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The Effect of Positive Psychological Interventions on Psychological and Physical Well-Being during Pregnancy

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Thesis submitted to University College Cork for the qualification of PhD

School of Applied Psychology

April 2015

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Supervisors: Dr Samantha Dockray

Dr Zelda Di Blasi

Dedication

To Leo, my sweetheart,

and his baby brother who I can’t wait to meet.

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Declaration

I hereby declare that this dissertation is the original work of the researcher and has not been submitted for any other degree.

Signed: _____ Date: _____

Abstract

Prenatal well-being can have significant effects on the mother and developing foetus. Positive psychological interventions, including gratitude and mindfulness, consistently demonstrate benefits for well-being in diverse populations. No research has been conducted on gratitude during pregnancy; the few studies of prenatal mindfulness interventions have demonstrated well-being benefits. The current study examined the effects of gratitude and mindfulness interventions on prenatal maternal well-being, cortisol and birth outcomes. Five studies were conducted. Study 1 was a systematic review of mindfulness intervention effects on cortisol; this highlighted potential benefits of mindfulness but the need for rigorous protocols in future research. In Study 2 a gratitude and a mindfulness intervention were developed and evaluated; findings indicate usefulness of two 3 week interventions. Study 3 examined the effects of these interventions in a randomised controlled trial (RCT) of non-pregnant women, before examining a pregnant group. No significant intervention effects were found in this study, potentially due to insufficient power and poor protocol adherence. Changes in expected directions were observed for most outcomes and the potential utility of a combined gratitude and mindfulness intervention was noted. In Study 4 a gratitude during pregnancy (GDP) scale was developed and the reliability of an existing mindfulness measure (MAAS) was examined in a pregnant group. Both scales were found to be suitable and reliable measures in pregnancy. Study 5 incorporated the findings of the previous four studies to examine of the effect of a combined mindfulness and gratitude intervention with a group of pregnant women. Forty-six participants took part in a 5-week RCT that examined intervention effects on prenatal gratitude, mindfulness,

happiness, satisfaction with life, social support, prenatal stress, depression and sleep. Findings indicated that the intervention improved sleep quality and that effects for prenatal distress were approaching significance. Issues of attrition and non-compliance to study protocols were problematic and are discussed.

In summary, the current thesis highlights the need for robust measurement, and intervention and cortisol sampling protocols in future research, particularly with pregnant groups. Findings also demonstrate tentative benefits of a gratitude and mindfulness intervention during pregnancy.

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Publications Arising from this Thesis

O' Leary, K., O' Neill, S., & Dockray (2015). A systematic review of the effects of mindfulness on cortisol. *Journal of Health Psychology* (in press).

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Chapter 1

Introduction

Prenatal well-being has significant implications for the health and well-being of mothers and infants. Low levels of prenatal well-being can result in impaired prenatal and postnatal functioning, with the potential for detrimental effects on future well-being. Pregnancy is a transitional period that can lead to increased distress for many women. Exposure to increased levels of distress directly influences women's psychological and hormonal stress responses, increasing maternal and foetal risk for negative outcomes. Despite an awareness of the effects of poor prenatal well-being, no dedicated programmes or interventions are currently in place at a national level in Ireland to foster and maintain positive well-being during pregnancy.

A positive psychological approach to human functioning aims to enhance existing positive facets of well-being, rather than attempting to ameliorate existing negative symptomatologies. The current research adopts this approach to examine the effect of positive psychological interventions on self-report and biomarkers (namely cortisol) of well-being during pregnancy. In order to adequately address intervention efficacy, it is also necessary to examine the suitability of existing interventions, and the appropriateness of extant measurement tools for evaluating positive prenatal well-being. The findings presented bring together existing bodies of research on prenatal well-being and positive interventions, and the relationship between cortisol and well-being during pregnancy. The research presented herein is comprised of five studies, which individually address the overall research aims. The designs used in each study allow for robust examinations of current conceptualisations and

measurement of prenatal well-being, the effects of positive interventions on cortisol, and the effect of positive psychological interventions during pregnancy.

