Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical investigations.

By

Kimina Lyall

Bachelor of Arts (Journalism) *RMIT*

Graduate Diploma of Psychology, *University of Melbourne*

Graduate Diploma of Psychology (Advanced), *University of Melbourne*

Submitted in partial fulfilment of the requirements for the degree of

Doctor of Psychology (Clinical)

Deakin University

23 October 2021

DEAKIN UNIVERSITY
ACCESS TO THESIS-A

I am the author of the thesis entitled

Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical investigations.

submitted for the degree of Doctor of Psychology (Clinical)

This thesis may be made available for consultation, loan and limited copying in

accordance with the Copyright Act 1968.

'I certify that I am the student named below and that the information provided in the form is correct'

Full Name: .....Kimina Lyall
(Please Print)

Signed: 

Date: 23 January 2022

DEAKIN UNIVERSITY
CANDIDATE DECLARATION

I certify the following about the thesis entitled (10 word maximum)

Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical explorations.

submitted for the degree of Doctor of Psychology (Clinical)

a. I am the creator of all or part of the whole work(s) (including content and layout) and that where reference is made to the work of others, due acknowledgment is given.

b. The work(s) are not in any way a violation or infringement of any copyright, trademark, patent, or other rights whatsoever of any person.

c. That if the work(s) have been commissioned, sponsored or supported by any organisation, I have fulfilled all of the obligations required by such contract or agreement.

d. That any material in the thesis which has been accepted for a degree or diploma by any university or institution is identified in the text.

e. All research integrity requirements have been complied with.

'I certify that I am the student named below and that the information provided in the form is correct'

Full Name: Kimina Lyall

Signed: ..... 

Date: 23 October 2021

Acknowledgements

I owe so much to my supervisors: Emeritus Professor Robert Cummins, Associate Professor Antonina Mikocka-Walus and Dr Subhadra Evans, without whose critical feedback, encouragement, and persistent reframing of obstacles, this thesis would never have been completed. Huge thanks to Dr George Youssef, for introducing me to GAMs and then generously helping me understand them and to Dr Lauren Beswick, whose knowledge of, and care for, her IBD patients provided an important perspective. Thanks also to the many other academics who gave me support, clarity, and advice at key times: Dr Melissa Weinberg, Dr Mathew Ling, Sarah Khor, and Tanja Capic; as well as Associate Professors Matthew Fuller-Tyszkiewicz, Melissa O'Shea and Nicki Dowling. Each of these interactions helped me overcome a particular challenge, and therefore contributed invaluably to the overall work. I am grateful to all my peer reviewers and examiners, each of whom provided me with valuable perspectives and enabled me to make important improvements to the final manuscript.

To my cohort of friends and colleagues during this roller-coaster D-Psych journey, in particular Julianne Livingstone, Celine Jona, Tara Laing, Sarah Morris, Nat James, Jessica Laird, and Gypsy O'Dea. Thank you for all the tomato sessions, peer supervision and endless encouragement.

To my yoga and mindfulness teachers: Frank Jesse, Frank Alberti, Ros Dennett, Subhana Barzhaghi, Wendy Knight and Gwenda Cannard. Thank you for sharing your knowledge and wisdom, and for introducing me to your lineages.

But my deepest thanks go to Leesa Nicholls: for everything—but especially for camping trips, ocean swims, warm fires, mindfulness retreats and the BLE. You have earned your "thesis by moral support".

List of peer reviewed publications

Study and Chapter	Title	Authors	Publication Status
Study 1, Chapter 2	Linking homeostatically protected mood, mindfulness, and depression: A conceptual synthesis and model of moodfulness	Lyall, Kimina Mikocka-Walus, Antonina; Evans, Subhadra; Cummins, Robert A	Published in *Review of General Psychology*^
Study 2, Chapter 3	Exploring evidence for mindfulness and subjective wellbeing homeostatic resilience buffering depression symptoms associated with inflammatory bowel disease	Lyall, Kimina Youssef, George Mickoka-Walus, Antonina Evans, Subhadra Cummins, Robert. A	Under review, *Journal of Happiness Studies*
Study 3, Chapter 4	Mindfulness practice is associated with subjective wellbeing homeostasis resilience in people with Crohn's disease but not ulcerative colitis	Lyall, Kimina Evans, Subhadra Cummins, Robert A Beswick, Lauren Mikocka-Walus, Antonina	Under review, *Frontiers in Psychiatry*
Study 4, Chapter 5	The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease: A pilot randomised control trial protocol	Lyall, Kimina Beswick, Lauren Evans, Subhadra Cummins, Robert A Mikocka-Walus, Antonina	Published in *Social Science Protocols*^^

Note: Authorship statements are included in Appendix 3

^Lyall, K., Mikocka-Walus, A., Evans, S., & Cummins, R. A. (2021). Linking homeostatically protected mood, mindfulness, and depression: A conceptual synthesis and model of moodfulness. *Review of General Psychology*, 25(3), 304-320. https://doi.org/10.1177/10892680211017523

^^Lyall, K., Beswick, L., Evans, S., Cummins, R. A., & Mikocka-Walus, A. (2021). The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease. *Social Science Protocols, 4*, 1-12. https://doi.org/10.7565/ssp.2021.6485

List of Abbreviations

CD	Crohn's disease
DASS	Depression, Anxiety and Stress Scale
GAM	Generalised Additive Model
HPMood	Homeostatically Protected Mood
IBD	Inflammatory Bowel Disease
MBSR	Mindfulness Based Stress Reduction
SWB	Subjective Wellbeing
UC	Ulcerative Colitis

Table of Contents

List of Figures

Study 1

Study 2

Study 4

List of Tables

General Introduction and Overview

Study 2

Study 3

Study 4

Abstract

This research builds on the theory of subjective wellbeing homeostasis (Homeostasis Theory), which proposes that a homeostatic system manages individual subjective wellbeing (SWB) within a setpoint range. This system protects an underlying, slightly positive, and weakly experienced affect known as homeostatically protected mood (HPMood), which represents the most abstract, affective understanding of the self. Depression is proposed to be a result of the defeat of the individual's internal, protective homeostatic mood system. Restoration of access to HPMood is the mechanism of recovery from symptoms of depression. Further, it is proposed that stress, both psychological and physiological, is likely to be the challenging agent that precipitates homeostatic defeat. This research project explored these propositions theoretically, and empirically with a sample of people with inflammatory bowel disease (IBD).

In Study 1, the theoretical relationship between mindfulness, SWB and homeostasis was explored through a critical review of literature spanning these fields. A model of *moodfulness* was proposed, which describes a conceptual synthesis between the state of equanimity, produced by mindfulness, and HPMood. The project then explored these relationships with a sample of people with IBD (n = 739). Study 2 employed generalised additive models to test whether the relationship between HPMood and psychological symptoms of stress and depression are curvilinear, as the theory proposes. The study found a curvilinear relationship between depression symptoms and HPMood for the sample of people with Crohn's disease (CD), where there was clear evidence of a resilience effect, a point at which levels of HPMood appears to withstand rising levels of depression. Results for the CD cohort also found tentative evidence that

trait mindfulness similarly interacts with HPMood in a curvilinear relationship, suggesting that dispositional mindfulness may play a role in the homeostatic system. Study 2's findings failed to support the hypothesised relationship between stress and HPMood, and there was no evidence that these same dynamics occurred for the cohort of our sample who were diagnosed with ulcerative colitis (UC).

Study 3 investigated whether psychological symptoms could predict the likelihood of the sample reporting SWB levels indicative of homeostatic defeat. It found that people with CD who have with higher levels of physical or psychological symptoms were more likely to be reporting SWB levels outside of the population setpoint range, and those who engage in mindfulness practice are more likely to be experiencing homeostatic resilience. These findings were restricted to the sample who have been diagnosed with CD.

Study 4 is a protocol for a pilot randomised control trial. A cohort of patients with CD would be delivered a MBSR intervention and their results would be compared with treatment-as-usual control. Outcome measures include levels of psychological symptoms, and inflammation. Results would also analyse whether, for each individual, MBSR led to a restoration of SWB homeostasis.

The project contributes novel perspectives on two previously disconnected areas of psychological research: Homeostasis Theory and mindfulness. It supports the growing body of research that explores the mind-body interaction in IBD. It offers a parsimonious explanation for the role of mindfulness interventions in the treatment of depression, as well as providing a previously unexplored potential path for further research and theory development.

Chapter 1

General Introduction and Overview

> You will never be happy if you continue to search for what happiness consists of.
>
> —Albert Camus, *Intuitions*, 1932
> published in Youthful Writings, 1976, p. 156

Subjective Wellbeing

Despite Camus' wise advice, psychologists have spent the best part of a century researching the origins and drivers of human happiness. Throughout this quest, one finding has demonstrated remarkable resilience: when people are asked to rate their own levels of life satisfaction, or subjective wellbeing (SWB), their answers are typically stable over time. Research as far back as the 1930s (Hartmann, 1934) has demonstrated this constancy. There is evidence of correlations of individuals' scores over time (Costa & McCrae, 1980; Eid & Diener, 2004; Headey & Wearing, 1989); as well as in cross-sectional samples (Cummins et al., 2003). Indeed, when mean scores of SWB from 17 separate studies were converted to percentage of scale maximums, Cummins (1995) found adult mean happiness to be 75 percentage points (pp), with a standard deviation of less than 3pp, a finding replicated in an average of subsequent surveys over 20 years (Cummins et al., 2021).

Theory development followed these remarkable findings. The field was largely led by personality researchers who consistently observed correlations between personality traits (particularly extraversion and neuroticism) and SWB and concluded that personality stability explained SWB stability (Costa & McCrae, 1980; DeNeve & Cooper, 1998; Steel et al., 2008). The proposed

explanation, by Costa and McCrae (1980) was that positive and negative affect are outcomes of personality traits, and this in turn predicts SWB.

Other research explored the biological nature of this stable component. After finding correlations between SWB over time in sets of monozygotic, but not dizygotic twins, Lykken and Tellegen (1996), suggested the stable component of SWB is heritable, leading to what has become known as setpoint theory. Setpoint theory suggested that a genetic setpoint (more recently, and accurately, conceptualised as a setpoint range: Luhmann & Intelisano, 2018) governs SWB. Numerous subsequent twin studies also suggest a sizeable proportion of SWB variance is explained by genetics (for a review, see Røysamb et al., 2014). These authors conclude that genetic factors contribute to stability in wellbeing, and environment factors contribute to its change.

Further theory development has sought to explain SWB within the framework of Adaptation Level Theory (Helson, 1964). In this, adaptation explains the ability to return to baseline, or setpoint, following an extraordinarily positive or negative life event. Further theoretical work incorporating SWB and adaptation included hedonic adaptation (Frederick & Loewenstein, 1999) and Dynamic Equilibrium Theory (Headey & Wearing, 1989), both of which sought to explain SWB's return to setpoint following a challenge, with personality as a key driver of stability.

Recently, however, setpoint theory has come under challenge, largely in the face of data that suggest SWB can and does change over time. One example is drawn from comparisons of SWB scores across the globe. These are sometimes presented as a "happiness ranking", where the top 10 SWB countries are largely from northern Europe, and the bottom ten largely from Africa and the middle

East (Helliwell et al., 2021; Kelley & Evans, 2017). Mean scores of populations from the lowest-ranked countries are typically well below the 75% proposed norm. It has been suggested these results are explained by economic inequality (Helliwell et al., 2019). One analysis of individuals who migrated from a low SWB country to a high one suggests such migration results in an increase in SWB levels to that of the destination country, with this result interpreted as evidence that life circumstances are primarily responsible for the non-stability of SWB (Helliwell et al., 2020). Other researchers propose cultural factors, including response bias and linguistic differences, as likely factors for these inconsistencies (Cummins, 2018b; Diener, Heintzelman, et al., 2017).

Critics of setpoint theory also point to evidence that individuals can have long-lasting changes to their SWB over time (Fujita & Diener, 2005; Lucas & Donnellan, 2007); findings that are well-replicated (Røysamb et al., 2014). Such evidence caused Headey to challenge the idea of a personal setpoint and substantially revise his Dynamic Equilibrium Theory (Headey, 2008). He later characterised setpoint theory as so brittle, it may have "snapped" (Headey & Muffels, 2018, p. 862). All these critiques assume setpoint theory to require a return, or consistency, to setpoint over time. Should this be considered a core requirement, setpoint theory is indeed flawed. As shall be shortly presented, there is another explanation for SWB's stability and change. But first, another area of controversy regarding SWB needs to be addressed: that of the nature of and component make-up of SWB.

Researchers agree that SWB is indeed subjective, which means it requires the individual's own perspective on their life. Most researchers adopt a definition from Diener (1984), who proposed that SWB comprises three components:

cognition, positive affect and negative affect. This conclusion was attributed to names given to three factors apparent in happiness and satisfaction data from 1072 survey respondents investigated by Andrews and Withey (1976). This tripartite view of SWB has been so well-adopted, it has been little questioned. However, there are reasons to challenge this view, not least being that the authors of the original paper cautioned that their label for one of the three factors, cognitive evaluation, "may imply a greater conceptual clarity than we believe actually exists" (Andrews & Withey, 1976, p. 88). Some research has found positive affect to have a larger influence on life satisfaction than negative affect (Jovanović & Joshanloo, 2021). Other studies have identified both unique and common variance between these three SWB components (Busseri, 2018; Jovanović, 2015), indicating that an underlying latent factor of SWB is also at play, a suggestion also endorsed by wider analysis of the similarity between happiness, quality of life and wellbeing constructs (Medvedev & Landhuis, 2018). There is one theory, however, that can provide conceptual clarity, both with regard to the components of SWB, and as an explanation for its stability and volatility. That theory is the theory of subjective wellbeing homeostasis. As it forms the underlying framework that supports this thesis, an overview is warranted.

The Theory of SWB Homeostasis

The Theory of SWB Homeostasis (hereafter, Homeostasis Theory), proposes that SWB is governed by an internal homeostatic system that defends individuals against challenges to their wellbeing. It was first proposed following the Cummins (1995) analysis of SWB stability, and subsequently substantially developed (Cummins, 2010, 2016b, 2021). Homeostasis Theory built on

understanding of physiological homeostatic systems, first proposed by Cannon (1932), and accepted by biological science to explain stability and variation in bodily functions such as temperature and blood pressure. Homeostasis Theory also advanced the SWB setpoint theory (Lykken & Tellegen, 1996), by explaining not just stability, but acute and chronic change to SWB.

The theory proposes that SWB setpoints ranges are individual differences, and at a population level are always positive (i.e., they are above 50 on a 0 to 100-percentage point [pp] scale of satisfaction strength). Evidence for the existence of setpoints was first produced using data from the Housing, Income and Labour Dynamics in Australia survey (Cummins et al., 2014). These results were repeated with both longitudinal and cross-sectional data from a two-decade long Australian SWB project (Capic, Li, et al., 2018, total sample: 13,203). Both studies concluded that each SWB setpoint range is an individual difference, with a population mean of 80 points and normal distribution of 70-90pps.

The setpoint range is the range within which an individual's SWB can normally vary as their homeostatic system responds to normal challenging agents, or stressors. Extremely positive or negative circumstances can elevate SWB above or below its setpoint range. When this occurs, and homeostasis is effective, such strong perturbations are acute, with a mixture of habituation, adaptation and other processes ensuring a return to the setpoint range. These 'resilience' processes include behaviour, external resources (money, relationships, and a sense of purpose); and cognitive buffers (self-esteem, perceived control, and optimism). For a review of these processes, see Cummins (2016b). These homeostatic processes explain why most individuals remain subjectively positive

despite changes in life circumstances. Thus, the theory of SWB homeostasis explains not only SWB stability, but also SWB fluctuations.

The theory also provides an explanation for why SWB sometimes remains outside its setpoint range for protracted periods. The defence mechanisms of SWB homeostasis, like all homeostatic systems, can be defeated. If the strength of the stressor is greater than the capacity of the homeostatic system to maintain control, defence fails, and SWB will move outside of the setpoint range. When this occurs, SWB will remain outside the setpoint range until resources are sufficient to dominate the source of stress. Thus, this could explain the migration-induced SWB increases described above (Helliwell et al., 2020). As with its physiological counterparts, SWB homeostatic defeat can be catastrophic, and is associated with an increased risk of depression (Cummins, 2010).

Homeostatically Protected Mood

The link between SWB defeat and depression can perhaps best be understood by clarifying the components of SWB. Contrasting with previous beliefs that SWB comprises a mix of cognition, positive affect, and negative affect (explained above), there is growing evidence that SWB is primarily an affective construct (Blore et al., 2011; Davern et al., 2007; Tomyn & Cummins, 2011). There are two components to the affective content of SWB. The first is emotion. The emotional component is situationally-infused: emotions are about something (Frijda, 2009). When emotion is present, it will be accompanied by cognition, or thoughts about the situation that has cued the emotional reaction. During these times, SWB may vary from its setpoint range, as the individual reacts or responds to the emotion-induced stress.

SWB also contains an underlying, stable, background affect, which is constantly present (Capic, Li, et al., 2018). This has been named homeostatically protected mood (HPMood: Cummins, 2010). HPMood represents the most abstract, affective understanding of the self and is the core variable that SWB homeostasis seeks to defend. HPMood has been found to be the common factor explaining why self-report variables inter-correlate (Cummins et al., 2018) and could be a hitherto unexplored explanation for research that has found a latent variable in SWB structure (Busseri, 2018; Jovanović, 2015; Medvedev & Landhuis, 2018). Given that HPMood represents the SWB setpoint, the homeostatic system is operating normally when HPMood is accessible to consciousness.

Thus, SWB homeostasis is proposed to be an internal, psychological, regulatory system protecting HPMood. The psychological constructs of stress and depression are both implicated: with stress acting as a challenge to the homeostatic system, and depression as the result of defeat. Further understanding of the role of stress and depression and homeostasis is thus warranted.

Stress and Homeostasis

Research into stress has its roots in a short letter to *Nature* in 1936, which outlined the "general adaptation syndrome" (GAS), as a three-stage response to "acute, non-specific nocuous agents" (Selye, 1936, p. 32). In the alarm phase, the body's defences are initially weakened slightly in response to the nocuous agent, or stress, before rebounding. In the resistance phase the body's defences fight off the impact of the stressor. In the final stage, exhaustion, the defences collapse and resistance plummets. The GAS, which later became known as the stress response theory, has been highly influential. Its author created the first physiological-

related definition of stress, adapted from physics as: “the interaction between damage and defence” (Selye, 1950, p. 1384). He later simplified his definition to the “nonspecific response of the body to any demand” (Selye, 1956, p. 1), shifting the emphasis away from the stressor, or threat, to the internal response, and crediting Cannon’s homeostasis as one of the theories upon which he was building. Selye believed that the stress response is always physiological, regardless of whether the threat is psychologically or biologically toxic (Selye, 1950). Since Selye, research into biological responses to stress has expanded considerably, with adaptation and homeostasis remaining central ideas. This research spans cellular, endocrine, and neurological systems (for examples, see Chovatiya & Medzhitov, 2014; Chrousos, 2009; Galluzzi et al., 2018).

Within psychology, Selye’s description of the stress process held sway for several decades. However, by the 1980s two strong alternative theories had emerged. The Conservation of Resources Theory (Hobfoll, 1989, 2011) suggested humans are motivated to protect or acquire resources, and that stress results from either the anticipated or actual loss of (or failure to gain) these resources. The theory has contemporary currency and has been widely explored within the context of organisational psychology and organisational behaviour (Hobfoll et al., 2018).

The second alternative to Selye is the transactional theory of stress and coping (Lazarus & Folkman, 1984). In this theory, resources are no longer centre stage. Stress is considered to be relational: “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being” (Lazarus & Folkman, 1984, p. 19). The key theoretical element is not the loss or gain of resources, but

the appraisal of the stressor's power in relation to the person's resources. This appraisal process generates emotions, which in turn initiate coping strategies. Thus, the experience of stress is dynamic and involves feedback loops between appraisal, emotion, and coping.

It is worth noting that the stress response system, involving neurological, emotional, hormonal and immunological reactions (Perrotta, 2021) is primarily adaptive. It invokes what is commonly described as the "flight, fight or freeze" response to perceived stress. Such reactions activate the sympathetic nervous system to mobilise defensive actions such as fleeing danger. These mechanisms and are associated with emotional, as well as behavioural, reactions. While short-term stress is thought to be an important motivator for performance (Dhabhar, 2018), persistent stress, particularly when accompanied by maladaptive coping mechanisms, can result in a persistent state of activation, alertness and emotional dysregulation and alertness that potentially compromises the functioning of the entire organism (Perrotta, 2021).

In summary, while these models differ in terms of their conceptual description, they each link stress and emotion and describe processes by which stressors are controlled, managed, or adapted to. They are, thus, consistent with the stress process being part of a broader system designed to maintain emotional homeostasis. Moreover, within this context, it follows that homeostatic defeat would be evident in disorders of mood, especially depression.

Depression and Homeostasis

Historical writings generally consider depression to be "an exaggerated form of normal human emotional response" to stressful life events (Horwitz et al., 2016, p. 19). Continuing in this vein, many contemporary depression screening

instruments assume this dimensional view, presenting degrees of impairment or severity (e.g., Beck et al., 1988; Lovibond & Lovibond, 1995; Zigmond & Snaith, 1983). However, clinical assessment of depression relies on a categorical approach to pathological diagnoses, in which the condition is either deemed to be present or not (Kotov et al., 2018). Thus, the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5: American Psychiatric Association, 2013) requires an episodic manifestation of a particular number of symptoms and minimum timeframes. Common features of the depressive disorders listed in the DSM-5 are the presence of "sad, empty, or irritable mood, accompanied by somatic and cognitive changes that significantly affect the individual's capacity to function" (p. 155).

A large number of symptom combinations can lead to a clinical diagnosis. One large study (n=3703) of people diagnosed with Major Depression Disorder (MDD) discovered more than a thousand unique symptom profiles (Fried & Nesse, 2015). Such diversity reflects the heterogeneous pathways to depressive illness, representing the multitude of neural pathways and brain systems involved in the disorder (Barrett et al., 2016). Added to this complexity in understanding are the multitudinous psychological risk factors (including dysfunctional schemas, or mental themes), and socio-cultural factors, including poverty, that contribute to depression pathogenesis (Schotte et al., 2006). It has been suggested that a common bridge between these diverse symptomatic and causal factors is the ubiquitous role of the hypothalamic-pituitary-adrenal (HPA) axis, which governs the interaction between the endocrine and the central nervous system. In other words, the role of stress (Roy & Campbell, 2013).

The Relationship Between Stress and Depression

Most key symptoms of depression, such as changed appetite, sleep dysfunction and anhedonia, can also be accounted for within the context of the stress system, according to Gold (2015). He argues that the activation of the stress response diverts resources away from functions such as appetite, sleep, and digestion, while the system instead focusses on responding to the threat in order to restore or maintain systemic balance, or physiological homeostasis. While these somatic functions are generally restored following resolution of the stressor in a healthy system, Gold contends that depression is an outcome of failure of this approach.

According to this view, depression is characterised by positive feedback loops between the brain systems involved in the stress response, including the amygdala, limbic structures and the HPA axis, which cascade the stress response into ever-further activation. In this way, many of the symptoms of depression are reinforced or perpetrated by the resulting change in brain structures from this cascading stress response (Gold, 2015; Gold & Chrousos, 2002; McEwen, 2004). Thus some forms of depression have been described as the inability to counter-regulate the activation of the stress response (Chrousos & Gold, 1992), leading to a broad conclusion that depression is a "dysregulated adaptive response: a stress system that has gone awry" (Gold, 2015, p. 33). When stress is physiological, it is typically manifested as inflammation (Rohleder, 2019). It is perhaps not surprising then, that for many patients, depression is associated with inflammation (Pariante, 2017), and that the relationship between depression, stress and inflammation is a burgeoning area of research (Leonard, 2018; Lopresti

et al., 2014). These relationships are further complicated by the role of psychological symptoms in inflammatory diseases.

Inflammatory Bowel Disease

If psychological stress is implicated in SWB homeostasis defeat, then it is possible that physiological stress, manifested as inflammation, is also implicated. This can be considered in the context of IBD, which is a banner term for two main diseases that represent inflammation of the bowel or digestive tract: Crohn's disease (CD) and ulcerative colitis (UC). These diseases are incurable, painful, and typically involve socially awkward symptoms such as abdominal pain, diarrhoea and rectal bleeding (Abautret-Daly et al., 2018). IBD is strongly associated with psychological symptoms of stress and depression (Mikocka-Walus, Knowles, et al., 2016). Patients themselves often report that stress precipitates their IBD flares (Larsson et al., 2017), and there is a growing body of research that identifies psychological stress as one of the key factors in IBD aetiology, activity and disease course (Ananthakrishnan, 2015; Bernstein et al., 2010; Triantafillidis et al., 2013). Similarly, depression is increasingly considered a likely comorbidity to IBD, and studies of large cohorts have found evidence for both incident depression predicting IBD diagnoses (Frolkis et al., 2018), and IBD inflammatory markers predicting later episodes of depression (Valkanova et al., 2013). There is emerging evidence, in a longitudinal study, of a bi-directional brain-gut axis interaction for people with IBD (Gracie et al., 2018). This was observed through relationships between antecedent psychological comorbidity and disease activity, as well as through the experience of psychological symptoms developing in conjunction with IBD activity in patients with no prior psychological comorbidity. Psychological treatments are increasingly part of the

management of patients with IBD (Gracie et al., 2017; Keefer, 2018; Knowles & Mikocka-Walus, 2015). One treatment that continues to attract research interest for its role in improving symptoms of both inflammatory conditions such as IBD, as well as psychological disorders such as depression, is mindfulness.

Mindfulness

Mindfulness has its roots in a 2500-year history of Buddhist practice that emphasises mental training to achieve the ultimate goal of eliminating suffering and achieving enlightenment (Bodhi, 2011; Olendzki, 2003). Since the 1970s, psychology has explored mindfulness-based interventions for psychological disorders (Keng et al., 2011, for a review). One of the most commonly researched interventions is Mindfulness Based Stress Reduction (MBSR), which was designed to support patients with chronic health conditions (Kabat-Zinn, 1990). Its author offered a definition of mindfulness that remains perhaps the most common definition in psychological literature: paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally (Kabat-Zinn, 2013).

Research into mindfulness has been complicated by the heterogeneity of mindfulness traditions, some of which emphasise practices that are akin to skills of attention, (such as one-pointed awareness), and others that encourage insight, curiosity, and acceptance of one's current mental processes. Despite these differing emphases, in traditional schools there is a broad view that mindfulness practices involve a combination of "cultivated concentration and experiential inquiry" (Batchelor, 2011, p. 159) where detachment from moment-to-moment mental and emotional states are encouraged. In short, they have in common an emphasis on the present moment—and in observing the mental fluctuations of the

mind without seeking to alter them. Thus, mindfulness creates a dispassionate state of self-observation that introduces "a 'space' between one's perception and response" (Bishop et al., 2004, p. 232). In this regard, mindfulness training has been described as akin to many of the objectives of cognitive behavioural therapy, including encouraging clients to form a "new relationship to old thought patterns" (Fennell & Segal, 2011).

Despite these apparent alliances, there are challenges for psychological research, particularly with how to measure mindfulness. A recent review critiquing the many mindfulness scales that have emerged in recent years concluded that the construct cannot currently be captured in any single measure (Davidson & Kaszniak, 2015). The difficulty stems from construct ambiguity: is mindfulness a trait, a state, or a skill? A recent proposed solution to this dilemma is to study not so much what mindfulness *is*, but on what it *does*, or, in other words, to consider the outcome state that is achieved by mindfulness practice. The proposal is that mindfulness practice produces the state of equanimity (Desbordes et al., 2015).

Equanimity

Equanimity is a core concept of most Buddhist teachings. It involves responding to stimuli, such as thoughts, emotions and body sensations, with a "neutral feeling, a mental feeling which leans neither to gladness nor dejection" (Bodhi, 2012, p. 34). It implies a state of non-reactivity (Dreyfus, 2011) and results in an experience that has been described as "restful and peaceful and thus slightly pleasant" (Batchelor, 2018, p. 62). Its practice involves cultivating conditions so that negative states do not arise; letting go of negative states that do arise; cultivating conditions so that positive states arise; and sustaining positive

states once they have arisen (Batchelor, 2011, p. 159). These echo the previously discussed process of homeostasis resilience and restoration: homeostatic systems seek conditions suitable for the relevant variable's set-point, monitor results and take corrective action to restore balance when required. Further, the conceptualisation of equanimity as an underlying peaceful consciousness, accessible after gaining detachment from the mind's mental and emotional contents, is similar to the conceptualisation of HPMood. Exploring this similarity, which is discussed in detail in Study 1, is at the heart of this thesis.

Implications of Homeostasis Theory

The implications of Homeostasis Theory are that depression is a result of the defeat of the individual's internal, protective homeostatic mood system, and is experienced when emotion dominates consciousness obscuring access to HPMood. A further implication is that restoration of conscious access to HPMood is the mechanism of recovery from symptoms of depression. How then, does one restore conscious access to HPMood? That is the core question asked by this research project, with a novel answer proposed: that mindfulness, which has been demonstrated as an effective treatment for depression, acts on the homeostatic system in just that way. An appropriate sample to investigate these questions is a sample of people living with inflammatory bowel disease, as these people are known to experience interrelationships between their psychological and physiological symptoms and their SWB, with the full extent of these relationships not previously investigated using the framework of Homeostasis Theory.

Project Aim

The project aims to explore the implications of the role of psychological symptoms and mindfulness in mood homeostatic defeat. It will expand this theoretical understanding by exploring the nature of the relationships between physiological symptoms, mindfulness, and HPMood, and identifying whether trait levels of mindfulness or regular mindfulness practice are associated with SWB homeostasis in a sample of individuals with IBD.

Overview of the Research

This thesis explores these propositions in novel ways, as outlined in Table 1. First, it is the first project to explore and integrate a possible theoretical relationship between mindfulness and SWB homeostasis. In Study 1 (Chapter 2), the mechanisms by which mindfulness reduces symptoms of depression are examined, and these are compared to what is known about the SWB homeostasis system (Lyall, Mikocka-Walus, et al., 2021). A model of *moodfulness* is proposed, by which mindfulness is thought to resolve symptoms of depression by activating restoration of HPMood. The *moodfulness* model proposes that the equanimous state produced by mindfulness practice reduces the influence of emotional fluctuation and enables HPMood to be restored to conscious awareness. As HPMood is representative of the SWB setpoint, access to HPMood restores SWB homeostasis.

Study 2 (Chapter 3) takes a deeper dive into the theory of SWB homeostasis. It employs generalised additive models to test whether the relationship between HPMood and psychological symptoms of stress and depression are curvilinear, as the theory proposes. Using a sample of people with IBD, it also investigates whether trait mindfulness has a similar curvilinear

relationship with HPMood. An IBD sample was chosen because of the known relationship between IBD physiological and psychological symptoms, and because of emerging evidence that mindfulness could be effective in reducing psychological distress associated with IBD (Ewais et al., 2020; Hood & Jedel, 2017; Jedel et al., 2014; Neilson et al., 2015; Schoultz et al., 2015; Schwartz et al., 2019).

Study 3 (Chapter 4) broadens these empirical investigations by examining the impact of stress and depression on the SWB of the same sample of people living with IBD. The study aimed to explore whether people with CD or UC experiencing psychological symptoms were more likely to be reporting levels of SWB that are outside of the population SWB homeostatic range.

Chapter 5 presents a protocol for a pilot intervention randomised control trial designed to empirically test the proposed benefits of MBSR on patients with CD (Lyall, Beswick, et al., 2021). The study has been approved by the relevant Barwon Health and Deakin University ethics committees and registered as a clinical trial. In the proposed study, a cohort of patients with CD would be delivered a MBSR intervention and their results would be compared with a wait-list control who receive treatment as usual. Outcome measures would be reported levels of psychological symptoms, inflammation, and analysis of whether, for each individual, the intervention led to a restoration of SWB homeostasis.

A general discussion about the implications of these findings is presented in Chapter 6. Chapter 7 presents concluding remarks and candidate reflections on the research project process.

Table 1

Thesis structure, research questions and methods

Thesis Section	Research Questions	Method
Thesis Abstract		
Chapter One General Introduction and Overview		
Chapter Two Study 1: Linking Homeostatically protected mood, mindfulness, and depression: a conceptual synthesis and model of *moodfulness*	Can SWB homeostasis provide a useful conceptual framework to understand the role of mindfulness in recovery from symptoms of depression?	Literature and theoretical conceptual review
Chapter Three Study 2: Exploring evidence for mindfulness and subjective wellbeing homeostatic resilience buffering depression symptoms associated with inflammatory bowel disease	For people living with IBD, do psychological symptoms, disease symptoms and mindfulness demonstrate non-linear relationships with HPMood, such that a resilience effect is evident in the data?	Design: Cross-sectional study Sample: People with IBD; n = 739 Main Analysis: Generalized additive models
Chapter Four Study 3: Mindfulness practice is associated with subjective wellbeing homeostasis resilience in people with Crohn's disease but not ulcerative colitis	Is mindfulness practice independently associated with SWB homeostatic resilience in people with IBD, after controlling for other psychological and demographic factors?	Design: Cross-sectional study Sample: People with IBD; n = 739 Main Analysis: Chi Square and Binomial Logistic Regression
Chapter Five Study 4: The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease: A pilot randomised control trial protocol	Can an eight-week Mindfulness Based Stress Reduction (MBSR) training reduce symptoms of stress, depression and inflammation and lead to the restoration of SWB homeostasis for people with Crohn's disease?	Design: RCT with waitlist control Sample: People with Crohn's disease; n = 40 Main analysis: Mixed ANOVA, clinical significance testing
Chapter Six General Discussion		
Chapter Seven Concluding Personal Reflections		

Chapter 2

Study 1: Linking homeostatically protected mood, mindfulness and depression: a conceptual synthesis and model of *moodfulness*

Note: This is an edited version of the paper published in the Review of General Psychology in August 2021. Edits attend to examiner comments.

Reference:

Lyall, K., Mikocka-Walus, A., Evans, S., & Cummins, R. A. (2021). Linking homeostatically protected mood, mindfulness, and depression: A conceptual synthesis and model of moodfulness. *Review of General Psychology*, 25(3), 304-320. https://doi.org/10.1177/10892680211017523

Abstract

Mindfulness is an ancient practice, derived from Buddhism and recently adapted for the treatment of depression and other psychological conditions. The mechanism of action is thought to involve the extinction of habitual or conditioned responses to internal cognitive and emotional content. In turn, this relies on mechanisms of attentional control and emotion regulation. The resulting state of consciousness is sometimes described as equanimity. This conceptual review paper explores the process of achieving equanimity within a homeostatic framework. The result is a model of *moodfulness,* which combines mindfulness with homeostatically protected mood to provide a new theoretical view of recovery from symptoms of depression. This model presents a case for mindfulness restoration of mood homeostasis following homeostatic defeat.

Keywords: Mindfulness, equanimity, subjective wellbeing, homeostatically protected mood, depression.

Linking homeostatically protected mood, mindfulness and depression: a conceptual synthesis and model of *moodfulness*

Mindfulness and the Alleviation of Suffering

According to Buddhism, the practice of mindfulness is a form of mental training in pursuit of the elimination of suffering. While there are a number of traditions, each emphasising different aspects of the original teachings, for most Buddhists, the practice is connected to an overarching philosophical goal of enlightenment, or *nirvana*, a state that is cultivated through continuous discipline and dedication (Bodhi, 2011; Olendzki, 2003).

For psychologists, the potential for mindfulness to reduce misery has been compelling, although in secular hands the emphasis has shifted from spiritual transcendence to symptom relief. Over the past 40 years the psychological literature has blossomed with research, interventions, and techniques for infusing psychological treatments with mindfulness. Overall, these report positive outcomes. Meta-analytic evidence demonstrates beneficial effects on diverse disorders, including anxiety, depression, addiction, and chronic pain (Bawa et al., 2015; Chiesa & Serretti, 2011; de Vibe et al., 2017; Li et al., 2017; Vøllestad et al., 2012). Mindfulness performs as well as evidence-based treatments for depression, such as cognitive behavioural therapy (CBT) and anti-depressants, significantly outperforming other control conditions, with effect sizes ranging from Cohen's *d*'s of .23 to .55 (Goldberg et al., 2018). Confirmatory evidence from another large meta-analysis (Khoury et al., 2013) demonstrated mindfulness to be as effective as pharmacology and CBT for the treatment of depression, with effects up to Hedge's *g* of .61, while mindfulness based cognitive therapy is

likewise as effective as pharmacological treatments (Kuyken et al., 2015; Kuyken et al., 2016).

These positive findings have also attracted some warnings regarding the quality of the studies, citing concerns with the clinical methodology and the generalisability of the results (Van Dam et al., 2018). However, accepting that the research indicates some therapeutic benefit of mindfulness, there is yet no consensus on the mechanisms by which mindfulness acts on psychological symptoms.

Our conceptual review proposes a novel model, which places the relationship between mindfulness and depression within the theory of subjective wellbeing (SWB) homeostasis (Cummins, 2016b). While there are signs of an emerging interest in investigating the links between SWB and mindfulness (Jones, 2020), the two fields have not yet been integrated. Our review, then, is by nature preliminary, conceptual, and theoretical. While it draws on existing empirical evidence, specific empirical testing of the new model lies in the future.

We first provide an initial overview of the relationship between Buddhism and psychology. We then explore the mechanisms of mindfulness and its outcome state, equanimity. The theory of subjective wellbeing (SWB) homeostasis and its underlying key variable, homeostatically protected mood (HPMood), is then described. Finally, depression, understood as SWB homeostasis defeat, is linked to HPMood and equanimity, forming the proposed model.

Buddhism and Psychology

In this century, there has been an exponential growth of scientific studies into mindfulness (Van Dam et al., 2018), but psychological interest in what

Buddhism has to say about the mind and its relationship with suffering is much older. In introducing her translation of a key Buddhist text, the Dhamma-Sangani, which is a compendium of states or phenomena, Rhys Davids (1900) comments, "even a superficial inspection of the manual should yield great promise to anyone interested in the history of psychology" (p. xvi). Indeed, such interest was evidenced by such notable 20th century psychological and psychoanalytical thinkers as William James, Carl Jung and Eric Fromm, each of whom wrote extensively on Buddhism's psychological components (e.g., Fromm et al., 1960; James, 1902; Jung, 1969). But the interaction between Buddhism and western science has not been without controversy (Harrington & Dunne, 2015; Stanley, 2012; Van Dam et al., 2018). One obvious area of contrast lies in the notion of self.

