpson (2011) and Zernicke and colleagues (2012) showed that mindfulness programs only produced small or non-significant treatment effects in terms of actual symptom changes.

With regards to the second hypothesis, it is interesting to note the lack of any temporal sequence of change in the variables measured, which contradicts the originally proposed integrated psychological model of FGIDs. Several explanations could account for these findings. The first explanation could be the possibility of a range effect – because the participants did not report sufficiently large changes in their mindfulness skills post-intervention, possible resultant

sequences of changes between visceral sensitivity, negative emotions, and distress were not elicited. The likelihood of this argument appears to be high in the present sample, as reflected in the non-clinically or reliably significant changes in their FFMQ scores.

The second explanation could be that there is another un-measured factor that mediates between mindfulness skills training and change in distress, to which negative emotions, visceral sensitivity and distress are all related. While this is a possibility, the literature also supports the close relationship between negative emotions and visceral sensitivity to IBS symptoms and distress (Labus et. al., 2004; Drews & Hazlett-Stevens, 2008), as well as their role as mediators between mindfulness training and symptom severity (Garland et. al., 2011). The third possibility is that these variables do indeed change simultaneously as proposed by Deary and colleagues (2007). Whether this was indeed the case remains to be validated.

Lastly, the lack of any apparent order of change in variables could be due to the size of the measurement occasion. Specifically, the variables were assessed on a daily basis. It could be that changes in the order of these variables occurred on a smaller time-scale, for example, hourly or within minutes, and that the measurement window in this study was too large to capture these changes. While this is a feasible reason, it is also viable to assess changes on a daily basis. That is, one would expect changes to occur gradually, to the extent that they can be captured by daily measurements, given that mindfulness skills acquisition/ improvement has been shown to occur gradually (Baer, et. al., 2012). Hence, it was expected that any resultant changes in visceral sensitivity, negative emotions and distress would also occur gradually.

Indeed, Baer and colleagues (2012) showed that changes in reported stress levels occurred gradually, measurable on a daily basis. Additionally, the time scale of the present study

is smaller, and hence more stringent than those employed by other studies. For instance, Lackner and colleagues (2006) and Jones and colleagues (2011) used longitudinal data of CBT interventions measured on weekly to monthly time scales. They were able to capture sequential changes even at these large time scales. It would seem that a lack of sequential changes in psychological and IBS outcome variables could be due to range effects.

The results for the third hypothesis provided further support for the possible role of visceral sensitivity in the maintenance of IBS related outcomes such as distress. This is consistent with findings from researchers using cross-sectional data (Labus et. al., 2007; Craske et. al., 2011; Garland et. al., 2011) indicating that visceral sensitivity predicted symptom severity and quality of life. The results were also consistent with findings from the previous study, further validating the role of FGID-specific psychological factors in the integrated psychological model. Overall, this result supports the role of visceral sensitivity as a linchpin psychological process (Berger, 1998) in IBS.

This study has three principal limitations. Firstly, the limited changes in the psychological model (i.e., the proposed dynamic relationships between psychological factors, symptoms and distress) could be due to a small intervention effect as participants might not have had enough mindfulness skills practice. Hence, the lack of dynamic relationships between the studied factors could be an artefact of the insufficient practice rather than an actual lack of dynamic relationships. Future studies should ascertain this point with a more intensive mindfulness skills practice component. Secondly, the generalisability of the effects of mindfulness training on IBS is limited by the small sample size. The participants in this sample were self-selected and might not be representative of the general and/ or severely clinical IBS populations. However, what this design lost in generalisability, it gained in depth and specificity

(Borckardt et. al., 2008). This allowed us to appreciate the subtleties in IBS and its response to treatment, which would otherwise be missed in other research designs. Thirdly, the daily diary was constructed without prior psychometric validation. Also, for the sake of practicality, the questions for each construct were few, which might have made the diary an imprecise measure of the variables of interest. That is, it might not have been an objective measures of symptom change. This was reflected in the moderate correlation between the VSI and the diary ratings for visceral sensitivity. Nonetheless, this is the first study of its kind attempting to tease apart the mechanisms of mindfulness training for IBS. It also provides further support for mindfulness training in IBS and highlights the complexity of the IBS experience.

Future studies could include replications of this case series design with other FGIDs and a combination of psychological interventions. It is also recommended that participants in randomised controlled trial designs could complete key measures at time scales closer to that in which we expect key psychological processes to interact. This will allow for both breadth and depth of results. Further, this study could be replicated using a more rigorous research design by including a control group, for example, a wait list or treatment as usual.

Overall, this study provided some further support for the role of mindfulness skills as protective factors in IBS. The results also demonstrated the important role of visceral sensitivity, relative to negative emotions, in IBS. These results provide some additional support for a previously proposed integrated psychological model of FGIDs.

References

- Arch, J.J., & Craske, M.G. (2010). Laboratory stressors in clinically anxious and non-anxious individuals: the moderating role of mindfulness. *Behaviour Research and Therapy*, 48, 495 – 505. DOI: 10.1016/j.brat.2010.02.005
- Baer, R.A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Psychological Science*, 10(2), 125-143. DOI: 10.1093/clipsy/bpg015
- Baer, R.A., Smith, G.T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J.M.G. (2008). Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment*, 15(3), 329 – 342. DOI: 10.1177/1073191107313003
- Baer, R. A, Carmody, J., & Hunsinger, M. (2012). Weekly Change in Mindfulness and Perceived Stress in a Mindfulness-Based Stress Reduction Program. *Journal of clinical psychology*, 68(7), 755-765. DOI:10.1002/jclp.21865
- Berger, R.M. (1998). Characteristics of optimal clinical case formulations: The linchpin concept. *American Journal of Psychotherapy*, 52(3), 287 – 300. Retrieved from, <http://faculty.coe.uh.edu/arbona/courses/epsy7393/Berger%20Linchpin%20concept.pdf>, on August 10, 2012.
- Bennett-Levy, J., Butler, G., Fennell, M., Hackmann, A., Mueller, M., & Westbrook, D. (2004). *Oxford Guide to Behavioural Experiments in Cognitive Therapy (Cognitive Behaviour Therapy: Science and Practice, 2)*. Oxford: Oxford University Press.

- Blanchard, E. B. (2001). *Irritable Bowel Syndrome: Psychosocial Assessment and Treatment*. Washington, DC: American Psychological Association.
- Borckardt, J. J., Nash, M. R., Murphy, M. D., Moore, M., Shaw, D., & O'Neil, P. (2008). Clinical practice as natural laboratory for psychotherapy research: a guide to case-based time-series analysis. *The American psychologist*, 63(2), 77-95. DOI:10.1037/0003-066X.63.2.77
- Boyce, P., Gilchrist, J., Talley, N.J., & Rose, D. (2000). Cognitive-behaviour therapy as a treatment for irritable bowel syndrome: a pilot study. *Australian and New Zealand Journal of Psychiatry*, 34, 300–309. DOI: 10.1046/j.1440-1614.2000.00731.x
- Brown, T.A., DiNardo, P.A., & Barlow, D.H. (1994). *Anxiety Disorders Interview Schedule for DSM-IV: Adult Version*. NY: Oxford University Press.
- Chambers, R., Gullone, R., & Allen, N.B. (2009). Mindful emotion regulation: An integrative review. *Clinical Psychology Review*, 29(6), 560 – 572. DOI: 10.1016/j.cpr.2009.06.005
- Craske, M.G., Wolitzky-Taylor, K.B., Labus, J., Wu, S., Frese, M., Mayer, E.A., & Naliboff, B.D. (2011). A cognitive-behavioral treatment for irritable bowel syndrome using interoceptive exposure to visceral sensations. *Behaviour Research and Therapy*, 49, 413 – 421. DOI: 10.1016/j.brat.2011.04.001.
- Crawford, J., Cayley, C., Lovibond, P.F., Wilson, P.H., & Hartley, C. (2011). Percentile norms and accompanying interval estimates from an Australian general adult population sample for self-report mood scales (BAI, BDI, CRS-D, CES-D, DASS, DASS-21, STAI-X,

- STAI-Y,SRDS, and SRAS). *Australian Psychologist*, 46, 3 – 14. DOI: 10.1111/j.1742-9544.2010.00003.x
- Deary, V., Chalder, T., & Sharpe, M. (2007). The cognitive behavioural model of medically unexplained symptoms: a theoretical and empirical review. *Clinical Psychology Review*, 27(7), 781 – 797. DOI: 10.1016/j.cpr.2007.07.002
- Drews, A., & Hazlett- Stevens, H. (2008). Relationships between irritable bowel syndrome, generalized anxiety disorder, and worry-related constructs. *International Journal of Clinical Health Psychology*, 8(2), 429- 436. Retrieved from <http://redalyc.uaemex.mx/pdf/337/33712001005.pdf>, on June 15, 2012.
- Drossman, D. A., & Dumitrascu, D. L. (2006). Rome III: New Standard for Functional Gastrointestinal Disorders. *Journal of Gastrointestinal and Liver Disorders*, 15(3), 237-241. DOI: 10.1053/j.gastro.2006.03.008
- Evans, C., Margison, F., & Barkham, M. (1998). The contribution of reliable and clinically significant change methods to evidence-based mental health. *Evidence-Based Mental Health*, 70-73. DOI:10.1136/ebmh.1.3.70
- Feltman, R., Robinson, M.D., & Ode, S. (in press). Mindfulness as a moderator of neuroticism-outcome relations: A self-regulation perspective. *Journal of Research in Personality*. DOI: 10.1016/j.jrp.2009.08.009
- Franklin, R.D., Allison, D.B., & Gorman, B.S. (1996). *Design and Analysis of Single-Case Research*. NJ: Lawrence Erlbaum Associates, Inc.