1.1 Relevance

Positive psychological states and traits are consistently associated with psychological well-being (Wood & Tarrier, 2010), including decreased depression and stress, and increased life satisfaction and positive affect. They are also associated with health outcomes (Aspinwall & Tedeschi, 2010) and positive behaviour changes (Steptoe, Dockray & Wardle, 2009). Positive psychology can be seen as an attempt to bring together previously disparate lines of enquiry into antecedents and effects of positive factors, to form a robust empirical base. In doing so, positive psychology does not neglect negative aspects of human functioning but incorporates both positive and negative factors to enhance well-being and predict risk. Two recent meta-analyses of positive psychological interventions have provided support for the utility of positive interventions for improving well-being (Bolier, 2013; Sin & Lyubomirsky, 2009).

1.1.1 Mindfulness and gratitude. Mindfulness and gratitude are two positive constructs that have consistently demonstrated benefits for well-being in terms of state and trait associations, and intervention effects (Keng et al., 2011; Wood, Taylor & Joseph, 2010). Gratitude is defined as a world view toward appreciating the positive in life. In a recent review, Wood et al. (2010) found robust, positive associations between gratitude and well-being. For instance it is associated with increased happiness, life satisfaction and health behaviours, as well as reduced stress, depression and anxiety. A number of gratitude interventions have been developed;

the most widely examined is the gratitude list. This involves listing things that elicit gratitude and has demonstrated positive and sustained improvements in well-being over time. Mindfulness-based interventions also consistently demonstrate beneficial effects for well-being. Mindfulness is defined as non-judgemental observation of all internal and external stimuli as they arise. The two main interventions, Mindfulness Based Stress Reduction (MBSR) and Mindfulness Based Cognitive Therapy (MBCT), have demonstrated consistent improvements in well-being in diverse populations including clinical and non-clinical groups (Keng et al., 2011). A comprehensive review of the literature surrounding gratitude and mindfulness is presented in Chapter 2.

Despite beneficial effects, existing research is limited by a number of methodological concerns. For instance, the time commitment inherent in current mindfulness interventions may limit interpretation of findings to a specific group of people less restricted by existing time constraints. Additionally mindfulness interventions involve multiple components that are not often examined individually. Interventions typically involve group sessions and despite the potentially confounding influence of social support, the role of social support has received scant attention in the literature. Gratitude interventions are limited by the use of often-inappropriate control conditions that do not facilitate true comparisons of intervention effects (Wood et al., 2010). Diversity in intervention protocols, populations and outcome measurement leads to difficulties in drawing coherent inferences from empirical findings on gratitude and mindfulness. Previous positive research has also failed to adequately incorporate biophysiological indicators of well-being, which can provide objective measures of intervention efficacy.

1.1.2 Cortisol. Cortisol is a useful and widely used biophysiological marker of psychological stress. It is produced by the hypothalamic pituitary adrenal (HPA) axis. This is a control and regulatory system involved in regulation of the cardiovascular and immune systems, and affective and cognitive processes. As such, cortisol is an important mediator between psychological states and health related outcomes. Alterations in cortisol functioning can have adverse physical and psychological outcomes. Cortisol can be examined in terms of the cortisol awakening response (CAR) and diurnal cortisol secretion. Although these two facets are not strongly associated with one another they are both strongly associated with well-being. For instance, in a review of the empirical literature, Chida and Steptoe (2009) found associations between the cortisol awakening response (CAR) and stress, fatigue and depression. They also found associations between cortisol levels and positive states and traits. Although literature in the area is scarce, cortisol is beginning to be used as an indicator of positive intervention efficacy. In relation to the current research, cortisol has been incorporated into a handful of examinations of mindfulness intervention efficacy (O'Leary et al., 2015). No research on cortisol and gratitude has been published. To examine the effects of mindfulness interventions on cortisol, Study 1 (Chapter 3) is a systematic review of the literature. Findings indicate some potential effects of mindfulness on cortisol but that observed outcome variability may be due to methodological inconsistencies. These inconsistencies relate to control groups, cortisol sampling protocols and intervention use.