Buddhist practitioners believe that all phenomena—including the "self"—are empty of inherent existence. They observe that an individual's 'self' neither exists in any of its constituent parts (body, mind, thoughts, perceptions and consciousness), nor in the whole (Shonin et al., 2014). Instead, Buddhist philosophers propose a process known as "dependent origination", in which interconnected phenomena co-arise with each other, with one thing leading to another as a result of this dependence, which in turn becomes our present-moment reality (Khong, 2003; Van Gordon et al., 2017). In other words, there is no inherent self, other than that constructed in the present (Stanley, 2012). As a result, Buddhist mindfulness focuses on recognising that the construction of self – and the clinging or grasping of desire that such construction facilitates – is in fact the cause of suffering (Olendzki, 2003). Thus, Buddhists strive to end suffering

by removing the "illusion of (self as) a continuous, fixed, separate entity" (Chodron, 2019, p. 113).

This Buddhist premise, sometimes described as "non-self" (Shonin et al., 2014), contrasts starkly with Western psychological therapy, which commonly proposes a strengthening of self, or self-concept, as a treatment for psychopathology. Such psychological therapy usually involves understanding the overarching narrative of the individual and their experiences (Kwee, 2013), as well as examining maladaptive thoughts and thought processes, particularly those involving self-blame or inadequacy in order to "correct … (these) erroneous judgements" (Beck, 1964, p. 571). This approach is clearly at odds with the Buddhist practice of non-judgemental acceptance of all thoughts (Bodhi, 2011).

It is notable that most psychological researchers and practitioners in this area avoid this larger philosophical conflict. Mindfulness interventions are often removed from their broader Buddhist context, commonly by incorporating mindfulness within behavioural and cognitive therapy. Examples include: Dialectical Behaviour Therapy (DBT: Linehan, 1993), which emphasises mindfulness as a way to gain acceptance over emotional experiences, and thus changing habitual behavioural responses to them, such as self-harm; Mindfulness Based Cognitive Therapy (MBCT: Segal et al., 2012), which emphasises awareness of thinking patterns; and Acceptance and Commitment Therapy (Hayes et al., 2006), which incorporates mindfulness as a way of achieving psychological flexibility.

Such separations of mindfulness, from its original ethical framework, has, according to Harrington and Dunne (2015) led to its use as a commodity. It has been used to promote such things as weight loss, better sex, and workplace

productivity. This detachment from its origins has made mindfulness "hostage to values that are tangential or even anathema to the traditions from which the practice arose" (Harrington & Dunne, 2015, p. 621).

Curiously, however, the teachings attributed to the Buddha do not explicitly prescribe ethical action. The teachings direct an eight-fold path, of which mindfulness is but one element, alongside such things as "right thought", "right action" and "right livelihood", without ever defining "right". Instead, Buddhist practitioners must obtain that knowledge by examining the contents of their own minds (Khong, 2003). Therefore, some scholars argue that Buddhism is a kind of "radical empiricism" (Segall, 2003, p. 92) where followers are urged not to take even the Buddha's word as authority. In Buddha's words, quoted by Segall (2003, p. 107): "*ehipassika*: come and see for yourself".

Such reflective practice has also been described as a "science of experience in which the stream of consciousness itself, as it is presented to the attentive and carefully trained observer, is the field of investigation" (Olendzki, 2003, p. 14). This process of attending, in a trained way, to the present stream of consciousness, is actually one description of mindfulness. In this it shares, with most Western psychological approaches, a reliance on introspection, or an understanding of the subjective experience (Olendzki, 2003; Segall, 2003).

What is Mindfulness?

In its secular application, the most common definition for mindfulness is 'paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally' (Kabat-Zinn, 1994, p. 4). However, the Pali word *sati,* which was first translated as mindfulness in the 19th century (Rhys Davids, 1881) is more accurately translated as recollection, or memory. Some interpret *sati* as a

call to remember, or stay focused on, in your present moment (Gethin, 2011), while others expand the meaning, suggesting mindfulness is a kind of attention that allows efficient encoding and recollection of experiences (Vago & David, 2012; Wallace & Shapiro, 2006). Still others propose "lucid awareness" (Bodhi, 2011) or bare attention (Nyanaponika, 1962) as what the Buddha meant in his mindfulness teachings. In turn, bare attention is understood as noticing, "observing all phenomena—physical, mental and emotional—whatever is presently taking place in the mind" (Gunaratana, 2011, p. 135).

Some of these semantic differences stem from differences in practice. There are generally thought to be two broad schools – those emphasizing concentration, sometimes describes as *samatha*, and those emphasizing insight, experiential enquiry, or *vipassana*, (Batchelor, 2011). Concentration practice develops focused attention, and involves directing and sustaining attention on a chosen object (such as the breath, or a candle); and training the mind to disengage from distracting stimuli (Lutz et al., 2008). Most novice practitioners are taught focused attention, and many teachers consider such practice as foundational training for later development of open and undirected practices that attend to whatever emerges in consciousness on a moment-to-moment basis (Bodhi, 2011). It is thought that these open monitoring practices (Lutz et al., 2008), or the ability to contemplate whatever phenomena arise, are advanced techniques that support the capacity for wisdom and discernment (Grossman & Van Dam, 2011).

Most mindfulness based psychological interventions are manualised programs that progress through these practices, drawing primarily on focused attention techniques, but including some analytical practices such as non-judgemental observation of thoughts and feelings, and sometimes incorporating

both into practices. An example is loving-kindness meditation, in which the focus is cultivating compassion for oneself and others (Harrington & Dunne, 2015; Lippelt et al., 2014).

The mindfulness practices that these psychological interventions draw on, share a common intended outcome: freedom from suffering, or "the endless cycle of desire and aversion" (Gunaratana, 2011, p. 6) and the attainment of *nirvana*. *Nirvana* is literally translated as "extinction". In Buddhism it refers to the extinction of processes, such as craving, clinging or grasping to thoughts or emotions that cause suffering (Buddhaghosa, ca. 412/2010).

How Does Mindfulness Work?

Cognitive Processes

Researchers have yet to agree on the mechanisms by which mindfulness operates, and there are likely as many proposals and possibilities for mechanistic operations as there are varieties of mindfulness practices (Hölzel et al., 2011). One of the earliest, and most influential, theoretical models involves cognitive processes. This suggests that training in three components of mindful practice—intention, attention, and attitude—creates a shift in an individual's perspective of themselves and their circumstances (Shapiro et al., 2006). The authors call this shift in perspective 're-perceiving'. They propose that intention and attitude combine to create self-regulation, such that the sustained observation of one's inner experiences enables the ability to "stand back" and witness the drama of the personal narrative, rather than being immersed in it (Shapiro et al., 2006, p. 377). In this regard, mindfulness has been described as "non-judgemental observation of the ongoing stream of internal and external stimuli as they arise" (Baer, 2003, p. 125). In a similar vein, other authors describe re-perceiving as a decoupling of

consciousness and mental content, thereby creating a "mental gap" between awareness and the objects of attention (Brown et al., 2007, p. 216).

These descriptions imply that the process of decoupling the contents of the mind from the self creates a sense of neutrality. However, many researchers propose that what flows from this change in perspective is not neutrality but "positive reappraisal", or the ability to attribute positive meaning to stressful events (Garland, 2007; Garland et al., 2011). This positivity is attributed to viewing thoughts as temporary phenomena. Thus, re-perceiving, which has also been described as decentering (Bernstein et al., 2019; Bernstein et al., 2015), is thought to be a protective mechanism against the kind of negative thinking characteristic of chronic depression (Lutz et al., 2015; Segal et al., 2012).

In summary, it is commonly taught that the practice of non-interfering observations of previously distressing stimuli (negative thoughts), leads to desensitisation and extinction of previously conditioned responses that yield the negative affect. Through such practice, habitual negative reactions are extinguished, while novel appraisals and positive responses are promoted (Farb et al., 2014; Hölzel et al., 2011; Roemer et al., 2015). Such extinguishment of negative emotional reactions, through mindfulness-based exposure, has been experimentally supported, and has also been found to survive later re-exposure (Uusberg et al., 2016). Some researchers, however, propose that monitoring present-moment experience can increase, rather than decrease, affective reactivity, unless it is coupled with affective strategies such as acceptance (Monitoring and Acceptance Theory: Lindsay & Creswell, 2017; Lindsay & Creswell, 2019). These elements of affective adaptation suggest a second candidate for mindfulness's effectiveness, which is emotion regulation.

Emotion Regulation

Emotion regulation is "the processes by which individuals influence which emotions they have, when they have them and how they experience and express these emotions," (Gross, 1998, p. 275). The literature and models explaining these processes are extensive, but can be summarised as involving cognitive and behavioural strategies that are evoked to alter the conscious experience of emotions (Gross, 2015a). Such proposed cognitive strategies include attentional deployment and reappraisal. It is therefore logical that mindfulness, which involves both attentional deployment and reappraisal, is considered an emotion regulation strategy.

The ability of mindfulness to provide emotion regulation through attentional deployment has also been explored by Farb et al. (2014), who adapted Gross's model. The proposition is that the attentional deployment extinguishes habitual responses to adverse emotional experiences. This is achieved through the engagement and direction of effortful cognitive resources to attend to the experience, rather than to distract from it. Crucial to this process is the attentional focus on the sensory nature of the experience. This is thought to disrupt automatic appraisals, thereby allowing new perceptions to emerge. In an expansion on this notion, Garland et al. (2015) propose that mindfulness creates regulation through the cultivation of positive mental states. Thus, this increased attentional focus on the emotional experience, along with non-judgemental awareness, strengthens the prefrontal cognitive control mechanisms, which are then better able to downregulate affect generation from brain regions such as the amygdala (Tang et al., 2015).

Further understanding about the impact of mindfulness as influencing affective perceptions comes from research into mindfulness treatment for pain, which has established that mindfulness—in particular focused attention—alters the subjective experience of pain (Zeidan et al., 2011). More specifically, mindfulness acts not on the sensory experience of pain itself, but on the perception of its unpleasantness. Thus, the pain experience is altered by a transformation of one's subjective relationship to it (Grant & Zeidan, 2019).

Adding to this theme, a proposed Buddhist psychological model of mindfulness (Grabovac et al., 2011) also contributes understanding to emotion regulation. The proposed mechanism concerns the process by which a physical sensation, thought or feeling occurs in the stream of consciousness. First, awareness of the event arises and evokes a feeling *tone* (pleasant, neutral, or unpleasant), leading to the habitual reaction of either 'attachment' (usually to pleasant tones) or 'aversion' (to unpleasant tones). This attachment or aversion creates mental proliferation, or the continuous production of additional mental events following the original feeling tone. Such mental proliferation can be interrupted through sustained attention on an object such as the breath. The result is an awareness of the feeling tones, and their stimuli, without any follow-on mental proliferation.

Emotion regulation is also thought to come from interoceptive awareness, which is a core element of many mindfulness practices, and involves mindfully observing bodily sensations. The tradition stems from the first of four mindfulness establishments (body, feelings, mind, phenomena) taught by the Buddha (Bodhi, 2011). Interoceptive awareness developed from mindfulness has been proposed to elicit a kind of "bottom-up" embodied cognition that supports

self-regulation (Khoury et al., 2017). It is perhaps not surprising, then, that mindfulness is also thought to engage physiological regulation.

Physiological Regulation

In addition to cognitive and emotion regulation, there is emerging evidence that mindfulness acts on autonomic biological systems. Research in this area is nascent, and some authors have expressed caution about the quality of studies and variability of objective biomarker measurements (Christodoulou et al., 2020; Rådmark et al., 2019). Nonetheless, a recent meta-analysis of randomised control trials has found that mindfulness training reliably decreases physiological markers of stress, resulting in lower cortisol, heart rate, blood pressure and cytokine levels (Pascoe et al., 2017). Such systems are largely governed by their own regulatory processes, particularly involving homeostatic control. It has been proposed that mindfulness supports such homeostatic control by decoupling the sensory and affective components of stressors (Vago & David, 2012). For example, mindfulness (partly, but not exclusively, through the relaxation response), increases cardiorespiratory synchronization and contributes to a shift toward parasympathetic activity and modulation of the autonomic nervous system. This in turn reduces physiological symptoms of anxiety, such as increased heart rate and irregular breathing, in turn reducing the experience of anxiety (Jerath et al., 2014). Thus, through generalised physiological quieting, mindfulness may aid in the maintenance of physiological homeostatic systems. Homeostasis is, therefore, an additional concept with which to explore mindfulness's role in prevention of and recovery from distress.

What is Homeostasis?

The term homeostasis was coined by Harvard physiologist Walter Cannon after he observed that blood sodium and glucose levels remained remarkably stable even when challenged by variations in the availability of their substrate. However, he also recognized that these variables exhibited variation within a stable range, hence, the Greek word *homeo* (meaning similar), and *stasis* (stable), describing processes that involve both variation and constancy (Cannon, 1929, 1932). In his masterwork, he writes of homeostasis: "the word does not imply something set and immobile, a stagnation. It means a condition—a condition which may vary, but which is relatively constant" (Cannon, 1932, p. 24).

Since Cannon, the understanding of biological systems has evolved considerably, and it is generally agreed that homeostatic systems are commonplace within biology (Chrousos, 2009; de Kloet et al., 2005). In any such system, the optimal resting level of the managed variable is described as its setpoint; a term borrowed from engineering and first applied to physiology within a few decades of Cannon's writings (Hardy, 1953; Yates & Urquhart, 1962). As predicted by Cannon, homeostatically managed variables normally fluctuate within a limited range around their setpoint (setpoint range) in response to changing conditions impinging on each homeostatic system. Under normal conditions, the level of each managed variable is restrained to move within its setpoint range. While temporary transgressions outside that range are also adaptive and normal, prolonged transgressions are a signal of pathology.

While for most of its history, homeostasis has been considered in relation to physiological systems, the term is increasingly being applied to psychological processes. In a review for Nature, homeostasis was described as a "dynamic

equilibrium" that governs all life forms and is managed by both physiological and behavioural responses (de Kloet et al., 2005, p. 463). In a similar vein, Damasio (2018, p. 34) describes homeostasis as "the collection of coordinated processes required to execute life's unthought and unwilled desire to persist and advance into the future through thick and thin". Further extending this general concept to social science, Montgomery (2018) proposes that some contemporary psychological disorders, such as post-traumatic stress disorder and depression, result from a lack of evolutionary adaptation to modern living. He describes psychological wellbeing as a homeostatic state, as a form of emotional homeostasis that reflects the underlying physiology.

This form of connection, between body and mind, is the concern of much contemporary research. One such exploration is the proposal that individual regulatory (homeostatic) systems interact with each other in dynamic, complex networks involving both physiological functioning as well as mood regulation. The resulting systemic resilience stems from a "dazzling web of mechanisms" that involve the mood, cognitive, and physical subsystems, with each of them contributing to the entire organism's resilience (Scheffer et al., 2018, p. 11888).

Can Mindfulness Support Homeostasis?

The connection between mindfulness and physiological systems is receiving increasing research attention, as has been already indicated. For example, a recent meta-analysis of randomised control trials found evidence that mindfulness training decreases physiological markers of stress (Pascoe et al., 2017). However, the responsible mechanism remains uncertain. One proposal, stemming from a literature review, suggests that cardiorespiratory

synchronization, elicited through mindfulness, modulates the autonomic nervous system. They call this process "homeostatic modulation" (Jerath et al., 2014).

Such proposals assume that mindfulness influences physiological systems already known to be governed by homeostasis. It is a larger step in logic to consider whether mindfulness can activate a *psychological* homeostatic system designed to defend a crucial psychological variable.

The notion may not be so far-fetched. Other researchers have proposed mindfulness as a mechanism of supporting internal homeostasis (Vago & David, 2012), while mindfulness practitioners and teachers often use descriptions akin to homeostasis to describe the role mindfulness has on global, and in particular, emotion regulation. For example, Batchelor (2011) proposes that mindfulness involves four "great efforts": cultivating conditions so that negative states do not arise; letting go of negative states that do arise; cultivating conditions so that positive states arise; and sustaining positive states once they have arisen. These four efforts can be loosely translated as a system managing its variable at its optimal point of functioning and taking corrective action to restore balance when required (Ramsay & Woods, 2014). In other words, homeostasis. The analogy has more than heuristic value; and warrants further exploration and testing.

What Variable Might Mindfulness be Defending?

Given that mindfulness extinguishes conditioned responses to thought and emotion, the residue in consciousness that follows this extinction is a possible candidate for a psychological variable protected by homeostasis.

Then, what must be considered, is the quality of the mental space created by mindfulness. If the normal emotional and cognitive dominance of consciousness is extinguished, what takes their place? Or, put in a Buddhist

frame, what happens when the reflexive response of grasping and clinging to objects, emotions, and cognitions, subsides? While the ultimate answer to that question is nirvana, or freedom from suffering, such enlightenment requires the deconstruction of a sense of inherent self, or non-duality (Grabovac et al., 2011; Kudesia & Nyima, 2015), and is the goal of Buddhist meditators. One of the precursors to this non-dual state is the ability to respond to stimuli with "calm and impersonal receptivity", or equanimity (Kudesia & Nyima, 2015, p. 918). The mental state achieved from mindfulness practice is often described as equanimity (Olendzki, 2006), and it has been proposed that equanimity is the outcome state that mindfulness research should investigate (Desbordes et al., 2015; Hadash et al., 2016).

Equanimity as a Homeostatic Outcome of Mindfulness Practice

Most Buddhist texts translate equanimity, a core Buddhist virtue, to mean a "neutral feeling, a mental feeling which leans neither to gladness nor dejection" and is manifested as "peacefulness" (Bodhi, 2012, pp. 34, 116). More contemporary definitions include the simple term "emotional balance" (Williams & Kabat-Zinn, 2011, p. 3). Equanimity is not indifference. Rather, as described by Desbordes et al. (2015), it is an even and unbiased response to the objects of awareness and a form of emotion regulation. In essence, it is viewed as a "balanced reaction to the joys and miseries of mental experience that protects the mind from emotional agitation" (Weber, 2017, p. 152). Such descriptions also evoke the components of homeostasis, suggesting there is some merit in further testing the role of equanimity in psychological homeostasis.

In understanding the descriptions of equanimity and balance used by these authors, the use of "neutral" does not mean the absence of affect. To the contrary,

renown Zen Buddhist master, Thich Nhat Hanh (2011), describes the neutral feelings that result from mindfulness as “very pleasant” and “wonderful”. He is not alone in that description. In a recent exploration of the three “feeling tones” – pleasant, unpleasant and neutral, Batchelor (2018) points out that the so-called neutral tones are in fact experienced as “restful and peaceful and thus slightly pleasant” (p. 62). While the description of equanimity as a feeling, or mental state, is common (Pagis, 2015), equanimity is also described as a “quality of awareness” (Grabovac et al., 2011, p. 159) a skill to be cultivated (Lindsay & Creswell, 2019) and an effect of mindfulness practice that leads to increased wellbeing (Eberth et al., 2019).

In this regard, equanimity could be understood as a mental process that facilitates the cognitive and emotional regulation mechanisms described above. The Buddhist texts also refer to equanimity as one of four “immeasurables”, a desired attitude that is limitless in range (Bodhi, 2012) , although that description hasn’t deterred the emergence of a number of proposed equanimity scales in recent years (Juneau et al., 2020; Rogers et al., 2020; Weber & Lowe, 2018). These different descriptions and definitions are not surprising, given the centrality of equanimity to the Buddhist process of enlightenment. Indeed, equanimity is linked to advanced states of concentration, achieved after the earlier phases (which coincide with joy and bliss) are transcended. The Buddha’s words for this advanced state has been translated as “absolute purity of mindfulness” (Powers, 2007, p. 84).

Notwithstanding those conceptual differences, the representation of equanimity as a balanced mental attitude, or quality of mind, is perhaps the most common interpretation of equanimity in the psychological literature to date. It

infers both a state that can be developed (with practice) as well as an effect of that practice (Juneau et al., 2020). Attributes of equanimity encompass the notion of non-reactivity to stimuli (Dreyfus, 2011). Bringing these thoughts together, the state of equanimity, produced through the development and practice of mindfulness, is a balanced mental state, devoid of reactivity to emotional content, and experienced as a slightly activated positive affect.

Is there an equivalent to this end-state in Western psychological thinking? A candidate variable is proposed by the theory of subjective wellbeing (SWB) homeostasis (Cummins, 1995, 2016b) and is known as homeostatically protected mood (HPMood). HPMood has been described as neuro-physiological and comprising the simplest, constant, non-reflective, feeling underlying consciousness (Cummins, 2010). Crucially for our proposal, it is important to note that HPMood is not strongly attached to views of the self except in an abstract way (Cummins, 2016b): it is the residue in consciousness once self-referencing emotion and cognition are reduced from dominance in consciousness. It is also *only* experienced in the moment: one cannot access one's levels of HPMood from the past. It therefore follows that mindfulness, which extinguishes the dominance of cognition and emotion in consciousness, and which grounds the subjective experience firmly in the present, would create the conditions by which this underlying mood is more directly accessed. Before exploring HPMood in more detail, the broader theory of SWB homeostasis will be described.

The Theory of Subjective Wellbeing Homeostasis

The theory of SWB homeostasis was developed to account for a remarkably consistent finding in social science research: most people are mostly happy with their lives, most of the time. Empirical evidence for the stability of SWB first emerged in 1934, when Hartmann found a 0.70 test-retest correlation for his subjective happiness scale administered to a sample of 195 college students, four weeks apart (Hartmann, 1934). Since then, SWB stability has been demonstrated in many longitudinal studies. For example, Palmore and Kivett (1977) found no change in life satisfaction in age-sex cohorts over a 4-year period; while a community sample of almost 5,000 adults studied over a 3-year period yielded similar results (Costa et al., 1987).

Stability has also been demonstrated in cross-sectional data. The first evidence came from an analysis of 16 unrelated studies of general population life satisfaction, involving samples totalling more than 100,000 people from Europe, North America and Australia (Cummins, 1995). Cummins converted each study's mean population score into the percentage of its scale's maximum. He found the combined scores formed a mean of 75.02 percentage points (pp), with a standard deviation of just 2.74pp. Subsequent data from the ongoing Australian Unity Wellbeing Index (AUWBI) project, which has involved 60,128 participants in 32 surveys over the past 16 years (Capic, Fuller-Tyszkiewicz, et al., 2018), provide further evidence of this population stability. During these 16 years, the average level of SWB of the Australian population varied less than 3 percentage points, with the mean of each survey lying between 72 and 76pp (the mean for the 16 years is 75.4).

The consistency of these data provided the basis for a proposition that homeostasis might be the underlying cause of SWB stability. However, the essential element for such a proposal is the demonstration of setpoints, corresponding with the level of SWB that is being homeostatically defended. This evidence did not emerge for a further 20 years when Cummins et al. (2014) and then Capic, Li, et al. (2018) demonstrated setpoints for SWB, within general population samples, as normally distributed and positive, lying between 70 to 90pp.

A conceptual challenge for the theory of SWB homeostasis is that SWB is not a single homogenous variable. This was first demonstrated by Davern et al. (2007), with cross-sectional data from the Australian Unity Wellbeing Index series (Capic, Fuller-Tyszkiewicz, et al., 2018). Davern et al. (2007) analysed the relationship between SWB, cognition and affect, with the choice of affects advised by the circumplex model, based on valanced and activated octants (Russell, 2003). They found that 90% of the variance in SWB was accounted for by an affective-cognitive model comprising three affects and cognitive items derived from multiple discrepancies theory (MDT; Michalos, 1985). Two later studies confirmed the role of affect, but found that MDT made little contribution after the variance attributed to affect had been accounted for (Blore et al., 2011; Tomyn & Cummins, 2011). Later research found the affective portion to be a specific blend of hedonic valence and arousal that sit between 353° and 18° on the circumplex, which is mildly pleasant and activated (Hartley-Clark, 2014, p. 183, Figure 20) . Thus, it has most recently been deduced that the three affects: happy, content, and alert, are the closest approximation to the constant affective content of SWB (Cummins et al., 2018).

Homeostatically Protected Mood

This affective content of SWB was initially described as "core affect" (Davern et al., 2007, p. 435). This term followed Russell (2003)'s description of this basic affect, as a neurophysiological state consciously accessible as the simplest raw, non-reflective feelings present in all emotion and mood. Russell's core affect was also described as "primitive, universal and simple … irreducible to anything else psychological" (Russell, 2003, p. 148). Finally, core affect was also proposed to be an underlying background affect, which Russell described as object-free or free-floating. This distinguished it from affect that is attributed to an object, which we could perhaps summarise as "I feel x because of y".

The later naming of this variable as HPMood (Cummins, 2010) was considered necessary to make it clear that the variable is a mood, not an emotion. Emotions are transient, may be strong or weak, and represent a response to a percept or the affective component of a memory (Ekkekakis, 2013; Holland & Kensinger, 2010). Mood, on the other hand, is an unchanging, weak, diffuse, non-specific affective state (Ekkekakis, 2013). HPMood is abstract and refers to the most basic general feelings about the self (Cummins, 2016b). Thus, it is proposed HPMood comprises the combined affects, "happy, content and alert" as the simplest, unchanging, non-reflective, feeling. HPMood is hard-wired for each individual and represents the tonic state of affect that provides a source of non-specific, activation energy, or motivation for behaviour (Cummins, 2010).

Crucial to this understanding is HPMood is an affective state not attached to a situation or event (Cummins, 2016b). However, this state can co-exist with other states of attention, such as mindfulness, or even absorption in a cognitive task, as in these instances the attention is focused on the object, not the affect.

The level of HPMood reflects the individual's SWB setpoint (Capic, Li, et al., 2018). Thus, providing there is no contamination in consciousness obscuring access to HPMood, when someone is asked to subjectively rate their wellbeing, they will draw upon this mildly-pleasant, free-floating affective state to influence their answer (Cummins et al., 2018).

Since, in its purest form, HPMood is devoid of both emotion and cognition, by its nature, it is also devoid of the broader narrative self-reference, which is generated by the development of a personal story to explain emotional responses to stimuli (Farb et al., 2007). The experience of this setpoint, without the influence of concurrent emotion, is the conscious experience of a mildly positive and activated mood; or a sense of what we call *moodfulness.* True to its nature, *moodfulness* is usually encountered as a mild background context to momentary experience. The purpose of SWB homeostasis, then, is to protect our sense of *moodfulness*. However, being moodful does not mean that the only affect in consciousness is HPMood. Normally, an individual's moment-to-moment conscious access to this underlying, affective state will be obscured by the coincident presence of emotion.

Measuring HPMood

HPMood normally co-exists with emotion in consciousness. However, since emotions are normally stronger than moods, responses to momentary levels of SWB tend to reflect the level of emotion in consciousness, rather than the underlying mood. Thus, the changing levels of SWB reflect the influence of emotion. The influence of HPMood is also contained within each SWB response, even though it is normally invisible within cross-sectional data. However, the presence of HPMood can be demonstrated by using longitudinal data.

With such data, contamination can be statistically removed through covariance, as demonstrated by Cummins et al. (2014) and confirmed by Capic, Li, et al. (2018). The procedure examines the within-person standard deviation of SWB scores over time. The logic, then, is that the emotional content is responsible for the variation in longitudinal SWB data, while the HPMood component remains constant. Thus, at the level of each individual respondent, using an iterative process, SWB values lying beyond two within-person standard deviations are considered outliers caused by emotion, and progressively eliminated. This procedure is repeated until no outliers are detected. Then, the mean SWB of the remaining scores is considered to approximate the level of HPMood for that person. A full description of the process is provided in the two above publications.

Independent confirmation of the differential role of SWB and emotions comes from a meta-analysis. Houben et al. (2015) report an inverse association between wellbeing and the degree of change in emotion over time. They analysed change over time as the amount of variability, instability, and inertia in the psychological wellbeing scores, and found effect sizes (measured as backward-transformed correlations) of between .15 and .20 for the change indicators. As the authors point out (p. 922), this pattern is consistent with psychological wellness being characterized by homeostatic control. Put another way, psychological dysfunction, in this context, can be interpreted as emotional fluctuations in reporting SWB and, when extreme, indicate homeostatic defeat.

These results are echoed in other research which specifically investigates the relationship between depression and resilience using ecological momentary assessments and the mathematical construct of “critical slowing down” (CSD),

which suggests that the time lag between perturbation and recovery is indicative of systemic resilience – the longer it takes for a perturbation to be regulated, the lower the resilience (van de Leemput et al., 2014; Wichers et al., 2016). These studies, which measure CSD through autocorrelations and variance between elements of the system, conclude that emotion variability is an indicator of low resilience, and thus an early warning of depression.

Homeostatic Resilience

The homeostatic system that protects HPMood is proposed to operate using the same broad principles as within physiology, in which effector responses counteract perturbations in the managed variable, here SWB. These principles are extensively described elsewhere (Cummins, 2016b, 2017), and will be summarised here, with an emphasis on those processes that overlap with current understanding of mindfulness mechanisms.

When SWB homeostasis is threatened, defensive cognitive strategies such as self-esteem, perceived control and optimism (Cummins & Nistico, 2002) are part of the immediate automatic response. Each of these are "positive buffers" that are in "intimate, conscious interaction with momentary experience" (Cummins & Wooden, 2014, p. 227) and are strongly perfused with HPMood (Lai & Cummins, 2013). When these resources are activated, there is a change in perspective of the challenging event and the meaning it has for the self. Thus, these could be further investigated to determine whether they echo the previously described cognitive mechanisms involved in mindfulness practice, in particular, reappraisal and decentering, which separate the notion of "self" from negative stimuli (Shapiro, 2009). From the perspective of homeostasis theory, these cognitive mechanisms protect the inherent positivity of HPMood. From the

perspective of mindfulness practice, these processes are also described in homeostatic terms, with the suggestion that they lead to self-regulation (Shapiro et al., 2006; Tang et al., 2015). Although these processes are largely conscious, and in the case of mindfulness practices deliberately so, they also involve the underlying long-term automatic processes of habituation and adaptation.

Habituation and Adaptation

Habituation is the process by which a system decreases its response to a specific stimulus after repeated exposure (Rankin et al., 2009). It is a function of primitive learning that has been described as a "fundamental form of behavioural plasticity" (Thompson, 2009, p. 3). In the context of SWB, it is the mechanism by which an individual learns to tolerate mild-to-moderate persistent stressors, such that the event that once caused significant distress (for example, a diagnosis of a chronic disease) over time loses its power to dominant consciousness, and so SWB.

Habituation is also the underlying cognitive mechanism involved in exposure therapies, in which a feared negative stimulus is habituated. Such therapies are generally effective in the treatment of anxiety disorders and post-traumatic stress disorder (Myers & Davis, 2007; Watkins et al., 2018). As has already been discussed, there is growing evidence that emotional exposure, and subsequent extinction of habitual emotional reactions, is the mechanism by which mindfulness reduces emotional distress (Uusberg et al., 2016). Therefore, both mindfulness and SWB homeostatic resilience involve the process of exposure; propositions that could be further tested in future research.

Adaptation is also automatic, and often unconscious. It is a process by which challenging experiences are internally assessed and contrasted with prior

experience, which reduces the perceived intensity of the experience. In the SWB literature, adaptation has mostly been referred to as hedonic adaptation, and is described as the process by which people typically acclimatise to events or stimuli that initially provoked intense positive or negative emotional responses (Armenta et al., 2014; Lucas et al., 2003; Luhmann & Intelisano, 2018). This form of adaptation is best understood through Adaptation Level Theory (Helson, 1964), which has been used to explain both sensory adaptation (adapting to the presence of a foul odour) as well as adaptation to affective states. Affective adaptation explains how the emotional effects of a positive or negative experience attenuate over time (Frederick & Loewenstein, 1999; Lyubomirsky, 2010).

While the adaptation process is largely automatic, it can also involve consciousness by directing attention away from the experience (Frederick & Loewenstein, 1999, p. 302) and, in this regard, has resonance with the process theory of emotion regulation (Gross, 2015b). Adaptation theory has also been used to describe the role of increased attention to the challenging event, a technique emphasised in mindfulness practice. According to Wilson and Gilbert (2008), attention allocation creates appraisal, accommodation and cognitive assessment, until the negative affect is “explained away”. While these authors do not consider mindfulness in this context, the process they identify has similarities with mindfulness attention, reappraisal, and emotion regulation discussed earlier. The similarities between mindfulness mechanisms and SWB habituation and adaptation deserves further investigation.

In summary, mindfulness mechanisms include positive reappraisal, exposure, and decentering, all of which have been previously described. Not only have these mechanisms been implicated in recovery from depression (Fresco et

al., 2007; Hayes et al., 2007; Segal et al., 2019; Troy et al., 2010), but they are similar to the cognitive mechanisms and habituation that are part of SWB homeostasis. Mindfulness creates a "mental gap" between awareness and its objects (Brown et al., 2007, p. 216), or "a 'space' between one's perception and response" (Bishop et al., 2004, p. 232). It effectively holds at bay the force of the *emotional* content, thus allowing the underlying *mood* (HPMood) to emerge to awareness, as the affective residue achieved while experiencing a general state of equanimity. We have described this as the experience of *moodfulness*, with *moodfulness* defined as conscious access to HPMood. This picture of *moodfulness*, however, is incomplete without an understanding of the relationship between SWB homeostasis and depression.

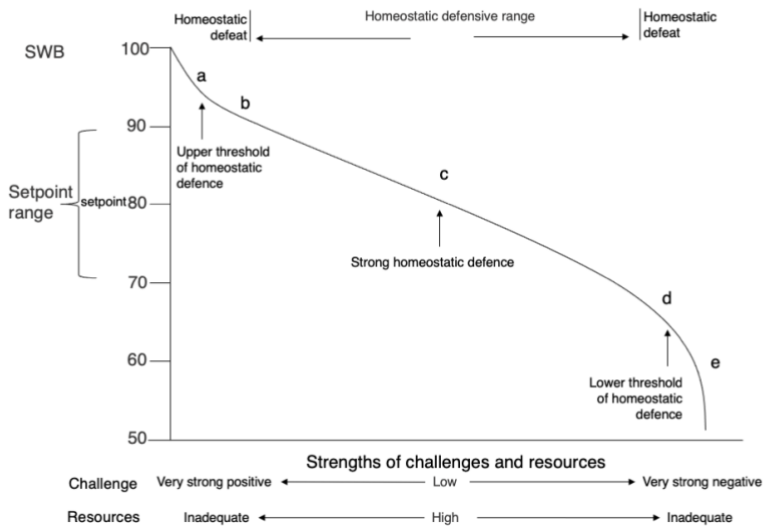
SWB Homeostasis and Depression

SWB homeostasis can withstand some modest level of challenge through the deployment of defensive resources. However, when the strength of challenge exceeds homeostatic capacity, homeostasis is defeated. In such cases, measures of HPMood and SWB will be flooded with emotional content, and SWB will move outside its setpoint range. Moreover, SWB will remain outside the range until homeostatic control is re-established.

The sum of these processes causes the relationship between SWB and challenging agents to be non-linear, as shown in Figure 1.

Figure 1

Changing levels of SWB as homeostasis is challenged.



Note: Adapted from Cummins (2016). The ordinate represents the level of SWB in percentage points. The lower abscissa depicts the competing levels of both homeostatic challenge and resources. The upper abscissa depicts the homeostatic defensive range. The curved line represents the changing level of SWB as it moves down from: (a) homeostatic defeat resulting from an overwhelming positive challenge; (b) (c) (d) represent the margins of homeostatic control around the illustrative setpoint (in this example, 80pp); (e) to homeostatic defeat resulting from an overwhelming negative challenge.

The theory of SWB homeostasis explains not just SWB stability, through the defence of HPMood, but also change. As such, it is an evolution from earlier theoretical notes relating to happiness setpoints (e.g.,Lykken & Tellegen, 1996), which assumed, without empirical support, that movements of SWB away from their setpoint were necessarily temporary, such that the level of SWB would always return to setpoint. This idea of impermanence has been commonly repeated in critiques of SWB setpoints, although recent reviews have recognised that complex dynamics involving stability and change are involved (Luhmann & Intelisano, 2018). For its part, homeostasis theory proposes that long-term change

in SWB is caused by the persistent domination of challenging conditions over resources. This is an important aspect of understanding because some researchers have erroneously interpreted long-term change in SWB as evidence that setpoint theories have been "falsified" (Headey & Muffels, 2018, p. 862). Such declarations misunderstand homeostatic theory. Long-term change in SWB indicates a failure of resources, not of theory. Theoretically, long-term changes representing homeostatic defeat can occur at both ends of the SWB scale – that is, both extremely high, and extremely low, levels of SWB can indicate homeostatic failure. Homeostatic defeat at the high end is not the subject of this review. When those long-term changes indicate a chronic failure of homeostasis at the low end, the likely implication is depression (Cummins, 2010).

The formal diagnosis of a major depressive episode involves the experience of persistent low mood and/or loss of pleasure in formerly pleasurable activities (American Psychiatric Association, 2013). It seems intuitive, therefore that such symptoms would equate to low levels of life satisfaction and wellbeing. At a broad level, the proposed inverse relationship finds ready support from the life satisfaction and wellbeing literature. For example, Headey et al. (1993) found depression and life satisfaction to be separate, yet highly negatively correlated (~-0.6) constructs, while Friberg and Melin (1996) found a linear negative relationship between the number of self-reported depression symptoms and a quality of life measure which includes subjective assessments of mood and energy. There is also emerging evidence of shared genetic influences on both psychopathology and levels of wellbeing or life satisfaction (Kendler et al., 2011; Nes et al., 2013). Moreover, both large-sample population studies (Strine et al., 2009) and longitudinal studies (Rissanen et al., 2011) have reported that low

levels of life satisfaction are associated with later episodes of depression. Results such as these have encouraged researchers to question whether SWB measures can form a screening tool for risk of depression (Bartels et al., 2013).