- Garland, E.L., Gaylord, S.A., Palsson, O., Faurot, K., Mann, J.D., & Whitehead, W.E. (2011). Therapeutic mechanisms of a mindfulness-based treatment for IBS: effects on visceral sensitivity, catastrophizing, and affective processing of pain sensations. *Journal of Behavioral Medicine*, 35(6), 591-602. DOI: 10.1007/s10865-011-9391-z
- Hauke, G. (2006). Self-regulation and mindfulness. *European Psychotherapy*, 6(1), 21 – 54.
- Henry, J.D., & Crawford, J.R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, 44, 227–239. DOI: 10.1348/014466505X29657
- Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The Use of Single-Subject Research to Identify Evidence-Based Practice in Special Education. *Exceptional Children*, 71(2), 165 - 179. Retrieved from, http://www.freewebs.com/lowvisionstuff/single_subject.pdf, on June 5, 2011.
- Jacobson, N., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, 59(1), 12-19. DOI: 10.1037/0022-006X.59.1.12
- Jones, M.P., Crowell, M.D., Olden, K.W., & Creed, F. (2007). Functional gastrointestinal disorders: an update for the psychiatrist. *Psychosomatics*, 48(2), 93 – 102. DOI: 10.1176/appi.psy.48.2.93
- Jones, M., Koloski, N., Boyce, P., & Talley, N. J. (2011). Pathways connecting cognitive behavioral therapy and change in bowel symptoms of IBS. *Journal of psychosomatic research*, 70(3), 278-85. DOI:10.1016/j.jpsychores.2010.10.004

- Kearney, D.J., McDermott, K., Martinez, M., Simpson, T.L. (2011). Association of participation in mindfulness programme with bowel symptoms, gastrointestinal symptom-specific anxiety and quality of life. *Alimentary Pharmacology & Therapeutics*, 34(3), 363 – 373. DOI: 10.1111/j.1365-2036.2011.04731.x.
- Kennedy, C.H. (2005). *Single-Case Designs For Educational Research*. Boston: Allyn and Bacon.
- Kerr, C. E., Josyula, K., & Littenberg, R. (2011). Developing an Observing Attitude: An Analysis of Meditation Diaries in an MBSR Clinical Trial. *Clinical Psychology*, 93(May 2010), 80-93. DOI:10.1002/cpp
- Labus, J.S., Bolus, R., Chang, L., Wiklund, I., Naesdal, J., Mayer, E.A., & Naliboff, B.D. (2004). The Visceral Sensitivity Index: development and validation of a gastrointestinal symptom-specific anxiety scale. *Alimentary Pharmacology & Therapeutics*, 20, 89–97. DOI: 10.1111/j.1365-2036.2004.02007.x
- Lackner, J. M., & Quigley, B. M. (2005). Pain catastrophizing mediates the relationship between worry and pain suffering in patients with irritable bowel syndrome. *Behaviour research and therapy*, 43(7), 943-57. DOI:10.1016/j.brat.2004.06.018
- Lackner, J. M., Coad, M.L., Mertz, H.R., Wack, D.S., Katz, L.A., Krasner, S.S., Firth, R., Mahl, T.C., & Lockwood, A.H. (2006). Cognitive therapy for irritable bowel syndrome is associated with reduced limbic activity, GI symptoms, and anxiety. *Behaviour research and therapy*, 44(5), 621 – 638. DOI: 10.1016/j.brat.2005.05.002

Ljotsson, B., Andreewitch, S., Hedman, E., Ruck, C., Andersson, G., & Lindefors, N. (2010).

Exposure and mindfulness based therapy for irritable bowel syndrome--an open pilot study. *Journal of Behavior Therapy and Experimental Psychiatry*, 41(3), 185 – 190.

DOI: 10.1016/j.jbtep.2010.01.001

Ljotsson, B., Falk, L., Vesterlund, A.W., Hedman, E., Lindfors, P., Ruck, C., Hursti, T.,

Andreewitch, S., Jansson, L., Lindefors, N., & Andersson, G. (2010). Internet-delivered exposure and mindfulness based therapy for irritable bowel syndrome--a randomized controlled trial. *Behaviour Research and Therapy*, 48(6), 531 - 539. DOI:

10.1016/j.brat.2010.03.003

Ljotsson, B., Hedman, E., Lindfors, P., Hursti, T., Lindefors, N., Andersson, G., Ruck, C.

(2011). Long-term follow-up of internet-delivered exposure and mindfulness based treatment for irritable bowel syndrome. . *Behaviour Research and Therapy*, 49(1), 58 - 61. DOI: 10.1016/j.brat.2010.10.006

Lovibond, P.F. & Lovibond, S.H. (1995). The structure of negative emotional states:

Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33, 335-343. DOI:

0.1016/0005-7967(94)00075-U

McCain, L.J., & McCleary, R. (1979). The statistical analysis of the simple interrupted time-

series quasi-experiment. In Cook, T.N., * Campbell, D.T (Eds.) *Quasi-experimentation: Design and Analysis Issues for Field Settings*. Boston: Houghtonm Mifflin.

Moskowitz, D. S., Russell, J. J., Sadikaj, G., & Sutton, R. (2009). Measuring People Intensively.

Canadian Psychologist, 50(3), 131–140. DOI: 10.1037/a0016625

- Moss-Morris, R., Weinman, J., Petrie, K.J., Horne, R., Cameron, L.D., & Buick, D. (2002). The revised Illness Perception Questionnaire (IPQ-R). *Psychology and Health, 17*(1), 1 – 16. DOI: 10.1080/08870440290001494
- Myers, B., & Greenwood-Van Meerveld, B. (2009). Role of anxiety in the pathophysiology of irritable bowel syndrome: importance of the amygdala. *Frontiers in neuroscience, 3*(June), 47. DOI:10.3389/neuro.21.002.2009
- Muscatello, M.R.A., Bruno, A., Pandolfo, G., Mico, U., Stilo, S., Scaffidi, M., Consolo, P., Tortora, A., Pallio, S., Giacobbe, G., Familiari, L., & Zoccali, R. (2010). Depression, anxiety and anger in subtypes of Irritable Bowel Syndrome patients. *Journal of Clinical Psychology in Medical Settings, 17*, 64–70. DOI: 10.1007/s10880-009-9182-7
- Onghena, P., & Edgington, E. S. (2005). Customization of Pain Treatments: Single-Case Design and Analysis. *Clinical Journal of Pain, 21*, 56–68. DOI: 10.1037/a0016625
- Ormel, J., Rosmalen, J., & Farmer, A. (2004). Neuroticism: a non-informative marker of vulnerability to psychopathology. *Social psychiatry and psychiatric epidemiology, 39*(11), 906-12. DOI:10.1007/s00127-004-0873-y
- Rees, G., Fry, A., Cull, A., & Sutton, S. (2004). Illness perceptions and distress in women at increased risk of breast cancer. *Psychology & Health, 19*(6), 749-765. DOI:10.1080/08870440412331279764
- Reme, S. E., Stahl, D., Kennedy, T., Jones, R., Darnley, S., & Chalder, T. (2011). Mediators of change in cognitive behaviour therapy and mebeverine for irritable bowel syndrome. *Psychological medicine, (2011)*, 1-11. DOI:10.1017/S0033291711000328

Segal, Z.V., Williams, J.M.G., & Teasdale, J.D. (2002). *Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse*. NY: The Guilford Press.

Shapiro, S.L., Carlson, L.E., Astin, J.A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, 62(3), 373 – 386. DOI: 10.1002/jclp

Siegal, R.D., Germer, C.K., & Olendzki, A. (2008). Mindfulness: What is it? Where does it come from? In Didonna, F. (Ed.). *Clinical Handbook of Mindfulness*. New York: Springer. Retrieved from, http://www.mindfulselfcompassion.org/articles/nicamb_mindfulness.pdf, on April 4, 2012.

Sim, K., Gwee, K.P., & Bateman, A. (2005). Case formulation in psychotherapy: Revitalizing its usefulness as a clinical tool. *Academic Psychiatry*, 29(3), 289 – 292. DOI: 10.1176/appi.ap.29.3.289

Stahl, B., & Goldstein, E. (2010). *A Mindfulness-Based Stress Reduction Workbook*. CA: New Harbinger Publications, Inc.

Vøllestad, J., Nielsen, M. B., & Nielsen, G. H. (2012). Mindfulness- and acceptance-based interventions for anxiety disorders: a systematic review and meta-analysis. *The British journal of clinical psychology / the British Psychological Society*, 51(3), 239-60. DOI:10.1111/j.2044-8260.2011.02024.x

Westbrook, D., Kennerley, H., & Kirk, J. (2011). *An Introduction to Cognitive Behaviour Therapy: Skills and Applications*. (2e). London: SAGE Publications Inc.

Wilhelmsen, I. (2005). Biological sensitisation and psychological amplification: Gateways to subjective health complaints and somatoform disorders. *Psychoneuroendocrinology*, 30(10), 990 – 995. DOI: 10.1016/j.psyneuen.2005.01.011

Zernicke, K.A., Lawlor-Savage, L., Lounsberry, J., Zhong, L. Blustein, P.K., Campbell, T.S., & Carlson, L.E. (2012). Mindfulness-based stress reduction improves distress in two different chronic illnesses. *Journal of Behavioral Health*, 1(3), 201 – 208. DOI: 10.5455/jbh.20120628011441.

CHAPTER 5.
OVERALL CONCLUSION: WHAT WAS LEARNT

This thesis aimed to compare two functional gastrointestinal disorders (FGIDs) in terms of psychological factors. This comparison laid the groundwork for determining if psychological treatments effective for one FGID are applicable to another. This thesis also addressed some gaps in current psychological models of FGIDs. These gaps included a lack of examination of the role of newly conceptualized psychological factors specific to FGIDs, as well as a lack of consideration of protective factors in FGIDs. An integrated psychological model of FGIDs (See Figure 5.1) which included some of these psychological factors was proposed, and aspects of it were tested.

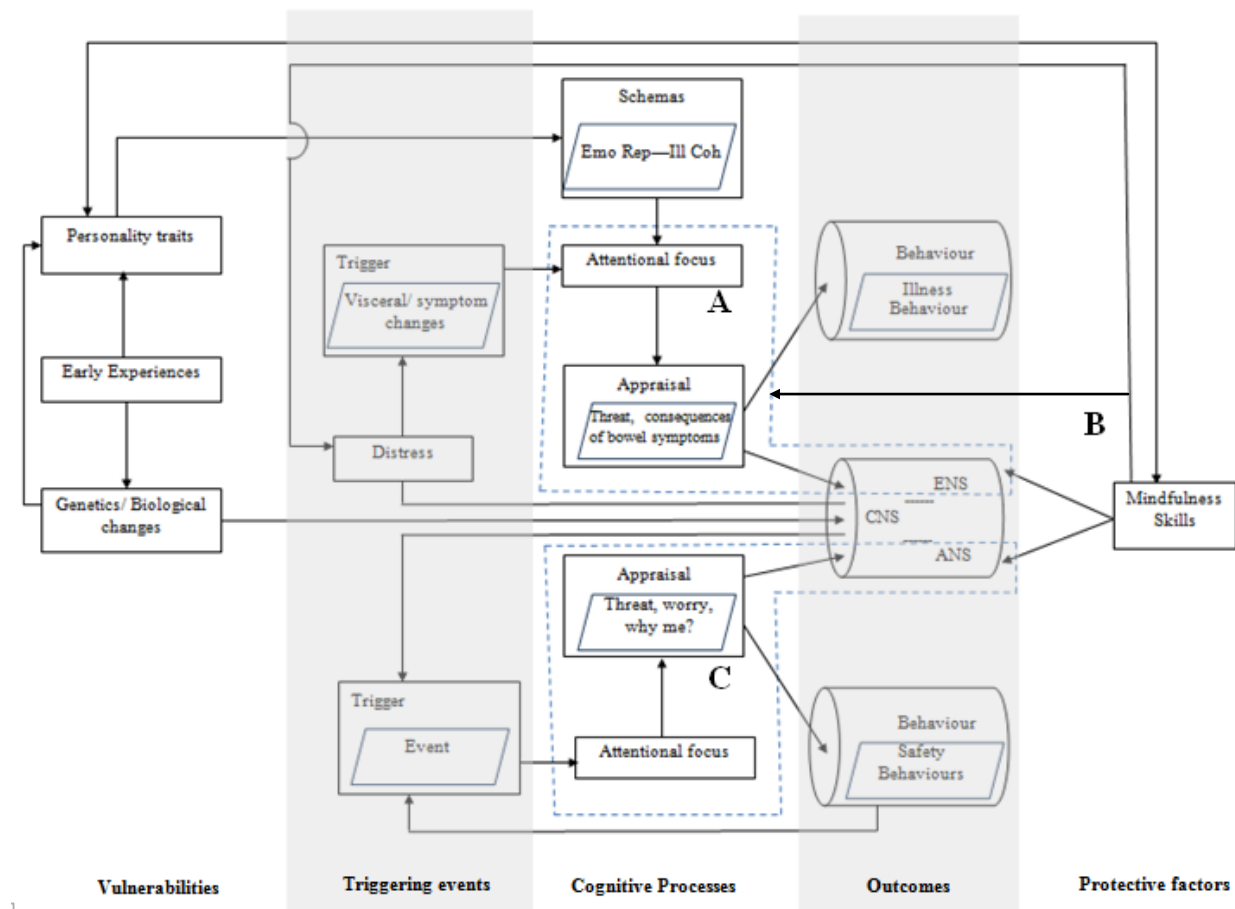


Figure. 5.1 The proposed Integrated Psychological model of FGIDs consisting of two processes – an FGID specific set of psychological processes (Part A) and a generic emotional process (Part C); and protective factors (Part B).