1.1.3 Intervention development and efficacy. Findings of Study 1 and previous outcomes of self-report examinations highlight a need for rigorous and robust evaluations of mindfulness and gratitude effects. As a result, Study 2 (Chapter 5)

outlines a pilot study in which 2 novel interventions are developed for use in a larger randomised controlled trial (RCT). One intervention is gratitude-based, the other is mindfulness-based; both interventions involve writing and listening components. The intervention format allows for an investigation of the role of separate intervention components on well-being, and an investigation of intervention usability and required duration. Study 3 (Chapter 6) incorporates the findings of the pilot study in an examination of intervention efficacy in a population of non-pregnant women. The aim is to examine intervention effects on indicators of psychological well-being, including stress, depression, sleep, happiness, satisfaction with life, social support, and positive and negative affect. Cortisol is also included to provide a robust assessment of intervention effects on both objective and subjective markers of well-being. This is done using a RCT design that includes a no treatment wait-list control against which intervention effects can be compared. The findings of Study 3 are essential for future intervention refinement and use with specific populations, including pregnant women.

1.1.4 Prenatal well-being. Pregnancy is no longer considered an unproblematic time for expectant mothers but is instead recognised as a time of potentially increased worry and distress. Low prenatal well-being is typically characterised by high levels of stress, depression and anxiety, as well as low levels of happiness and life satisfaction. The effects of low well-being during pregnancy have been extensively documented; it is associated with pregnancy complications (DaCosta, Brender & Larouche, 1998), preterm delivery and low birth weight (Lobel et al., 2008), and pre and post natal depression (Brummelte & Galea, 2010). Prenatal stress for instance is associated with poor obstetric outcomes, including labour and delivery

complications (Saunders et al., 2006), low birth weight, gestational age, and preterm labour (Dunkel Schetter, 2011), foetal neurobehavioral development, cognitive functioning, and emotional regulation in infancy and childhood (Entringer et al., 2009; Huizink et al., 2003). It is estimated that 25% of women experience prenatal stress (Yali & Lobel, 1999), which can arise from a broad range of psychological, psychosocial and environmental factors (Dunkel Schetter, 2011). These include physical changes and complaints, worries about the baby and birth, previous pregnancy experience, and social support. The prevalence of pregnancy related concerns indicates that stress during pregnancy should be considered as a contextually specific experience. This is particularly important given that prenatal stress is more robustly associated with foetal development and birth outcomes than general stress (Alderdice, Lynn & Lobel, 2012; DiPietro, Ghera, Costigan & Hawkins, 2004).

1.1.5 Measuring prenatal well-being. Prenatal maternal well-being is of clear importance for foetal and maternal outcomes. It is therefore essential to effectively measure aspects of prenatal well-being as they occur. The predominant focus in the pregnancy literature has been on measuring negative aspects of well-being however. Positive aspects that may foster and improve well-being have been neglected as a result. Adequate measurement is particularly important when evaluating the effects of interventions based on gratitude and mindfulness because increases in these constructs, resulting from intervention participation, are posited to mediate improvements in well-being (Emmons & McCullough, 2003; Shapiro et al., 2008). Gratitude has not previously been examined in pregnancy and psychometric data on existing mindfulness scales in pregnancy are not currently available. A gap therefore

exists in the literature regarding the reliability of such tools during the prenatal period. As a result, in Study 4 (Chapter 8) a gratitude scale for use during pregnancy is developed and an existing mindfulness scale is evaluated. A thematic analysis of pregnant women's self-reported sources of gratitude is conducted initially to provide insight into subjective experiences of positive constructs in pregnancy, and to inform item construction for a pregnancy specific gratitude measure. The second part of Study 4 develops and validates a Gratitude during Pregnancy (GDP) scale, and evaluates the psychometric properties of an existing mindfulness scale, the Mindfulness Awareness Attention Scale (MAAS), during pregnancy. The findings enable us to conduct a robust examination of intervention effects in a pregnant group, with confidence in the contextually specific measurement of constructs.