Further exploration of the relationship between SWB and depression, must however, confront two crucial methodological issues. The first involves nomenclature. As has been discussed, homeostatic theory concerns the infusion of mood, specifically HPMood, into SWB. Thus, while many instruments purport to measure "quality of life" or the like, unless they specifically assess a subjective reflection of mood or affect, they are unlikely to be measuring SWB. One well-studied SWB instrument that has reliably demonstrated the infusion of HPMood is the Personal Wellbeing Index (PWI: International Wellbeing Group, 2013), and so this index features strongly in the following discussion.

The second issue involves the failure of most analyses to recognise the predicted non-linear relationship between levels of SWB and depression. Homeostasis theory predicts that the relationships will plateau, as resources rise to protect SWB from the challenge (see Figure 1). This plateau should be evident for mild levels of challenge (Cummins, 2010). Empirical supporting evidence comes from Bittar (2009). Analysing cross-sectional PWI data, she demonstrated that while levels of SWB dropped as depression ratings increased, this fall was slight as depression increased from moderate to severe levels, before dropping more steeply as depression scores reached extremely severe (p. 130). She proposed that the PWI was as reliable an indicator of depression as other common depression screening measures.

A reasonable conclusion from these results is that low level SWB and indicators of depression are linked. However, a more determined understanding

of the relationship between SWB homeostatic defeat and depression requires a longitudinal study that could first establish the active relationship between SWB and depression symptoms while in homeostatic defeat.

In summary, there is certainly a relationship, at some level, between depression and homeostatic defeat. It therefore follows that the provision of additional homeostatic resources would be effective interventions for depression, by enabling the homeostatic system to better counter a challenge. If such support was sufficient to enable SWB to enter its setpoint range, then the homeostatic system would resume automatic control over negative emotions. If, however, these resources remain inadequate to deal with the level of challenge, then emotion will continue to dominate the conscious awareness of SWB. Therefore, the process by which such homeostatic defeat is restored may be by either, or both of, the weakening of the emotional reaction and the recruitment of homeostatic resources. Mindfulness aids in both processes.

Moodfulness: A synthesis

To date, mindfulness has not been considered in the context of SWB homeostasis theory. However, a possible synthesis of these two bodies of research is as follows and is demonstrated in Figure 2. When SWB is within its setpoint range, HPMood, as a mildly pleasant, free-floating affective state, effectively contributes to the experienced level of SWB. Emotion is normally also present but does not dominate the subjective experience of wellbeing. However, as emotions become stronger, homeostatic control is challenged. As emotion strength continues to rise, it generates strong and concomitant cognitions such as rumination, worry, etc. As such, emotions begin to dominate consciousness, and increasing pressure is placed on the subjective experience of wellbeing to shift—

acutely or chronically—away from its HPMood setpoint. The more SWB moves away from setpoint, the more conscious access to HPMood is reduced.

Resources, including cognitive mechanisms such as positive buffers, habituation, and adaptation, are homeostatically employed to counter such perturbations. If these counter measures are successful, homeostasis is maintained. If, on the other hand, such resources are insufficient to overcome the stressors, emotional dysregulation continues, and SWB plummets below its setpoint range as homeostasis is defeated. This defeat leads to an increased risk of depression.

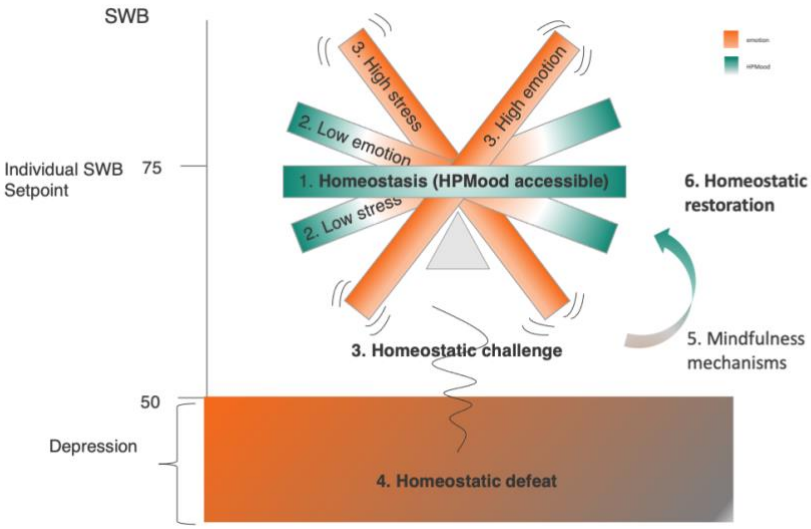
Mindfulness acts as a circuit breaker in this downward spiral through the application of attention, emotion, and physiological regulation mechanisms, including reappraisal and exposure. Through these regulatory mechanisms, mindfulness reduces the intensity of the *emotional* content and assists in extinguishing maladaptive *cognitive* responses. Both self-focused emotion and cognition ("I am not good enough", "I feel sad because I have no friends"), are transcended into mental phenomena or body sensations that are accompanied by curiosity rather than reactivity: in other words, they are met with equanimity. Such engagement, framed within the context of non-judgemental awareness, enables the partial or complete separation of the attribution of the distress to a situation, object, or the self.

The successful result of these processes, over time, is to regenerate a state of consciousness which allows the underlying *mood* (HPMood) to resurface as an active component of SWB. That is, a return to the experience of *moodfulness*, as the normally functioning state of consciousness, under conditions where emotion and cognition do not chronically overpower HPMood. Equanimity, then, is an

outcome of the mindfulness processes engaged to dampen the overpowering mental content. Equanimity is the cognitive (non-judgemental) and affective (peaceful) experience of HPMood: the state of *moodfulness*.

Figure 2

The relationship between stress, mood homeostasis and depression, and the proposed role of mindfulness in restoring homeostasis, or moodfulness.



The process is summarised as follows. 1: When SWB homeostasis is operating, SWB rests within its setpoint range, in this example 75 pp, and HPMood dominates consciousness. 2: Stress, introducing emotion into consciousness, creates perturbation and disturbs homeostasis, however homeostatic mechanisms retain control and HPMood remains accessible to consciousness. 3. When stress and emotion levels are high, homeostasis is challenged and HPMood is no longer consciously accessible. 4: Homeostasis fails, SWB plummets and depression is likely. 5: Mindfulness mechanisms of decentering, exposure, and extinction, create equanimity, diminishing the dominance of emotion; and, so, the levels of psychological stress, 6. ultimately restoring conscious access to HPMood, or moodfulness and returning SWB to its setpoint range.

Future Directions

The *moodfulness* model offers new understanding for the interaction between mindfulness and the homeostatic mood system. It explains how exposure, cognitive reappraisal and emotion regulation are central to the effectiveness of mindfulness as a treatment for mood disorders, particularly depression. It thereby integrates mindfulness with the theory of SWB homeostasis, which explains both stability and change in SWB. However, areas that warrant further consideration include the following.

First, Buddhist philosophy assumes the path to happiness, or the alleviations of suffering can be cultivated (Wallace & Shapiro, 2006), and that mindfulness practice (along with other components of the religious path) leads to the cultivation of *nirvana*, which has been described as a state of "transcendent bliss and peace" (Bodhi, 2011, p. 21). At first consideration, these might contradict the model. However, these two concepts are compatible with *moodfulness* when the cultivation of happiness is the cultivation of conditions that enable the normal experience of HPMood to emerge in consciousness. Then, the act of "cultivation" is a practice which increases conscious access to enduring HPMood, or the experience of *moodfulness*.

Second, our model focuses on the therapeutic mechanisms of mindfulness, concerning the treatment of psychological disorders. It is not proposed to explain the impact of long-term, intensive, meditation practice, such as that experienced by dedicated Buddhist monks and other practitioners who have committed to a path leading to enlightenment. For this group, mindfulness practice has been described as leading to "rapture, a form of pleasure that lies above and beyond anything that can be experienced in the normal state of consciousness"

(Gunaratana, 2011, p. 12). It is possible, given this broader view, that our model has fallen into the trap warned by Grossman and Van Dam (2011), of exploring not mindfulness per se, but a feature of consciousness that is related to mindfulness. While it is almost certainly true that HPMood cannot explain all experiences of bliss, rapture and insight that derives from long-term mindfulness practice, it can perhaps form a bridge to further such understanding.

Third, the model focuses on the cognitive and affective elements of mindfulness, omitting somatic processes. This is an issue because such processes are a core part of mindfulness training as outlined in the *Satipatthana Sutta*, the 'discourse on the Establishment of Mindfulness', a significant text in the Buddhist teaching (Bodhi, 2011). This text describes the four "establishments" (components) of mindfulness as contemplating "the body in the body … feelings in feelings … mind in mind … phenomena in phenomena" (Bodhi, 2011, p. 21). Indeed, many mindfulness practices lead to increased somatic awareness, or attention to body sensations, and the emergence of body sensations in consciousness is a core element of present-moment awareness. Such somatic awareness could form part of the stress reduction outcomes of mindfulness practice. Further insight into this possibility requires a systematic study into the relationship between physiological stress, psychological stress, and homeostatic restoration.

Fourth, we have not explored whether other psychological disorders might also involve the failure of SWB homeostasis, particularly those that involve habituated responses to stimuli, such as post-traumatic stress disorder and anxiety disorders. Given there is emerging evidence that mindfulness can provide beneficial results for these symptoms (Chiesa & Serretti, 2011; Hopwood &

Schutte, 2017; Khoury et al., 2013), knowledge about the relationship between these conditions and SWB homeostatic defeat could also help to inform our model.

Finally, a technical challenge to testing this proposed model is that while certain homeostatic defeat is indicated by a level of SWB below 50 pp (Cummins, 2010), when such an evaluation is made within a single measurement, this could indicate a short-term acute event that may only temporarily defeat homeostasis. Chronic homeostatic defeat can only be confidently concluded through longitudinal data and, at best, the establishment of individual setpoints. These requirements prescribe challenging conditions of measurement for clinical purposes.

Conclusion

The conscious state created through mindfulness practice, described as equanimity, deserves more research attention. It is intriguing that this state, which is so central to Buddhist teachings, creates a mental gap, or space in consciousness, that reduces reactivity to cognition and emotion. Such reduction, in conditions of psychopathology, could allow for the re-emergence in conscious experience of the biologically determined, mildly activated and slightly positive affect known as HPMood. This new understanding offers a practical advantage. If, as proposed, homeostatic defeat is the precursor of depression, then any activity that can restore normal homeostatic functioning can be used to aid recovery from depression. Instructed mindfulness offers such a restorative activity. Here, the associated mechanisms of exposure, decentering and reappraisal, reduce the pathological dominance of emotion and cognition in consciousness, allowing the natural homeostatic state of HPMood to emerge as

present-moment awareness. It is thus possible that investigations into the scientifically derived theory of SWB homeostasis have serendipitously led to this link with ancient spiritual practice. Such a confluence of religion, philosophy and science is an important step to better understanding of how human suffering can be eased.

Summary and Link to Chapter 3

Several questions arise from this conceptual review, including whether the proposed model of *moodfulness* can be supported by empirical evidence. However, before exploring the role of mindfulness in mood homeostasis, it is important to understand more clearly the role of the HPMood in the homeostatic system. Specifically, the nature of a theorised plateau effect (Cummins et al., 2012), by which homeostasis can withstand some pressure from challenging agents, needs to be further demonstrated. This is the objective of Study 2, which aims to identify any non-linear relationships between psychological stress, depression, mindfulness and HPMood. These questions are explored in a sample of patients with inflammatory bowel disease, a sample chosen because of the common comorbidity of psychological and physiological symptoms (Hu et al., 2021; Mikocka-Walus, Knowles, et al., 2016).

Chapter 3

Study 2: Exploring evidence for mindfulness and subjective wellbeing homeostatic resilience buffering depression symptoms associated with inflammatory bowel disease

Note: This is an edited version of the paper under review with the Journal of Happiness Studies. Edits are to respond to examiners' comments.

Abstract

People with inflammatory bowel disease (IBD) are known to experience high levels of psychological symptoms, associated with low subjective wellbeing (SWB). Most existing research assumes such relationships are linear. An alternative proposition comes from the theory of SWB homeostasis. This proposes a resilience effect, where SWB levels resist rising levels of challenge. The non-linear proposition was tested using generalised additive models (GAMs). The sample comprised people with Crohn's disease (CD: $n = 461$) and ulcerative colitis (UC: $n = 277$). Psychological symptoms (depression and stress), patient-reported disease symptoms, and levels of trait mindfulness were modelled to predict levels of homeostatically protected mood (HPMood), which is the core affective component of SWB. There was some evidence of a resilience effect buffering against depression symptoms for the CD cohort. Within this sample, the curve emerged for HPMood at around 60 percentage points. There was no evidence of this resilience effect within the UC cohort, nor was resilience apparent in the models exploring psychological stress or IBD symptoms. There was some tentative support for the role of trait mindfulness in supporting HPMood, but this was again only for the cohort of people with CD. The implications of these results are discussed.

Exploring evidence for mindfulness and subjective wellbeing homeostatic resilience buffering depression symptoms associated with inflammatory bowel disease

SWB homeostasis

The theory of subjective wellbeing (SWB) homeostasis (Homeostasis Theory: Cummins, 2016b; Cummins et al., 2012) seeks to explain a remarkably consistent finding in general population studies: people typically feel about 75% satisfied and positive about their lives (Capic, Li, et al., 2018; Khor et al., 2019). Homeostasis Theory proposes SWB is managed by a homeostatic system that is designed to maintain this normally positive state of satisfaction, even in the face of adversity or challenge. This internal system regulates levels of affective and emotional content in consciousness to protect access to an underlying, positive affect known as homeostatically protected mood (HPMood: Cummins, 2010). When that system is operating as designed, psychological perturbations, or intense emotions provoked by situational stressors, are responded to with adaptive mechanisms that enable a return to equilibrium, or homeostasis. When those perturbations are stronger than these homeostatic resources, homeostasis fails, and SWB plunges to chronic low levels, increasing the risk of psychological conditions such as depression (Cummins, 2010). However, despite data supporting Homeostasis Theory (Khor et al., 2019), the theorised relationship between psychological symptoms and SWB has rarely been investigated in clinical populations, and not at all in clinical populations where both psychological and physiological stress are involved, such as occurs in people living with inflammatory bowel disease (IBD). Additionally, there is scant research into likely behavioural mechanisms, such as mindfulness, that might

support this adaptive system. These are major research gaps, which, if addressed, could benefit both theory development and treatment models.

Central to Homeostasis Theory is the notion that the relationship between SWB and psychological challenges is non-linear, especially at the extremes of the distribution, where the impact of the stressor results in the failure of homeostasis and the loss of resilience. At the point at which homeostasis, or resilience against challenge, fails, SWB plunges. Prior research has found evidence for a theorised resilience effect prior to the collapse in SWB, and pinpointed depression as the correlating condition (Cummins et al., 2012). As depression scores moved from the moderate to severe range, the declining SWB line levelled off slightly, forming what the authors called a 'plateau effect' between about 58pp and 63pp of SWB. Beyond this level, as depression scores moved into the extremely severe range, SWB scores fell more steeply. This was interpreted as evidence for homeostatic support at around 60pp of SWB.

The role of stress in SWB homeostasis resilience and defeat has also been proposed (Cook, 2003), but not extensively explored. Stress is relevant given the known role of stress as a predictor of developing depression (Miller & Raison, 2016). Stress has been described as "the state at which homeostasis is threatened or perceived to be so" (Chrousos, 2009, p. 374) with the stress response being "the activation of a number of neurophysiological systems that help an organism cope with the actual or perceived threat or loss of homeostasis" (Domes & Frings, 2020, p. 73).

Inflammation is a core feature of the body's stress response system (Robles et al., 2005). Immuno-biologists commonly consider inflammation as an indicator of homeostatic defeat (Chovatiya & Medzhitov, 2014) and there is

growing evidence that immune system mediators are associated with levels of SWB (Diener, Pressman, et al., 2017). Increasingly, researchers are investigating the relationship between stress, depression and dysregulation of the immune system that accompanies inflammation (Robles et al., 2005; Slavich & Irwin, 2014) with recent research proposing inflammation reduction as a modern treatment target for depression (Miller & Raison, 2016).

A similar process may be involved in SWB homeostatic defeat: with stress indicative of homeostasis under challenge, and depression forming the outcome of failed SWB homeostasis. Mood homeostatic defeat might therefore also be associated with the physiological manifestation of stress dysregulation, or inflammation. One way to explore this further is to identify an inflammatory condition known to be associated with both stress and depression. One such condition is inflammatory bowel disease (IBD).

Inflammatory Bowel Disease

IBD is a banner term for two chronic and incurable inflammatory conditions: Crohn's disease (CD) and ulcerative colitis (UC). Although they are often studied together, the conditions have different characteristics. UC is generally restricted to inflammation of the colon or rectum, while CD can affect any aspect of the digestive system (Lang, 2020; Le Berre et al., 2020). IBD symptoms include abdominal pain, diarrhoea and rectal bleeding (Abautret-Daly et al., 2018). IBD is increasing in incidence and prevalence across ethnic groups and geographies (Baumgart & Sandborn, 2012; Ng et al., 2017).

Many patients report that their IBD flares are precipitated by stress (Larsson et al., 2017); and there is growing evidence of significant relationships between psychological stress and IBD outcomes (Cámara et al., 2009). Increasing

knowledge about stress's impact on the autonomic nervous system, the enteric nervous system, the immune system and in the gut (for reviews, see Bonaz & Bernstein, 2013; Konturek et al., 2011; Sinagra et al., 2020) has supported questions about whether stress management should be a part of IBD treatment (Goodhand et al., 2009; Knowles & Mikocka-Walus, 2015; Triantafillidis et al., 2013).

Depression is also implicated in IBD. People with IBD have been found to have higher prevalence of depression than healthy controls, with the prevalence rising for those with active disease symptoms (Barberio et al., 2021; Mikocka-Walus, Knowles, et al., 2016). A nine-year study of more than 2000 people with IBD reported significant associations between depression symptoms and disease recurrence, with depressed patients having a shorter time to a disease episode than participants without psychological symptoms (Mikocka-Walus, Pittet, et al., 2016). The direction of the relationship remains unclear. A retrospective cohort study using 26 years of UK health department data concluded people who had incident depression had a significantly greater risk of later developing IBD, after controlling for demographic and comorbid conditions (Frolkis et al., 2018). There is evidence suggesting that depression predicts IBD development if associated gastro-intestinal symptoms are involved (Blackwell et al., 2020). However, a systematic review of longitudinal studies determined the opposite direction: raised inflammatory markers were associated with later episodes of depression (Valkanova et al., 2013). The reasons for these bidirectional findings may be explained by common biological underpinnings. Both IBD and depression activate the immune-inflammatory, oxidative and nitrosative stress pathways, with evidence of the common involvement of pro-inflammatory cytokines

(Martin-Subero et al., 2016). Increasingly, these cytokines are thought to have a role in inducing depression, and medical treatments for depression are targeting inflammation (Maes et al., 2012).

Despite the extensive interest in psycho-social outcomes of people with IBD (Ho et al., 2019; Lönnfors et al., 2014; Polak et al., 2020), to date there has been no research how psychological and physiological symptoms of IBD interact with SWB homeostasis. This is a major research gap because of the theoretical framework which SWB homeostasis theory can provide: stress and inflammation can be understood to challenge mood homeostasis such that resilience is lost, homeostasis is defeated, and psychological symptoms overwhelm SWB. Notwithstanding this research gap, the high levels of co-morbidity of depression and IBD have led to an increase of research into appropriate psychological treatments for people with IBD (Gracie et al., 2017; Knowles & Mikocka-Walus, 2015; von Wietersheim & Kessler, 2006) and evidence that such treatments reduce costs, particularly through reduced emergency department visits (Lores et al., 2021). Increasingly, IBD treatments include those that target psycho-social factors, such as mindfulness.

Mindfulness and IBD

Despite emerging evidence that mindfulness can reduce stress and inflammation (Ludwig & Kabat-Zinn, 2008); evidence of the role of mindfulness in IBD populations is mixed (Hood & Jedel, 2017; Langhorst et al., 2015). One review reported few effects (Hood & Jedel, 2017), however, small mindfulness studies of patients with CD (Schwartz et al., 2019) and UC (Mazaheri et al., 2020) provided some evidence of reduced subjective stress. A feasibility study of mindfulness with adolescents and young people with IBD found the participants

perceived the intervention to be acceptable and effective (Ewais et al., 2020). Further, a recent randomised control trial showed that a mindfulness intervention could improve IBD biomarkers, while another study has found dispositional mindfulness to mediate the relationship between IBD disease symptoms and quality of life and perceived stress (Navarrete et al., 2021). However, the lack of robustness of the research to date means that some positive results can be best described as tentative (Black & Slavich, 2016).

A clear picture is yet to emerge about the mechanisms of mindfulness involved in improvements in psychological symptoms (de Vibe et al., 2017; Van Dam et al., 2018). A novel suggestion is that mindfulness could play a role in the restoration of HPMood homeostasis (Lyall, Mikocka-Walus, et al., 2021). Because HPMood is the underlying variable which SWB homeostasis defends (Davern et al., 2007), mechanisms that support access to HPMood are likely to support SWB homeostasis in times of stress. Mindfulness, and its outcome state, equanimity, (Desbordes et al., 2015) could play a role to support SWB homeostasis. If this is the case, there should be evidence that mindfulness supports the maintenance of SWB at within the healthy range.

SWB: HPMood and emotion

Homeostatic Theory provides a basis for understanding SWB as largely an affective construct, comprising both situationally-infused emotion, as well as the underlying, biologically determined HPMood (Cummins et al., 2012; Davern et al., 2007). The emotional content represents the reported variation in levels of SWB. This is because emotions relate to specific events (one feels something about something) and by design, these dominate consciousness and attention (Ekkekakis, 2013). When emotion is present, access to the underlying, positive

affect of HPMood, is obscured. The purpose of homeostasis is to defend this affective core, so that it permeates conscious experience (Tomyn & Weinberg, 2018).

For our aim to understand the relationship between homeostasis and psychological symptoms, it is necessary to measure, as accurately as possible, the levels of HPMood available to conscious experience. Therefore, as far as possible, measures of cognitive evaluations, as well as situationally infused emotions, need to be avoided. While it is not possible to accurately measure only HPMood, due to the concurrent presence of emotion, it has been found that three affects—happy, content, alert—approximate HPMood (Blore et al., 2011; Davern et al., 2007; Tomyn & Cummins, 2011). HPMood is thought to be an underlying, constant variable, which, like SWB, is subject to individual setpoints. At a population level these range from 70 to 90pp (Capic, Li, et al., 2018). In sum, HPMood is the most appropriate measure for our purposes as it relates to subjective levels of the underlying affect that SWB seeks to defend (Cummins, 2010). The pertinent value is between 50 and 60 pp, as these values represent one or two standard deviations below the mean for general populations (Khor et al., 2020). Therefore, the relationship between HPMood and the levels of psychological symptoms should form a resilience effect at around this level despite increasing levels of challenge, until a point at which the challenge overwhelms homeostasis leads to a steeper decline.

Generalised Additive Models

An appropriate statistical technique for examining non-linear relationships employs generalised additive models (GAMs). GAMs estimate flexible curvilinear relationships between predictor covariates and outcome variables by

allowing the data to determine the line of best fit (Hastie & Tibshirani, 1986; Wood, 2017). Thus, GAMs identify shapes in the data that demonstrate if a resilience effect is evident in the relationships between variables.

Research questions and hypotheses

This study aims to understand whether the relationship between HPMood and psychological and physical symptomatology for patients with IBD is non-linear. It is hypothesised that psychological and IBD symptoms will form non-linear relationships with HPMood, with a resilience effect forming at around the lower levels of the sample's HPMood distribution. It is also hypothesised that, of the psychological symptoms, stress will most clearly demonstrate this resilience effect.

Further, that trait mindfulness will similarly form a non-linear relationship with HPMood.

Methods

Design

A cross-sectional survey was conducted.

Participants

Participants were recruited through on-line support groups for people with IBD in Australia, which asked for participants aged over 18 who had a diagnosis of Crohn's disease or ulcerative colitis. The final sample was 739.

Measures

HPMood, Depression and Stress

Homeostatically protected mood (HPMood) involves rating the level of three affect items, happy, content and alert (Capic, Li, et al., 2018). The questions were framed: "Please indicate how you generally feel each day. In general, I feel

…". These items demonstrated a Cronbach's alpha of 0.90. Total scores for HPMood were standardised to the 0-100 pp scale. The depression and stress items were each 4 items taken from the depression and stress sub-scales of the Depression, Anxiety and Stress Scales (DASS: Lovibond & Lovibond, 1995). These were, for depression: "I couldn't seem to feel any positive feelings", I felt that I had nothing to look forward to", I felt down-hearted and blue," and I felt I wasn't worth much as a person". For stress: "I found it hard to wind down", I found myself getting agitated", "I found it difficult to relax", "I felt that I was rather touchy". The items were chosen from each of the depression and stress sub-scales to reduce participant burden. An exploratory factor analysis indicated the items loaded on to two factors as expected, with no cross-loadings greater than .4, and thus the items chosen were determined to have an acceptable factor structure. Participant scores were converted to a percentage of scale maximum to enable comparison with the full scale. The anxiety sub-scale was not used as anxiety did not form part of our hypotheses. In this sample, Cronbach's α for HPMood was 0.85; for stress, 0.83; and depression, 0.90.

IBD disease symptoms

IBD disease symptoms were measured by separate patient-reported outcome instruments for patients with CD and UC (CD-PRO: Higgins, Harding, Leidy, et al., 2018a; UC-PRO: Higgins, Harding, Revicki, et al., 2018b). Each instrument includes two sub-scales measuring bowel symptoms and abdominal functioning, with higher scores referring to more frequent symptoms. Example items are: "over the last 24 hours, how many bowel movements did you have?" and "over the past 24 hours, did you have mucus in your bowel movements?" In this sample, Cronbach's α for the CD bowel data was 0.74 and the UC Bowel

data was 0.80. These results replicated the scales' validation studies. Cronbach's α for the abdominal functioning items 0.58 for CD and 0.63 for UC, lower than that achieved by the scale validation studies (.67 and .66 respectively).

Total scores for the CD-PRO and UC-PRO were calculated according to the scale authors' instructions, that is, each of the items in the bowel and abdominal functioning scales were summed and averaged into the separate scale total.

Mindfulness

Mindfulness was measured using the "acceptance" facet of the Philadelphia Mindfulness Scale (PHLMS: Cardaciotto et al., 2008), following analysis by Zeng et al. (2015) that this scale most represents the construct of equanimity. The PHLMS acceptance facet measures trait levels of mindful acceptance; that is, as an attribute that exists as an individual difference and is not dependent on or related to mindfulness training. Items involve five-point scales and are all reverse-scored. Example questions include: "I try to put my problems out of my mind" and "when I have a bad memory, I try to distract myself to make it go away". The sample's Cronbach's α was 0.90.

Statistical Analyses

SPSS version 26.0 was used for preliminary analyses. The package mgcv in the softwareR (R CoreTeam 2014) was used to fit the GAMs and alternative models. GAMs model non-linear relationships through a series of functions known as 'basis' functions. The model uses these basis functions to estimate a smooth function that best represents the pattern of the data. GAMs are interpreted through their effective degrees of freedom (EDF), which represent the complexity of the smooth function. An EDF close to one is equivalent to a straight line. EDFs

of increasing value indicate greater curvature. GAMs were fitted via restricted maximum likelihood and upon examination were found to have an adequate number of basis functions and no evidence of concurvity (See Wood, 2017, for details of these tests).

Due to the nature of the bowel and abdominal symptom scales, separate GAMs were conducted according to IBD diagnosis. HPMood was the outcome variable. All covariates of interest were included in each model: stress, depression, bowel symptoms, abdominal functioning, mindfulness. Demographic variables: age, income and gender were also included. Missing data were determined to be missing completely at random; for the GAM models only complete cases were used.

Our analysis examined (a), whether the smoothed function from each of these models was statistically significant (i.e., suggesting there was some non-zero relationship between the psychological symptoms and HPMood), and (b) the magnitude of the EDF (i.e., higher values suggesting increased complexity of curvature). As recommended by others (Ross, 2019), we (c) compared whether fitting a GAM was a better fit to the data than simply fitting a linear regression model (LM) to the same data. Comparisons of fit were based on identifying the model with the smaller Akaike Information Criterion (AIC) value. According to Burnham and Anderson (2004), when comparing more than one model, the model with the lower AIC value is better fitting, but differences in AIC levels of less than 10 points may be considered negligible. Preferred models can also be determined by the model that produces a larger proportion of adjusted R^2.

Ethical Considerations

Ethics approval was obtained through the Deakin University human research ethics committee (approval HEAG-H 66_2019). All participants consented to the research.

Results

Descriptive Statistics

Most of the sample (85.6%; *n* = 625) were female. Age ranged from 18 to 78 (*M* = 37.86; *SD* = 11.98 years). People diagnosed with CD made up almost two-thirds of the sample (CD; *n* = 461: 62.4%; UC: *n* = 277, 37.5%). Almost half (43%) said they had another chronic health condition. Most (67%) received their IBD diagnosis more than five years ago.

Pearson correlations are shown in Table 1. As expected by theory, HPMood was negatively correlated with the depression and stress scores, and with bowel and abdominal symptom scores.

Trait mindfulness displayed small to medium correlations with each of the other measures.

Table 1

Pearson correlations

	HPMood	Depression	Stress	Mindfulness	Bowel
Depression†	-.59***				
Stress†	-.43***	.66***			
Mindfulness	.38***	-.50***	-.53***		
CD					
-Bowel	-.31***	.28***	.19***	-.23***	
-Abdominal	-.28***	.25***	.30***	-.29**	.33***
UC					
-Bowel	-.29***	.21***	.23***	-.13*	
-Abdominal	-.20**	.20**	.21**	-.21**	.40***

Note: *n* varies due to pairwise deletion and ranges from 675 to 739. *** significant at $p < .001$ level. † Depression and Stress items are a subset of the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995)

Means and standard deviations are shown in Table 2. Participants were experiencing higher levels than shown in normative data for both depression and stress, with large effect sizes (Hedge's *g*: 1.13 and 1.30 respectively). Participants' mean scores on the trait mindfulness measure were slightly below the normative data, with a small effect size (Hedge's *g*: -0.24).

Table 2

Means and Standard Deviations

Variable	*n*	*M*	*SD*	Norm *M**	Norm *SD**	Mean difference	Hedges *g*	Hedges *g* 95% CI
HPMood	726	55.84	18.07	n/a	n/a			
Depression	730	36.01	24.69	15.09	16.59	20.92	1.13	1.05, 1.22
Stress	730	49.61	22.75	24.07	18.83	25.54	1.30	1.21, 1.38
CD-Bowel	459	1.92	1.03	n/a	n/a			
CD-Abd	461	1.89	0.78	n/a	n/a			
UC-Bowel	274	1.41	0.93	n/a	n/a			
UC-Abd	276	1.85	0.81	n/a	n/a			
Mindfulness	716	28.5	7.51	30.19	5.84	-1.65	-0.24	-0.35, -0.13

* Depression and Stress were compared to the Depression Anxiety and Stress Scales, (Lovibond & Lovibond, 1996, p. 28, converted to percentage of scale maximum, n = 2914); Mindfulness is the Acceptance facet of the PHLMS, Cardaciotto et al. (2008, p. 211, n = 559)

Generalised Additive Models

Table 3 outlines whether each of the independent variables had a non-zero relationship with the outcome and presents the effective degrees of freedom (EDF), which represents the complexity of any non-linear associations. Results varied across disease condition. In both models, depression was a significant predictor of HPMood. In the CD subsample, the relationship between the predictor variables and HPMood show higher levels of curvilinearity, with depression, bowel symptoms and mindfulness all showing EDF values higher than 1, indicative of non-linearity. This was not the case for the UC subsample.

Results largely indicated that the relationships are linear, with a small, non-significant exception for stress in the HPMood model.

Table 3

Psychological and physiological predictors of HPMood

Crohn's Disease	EDF	F stat
Depression	3.09	26.59***
Stress	1.00	0.78
CD-bowel	2.26	2.30
CD-abdominal	1.00	7.15**
Mindfulness	2.88	1.08
Ulcerative Colitis		
Depression	1.00	35.01***
Stress	1.44	1.06
UC-bowel	1.00	1.91
UC-abdominal	1.00	0.78
Mindfulness	1.00	4.25*

Crohn's disease (CD) $n = 363$, ulcerative colitis (UC) $n = 227$. *** $p < .001$, ** $p < .01$. Model adjusted for age, income, and gender. EDF = effective degrees of freedom (EDF = 1 indicates a linear relationship; EDF > 1 indicates a non-linear relationship).

A visual inspection of the partial effects plots was conducted. Partial effects plots graphically illustrate the relationship between each variable and the outcome variable, while holding co-variates at their means. Partial effects for the CD model are shown in Figure 1 and for the UC model is shown in Figure 2. The partial effects plots confirm that depression, bowel symptoms and mindfulness for the CD subsample form non-linear relationships with HPMood. In Figure 1a, the rate of decline in HPMood for the CD subsample increases more starkly when depression scores are high. The critical point, at which linearity is lost, is when depression scores are around 60pp, which corresponds to HPMood values of slightly below 60pp. A visual inspection of the non-linearity present for Bowel symptoms (Figure 1c), shows a slight uptick of HPMood values at high levels of Bowel symptoms. The mindfulness relationship was also non-significant,

however, the shape shown in Figure 1e indicates that low levels of trait mindfulness were associated with low levels of HPMood. As trait mindfulness levels increased, HPMood became relatively stable at around 60pp, and did not increase further with higher trait mindfulness.

As shown in Figure 2, all the partial effects plots for the UC subsample demonstrate linear relationships with HPMood.

Figure 1

Partial effects plots for the smoothed terms predicting HPMood for patients with Crohn's disease: a) Depression, b) Stress, c) Bowel symptoms, d) Abdominal symptoms, e) Mindfulness.

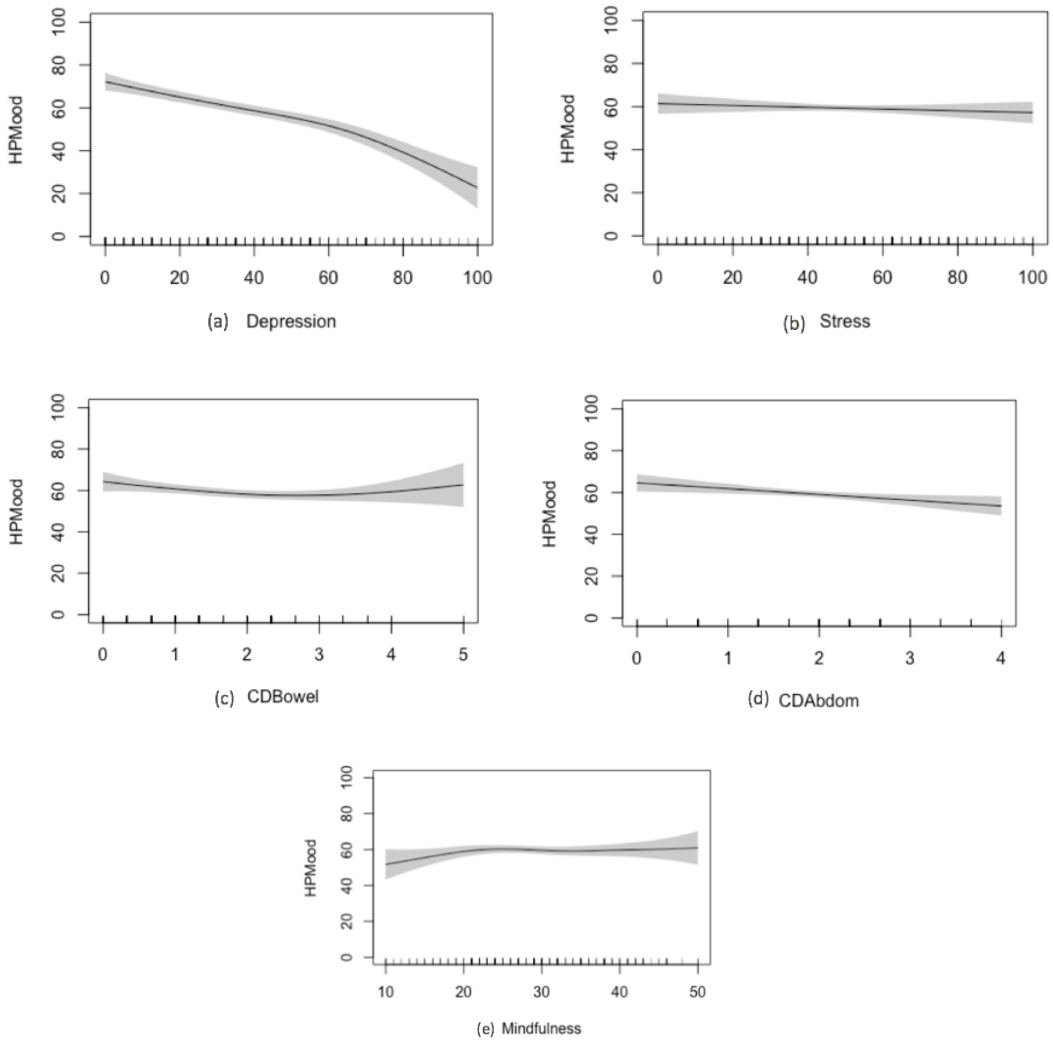
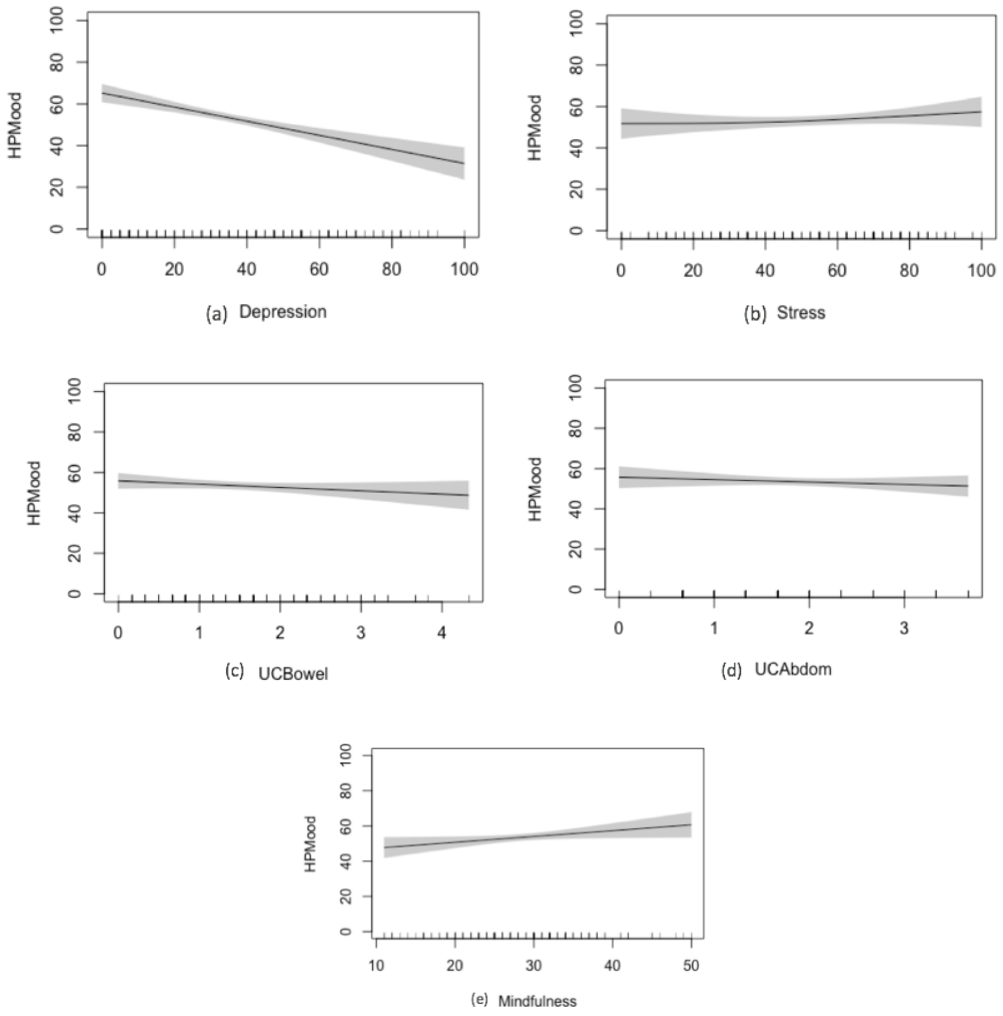


Figure 2

Partial effects plots for the smoothed terms predicting HPMood for patients with ulcerative colitis: a) Depression, b) Stress, c) Bowel symptoms, d) Abdominal symptoms, e) Mindfulness.