This chapter will discuss the findings and summarize the themes that were revealed in the results. Implications for clinical practice and research will also be considered.

5.1 What was studied?

In Chapter 2, functional constipation (FC) and irritable bowel syndrome (IBS) were compared along psychological factors. The rationale for this comparison is that FC and IBS are very similar and share many symptoms. Research has also shown that IBS and FC symptom patterns are dynamic, with some individuals experiencing changing frequency of symptoms over time, resulting in changing diagnostic categories. (Wong et. al., 2010). The fluid nature of these syndromes, coupled with their overlapping symptoms, undermines their distinction. (Wong et. al., 2010). Thus, a comparison of the psychological factors between these two FGIDs will have implications for the psychological treatment of FC, which had hitherto received little attention. Specifically, should the psychological factors of FC and IBS overlap as well, then psychological interventions for IBS should be applicable to FC.

Based on past research demonstrating the similarities between FC and IBS, the study in Chapter 2 compared psychological factors such as neuroticism, anxiety, depression, stress, alexithymia, visceral sensitivity and FGID-specific illness representations between individuals with FC and those with IBS. A total of 144 participants were sampled. Logistic regression was used to ascertain which psychological factors predicted inclusion in the IBS versus the FC diagnostic category.

Chapter 3 considered in depth the inter-relationship between psychological factors that are specific to FGIDs, as well as mindfulness skills as protective factors (Baer, 2003; Khong,

2009). These psychological factors were considered to be important additional parts of a psychological model that integrated the key processes stated in the Bio-Psycho-Social (Ghaemi, 2009), Cognitive Behavioural (Deary, Chalder & Sharpe, 2007) and Dual Etiology (Wilhelmsen, 2005) models. This is because these psychological factors constitute newly conceptualized processes (schemas, attentional bias, appraisals) with FGID-specific content (Part A of Figure 5.1) that have not otherwise been considered in depth in the existing psychological models.

The newly conceptualized psychological factors that are specific to FGIDs include FGID-related illness representations such as illness coherence – the degree of understanding an individual has about his FGID (Rees, Fry, Cull & Sutton, 2004), and emotional representation – the emotional schema or reaction an individual has towards his or her FGID experience (Chaboyer, Lee, Wallis, Gillespie, & Jones, 2010), as well as visceral sensitivity, characterized by hyper-vigilance to, negative appraisal of and emotional reactions to abdominal sensations (Labus, Mayer, Chang, Bolus, & Naliboff, 2007). The inter-relationships of these psychological factors as well as their influence on perceived symptom severity (a representation of distress) and symptom frequency were examined using path analysis. Additionally, the relationship of mindfulness skills (assessed by the FFMQ) to these psychological processes was also examined. A total of 144 participants were sampled for this study.

In Chapter 4, the dynamic relationship between aspects of the integrated psychological model, specifically, visceral sensitivity, negative emotions and mindfulness, were further tested through a case series applied in a clinical setting. The impact of mindfulness skills training was tested and the influence of visceral sensitivity on IBS outcomes was compared with the influence of negative emotions. To do so, six individuals diagnosed with IBS were recruited from the Australian community to participate in an eight-week mindfulness skills training program. The

objective was to directly examine the validity of mindfulness skills as protective factors that would mitigate IBS symptoms, distress, visceral sensitivity and negative emotions (Part B of Figure. 5.1), by enhancing mindfulness skills with training. This study was based on the empirical evidence which showed that the emotional regulatory properties of mindfulness skills mitigated the emotional processes in FGIDs (Garland et. al., 2011). The importance of visceral sensitivity and its role as a key process in FGIDs compared to generic emotional processes, was also examined (Part A versus Part C of Figure. 5.1).

To elaborate, changes in IBS symptoms, mindfulness skill, distress, negative emotions and visceral sensitivity before and after mindfulness skills training were examined. Reliable and clinically significant change calculations and visual analysis of participants' daily diary plots were analysed to ascertain the effects of mindfulness skills training. Additionally, the contribution of changes in visceral sensitivity after mindfulness skills training in explaining changes in distress, compared to the contribution of negative emotions, was also examined. Cross-correlation function analyses and random effects regression modelling were used to answer this question.

5.2 What was found?

The results in Chapter 2 indicated that individuals with chronic constipation and IBS had similar levels of alexithymia, personal control, illness coherence, emotional representations, psychological causal attributions, risk factor causal attributions, altered immunity causal attributions and chance attributions. This means that FC and IBS were similar in terms of these psychological factors. However, it was found that higher levels of visceral sensitivity and

neuroticism predicted inclusion into the IBS diagnostic category while higher levels of emotional distress/ negative emotions predicted inclusion into the FC diagnostic category.

The reasons for this pattern of results were discussed, and it was considered that visceral sensitivity might be more salient to IBS because of the experience of pain experienced in IBS, compared to FC. In particular, pain is likely to increase hyper-vigilance (Chapman & Martin, 2011) and negative appraisal both of which are constituents of visceral sensitivity. Another reason for this pattern of findings could be attributed to the use of the Visceral Sensitivity Index (VSI) in the measurement of visceral sensitivity. Specifically, the VSI had items that focused on diarrhoea and its negative consequences (Labus et. al., 2007), which might have biased the results against those who endorsed more constipation symptoms. Hence, the problem became a measurement issue. Additionally, reasons were explored as to why IBS sufferers tended to report higher levels of neuroticism than FC. One hypothesis was that neuroticism plays a greater role in influencing the development of IBS symptoms than FC and might be a predictor of severity of bowel symptoms (Wong et. al., 2010). The lack of existing examination of the relationship between neuroticism and FC was also highlighted.

However, caution is needed when using this approach as the results are only preliminary, and require further validation. Furthermore, the study was based on a small sample which limits the generalisability of its findings. There was also a lack of comparison of the factors across different demographic indicators, which might have provided important information about the findings. For instance, such a comparison would have informed the appropriateness of combining FC sufferers with sub-clinical chronic constipation sufferers in the analysis). Lastly, the results in Chapter 2 could lead to the assumption that common psychological factors reflect similar core psychological processes. However, such an assumption remains to be validated,

amidst the possibility that similar psychological factors might not reflect similar core psychological processes.

In Chapter 3, it was found that emotional representation and visceral sensitivity fully mediated the relationship between neuroticism and symptom severity and frequency. Illness coherence was found to independently predict both symptom severity and frequency, while the effects of mindfulness skills such as acting with awareness, non-reacting and non-judging negatively predicted neuroticism. Contrary to the argument by Craske and colleagues (2011) that visceral sensitivity perpetuates FGID symptoms in the same way that catastrophic appraisal of bodily sensation maintains panic attacks, the study in Chapter 3 did not find the a cyclical relationship between visceral sensitivity and symptom frequency.

These results validate the role of FGID-specific psychological processes in explaining FGID symptoms and distress (Part A of Figure. 5.1), as well as the role of mindfulness skills as a protective factor (Part B of Figure. 5.1). The results suggest that visceral sensitivity is an important factor that ties together emotional schemas and FGID outcomes, such as symptoms and distress. They also support the suggestion that emotional representation provides the content of appraisal (i.e., bowel sensations) in visceral sensitivity. Additionally, the path model specified suggested that increased illness coherence, that is, an understanding of one's illness, might result in improved FGID outcomes, making illness coherence another potential protective factor. It is unsure why there was no cyclical relationship between visceral sensitivity and symptom frequency, although it raises the possibility of other mediating psychological factors. Another possibility could be due to the limitations of assessing visceral sensitivity by using a psychometric measure in a cross-sectional design. This instrument might not have captured the dynamic changes in visceral sensitivity, which could have further explained its relationship to

FGID symptoms. The lack of cyclical relationship between visceral sensitivity and symptom frequency also reflected the difficulties in assessing such a dynamic relationship.

In Chapter 4, it was found that mindfulness skills training did result in some changes in IBS symptoms, distress, visceral sensitivity and negative emotions, although the changes were not of a magnitude to be considered clinically significant. It was observed that mindfulness skills training served to stabilize the emotional and symptom fluctuations for some participants. Moreover, the changes in visceral sensitivity following mindfulness skills training predicted significantly more variance in distress than changes in negative emotions did. Nonetheless, negative emotions still contributed unique variance to distress. Additionally, it was found that visceral sensitivity occurred more regularly in the sample than negative emotions. What was not found was any temporal sequence of change between visceral sensitivity, negative emotions and distress across time. No temporal sequence of change between these factors was observed following mindfulness skills training either. Several reasons were hypothesized for these observations. For instance, the impact of mindfulness training was insufficient to result in significant manifestation of temporal sequences. Also, there might have been an unmeasured common mediating factor underlying the factors studied that changed with mindfulness training. Lastly it was possible that all these psychological and symptom factors occurred simultaneously and an insufficiently small measurement window failed to capture the dynamic relationship between them.

These results further validate the role of mindfulness skills as protective factors in FGIDs (Part B of Figure. 5.1). They also underscore the importance of an FGID-specific process such as visceral sensitivity in an FGID such as IBS, while generic emotions represent generic processes that contribute to the exacerbation of FGID outcomes (Parts A & C of Figure. 5.1).

Additionally, these results reflect the importance of regular and more intensive mindfulness skills practice to ensure that they benefit FGID outcomes. Further, the clinical reality of the participants highlights the fact that mindfulness training skills alone is not enough to manage FGIDs that are co-morbid with other mental illnesses.

5.3 Thematic Considerations: Tying It All Together

Several themes arose from the results. These were the psychological similarities and differences between FC and IBS, the centrality of psychological processes unique to FGIDs, the role of emotional processes and emotional regulation in FGIDs, and the importance of considering protective factors in FGIDs.

5.3.1 Psychological Factors: Similarities and differences between IBS and FC

As previously considered, FC has received very little study in terms of its treatment and its association with psychological factors. The findings from Chapter 2 suggest that psychological factors such as alexithymia, personal control, emotional representations, psychological causal attributions, risk factor causal attributions, altered immunity causal attributions and chance attributions are associated with FC. None of these factors have hitherto been studied in FC. Moreover, sufferers of FC and IBS seem to share similar levels of alexithymia, endorse similar levels of personal control and beliefs about the causes of their FGIDs, and have similar levels of emotional reactions toward their FGIDs. This identifies the psychological factors for further study with regard to their specific roles in FC symptom presentation and perpetuation. Building a psychological model for FC will inform psychological

treatment options for this syndrome. Conversely, the differences in levels of visceral sensitivity and neuroticism between FC and IBS might suggest that targeting these factors in psychological treatments might not be applicable to FC. Whether this is true remains to be ascertained in clinical studies.