1.1.6 Cortisol during pregnancy. In addition to accurately measuring change in positive and negative psychological constructs as they occur in pregnancy, the current research also incorporates cortisol as an outcome measure. During pregnancy, psychosocial stress has the potential to alter cortisol secretion, which may directly impact or mediate adverse birth outcomes. The CAR and diurnal patterns remain intact during pregnancy but a progressive increase in cortisol levels occurs from approximately 25 weeks gestation. In pregnancy cortisol is produced by both the placenta and maternal HPA axis; placental cortisol modulates foetal and maternal pituitary functioning and is simultaneously regulated by the intrauterine and maternal environment. Cortisol responding is attenuated in later pregnancy and the foetus is protected from excessive cortisol by the placental enzyme 11βHSD2. However maternal cortisol can still account for up to 40% of the variance in foetal levels. As a result, even small increases in maternal cortisol can potentially double

foetal amounts (deWeerth & Buitelaar, 2005a). Increased maternal cortisol may be particularly detrimental during sensitive periods of rapid growth, such as early pregnancy when cortisol responding is not yet attenuated.

Incorporating positive aspects of well-being in an examination of prenatal interventions enables a more holistic approach to fostering and improving well-being during pregnancy. Similarly, incorporating positive constructs in studies of self-report outcomes and cortisol allows an examination of the effects of these constructs on objective indicators of pregnancy health and outcomes. There is little research to date examining potential benefits of positive factors of well-being on cortisol outcomes during pregnancy. Research that has been conducted indicates that positive life events (Pluess, Bolten, Pirke & Hellhammer, 2010) and positive constructs, such as happiness (Cheng & Pickler, 2010), are associated with morning cortisol and the CAR beyond the effects of negative facets of well-being. As stated, no research has been conducted on gratitude in pregnancy or the effects of gratitude on cortisol. Research that has been conducted on mindfulness effects during pregnancy has not examined cortisol but has demonstrated potential benefits for prenatal well-being. Findings include reduced levels of depression, anxiety, negative affect (for example, Duncan & Bardacke, 2010) and stress (Dunn, Hanieh, Roberts & Powrie, 2012). Mindfulness interventions have also demonstrated improvements in positive affect (Duncan & Bardacke, 2010) and sleep (Beddoe et al., 2010).

1.1.7 Examining intervention effects on prenatal well-being. Study 5 (Chapter 9) addresses the current gap in the literature relating to mindfulness and gratitude intervention effects on psychological well-being and cortisol during pregnancy. In Study 5, a RCT is conducted to examine intervention efficacy on prenatal

psychological well-being, cortisol levels and birth outcomes. This study is conducted with a group of women in early pregnancy, recruited prior to 20 weeks gestation, who participated in either a wait-list, no-treatment control or an intervention condition. The intervention is based on the findings of Studies 2 and 3; cortisol protocols are guided by the findings of Study 1; gratitude and mindfulness are measured as per the findings of Study 4. The findings of this research provide an insight into the utility of gratitude and mindfulness for improving well-being in pregnancy.

1.2 Summary

There is a need to examine the effects of positive psychological interventions, based on mindfulness and gratitude, on psychological self-report and biomarkers (cortisol) of well-being during pregnancy. Brief, cost-effective interventions that can foster and maintain well-being can have considerable benefits for mother and foetus. It is essential that such investigations adopt rigorous protocols and the current thesis outlines a robust approach to examining intervention effects during pregnancy. This involves a rigorous review of the literature relating to gratitude, mindfulness and cortisol (Chapter 2); a systematic review of mindfulness effects on cortisol (Study 1, Chapter 3); the development of suitable interventions (Study 2, Chapter 5); and a preliminary examination of these interventions in a non-pregnant group (Study 3, Chapter 6). This is followed by an in-depth review of the empirical literature on psychological well-being, cortisol during pregnancy, and positive prenatal intervention effects (Chapter 7). Study 4 addresses current measurement issues by developing a gratitude during pregnancy scale, in conjunction with the evaluation of the MAAS scale in pregnancy (Study 4, Chapter 8). Once these conceptual,