Model Comparison to Linear Regression Models

Given the added complexity of the GAM over LM, GAMs should only be used if they provide better model fits than linear models (LM). To test this, LMs for each of the outcome variables and the same predictor variables were also run, and each of the models were compared using Akaike information criterion (AIC) estimates and Adjusted R^2. As shown in Table 4, the AIC values for the CD subsample GAM was 9.95 units smaller than the LM, which is close to the recommended 10 AIC units' threshold for model superiority.

For the UC subsample, the GAM model AIC was higher in value than the LM, further indicating that specifically modelling non-linearities in the data was not useful for understanding the impact of symptoms on SWB for this population.

Table 4

Model comparisons between Generalised Additive Models and Linear Models for patients with Crohn's Disease and Ulcerative Colitis

	Akaike Information Criteria			Adjusted R^2	
	GAM	LM	Δ	GAM	LM
Crohn's Disease					
	2936.08	2946.03	9.95	.45	.42
Ulcerative Colitis					
	1863.70	1863.27	-.43	.30	.30

AIC: Akaike information criterion; GAM: generalised additive model; LM: linear model
Δ calculated as LM AIC minus GAM AIC

Discussion

It is well-established that people living with inflammatory bowel disease (IBD) are likely to experience symptoms of psychological stress and depression in addition to their physical disease symptoms and that these each contribute to reduced quality of life (Gracie et al., 2017; Guthrie et al., 2002; Halloran et al., 2020; Polak et al., 2020). This study is the first to seek to understand these

symptom patterns by considering the role of the underlying, positive affect, homeostatically protected mood (HPMood) that is the basic component of subjective wellbeing (Cummins et al., 2018), and has therefore responded to growing calls in the literature for integrating theoretical innovation with SWB research (Gan, 2020). We used a series of generalised additive models, exploring predicted values of HPMood according to psychological and physical symptoms, as well as trait mindfulness. Due to the nature of the IBD symptoms measures used, we divided our sample into subsamples according to their disease diagnosis (Crohn's disease: CD, and ulcerative colitis: UC). As expected, there was an inverse relationship between HPMood and the psychological variables tested, such that as stress and depression symptoms in our sample increased, HPMood levels decreased. Consistent with our predictions, for a cohort of people living with Crohn's disease, increasing levels of depression were not linked with HPMood levels in a consistent, linear pattern. Instead, we found a resilience effect whereby HPMood stabilised (i.e., slowed its decrease in the face of increasing depressive symptoms) at slightly less than 60 percentage points (pp) of HPMood. As expected, the resilience effect did not survive increasing levels of depression, with HPMood falling more strongly in the face of high levels of depression symptoms.

This important finding further supports the proposition that SWB, through its primary component ingredient, HPMood, is governed by a homeostatic system that protects individuals against some degree of psychological challenge (Cummins, 2010; Cummins et al., 2012). Homeostatic systems are designed to regulate specific internal variables from the impact of noxious agents by diverting resources to maintain the target variable's levels within a healthy range, in the

face of the adversity (Cummins & Wooden, 2014). This suggests that individuals who score in the 60s for HPMood and potentially SWB may be experiencing a degree of resilience to chronic or acute psychological stressors. Prior research has identified that the population healthy range, or setpoint range, for HPMood is between 70 and 90pp (Capic, Li, et al., 2018; Cummins et al., 2014). One standard deviation below the normative mean of SWB is around 63pp (Khor et al., 2020). Normative means are not available for HPMood, however, it is likely that they align with SWB given the nature of HPMood as the core component of SWB (Capic, Li, et al., 2018). A resilience effect at the lower level of the normal distribution of these scores is theoretically plausible. Our findings suggest that levels of HPMood around 60pp are clinically relevant. It is possible that this represents the point at which homeostatic resources are at their capacity and are at risk of collapse in the face of increasing psychological challenge.

Homeostasis Theory proposes that SWB homeostasis involves a number of cognitive and behavioural adaptive responses that protect SWB against challenge (Cummins, 2018a). This study sought to test whether trait mindfulness could be a protective mechanism supporting mood homeostasis. It has been proposed that mechanisms involved with mindfulness-based psychological treatments create the state of equanimity (Desbordes et al., 2015). Thus, mindfulness could act to restore psychological equilibrium that is akin to the kind expected of a properly functioning SWB homeostasis system (Lyall, Mikocka-Walus, et al., 2021). For this cohort of people with Crohn's disease, their levels of trait mindfulness did not follow a linear relationship with HPMood, consistent with our predictions. Instead, low levels of trait mindfulness were associated with much lower levels of HPMood for this cohort. As trait mindfulness levels

increased, HPMood became relatively stable at around 60pp, and did not increase further with higher trait mindfulness. However, mindfulness did not significantly predict HPMood in our models, which means this non-linear finding can be interpreted only as tentative evidence that mindfulness may have a role in stabilizing HPMood, at least for people with CD.

We also modelled the relationship between IBD symptoms and HPMood. Once again, we predicted that a non-linear relationship between these symptoms and HPMood would emerge. For the CD cohort, this was the case with bowel symptoms only, and not with symptoms associated with abdominal functioning. Bowel symptoms interacted with HPMood in a non-linear manner, whereby both low and high levels of bowel symptoms were associated with increased levels of HPMood. However, these results were not significant, and we conclude that there is no compelling evidence from this study that IBD symptoms impact on HPMood as predicted.

Interestingly, and contrary to expectations, for our participants with UC, all the modelled relationships between HPMood and psychological, IBD symptoms, and trait mindfulness were linear. It is not clear why the resilience effect relating to depression, seen in our participants with CD, did not also emerge with people with UC. There are diagnostic differences between the two major IBD diseases, involving different cytokine profiles (Abautret-Daly et al., 2017) and tissue inflammation biomarkers (Mortensen et al., 2017). CD can affect the entire gastro-intestinal tract and is considered more complex and chronic than UC (Le Berre et al., 2020; Tribbick et al., 2017). Furthermore, limited prior evidence suggests the conditions differ in the economic and life stressor contributors to disease activity (Sarid et al., 2018). There is also evidence

that patients with CD experience higher levels of psychological distress than those with UC (Leone et al., 2019). Additionally, there is epidemiological evidence that CD is more responsive to protective factors, such as diet, than UC (Bernstein, 2017).

However, to the best of our knowledge, this is the first study that has sought to understand the different impacts of psychological and physiological symptoms on the SWB of patients with CD and UC. Our results suggest there may be some important distinctions in the mechanisms underpinning psychological resilience in people living with these diseases. One potential explanation is the more complex nature of CD symptoms could lead to increased emphasis on coping strategies by people living with CD, and this could in turn lead to improved resilience.

An alternate explanation concerns access to resources. Le Berre et al. (2020) have argued that the perceived differences in quality of life between people with CD and UC are erroneous, and often lead to patients with UC potentially receiving undertreatment. Thus, the different findings between the two groups may relate to the participants' different levels of support and access to resources to promote resilience. Indeed, resources have been shown to support SWB homeostasis in non-clinical populations (Cummins, 2018a); and should be the focus of additional research in this population, given our findings and the importance of psychological support for people living with IBD (Lores et al., 2021).

Our study failed to find support for the hypothesized relationship between psychological stress and HPMood for people living with IBD. In our study, stress did not significantly predict HPMood levels, for either the CD or UC cohort, and

nor were the relationships non-linear. We had hoped to explore the role of psychological stress in SWB homeostasis, by identifying a resilience effect between psychological stress and HPMood levels, however, the models did not provide any evidence for the role of homeostatic resilience in responding to stress.

Implications

Taken together, our results present some important novel information about the role of psychological resilience in SWB homeostasis. For people living with the complex, chronic, inflammatory condition of CD, there is evidence that homeostasis protects levels of HPMood and offers some resistance to depression symptoms. This has implications for the treatment of CD.

Homeostasis theory says that small changes in SWB, or HPMood, are normal and adaptive, but that, under increasing pressure, homeostasis can fail, leading to chronic levels of SBW outside of its setpoint. It is clinically important, therefore, to identify the level of SWB, or its core component, HPMood, at which the homeostatic system is at risk of overload. Our study suggests that critical point, or resilience level, to be at around 60pp of HPMood. People living with CD who experience some levels of psychological challenge, are likely operating within homeostasis if they are reporting above 60pp of HPMood. However, at levels below 60pp, it is likely they are at risk of homeostatic defeat, which would lead to chronically low levels of SWB. In other words, 60pp of HPMood could be considered a critical intervention point.

This emphasises the importance of assessing both depression symptoms and SWB in individuals with CD to ascertain the risk of homeostatic defeat, and to provide appropriate psychological support.

Our findings also point to the need to better understand the different nature of homeostatic resilience for people living with CD and UC. The lack of a resilience effect for people living with UC may indicate this population is more at risk of the impact of psychological symptoms, and thus should be provided with relevant resources. It is important that perceptions that UC is less medically complex than CD should not be transferred to questions of psychological support for this population.

Limitations and future research

A strength of the study is the large sample size and the use of statistical techniques appropriate to test the hypotheses. These discovered relationships between HPMood and depression that highlighted adults with CD may be at risk of steep declines in SWB that would have been overlooked using standard linear analytical methods.

The cross-sectional nature of the analyses prevented examination of within-person change in levels of HPMood over time. Ideally, HPMood should be assessed repeatedly. It has been demonstrated that multiple assessment points enable analyses that can remove the individual variance that is caused by emotion contamination, and thus predict individual setpoints (Capic, Li, et al., 2018). The cross-sectional design also prevented understanding of any causal relationship between psychological and physiological symptoms and HPMood. Future studies should test these propositions in longitudinal research to ascertain directionality of relationships between psychological symptoms and HPMood.

The results of the current study suggest that psychological symptoms, particularly depression, more strongly predict levels of HPMood than physiological symptoms. The use of a subset of depression and stress items could

have influenced our results, and future studies should adopt the full DASS scales. However, the current study was not able to investigate whether objective assessment of inflammation, such as levels of c-reactive protein, is associated with SWB or its component affect, HPMood, as these data were not gathered.

This study provided novel insights into the role of trait mindfulness as a potential resilience factor in people living with IBD. It is not entirely surprising that trait mindfulness did not perform in our models as predicted. Dispositional mindfulness is a different construct from learned or cultivated mindfulness practice (Medvedev et al., 2017), and reflects inherent personality characteristics (Rau & Williams, 2016). It may be that mindfulness practice is a more relevant predictor of SWB, as it engages specific cognitive and emotional regulation mechanisms, as discussed in Lyall, Mikocka-Walus, et al. (2021).

Conclusion

This study makes an important novel contribution to a growing body of research exploring psychological associations with IBD symptoms. This study is the first to identify a "resilience effect" that supports individuals to maintain healthy levels of their underlying positive affect, HPMood, in the face of increased depression symptoms. This finding, which was only evident for people with Crohn's disease (CD), is an important first step for understanding the mechanisms by which subjective wellbeing (SWB) homeostasis can buffer the impact of depression symptoms. It suggests the importance of ensuring people with IBD receive appropriate psychological support and resources to assist in the functioning of a healthy SWB homeostasis system.

Summary and Link to Chapter 4

In summary, in Study 2, a clear non-linear pattern emerged between depression and homeostatically protected mood (HPMood) for people living with Crohn's disease (CD). This is the first time the proposed theoretical relationship between HPMood and psychological symptoms has been substantiated using statistical tools designed to measure non-linear relationships, generalised additive models. The emergence of a "resilience effect" at around 60 percentage points (pp) was in line with expectations stemming from theory. In line with our proposed model of *moodfulness*, there was tentative evidence for the role of trait mindfulness in supporting HPMood. However, these effects were not observed for the cohort of people with ulcerative colitis (UC), nor was the non-linear relationship evident in models involved psychological stress or disease symptoms.

It is possible that SWB homeostasis may operate differently in clinical populations, although there is no theoretical basis for this assumption. It is also interesting that 60% of the sample were experiencing SWB at levels below the normal setpoint range (70pp). It is possible that these scores, which are already indicative of SWB homeostatic defeat, follow other evidence of extremely low SWB scores not operating in predicted ways (Richardson et al., 2016).

Study 2 also found limited evidence for the beneficial impact of mindfulness in predicting SWB. However, the study focused on dispositional mindfulness, rather than the practice of mindfulness, and thus was unable to ascertain whether specific mindfulness mechanisms, such as decentering (Bernstein et al., 2019) or emotion regulation (Farb et al., 2014), might aid to build resilience for SWB homeostasis.

One advantage of a sample with a high proportion of individuals who are likely to be in SWB defeat is that it provides a significant enough sample size to explore the research questions in another way: by ascertaining the probability of someone's SWB scores occurring within the homeostasis setpoint range, given psychological and physiological predictors.

Study 3, therefore, takes this approach with the same sample of people living with inflammatory bowel disease (IBD). In so doing, the role of mindfulness is further explored by examining the relationship of mindful practice to SWB homeostasis.

Chapter 4

Study 3: Mindfulness practice is associated with subjective wellbeing homeostasis resilience in people with Crohn's disease but not ulcerative colitis

Note: This is an edited version of the paper under review by Frontiers in Psychiatry. Edits attend to examiner comments.

Abstract

Objectives: People with Crohn's disease and ulcerative colitis (inflammatory bowel disease: IBD), commonly experience high levels of depressive symptoms and stress and low levels of subjective wellbeing (SWB). Mindfulness is increasingly considered an adjuvant IBD treatment. The relationships between depression, disease symptoms and mindfulness have not previously been considered within the theory of SWB homeostasis. This theory states that SWB is normally maintained by a homeostatic system around a setpoint range but can fail when psychological challenges dominate consciousness. This study explored the relationship among SWB and patient-reported psychological and IBD symptoms and investigated whether mindfulness practice is independently associated with SWB homeostatic resilience. **Design**: This cross-sectional study recruited participants through online IBD support groups. Methods: Participants (n = 739; 62% Crohn's disease) detailed symptoms of depression and stress, patient-reported disease symptoms, and regularity of mindfulness practice. **Results:** The sample had significantly lower SWB (Hedges g = -0.98) than normative data. A logistic regression found mindfulness practice doubled the Crohn's disease participants' odds of reporting SWB within the normal homeostatic range, after controlling for psychological, physical, and

demographic variables (OR 2.17, 95% CI: 1.27, 3.69). A one-point increase of patient-reported bowel symptoms reduced the participant's odds of reporting SWB in the normal homeostatic range by about a third (OR 0.67, 95% CI: 0.50, 0.88]). However, the influence of mindfulness or disease symptoms on SWB was not observed for people with ulcerative colitis. **Conclusion**: These findings provide initial evidence for an association between mindfulness and SWB homeostatic resilience in a clinical population.

Mindfulness practice is associated with subjective wellbeing homeostasis resilience in people with Crohn's disease, but not ulcerative colitis

Inflammatory bowel disease (IBD) refers to two chronic, gastrointestinal conditions: ulcerative colitis (UC) and Crohn's disease (CD). Symptoms include abdominal pain, changed bowel habit, rectal bleeding, urgency and loss of appetite (Abautret-Daly et al., 2018). IBD is increasing in prevalence across ethnic groups and geographies (Baumgart & Sandborn, 2012). Its etiology and pathogenesis are unclear, with genetic susceptivity accounting for only 20-25% of cases (De Souza et al., 2017). The interaction of internal microbial factors and external environmental factors in IBD is the subject of many studies, but a clear picture is yet to emerge.

The disease's unpredictability, the uncertain nature of flares and their triggers, and its socially awkward symptoms (including faecal incontinence, toilet urgency and increased flatulence) contribute to significant psycho-social anxieties for people with IBD. These range from specific stressors relating to always needing to be near a toilet (Larsson et al., 2017), to general worries such as body image or the effect of IBD on one's future (Keeton et al., 2015). Consequently, the psychological impacts of living with IBD are increasingly being investigated, with depression and psychological stress key factors (Bernstein et al., 2010; Fairbrass et al., 2021; Ho et al., 2019; Knowles & Mikocka-Walus, 2015; Neuendorf et al., 2016; Trivedi et al., 2019).

Quality of life measurements are commonly used as outcome indicators for IBD research (Best et al., 1976; Gracie et al., 2017; Guyatt et al., 1989); however, most quality of life measures focus on health outcomes and do not capture all elements of patient experience (Skevington & Böhnke, 2018). An

alternative measure is subjective wellbeing (SWB), which measures the subjective assessment of satisfaction with life, generally measured through a set of broadly described domains, and resulting in largely affective, rather than cognitive, responses (Cummins, 2016a; Davern et al., 2007). A strength of SWB is that it is grounded in theory and empirical research, namely the theory of subjective wellbeing (SWB) homeostasis, which has so far not been explored in IBD populations. The theory (Cummins, 1995, 2016b, 2021) builds on evidence of remarkable SWB stability across populations. Most people indicate they are about 75% satisfied with their lives (Cummins, 1995). The theory proposes that each person has a SWB setpoint, which is an individual difference. Maintenance of SWB within the individual's setpoint range is governed by a homeostatic system that, when operating effectively, applies cognitive and behavioural resources to maintain equilibrium (Cummins, 2016b). At population levels, setpoint ranges have been shown to be between 70 and 90 points on a 0-100 percentage point (pp) scale (Capic, Li, et al., 2018).

According to the theory, SWB homeostasis protects an underlying, and constant, affect known as homeostatically protected mood (HPMood: Cummins, 2010). This mood is the internal state of affective equilibrium for each person when SWB is at its setpoint, and is the information drawn upon to answer questions about levels of satisfaction with life (Cummins, 2021). However, stressors challenge homeostatic control, as the high levels of emotional content shifts awareness away from the underlying HPMood. If stress is strong and chronic, homeostatic control chronically fails. The consequence is a level of SWB that lies persistently outside its setpoint range. Under such conditions, negative

affect dominates consciousness, with a consequential increase in the likelihood of depression (Cummins, 2010).

This theoretical approach could be useful for studying an IBD population as there is an emerging consensus that psychological stress and depression are part of the lived experience of people with IBD (Fairbrass et al., 2021; Keeton et al., 2015; Knowles & Mikocka-Walus, 2015; Larsson et al., 2017; Neuendorf et al., 2016; Triantafillidis et al., 2013). Thus, it seems likely that people with IBD with depression symptoms are experiencing SWB homeostatic defeat.

The connections among stress, depression and IBD have invited explorations into the effectiveness of mindfulness interventions for reducing psychological symptoms for people with IBD. Mindfulness is theorized to reduce stress, and possibly inflammation, through a set of techniques that target the autonomic nervous system (Ludwig & Kabat-Zinn, 2008). Mindfulness has been shown to support emotional regulation through positive reappraisal (Garland, 2007) and extinction of habitual emotional responses to stressors (Farb et al., 2014; Hölzel et al., 2011) benefitting psychological symptoms such as depression and anxiety (Ewais et al., 2020; Hood & Jedel, 2017; Jedel et al., 2014; Neilson et al., 2015; Schoultz et al., 2015). There is, however, mixed evidence of mindfulness reducing stress in people with IBD. A systematic review found few effects (Hood & Jedel, 2017), however, subsequent studies involving people with CD (Schwartz et al., 2019) and UC (Mazaheri et al., 2020) provide some support for the role of mindfulness in reduced subjective stress and results from a recent randomized control trial showed that a mindfulness intervention could improve IBD biomarkers (González-Moret et al., 2020), while a recent study found trait mindful awareness mediates the association between disease severity, quality of

life, fatigue, and stress (Navarrete et al., 2021). In summary, evidence for the effectiveness of mindfulness in reducing psychological symptoms associated with IBD is uncertain, but emerging (Hood & Jedel, 2017; Langhorst et al., 2015).

A limitation of prior research is that it has largely focused on people with IBD who are not experiencing significant mental illness or active disease symptoms (Ewais et al., 2019). It is also notable that randomized studies have typically relied on manualized interventions (Ewais et al., 2019) and many cross-sectional studies use dispositional mindfulness measures (Jedel et al., 2013). Dispositional mindfulness is a different construct from learned or cultivated mindful practice in that it is an innate individual difference that maps on to personality traits (Rau & Williams, 2016). For the purposes of providing psychological interventions, therefore, it is important to consider programs that build cultivated mindfulness, or mindfulness skills. To our knowledge, no IBD studies have explored the impact of regular mindful practice on outcomes of interest.

There has been much research indicating that mindfulness is positively associated with subjective wellbeing (Brown & Ryan, 2003; Brown et al., 2007), including in populations with psychiatric disorders (Yu & Clark, 2015); however to date there have been no studies exploring the theoretical proposition that mindfulness can improve access to HPMood, and therefore aid in homeostatic resilience.

This study responds to a growing call for more specific research into the environmental triggers, including psychological stress, that contribute to IBD (Ho et al., 2019). It aims to understand the relationship between SWB homeostasis and psychological and physical symptomatology for people with IBD; and to

explore whether mindfulness practice is independently associated with SWB homeostatic resilience in people with IBD, after controlling for other psychological and demographic factors. We hypothesised that:

1. Compared to normative data, an IBD sample will demonstrate lower levels of SWB.
2. Patient-reported levels of stress and depression symptoms will be negatively associated with SWB.
3. Patient-reported IBD symptoms will be negatively associated with SWB.
4. After controlling for the influence of demographics, patient-reported stress, and depression symptoms and patient-reported IBD symptoms, mindfulness practice will independently predict an enhanced probability that SWB scores will fall within the normal homeostatic range (i.e., between 70-90 pp).

Methods

Design

A cross-sectional survey was conducted, using an on-line questionnaire.

Participants

Participants were recruited through on-line support groups for people with IBD in Australia. They were asked to complete the survey if they were aged over 18 and had a diagnosis of CD or UC. More than 900 participants began the survey. Participants who failed to provide answers for all variables of interest were excluded, leaving $n = 739$ for analysis.

Measures

Subjective wellbeing. The Personal Wellbeing Index (PWI) (International Wellbeing Group, 2013) comprises seven items, each representing a life domain (standard of living, health, achieving in life, relationships, safety, community connection and future security). Responses involved an 11-point, end-defined scale, anchored by not satisfied at all (0) and completely satisfied (10). The composite and average of these items measures subjective wellbeing (SWB) as a continuous variable, with Cronbach's alpha = 0.89.

Total PWI scores were standardized to a 0-100 percentage point (pp) scale (International Wellbeing Group, 2013). Cases with missing values in one or more domains were coded as missing data, and, in accordance with the manual, respondents with PWI scores of 0 (n = 2) or 100 (n = 1) were excluded. PWI total scores between 70pp and 89.9pp were categorized within normal homeostasis range.

Depression and stress. Self-reported symptoms were measured using items derived from the Depression and Stress scales of the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995). To reduce the number of items in the survey, 4 items were chosen from each of the scales, following research into strongest loading factors (Osman et al., 2012). An exploratory factor analysis indicated the items loaded on to two factors as expected, with no cross-loadings greater than .4, and thus the items chosen were determined to have an acceptable factor structure. The items employed were depression; I couldn't seem to feel any positive feelings at all, I felt that I had nothing to look forward to, I felt downhearted and blue, I felt I wasn't worth much as a person. For stress: I found it hard to wind down, I found myself getting agitated, I found it difficult to relax,

I felt that I was rather touchy. Respondents were asked on an end-defined 11-choice scale anchored by not at all (0) to completely (10), how much the item applied over the past week. The scale was chosen following recommendations 11-point scales produce clearer normal distributions (Cummins & Gullone, 2000; Leung, 2011). Cronbach's alpha was 0.83 and 0.90 for stress and depression respectively. Cases that contained missing values in one or more items had the relevant symptom score coded as missing.

Disease symptoms. IBD symptoms were measured by CD patient reported outcome signs and symptoms (Higgins, Harding, Leidy, et al., 2018a) and the UC counterpart (Higgins, Harding, Revicki, et al., 2018b), both of which were developed to respond to US Food and Drug Administration guidelines. Each measure has two scales: bowel and abdominal functioning outcomes, with higher scores indicating more frequent symptoms. Example questions are: "over the last 24 hours, how many bowel movements did you have?" and "over the past 24 hours, did you have pain in your belly?" For abdominal functioning, the items for both disease conditions are identical. For bowel symptoms, there are three common items across both disease conditions; and UC patients are asked an additional three items (relating to blood in bowel movements, mucus in bowel movements and leaking prior to reaching the toilet). Total scores were calculated according to the authors' instructions, with separate scores relating to patient reported bowel symptoms and patient reported abdominal symptoms. Total scores for cases with one or more missing items were coded as missing. Cronbach's alpha for bowel symptoms was .74 for CD and .80 for UC. Cronbach's alpha for abdominal symptom items was .58 for CD and .63 for UC, slightly lower than the scale validation studies.

Symptom severity was categorized following cut-offs outlined in the additional files to the above papers (Higgins, Harding, Leidy, et al., 2018b; Higgins, Harding, Revicki, et al., 2018a), with moderate or severe symptoms cut-offs as follows: CD bowel symptoms, a score of 2.4 or more; CD abdominal symptoms, a score of 1.7 or more; UC bowel symptoms, a score of 1.2 or more; UC abdominal symptoms, a score of 1.5 or more. These categories were used for descriptive statistics only, to present a picture of the clinical characteristics of the sample. Inferential analyses used the continuous variables and divided the sample into separate diagnosis cohorts.

Mindfulness. Participants were asked how often (never, occasionally, weekly, a couple of times a week and daily) they practice mindfulness. Mindfulness practiced was described as including focused breathing, body scans, yoga exercises, or guided meditations. Responses were coded as 'yes' or 'no'. To be conservative, answers of "never" or "hardly ever" were categorized as no and "occasionally", "weekly", "a couple of times a week" or "daily" were categorized as yes.

Demographics. Participants were also asked to report their gender, age, income, disease type, when they were diagnosed, and whether they have another chronic disease.

Statistical Analyses

SPSS version 26.0 was used for analyses. All variables of interest had less than 3% of missing values, except for regularity of mindfulness practice (6.1%). The Little's MCAR test (chi-square = 503.65, df = 530, p = .79), indicated a pattern of data missing completely at random. Thus, subsequent analyses were conducted with pairwise deletion. Twenty-four univariate outliers (z-scores > +/-

3.29) were identified involving 18 cases. Correlation analyses using all cases and excluding cases containing outliers were compared. None of the differences were significant, thus, all outliers were retained.

For hypothesis 1, mean effect size comparisons with normative data (Khor et al., 2020) were conducted. For hypotheses 2 and 3, Spearman's correlational analysis was conducted. For hypothesis 4, logistic regression employed SWB homeostasis status (scores within normal homeostasis range or not) as the outcome variable, with mindfulness practice, stress, and depression symptoms, and bowel and abdominal symptoms as predictors. Analysis of the impact of gender, income, age, presence of additional chronic disease and when IBD was diagnosed was conducted using Spearman's correlations. As each of these correlated significantly with at least one patient-reported disease symptom, these were controlled for in the analysis.

Ethical Considerations

Ethics approval was obtained from the university human research ethics committee.

Results

The majority of the sample (85.6%; n = 625) was female; with 14.2% (n=104) male and 1 participant identifying as 'other gender'. Age ranged from 18 to 78, with a mean of 37.86 and standard deviation of 11.98 years. CD was the most common IBD condition. A sizeable proportion (43%) indicated they also live with another chronic health condition. Between 30 and 51 percent of people with CD and 47 and 64 percent of people with UC self-reported disease symptoms at moderate or severe levels (Table 1).

Table 1

Sample's demographic and clinical characteristics

Variable	Count	%
Gender		
female	625	84.6
male	104	14.1
other	1	0.1
Subjective wellbeing		
<70 pp	437	59.2
70-89.9 pp	264	35.7
>90 pp	19	2.6
IBD type		
Crohn's	461	62.4
UC	277	37.5
When diagnosed		
past month	5	0.7
past year	38	5.1
past 2 years	63	8.5
past 5 years	135	18.3
5-10 years ago	183	24.8
10-20 years ago	191	25.8
> 20 years ago	123	16.6
CD bowel symptoms		
Mild	319	69.2
Moderate or severe	139	30.2
CD abdominal symptoms		
Mild	225	48.8
Moderate or severe	235	51.0
UC bowel symptoms		
Mild	144	52.0
Moderate or severe	130	46.9
UC abdominal symptoms		
Mild	100	36.1
Moderate or severe	176	63.5
Other chronic conditions		
Yes	318	43.0
No	419	56.7
Mindfulness practice		
No	435	58.9
Yes	259	35.0

IBD – inflammatory bowel disease; CD = Crohn's disease; UC = ulcerative colitis

The results supported hypothesis 1, that compared to normative data, an IBD sample will demonstrate lower SWB. Participants' mean SWB scores were significantly lower than normative data, with a mean difference of -12.4pp (Hedge's *g*: -0.98; 95% confidence interval: -1.06, -0.91), which indicate a difference of one standard deviation (Table 2).

Table 2

Means and Standard Deviations

Variable	*n*	*M*	*SD*	Norm *M*†	Norm *SD*†
Subjective wellbeing	720	62.99	16.88	75.39	12.54
Depression	730	36.01	24.69	n/a	n/a
Stress	730	49.61	22.75	n/a	n/a
Mindful practice	694	2.38	1.38	n/a	n/a
CD patient reported symptoms					
-Bowel	459	1.92	1.03	n/a	n/a
-Abdominal	461	1.89	0.78	n/a	n/a
UC patient-reported symptoms					
-Bowel	274	1.41	0.93	n/a	n/a
-Abdominal	276	1.85	0.81	n/a	n/a

Depression and Stress measures were based on a subset of items derived from the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995).
† Normative mean and standard deviations sourced from Table 2 in Khor et al. (2020), *n*>60,000.
CD = Crohn's disease; UC = ulcerative colitis.
Patient reported bowel and abdominal symptoms measured with Crohn's disease/ulcerative colitis patient reported outcomes signs and symptoms scales (Higgins, Harding, Leidy, et al., 2018a; Higgins, Harding, Revicki, et al., 2018b).

Results supported the hypotheses 2 and 3, that patient-reported psychological and disease symptoms will be negatively associated with SWB. As shown by the Spearman correlational matrix (Table 3), SWB negatively correlates with depression symptoms, stress, and bowel and abdominal symptoms for both the CD and UC cohorts.

Table 3

Spearman's Correlation Matrix Showing Relationships between Psychological, Disease, Demographic and Mindfulness characteristics

	SWB	Depression	Stress	Gender	Age	Income	Time since diagnosis	Mindful practice	Other chronic condition	CD-Bowel	UC-Bowel
Depression	-.57***										
Stress	-.40***	.65***									
Gender	.09*	-.14***	-.04								
Age	-.04	-.03	-.11***	-.00							
Income	.26***	-.21***	-.07	.01	.05						
Time since diagnosis	-.01	-.01	-.05	-.00	.46***	.05					
Mindful practice	.07	-.15**	-.12***	-.02	.11***	-.02	.03				
Other chronic condition	-.17***	.06	.06	.01	.16***	-.03	.07*	.12***			
CD-Bowel	-.31***	.28***	.19***	-.03	.08	.03	.09	-.08	.04		
CD-Abdom	-.24***	.26***	.29***	.06***	-.09*	-.09	-.14***	-.06	.05	.33***	
UC-Bowel	-.29***	.22***	.22***	-.04	-.03	-.21***	-.03	-.13*	.05	n/a	
UC-Abdom	-.18***	.21***	.21***	-.07	-.09	-.14***	.03	-.01	.16***	n/a	.40***

* significant at .05; *** significant at .001

SWB = Subjective wellbeing

Depression and Stress measures were based on a subset of items derived from the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995).

Mindful practice = self-reported regularity of practice

CD-Bowel = Crohn's disease Patient Reported Bowel Symptoms; CD-Abdom = Crohn's disease Patient Reported Abdominal Symptoms

UC-Bowel = Ulcerative Colitis Patient Reported Bowel Symptoms; UC-Abdom = Ulcerative Colitis Patient Reported Abdominal Symptoms

Note: participants completed the patient-report scales relevant to their disease diagnosis, hence there are no correlation coefficients between the diagnosis categories.

Hypothesis 4 proposed that, after controlling for the influence of demographic, patient-reported stress, depression symptoms and IBD symptoms, mindfulness practice would independently predict SWB in the normal homeostasis range (i.e., scores between 70-90pp). A binomial logistic regression was performed, with the data file split according to IBD-type. Age, income, gender, when diagnosed, and presence of another chronic disease were included in the model because each significantly correlated with either disease symptoms or SWB. All logistic regression assumptions were met. The dependent variable was coded such that 0 = a SWB score outside the normal homeostatic range, and 1 = a score inside of the normal homeostatic range. Results are shown in Table 4.

For the CD cohort, the model was statistically significant, χ^2 (10, n = 341) = 97.49, $p < .001$. The model explained between 25% (Cox and Snell R^2) and 34% (Nagelkerke R^2) of the probability of being in the normal homeostatic range. It correctly classified 73% of cases (82% of SWB outside the normal homeostatic range and 59% of SWB within). Mindfulness practitioners were more than twice as likely to report SWB within the normal homeostatic range (*OR* 2.17, 95% CI: 1.27, 3.69), after controlling for the influence of the other variables. Bowel symptoms, but not abdominal symptoms, significantly contributed to the model. An increase of one point on the bowel symptom measure reduced the odds of the participant reporting SWB in the normal homeostatic range by about a third (*OR* .67, 95% CI: 0.50, 0.88). Depression symptoms, but not stress, significantly predicted the odds of reported SWB in the normal homeostatic range, such that a one-point increase in depression scores decreased the chances of the participant reporting SWB inside the range (*OR* 0.97, 95% CI: 0.95, 0.98). Higher income increased the odds of SWB lying within the normal homeostatic range (*OR* 1.2,

95%CI: 1.0, 1.6). No other demographic factor contributed significantly to the model.

For the UC cohort, the model was also statistically significant, χ^2 (10, n =226 = 51.61, $p < .001$. The model explained between 20% (Cox and Snell R^2) and 28% (Nagelkerke R^2) of the probability of being in the normal homeostatic range. It correctly classified 72% of cases (81% of SWB outside normal range and 59% of SWB within). Mindfulness did not significantly predict SWB homeostasis for this cohort, nor did the patient-reported physical symptoms, nor stress. Depression significantly predicted SWB homeostasis, after controlling for the other variables (*OR* 0.97, 95% CI: 0.95, 0.98). The presence of another chronic condition was statistically significant and halved the odds of reporting SWB in the normal homeostatic range (*OR* 0.50, 95% CI: 0.26, 0.97). Income was the only statistically significant demographic variable, at the .05 level; an increase in income slightly increasing the odds of reporting SWB in the normal homeostatic range (*OR* 1.3, 95% CI: 1.0, 1.6).

Table 4

Predictors of Subjective Wellbeing in the Normal Homeostasis Range for People with Crohn's disease or ulcerative colitis

		Odds of subjective wellbeing within normal homeostatic range (70-90pp)	
Crohn's disease	Predictor	Odds Ratio	(95% CI)
	Engage in mindfulness practice (if yes) **	2.16	(1.27, 3.69)
	Depression score higher***	.97	(0.95, 0.98)
	Stress score higher ns	1.00	(0.98, 1.01
	Patient-reported Bowel Symptoms higher***	.68	(0.50, 0.88)
	Patient-reported Abdominal Symptoms higher ns	.89	(0.61, 1.29)
	Greater time since diagnosis ns	.96	(0.78, 1.17)
	Having another chronic condition (if yes) ns	.89	(0.52, 1.52)
	Gender (if female) ns	1.44	(0.64, 3.28)
	Older age ns	.98	(0.95, 1.00)
	Higher income*	1.24	(1.03, 1.51)
Ulcerative colitis	Engage in mindfulness practice (if yes) ns	1.49	(0.79, 2.80)
	Depression score higher***	.97	(0.95, 0.98)
	Stress score higher ns	1.00	(0.99, 1.02)
	Patient-reported Bowel Symptoms higher ns	.73	(0.49, 1.09)
	Patient-reported Abdominal Symptoms higher ns	1.45	(0.93, 2.26)
	Greater time since diagnosis ns	.88	(0.69, 1.12)
	Having another chronic condition (if yes) *	.50	(0.26, 0.97)
	Gender (if female) ns	.70	(0.28, 1.78)
	Older age ns	.99	(0.96, 1.02)
	Higher income*	1.31	(1.03, 1.65)

Logistic regression coefficient $^{*}p<{}^{*}.05$; $p<{}^{**}.01$; $^{***}p<.001$; ^{ns} not significant

Depression and Stress measures were based on a subset of items derived from the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995).