5.3.2 Psychological Processes Specific to FGIDs: The Key Role of Visceral Sensitivity

The results of Chapters 3 and 4 provided support for the predominant role of FGID-specific psychological processes (Part A of Figure. 5.1) over generic psychological processes (Part C of Figure. 5.1) in influencing FGID outcomes. This was determined by the greater influence of central and FGID-specific psychological factors in predicting FGID outcomes, the size of the additional influence these factors have on FGID outcomes, and how consistently these central processes presented in FGIDs across individuals, as compared to generic psychological processes that have been proposed by existing psychological models. Hence, it is possible that there are central psychological processes in FGIDs that are crucial to their operation (Part A of Figure. 5.1), as well as generic/ non-FGID-specific psychological processes that might (and might not necessarily) moderate the operation of FGIDs (Part C of Figure. 5.1).

This proposition is supported qualitatively by the participant clinical formulations in Chapter 4. Specifically, almost all six participants reported aspects of central psychological processes such as excessive attentional focus on bowel symptoms, negative cognitive appraisal and worrying about symptoms, emotional reaction and arousal which resulted in symptom maintenance, and illness behaviours (Part A of Figure. 5.1). These case formulations also highlighted the role of generic psychological processes such as emotional processes involved in

anxiety and dysthymia in the initial activation of or exacerbation of bowel symptoms for some participants (Part C of Figure. 5.1). Further, they highlight the dynamic relationship between specific and generic psychological processes, something not otherwise captured by the static cross-sectional research design of Chapter 3.

Further exploration suggests that visceral sensitivity might be a key psychological factor (Berger, 1998) in the central psychological process of FGIDs (Part A of Figure. 5.1). It seems to be the mechanism which “channels” the effects of broader factors such as personality (i.e., neuroticism) and the content of illness schemata (i.e., emotional representation) into symptom severity and increased symptom activation. This hypothesis is further supported by the results in Chapter 4 showing that visceral sensitivity predicted distress in people suffering from IBS more consistently, and to a greater degree, than general negative emotions following mindfulness skills training. Hence visceral sensitivity, with its specific focus on gut-related sensations and consequences (Labus et. al., 2007), might be an important psychological factor in predicting the activation and maintenance of FGID symptoms and distress. Nonetheless, the nature and measurement of this particular construct deserves further study.

5.3.3 The Role of Emotional Process and Emotional Regulation in FGIDs

From a different angle, the results of Chapters 2 to 4 emphasize the role that emotions and emotional processes play in FGIDs. As discussed above, psychological factors such as visceral sensitivity are closely involved in the FGID-specific emotional reactions, particularly gut-related anxiety (Jones, Crowell, Olden, & Creed, 2007), and is itself influenced by emotional representations. Additionally, peripheral emotional processes have also been shown to influence

FGID outcomes. This was indicated by the results in Chapter 4 which demonstrated that *both* visceral sensitivity and negative emotions contributed to distress.

The influence of emotional processes in FGIDs implicates the role of emotional dysregulation (Oudenhove, Demttenaere, Tack, & Aziz, 2004) in the manifestation and maintenance of FGID symptoms and distress. By extension, this highlights the importance of emotional regulation in the management of FGIDs. Indeed, findings in Chapters 3 and 4 support the emotional regulatory role of mindfulness skills (Arch & Craske, 2006; Weinstein, Brown & Ryan, 2009) in the management of emotional processes in FGIDs, and FGID symptoms (Garland et. al., 2011). Specifically, mindfulness skills such as acting with awareness, avoiding judgment-evaluation of experiences as good or bad, and not-reacting to experience were found to influence distal emotional factors such as neuroticism, and more directly influenced visceral sensitivity, negative emotions and FGID outcomes. While it is still unclear if the mindfulness “induced” changes to emotional processes then resulted in changes in FGID outcomes, it is evident that these important emotional processes have benefitted from improvements in mindfulness skills.

5.3.4 Protective Factors in FGIDs

The study of Part B of the integrated psychological model supports the importance of considering protective factors in FGIDs. Mindfulness skills have been found to be an important protective factor in regulating the emotional processes that trigger, exacerbate or maintain FGID symptoms (Parts A and C of Figure. 5.1). They also have a strong theoretical basis as generic protective factors (Segal, Williams and Teasdale, 2002).

Interestingly, the results of Chapter 3 reveal another protective factor for FGIDs - illness coherence or the understanding an individual has of his illness. Studies of other medical conditions such as chronic pain have found that better understanding, or being able to make sense of one's otherwise confusing illness, is beneficial to illness outcomes (Graham, Lobel, Glass, & Lokshina 2008). Indeed, studies by these researchers (Graham, et. al., 2008) demonstrate that interventions that function to cultivate a greater personal understanding for sufferers of chronic illnesses serves to reduce the distress associated with these chronic illnesses. Likewise, the results of Chapter 3 suggest that effects of sense making are also beneficial for FGID outcomes, and might even mitigate FGID symptoms. What remains to be examined is the mechanism of illness coherence in FGIDs.

In terms of the integrated model, the positive effects of mindfulness skills and illness coherence on FGID symptoms and distress support the role of protective factors in FGIDs. The presence of illness coherence further suggests the presence of multiple protective factors or personal resources. The presence of protective or mitigating factors might explain why some individuals did not develop FGID symptoms despite their predisposing vulnerabilities (Alpers, 2008). Protective factors might also partially contribute to the fluidity of the FGID symptoms across time (Wong et. al., 2010). Specifically, it is possible that the symptoms of FGIDs might wax and wane according to the levels of personal resources or protective factors an individual has at any one time.

5.4 Visceral Sensitivity: Further Important Considerations

Visceral sensitivity (Labus et. al., 2004) as a construct warrants special consideration as it has been found to play a significant role in FGIDs, based on the results from Chapters 2 to 4. While the role of visceral sensitivity has received some study (Craske et. al., 2011; Garland et. al., 2011), the nature of this construct remains unclear.

Although Labus and colleagues (2007) defined visceral sensitivity as “gut-specific anxiety”, an examination of the VSI they designed to assess this construct revealed a greater emphasis on negative cognitive appraisal to perceived threat of bowel sensations, and hyper-vigilance towards changes in abdominal sensations. There is less emphasis on emotion in the measure and it might be the case that the emotional reaction, specifically, gut-specific anxiety, is a function of the cognitive appraisal, hyper-vigilance and arousal triggered by these processes (see Figure. 5.1; area surrounded by dotted lines; & Figure. 5.2.). Indeed, Oudenhove and colleagues (2004) reviewed brain imaging research which showed that the areas involved in visceral processing and emotional regulation overlap significantly, suggesting the close association between appraisal, hyper-vigilance and emotions. Additionally, while the psychometric analyses by Labus and colleagues (2007) demonstrated that the VSI has a single factor loading, implying that visceral sensitivity is a unitary construct, the fact that the VSI consists of items assessing cognitive appraisal and attention focus (hyper-vigilance) suggests otherwise.

The possibility that visceral sensitivity is a dynamic process consisting of many “aspects” is a plausible conceptualization. For instance, studies show that individuals suffering from IBS tend to have selective attentional biases towards visceral sensations such as pain (Chapman &

Martin, 2011). This observation has also been made in studies which showed that individuals suffering from IBS respond faster to IBS-related words presented subliminally, as compared to healthy controls (Afzal, Potokar, Probert, & Munafo, 2006). Additionally, IBS patients selectively recall words associated with gastrointestinal sensations (Gibbs-Gallagher and colleagues, 2001). These findings suggest that attentional bias might be a separate but closely related psychological process to visceral sensitivity. Alternatively, attentional bias can be viewed as a separate construct in FGIDs, of which hyper-vigilance in visceral sensitivity is a subset (see Figure 5.2). Indeed, Lackner (2005) define visceral sensitivity as the heightened awareness of normal intestinal activity, which is one area of attentional focus in individuals with FGIDs.

Further, the appraisal “aspect” of visceral sensitivity might have some overlaps with catastrophic appraisals of bowel symptoms found by researchers (Lackner, 2005; Lackner et. al., 2006; Garland et. al., 2011; Jones Koloski, Bpyce, & Talley, 2011). In other words, catastrophic appraisals and visceral sensitivity might share similar cognitive *content*, with visceral sensitivity being more focused on the implications of abdominal sensations and hence constituting a subset of illness specific cognitive appraisals (see Figure 5.2). Additionally, there have been studies that seem to link or combine visceral sensitivity with visceral hyper-sensitivity, which is the tendency to amplify subjective reporting of visceral changes (Craske et. al., 2011). Whether these propositions are true remain to be validated.

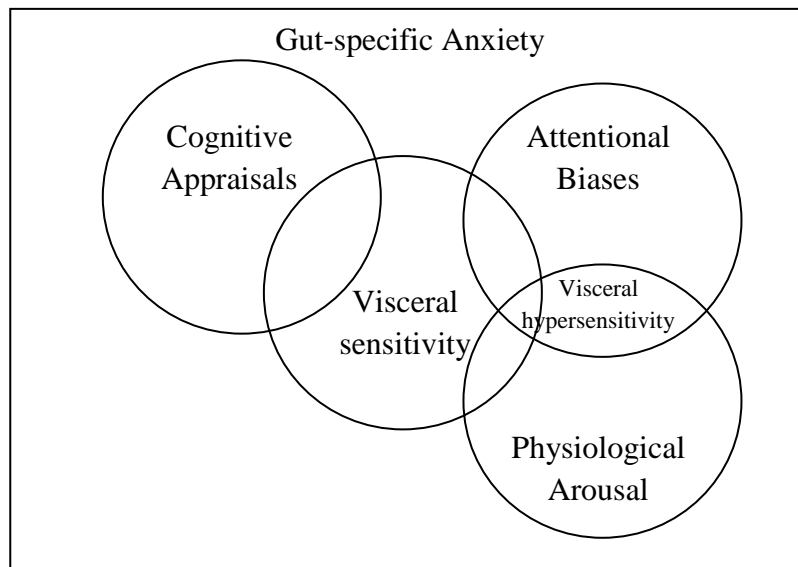


Figure. 5.2. Overlap between visceral sensitivity and other psychological processes

The present ambiguity regarding the nature of visceral sensitivity can be attributed to its measurement. Specifically, a cross-sectional psychometric measure might not be able to capture the full characteristics of visceral sensitivity. For instance, the cognitive appraisal and attentional focus “aspects” of visceral sensitivity might in reality have a dynamic relationship that cannot be captured by the VSI. In other words, while it is psychometrically sound (Labus et. al., 2004), the VSI is limited because it only captures a cross-section of visceral sensitivity. Indeed, the VSI is the only instrument to date that assesses this construct specifically. Using a single measure to assess and define a psychological construct risks skewing the conclusions about the actual nature of the construct assessed. The construct is not the measure. Rather, it only captures an approximation of the construct (Smith, 2005). It is hence important to consider other equally valid measures of visceral sensitivity, and other ways of operationalizing this construct.

In essence, visceral sensitivity as a construct is not well understood due to the way it is conceptualized and measured. This scenario is similar to that encountered with classifying FGIDs using only one type of measurement approach to capture an ambiguous syndrome (Wong et. al., 2010). Because of the importance of visceral sensitivity in FGIDs, this construct warrants more careful study.

5.5 Limitations, Unique Contributions and Implications for Clinical Practice

There are several limitations in this thesis. Firstly, the sample size used to compare FC and IBS in Study 1 are moderate, which could have limited statistical power to detect changes with small effect sizes. A lack of statistical power increases the chances of missing significant results. In other words, there could have been more differences observed in the other psychological factors between FC and IBS if statistical power were greater. Secondly, and as discussed above, the use of the VSI in Study 2 to assess visceral sensitivity might not have captured the dynamic nature of this psychological process. Thirdly, the small sample used in Study 3 limited the generalizability of its results to the larger FGID population.

Nonetheless, the results of this thesis provide a good start in the right direction for studying other FGIDs and expanding our understanding of FGIDs. It is the first study to consider using psychological factors as an additional way of defining FGIDs. As a result of this effort, the thesis also added to the knowledge of FC, which has received much less research consideration than IBS.

Additionally, this thesis provides preliminary support for a theoretically sensible psychological model of FGIDs which can be applied in assessing and formulating clinical cases.

Because aspects of it have been applied to and tested in actual clinical practice (Chapter 4), this integrated model can be used as a template that guides clinical case formulation when working with individuals suffering from FGIDs. This thesis is also the first of its kind to consider the relationship between illness schemata and visceral sensitivity, to consider the role of protective factors in FGIDs, and also the possibility of a linchpin psychological factor (Berger, 1998; Labus et. al., 2007) that significantly influences FGIDs.

These findings suggest targets for psychological treatments of FGIDs such as managing visceral sensitivity, focusing on making coherent personal meaning from one's FGID experience, and focusing on enhancing emotional regulatory abilities by using interventions such as mindfulness training in conjunction with CBT. Furthermore, the presence of central and peripheral psychological processes in FGIDs (Parts A and C of Figure 1.) and the dynamic relationship between them afford the clinician flexibility in explaining the variability in symptomatic and psychological presentations of individuals with FGID (Alpers, 2008; Wong et. al., 2010). This increases the efficiency of identifying treatment targets.

5.6 Future Research

There remain many questions about FGIDs and the role that psychological factors play in them. Several research directions present themselves from the findings in this thesis. Firstly, the viability of using psychological correlates to define FGIDs should be replicated, as the findings in Chapter 2 are based on a relatively small sample. Secondly, this research can be extended to other FGIDs such as functional dyspepsia, which is also closely associated with psychological factors (e.g., Jones et. al., 2004).

Thirdly, the integrated psychological model requires further validation and expansion. One such area of expansion would be to consider the role of illness coherence in much greater depth, as well as the roles of other protective factors in FGIDs. By extension, these psychological protective factors might illuminate directions for newer and more innovative psychological treatments for FGIDs. For instance, interventions that serve to increase sense making in FGIDs (Graham et. al., 2008) can be tested and incorporated into existing cognitive behaviour treatments.

Finally and perhaps most importantly, the construct of visceral sensitivity requires much greater research attention. Several directions present themselves here: 1) the development of other psychometric tools and methods of assessing visceral sensitivity, for example, experimental paradigms, 2) the clarification of the definition of visceral sensitivity as compared to illness-specific cognitive appraisals, attentional biases and gut-related anxiety, 3) the examination of visceral sensitivity as a possibly dynamic psychological process by using a longitudinal research design, and 4) the examination of the role of this newly clarified construct in the integrated psychological model.

5.7 Concluding Comments

The findings in this thesis make several unique contributions to the definition and conceptualization of FGIDs. It provides preliminary support for the use of psychological factors in differentiating between FGIDs, particularly those that are very similar. It also provides strong initial support for an integrated psychological model of FGIDs which consists of central and peripheral psychological processes that are involved in the activation and maintenance of

symptoms. Visceral sensitivity has an important role in the model and is influenced by mindfulness skills training. Mindfulness skills and illness coherence prove to be two protective factors that mitigate symptom severity/ distress and symptom frequency in FGIDs. These findings have important clinical relevance and further research based on this new body of knowledge will hopefully elucidate the complex nature of FGIDs, and provide patients with better evidence-based treatment

References

- Alpers, D.H. (2008). Multidimensionality of symptom complexes in irritable bowel syndrome and other functional gastrointestinal disorders. *Journal of Psychosomatic Research*, 64(6), 567 – 572. DOI: 10.1016/j.jpsychores.2008.02.023.
- Afzal, M., Potokar, J.P., Probert, C.S.J., Munafo, M.R. (2006). Selective processing of gastrointestinal symptom-related stimuli in irritable bowel syndrome. *Psychosomatic Medicine*, 68, 758 – 761. DOI: 10.1097/01.psy.0000232270.78071.28
- Arch, J. J., & Craske, M. G. (2006). Mechanisms of mindfulness: emotion regulation following a focused breathing induction. *Behaviour research and therapy*, 44(12), 1849-58.
DOI:10.1016/j.brat.2005.12.007
- Baer, R.A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Psychological Science*, 10(2), 125-143. DOI: 10.1093/clipsy/bpg015
- Berger, R.M. (1998). Characteristics of optimal clinical case formulations: The linchpin concept. *American Journal of Psychotherapy*, 52(3), 287 – 300. Retrieved from, <http://faculty.coe.uh.edu/arbona/courses/epsy7393/Berger%20Linchpin%20concept.pdf>, on August 10, 2012.
- Chaboyer, W., Lee, B.O., Wallis, M., Gillespie, B., & Jones, C. (2010). Illness representations predict health-related quality of life 6 months after hospital discharge in individuals with injury: a predictive survey. *Journal of Advanced Nursing*, 66(12), 2743-50.
DOI:10.1111/j.1365-2648.2010.05431.x
- Chapman, S., & Martin, M. (2011). Attention to pain words in irritable bowel syndrome: Increased orienting and speeded engagement. *British Journal of Health Psychology*, 16, 47 – 60. DOI: 10.1348/135910710X505887

- Craske, M.G., Wolitzky-Taylor, K.B., Labus, J., Wu, S., Frese, M., Mayer, E.A., & Naliboff, B.D. (2011). A cognitive-behavioral treatment for irritable bowel syndrome using interoceptive exposure to visceral sensations. *Behaviour Research and Therapy*, 49, 413 – 421. DOI: 10.1016/j.brat.2011.04.001.
- Deary, V., Chalder, T., & Sharpe, M. (2007). The cognitive behavioural model of medically unexplained symptoms: a theoretical and empirical review. *Clinical Psychology Review*, 27(7), 781 – 797. DOI: 10.1016/j.cpr.2007.07.002
- Garland, E.L., Gaylord, S.A., Palsson, O., Faurot, K., Mann, J.D., & Whitehead, W.E. (2011). Therapeutic mechanisms of a mindfulness-based treatment for IBS: effects on visceral sensitivity, catastrophizing, and affective processing of pain sensations. *Journal of Behavioral Medicine*, 35(6), 591-602. DOI: 10.1007/s10865-011-9391-z
- Gibbs-Gallagher, N., Palsson, O.S., Levy, R.L., Meyer, K., Drossman, D.A., & Whitehead, W.E. (2001). Selective recall of gastrointestinal-sensation words: Evidence for a cognitive-behavioral contribution to irritable bowel syndrome. *The American Journal of Gastroenterology*, 96(4), 1133 – 1138. DOI: 10.1016/S0002-9270(01)02322-X
- Graham, J.E., Lobel, M., Glass, P., & Lokshina, I. (2008). Effects of written anger expression in chronic pain patients: Making meaning from pain. *Journal of Behavioural Medicine*, 31, 201 – 212. DOI 10.1007/s10865-008-9149-4.
- Ghaemi, S. N. (2009). The rise and fall of the biopsychosocial model. *The British journal of psychiatry: the journal of mental science*, 195(1), 3-4. DOI:10.1192/bjp.bp.109.063859
- Jones, M.P., Crowell, M.D., Olden, K.W., & Creed, F. (2007). Functional gastrointestinal disorders: an update for the psychiatrist. *Psychosomatics*, 48(2), 93 – 102. DOI: 10.1176/appi.psy.48.2.93

- Jones, M.P., Schettler, A., Olden, K., & Crowell, M.D. (2004). Alexithymia and Somatosensory Amplification in Functional Dyspepsia. *Psychosomatics*, 45, 508–516. DOI: 10.1176/appi.psy.45.6.508
- Jones, M., Koloski, N., Boyce, P., & Talley, N. J. (2011). Pathways connecting cognitive behavioral therapy and change in bowel symptoms of IBS. *Journal of Psychosomatic Research*, 70(3), 278-85. DOI:10.1016/j.jpsychores.2010.10.004
- Khong, B.S.L. (2009). Expanding the understanding of Mindfulness: Seeing the tree and the forest. *The Humanistic Psychologist*, 37(2), 117 – 136. DOI: 10.1080/08873260902892006
- Labus, J.S., Bolus, R., Chang, L., Wiklund, I., Naesdal, J., Mayer, E.A., & Naliboff, B.D. (2004). The Visceral Sensitivity Index: development and validation of a gastrointestinal symptom-specific anxiety scale. *Alimentary Pharmacology & Therapeutics*, 20, 89–97. DOI: 10.1111/j.1365-2036.2004.02007.x
- Labus, J.S., Mayer, E.A., Chang, L., Bolus, R., & Naliboff, B.D. (2007). The central role of gastrointestinal-specific anxiety in irritable bowel syndrome: further validation of the visceral sensitivity index. *Psychosomatic Medicine*, 69(1), 89 – 98. DOI: 10.1097/PSY.0b013e31802e2f24
- Lackner., J.M. (2005). No brain, no gain: The role of cognitive processes in irritable bowel syndrome. *Journal of Cognitive Psychotherapy: An International Quarterly*, 19(2), 125 – 136. DOI: 10.1891/jcop.19.2.125.66788
- Lackner, J. M., Coad, M.L., Mertz, H.R., Wack, D.S., Katz, L.A., Krasner, S.S., Firth, R., Mahl, T.C., & Lockwood, A.H. (2006). Cognitive therapy for irritable bowel syndrome is associated with reduced limbic activity, GI symptoms, and anxiety. *Behaviour research and therapy*, 44(5), 621 – 638. DOI: 10.1016/j.brat.2005.05.002

- Oudenhove, L.V., Demyttenaere, K., Tack, J., & Aziz, Q. (2004). Central nervous system involvement in functional gastrointestinal disorders. *Best Practice & Research Clinical Gastroenterology*, 18(4), 663–680. DOI: 10.1016/j.bpg.2004.04.010
- Rees, G., Fry, A., Cull, A., & Sutton, S. (2004). Illness perceptions and distress in women at increased risk of breast cancer. *Psychology and Health*, 19(6), 749 – 765. DOI: 10.1080/08870440412331279764
- Segal, Z.V., Williams, J.M.G., & Teasdale, J.D. (2002). *Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse*. New York: The Guilford Press.
- Smith, G.T. (2005). On construct validity: Issues of method and measurement. *Psychological Assessment*, 17(4), 396–408. DOI: 10.1037/1040-3590.17.4.396
- Weinstein, N., Brown, K. W., & Ryan, R. M. (2009). A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. *Journal of Research in Personality*, 43(3), 374-385. DOI:10.1016/j.jrp.2008.12.008
- Wilhelmsen, I. (2005). Biological sensitisation and psychological amplification: Gateways to subjective health complaints and somatoform disorders. *Psychoneuroendocrinology*, 30(10), 990 – 995. DOI: 10.1016/j.psyneuen.2005.01.011
- Wong, R.K., Palsson, O.S., Turner, M.J., Levy, R.L., Field, A.D., Korff, M.V., & Whitehead, W.E. (2010). Inability of the Rome III criteria to distinguish functional constipation from constipation-subtype irritable bowel syndrome. *The American Journal of Gastroenterology*, 105(10), 2228- 2234. DOI: 10.1038/ajg.2010.200

Appendix A

Final Ethics Approval Letters

Pages 205-208 of this thesis have been removed as they contain confidential material.