Patient reported bowel and abdominal symptoms measured with Crohn's disease/ulcerative colitis patient reported outcomes signs and symptoms scales (Higgins, Harding, Leidy, et al., 2018a; Higgins, Harding, Revicki, et al., 2018b).

Discussion

This is the first time an IBD sample has been studied within the theoretically robust framework of SWB homeostasis. This theory adds an important understanding to our knowledge of the relationship between IBD and wellbeing because it provides a framework to understand expected homeostatic resilience (SWB scores in the setpoint range; 70-90 pp).

As predicted, the IBD sample demonstrated significantly lower SWB than normative data and reported a mean SWB below the typical range of SWB homeostasis, indicative of potential homeostatic failure. Homeostatic failure represents the point at which the homeostatic system has failed to be resilient to psychological challenges and indicates that the individual has insufficient resources to apply to their stressors (Cummins, 2016b). The negative psychological impact of IBD is well-established (Fairbrass et al., 2021; Mikocka-Walus, Knowles, et al., 2016).

To further explore the relationships within SWB homeostasis theory, this study sought to identify independent predictors of reporting SWB scores within the normal homeostatic range (Capic, Li, et al., 2018; Cummins et al., 2014). Depression symptoms decreased the odds of participants reporting SWB within the range, after controlling for the impact of other psychological and physical symptoms and demographics. However, the same result was not found for stress. Stress was not a significant independent predictor of SWB lying within the homeostasis range for either cohort. This result is interesting given the proposed theoretical role of stress in SWB homeostatic defeat, as well as the prevalence of perceived stress in people with IBD (Knowles & Mikocka-Walus, 2015).

Results for disease symptoms were inconsistent. Patient-reported bowel symptoms independently predicted the odds of reporting SWB in the resilient range for the CD cohort, but not the UC cohort. Abdominal symptoms were not significant for either group, though these may have been influenced by the low reliability of this measure in our sample. These are important findings, given that a strength of our study was the high proportion of participants with moderate or severe levels of both bowel and abdominal symptoms. It is possible that, insofar as SWB is concerned, psychological symptoms have more impact than physical ones. However, it is worth noting that patient-reported disease symptoms do not always correlate with objective markers of disease activity (Dragasevic et al., 2020), further pointing to the need to collect biomarkers as well as subjective measures.

The study also sought to explore whether mindfulness practice could be predictive of homeostatic resilience in the presence of psychological and IBD disease symptoms. The results were also mixed. For the CD cohort, engagement in mindfulness practice increased the odds of a participant reporting SWB levels consistent with the normal homeostatic range, after controlling for the influence of demographic variables and psychological and IBD symptoms. However, for the UC cohort, engaging in mindfulness practice did not increase the odds of reporting SWB in the normal homeostatic range.

The finding that income was the only significant independent demographic predictor in our model, is supported by other evidence of the protective factors of resources such as income in maintaining homeostasis (Cummins, 2018a).

Summary

Taken together, the findings provide the following picture. Participants with IBD experience lower levels of subjective wellbeing than the healthy population, at average levels indicative of SWB homeostasis defeat. Depression symptoms are an indicator that SWB homeostasis is challenged, along with, for the CD population, an increase in self-reported bowel symptoms. While we could not demonstrate a causal effect of these psychological and physical impacts, due to the cross-sectional nature of our study, it is possible that these challenges place pressure on SWB homeostasis, and this aligns with prior research and theory (Cummins, 2010). Many individuals with IBD, particularly those with higher levels of disease symptoms, have insufficient resources to respond to homeostatic challenge, and are more likely to experience homeostatic defeat.

An important clinical question in the provision of psychological support for people with IBD involves factors or interventions that increase the chances of homeostatic resilience. In this study, engagement in regular mindfulness practice was found to be an independent predictor of lying within the SWB homeostatic range, but only for the CD cohort. The interpretation of these findings could be twofold. Either individuals with CD who engage in mindfulness practice are more likely to retain homeostatic control despite the presence of psychological and IBD symptoms; or individuals who maintain homeostatic control are more likely to engage in mindfulness practice. While either of these is feasible, the former explanation is most likely because it links simply to theory. This also concords with other research that indicates mindfulness is effective in mitigating stress (Ewais et al., 2019) and depression (Neilson et al., 2015) for people with IBD, and with research that suggests mindfulness reduces the physiological indicators

of stress (Pascoe et al., 2017). The fact that the findings did not translate to the UC cohort could be explained by the impact of comorbidities in this cohort, as our study found their presence to be a significant contributor to that model. It is possible that these other conditions are influencing the benefits of mindfulness for this cohort, although this hypothesis would need further testing. Another explanation might lie in the nature of CD as a disease, which is associated with greater levels of depression and anxiety symptoms, compared to UC (Mikocka-Walus, Knowles, et al., 2016). This might result in participants deriving greater proportional benefits from psychological treatment. To understand these relationships further, studies that differentially analyse psychological treatment between disease conditions would be required.

SWB homeostasis theory states that the variable homeostasis is protecting is an underlying positive mood called homeostatically protected mood (HPMood: Cummins, 2010). This affect underlies all conscious experience and provides an inbuilt reference point for SWB-level management by homeostasis. HPMood exists in consciousness as an amalgam with emotion, forming the responses measured as SWB. Thus, the presence of HPMood is normally masked by situationally-created emotion, e.g., anger, sadness, or joy, that are connected to a specific, temporal event. Where high levels of stress and depression symptoms are involved, these emotions obscure access to HPMood, and take control of SWB levels away from the homeostatic system, leading to low levels of reported SWB (Cummins & Wooden, 2014; Richardson et al., 2016).

Linking into this explanation, mindfulness has been described as creating a kind of "mental gap" between awareness and its objects (Brown et al., 2007, p. 216) or "a 'space' between one's perception and response" (Bishop et al., 2004,

p. 232). It effectively holds at bay the force of the emotional content. This could also be described as restoring conscious access to HPMood (Lyall, Mikocka-Walus, et al., 2021). This study provides some initial, albeit cautious, evidence to support this proposal, and aligns with a growing body of research that suggests mindfulness improves psychological outcomes by a combination of regulatory mechanisms, including cognitive reappraisal, self-regulation and emotion regulation (Hölzel et al., 2011; Tang et al., 2015; Vago & David, 2012). For people with CD who experience significant psycho-social anxieties associated with their symptoms, the ability to regulate emotional and cognitive responses to these stressors may provide an important pathway to restored levels of SWB.

Clinical Implications

These results indicate the potential role of SWB homeostatic resilience to mitigate the experience of psychological symptoms associated with IBD. Homeostasis theory suggests the provision of resources to individuals experiencing homeostatic defeat is essential to restore homeostasis. For an IBD cohort, this study suggests that mindfulness could potentially act as such a homeostatic resource, and this is particularly the case for people with CD. Given that once SWB returns to setpoint range, the internal stability of the homeostatic system once again resumes control, this suggests that mindfulness could be an efficient technique to assist people to manage their psychological symptoms.

These results support a growing body of literature that points to the need for gastroenterology treatment to incorporate psychological care and referrals (Keefer et al., 2018). It is especially important that patients at risk of SWB homeostatic defeat are identified and provided with appropriate resources and resources alongside their medical support.

Limitations and Future Directions

As the study was cross-sectional, it remains uncertain whether mindfulness practice could be an effective intervention for people with IBD who experience stress and depression symptoms. Prospective studies could help to test this proposition. Similarly, the direction of the relationship among psychological and physical symptoms and SWB was also unable to be determined. Future studies could be designed to better investigate the causal links between psychological symptoms, mindfulness and SWB. This study did not measure anxiety levels as it was not a construct of interest; future studies could identify whether anxiety levels predict homeostasis. The use of a subset of depression and stress items could have influenced our results, and future studies should adopt the full DASS scales.

The study relied on subjective, rather than objective, measures of symptomatology. Patient reports are becoming important outcome measures for clinical research (Williet et al., 2014), however, some studies have found subjective measures of patient functioning do not always correlate with objective measures of disease activity (Creemers et al., 2020; Lauriot dit Prevost et al., 2020). Future studies exploring the relationship between endoscopy or biomarkers and SWB would provide a fuller picture.

Third, this study relied on self-reports for mindfulness practice, and did not examine the discriminatory features of mindfulness practice. Not all such practices are alike, thus participants will vary significantly in the type, duration, and application of mindfulness techniques, creating challenges for mindfulness measurement (Van Dam et al., 2018). However, to the extent that engaging in

self-described mindfulness practice is protective of SWB homeostasis, these results remain relevant.

The sample was predominantly female, which is not unusual in online research with IBD populations (Lönnfors et al., 2014; Tew et al., 2016), but future studies should seek to target more male respondents. It is possible that our study attracted people who were interested in mindfulness, however, our recruitment flyers emphasized that mindfulness experience was not required to participate in the study. Finally, we were not able to ascertain which of the potential mindfulness mechanisms are most relevant for people with IBD. SWB homeostasis theory would suggest a role for emotion regulation in restoring psychological homeostasis, and this could be further explored in future research.

Conclusion

This study provides the first evidence that individuals with IBD are at risk of being unable to retain SWB homeostasis and indicates that this population requires specific support to shore up SWB resilience in the light of expected disease-related physical and psychological challenges. This study provides preliminary evidence that mindfulness could support SWB homeostasis, particularly for people with CD. While causal interpretations are not possible, they accord with homeostatic theory, which suggests the ability to restore homeostasis requires a reduction of the dominance of emotion in consciousness. Formal mindfulness practice has been shown to support emotional regulation (Farb et al., 2014; Garland, 2007; Hölzel et al., 2011). It follows that regular mindfulness practice could provide a protective factor against homeostatic defeat experienced by some people with IBD, as potentially indicated by the results in this study.

Summary and Link to Chapter 5

The empirical investigations of this research project have identified that there is merit in continuing to explore the role of mindfulness in restoring mood homeostasis to people experiencing depression. However, without a prospective study, causal relationships between homeostatic defeat, recovery and mindfulness and the presence of psychological and disease symptoms cannot be definitively understood.

It is therefore appropriate to design a study that can prospectively identify the role of mindfulness in SWB homeostasis restoration and improvement of symptoms of depression. Such a protocol is proposed in Study 4.

Chapter 5

Study 4: The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease: A pilot randomised control trial protocol

Note: This is an edited version of the paper published in Social Science Protocols. Edits attend to examiner comments.

Reference:

Lyall, K., Beswick, L., Evans, S., Cummins, R. A., & Mikocka-Walus, A. (2021). The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease. *Social Science Protocols, 4*, 1-12. https://doi.org/10.7565/ssp.2021.6485

Abstract

Objective: The relationship between stress, symptoms of inflammatory bowel disease (IBD), and depression has not previously been considered using the theory of subjective wellbeing (SWB) homeostasis as a conceptual framework. It is proposed that mindfulness, as a mechanism of down-regulating challenging emotion, can aid in the restoration of mood homeostasis and reduce symptoms of both psychological and physiological stress. The study aims to identify whether individuals with Crohn's disease (CD) and co-occurring psychological depression or stress are experiencing the defeat of SWB homeostasis. Further, the study aims to test whether a Mindfulness Based Stress Reduction (MBSR) intervention can restore homeostasis. The study would also identify whether this restoration of homeostasis is associated with a reduction in disease symptomatology. **Methods:** An exploratory randomised control trial with 40 participants recruited from public health gastroenterology patients and

randomly allocated to an 8-week MBSR program or wait-list control. Measures of SWB, depression, stress, and C-reactive protein (CRP) levels will be collected prior to and after the intervention. Individual HPMood set points will be determined from affect data collected over 7 days through momentary sampling techniques prior to the commencement of the intervention. Measures will be repeated at 6-month follow-up. Following this, the wait-list group will be offered the same 8-week MBSR. Hypotheses will be tested using mixed ANOVA and clinical significance tests. **Conclusions:** This study will be an important contributor to knowledge about psychological vulnerability and resilience for people with CD and will provide initial evidence that could contribute to the development of a larger future trial. **Trial Registration:** The trial has been prospectively registered in the Australian New Zealand trial registry - ACTRN12618002009291.

Keywords: Crohn's disease, depression, stress, mindfulness, resilience, SWB homeostasis

The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease: A pilot randomised control trial protocol

Crohn's Disease and Psychological Symptoms

Crohn's disease (CD) is a type of inflammatory bowel disease (IBD), with relapsing symptoms including abdominal pain, change in bowel habit, weight loss and rectal bleeding (Abautret-Daly et al., 2018). CD is increasing in incidence and prevalence across ethnic groups and geographies (Baumgart & Sandborn, 2012). A number of studies have found relationships between stress and disease outcomes (Bernstein et al., 2010; Cámara et al., 2009; Duffy et al., 1991), and there appears to be a growing consensus that stress plays a role in IBD activity (Knowles & Mikocka-Walus, 2015; Triantafillidis et al., 2013). Other psychological conditions are also strongly associated with IBD. A longitudinal analysis of more than 2000 patients (56% with CD) over nine years found a significant association between symptoms of depression and anxiety and disease recurrence (Fairbrass et al., 2021; Mikocka-Walus, Pittet, et al., 2016). A systematic literature review confirmed the higher prevalence of anxiety and depression amongst patients with IBD than healthy controls, with the prevalence rising for those with active disease symptoms (Barberio et al., 2021; Mikocka-Walus, Knowles, et al., 2016).

The high levels of co-morbidity have led to an increase in research into appropriate psychological treatments for patients with IBD (Gracie et al., 2017; Triantafillidis et al., 2013; von Wietersheim & Kessler, 2006). Longitudinal studies have provided evidence that psychological co-morbidity negatively

impacts disease course (Fairbrass et al., 2021) and there are growing calls for patients with IBD to be monitored for mood disorders (Gracie et al., 2018). Psychological treatment is not currently part of usual care in IBD treatment. This may be because there are typically only modest or short-term gains, when the IBD populations is considered (Gracie et al., 2017). However, there is a growing awareness that there are groups who, when targeted, may strongly benefit (Gracie et al., 2017; Mikocka-Walus et al., 2015).

There is, however, a theoretical model which may assist in identifying a subset of people who may benefit from psychological intervention: the theory of subjective wellbeing homeostasis (Homeostasis Theory).

Subjective Wellbeing Homeostasis

Homeostasis Theory was developed to explain constancy in reported levels of SWB across time and populations (Cummins, 1995; Cummins et al., 2018; Cummins et al., 2014; Davern et al., 2007). It proposes that SWB operates as an internal psychological system using homeostatic mechanisms, which maintain SWB within an individual set-point range, even in the face of psychological stressors. It is only when these stressors become overwhelming, and homeostasis is defeated, that chronic psychological consequences emerge (Lyall, Mikocka-Walus, et al., 2021). The theory proposes that there is, for each person, a set-point for a mood-derived positive-activated affect called homeostatically protected mood (HPMood), and that this underlying mood governs subjective levels of wellbeing (Capic, Li, et al., 2018). The level of this set-point is genetically determined and constant. Moreover, the maintenance of this level is supported by a homeostatic system that strives to maintain experienced levels of HPMood within each individual's set-point range

(Cummins, 2016b). According to the theory, stressors challenge homeostatic control, by shifting conscious awareness of affect to the situationally created emotion, rather than the underlying HPMood. If the challenge is strong and chronic, homeostatic control fails, and the consequence is persistent negative affect, and depression (Cummins, 2010).

Measuring HPMood and homeostatic defeat

Measuring HPMood, and homeostatic defeat, requires the ability to separate out the emotional content of responses to affect-related questions, from the underlying HPMood. This has been demonstrated by a processes that examines the within-person standard deviation of SWB scores over time, demonstrated first by Cummins et al. (2014); and then (Capic, Li, et al., 2018). Individuals who are experiencing homeostatic failure will have a higher level of emotional content, arising from stress, and this emotional content will dominate their underlying HPMood and mask their responses to either questions of SWB, or the questions used to elicit HPMood (happy, content, alert). Thus, the individual will have much larger variations of those reported measures over time.

A substantial empirical literature supports Homeostatic Theory (see Cummins, 2017, for a summary). Clinical benefits of this theory are that individuals who are experiencing mood homeostasis defeat can be targeted to identify appropriate treatment. However, there has been little research into how the theory may be effectively translated into clinical programs or interventions. Specifically, this theorised relationship has not been empirically tested using a randomised control trial (RCT) with a population known to be a risk of psychological distress. This study aims to explore this research gap by focussing

on an intervention that has been proposed to have similar mechanisms to mood homeostasis: mindfulness (Lyall, Mikocka-Walus, et al., 2021).

Mindfulness

Mindfulness first came to the attention of western psychologists in the 1970s with the development of Mindfulness Based Stress Reduction (Kabat-Zinn, 2013). There are many approaches and definitions of mindfulness, but a common thread is that mindfulness introduces "a space between one's perception and response" (Bishop et al., 2004, p. 232). The outcome of mindfulness has been described as equanimity, defined as "an even-minded mental state or dispositional tendency toward all experiences or objects, regardless of their affective valence … or source" (Desbordes et al., 2015, p. 4). This description is analogous to a conscious awareness of HPMood. If stress precipitates failure of SWB homeostasis, the alleviation of stress should assist the restoration of homeostasis; leading to improvements in both mood and disease symptoms (Lyall, Mikocka-Walus, et al., 2021).

Few studies have explored the impact of mindfulness on wellbeing in patients with inflammatory bowel disease, and even fewer have focused on the disease of interest in this study, CD, or on the intervention of interest, Mindfulness Based Stress Reduction (MBSR). One study, involving 60 inflammatory bowel disease patients (44 with CD) compared a mindfulness-based intervention with a treatment-as-usual control and found significantly greater improvements in depression at the six-month follow up. Impact on disease symptoms was not measured (Neilson et al., 2015). A pilot RCT involving 44 patients investigated the feasibility of conducting a larger mindfulness-based cognitive therapy RCT (Schoultz et al., 2015). Their exploratory findings found a

significant improvement in scores for depression for the intervention group compared to the wait-list control.

Emerging evidence that MSBR interventions may be effective for both psychological and physiological stress comes from a randomised experimental study with 49 healthy participants (Rosenkranz et al., 2013). Both psychological and physiological stress were induced, separately, to participants before and after their training (MBSR or active education-based control) programs. Results showed both groups had comparable post-training cortisol responses; however, the MSBR group had a significantly smaller post-stress inflammatory response despite the similar levels of stress hormones.

It is not known if mindfulness can reduce inflammatory markers of IBD. One small randomized control trial involving 29 IBD patients explored the effectiveness of breathing, movement and meditation on psychological and disease symptoms (Gerbarg et al., 2015). The treatment group had significant improvements in psychological measures (anxiety, depression, and stress) as well as disease measures (C-reactive protein, a marker of disease activity) at the six-month follow-up. The intervention, however, was a collection of techniques, mostly based on the martial art of Qigong, making replication difficult.

Many previous IBD studies have recruited patients with either ulcerative colitis or CD, reducing the size of the sample in each disease category. This approach has been critiqued as creating dilution effects (Cámara et al., 2009), with a recommendation that future studies consider each condition separately. To the authors' knowledge there has been no study of the impact of MBSR training on objective inflammatory markers of CD such as C-reactive protein levels (CRP). CRP is considered to be an important measure in CD diagnosis, as well as

measurement of disease activity measurement and response to treatment (Magro et al., 2014). If MBSR is found to improve disease activity in patients with CD, while simultaneously restoring mood homeostasis, it would provide further support for interventions that target psychological stress reduction to improve physiological outcomes.

Study Objectives

The overarching aim of the study is to explore the relationship between HPMood, stress, inflammation, and depression in a sample of patients with CD. Specifically, the study aims to explore whether mindfulness training can:

1. Reduce symptoms of *stress* following the MBSR course as compared to standard care and to investigate whether this is sustained at 6 month follow up,
2. Reduce symptoms of *depression* following the MBSR course as compared to standard care and to investigate whether this is sustained at 6 month follow up
3. Reduce *inflammation* following the MBSR course as compared to standard care and to investigate whether this is sustained at 6 month follow up.
4. Reduce the fluctuation of *emotional content* in participants' experience of their underlying mood following the MBSR course as compared standard care and to investigate whether this is sustained at 6 month follow up.

Hypotheses

1. That, prior to the MBSR intervention, levels of perceived stress, depression, CRP and HPMood variance will not differ between the intervention and usual care control groups.
2. That, following the intervention, levels of perceived stress, depression, CRP and HPMood variance will decrease for the intervention, but not for the usual care control groups.
3. That the effectiveness of the intervention can be predicted from the baseline levels of HPMood, such that only participants whose baseline levels show evidence of homeostatic defeat would be predicted to achieve homeostasis as a result of the intervention.

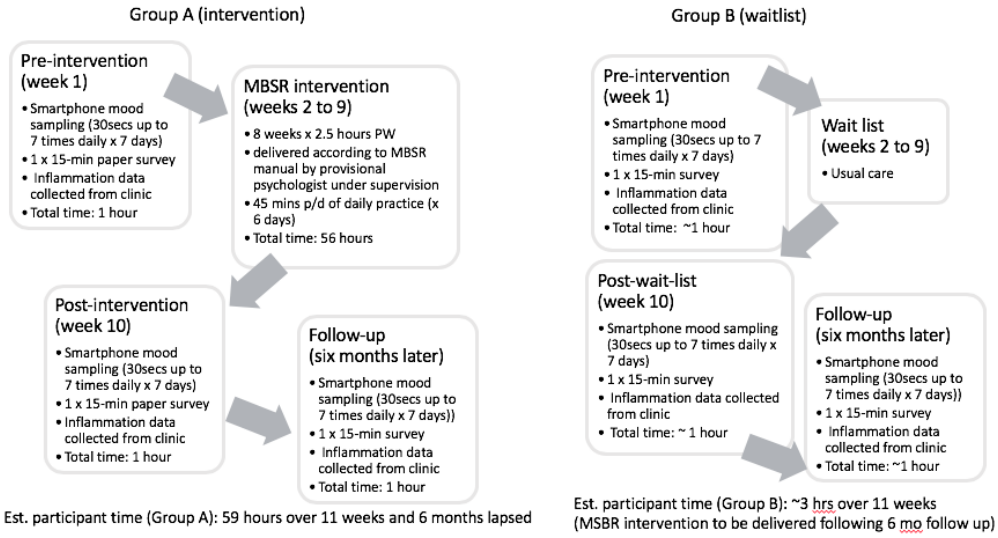
Method and Analysis

Design

An exploratory randomised single-blind controlled trial, with a sample of approximately 40 CD patients, with 20 forming the mindfulness group and 20 participating in a wait-list control/treatment as usual (Figure 1). Patients will be randomly assigned to either group A (mindfulness) or group B (waitlist/usual care) using a computer-generated block randomisation by a statistician with no patient contact. The intervention group will participate in an 8-week Mindfulness Based Stress Reduction (MBSR program).

Figure 1

Study Design and Timeline



Participants

Participants will be CD patients currently receiving treatment at public gastroenterology practices in Victoria (e.g., Barwon Health Gastroenterology).

Inclusion Criteria

1. A clinically established diagnosis of Crohn's disease (per usual clinical practice in a tertiary care centre)
2. Sufficient knowledge of English to understand the study instructions, answer the questionnaires and participate in the MBSR group.
3. 18 years of age or older
4. Competence to consent
5. Access to the internet by a smart phone and the willingness to download the Instant Survey app.
6. A willingness to commit to 2.5 hours of MBSR at the identified times for a period of 8 consecutive or near-consecutive weeks, and engage with the homework sheets in the intervening period.

7. Scores of depressive symptoms at mild or moderate levels of the DASS scales

Exclusion Criteria

1. Alcohol/substance dependence, as identified by the gastroenterology team
2. Severe mental illness (e.g., psychosis, schizophrenia), as identified by the gastroenterology team
3. Severe anxiety or depressive symptoms as indicated by a scores >21 on the depression scale or > 15 on the anxiety scale of the DASS measure
4. Significant cognitive impairment
5. Inability to read or write
6. Inability to speak or understand English
7. A regular (weekly or more often) mindfulness practice.

Withdrawal criteria

Participants will be free to withdraw at any time without any aspect of their IBD care being affected by their decision to withdraw from the study.

Recruitment

Potentially eligible patients will be identified by the IBD nurse and/or gastroenterologists and contacted in person, via letter, or email and invited to participate. The study objectives and procedure will be outlined in an initial conversation between the study investigators and potential participant. The potential participant will be provided with the participant information and consent form. Participants will be assured their participation is voluntary and will not impact their treatment.

Intervention and control condition

The MBSR intervention will be delivered following the procedure on the Palouse Mindfulness training course, as shown in Table 1. Each week consists of a 2.5-hour group session and up to 45 minutes of daily mindfulness practice using homework exercises. The group sessions involve a combination of watching videos explaining various mindfulness techniques, practicing those techniques and group discussion. Homework sessions will involve daily practice of the techniques learned.

The waitlist control group will be provided with the opportunity to complete the same MBSR course, following the completion of the 6-month follow-up period. In the event that the intervention is of no benefit or produces some undesired effects it will not be offered to the control group. However, the control group will then receive information on other free evidence-based tools for self-care, e.g., www.tameyourgut.com.

Table 1

Session Structure of the MBSR program

Week	Content	Format/materials	Homework tasks
1 “Simple Awareness”	Introduction to the body scan	Videos, and introductory reading, participation in 30-minute body scan, group discussion	Reading, practice sheets
2 “Attention and the brain”	Introduction to sitting meditation	Videos, formal sitting meditation practice (10 minutes), group discussion	Reading, practice sheets
3 “Dealing with Thoughts”	Introduction to yoga	Videos, formal introduction to yoga practice (30 minutes), group discussion	Reading, practice sheets
4 “Stress: responding vs reacting”	Stop: the one-minute breathing space	Videos, formal introduction to yoga 2, Group discussion	Reading, practice sheets
5 “Dealing with Difficult emotions or physical pain”	Turning toward	Videos, the Turning Toward meditation, group discussion	Reading, practice sheets
6 “Mindfulness and Communication”	Mountain and Lake meditations	Videos, Mountain and Lake meditation, communication calendar, group discussion.	Reading, practice sheets
7 “Mindfulness and compassion”	Lovingkindness meditation	Videos, Lovingkindness meditation, group discussion	Reading, practice sheets
8 “Conclusion”	Developing a practice of your own	Videos, group discussion and certificates	

As part of the introduction in the first session of the course, participants will be informed about the possibility that some aspects of mindfulness practice could result in some distress and recommended actions to take should this occur. This information will also be prominently feature in the participant manual.

Measures

Subjective wellbeing (SWB) will be measured with the Personal Wellbeing Index (International Wellbeing Group, 2013). HPMood will be measured by three items: right now, how happy do you feel, right now, how content do you feel, right now, how alert do you feel (Davern et al., 2007). Symptoms of depression and stress will be measured through the relevant sub-scales of the Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995). Inflammation will be measured through c-reactive protein levels.

Procedure

At T1, participants will be prompted, via a smartphone app known as Instant Survey, to answer a short series of questions relating to their HPMood. These will include the 3 HPMood variables, along with additional questions, "how depressed do you feel" and "how stressed do you feel". They will be prompted to answer these questions up to 7 times per day for 7 days. Each questionnaire will take approximately 30 seconds to complete. At the end of the 1-week period, participants will be asked a series of general questions about their SWB, depression and stress, once only and also via the smart-phone app. These questions will take approximately 15 minutes to complete. Following the completion of these initial surveys, participants in the intervention group will be provided with the 8-week MBSR intervention; while those in the wait-list will be provided with usual treatment, including anti-inflammatory medication if indicated. At completion of the MBSR course, the 1-week moment sampling questions and the longer survey will be repeated; along with an evaluation of the MSBR course. Participants will also be asked to provide a log of their homework practice. Participants will then be asked to participate in a follow-up 6 months

later, which will repeat the 1-week moment sample and longer surveys. Participants in the control group will be provided with the surveys eight weeks after they completed them in T1.

Data Analysis

Analysis of quantitative data

Given the exploratory nature of this pilot RCT, no *a priori* power analysis was conducted. The sample size of 40 was chosen as being an achievable size for the study's resources, and will allow up to four MBSR groups, each containing 10 participants.

Data analyses conducted for the hypotheses are as follows:

Analyses: For all outcome variables (stress, depression, SWB and CRP levels, HPMood variance), mixed ANOVA (with both between-subjects and within subject factors) analyses will be conducted to compare the results for the intervention and control groups. For mood homeostasis, the outcome measure is the level of within-person variance, calculated by analysing each individual's scores contributed over the one-week period (Capic, Li, et al., 2018).

To account for the likely lack of power, data from the intervention group will also be analysed using clinical significance testing to identify whether their scores are closer to known normative data or to pathological norms (Jacobson & Truax, 1991). Normative range for each outcome measure will be sourced as follows: For SWB and HPMood: Capic, Li, et al. (2018); for depression and stress, the DASS severity scales; for CRP levels, based on Australian Clinical Laboratories reference range.

For the intervention group, analyses for the six-month follow-up will control for whether the individual is continuing to engage in regular mindfulness

practice. This will be assessed via self-report, by asking participants to report how often they continue to engage in mindfulness practice.

Ethical Approval and Trial Registration

This protocol has been approved by the Barwon Health Human Research Ethics Committee (ref: 18/182) and registered with the Australian New Zealand Clinical Trials Registry (ACTRN12618002009291).

Discussion

The psychological cost of Crohn's disease (CD) is high. Given the prevalence of the disease in Australia, and the high levels of psychological symptoms associated with the condition, it is important that potential treatments that might help to improve both psychological and physiological outcomes are explored (Häuser et al., 2014; Lores et al., 2021). While many IBD patients are increasingly exploring the use of non-traditional psychological treatments such as mindfulness, more research is needed to identify the specific benefits on both disease activity and psychological symptoms (Torres et al., 2019). More broadly, there is a growing call for research that more comprehensively understands the environmental triggers associated with IBD (Ho et al., 2019), and in particular to do this with longitudinal research that can provide insight into causal relationships. In addition, studies that identify the role of resilience in combatting the psychological and physiological symptoms associated with IBD are needed, building on emerging evidence of resilience protecting wellbeing in IBD patients (Sehgal et al., 2021; Wang et al., 2021).

Our proposed study can make an important contribution to knowledge. The study has been framed within a clear theoretical context, outlining the likely relationship between stress, mood, depression, and inflammation. This pilot trial

has the potential to contribute to further research in three ways. First, its randomised control design will allow between-group comparisons that will provide pilot data for subsequent effectiveness studies. Second, data from the participants can be analysed on an individual basis to determine whether progress made was clinically significant. Third, the ability to identify whether individuals are in HPMood homeostatic defeat could help to identify likely targets of people who could benefit from MBSR interventions.

There are some limitations with this proposed study. The small sample size would mean that the results can be considered indicative only; however, they will add to the growing literature and provide useful guidance for larger, future studies. Our focus on CD patients would mean results could not be generalised to other populations with IBD; however this is also a strength as it supports calls to research interventions with each IBD disease cohort separately (Cámara et al., 2009) and also responds to evidence that people with CD have more psychological complaints than those with another common subtype of IBD, ulcerative colitis (Mikocka-Walus, Knowles, et al., 2016; von Wietersheim & Kessler, 2006). Another potential limitation could emerge should coronavirus-19 pandemic continue and result in restrictions preventing group work. Given the MBSR protocol involves weekly group sessions, it will be important to consider the impact on the study should an on-line alternative need to be developed.

Strengths of the proposed study are the RCT design, and the collection of inflammatory markers as well as subjective symptoms. Recruitment through the gastroenterology unit is also likely to include a wide cohort of patients experiencing both active and inactive disease, responding to a known challenge in prior studies that more commonly involve only patients with inactive or mild

disease symptoms (Knowles et al., 2013). Finally, the ability to determine the clinical significance of any improvement of each individual participant, which can provide direct guidance for future research as well as inform clinical decisions, is the study's clear strength.

Chapter 6

General discussion

Summary of findings and contribution to knowledge

This project started with a bold aim to investigate a novel idea: that there are conceptual similarities between mindfulness and mood homeostasis, and these similarities may explain the clinical benefits of mindfulness on the treatment of symptoms of depression. The proposal, presented in this thesis for the first time, was that mindfulness supports the efficient operation of the internal homeostatic psychological system known as subjective wellbeing (SWB) homeostasis by promoting conscious access to the underlying positive affect, homeostatically protected mood (HPMood) that this system protects. In so doing, symptoms of depression, which are a consequence of homeostatic failure, are alleviated and replaced with equanimity, or psychological homeostasis.

The conceptual review provided in Study 1 presented a clear relationship between the mechanisms involved in mindfulness practice, their proposed role in promoting recovery from depression, and the theoretical constructs of HPMood and homeostasis (Lyall, Mikocka-Walus, et al., 2021). The presented model of *moodfulness*, by which mindfulness is thought to resolve symptoms of depression by activating restoration of HPMood, offers new understanding about how mood homeostasis might be facilitated by mindfulness practice and be involved in the restoration of homeostasis following depression. Its synthesis of two hitherto unconnected fields of research – mindfulness and SWB homeostasis – is a major contribution to knowledge. The result is an important new conceptual link between ancient and contemporary knowledge of human suffering and the pathways to relief of this suffering.

Having presented this conceptual synthesis, the project then turned to investigating the proposed relationships empirically, using a sample of people with Crohn's disease (CD) or ulcerative colitis (UC), both types of inflammatory bowel disease (IBD). The sample was chosen due to the known associations between IBD and psychological symptoms (Hu et al., 2021), and to enable the exploration of the potential relationship between psychological and physiological stress (disease symptoms) and SWB homeostasis. Study 2 aimed to empirically investigate a core component of the theory of SWB homeostasis (Homeostasis Theory); that relationships between HPMood and predictor variables such as psychological or disease symptoms, are non-linear and can be shown to demonstrate a 'resilience effect". Such a resilience effect, seen in the data, can be understood as evidence of the homeostatic system.

The reason for this proposed resilience effect stems from the nature of the HPMood setpoint. This setpoint provides the constant presence of the HPMood composite affect (happy, content, and alert) at an idiosyncratic level for each person (Capic, Li, et al., 2018). However, the accuracy of the current measure of HPMood (the aforementioned affects) depends on the level of challenge to homeostatic control experienced by the individual. The challenge is experienced as situationally derived emotion (emotion about something), that can be positive (e.g., a recent marriage) or negative (e.g., recent monetary loss). The level of emotional challenge influences the HPMood measure as emotion dominates consciousness so as to provoke behavioural responses (Ekkekakis, 2013).

Under operating conditions where the level of challenge is gradually increased, from low to moderate levels, homeostasis will continue to chronically maintain HPMood within its setpoint range for each person. This range averages

about 8 percentage points on either side of the setpoint (Capic, Li, et al., 2018). Provided that this homeostatic control remains intact, the HPMood setpoint variance will remain in each response. This variance adds stability to the measure which, when combined with a linear increase in psychological challenge, creates a linear relationship with the challenging variable. However, as the level of challenge increases to the point of homeostatic failure, the HPMood setpoint will disappear from the individual's response. This is due to the negativity of the challenge dominating the individual's internal experience of the composite affects inquired about. This will be evident in the measured variable as an accelerated downward turn.

As predicted, Study 2 did find evidence for the proposed non-linear relationship between depression and HPMood, and the resilience effect appeared at around 60 percentage points (pp) of HPMood, which is where the theory would expect it to emerge. This, too, is an important contribution to knowledge as hitherto this theorised relationship has not been demonstrated in data of people known to be psychologically challenged.

Interestingly, this occurred only for the cohort of people with CD and not for people living with UC. Even for the CD cohort, the proposed non-linear relationship was limited to the interplay between depression and HPMood and was not apparent for either psychological stress or the disease symptoms associated with IBD. It is not entirely clear why these distinctions occurred between these two samples, although some evidence suggests that people with CD carry a greater psychological burden than those with UC (Leone et al., 2019) Homeostasis Theory would suggest that differential access to resources, which has been observed between these two populations, might be a factor (Le Berre et

al., 2020). Future research should collect data on the differential factors involved in the two disease conditions, focusing on more sophisticated measures of disease activity and location, so as to better investigate the disease-related factors involved in SWB homeostasis and homeostatic defeat.

Additionally, there was only tentative evidence for the role of trait mindfulness in aiding the resilience effect, with a non-linear relationship between mindfulness and HPMood observed, but again, only for people with CD. This study, however, modelled the relationship between trait mindfulness and HPMood. Given that our core proposal is that mindfulness practice (rather than personality characteristics) promotes conscious access to HPMood, empirical tests were required to identify the nature of mindful practice on HPMood and homeostasis. Study 3 undertook this task, by identifying whether mindfulness practice increased the chances of a participant reporting a SWB score within the normal (homeostasis) range.

The study found some support for the role of mindfulness practice in SWB homeostasis, in that participants with CD were more likely to be reporting SWB levels within the population setpoint range if they were engaged in mindfulness practice. However, the findings did not extend to those participants living with UC. It is not immediately clear why participants with different types of inflammatory diseases might have these differing experiences of the role of mindfulness, but it is possible that the more complex disease path of CD might be more sensitive to the positive intervention of resources.

Interestingly, the study failed to find evidence for the proposed role of psychological stress in predicting homeostasis defeat. These results could have been influenced by our choice of DASS depression and stress items, as there is

some evidence that the DASS scales are primarily measuring a single construct, psychological distress (Henry & Crawford, 2005; Osman et al., 2012). Thus, our items may not have been able to identify the differential nature of stress and depression symptoms. It is also possible that our limited measures of stress were unable to discern between adaptive and maladaptive stress responses. It is possible that for some individuals, stress provides a motivator for protective behaviours that may support the maintenance of homeostasis, in the same way that stress is considered necessary for performance (Dhabhar, 2018). Similarly, it is possible that chronic, or enduring stress, might influence homeostasis differently to short-term stress. Further investigations exploring the nature of psychological stress, SWB and IBD are warranted.

While the above empirical evidence provides some intriguing insights into these relationships, it is clear the proposed connection between depression, mood homoeostatic defeat, mindfulness, and homeostatic restoration, requires further investigation. Study 4 presented a protocol for a prospective randomised control trial that, if conducted, would provide more fulsome answers to the research questions our *moodfulness* synthesis propose (Lyall, Beswick, et al., 2021).

Contribution to Theory and Future Directions

Homeostasis Theory, which has been developed over the past 25 years to explain SWB stability and volatility, has not yet been well integrated with clinical practice, and key elements of the theory have been only weakly empirically tested. This research project goes some way to bridging these gaps, and its findings offer some optimism that Homeostasis Theory can be validly applied to clinical populations. It provides new information about homeostatic resilience with support for the theorised relationship between psychological challenge and

SWB resilience. In addition, it offers new insight into the potential role of HPMood in recovery from clinical presentations such as depression and inflammatory bowel diseases and proposes how mindfulness might interact with this homeostatic system.

One way to understand homeostasis is the role of the system's response to perturbations that threaten to push the controlled variable beyond its healthy range. Thus, Homeostasis Theory has long proposed that the homeostatic system governing SWB would operate, as do other homeostatic systems, by responding to challenges to SWB levels at or near the limits of the setpoint range. The theory proposes that resources (internal and automatic, as well as external and behavioural) would be diverted to ensure that the system is managed within its setpoint range. Inherent in this assumption is that the relationship between SWB and its challenging agents is non-linear, as defences buffer SWB through increasing levels of challenge. Although there has been empirical evidence of such a relationship, until now, this has been presented using linear statistics only (Bittar, 2009; Cummins et al., 2012).

This thesis has contributed to this theoretical view by applying Generalised additive models (GAMs) to cross-sectional data containing levels of HPMood and psychological symptoms. The results confirm that, for a population experiencing a chronic inflammatory condition, CD, the relationship between depression and HPMood, is indeed non-linear, and that HPMood levels withstand some increased pressure from challenges. This ability to be resilient to challenges has limits, and as predicted, the rate of decline in HPMood increases once the outer limit of resilience is achieved.

In so doing, the thesis identified some interesting elements that could be incorporated into further theoretical knowledge. First, the predicted non-linear relationship was only apparent in a cohort of people who have CD, and not for a sample who experience UC, a different chronic inflammatory condition. Second, there was no evidence that psychological stress, or physiological stress (in the form of disease symptoms) contributed to the resilience effect in the same way. This contrasts with expectation from Homeostatic Theory, which would point to the role of stress in challenging homeostasis.

The results of analysis of the IBD sample, did, on the other hand, provide powerful insight into the role of resources applied to homeostatic systems. In this case, we were able to identify that one of the IBD cohorts – those who live with CD – were more likely to remain in the SWB homeostasis range if they practiced mindfulness. This suggests the possibility that resources, applied to a system under strain, can protect homeostatic control. A prospective test of this potential relationship is an exciting avenue of future research.

In sum, this thesis has demonstrated, to some extent, that the proposed conceptual similarities between mindfulness and HPMood warrant further exploration. It is clear that, for some people, the practice of mindfulness increases their chances of being within a healthy range of SWB, and this finding supports the *moodfulness* model proposed in this thesis. Further empirical support for the *moodfulness* model could provide opportunities to substantially adapt Homeostatic Theory in the following ways.

1. If mindfulness practice can aid in the restoration of SWB homeostasis and lead to the experience of HPMood, or *moodfulness*, then these mechanisms need to be more fully integrated into Homeostatic

Theory. Currently, the theory largely focuses on the homeostatic mechanisms of internal and external resources to buffer SWB homeostasis. Further research could more fully identify cognitive and emotional regulation processes (including exposure) that might provide a more complete understanding of the psychological homeostatic system.

2. The processes discussed above, could be the key features of homeostatic support, rather than mindfulness *per se*. Other activities that similarly involve the decentering of emotional and cognitive content associated with distress could similarly lead to homeostatic restoration. Future research could seek to identify whether these processes, delivered through other forms of psychological treatment (for example eye movement desensitisation and reprocessing, or art-based therapy), could lead to improved conscious access to HPMood. The aim here would be to determine whether different forms of cognitive decentering or the extinction of emotional responses to stimuli are equally effective in achieving mood homeostasis.
3. A consequence of such investigations would be the ability to offer a variety of HPMood-inducing therapies to respond to different needs and preferences of individuals.
4. In general, acceptance of HPMood as a homeostatically managed psychological variable requires much additional research support before becoming a generally acceptable phenomenon. There are many avenues such support could take but, essentially, all the principles that attend physiological homeostasis must also apply within psychological

homeostasis. No doubt the earliest instances of homeostasis occurred within biology. It therefore follows that, based on evolutionary parsimony, the development of psychological homeostasis will most likely be based on similar operational principles. Additionally, it is likely that the operation of psychological homeostasis is embedded within genetics, and that individual setpoints are genetically determined. If this is so, then all humans will share the same essential operational mechanisms, such as the same average level of the homeostatic setpoint and the extent of the setpoint range. Further research into Homeostatic Theory, therefore, needs to involve cognitive neuroscience and behavioural biology as well as psychological interventions.

5. Finally, the proposed theoretical relationship between homeostasis and depression has achieved some additional support with the studies presented in this thesis. However, given the complexity of depression and its symptomatology, and the limitations of the current study, this proposed relationship requires further testing. However, further insight into this relationship has the potential to enhance depression diagnosis and treatment.

Clinical Implications

The findings of this research are pertinent to any population of individuals who are experiencing SWB homeostasis defeat. Homeostatic Theory would say that human evolution has provided a mechanism by which we can naturally recover from adversity and stress, through a system that maintains homeostatic control of SWB. Thus, acute variances in SWB outside each setpoint range, in

response to conditions of challenge, are expected. However, chronic homeostatic defeat (i.e., long-term levels of SWB outside the individual's setpoint range) is maladaptive and indicates the homeostatic system is suffering from a lack of resources. Under such conditions, HPMood has been obscured from consciousness, and the system is overwhelmed by emotion and stress.

Thus, clinical responses to such events require a focus on providing the needed resources to enable the system to regain homeostatic control. The importance of this factor cannot be over-estimated. If each person has access to an internal, robust, and effective system of psychological resilience to aid recovery from challenge, then clinical considerations must turn to understanding how to identify individuals in homeostatic defeat, and how to support them to re-engage their internal resilience through conscious access to HPMood.

One proposed resource is mindfulness practice and the development of equanimity. According to the understanding gained by this research project, mindfulness practice, and the development of equanimity, is a powerful homeostatic resource because of its ability to reduce the dominance of emotion in consciousness (and thus SWB levels) and allow the underlying, slightly positive affect of HPMood to be accessed. It offers therefore a parsimonious explanation for the role of mindfulness interventions in treatment of depression, as well as providing a previously unexplored potential path for further research and theory development.

Limitations and Directions for Future Research

The main limitation of this research project was the inability, due to resource challenges, to test a central question: does mindfulness practice restore SWB homeostasis in individuals in SWB defeat? While the evidence presented in

this thesis provides a compelling story that this may well be the case, without prospective studies, definitive conclusions cannot be drawn. This question is proposed to be followed up in the future with a study that longitudinally assesses the SWB of a group of individuals to ascertain their likely SWB setpoint and identify individuals in SWB homeostasis defeat. Then, a mindfulness-based intervention could determine whether the theorised re-activation of the homeostatic system has occurred. The proposed study would aim to further understand the relationship between stress and inflammation by identifying whether individuals with Crohn's disease are experiencing the defeat of SWB homeostasis. Further, the study aims to test whether the MBSR intervention could restore homeostasis. The study would also identify whether any such restoration of HPMood homeostasis is associated with a reduction in disease symptomatology, perceived stress levels and symptoms of depression.

Additional questions arise from this research. First, the results that indicate a non-linear relationship between HPMood and psychological symptoms should be tested on subsequent samples to identify whether the result can be repeated. Second, the relationship between different types of psychological symptoms, as well as physiological counterparts such as inflammation, needs to be further understood, again by identifying relevant samples and further testing this project's hypotheses.

Conclusion

This project considered an ambitious task to understand the nature of human suffering within the context of two previously unconnected spheres: mindfulness practice and psychological research. It proposed some important areas of potential cross-over and synthesis and presented a new model of

moodfulness. It therefore opened what is hoped to be a new and important line of human inquiry.

Chapter 7

Concluding Personal Reflections

The seeds of this project were sown with a conversation between myself and Emeritus Professor Robert Cummins in a café in Brunswick Street, Melbourne, some years before I enrolled in my doctorate program, at a time when our relationship was established through a different set of circumstances. We were musing on his discovery of HPMood, and how its presence could be tested. "We could ask the Buddhists," he said at one point, "as I suspect that meditative states are just states of HPMood".

As I am a long-time yoga and mindfulness practitioner, this piqued my curiosity. We returned to the conversation many times, pondering how to identify and test these propositions—at first, in purely speculative terms. By the time I was accepted into the candidature at Deakin University, it felt inevitable that I would be the doctoral student who would take these ideas forward.

Initially, the proposal was to create an intervention study that would ascertain whether people who were depressed were firstly, in SWB homeostatic defeat, and secondly, could experience a return to SWB homeostasis following a mindfulness intervention. Many obstacles prevented that study from forming a core part of this thesis, and thus the focus turned to a theoretical and empirical investigation of some of the core assumptions behind such a research question. It quickly became apparent that, while there was *prime facie* merit for the idea that meditation and mood homeostasis have much in common, it required a major analysis and integration of the literature that had not previously been attempted.

And so, the work began to bring together teachings from thousands of years of contemplative practice with more recent knowledge about subjective

wellbeing and depression. This part of the project provided its own challenges, with multiple drafts of Study 1 required to fully, and effectively, communicate the theorised synthesis between these two hitherto disconnected areas of scholarship.

Attempts to identify a research sample that could aid in the advancement of these thoughts led me to a group of adults who live with inflammatory bowel disease (IBD); a disease that often manifests with psychological symptoms. Although an intervention study was not achieved in this project, a randomised control study was designed, ethics approval received, and the trial was registered before circumstances led to its deferral. Nonetheless, the contribution of a cross-sectional sample of people with IBD provided valuable, albeit, initial support, that mindfulness practice could be associated with SWB homeostatic resilience. I am very grateful for these participants' willingness to contribute to this research.

Finally, this project led me to develop new skills in statistical techniques, namely generalised additive models, which provided a solid framework from which to test a core component of Homeostatic Theory.

I end this project with as much curiosity as I began it. There are many questions that remain unanswered. My thirst for knowledge has not yet been quenched, and I would hope that, in itself, is an indication of a successful doctoral project.

References

Abautret-Daly, Á., Dempsey, E., Parra-Blanco, A., Medina, C., & Harkin, A. (2018). Gut–brain actions underlying comorbid anxiety and depression associated with inflammatory bowel disease. *Acta Neuropsychiatrica, 30*(5), 275-296. https://doi.org/10.1017/neu.2017.3

Abautret-Daly, Á., Dempsey, E., Riestra, S., de Francisco-García, R., Parra-Blanco, A., Rodrigo, L., Medina, C., Connor, T. J., & Harkin, A. (2017). Association between psychological measures with inflammatory anddisease-related markers of inflammatory bowel disease. *International Journal of Psychiatry in Clinical Practice, 21*(3), 221-230. https://doi.org/10.1080/13651501.2017.1306081

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596

Ananthakrishnan, A. N. (2015). Epidemiology and risk factors for IBD. *Nature Reviews Gastroenterology & Hepatology, 12*(4), 205. https://doi.org/10.1038/nrgastro.2015.34

Andrews, F. M., & Withey, S. B. (1976). *Social indicators of well-being: Americans' perceptions of life quality*. Plenum Press.

Armenta, C., Bao, K. J., Lyubomirsky, S., & Sheldon, K. M. (2014). Is lasting change possible? Lessons from the Hedonic Adaptation Prevention model. In *Stability of Happiness* (pp. 57-74). Elsevier. https://doi.org/10.1016/b978-0-12-411478-4.00004-7

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125-143. https://doi.org/10.1093/clipsy/bpg015

Barberio, B., Zamani, M., Black, C. J., Savarino, E. V., & Ford, A. C. (2021). Prevalence of symptoms of anxiety and depression in patients with inflammatory bowel disease: A systematic review and meta-analysis. *The Lancet Gastroenterology & Hepatology*. https://doi.org/10.1016/S2468-1253(21)00014-5

Barrett, L. F., Quigley, K. S., & Hamilton, P. (2016). An active inference theory of allostasis and interoception in depression. *Philosophical Transactions of the Royal Society B, 371*(1708), 20160011. https://doi.org/10.1098/rstb.2016.0011

Bartels, M., Cacioppo, J. T., van Beijsterveldt, T. C., & Boomsma, D. I. (2013). Exploring the association between well-being and psychopathology in adolescents. *Behavior Genetics, 43*(3), 177-190. https://doi.org/10.1007/s10519-013-9589-7

Batchelor, M. (2011). Meditation and mindfulness. *Contemporary Buddhism, 12*(01), 157-164. https://doi.org/10.1080/14639947.2011.564832

Batchelor, M. (2018). Vedanā or Feeling Tone: A practical and contemporary meditative exploration. *Contemporary Buddhism, 19*(1), 54-68. https://doi.org/10.1080/14639947.2018.1442142

Baumgart, D. C., & Sandborn, W. J. (2012). Crohn's disease. *The Lancet, 380*(9853), 1590-1605. https://doi.org/10.1016/S0140-6736(12)60026-9

Bawa, F. L. M., Mercer, S. W., Atherton, R. J., Clague, F., Keen, A., Scott, N. W., & Bond, C. M. (2015). Does mindfulness improve outcomes in

patients with chronic pain? Systematic review and meta-analysis. *British Journal of General Practice, 65*(635), e387-e400. https://doi.org/10.3399/bjgp15X685297

Beck, A. T. (1964). Thinking and depression: II. Theory and therapy. *Archives of General Psychiatry, 10*(6), 561-571. https://doi.org/10.1001/archpsyc.1964.01720240015003

Beck, A. T., Steer, R. A., & Carbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review, 8*(1), 77-100. https://doi.org/10.1016/0272-7358(88)90050-5

Bernstein, A., Hadash, Y., & Fresco, D. M. (2019). Metacognitive processes model of decentering: Emerging methods and insights. *Current Opinion in Psychology, 28*, 245-251. https://doi.org/10.1016/j.copsyc.2019.01.019

Bernstein, A., Hadash, Y., Lichtash, Y., Tanay, G., Shepherd, K., & Fresco, D. M. (2015). Decentering and related constructs: A critical review and metacognitive processes model. *Perspectives on Psychological Science, 10*(5), 599-617. https://doi.org/10.1177/1745691615594577

Bernstein, C. N. (2017). Changes in the epidemiology of inflammatory bowel disease—Clues for aetiology. *Alimentary Pharmacology & Therapeutics, 46*(10), 911-919. https://doi.org/10.1111/apt.14338

Bernstein, C. N., Singh, S., Graff, L. A., Walker, J. R., Miller, N., & Cheang, M. (2010). A prospective population-based study of triggers of symptomatic flares in IBD. *The American Journal of Gastroenterology, 105*(9), 1994. https://doi.org/10.1038/ajg.2010.140

Best, W. R., Becktel, J. M., Singleton, J. W., & Kern Jr, F. (1976). Development of a Crohn's disease activity index: National Cooperative Crohn's Disease Study. *Gastroenterology, 70*(3), 439-444. https://doi.org/10.1016/S0016-5085(76)80163-1

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., & Velting, D. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230-241. https://doi.org/10.1093/clipsy/bph077

Bittar, R. (2009). *Subjective well-being maintenance: investigating depression as suppressed homeostatically protected mood* [D.Psych. (clinical) thesis, Deakin University]. DRO. http://hdl.handle.net/10536/DRO/DU:30030531

Black, D. S., & Slavich, G. M. (2016). Mindfulness meditation and the immune system: A systematic review of randomized controlled trials. *Annals of the New York Academy of Sciences, 1373*(1), 13. https://doi.org/10.1111/nyas.12998

Blackwell, J., Saxena, S., Petersen, I., Hotopf, M., Creese, H., Bottle, A., Alexakis, C., & Pollok, R. C. (2020). Depression in individuals who subsequently develop inflammatory bowel disease: A population-based nested case–control study. *Gut*. https://doi.org/10.1136/gutjnl-2020-322308

Blore, J. D., Stokes, M. A., Mellor, D., Firth, L., & Cummins, R. A. (2011). Comparing multiple discrepancies theory to affective models of subjective wellbeing. *Social Indicators Research, 100*(1), 1-16. https://doi.org/10.1007/s11205-010-9599-2

Bodhi, B. (2011). What does mindfulness really mean? A canonical perspective. *Contemporary Buddhism, 12*(01), 19-39. https://doi.org/10.1080/14639947.2011.564813

Bodhi, B. (2012). *Comprehensive manual of Abhidhamma: The Abhidhammattha Sangaha of Acariya Anuruddha*. Pariyatti Publishing.

Bonaz, B. L., & Bernstein, C. N. (2013). Brain-gut interactions in inflammatory bowel disease. *Gastroenterology, 144*(1), 36-49. https://doi.org/10.1053/j.gastro.2012.10.003

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry, 18*(4), 211-237. https://doi.org/10.1080/10478400701598298

Buddhaghosa, B. (ca. 412/2010). *Visuddhimagga: The path of purification* (B. Nanomoli, Trans.; 4th ed.). Buddhist Publication Society.

Burnham, K. P., & Anderson, D. R. (2004). Multimodel inference: Understanding AIC and BIC in model selection. *Sociological Methods & Research, 33*(2), 261-304. https://doi.org/10.1177/0049124104268644

Busseri, M. A. (2018). Examining the structure of subjective well-being through meta-analysis of the associations among positive affect, negative affect, and life satisfaction. *Personality and Individual Differences, 122*, 68-71. https://doi.org/10.1016/j.paid.2017.10.003

Cámara, R. J., Ziegler, R., Begré, S., Schoepfer, A. M., & Von Känel, R. (2009). The role of psychological stress in inflammatory bowel disease: Quality

assessment of methods of 18 prospective studies and suggestions for future research. *Digestion, 80*(2), 129-139. https://doi.org/10.1159/000226087

Cannon, W. B. (1929). Organization for physiological homeostasis. *Physiological Reviews, 9*(3), 399-431. https://doi.org/10.1152/physrev.1929.9.3.399

Cannon, W. B. (1932). *The wisdom of the body*. WW Norton and Company.

Capic, T., Fuller-Tyszkiewicz, M., Cummins, R. A., Khor, S., Richardson, B., Olsson, C., & Hutchinson, D. (2018). *Australian Unity Wellbeing Index (AUWI) summary report 2002-2017*. Deakin University. http://www.acqol.com.au/uploads/surveys/survey-034-1-report.pdf

Capic, T., Li, N., & Cummins, R. A. (2018). Confirmation of subjective wellbeing set-points: Foundational for subjective social indicators. *Social Indicators Research*, 1-28. https://doi.org/10.1007/s11205-017-1585-5

Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008). The assessment of present-moment awareness and acceptance: The Philadelphia Mindfulness Scale. *Assessment, 15*(2), 204-223. https://doi.org/ 10.1177/1073191107311467

Chiesa, A., & Serretti, A. (2011). Mindfulness based cognitive therapy for psychiatric disorders: A systematic review and meta-analysis. *Psychiatry Research, 187*(3), 441-453. https://doi.org/10.1016/j.psychres.2010.08.011

Chodron, P. (2019). *Welcoming the unwelcome: Wholehearted living in a brokenhearted world*. Shambhala.

Chovatiya, R., & Medzhitov, R. (2014, Apr 24). Stress, inflammation, and defense of homeostasis. *Molecular Cell, 54*(2), 281-288. https://doi.org/10.1016/j.molcel.2014.03.030

Christodoulou, G., Salami, N., & Black, D. S. (2020). The utility of heart rate variability in mindfulness research. *Mindfulness, 11*(3), 554-570. https://doi.org/10.1007/s12671-019-01296-3

Chrousos, G. P. (2009). Stress and disorders of the stress system. *Nature Reviews Endocrinology, 5*(7), 374-381. https://doi.org/10.1038/nrendo.2009.106

Chrousos, G. P., & Gold, P. W. (1992). The concepts of stress and stress system disorders: Overview of physical and behavioral homeostasis. *Jama, 267*(9), 1244-1252. https://doi.org/10.1001/jama.1992.03480090092034

Cook, V. (2003). *Subjective wellbeing: An Integration of Depression, Stress, and Homeostasis Theory* [Doctor of Psychology thesis, Deakin University, http://www.acqol.com.au/uploads/theses/thesis-cook-v.doc

Costa, P. T., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology, 38*(4), 668-678. https://doi.org/10.1037/0022-3514.38.4.668

Costa, P. T., Zonderman, A. B., McCrae, R. R., Huntley, J. C., Locke, B. Z., & Barbano, H. E. (1987). Longitudinal analyses of psychological well-being in a national sample: Stability of mean levels. *Journal of Gerontology, 42*(1), 50-55. https://doi.org/10.1093/geronj/42.1.50

Creemers, R. H., Bloem, S., & van Bodegraven, A. A. (2020). The most commonly used IBD indices still fail to represent real life and subjective

patient experience. *Alimentary Pharmacology & Therapeutics, 51*(11), 1202-1203. https://doi.org/10.1111/apt.15720

Cummins, R. A. (1995). On the trail of the gold standard for subjective well-being. *Social Indicators Research, 35*(2), 179-200. https://doi.org/10.1007/bf01079026

Cummins, R. A. (2010). Subjective wellbeing, homeostatically protected mood and depression: A synthesis. *Journal of Happiness Studies, 11*(1), 1-17. https://doi.org/10.1007/s10902-009-9167-0

Cummins, R. A. (2016a). Quality of Life in Older People. In N. A. Pachana (Ed.), *Encyclopedia of Geropsychology* (pp. 1-12). Springer. https://doi.org/10.1007/978-981-287-080-3_295-1

Cummins, R. A. (2016b). The theory of subjective wellbeing homeostasis: A contribution to understanding life quality. In F. Maggino (Ed.), *A Life devoted to quality of life* (pp. 61-79). Springer. https://doi.org/10.1007/978-3-319-20568-7_4

Cummins, R. A. (2017). Subjective Wellbeing Homeostasis. In D. S. Dunn (Ed.), *Oxford Bibliographies in Psychology*. Oxford University Press. https://doi.org/10.1093/OBO/9780199828340-0167

Cummins, R. A. (2018a). The golden triangle of happiness: Essential resources for a happy family. *International Journal of Child, Youth and Family Studies, 9*(4), 12-39. https://doi.org/10.18357/ijcyfs94201818638

Cummins, R. A. (2018b). *Measuring and interpreting subjective wellbeing in different cultural contexts: a review and way forward* (K. Keith, Ed.). Cambridge University Press. https://doi.org/10.1017/9781108685580

Cummins, R. A. (2021). Homeostasis. In F. Maggino (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 1-4). Springer International Publishing. https://doi.org/10.1007/978-3-319-69909-7_1303-2

Cummins, R. A., Capic, T., Fuller-Tyszkiewicz, M., Hutchinson, D., Olsson, C. A., & Richardson, B. (2018). Why self-report variables inter-correlate: The role of Homeostatically Protected Mood. *Journal of Well-Being Assessment, 2*(2-3), 93-114. https://doi.org/10.1007/s41543-018-0014-0

Cummins, R. A., Eckersley, R., Pallant, J., Van Vugt, J., & Misajon, R. (2003). Developing a national index of subjective wellbeing: The Australian Unity Wellbeing Index. *Social Indicators Research, 64*(2), 159-190. https://doi.org/10.1023/A:1024704320683

Cummins, R. A., & Gullone, E. (2000). Why we should not use 5-point Likert scales: The case for subjective quality of life measurement. *Proceedings, Second international conference on quality of life in cities*, National University of Singapore, 74-93.

Cummins, R. A., Lau, A. L., & Davern, M. T. (2012). Subjective wellbeing homeostasis. In *Handbook of social indicators and quality of life research* (pp. 79-98). Springer. https://doi.org/10.1007/978-94-007-2421-1_4

Cummins, R. A., Li, N., Wooden, M., & Stokes, M. (2014). A demonstration of set-points for subjective wellbeing. *Journal of Happiness Studies, 15*(1), 183-206. https://doi.org/10.1007/s10902-013-9444-9

Cummins, R. A., Mead, R., & The Australian Unity-Deakin University Wellbeing Research Partnership. (2021). *The Australian Unity wellbeing index 20th anniversary commemorative edition*. http://www.acqol.com.au/uploads/surveys/20yr-anniversary-report.pdf

Cummins, R. A., & Nistico, H. (2002). Maintaining life satisfaction: The role of positive cognitive bias. *Journal of Happiness Studies, 3*(1), 37-69. https://doi.org/10.1023/A:1015678915305

Cummins, R. A., & Wooden, M. (2014). Personal resilience in times of crisis: The implications of SWB homeostasis and set-points. *Journal of Happiness Studies, 15*(1), 223-235. https://doi.org/10.1007/s10902-013-9481-4

Damasio, A. (2018). *The strange order of things: Life, feeling, and the making of cultures*. Pantheon.

Davern, M. T., Cummins, R. A., & Stokes, M. A. (2007). Subjective wellbeing as an affective-cognitive construct. *Journal of Happiness Studies, 8*(4), 429-449. https://doi.org/10.1007/s10902-007-9066-1

Davidson, R. J., & Kaszniak, A. W. (2015). Conceptual and methodological issues in research on mindfulness and meditation. *American Psychologist, 70*(7), 581. https://doi.org/10.1037/a0039512

de Kloet, E. R., Joels, M., & Holsboer, F. (2005, Jun). Stress and the brain: From adaptation to disease. *Nature Reviews Neuroscience, 6*(6), 463-475. https://doi.org/10.1038/nrn1683

De Souza, H. S., Fiocchi, C., & Iliopoulos, D. (2017). The IBD interactome: an integrated view of aetiology, pathogenesis and therapy. *Nature Reviews Gastroenterology & Hepatology, 14*(12), 739. https://doi.org/10.1038/nrgastro.2017.110

de Vibe, M., Bjørndal, A., Fattah, S., Dyrdal, G. M., Halland, E., & Tanner-Smith, E. E. (2017). Mindfulness-based stress reduction (MBSR) for improving health, quality of life and social functioning in adults: A

systematic review and meta-analysis. *Campbell Systematic Reviews, 13*(1), 1-264. https://doi.org/10.4073/csr.2017.11

DeNeve, K. M., & Cooper, H. (1998). The happy personality: A meta-analysis of 137 personality traits and subjective well-being. *Psychological Bulletin, 124*(2), 197. https://doi.org/10.1037//0033-2909.124.2.197

Desbordes, G., Gard, T., Hoge, E. A., Hölzel, B. K., Kerr, C., Lazar, S. W., Olendzki, A., & Vago, D. R. (2015). Moving beyond mindfulness: Defining equanimity as an outcome measure in meditation and contemplative research. *Mindfulness, 6*(2), 356-372. https://doi.org/10.1007/s12671-013-0269-8

Dhabhar, F. S. (2018). The short-term stress response–Mother nature's mechanism for enhancing protection and performance under conditions of threat, challenge, and opportunity. *Frontiers in neuroendocrinology, 49*, 175-192. https://doi.org/10.1016/j.yfrne.2018.03.004

Diener, E. (1984). Subjective Well-Being. *Psychological Bulletin, 95*(3), 542-575. https://doi.org/10.1037/0033-2909.95.3.542

Diener, E., Heintzelman, S. J., Kushlev, K., Tay, L., Wirtz, D., Lutes, L. D., & Oishi, S. (2017). Findings all psychologists should know from the new science on subjective well-being. *Canadian Psychology, 58*(2), 87. https://doi.org/10.1037/cap0000063

Diener, E., Pressman, S. D., Hunter, J., & Delgadillo-Chase, D. (2017). If, why, and when subjective well-being influences health, and future needed research. *Applied Psychology: Health and Well-Being, 9*(2), 133-167. https://doi.org/10.1111/aphw.12090

Domes, G., & Frings, C. (2020). Stress and Cognition in Humans. *Experimental Psychology, 62*(2), 73-76. https://doi.org/10.1027/1618-3169/a000476

Dragasevic, S., Sokic-Milutinovic, A., Stojkovic Lalosevic, M., Milovanovic, T., Djuranovic, S., Jovanovic, I., Rajic, S., Stojkovic, M., Milicic, B., & Kmezic, S. (2020). Correlation of patient-reported outcome (PRO-2) with endoscopic and histological features in ulcerative colitis and Crohn's disease patients. *Gastroenterology Research and Practice, 2020*. https://doi.org/10.1155/2020/2065383

Dreyfus, G. (2011). Is mindfulness present-centred and non-judgmental? A discussion of the cognitive dimensions of mindfulness. *Contemporary Buddhism, 12*(1), 41-54. https://doi.org/10.1080/14639947.2011.564815

Duffy, L. C., Zielezny, M. A., Marshall, J. R., Weiser, M. M., Phillips, J. F., Byers, T. E., Calkins, B. M., Graham, S., & Ogra, P. L. (1991). Lag time between stress events and risk of recurrent episodes of inflammatory bowel disease. *Epidemiology*, 141-145. https://doi.org/10.1097/00001648-199103000-00009

Eberth, J., Sedlmeier, P., & Schafer, T. (2019). PROMiSE: A model of insight and equanimity as the key effects of mindfulness meditation. *Frontiers in Psychology, 10*, 2389. https://doi.org/10.3389/fpsyg.2019.02389

Eid, M., & Diener, E. (2004). Global judgments of subjective well-being: Situational variability and long-term stability. *Social Indicators Research, 65*(3), 245-277. https://doi.org/10.1023/b:soci.0000003801.89195.bc

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioral research*. Cambridge University Press. https://doi.org/10.1017/CBO9780511820724

Ewais, T., Begun, J., Kenny, M., Headey, A., Tefay, M., & Kisely, S. (2020). Mindfulness-based cognitive therapy experiences in youth with inflammatory bowel disease and depression: Findings from a mixed methods qualitative study. *BMJ open, 10*(11), e041140. https://doi.org/10.1136/bmjopen-2020-041140

Ewais, T., Begun, J., Kenny, M., Rickett, K., Hay, K., Ajilchi, B., & Kisely, S. (2019). A systematic review and meta-analysis of mindfulness based interventions and yoga in inflammatory bowel disease. *Journal of Psychosomatic Research, 116*, 44-53. https://doi.org/10.1016/j.jpsychores.2018.11.010

Fairbrass, K. M., Gracie, D. J., & Ford, A. C. (2021). Longitudinal follow-up study: effect of psychological co-morbidity on the prognosis of inflammatory bowel disease. *Alimentary Pharmacology & Therapeutics*. https://doi.org/10.1111/apt.16454

Farb, N. A., Anderson, A. K., Irving, J. A., & Segal, Z. V. (2014). Mindfulness interventions and emotion regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (2nd ed., pp. 548-570). Guilford.

Farb, N. A., Segal, Z. V., Mayberg, H., Bean, J., McKeon, D., Fatima, Z., & Anderson, A. K. (2007). Attending to the present: Mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive and Affective Neuroscience, 2*(4), 313-322. https://doi.org/10.1093/scan/nsm030

Fennell, M., & Segal, Z. (2011). Mindfulness-based cognitive therapy: culture clash or creative fusion? *Contemporary Buddhism, 12*(01), 125-142. https://doi.org/10.1080/14639947.2011.564828

Frederick, S., & Loewenstein, G. (1999). Hedonic Adaptation. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 302-329). Russell Sage Foundation.

Fresco, D. M., Moore, M. T., van Dulmen, M. H., Segal, Z. V., Ma, S. H., Teasdale, J. D., & Williams, J. M. G. (2007). Initial psychometric properties of the experiences questionnaire: Validation of a self-report measure of decentering. *Behavior Therapy, 38*(3), 234-246. https://doi.org/10.1016/j.beth.2006.08.003

Friberg, A., & Melin, L. (1996). Depressive symptoms and quality of life. *Nordic Journal of Psychiatry, 50*(3), 193-198. https://doi.org/10.3109/08039489609081408

Fried, E. I., & Nesse, R. M. (2015). Depression is not a consistent syndrome: An investigation of unique symptom patterns in the STAR* D study. *Journal of Affective Disorders, 172*, 96-102. https://doi.org/10.1016/j.jad.2014.10.010

Frijda, N. H. (2009). Emotion experience and its varieties. *Emotion Review, 1*(3), 264-271. https://doi.org/10.1177/1754073909103595

Frolkis, A. D., Vallerand, I. A., Shaheen, A.-A., Lowerison, M. W., Swain, M. G., Barnabe, C., Patten, S. B., & Kaplan, G. G. (2018). Depression increases the risk of inflammatory bowel disease, which may be mitigated by the use of antidepressants in the treatment of depression. *Gut*, 1606-1612. https://doi.org/10.1136/gutjnl-2018-317182

Fromm, E., Suzuki, D. T., & De Martino, R. (1960). *Zen Buddhism and psychoanalysis*. Harper & Row.

Fujita, F., & Diener, E. (2005). Life satisfaction set point: Stability and change. *Journal of Personality and Social Psychology, 88*(1), 158. https://doi.org/10.1037/0022-3514.88.1.158

Galluzzi, L., Yamazaki, T., & Kroemer, G. (2018). Linking cellular stress responses to systemic homeostasis. *Nature Reviews Molecular Cell Biology, 19*(11), 731-745. https://doi.org/10.1038/s41580-018-0068-0

Gan, Y. (2020). Happy People Live Longer and Better: Advances in Research on Subjective Well-Being. *Applied Psychology: Health and Well-Being, 12*(1), 3-6. https://doi.org/10.1111/aphw.12192

Garland, E. L. (2007). The meaning of mindfulness: A second-order cybernetics of stress, metacognition, and coping. *Complementary Health Practice Review, 12*(1), 15-30. https://doi.org/10.1177/1533210107301740

Garland, E. L., Farb, N. A., R. Goldin, P., & Fredrickson, B. L. (2015). Mindfulness broadens awareness and builds eudaimonic meaning: A process model of mindful positive emotion regulation. *Psychological Inquiry, 26*(4), 293-314. https://doi.org/10.1080/1047840X.2015.1064294

Garland, E. L., Gaylord, S. A., & Fredrickson, B. L. (2011). Positive reappraisal mediates the stress-reductive effects of mindfulness: An upward spiral process. *Mindfulness, 2*(1), 59-67. https://doi.org/10.1007/s12671-011-0043-8

Gerbarg, P. L., Jacob, V. E., Stevens, L., Bosworth, B. P., Chabouni, F., DeFilippis, E. M., Warren, R., Trivellas, M., Patel, P. V., & Webb, C. D. (2015). The effect of breathing, movement, and meditation on psychological and physical symptoms and inflammatory biomarkers in inflammatory bowel disease: A randomized controlled trial. *Inflammatory*

Bowel Diseases, 21(12), 2886-2896. https://doi.org/10.1097/MIB.0000000000000568

Gethin, R. (2011). On some definitions of mindfulness. *Contemporary Buddhism, 12*(1), 263-279. https://doi.org/10.1080/14639947.2011.564843

Gold, P. W. (2015). The organization of the stress system and its dysregulation in depressive illness. *Molecular Psychiatry, 20*(1), 32. https://doi.org/10.1038/mp.2014.163

Gold, P. W., & Chrousos, G. P. (2002). Organization of the stress system and its dysregulation in melancholic and atypical depression: High vs low CRH/NE states. *Molecular Psychiatry, 7*(3), 254. https://doi.org/10.1038/sj.mp.4001032

Goldberg, S. B., Tucker, R. P., Greene, P. A., Davidson, R. J., Wampold, B. E., Kearney, D. J., & Simpson, T. L. (2018). Mindfulness-based interventions for psychiatric disorders: A systematic review and meta-analysis. *Clinical Psychology Review, 59*, 52-60. https://doi.org/10.1016/j.cpr.2017.10.011

González-Moret, R., Cebolla, A., Cortés, X., Baños, R. M., Navarrete, J., de la Rubia, J. E., Lisón, J. F., & Soria, J. M. (2020). The effect of a mindfulness-based therapy on different biomarkers among patients with inflammatory bowel disease: A randomised controlled trial. *Scientific Reports, 10*(1), 1-7. https://doi.org/10.1038/s41598-020-63168-4

Goodhand, J. R., Wahed, M., & Rampton, D. S. (2009). Management of stress in inflammatory bowel disease: A therapeutic option? *Expert Review of Gastroenterology & Hepatology, 3*(6), 661-679. https://doi.org/10.1586/EGH.09.55

Grabovac, A. D., Lau, M. A., & Willett, B. R. (2011). Mechanisms of mindfulness: A Buddhist psychological model. *Mindfulness, 2*(3), 154-166. https://doi.org/10.1007/s12671-011-0054-5

Gracie, D. J., Guthrie, E. A., Hamlin, P. J., & Ford, A. C. (2018). Bi-directionality of brain–gut interactions in patients with inflammatory bowel disease. *Gastroenterology, 154*(6), 1635-1646. e1633. https://doi.org/10.1053/j.gastro.2018.01.027

Gracie, D. J., Irvine, A. J., Sood, R., Mikocka-Walus, A., Hamlin, P. J., & Ford, A. C. (2017). Effect of psychological therapy on disease activity, psychological comorbidity, and quality of life in inflammatory bowel disease: a systematic review and meta-analysis. *The Lancet Gastroenterology & Hepatology, 2*(3), 189-199. https://doi.org/10.1016/S2468-1253(16)30206-0

Grant, J. A., & Zeidan, F. (2019). Employing pain and mindfulness to understand consciousness: A symbiotic relationship. *Current Opinion in Psychology, 28*, 192-197. https://doi.org/10.1016/j.copsyc.2018.12.025

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology, 2*(3), 271-299. https://doi.org/10.1037//1089-2680.2.3.271

Gross, J. J. (2015a). Emotion regulation: Current status and future prospects. *Psychological Inquiry, 26*(1), 1-26. https://doi.org/10.1080/1047840X.2014.940781

Gross, J. J. (2015b). The extended process model of emotion regulation: Elaborations, applications, and future directions. *Psychological Inquiry, 26*(1), 130-137. https://doi.org/10.1080/1047840X.2015.989751

Grossman, P., & Van Dam, N. T. (2011). Mindfulness, by any other name…: Trials and tribulations of sati in western psychology and science. *Contemporary Buddhism, 12*(1), 219-239. https://doi.org/10.1080/14639947.2011.564841

Gunaratana, H. (2011). *Mindfulness in plain English*. Wisdom Publications.