Appendix B

Study Measures

Demographics Data

WITHOUT providing your name or any identification details, please indicate your:

Gender	M/F [circle]	Age in years (Circle one)	18 – 24 25 – 30 31 – 35 36 – 40 41 – 45 46 – 50 51 – 55 56 – 60 61 – 65 66 – 70 71 – 75 76 – 80 81 – 85 86 – 90
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Marital Status	Single/ Married/ Widowed/ Divorced [circle one]	Country of birth	
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Language spoken at home [circle]	English Other : _____
	If “Other”, Please indicate language

Employment status [circle one]	Student Unemployed Self-employed Professional Skilled profession/ Trade
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Highest Academic grade attained [circle one]	Postgraduate Graduate TAFE Grade:
	If you circled “grade”, please indicate highest grade you studied up to

Gastrointestinal Symptoms Questionnaire (ROME)

The purpose of this survey is to learn more about the health problems that people sometimes have with their stomach and intestines. The whole questionnaire will take about 30 -45 minutes to complete. For this questionnaire, to answer each question, circle number corresponding to your answer. You may find that you have not had any of the symptoms that we will ask you about. When this happens, you will be instructed to skip over the questions that do not apply to you. If you are not sure about an answer, or you cannot remember the answer to a question, just answer as best you can. It is easy to miss questions, so please check that you haven't left any out as you go.

1. In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?

0	1	2	3	4	5	6
Never	Less than 1 day a month	1 day a month	2 – 3 days a month	1 day a week	More than 1 day a week	Everyday

If you circled 0 = "Never" Skip to **Question 9**

2. For women: Did this discomfort or pain occur only during your menstrual bleeding and not at other times?

0	1	2
No	Yes	Does not apply because I have had the change in life (menopause) or I am a male

3. Have you had this discomfort or pain 6 months or longer?

0	1
No	Yes

4. How often did this discomfort or pain get better or stop after you had a bowel movement?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

5. When this discomfort or pain started, did you have more frequent bowel movements?

0	1	2	3	4
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Never or Rarely	Sometimes	Often	Most of the time	Always
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6. When this discomfort or pain started, did you have less frequent bowel movements?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

7. When this discomfort or pain started, were your stools (bowel movements) looser?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

8. When this discomfort or pain started, how often did you have harder stools?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

9. In the last 3 months, how often did you have fewer than three bowel movements (0-2) a week?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

10a. In the last 3 months, how often did you have hard or lumpy stools?

0	1	2	3	4
Never or Rarely	About 25% of the time	About 50% of the time	About 75% of the time	Always, 100% of the time

10b. In the last 3 months, how often did you have loose, mushy or watery stools?

0	1	2	3	4
Never or Rarely	About 25% of the time	About 50% of the time	About 75% of the time	Always, 100% of the time

11. In the last 3 months, how often did you strain during bowel movements?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

12. In the last 3 months, how often did you have a feeling of incomplete emptying after bowel movements?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

13. In the last 3 months, how often did you have a sensation that the stool could not be passed, (i.e., blocked), when having a bowel movement?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

14. In the last 3 months, how often did you press on or around your bottom or remove stool in order to complete a bowel movement?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

15. In the last 3 months, how often did you have difficulty relaxing or letting go to allow the stool to come out during a bowel movement?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

16. Did any of the symptoms of constipation listed in questions 9-15 above begin more than 6 months ago?

0	1
No	Yes

17. In the last 3 months, how often did you have loose, mushy or watery stools?

0	1	2	3	4
Never or Rarely	Sometimes	Often	Most of the time	Always

The 2 questions below are interested in how the symptoms you have indicated above have affected your daily life. If you cannot provide specific information for these 2 questions, take your best guest/ estimate.

1. In the past 30 days, for how many days were you totally unable to carry out your usual activities or work because of the symptoms above?	RECORD NUMBER OF DAYS ____/30 days
2. In the past 30 days, not counting the days that you were totally unable, for how many days did you cut back or reduce your usual activities or work because of the symptoms above?	RECORD NUMBER OF DAYS ____/30 days

How Accurately Can You Describe Yourself?

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Indicate for each statement whether it is:

Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate as a description of you
1	2	3	4	5

Write the corresponding number on the right of each statement.

1	Often feel blue.	
2	Rarely get irritated.	
3	Am not easily bothered by things.	
4	Dislike myself.	
5	Am often down in the dumps.	

6	Feel comfortable with myself.	
7	Am very pleased with myself.	
8	Have frequent mood swings.	
9	Seldom feel blue.	
10	Panic easily.	

TAS – 20

This questionnaire contains statements that describe some experiences people encounter. Please read through each of the statements below and rate how much they agree or disagree with your own experience. Circle a number for each statement.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. I am often confused about what emotion I am feeling				
1	2	3	4	5

2. It is difficult for me to find the right words for my feelings				
1	2	3	4	5

3. I have physical sensations that even doctors don't understand				
1	2	3	4	5

4. I am able to describe my feelings easily				
1	2	3	4	5

5. I prefer to analyze problems rather than just describe them				
1	2	3	4	5

6. When I am upset, I don't know if I am sad, frightened, or angry				
1	2	3	4	5

7. I am often puzzled by sensations in my body				
1	2	3	4	5

8. I prefer to just let things happen rather than to understand why they turned out				
--	--	--	--	--

that way				
1	2	3	4	5

9. I have feelings that I can't quite identify				
1	2	3	4	5

10. Being in touch with emotions is essential				
1	2	3	4	5

11. I find it hard to describe how I feel about people				
1	2	3	4	5

12. People tell me to describe my feelings more				
1	2	3	4	5

13. I don't know what's going on inside me				
1	2	3	4	5

14. I often don't know why I am angry				
1	2	3	4	5

15. I prefer talking to people about their daily activities rather than their feelings				
1	2	3	4	5

16. I prefer to watch "light" entertainment shows rather than psychological dramas				
1	2	3	4	5

17. It is difficult for me to reveal my innermost feelings, even to close friends				
1	2	3	4	5

18. I can feel close to someone, even in moments of silence				
1	2	3	4	5

19. I find examination of my feelings useful in solving personal problems				
1	2	3	4	5

20. Looking for hidden meanings in movies or plays distracts from their entertainment				
1	2	3	4	5

VSI

Below are statements that describe how some people respond to symptoms or discomfort in their belly or lower abdomen. These may include pain, diarrhoea, constipation, bloating or sense of urgency. Please answer 'how strongly you agree or disagree' with each of these statements by

writing a number next to each statement, AS THEY RELATE TO YOU. Answer all of the statements as honestly and thoughtfully as you can according to the rating scale below.

1	2	3	4	5	6
Strongly Agree	Moderately Agree	Mildly Agree	Mildly Disagree	Moderately Disagree	Strongly Disagree

No.	Statement	rating
1	I worry that whenever I eat during the day, bloating and distension in my belly will get worse	
2	I get anxious when I go to a new restaurant	
3	I often worry about problems in my belly	
4	I have a difficult time enjoying myself because I cannot get my mind off of discomfort in my belly	
5	I often fear that I won't be able to have a normal bowel movement	
6	Because of fear of developing abdominal discomfort, I seldom try new foods	
7	No matter what I eat, I will probably feel uncomfortable	
8	As soon as I feel abdominal discomfort I begin to worry and feel anxious	
9	When I enter a place I haven't been before, one of the first things I do is to look for a bathroom	
10	I am constantly aware of the feelings I have in my belly	
11	I often feel discomfort in my belly could be a sign of a serious illness	
12	As soon as I awake, I worry that I will have discomfort in my belly during the day	
13	When I feel discomfort in my belly, it frightens me	
14	In stressful situations, my belly bothers me a lot	
15	I constantly think about what is happening inside my belly	

DASS 21

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

- 0 Did not apply to me at all
- 1 Applied to me to some degree, or some of the time
- 2 Applied to me to a considerable degree, or a good part of time
- 3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

FFMQ

Please rate each of the following statements using the scale provided. Write the number in the blank next to each statement that best describes your own opinion of what is generally true for you.

1	2	3	4	5
---	---	---	---	---

Never or Very Rarely True	Rarely True	Sometimes True	Often True	Very Often or Always True
------------------------------	-------------	-------------------	------------	------------------------------

1	When I'm walking, I deliberately notice the sensations of my body moving.	
2	I'm good at finding words to describe my feelings.	
3	I criticize myself for having irrational or inappropriate emotions.	
4	I perceive my feelings and emotions without having to react to them.	
5	When I do things, my mind wanders off and I'm easily distracted.	
6	When I take a shower or bath, I stay alert to the sensations of water on my body.	
7	I can easily put my beliefs, opinions, and expectations into words.	
8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.	
9	I watch my feelings without getting lost in them.	
10	I tell myself I shouldn't be feeling the way I'm feeling.	
11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.	
12	It's hard for me to find the words to describe what I'm thinking.	
13	I am easily distracted.	
14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way.	
15	I pay attention to sensations, such as the wind in my hair or sun on my face.	
16	I have trouble thinking of the right words to express how I feel about things	
17	I make judgments about whether my thoughts are good or bad.	
18	I find it difficult to stay focused on what's happening in the present.	

19	When I have distressing thoughts or images, I “step back” and am aware of the thought or image without getting taken over by it.	
20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.	
21	In difficult situations, I can pause without immediately reacting.	
22	When I have a sensation in my body, it’s difficult for me to describe it because I can’t find the right words.	
23	It seems I am “running on automatic” without much awareness of what I’m doing.	
24	When I have distressing thoughts or images, I feel calm soon after.	
25	I tell myself that I shouldn’t be thinking the way I’m thinking.	
26	I notice the smells and aromas of things.	
27	Even when I’m feeling terribly upset, I can find a way to put it into words.	
28	I rush through activities without being really attentive to them.	
29	When I have distressing thoughts or images I am able just to notice them without reacting.	
30	I think some of my emotions are bad or inappropriate and I shouldn’t feel them.	
31	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.	
32	My natural tendency is to put my experiences into words.	
33	When I have distressing thoughts or images, I just notice them and let them go.	
34	I do jobs or tasks automatically without being aware of what I’m doing.	
35	When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.	
36	I pay attention to how my emotions affect my thoughts and behavior.	

37	I can usually describe how I feel at the moment in considerable detail.	
38	I find myself doing things without paying attention.	
39	I disapprove of myself when I have irrational ideas.	

IPQ-R

YOUR VIEWS ABOUT YOUR ILLNESS

Listed below are a number of symptoms that you may or may not have experienced since your bowel symptoms. Please indicate by circling *Yes* or *No*, whether you have experienced any of these symptoms since your illness, and whether you believe that these symptoms are related to your illness.