Guthrie, E., Jackson, J., Shaffer, J., Thompson, D., Tomenson, B., & Creed, F. (2002). Psychological disorder and severity of inflammatory bowel disease predict health-related quality of life in ulcerative colitis and Crohn's disease. *The American Journal of Gastroenterology, 97*(8), 1994-1999.

Guyatt, G., Mitchell, A., Irvine, E. J., Singer, J., Williams, N., Goodacre, R., & Tompkins, C. (1989). A new measure of health status for clinical trials in inflammatory bowel disease. *Gastroenterology, 96*(2), 804-810. https://doi.org/10.1016/s0016-5085(89)80080-0

Hadash, Y., Segev, N., Tanay, G., Goldstein, P., & Bernstein, A. (2016). The decoupling model of equanimity: theory, measurement, and test in a mindfulness intervention. *Mindfulness, 7*(5), 1214-1226. https://doi.org/10.1007/s12671-016-0564-2

Halloran, J., McDermott, B., Ewais, T., Begun, J., Karatela, S., D'Emden, H., Corias, C., & Denny, S. (2020). The psychosocial burden of inflammatory bowel disease in adolescents and young adults. *Internal Medicine Journal*. https://doi.org/10.1111/imj.15034

Hardy, J. (1953). Control of heat loss and heat production in physiologic temperature regulation. In The Harvey Society of New York (Ed.), *The Harvey Lectures Series 49* (pp. 242-271). Academic Press Ink.

https://archive.org/stream/in.ernet.dli.2015.109119/2015.109119.The-Harvey-Lectures-1953-54_djvu.txt

Harrington, A., & Dunne, J. D. (2015). When mindfulness is therapy: Ethical qualms, historical perspectives. *American Psychologist, 70*(7), 621. https://doi.org/10.1037/a0039460

Hartley-Clark, L. (2014). *Investigating the affective core of subjective wellbeing: The circular way.* [PHD thesis, Deakin University]. http://dro.deakin.edu.au/view/DU:30074804.

Hartmann, G. W. (1934). Personality traits associated with variations in happiness. *Journal of Abnormal and Social Psychology, 29*(2), 202. https://doi.org/10.1037/h0073108

Hastie, T. J., & Tibshirani, R. (1986). Generalized additive models. *Statistical Science, 1*(3), 297-318.

Häuser, W., Moser, G., Klose, P., & Mikocka-Walus, A. (2014). Psychosocial issues in evidence-based guidelines on inflammatory bowel diseases: A review. *World Journal of Gastroenterology, 20*(13), 3663. https://doi.org/10.3748/wjg.v20.i13.3663

Hayes, A. M., Feldman, G. C., Beevers, C. G., Laurenceau, J.-P., Cardaciotto, L., & Lewis-Smith, J. (2007). Discontinuities and cognitive changes in an exposure-based cognitive therapy for depression. *Journal of Consulting and Clinical Psychology, 75*(3), 409. https://doi.org/10.1037/0022-006X.75.3.409

Hayes, S. C., Shenk, C., Masuda, A., & Bunting, K. (2006). The psychological processes underlying mindfulness: Exploring the link between Buddhism and modern contextual behavioral psychology. In D. K. Nauriyal, M. S.

Drummond, & Y. Lal (Eds.), *Buddhist thought and applied psychological research: Transcending the boundaries* (pp. 431-451). Routledge.

Headey, B. (2008). Life goals matter to happiness: A revision of set-point theory. *Social Indicators Research, 86*(2), 213-231. https://doi.org/10.1007/s11205-007-9138-y

Headey, B., Kelley, J., & Wearing, A. (1993). Dimensions of mental health: Life satisfaction, positive affect, anxiety and depression. *Social Indicators Research, 29*(1), 63-82. https://doi.org/10.1007/bf01136197

Headey, B., & Muffels, R. (2018). A theory of life satisfaction dynamics: Stability, change and volatility in 25-year life trajectories in Germany. *Social Indicators Research, 140*(2), 837-866. https://doi.org/10.1007/s11205-017-1785-z

Headey, B., & Wearing, A. (1989). Personality, life events, and subjective well-being: Toward a dynamic equilibrium model. *Journal of Personality and Social Psychology, 57*(4), 731. https://doi.org/10.1037/0022-3514.57.4.731

Helliwell, J. F., Layard, R., Sachs, J., & De Neve, J.-E. (2021). *World happiness report*. https://worldhappiness.report/ed/2021/

Helliwell, J. F., Layard, R., & Sachs, J. D. (2019). *World happiness report*. https://worldhappiness.report/ed/2019/

Helliwell, J. F., Shiplett, H., & Bonikowska, A. (2020). Migration as a test of the happiness set-point hypothesis: Evidence from immigration to Canada and the United Kingdom. *Canadian Journal of Economics/Revue canadienne d'économique*. https://doi.org/10.1111/caje.12474

Helson, H. (1964). *Adaptation-level theory: An experimental and systematic approach to behavior*. Harper & Row.

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*(2), 227-239. https://doi.org/10.1348/014466505X29657

Higgins, P. D., Harding, G., Leidy, N. K., DeBusk, K., Patrick, D. L., Viswanathan, H. N., Fitzgerald, K., Donelson, S. M., Cyrille, M., & Ortmeier, B. G. (2018a). Development and validation of the Crohn's disease patient-reported outcomes signs and symptoms (CD-PRO/SS) diary. *Journal of Patient-Reported Outcomes, 2*(1), 24. https://doi.org/10.1186/s41687-018-0044-7

Higgins, P. D., Harding, G., Leidy, N. K., DeBusk, K., Patrick, D. L., Viswanathan, H. N., Fitzgerald, K., Donelson, S. M., Cyrille, M., & Ortmeier, B. G. (2018b). Development and validation of the Crohn's disease patient-reported outcomes signs and symptoms (CD-PRO/SS) diary: additional file. *Journal of Patient-Reported Outcomes, 2*(1), 24. https://static-content.springer.com/esm/art%3A10.1186%2Fs41687-018-0044-7/MediaObjects/41687_2018_44_MOESM1_ESM.docx

Higgins, P. D., Harding, G., Revicki, D. A., Globe, G., Patrick, D. L., Fitzgerald, K., Viswanathan, H., Donelson, S. M., Ortmeier, B. G., & Chen, W. H. (2018a). Development and validation of the UIcerative Colitis patient-reported outcomes signs and symptoms (UC-pro/SS) diary: Supplementary material. *Journal of Patient-Reported Outcomes, 2*(1), 26.

https://static-content.springer.com/esm/art%3A10.1186%2Fs41687-018-0049-2/MediaObjects/41687_2018_49_MOESM1_ESM.docx

Higgins, P. D., Harding, G., Revicki, D. A., Globe, G., Patrick, D. L., Fitzgerald, K., Viswanathan, H., Donelson, S. M., Ortmeier, B. G., & Chen, W. H. (2018b). Development and validation of the Ulcerative Colitis patient-reported outcomes signs and symptoms (UC-pro/SS) diary. *Journal of Patient-Reported Outcomes, 2*(1), 26. https://doi.org/10.1186/s41687-018-0049-2

Ho, S.-M., Lewis, J. D., Mayer, E. A., Bernstein, C. N., Plevy, S. E., Chuang, E., Rappaport, S. M., Croitoru, K., Korzenik, J. R., & Krischer, J. (2019). Challenges in IBD research: Environmental triggers. *Inflammatory Bowel Diseases, 25, Supplement_2*, S13-S23. https://doi.org/10.1093/ibd/izz076

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist, 44*(3), 513. https://doi.org/10.1037//0003-066x.44.3.513

Hobfoll, S. E. (2011). Conservation of resources theory: Its implication for stress, health, and resilience. In S. Folkman (Ed.), *The Oxford handbook of stress, health, and coping* (pp. 127-147). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195375343.013.0007

Hobfoll, S. E., Halbesleben, J., Neveu, J.-P., & Westman, M. (2018). Conservation of resources in the organizational context: The reality of resources and their consequences. *Annual Review of Organizational Psychology and Organizational Behavior, 5*, 103-128. https://doi.org/10.1146/annurev-orgpsych-032117-104640

Holland, A. C., & Kensinger, E. A. (2010). Emotion and autobiographical memory. *Physics of Life Reviews, 7*(1), 88-131. https://doi.org/10.1016/j.plrev.2010.01.006

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science, 6*(6), 537-559. https://doi.org/10.1177/1745691611419671

Hood, M. M., & Jedel, S. (2017). Mindfulness-based interventions in inflammatory bowel disease. *Gastroenterology Clinics, 46*(4), 859-874. https://doi.org/10.1016/j.gtc.2017.08.008

Hopwood, T. L., & Schutte, N. S. (2017). A meta-analytic investigation of the impact of mindfulness-based interventions on post traumatic stress. *Clinical Psychology Review, 57*, 12-20. https://doi.org/10.1016/j.cpr.2017.08.002

Horwitz, A. V., Wakefield, J. C., & Lorenzo-Luaces, L. (2016). History of depression. In R. J. DeRubeis & D. R. Strunk (Eds.), *The Oxford handbook of mood disorders* (pp. 11-23). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199973965.013.2

Houben, M., Van Den Noortgate, W., & Kuppens, P. (2015). The relation between short-term emotion dynamics and psychological well-being: A meta-analysis. *Psychological Bulletin, 141*(4), 901. https://doi.org/10.1037/a0038822

Hu, S., Chen, Y., Chen, Y., & Wang, C. (2021, 2021-October-08). Depression and Anxiety Disorders in Patients With Inflammatory Bowel Disease.

Frontiers in Psychiatry, 12(1643). https://doi.org/10.3389/fpsyt.2021.714057

International Wellbeing Group. (2013). *Personal Wellbeing Index - Adult (PWI-A) Manual*. http://www.acqol.com.au/uploads/pwi-a/pwi-a-english.pdf

James, W. (1902). *The varieties of religious experience*. Longmans, Green, and Co.

Jedel, S., Hoffman, A., Merriman, P., Swanson, B., Voigt, R., Rajan, K., Shaikh, M., Li, H., & Keshavarzian, A. (2014). A randomized controlled trial of mindfulness-based stress reduction to prevent flare-up in patients with inactive ulcerative colitis. *Digestion, 89*(2), 142-155. https://doi.org/10.1159/000356316

Jedel, S., Merriman, P., Hoffman, A., Swanson, B., Fogg, L. F., & Keshavarzian, A. (2013). Relationship of mindfulness, quality of life, and psychiatric symptoms among patients with ulcerative colitis. *Mindfulness, 4*(4), 296-300. https://doi.org/10.1007/s12671-012-0128-z

Jerath, R., Barnes, V. A., & Crawford, M. W. (2014). Mind-body response and neurophysiological changes during stress and meditation: Central role of homeostasis. *Journal of Biological Regulators and Homeostatic Agents, 28*(4), 545-554.

Jones, P. (2020). *Quality of Life and Well-Being: An inquiry into causes and conditions, and the development of a questionnaire, mindfulness intervention, and critique of the existing paradigm* [PhD thesis, Murdoch University, https://researchrepository.murdoch.edu.au/id/eprint/58537/1/Jones2020.pdf

Jovanović, V. (2015). A bifactor model of subjective well-being: A re-examination of the structure of subjective well-being. *Personality and Individual Differences, 87*, 45-49. https://doi.org/10.1016/j.paid.2015.07.026

Jovanović, V., & Joshanloo, M. (2021). The Contribution of Positive and Negative Affect to Life Satisfaction across Age. *Applied Research in Quality of Life*, 1-14. https://doi.org/10.1007/s11482-020-09903-5

Juneau, C., Pellerin, N., Trives, E., Ricard, M., Shankland, R., & Dambrun, M. (2020). Reliability and validity of an equanimity questionnaire: The two-factor equanimity scale (EQUA-S). *PeerJ, 8*, e9405. https://doi.org/10.7717/peerj.9405

Jung, C. G. (1969). *Psychology and religion: West and east* (Second ed.). Princeton University Press.

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind in everyday life*.

Kabat-Zinn, J. (1994). *Wherever you go there you are*. Hyperion.

Kabat-Zinn, J. (2013). *Full catastrophe living: How to cope with stress, pain and illness using mindfulness meditation* (Revised ed.). Hachette UK.

Keefer, L. (2018). Behavioural medicine and gastrointestinal disorders: The promise of positive psychology. *Nature Reviews Gastroenterology & Hepatology, 15*(6), 378-386. https://doi.org/10.1038/s41575-018-0001-1

Keefer, L., Palsson, O. S., & Pandolfino, J. E. (2018). Best practice update: Incorporating psychogastroenterology into management of digestive disorders. *Gastroenterology, 154*(5), 1249-1257. https://doi.org/10.1053/j.gastro.2018.01.045

Keeton, R. L., Mikocka-Walus, A., & Andrews, J. M. (2015). Concerns and worries in people living with inflammatory bowel disease (IBD): A mixed methods study. *Journal of Psychosomatic Research, 78*(6), 573-578. https://doi.org/10.1016/j.jpsychores.2014.12.004

Kelley, J., & Evans, M. D. (2017). Societal Inequality and individual subjective well-being: Results from 68 societies and over 200,000 individuals, 1981–2008. *Social Science Research, 62*, 1-23. https://doi.org/10.1016/j.ssresearch.2016.04.020

Kendler, K. S., Myers, J. M., Maes, H. H., & Keyes, C. L. (2011). The relationship between the genetic and environmental influences on common internalizing psychiatric disorders and mental well-being. *Behavior Genetics, 41*(5), 641-650. https://doi.org/10.1007/s10519-011-9466-1

Keng, S.-L., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review, 31*(6), 1041-1056. https://doi.org/10.1016/j.cpr.2011.04.006

Khong, B. S. L. (2003). The Buddha teaches an attitude not an affiliation. In S. R. Segall (Ed.), *Encountering Buddhism: Western psychology and Buddhist teachings* (pp. 61-74). SUNYP.

Khor, S., Cummins, R. A., Fuller-Tyszkiewicz, M., Capic, T., Jona, C., Olsson, C., & Hutchinson, D. (2019). *Australian Unity Wellbeing Index Report 36: Social connectedness and wellbeing*. Australian Centre on Quality of Life, Deakin University. http://www.acqol.com.au/uploads/surveys/survey-036-report.pdf

Khor, S., Fuller-Tysziewicz, M., & Hutchinson, D. (2020). Australian normative data - subjective wellbeing. In I. W. Group. (Ed.), *Personal Wellbeing Index manual* (6th ed.). http://www.acqol.com.au/uploads/publications/rcp_Khor,%20S.,%20et%20al.%202020.%20AUWI%20Normative%20Data.pdf

Khoury, B., Knäuper, B., Pagnini, F., Trent, N., Chiesa, A., & Carrière, K. (2017). Embodied mindfulness. *Mindfulness, 8*(5), 1160-1171. https://doi.org/10.1007/s12671-017-0700-7

Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., Chapleau, M.-A., Paquin, K., & Hofmann, S. G. (2013). Mindfulness-based therapy: A comprehensive meta-analysis. *Clinical Psychology Review, 33*(6), 763-771. https://doi.org/10.1016/j.cpr.2013.05.005

Knowles, S. R., & Mikocka-Walus, A. A. (2015). *Psychological aspects of inflammatory bowel disease: a biopsychosocial approach*. Routledge. https://doi.org/10.4324/9781315815374

Knowles, S. R., Monshat, K., & Castle, D. J. (2013). The efficacy and methodological challenges of psychotherapy for adults with inflammatory bowel disease: A review. *Inflammatory Bowel Diseases, 19*(12), 2704-2715. https://doi.org/10.1097/MIB.0b013e318296ae5a

Konturek, P. C., Brzozowski, T., & Konturek, S. (2011). Stress and the gut: Pathophysiology, clinical consequences, diagnostic approach and treatment options. *Journal of Physiology and Pharmacology, 62*(6), 591-599.

Kotov, R., Krueger, R. F., & Watson, D. (2018). A paradigm shift in psychiatric classification: The Hierarchical Taxonomy Of Psychopathology (HiTOP). *World Psychiatry, 17*(1), 24-25. https://doi.org/10.1002/wps.20478

Kudesia, R. S., & Nyima, V. T. (2015). Mindfulness contextualized: An integration of Buddhist and neuropsychological approaches to cognition. *Mindfulness, 6*(4), 910-925. https://doi.org/10.1007/s12671-014-0337-8

Kuyken, W., Hayes, R., Barrett, B., Byng, R., Dalgleish, T., Kessler, D., Lewis, G., Watkins, E., Brejcha, C., & Cardy, J. (2015). Effectiveness and cost-effectiveness of mindfulness-based cognitive therapy compared with maintenance antidepressant treatment in the prevention of depressive relapse or recurrence (PREVENT): A randomised controlled trial. *The Lancet, 386*(9988), 63-73. https://doi.org/10.1016/S0140-6736(14)62222-4

Kuyken, W., Warren, F. C., Taylor, R. S., Whalley, B., Crane, C., Bondolfi, G., Hayes, R., Huijbers, M., Ma, H., & Schweizer, S. (2016). Efficacy of mindfulness-based cognitive therapy in prevention of depressive relapse: An individual patient data meta-analysis from randomized trials. *JAMA Psychiatry, 73*(6), 565-574. https://doi.org/10.1001/jamapsychiatry.2016.0076.

Kwee, G. M. (2013). Relational Buddhism: An integrative psychology of happiness amidst existential suffering. In S. A. David, I. Boniwell, & A. C. Ayers (Eds.), *Oxford handbook of happiness* (pp. 394-407). https://doi.org/10.1093/oxfordhb/9780199557257.013.0028

Lai, L. C., & Cummins, R. A. (2013). The contribution of job and partner satisfaction to the homeostatic defense of subjective wellbeing. *Social*

Indicators Research, 111(1), 203-217. https://doi.org/10.1007/s11205-011-9991-6

Lang, B. M. (2020). *Statistical studies of gastrointestinal diseases* [PhD, ETH Zurich]. https://doi.org/10.3929/ethz-b-000412680

Langhorst, J., Wulfert, H., Lauche, R., Klose, P., Cramer, H., Dobos, G., & Korzenik, J. (2015). Systematic review of complementary and alternative medicine treatments in inflammatory bowel diseases. *Journal of Crohn's and Colitis, 9*(1), 86-106. https://doi.org/10.1093/ecco-jcc/jju007

Larsson, K., Lööf, L., & Nordin, K. (2017). Stress, coping and support needs of patients with ulcerative colitis or Crohn's disease: A qualitative descriptive study. *Journal of Clinical Nursing, 26*(5-6), 648-657. https://doi.org/10.1111/jocn.13581

Lauriot dit Prevost, C., Azahaf, M., Nachury, M., Branche, J., Gerard, R., Wils, P., Lambin, T., Desreumaux, P., Ernst, O., & Pariente, B. (2020). Bowel damage and disability in Crohn's disease: A prospective study in a tertiary referral centre of the Lémann Index and Inflammatory Bowel Disease Disability Index. *Alimentary Pharmacology & Therapeutics, 51*(9), 889-898. https://doi.org/10.1111/apt.15681

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Publishing Company.

Le Berre, C., Ananthakrishnan, A. N., Danese, S., Singh, S., & Peyrin-Biroulet, L. (2020). Ulcerative colitis and Crohn’s disease have similar burden and goals for treatment. *Clinical Gastroenterology and Hepatology, 18*(1), 14-23. https://doi.org/10.1016/j.cgh.2019.07.005

Leonard, B. E. (2018). Inflammation and depression: A causal or coincidental link to the pathophysiology? *Acta Neuropsychiatrica, 30*(1), 1-16. https://doi.org/10.1017/neu.2016.69

Leone, D., Gilardi, D., Corrò, B. E., Menichetti, J., Vegni, E., Correale, C., Mariangela, A., Furfaro, F., Bonovas, S., & Peyrin-Biroulet, L. (2019). Psychological characteristics of inflammatory bowel disease patients: A comparison between active and nonactive patients. *Inflammatory Bowel Diseases, 25*(8), 1399-1407. https://doi.org/10.1093/ibd/izy400

Leung, S. O. (2011). A comparison of psychometric properties and normality in 4-, 5-, 6-, and 11-point Likert scales. *Journal of Social Service Research, 37*(4), 412-421. https://doi.org/10.1080/01488376.2011.580697

Li, W., Howard, M. O., Garland, E. L., McGovern, P., & Lazar, M. (2017). Mindfulness treatment for substance misuse: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment, 75*, 62-96. https://doi.org/10.1016/j.jsat.2017.01.008

Lindsay, E. K., & Creswell, J. D. (2017). Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clinical Psychology Review, 51*, 48-59. https://doi.org/10.1016/j.cpr.2016.10.011

Lindsay, E. K., & Creswell, J. D. (2019). Mindfulness, acceptance, and emotion regulation: Perspectives from Monitor and Acceptance Theory (MAT). *Current Opinion in Psychology, 28*, 120-125. https://doi.org/10.1016/j.copsyc.2018.12.004

Linehan, M. M. (1993). *Skills training manual for treating borderline personality disorder*. Guilford Press.

Lippelt, D. P., Hommel, B., & Colzato, L. S. (2014). Focused attention, open monitoring and loving kindness meditation: Effects on attention, conflict monitoring, and creativity–A review. *Frontiers in Psychology, 5*, 1083. https://doi.org/10.3389/fpsyg.2014.01083

Lönnfors, S., Vermeire, S., & Avedano, L. (2014). IBD and health-related quality of life—discovering the true impact. *Journal of Crohn's and Colitis, 8*(10), 1281-1286. https://doi.org/10.1016/j.crohns.2014.03.005

Lopresti, A. L., Maker, G. L., Hood, S. D., & Drummond, P. D. (2014). A review of peripheral biomarkers in major depression: The potential of inflammatory and oxidative stress biomarkers. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 48*, 102-111. https://doi.org/10.1016/j.pnpbp.2013.09.017

Lores, T., Goess, C., Mikocka-Walus, A., Collins, K. L., Burke, A. L., Chur-Hansen, A., Delfabbro, P., & Andrews, J. M. (2021). Integrated psychological care reduces health care costs at a hospital-based inflammatory bowel disease service. *Clinical Gastroenterology and Hepatology, 19*(1), 96-103. e103. https://doi.org/10.1016/j.cgh.2020.01.030

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*(3), 335-343. https://doi.org/10.1016/0005-7967(94)00075-u

Lovibond, S. H., & Lovibond, P. F. (1996). *Manual for the Depression Anxiety Stress Scales*. Psychology Foundation of Australia.

Lucas, R. E., Clark, A. E., Georgellis, Y., & Diener, E. (2003). Reexamining adaptation and the set point model of happiness: Reactions to changes in marital status. *Journal of Personality and Social Psychology, 84*(3), 527. https://doi.org/10.1037/0022-3514.84.3.527

Lucas, R. E., & Donnellan, M. B. (2007). How stable is happiness? Using the STARTS model to estimate the stability of life satisfaction. *Journal of Research in Personality, 41*(5), 1091-1098. https://doi.org/10.1016/j.jrp.2006.11.005

Ludwig, D. S., & Kabat-Zinn, J. (2008). Mindfulness in medicine. *Jama, 300*(11), 1350-1352. https://doi.org/10.1001/jama.300.11.1350

Luhmann, M., & Intelisano, S. (2018). Hedonic adaptation and the set point for subjective well-being. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of Well-Being* (pp. 219-243). https://nobascholar.com/chapters/21

Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist, 70*(7), 632. https://doi.org/10.1037/a0039585

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*(4), 163-169. https://doi.org/10.1016/j.tics.2008.01.005

Lyall, K., Beswick, L., Evans, S., Cummins, R. A., & Mikocka-Walus, A. (2021). The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease. *Social Science Protocols, 4*, 1-12. https://doi.org/10.7565/ssp.2021.6485

Lyall, K., Mikocka-Walus, A., Evans, S., & Cummins, R. A. (2021). Linking homeostatically protected mood, mindfulness, and depression: A conceptual synthesis and model of moodfulness. *Review of General Psychology, 25*(3), 304-320. https://doi.org/10.1177/10892680211017523

Lykken, D., & Tellegen, A. (1996). Happiness is a stochastic phenomenon. *Psychological Science, 7*(3), 186-189. https://doi.org/10.1111/j.1467-9280.1996.tb00355.x

Lyubomirsky, S. (2010). Hedonic adaptation to positive and negative experiences. In S. Folkman (Ed.), *The Oxford handbook of stress, health, and coping* (pp. 200-224). Oxford Library of Psychology. https://doi.org/10.1093/oxfordhb/9780195375343.013.0011

Maes, M., Mihaylova, I., Kubera, M., & Ringel, K. (2012). Activation of cell-mediated immunity in depression: Association with inflammation, melancholia, clinical staging and the fatigue and somatic symptom cluster of depression. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 36*(1), 169-175. https://doi.org/10.1016/j.pnpbp.2011.09.006

Magro, F., Sousa, P., & Ministro, P. (2014). C-reactive protein in Crohn's disease: How informative is it? *Expert Review of Gastroenterology & Hepatology, 8*(4), 393-408. https://doi.org/10.1586/17474124.2014.893821

Martin-Subero, M., Anderson, G., Kanchanatawan, B., Berk, M., & Maes, M. (2016). Comorbidity between depression and inflammatory bowel disease explained by immune-inflammatory, oxidative, and nitrosative stress; tryptophan catabolite; and gut–brain pathways. *CNS Spectrums, 21*(2), 184-198. https://doi.org/10.1017/S1092852915000449

Mazaheri, M., Aghaei, A., Abedi, A., & Adibi, P. (2020). Effectiveness of Mindfulness-based Cognitive Therapy on the Perceived Stress of Patients with Ulcerative Colitis. *Journal of Guilan University of Medical Sciences, 29*(113), 85-94.

McEwen, B. S. (2004). Protection and damage from acute and chronic stress: Allostasis and allostatic overload and relevance to the pathophysiology of psychiatric disorders. *Annals of the New York Academy of Sciences, 1032*(1), 1-7. https://doi.org/10.1196/annals.1314.001

Medvedev, O. N., Krägeloh, C. U., Narayanan, A., & Siegert, R. J. (2017). Measuring mindfulness: Applying generalizability theory to distinguish between state and trait. *Mindfulness, 8*(4), 1036-1046. https://doi.org/10.1007/s12671-017-0679-0

Medvedev, O. N., & Landhuis, C. E. (2018). Exploring constructs of well-being, happiness and quality of life. *PeerJ, 6*, e4903. https://doi.org/10.7717/peerj.4903

Michalos, A. C. (1985). Multiple discrepancies theory (MDT). *Social Indicators Research, 16*(4), 347-413. https://doi.org/10.1007/bf00333288

Mikocka-Walus, A., Bampton, P., Hetzel, D., Hughes, P., Esterman, A., & Andrews, J. M. (2015). Cognitive-behavioural therapy has no effect on disease activity but improves quality of life in subgroups of patients with inflammatory bowel disease: A pilot randomised controlled trial. *BMC gastroenterology, 15*(1), 1-12. https://doi.org/10.1186/s12876-015-0278-2

Mikocka-Walus, A., Knowles, S. R., Keefer, L., & Graff, L. (2016). Controversies revisited: A systematic review of the comorbidity of depression and anxiety with inflammatory bowel diseases. *Inflammatory*

Bowel Diseases, 22(3), 752-762. https://doi.org/10.1097/MIB.0000000000000620

Mikocka-Walus, A., Pittet, V., Rossel, J.-B., von Känel, R., & Group, S. I. C. S. (2016). Symptoms of depression and anxiety are independently associated with clinical recurrence of inflammatory bowel disease. *Clinical Gastroenterology and Hepatology, 14*(6), 829-835. e821. https://doi.org/10.1016/j.cgh.2015.12.045

Miller, A. H., & Raison, C. L. (2016). The role of inflammation in depression: From evolutionary imperative to modern treatment target. *Nature Reviews Immunology, 16*(1), 22. https://doi.org/10.1038/nri.2015.5.

Montgomery, J. (2018). Evolutionary mismatch, emotional homeostasis, and "emotional addiction": A unifying model of psychological dysfunction. *Evolutionary Psychological Science, 4*(4), 428-442. https://doi.org/10.1007/s40806-018-0153-9

Mortensen, J. H., Manon-Jensen, T., Jensen, M. D., Hägglund, P., Klinge, L. G., Kjeldsen, J., Krag, A., Karsdal, M. A., & Bay-Jensen, A.-C. (2017). Ulcerative colitis, Crohn's disease, and irritable bowel syndrome have different profiles of extracellular matrix turnover, which also reflects disease activity in Crohn's disease. *PloS one, 12*(10), e0185855. https://doi.org/10.1371/journal.pone.0185855

Myers, K. M., & Davis, M. (2007). Mechanisms of fear extinction. *Molecular Psychiatry, 12*(2), 120. https://doi.org/10.1038/sj.mp.4001939

Navarrete, J., González-Moret, R., Cortés, X., Lisón, J. F., Soria, J. M., Baños, R. M., & Cebolla, A. (2021). Dispositional Mindfulness and Inflammatory Bowel Disease: Mindful Awareness Mediates the Relation Between

Severity and Quality of Life, Stress, and Fatigue. *Mindfulness*, 1-10. https://doi.org/10.1007/s12671-021-01620-w

Neilson, K., Ftanou, M., Monshat, K., Salzberg, M., Bell, S., Kamm, M. A., Connell, W., Knowles, S. R., Sevar, K., & Mancuso, S. G. (2015). A controlled study of a group mindfulness intervention for individuals living with inflammatory bowel disease. *Inflammatory Bowel Diseases, 22*(3), 694-701. https://doi.org/10.1097/MIB.0000000000000629

Nes, R. B., Czajkowski, N. O., Røysamb, E., Ørstavik, R. E., Tambs, K., & Reichborn-Kjennerud, T. (2013). Major depression and life satisfaction: A population-based twin study. *Journal of Affective Disorders, 144*(1-2), 51-58. https://doi.org/10.1016/j.jad.2012.05.060

Neuendorf, R., Harding, A., Stello, N., Hanes, D., & Wahbeh, H. (2016). Depression and anxiety in patients with inflammatory bowel disease: A systematic review. *Journal of Psychosomatic Research, 87*, 70-80. https://doi.org/10.1016/j.jpsychores.2016.06.001

Ng, S. C., Shi, H. Y., Hamidi, N., Underwood, F. E., Tang, W., Benchimol, E. I., Panaccione, R., Ghosh, S., Wu, J. C., & Chan, F. K. (2017). Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: A systematic review of population-based studies. *The Lancet, 390*(10114), 2769-2778. https://doi.org/10.1016/S0140-6736(17)32448-0

Nhat Hanh, T. (2011). *The happiness of neutral feelings*, Plum Village Online Monastery. https://tnhaudio.org/2011/01/19/the-happiness-of-neutral-feelings/

Nyanaponika, T. (1962). *Satipatthana: The heart of Buddhist meditation: Satipaṭṭhāna: A handbook of mental training based on the Buddha's way of mindfulness*. Buddhist Publication Society.

Olendzki, A. (2003). Buddhist psychology. In S. R. Segall (Ed.), *Encountering Buddhism: Western psychology and Buddhist teachings* (pp. 9-30). SUNY Press.

Olendzki, A. (2006). The transformative impact of non-self. In *Buddhist Thought and applied psychological research: Transcending the boundaries* (pp. 286-297). Routledge.

Osman, A., Wong, J. L., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., & Lozano, G. (2012). The depression anxiety stress Scales—21 (DASS-21): Further examination of dimensions, scale reliability, and correlates. *Journal of Clinical Psychology, 68*(12), 1322-1338. https://doi.org/10.1002/jclp.21908

Pagis, M. (2015). Evoking equanimity: Silent interaction rituals in Vipassana meditation retreats. *Qualitative Sociology, 38*(1), 39-56. https://doi.org/10.1007/s11133-014-9295-7

Palmore, E., & Kivett, V. (1977). Change in life satisfaction: A longitudinal study of persons aged 46-70. *Journal of Gerontology, 32*(3), 311-316. https://doi.org/10.1093/geronj/32.3.311

Pariante, C. M. (2017). Why are depressed patients inflamed? A reflection on 20 years of research on depression, glucocorticoid resistance and inflammation. *European Neuropsychopharmacology, 27*(6), 554-559. https://doi.org/10.1016/j.euroneuro.2017.04.001

Pascoe, M. C., Thompson, D. R., Jenkins, Z. M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. *Journal of Psychiatric Research, 95*, 156-178. https://doi.org/10.1016/j.jpsychires.2017.08.004

Perrotta, G. (2021). Maladaptive stress: Theoretical, neurobiological and clinical profiles. *Archives of Depression and Anxiety, 7*(1), 001-007. https://doi.org/10.17352/2455-5460.000057

Polak, E.-J., O'Callaghan, F., & Oaten, M. (2020). Perceptions of IBD within patient and community samples: A systematic review. *Psychology & Health, 35*(4), 425-448. https://doi.org/10.1080/08870446.2019.1662014

Powers, J. (2007). *Introduction to Tibetan Buddhism*. Snow Lion.

Rådmark, L., Sidorchuk, A., Osika, W., & Niemi, M. (2019). A systematic review and meta-analysis of the impact of mindfulness based interventions on heart rate variability and inflammatory markers. *Journal of Clinical Medicine, 8*(10), 1638. https://doi.org/10.3390/jcm8101638

Ramsay, D. S., & Woods, S. C. (2014). Clarifying the roles of homeostasis and allostasis in physiological regulation. *Psychological Review, 121*(2), 225. https://doi.org/10.1037/a0035942.

Rankin, C. H., Abrams, T., Barry, R. J., Bhatnagar, S., Clayton, D. F., Colombo, J., Coppola, G., Geyer, M. A., Glanzman, D. L., & Marsland, S. (2009). Habituation revisited: An updated and revised description of the behavioral characteristics of habituation. *Neurobiology of Learning and Memory, 92*(2), 135-138. https://doi.org/10.1016/j.nlm.2008.09.012.

Rau, H. K., & Williams, P. G. (2016). Dispositional mindfulness: A critical review of construct validation research. *Personality and Individual Differences, 93*, 32-43. https://doi.org/10.1016/j.paid.2015.09.035

Rhys Davids, C. A. F. (1900). *A Buddhist manual of psychological ethics of the fourth century B.C.: Being a translation, now made for the first time, from the original Pali, of the first book in the Abhidhamma Piṭaka, entitled Dhamma-sangaṇi (compendium of states or phenomena)* (Vol. 12). Royal Asiatic Society.

Rhys Davids, T. W. (1881). *Buddhist Suttas*. Clarendon Press.

Richardson, B., Tyszkiewicz, M. D. F., Tomyn, A. J., & Cummins, R. A. (2016). The Psychometric equivalence of the Personal Wellbeing Index for normally functioning and homeostatically defeated Australian adults. *Journal of Happiness Studies, 17*(2), 627-641. https://doi.org/10.1007/s10902-015-9613-0

Rissanen, T., Viinamäki, H., Honkalampi, K., Lehto, S. M., Hintikka, J., Saharinen, T., & Koivumaa-Honkanen, H. (2011). Long term life dissatisfaction and subsequent major depressive disorder and poor mental health. *BMC Psychiatry, 11*(1), 140. https://doi.org/10.1186/1471-244x-11-140

Robles, T. F., Glaser, R., & Kiecolt-Glaser, J. K. (2005). Out of balance: A new look at chronic stress, depression, and immunity. *Current Directions in Psychological Science, 14*(2), 111-115. https://doi.org/10.1111/j.0963-7214.2005.00345.x

Roemer, L., Williston, S. K., & Rollins, L. G. (2015). Mindfulness and emotion regulation. *Current Opinion in Psychology, 3*, 52-57. https://doi.org/10.1016/j.copsyc.2015.02.006

Rogers, H. T., Shires, A. G., & Cayoun, B. A. (2020). Development and Validation of the Equanimity Scale-16. *Mindfulness*, 1-14. https://doi.org/10.1007/s12671-020-01503-6

Rohleder, N. (2019). Stress and inflammation–The need to address the gap in the transition between acute and chronic stress effects. *Psychoneuroendocrinology, 105*, 164-171. https://doi.org/10.1016/j.psyneuen.2019.02.021

Rosenkranz, M. A., Davidson, R. J., MacCoon, D. G., Sheridan, J. F., Kalin, N. H., & Lutz, A. (2013). A comparison of mindfulness-based stress reduction and an active control in modulation of neurogenic inflammation. *Brain, Behavior, and Immunity, 27*, 174-184. https://doi.org/10.1016/j.bbi.2012.10.013.