	I have experienced this symptom <i>since my illness</i>			This symptom is <i>related to my illness</i>	
Pain	Yes	No		Yes	No
Sore Throat	Yes	No	_____	Yes	No
Nausea	Yes	No	_____	Yes	No
Breathlessness	Yes	No	_____	Yes	No
Weight Loss	Yes	No	_____	Yes	No
Fatigue	Yes	No	_____	Yes	No
Stiff Joints	Yes	No	_____	Yes	No
Sore Eyes	Yes	No	_____	Yes	No
Wheeziness	Yes	No	_____	Yes	No
Headaches	Yes	No	_____	Yes	No
Upset Stomach	Yes	No	_____	Yes	No
Sleep Difficulties	Yes	No	_____	Yes	No
Dizziness	Yes	No	_____	Yes	No

Loss of Strength

Yes

No

Yes

No

We are interested in your own personal views of how you now see your current bowel symptoms. Please indicate how much you agree or disagree with the following statements about your illness by ticking/checking the appropriate box.

	IEWS ABOUT YOUR ILLNESS	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
IP1	My illness will last a short time					
IP2	My illness is likely to be permanent rather than temporary					
IP3	My illness will last for a long time					
IP4	This illness will pass quickly					
IP5	I expect to have this illness for the rest of my life					
IP6	My illness is a serious condition					
IP7	My illness has major consequences on my life					
IP8	My illness does not have much effect on my life					
IP9	My illness strongly affects the way others see me					
IP10	My illness has serious financial consequences					
IP11	My illness causes difficulties for those who are close to me					
IP12	There is a lot which I can do to control my symptoms					
IP13	What I do can determine whether my illness gets better or worse					
IP14	The course of my illness depends on me					
IP15	Nothing I do will affect my illness					
IP16	I have the power to influence my illness					
IP17	My actions will have no effect on the outcome of my illness					
IP18	My illness will improve in time					
IP19	There is very little that can be done to improve my illness					
IP20	My treatment will be effective in curing my illness					

IP21	The negative effects of my illness can be prevented (avoided) by my treatment					
IP22	My treatment can control my illness					
IP23	There is nothing which can help my condition					
IP24	The symptoms of my condition are puzzling to me					
	VIEWS ABOUT YOUR ILLNESS	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
IP25	My illness is a mystery to me					
IP26	I don't understand my illness					
IP27	My illness doesn't make any sense to me					
IP28	I have a clear picture or understanding of my condition					
IP29	The symptoms of my illness change a great deal from day to day					
IP30	My symptoms come and go in cycles					
IP31	My illness is very unpredictable					
IP32	I go through cycles in which my illness gets better and worse					
IP33	I get depressed when I think about my illness					
IP34	When I think about my illness I get upset					
IP35	My illness makes me angry					
IP36	My illness does not worry me					
IP37	Having this illness makes me feel anxious					
IP38	My illness makes me feel afraid					

CAUSES OF MY ILLNESS

We are interested in what you consider may have been the cause of your bowel symptoms. As people are very different, there is no correct answer for this question. We are most interested in your own views about the factors that caused your illness rather than what others including doctors or family may have suggested to you. Below is a list of possible causes for your illness. Please indicate how much you agree or disagree that they were causes for you by ticking the appropriate box.

	POSSIBLE CAUSES	Strongly	Disagree	Neither	Agree	Strongly
--	------------------------	----------	----------	---------	-------	----------

		Disagree		Agree nor Disagree		Agree
C1	Stress or worry					
C2	Hereditary – it runs in my family					
C3	A germ or virus					
C4	Diet or eating habits					
C5	Chance or bad luck					
C6	Poor medical care in my past					
C7	Pollution in the environment					
C8	My own behaviour					
C9	My mental attitude e.g., thinking about life negatively					
	POSSIBLE CAUSES	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
C10	Family problems or worries caused my illness					
C11	Overwork					
C12	My emotional state e.g., feeling down, lonely, anxious, empty					
C13	Ageing					
C14	Alcohol					
C15	Smoking					
C16	Accident or injury					
C17	My personality					
C18	Altered immunity					

In the table below, please list in rank-order the three most important factors that you now believe caused YOUR bowel symptoms. You may use any of the items from the box above, or you may have additional ideas of your own.

The most important causes for me:-

1	
2	
3	

BSSS

General Instructions

Please indicate below, how often you have had each bowel symptom **over the past week.** Do this by checking one option for each question below. If you do not have the symptom, check **not at all**, below the question. Please ensure you answer all of the questions.

1a. Over the past week how often have you had loose or watery bowel motions?				
Not at all	Every other day	Every day	1 – 3 times a day	More than 3 times a day

1b. How distressed were you by this?				
Not at all	A little bit	Moderately	Quite a bit	Extremely

1c. How much did this interfere with your everyday life?				
Not at all	A little bit	Moderately	Quite a bit	Extremely

2a. Over the past week on how many occasions did you have hard or lumpy stools when you had a bowel motion?				
Not at all	Once or twice	3-5 times	Everyday	More than once a day

2b. How distressed were you by this?				
Not at all	A little bit	Moderately	Quite a bit	Extremely

2c. How much did this interfere with your everyday life?				
Not at all	A little bit	Moderately	Quite a bit	Extremely

3a. Over the past week how often have you had abdominal (tummy) pain?				
Not at all	Once or twice	3-5 times	Everyday	More than once a day

3b. How distressed were you by this?				
--------------------------------------	--	--	--	--

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

3c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

4a. Over the past week, on how many days have you had more than 3 bowel motions a day?

Not at all	Once or twice	3-5 times	Everyday	More than once a day
------------	---------------	-----------	----------	----------------------

4b. How distressed were you by this?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

4c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

5a. Over the past week, how often have you felt bloated or had an uncomfortable fullness in your abdomen?

Not at all	Once or twice	3-5 times	Everyday	More than once a day
------------	---------------	-----------	----------	----------------------

5b. How distressed were you by this?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

5c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

6a. Over the past week, how often have you had an urgent need to have a bowel motion?

Not at all	Once or twice	3-5 times	Everyday	More than once a day
------------	---------------	-----------	----------	----------------------

6b. How distressed were you by this?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

6c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

7a. Over the past week, how many days have there been when you were unable to have a bowel motion?

Not at all	Once or twice	3-5 times	Everyday	More than once a day
------------	---------------	-----------	----------	----------------------

7b. How distressed were you by this?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

7c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

8a. Over the past week, how often have you had a general feeling of discomfort in your abdomen (tummy)?

Not at all	Once or twice	3-5 times	Everyday	More than once a day
------------	---------------	-----------	----------	----------------------

8b. How distressed were you by this?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

8c. How much did this interfere with your everyday life?

Not at all	A little bit	Moderately	Quite a bit	Extremely
------------	--------------	------------	-------------	-----------

Participant Daily Monitoring Diary

Today's Date: _____

Bowel Movements		Abdominal Pain/ Discomfort?	Bloating?	Do you feel as if you have not completely emptied your bowels even after going to the toilet/ bathroom? (Circle one)	Diarrhea? (circle one)
Number of bowel movements today (Circle one) 0 = None 1 = once 2 = twice 3 = thrice > 3 = More than thrice	How much did you have to strain to help you move your bowels today? 0 1 2 3 4 5 6 7 8 (nil) (moderately) (very hard) [Write one number]	How much pain & bloating today? 0 1 2 3 4 5 6 7 8 (none) (moderately) (alot) [Write one number for Pain & Bloating each]			
0 1 2 3 >3				Yes No	Yes No

1. What is the quality of your stool (if more than once, the most frequent quality/ If no bowel movement, choose 8)?

0 1 2 3 4 5 6 7 8
Very watery Not watery Very Hard
or hard

2. How distressing/ disabling has your IBS/ constipation been today?

0 1 2 3 4 5 6 7 8
Not at all Moderately Extremely

3. How much did you avoid activities because of your IBS/ constipation? Place a number from the scale on each item.

0 1 2 3 4 5 6 7 8
Not at all Cut-back a little ½ of the time Cut-back alot Completely

Work: _____ Going out with family/ friends: _____ Others (specify): _____
Physical Exercise: _____ Recreational activities: _____

4. How much were you able to do the following? Place a number from the scale on each item.

0 1 2 3 4 5 6 7 8
Not at all ½ of the time Completely

Observe your inner & external experience	_____	Stay present with your experiences	_____	Stand back from experiences	_____
Find words for your inner experiences	_____	Avoid judging your experiences	_____	Avoid reacting to experiences/ events	_____
Identify your feelings & physical sensations	_____	Describe your feelings	_____	Focus on your feelings and thoughts, instead of on external events	_____

5. How would you rate the following for today? Place a number from the scale on each item.

0 1 2 3 4 5 6 7 8
Not at all moderately Completely

Your emotional stability _____ Depressed/ Down in the dumps _____ Anxious/ Scared _____ Stressed Out _____

6. How would you rate the following for today? Place a number from the scale on each item.

0 1 2 3 4 5 6 7 8
Not at all moderately Completely

You **worry about sensations** in your abdomen _____

How much the sensations in your abdomen **frighten you** _____

How much you **keep focusing on the sensations in your abdomen** at the expense of what's happening around you? _____

How **sensitive you are to changes** in your abdomen _____

7. Place a number from the scale on each item. How much do you believe your illness is caused by:

0 1 2 3 4 5 6 7 8

Not at all moderately Completely

External/ situational forces beyond your control _____

Your lifestyle _____

Worrying about your illness and what it might mean _____

How you are feeling (Stress, mood, etc.) _____

Biological/ medical factors _____

8. Place a number from the scale on each item. How much do you believe your illness can be managed by:

0 1 2 3 4 5 6 7 8

Not at all moderately Completely

Medical treatment _____

Stress management _____

Any other treatments _____

What? _____

9. How serious a condition do you think your IBS/ Constipation is?

0 1 2 3 4 5 6 7 8

Not at all moderately Extremely

10. Place a number from the scale on each item. How much personal control do you feel you have over your:

0 1 2 3 4 5 6 7 8

Not at all moderately Extremely

IBS/ Constipation symptoms _____

Feelings and stress _____

Life in general _____

In total, how much time did you spend on full Mindfulness practice today?	(Mins)
---	--------

Appendix C
Cross-correlograms for six participants (Chapter 4)