Ross, N. (2019, 30 May). *GAMs in R: A free, interactive course using mgcv*. https://noamross.github.io/gams-in-r-course/

Roy, A., & Campbell, M. K. (2013). A unifying framework for depression: Bridging the major biological and psychosocial theories through stress. *Clinical & Investigative Medicine, 36*(4), 170-190. https://doi.org/10.25011/cim.v36i4.19951

Røysamb, E., Nes, R. B., & Vittersø, J. (2014). Well-being: Heritable and changeable. In K. M. Sheldon & R. E. Lucas (Eds.), *Stability of happiness* (pp. 9-36). Elsevier. https://doi.org/10.1016/c2012-0-06722-1

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110*(1), 145. https://doi.org/10.1037/0033-295X.110.1.145

Sarid, O., Slonim-Nevo, V., Schwartz, D., Friger, M., Sergienko, R., Pereg, A., Vardi, H., Chernin, E., Singer, T., & Greenberg, D. (2018). Differing relationship of psycho-social variables with active ulcerative colitis or Crohn's disease. *International Journal of Behavioral Medicine, 25*(3), 341-350. https://doi.org/10.1007/s12529-018-9712-5

Scheffer, M., Bolhuis, J. E., Borsboom, D., Buchman, T. G., Gijzel, S. M., Goulson, D., Kammenga, J. E., Kemp, B., van de Leemput, I. A., & Levin, S. (2018). Quantifying resilience of humans and other animals. *Proceedings of the National Academy of Sciences, 115*(47), 11883-11890. https://doi.org/10.1073/pnas.1810630115

Schotte, C. K., Van Den Bossche, B., De Doncker, D., Claes, S., & Cosyns, P. (2006). A biopsychosocial model as a guide for psychoeducation and treatment of depression. *Depression and Anxiety, 23*(5), 312-324. https://doi.org/10.1002/da.20177

Schoultz, M., Atherton, I., & Watson, A. (2015). Mindfulness-based cognitive therapy for inflammatory bowel disease patients: Findings from an exploratory pilot randomised controlled trial. *Trials, 16*(1), 379. https://doi.org/10.1186/s13063-015-0909-5

Schwartz, D., Goren, G., Perpinial, P., Friger, M., Sarid, O., Slonim-Nevo, V., Sergienko, R., Nemirovsky, A., Vinogradov, E., & Greenberg, D. (2019). P644 Mindfulness-based stress reduction in adult patients with active Crohn's disease: Preliminary findings based on the subjective units of

distress scale: an IIRN study. *Journal of Crohn's and Colitis, 13*(Supplement_1), S440-S441. https://doi.org/10.1093/ecco-jcc/jjy222.768

Segal, Z. V., Anderson, A. K., Gulamani, T., Dinh Williams, L.-A., Desormeau, P., Ferguson, A., Walsh, K., & Farb, N. A. (2019). Practice of therapy acquired regulatory skills and depressive relapse/recurrence prophylaxis following cognitive therapy or mindfulness based cognitive therapy. *Journal of Consulting and Clinical Psychology, 87*(2), 161. https://doi.org/10.1037/ccp0000351

Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2012). *Mindfulness-based cognitive therapy for depression*. Guilford Press.

Segall, S. R. (2003). On being a non-Buddhist Buddhist: A conversation with myself. In S. R. Segall (Ed.), *Encountering Buddhism: Western psychology and Buddhist teachings* (pp. 75-108). SUNY Press.

Sehgal, P., Ungaro, R. C., Foltz, C., Iacoviello, B., Dubinsky, M. C., & Keefer, L. (2021). High levels of psychological resilience associated with less disease activity, better quality of life, and fewer surgeries in inflammatory bowel disease. *Inflammatory Bowel Diseases, 27*(6), 791-796. https://doi.org/10.1093/ibd/izaa196

Shapiro, S. L. (2009). The integration of mindfulness and psychology. *Journal of Clinical Psychology, 65*(6), 555-560. https://doi.org/10.1002/jclp.20602

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology, 62*(3), 373-386. https://doi.org/10.1002/jclp.20237

Shonin, E., Van Gordon, W., & Griffiths, M. D. (2014). The emerging role of Buddhism in clinical psychology: Toward effective integration. *Psychology of Religion and Spirituality, 6*(2), 123. https://doi.org/10.1037/a0035859

Sinagra, E., Utzeri, E., Morreale, G. C., Fabbri, C., Pace, F., & Anderloni, A. (2020). Microbiota-gut-brain axis and its affect inflammatory bowel disease: Pathophysiological concepts and insights for clinicians. *World Journal of Clinical Cases, 8*(6), 1013. https://doi.org/10.12998/wjcc.v8.i6.1013

Skevington, S. M., & Böhnke, J. R. (2018). How is subjective well-being related to quality of life? Do we need two concepts and both measures? *Social Science & Medicine, 206*, 22-30. https://doi.org/10.1016/j.socscimed.2018.04.005

Slavich, G. M., & Irwin, M. R. (2014). From stress to inflammation and major depressive disorder: A social signal transduction theory of depression. *Psychological Bulletin, 140*(3), 774. https://doi.org/10.1037/a0035302

Stanley, S. (2012). Intimate distances: William James' introspection, Buddhist mindfulness, and experiential inquiry. *New Ideas in Psychology, 30*(2), 201-211. https://doi.org/10.1016/j.newideapsych.2011.10.001

Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin, 134*(1), 138. https://doi.org/10.1037/0033-2909.134.1.138

Strine, T. W., Kroenke, K., Dhingra, S., Balluz, L. S., Gonzalez, O., Berry, J. T., & Mokdad, A. H. (2009). The associations between depression, health-related quality of life, social support, life satisfaction, and disability in

community-dwelling US adults. *Journal of Nervous and Mental Disease, 197*(1), 61-64. https://doi.org/10.1097/NMD.0b013e3181924ad8

Tang, Y.-Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience, 16*(4), 213. https://doi.org/10.1038/nrn3916

Tew, G. A., Jones, K., & Mikocka-Walus, A. (2016). Physical activity habits, limitations, and predictors in people with inflammatory bowel disease: A large cross-sectional online survey. *Inflammatory Bowel Diseases, 22*(12), 2933-2942. https://doi.org/10.1097/MIB.0000000000000962

Thompson, R. F. (2009). Habituation: A history. *Neurobiology of Learning and Memory, 92*(2), 127. https://doi.org/10.1016/j.nlm.2008.07.011

Tomyn, A. J., & Cummins, R. A. (2011). Subjective wellbeing and homeostatically protected mood: Theory validation with adolescents. *Journal of Happiness Studies, 12*(5), 897-914. https://doi.org/10.1007/s10902-010-9235-5

Tomyn, A. J., & Weinberg, M. K. (2018). Resilience and subjective wellbeing: A psychometric evaluation in young Australian adults. *Australian Psychologist, 53*(1), 68-76. https://doi.org/10.1111/ap.12251

Torres, J., Ellul, P., Langhorst, J., Mikocka-Walus, A., Barreiro-de Acosta, M., Basnayake, C., Ding, N. J. S., Gilardi, D., Katsanos, K., & Moser, G. (2019). European crohn's and colitis organisation topical review on complementary medicine and psychotherapy in inflammatory bowel disease. *Journal of Crohn's and Colitis, 13*(6), 673-685e. https://doi.org/10.1093/ecco-jcc/jjz051

Triantafillidis, J. K., Merikas, E., & Gikas, A. (2013). Psychological factors and stress in inflammatory bowel disease. *Expert Review of Gastroenterology & Hepatology, 7*(3), 225-238. https://doi.org/10.1586/egh.13.4

Tribbick, D., Salzberg, M., Connell, W., Macrae, F., Kamm, M., Bates, G., Cunningham, G., Austin, D., & Knowles, S. (2017). Differences across illness perceptions in inflammatory bowel disease and their relationships to psychological distress and quality of life. *Gastroenterology Nursing, 40*(4), 291-299. https://doi.org/10.1097/SGA.0000000000000225

Trivedi, I., Darguzas, E., Balbale, S. N., Bedell, A., Reddy, S., Rosh, J. R., & Keefer, L. (2019). Patient Understanding of "Flare" and "Remission" of Inflammatory Bowel Disease. *Gastroenterology Nursing, 42*(4), 375-385. https://doi.org/10.1097/SGA.0000000000000373

Troy, A. S., Wilhelm, F. H., Shallcross, A. J., & Mauss, I. B. (2010). Seeing the silver lining: Cognitive reappraisal ability moderates the relationship between stress and depressive symptoms. *Emotion, 10*(6), 783. https://doi.org/10.1037/a0020262

Uusberg, H., Uusberg, A., Talpsep, T., & Paaver, M. (2016). Mechanisms of mindfulness: The dynamics of affective adaptation during open monitoring. *Biological Psychology, 118*, 94-106. https://doi.org/10.1016/j.biopsycho.2016.05.004

Vago, D. R., & David, S. A. (2012). Self-awareness, self-regulation, and self-transcendence (S-ART): A framework for understanding the neurobiological mechanisms of mindfulness. *Frontiers in Human Neuroscience, 6*, 1-30. https://doi.org/10.3389/fnhum.2012.00296

Valkanova, V., Ebmeier, K. P., & Allan, C. L. (2013). CRP, IL-6 and depression: A systematic review and meta-analysis of longitudinal studies. *Journal of Affective Disorders, 150*(3), 736-744. https://doi.org/10.1016/j.jad.2013.06.004

Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., Meissner, T., Lazar, S. W., Kerr, C. E., & Gorchov, J. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science, 13*(1), 36-61. https://doi.org/10.1177/1745691617709589

van de Leemput, I. A., Wichers, M., Cramer, A. O., Borsboom, D., Tuerlinckx, F., Kuppens, P., van Nes, E. H., Viechtbauer, W., Giltay, E. J., & Aggen, S. H. (2014). Critical slowing down as early warning for the onset and termination of depression. *Proceedings of the National Academy of Sciences, 111*(1), 87-92. https://doi.org/10.1073/pnas.1312114110

Van Gordon, W., Shonin, E., & Griffiths, M. D. (2017). Buddhist emptiness theory: Implications for psychology. *Psychology of Religion and Spirituality, 9*(4), 309. https://doi.org/10.1037/rel0000079

Vøllestad, J., Nielsen, M. B., & Nielsen, G. H. (2012). Mindfulness-and acceptance-based interventions for anxiety disorders: A systematic review and meta-analysis. *British Journal of Clinical Psychology, 51*(3), 239-260. https://doi.org/10.1111/j.2044-8260.2011.02024.x

von Wietersheim, J., & Kessler, H. (2006). Psychotherapy with chronic inflammatory bowel disease patients: A review. *Inflammatory Bowel Diseases, 12*(12), 1175-1184. https://doi.org/10.1097/01.mib.0000236925.87502.e0

Wallace, B. A., & Shapiro, S. L. (2006). Mental balance and well-being: Building bridges between Buddhism and Western psychology. *American Psychologist, 61*(7), 690. https://doi.org/10.1037/0003-066X.61.7.690

Wang, M., Lu, X., & Liu, M. (2021). The mediating effect of psychological resilience on the level of mindfulness and general well-being in patients with inflammatory bowel disease. *Annals of Palliative Medicine, 10*(8), 9215-9222. https://doi.org/10.21037/apm-21-2053

Watkins, L. E., Sprang, K. R., & Rothbaum, B. (2018). Treating PTSD: A review of evidence-based psychotherapy interventions. *Frontiers in Behavioral Neuroscience, 12*, 258. https://doi.org/10.3389/fnbeh.2018.00258

Weber, J. (2017). Mindfulness is not enough: Why equanimity holds the key to compassion. *Mindfulness & Compassion, 2*(2), 149-158. https://doi.org/10.1016/j.mincom.2017.09.004

Weber, J., & Lowe, M. (2018). Development and validation of the Equanimity Barriers Scale [EBS]. *Current Psychology*, 1-15. https://doi.org/10.1007/s12144-018-9969-5

Wichers, M., Groot, P. C., Psychosystems, E., & Group, E. (2016). Critical slowing down as a personalized early warning signal for depression. *Psychotherapy and Psychosomatics, 85*(2), 114-116. https://doi.org/10.1159/000441458

Williams, J. M. G., & Kabat-Zinn, J. (2011). Mindfulness: Diverse perspectives on its meaning, origins, and multiple applications at the intersection of science and dharma. *Contemporary Buddhism, 12*(01), 1-18. https://doi.org/10.1080/14639947.2011.564811

Williet, N., Sandborn, W. J., & Peyrin–Biroulet, L. (2014). Patient-reported outcomes as primary end points in clinical trials of inflammatory bowel disease. *Clinical Gastroenterology and Hepatology, 12*(8), 1246-1256. e1246. https://doi.org/10.1016/j.cgh.2014.02.016

Wilson, T. D., & Gilbert, D. T. (2008). Explaining away: A model of affective adaptation. *Perspectives on Psychological Science, 3*(5), 370-386. https://doi.org/10.1111/j.1745-6924.2008.00085.x.

Wood, S. N. (2017). *Generalized additive models: An introduction with R*. CRC press.

Yates, F. E., & Urquhart, J. (1962). Control of plasma concentrations of adrenocortical hormones. *Physiological Reviews, 42*(3), 359-443. https://doi.org/10.1152/physrev.1962.42.3.359

Yu, M., & Clark, M. (2015). Investigating mindfulness, borderline personality traits, and well-being in a nonclinical population. *Psychology, 6*(10), 1232. https://doi.org/10.4236/psych.2015.610121

Zeidan, F., Martucci, K. T., Kraft, R. A., Gordon, N. S., McHaffie, J. G., & Coghill, R. C. (2011). Brain mechanisms supporting the modulation of pain by mindfulness meditation. *Journal of Neuroscience, 31*(14), 5540-5548. https://doi.org/10.1523/JNEUROSCI.5791-10.2011

Zeng, X., Oei, T. P., Ye, Y., & Liu, X. (2015). A critical analysis of the concepts and measurement of awareness and equanimity in Goenka's Vipassana meditation. *Journal of Religion and Health, 54*(2), 399-412. https://doi.org/10.1007/s10943-013-9796-9

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67*(6), 361-370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

Appendices

Appendix 1: Survey

Q1
Dear Study Participant,
Thank you for visiting this study's website and considering participation in our online survey on wellbeing and mindfulness in inflammatory bowel disease.

Why is this study important?
Inflammatory bowel disease is an umbrella term that covers two main relapsing inflammatory conditions, Crohn's disease and ulcerative colitis. Around 29.3 per 100,000 Australians have inflammatory bowel disease, which can cause symptoms including abdominal pain, fever, diarrhoea, weight loss and rectal bleeding.
Stress has long been considered a likely contributor to inflammatory bowel disease activity, given the relationship between stress and the parts of the brain that interact with the gut. Previous research has found there to be a relationship between stress and disease outcomes, including disease flares. Depression and anxiety are also commonly experienced by individuals with inflammatory bowel disease; however, psychological treatment is not currently part of recommended treatment.
Mindfulness is a stress reduction technique that people can learn and practice. The ability to be mindful exists within all people, even those who have not had formal mindfulness training. There is growing interest in the use of mindfulness to reduce stress in individuals with physical or psychological symptoms. Research examining the relationships between mindfulness, stress and wellbeing for individuals with diseases such as inflammatory bowel disease can potentially lead to the development of new treatments to reduce psychological symptoms associated with inflammatory bowel disease.

Purpose
To explore the relationships between stress, wellbeing, and depression in a group of people with Crohn's disease or ulcerative colitis, and to investigate whether personal differences in levels of mindfulness impact on these relationships.

Who can participate?
To be eligible to participate in the study you must be an adult (18 years or older) with Crohn's disease or ulcerative colitis. You must have access to the internet and be able to answer the survey in English. You do not need to practice mindfulness, or to have had any experience of mindfulness, in order to participate in this study. **You also do not need to experience depression as we are interested in the perspectives of a variety of people.**

How will this study be conducted?
You may have been invited to take part in this research by following an online link on patient forums or social media platforms. We provided a link to this survey in the advertisement. In order to participate, you need to read this plain language statement carefully, consider participation and if you are interested, consent to participate by pressing the consent button that follows. There is no

separate consent form involved. Pressing the consent button implies your consent to have your data included in our study.
After reading this section and consenting to the survey, you will be directed to a questionnaire comprising several parts. Answering it should take you approximately 30 minutes. You will be asked about your physical and psychological health. The data you will provide will be anonymous and collated with those of other study participants. We will later write research papers and present these data at conferences.
If you are interested in receiving the study findings, we will provide you with a summary via email. If you would like this, please contact klyall@deakin.edu.au.

Risks of the study
We do not anticipate any lasting risks to your health as a result of participating in this study. However, while most people do not find questions about their physical and psychological health problematic, some people may feel uncomfortable thinking of their health or psychological issues. If you are needing support, you may like to contact 24 hour mental health support services such as Beyond Blue on 1300 22 4636 or Life Line on 13 11 14, or discuss your health with your General Practitioner (GP). If, at any stage of this study, you are concerned about the questions we ask, please do not hesitate to contact Associate Professor Antonina Mikocka-Walus at mikocka@deakin.edu.au or 03 9246 8575. These details are provided again at the end of the survey.
In addition, taking the time to complete the survey may be considered an inconvenience for participants but we have ensured the survey is as short as possible to provide the necessary data.
Please remember your participation in this study is voluntary and you may withdraw from the survey prior to submitting your responses. However, since we do not ask you to provide any identifying information, we will not be able to withdraw your data from the study, as we will not be able to identify which are your responses.

Benefits of the study
There is no direct benefit to you from participating in this study. You will not be paid for your participation as this study received no external funding or sponsorship. However, this project is likely to provide necessary data to design pilot trials of interventions to target poor mental health in inflammatory bowel disease. The project will provide background data about the relationship between stress, wellbeing, depression and mindfulness. Thus, it could lead to the development of further research or interventions for this population in the future.

How your privacy and confidentiality will be protected?
This survey will be anonymous. We will not ask you about your name, address or any information which would enable your identification. We will remind you at the start of the survey to not provide any identifying information. If you are interested in receiving the study findings summary, please email Kimina Lyall at klyall@deakin.edu.au. We will provide the summary as soon as possible after the study's completion. We will keep your email safe on a password protected computer drive at Deakin University. We will not share the data you will provide us with anyone outside this study's team. The data will be destroyed after five years.

Monitoring of study conduct and declaration of interest
The project will be conducted by the Deakin University's Doctor of Psychology student Kimina Lyall, together with the two listed 4th year Honours students, Sarah David and Rebecca Orr. The students will conduct the study under the supervision of senior staff members. These are Emeritus Professor Robert Cummins (robert.cummins@deakin.edu.au), Associate Professor Antonina Mikocka-Walus (mikocka@deakin.edu.au) and Dr Subhadra Evans (subhadra.evans@deakin.edu.au). We have no conflict of interest to report. This study is not funded by any external entity and will be conducted using Deakin University's resources.

Ethics approval and complaints
This study has been approved by the Deakin University Human Research Ethics Committee. If you have any questions, please contact the researchers using the above details. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, please contact the manager of the Human Research Ethics Office, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, research-ethics@deakin.edu.au. Please quote project number HEAG-H 66_2019.

Thank you for your participation.

Q2 I consent to participate in this research

- ○ Yes (1)
- ○ No (2)

End of Block: PLS

Start of Block: No consent

Q32 Thank you for considering your participation. As you have not provided consent, the survey will now close.

End of Block: No consent

Start of Block: Wellbeing

Q3
Please answer every question. Please do not provide us with any identifying

information.

PERSONAL WELLBEING

Thinking about your own life and personal circumstances please select the number below that best represents how satisfied you feel with your life.

How satisfied are you with...

	0-Not satisfied at all (0)	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10-Completely satisfied (10)	Don't know (-999)
Your life as a whole? (lifesatc20l)	○										○	○
Your standard of living? (s1matc20l)	○										○	○
Your health? (s2heac20l)	○										○	○
What you are currently achieving in life? (s3proc20l)	○										○	○
Your personal relationships? (s4intc20l)	○										○	○
How safe you feel? (s5safc20l)	○										○	○
Feeling part of your community? (s6comc20l)	○										○	○
Your future security? (s7secc20l)	○										○	○

Page Break

Q4 **HOW YOU GENERALLY FEEL**

Please indicate how you generally feel each day.

In general I feel...

	0-Not at all (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	10-Extremely (11)	Don't know (12)
I feel active (1)	(									(	○	○
I feel contented (4)	(									(	○	○
I feel energised (5)	(									(	○	○
I feel alert (6)	(									(	○	○
I feel happy (7)	(									(	○	○
I feel excited (8)	(									(	○	○
I feel satisfied (9)	(									(	○	○

Page Break

Q5 **OVER THE PAST WEEK**

How much did these statements apply to you over the past week?

Thinking about the past week...

	0- Not at all (0)	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10- Completely (10)	Don't know (-999)
I found it hard to wind down. (1)	(										○	○
I couldn't seem to feel any positive feelings at all. (2)	(										○	○
I felt that I had nothing to look forward to. (3)	(										○	○
I found myself getting agitated. (4)	(										○	○
I found it difficult to relax. (9)	(										○	○
I felt down-hearted and blue. (5)	(										○	○
I felt I wasn't worth much as a person. (6)	(										○	○

I felt that I was rather touchy. (7)	(										○	○

Page Break

Q6 **EVENTS IN YOUR LIFE**

	0-No happiness (0)	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10-Complete happiness (10)	Don't know (-999)
Thinking back on your life, what is the highest level of happiness you've ever experienced? (1)	○										○	○

Q7 Has anything happened to you recently causing you to feel happier or sadder than normal? Please select as appropriate.

- ○ Yes, happier (1)
- ○ Yes, both happier and sadder (2)
- ○ Yes, sadder (3)
- ○ No (4)
- ○ Don't know (5)

Display This Question:

If Has anything happened to you recently causing you to feel happier or sadder than normal? Please s... = Yes, happier

Or Has anything happened to you recently causing you to feel happier or sadder than normal? Please s... = Yes, sadder

Q8 On a scale of 0 to 10 how strongly is what happened affecting your feelings right now?

	0-Very weakly (0)	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	Very strongly-10 (10)	Don't know (-999)
(1)	○										○	○

Page Break

End of Block: Wellbeing

Start of Block: IBD

Q9

INFLAMMATORY BOWEL DISEASE

When were you first diagnosed with inflammatory bowel disease?

- ○ Within the past month (1)
- ○ Within the past year (2)
- ○ Within the past 2 years (3)
- ○ Within the past 5 years (4)
- ○ Between 5 and 10 years ago (5)
- ○ Between 10 and 20 years ago (6)
- ○ More than 20 years ago (7)

Q10 My inflammatory bowel disease is

- ○ Crohn's disease (1)
- ○ ulcerative colitis (2)

Q11 In the past 24 hours, how many bowel movements did you have?

- 0 (1)
- 1-2 (2)
- 3-4 (3)
- 5-6 (4)
- 7-9 (5)
- 10-12 (6)
- 13-17 (7)
- More than 17 (8)

Q12 In the past 24 hours, how often were your bowel movements mostly or completely liquid?

- Never (1)
- Rarely (2)
- Sometimes (6)
- Often (7)
- Always (8)

Q13 In the past 24 hours, did you feel the need to have a bowel movement right away?

- ○ No (1)
- ○ Mild (2)
- ○ Moderate (4)
- ○ Severe (5)
- ○ Very severe (6)

Q14 In the past 24 hours, did you pass gas?

- ○ No (1)
- ○ Rarely (2)
- ○ Sometimes (4)
- ○ Often (5)
- ○ Very often (6)

Q15 In the past 24 hours, did you feel pain in your belly?

- ○ No (1)
- ○ Mild (2)
- ○ Moderate (4)
- ○ Severe (5)
- ○ Very severe (6)

Q16 In the past 24 hours, did you feel bloating in your belly?

- ○ No (1)
- ○ Mild (2)
- ○ Moderate (4)
- ○ Severe (5)
- ○ Very severe (6)

Display This Question:

If My inflammatory bowel disease is = ulcerative colitis

Q17 In the past 24 hours, did you have blood in your bowel movements?

- ○ No (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Very often (5)

Display This Question:

If My inflammatory bowel disease is = ulcerative colitis

Q18 In the past 24 hours, did you have mucus in your bowel movements?

- ○ No (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Very often (5)

Display This Question:

If My inflammatory bowel disease is = ulcerative colitis

Q19 In the past 24 hours, did stool, blood or liquid leak out before you reached a toilet?

- ○ No (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Very often (5)

End of Block: IBD

Start of Block: Other health conditions

Q20 Do you experience other chronic health conditions?

- ○ Yes (1)
- ○ No (2)
- ○ If yes, please list (3) _____

End of Block: Other health conditions

Start of Block: Mindfulness

Q21 **MINDFULNESS**
The next questions are about mindfulness practices. Mindfulness practices

include focused breathing, bodyscans, yoga exercises, or guided meditations delivered through classes or smartphone apps.

	0-No experience at all (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10-Extensive experience (10)	Don't know (13)
How would you describe your level of experience with mindfulness practices? (3)	○									○	○

Q22 How often do you engage in formal mindfulness practice?

- ○ Never (1)
- ○ Hardly ever (2)
- ○ Occasionally (6)
- ○ Weekly (7)
- ○ A couple of times a week (8)
- ○ Daily (9)

Q23
Please respond to each item how often you have experienced each of the following statements over the *past week*.

	Never (1)	Rarely (2)	Sometimes (6)	Often (7)	Very often (8)
I try to distract myself when I feel unpleasant emotions (1)	○	○	○	○	○
There are aspects of myself I don't want to think about (2)	○	○	○	○	○
I try to stay busy to keep thoughts or feelings from coming to mind (3)	○	○	○	○	○
I wish I could control my emotions more easily (4)	○	○	○	○	○
I tell myself that I shouldn't have certain thoughts (5)	○	○	○	○	○
There are things I try not to think about (6)	○	○	○	○	○
I tell myself that I shouldn't feel sad (7)	○	○	○	○	○
If there is something I don't want to think about, I'll try many things to get it out of my mind (8)	○	○	○	○	○

I try to put my problems out of my mind (9)	○	○	○	○	○
When I have a bad memory, I try to distract myself to make it go away (10)	○	○	○	○	○

End of Block: Mindfulness

Start of Block: Demographics

Q24 **PERSONAL DETAILS**

Below you will find some questions that refer to your personal details.

Q25 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Other (4)
- ○ Decline to answer (5)

Q26 Your age (years):

_____

Q27 Please indicate from the list who lives with you. (Tick whichever boxes apply)

- ☒ No one, you live by yourself (1)
- ☐ Your partner (2)
- ☐ One or more adults who are neither your partner nor your parent (3)
- ☐ One or more children (4)
- ☐ One or both of your parents (5)
- ☒ Don't know (7)

Q28 Which of the following categories apply to you at the present time?

- ○ Married (1)
- ○ Widowed (2)
- ○ De facto or living together (3)
- ○ Separated but not divorced (4)
- ○ Divorced (5)
- ○ Never married (7)

Q29 Which of the following categories best applies to you at the present time.

- ☐ Full-time paid employment (1)
- ☐ Full-time study (2)
- ☐ Full-time volunteer (3)
- ☐ Full-time home or family care (4)
- ☐ Semi-retirement (5)
- ☐ Full-time retirement (6)
- ☐ Unemployed (7)
- ☐ None of these (9)

Q30 Please indicate whether any of the following part-time categories applies to you at the present time.

- ☐ Part-time employment (1)
- ☐ Casual employment (2)
- ☐ Part-time volunteer (3)
- ☐ Part-time study (4)
- ☒ None of these (6)

Q31 What is your household's total annual income before tax?

- ○ Less than $15,000 (1)
- ○ $15,000-$30,000 (2)
- ○ $31,000-$60,000 (3)
- ○ $61,000-$100,000 (4)
- ○ $101,000-$150,000 (5)
- ○ $151,000-$250,000 (6)
- ○ $251,000-$500,000 (7)
- ○ More than $500,000 (8)
- ○ Prefer not to answer (9)

Q32 Is there anything else you would like to share with us?

_____

Q33 Thank you. The survey is now complete. If you have any concerns about this study, please contact Assoc. Prof. Antonina Mikocka-Walus at mikocka@deakin.edu.au or 03 9246 8575. If you would like a summary of the results when they are available, please contact Kimina Lyall at klyall@deakin.edu.au.

Appendix 2: Ethics approvals

ETHICS COMMITTEE
CERTIFICATE OF APPROVAL

Barwon Health

Barwon Health Reference	**18/182**
Project Title	**The role of mindfulness in promoting wellbeing in patients with Crohn's disease: An exploratory randomised controlled trial**
Protocol Reference	**N/A**
Principal Researcher	**Associate Professor Antonina Mikocka-Walus**
Research Team	**Ms Kimina Lyall, Dr Lauren Beswick**

The above project was considered by the Human Research Ethics Committee at the meeting of 10 October 2018 and having fulfilled the requirements of the National Statement on Ethical Conduct in Human Research (2007), was approved on 27 November 2018.

The documents reviewed and approved are:

HREA
SSA
Protocol Version 7 dated 07/11/2018
PICF Version 4 dated 07/11/2018
VSM dated 07/11/2018
Flyer Mindfulness Version 2 dated 07/11/2018

It is the Principal Researcher's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Research Ethics, Governance & Integrity (REGI) Unit, via amendment or report, of:

- Any significant change to the project and the reason for that change, including an indication of ethical implications (if any);
- Any serious adverse effects on participants and the action taken to address those effects;
- Any other unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in their role, or any other change in research personnel involved in the project;
- A delay of more than 12 months in the commencement of the project;

Memo

To:	Professor Robert Cummins and Associate Professor Antonina Mikocka-Walus School of Psychology
From:	Secretary – HEAG-H Faculty of Health
CC:	Dr Subhadra Evans, Dr Lauren Beswick, Kimina Lyall, Sarah David, and Bec Orr
Date:	13 June 2019
Re:	**HEAG-H 66_2019:** ***The influence of stress, mood, and mindfulness attributes on the subjective wellbeing of people with Crohn's disease.***

Approval has been given for Professor Robert Cummins and Associate Professor Antonina Mikocka-Walus, of the School of Psychology, to undertake this project with the modifications that were requested on the **13 June, 2019**. The project has been given approval as it meets the requirements of the National Statement on Ethical Conduct in Human Research (2007).

Please note that the current end date for this project is **06 June, 2020**

Steven Sawyer
Secretary
HEAG-H

Appendix 3: Authorship Statements

AUTHORSHIP STATEMENT

1. Details of publication and executive author

Title of Publication		Publication details
Linking homeostatically protected mood, mindfulness, and depression: A conceptual synthesis and model of moodfulness		*Review of General Psychology*, published August 2021
Name of executive author	School/Institute/Division if based at Deakin; Organisation and address if non-Deakin	Email or phone
Kimina Lyall	Deakin University School of Psychology	klyall@deakin.edu.au

2. Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis?	Yes / No YES	If Yes, please complete Section 3 If No, go straight to Section 4.

3. HDR thesis author's declaration

Name of HDR thesis author if different from above. (If the same, write "as above")	School/Institute/Division if based at Deakin	Thesis title
As above	School of Psychology	Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical explorations.
If there are multiple authors, give a full description of HDR thesis author's contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)		
I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.	Signature and date	[redacted]

4. Description of all author contributions

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Assoc Prof. Antonina Mikocka-Walus Deakin University School of Psychology	Conceptualisation, resources, Writing – review and editing, supervision
Dr Subhadra Evans Deakin University School of Psychology	Conceptualisation, resources, Writing – review and editing, supervision
Em. Prof Robert A. Cummins	Conceptualisation, resources, Writing – review and editing, supervision

5. Author Declarations

I agree to be named as one of the authors of this work, and confirm:

i. that I have met the authorship criteria set out in the Deakin University Research Conduct Policy,

ii. that there are no other authors according to these criteria,

iii. that the description in Section 4 of my contribution(s) to this publication is accurate,

iv. that the data on which these findings are based are stored as set out in Section 7 below.

If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further

v. consent to the incorporation of the publication into the candidate's HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

Name of author	Signature*	Date
Assoc. Prof Antonina Mikocka-Walus	[redacted]	23 October 2021
Dr Subhadra Evans		23 October 2021
Em. Prof Robert. A. Cummins		23 October 2021

6. Other contributor declarations

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A		

***** If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

Data format	Storage Location	Date lodged	Name of custodian if other than the executive author
N/A			

This form must be retained by the executive author, within the school or institute in which they are based.

If the publication is to be included as part of an HDR thesis, a copy of this form must be included in the thesis with the publication.

AUTHORSHIP STATEMENT

1. Details of publication and executive author

Title of Publication		Publication details
Exploring evidence for mindfulness and subjective wellbeing homeostatic resilience buffering depression symptoms associated with inflammatory bowel disease		Submitted to *Journal of Happiness Studies*
Name of executive author	School/Institute/Division if based at Deakin; Organisation and address if non-Deakin	Email or phone
Kimina Lyall	Deakin University School of Psychology	klyall@deakin.edu.au

2. Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis?	Yes / No YES	If Yes, please complete Section 3 If No, go straight to Section 4.

3. HDR thesis author's declaration

Name of HDR thesis author if different from above. (If the same, write "as above")	School/Institute/Division if based at Deakin	Thesis title
As above	School of Psychology	Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical explorations.
If there are multiple authors, give a full description of HDR thesis author's contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)		
I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.	Signature and date	[redacted]

4. Description of all author contributions

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Dr George Youssef	Conceptualisation, methodology, resources, writing – review and editing
Assoc Prof. Antonina Mikocka-Walus Deakin University School of Psychology	Conceptualisation, resources, writing – review and editing, supervision
Dr Subhadra Evans Deakin University School of Psychology	Conceptualisation, resources, writing – review and editing, supervision
Em. Prof Robert A. Cummins	Conceptualisation, resources, writing – review and editing, supervision

5. Author Declarations

I agree to be named as one of the authors of this work, and confirm:

i. that I have met the authorship criteria set out in the Deakin University Research Conduct Policy,

ii. that there are no other authors according to these criteria,

iii. that the description in Section 4 of my contribution(s) to this publication is accurate,

iv. that the data on which these findings are based are stored as set out in Section 7 below.

If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further

v. consent to the incorporation of the publication into the candidate's HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

Name of author	Signature*	Date
Dr George Youssef	[redacted]	23 October 2021
Assoc. Prof Antonina Mikocka-Walus		23 October 2021
Dr Subhadra Evans		23 October 2021
Em. Prof Robert. A. Cummins		23 October 2021

6. Other contributor declarations

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A		

***** If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

Data format	Storage Location	Date lodged	Name of custodian if other than the executive author
SPSS (all data are deidentified, no identifying data were collected)	Deakin University VPN	August 2019	

This form must be retained by the executive author, within the school or institute in which they are based.

If the publication is to be included as part of an HDR thesis, a copy of this form must be included in the thesis with the publication.

AUTHORSHIP STATEMENT

1. Details of publication and executive author

Title of Publication		Publication details
Mindfulness practice is associated with subjective wellbeing homeostasis resilience in people with Crohn's disease but not ulcerative colitis		Submitted to *Frontiers in Psychiatry*
Name of executive author	School/Institute/Division if based at Deakin; Organisation and address if non-Deakin	Email or phone
Kimina Lyall	Deakin University School of Psychology	klyall@deakin.edu.au

2. Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis?	Yes / No YES	If Yes, please complete Section 3 If No, go straight to Section 4.

3. HDR thesis author's declaration

Name of HDR thesis author if different from above. (If the same, write "as above")	School/Institute/Division if based at Deakin	Thesis title
As above	School of Psychology	Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical explorations.
If there are multiple authors, give a full description of HDR thesis author's contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)		
I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.	Signature and date	[redacted]

4. Description of all author contributions

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Dr Subhadra Evans Deakin University School of Psychology	Conceptualisation, resources, writing – review and editing, supervision
Em. Prof Robert A. Cummins	Conceptualisation, resources, writing – review and editing, supervision
Dr Lauren Beswick, Barwon Health Gastroenterology Department and Deakin University School of Medicine	Conceptualisation, methodology, resources, writing – review and editing
Assoc Prof. Antonina Mikocka-Walus Deakin University School of Psychology	Conceptualisation, methodology, resources, writing – review and editing, supervision

5. Author Declarations

I agree to be named as one of the authors of this work, and confirm:

i. that I have met the authorship criteria set out in the Deakin University Research Conduct Policy,

ii. that there are no other authors according to these criteria,

iii. that the description in Section 4 of my contribution(s) to this publication is accurate,

iv. that the data on which these findings are based are stored as set out in Section 7 below.

If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further

v. consent to the incorporation of the publication into the candidate's HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

Name of author	Signature*	Date
Dr Subhadra Evans	[redacted]	23 October 2021
Em. Prof Robert. A. Cummins		23 October 2021
Dr Lauren Beswick		23 October 2021
Assoc. Prof Antonina Mikocka-Walus		23 October 2021

6. Other contributor declarations

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A		

***** If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

Data format	Storage Location	Date lodged	Name of custodian if other than the executive author
SPSS (all data are deidentified, no identifying data were collected)	Deakin University VPN	August 2019	

This form must be retained by the executive author, within the school or institute in which they are based.

If the publication is to be included as part of an HDR thesis, a copy of this form must be included in the thesis with the publication.

AUTHORSHIP STATEMENT

1. Details of publication and executive author

Title of Publication		Publication details
The role of mindfulness in promoting subjective wellbeing and mood homeostasis in patients with Crohn's disease: A pilot randomised control trial protocol		Accepted for publication in *Social Science Protocols*
Name of executive author	School/Institute/Division if based at Deakin; Organisation and address if non-Deakin	Email or phone
Kimina Lyall	Deakin University School of Psychology	klyall@deakin.edu.au

2. Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis?	Yes / No YES	If Yes, please complete Section 3 If No, go straight to Section 4.

3. HDR thesis author's declaration

Name of HDR thesis author if different from above. (If the same, write "as above")	School/Institute/Division if based at Deakin	Thesis title
As above	School of Psychology	Mindfulness, depression, and subjective wellbeing homeostasis: theoretical and empirical explorations.
If there are multiple authors, give a full description of HDR thesis author's contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)		
I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.	Signature and date	[redacted]

4. Description of all author contributions

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Dr Lauren Beswick, Barwon Health Gastroenterology Department and Deakin University School of Medicine	Conceptualisation, methodology, resources, writing – review and editing
Dr Subhadra Evans Deakin University School of Psychology	Conceptualisation, resources, writing – review and editing, supervision
Em. Prof Robert A. Cummins	Conceptualisation, resources, writing – review and editing, supervision
Assoc Prof. Antonina Mikocka-Walus Deakin University School of Psychology	Conceptualisation, methodology, resources, writing – review and editing, supervision

5. Author Declarations

I agree to be named as one of the authors of this work, and confirm:

i. that I have met the authorship criteria set out in the Deakin University Research Conduct Policy,

ii. that there are no other authors according to these criteria,

iii. that the description in Section 4 of my contribution(s) to this publication is accurate,

iv. that the data on which these findings are based are stored as set out in Section 7 below.

If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further

v. consent to the incorporation of the publication into the candidate's HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

Name of author	Signature*	Date
Dr Lauren Beswick	[redacted]	23 October 2021
Dr Subhadra Evans		23 October 2021
Em. Prof Robert. A. Cummins		23 October 2021
Assoc. Prof Antonina Mikocka-Walus		23 October 2021

6. Other contributor declarations

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A		

***** If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

Data format	Storage Location	Date lodged	Name of custodian if other than the executive author
N/A			

This form must be retained by the executive author, within the school or institute in which they are based.

If the publication is to be included as part of an HDR thesis, a copy of this form must be included in the thesis with the publication.