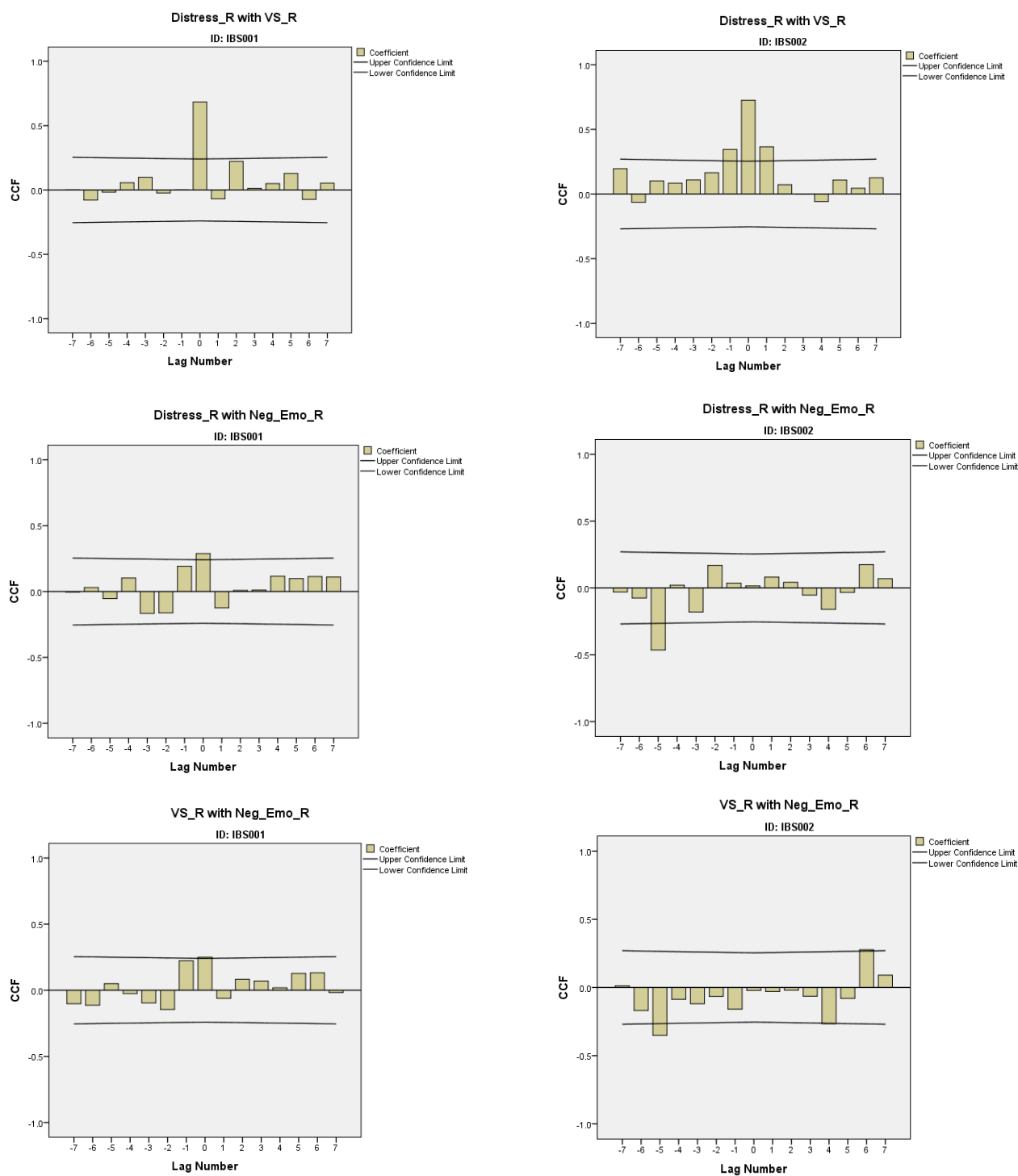


Figure 1. Cross-Correlograms for Miss C (IBS001) and Mrs P (IBS002). These include the cross-correlograms between distress (Distress_R) and visceral sensitivity (VS_R), distress and negative emotions (Neg_Emo_R), and visceral sensitivity and negative emotions.

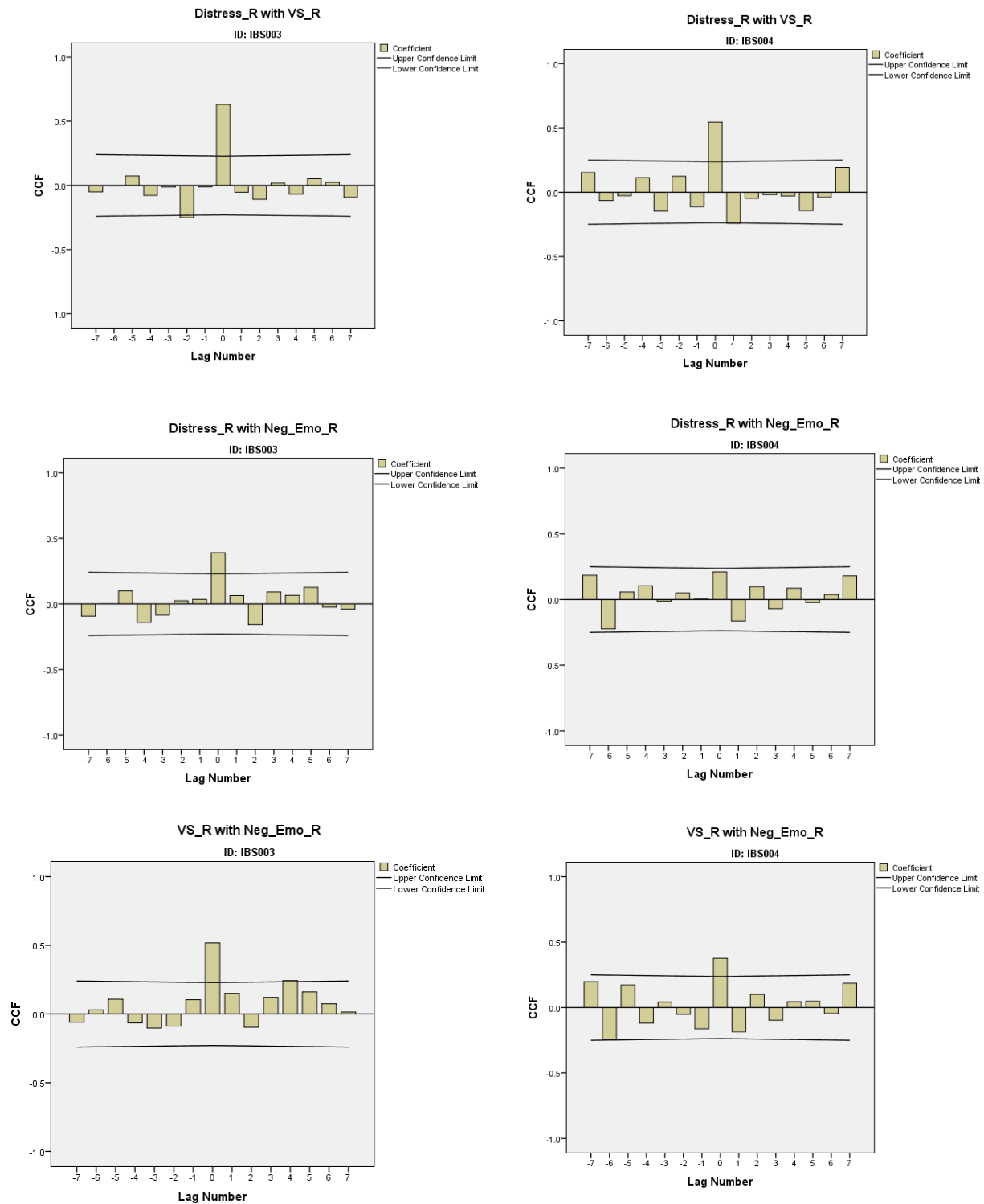


Figure 2. Cross-Correlograms for Mr K (IBS003) and Mrs W (IBS004). These include the cross-correlograms between distress (Distress_R) and visceral sensitivity (VS_R), distress and negative emotions (Neg_Emo_R), and visceral sensitivity and negative emotions.

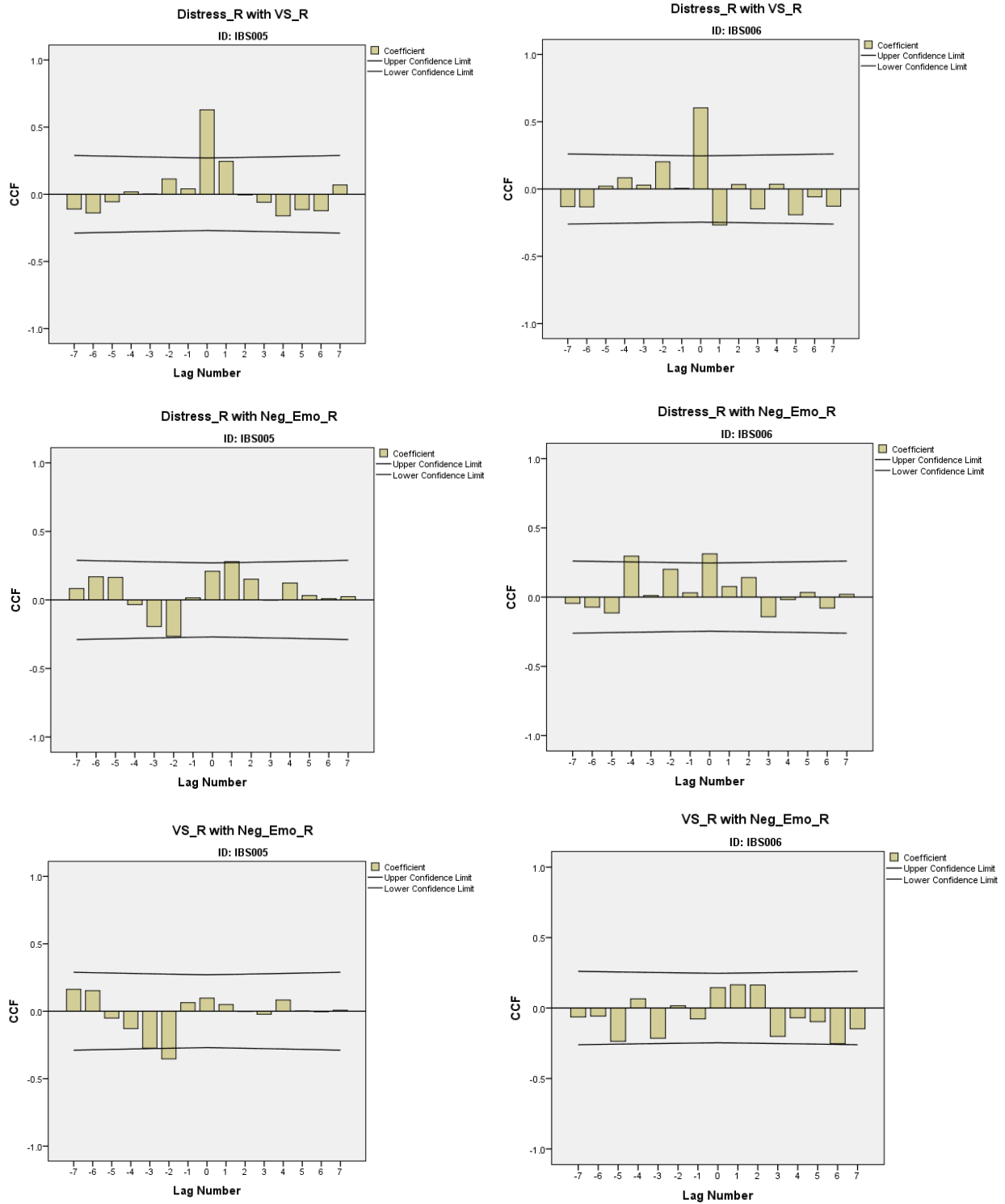


Figure 3. Cross-Correlograms for Miss G (IBS005) and Ms Q (IBS006). These include the cross-correlograms between distress (Distress_R) and visceral sensitivity (VS_R), distress and negative emotions (Neg_Emo_R), and visceral sensitivity and negative emotions.