theoretical, practical and measurement issues are addressed, a RCT of a combined gratitude and mindfulness intervention is conducted with a sample of pregnant women in Study 5 (Chapter 9). The findings of each study build upon each other to answer the research question of whether positive psychological interventions demonstrate effects on psychological and physical well-being during pregnancy.

Chapter 2

The Effect of Gratitude and Mindfulness on Psychological and Physical Well-being

This literature review will critically evaluate existing literature relevant to two important positive psychological constructs, mindfulness and gratitude, with a focus on their usefulness as interventions. The review will discuss the use of objective measurements, specifically biomarkers, of positive states and intervention efficacy. Reviewing the application of both objective and subjective measures of well-being highlights their importance in assessing positive psychological constructs.

2.1 Positive States and Traits

In recent years, consistent evidence has supported the importance of positive states and traits for promoting individual's well-being (Wood & Tarrier, 2010). Positive facets of human functioning, such as gratefulness and mindfulness, have been consistently and robustly associated with improved psychological well-being (Keng et al., 2011; Wood et al., 2010), cognitive processes (Aspinwall & Tedeschi, 2010), and physiological and health outcomes (Steptoe et al., 2009). Positive states and traits are also associated with behavioural changes, such as healthy eating, increased exercise and smoking cessation (Steptoe et al., 2009). Therefore associations between positive well-being and health outcomes may be direct or mediated by positive behavioural changes.

2.2 Positive Psychology

The domain of positive psychology aims to redirect the focus of psychology toward more positive aspects of functioning, in both research and practitioner domains. Positive psychology can be defined as the "scientific study of ordinary human strengths and virtues [...] with an interest in finding out what works, what is right" (Sheldon & King, 2001, p. 216). It can therefore be considered an umbrella term for the study of well-being in terms of positive emotions, positive character traits, and institutions that enable and encourage these (Seligman, Steen, Park & Peterson, 2005). The shift in focus towards positive functioning partly emerged in response to the pervasive, existing model of psychology that focused on disorder and distress, to the neglect of positive aspects of well-being (Wood & Tarrier, 2010). Following the Second World War, the focus of psychology was concerned predominantly with repairing and reducing damage, suffering and weakness (Seligman et al., 2005; Wood & Tarrier, 2010). As a result, a wealth of empirical research had amassed surrounding negative aspects of functioning and well-being; there was however, a dearth of knowledge on strengths, virtues and positive aspects of well-being (Wood & Tarrier, 2010). One aim of positive psychology is to address this issue and redress the imbalance of focus within scientific psychological enquiry. In doing so, it aims to reaffirm the importance of positive aspects of well-being in scientific research and practice (Seligman & Csikszentmihalyi, 2000).

Positive psychology is not unique in this endeavour nor does it represent the first attempts at investigating positive aspects of well-being. The work of Rogers (1951) and Maslow (1970) among others, has been cited as underlying and pioneering what is today labelled 'positive psychology' (Seligman et al., 2005). Counselling psychology approaches, such as humanistic, person-centred and existential

psychology, have also previously called for a study of the positive (Wood & Tarrier, 2010). In addition, Aspinwall and Tedeschi (2010) argue that significant contributions to the positive movement such as cognitive adaptation theory (Taylor, 1983), have emerged from within health psychology. However, Seligman and Csikszentmihalyi (2000) argued that a stronger empirical research base is needed to support the usefulness and importance of positive states and traits for the maintenance and improvement of well-being. Positive psychology can therefore be seen as an attempt to build this empirical base by bringing together previously "scattered and disparate lines of theory and research" (Seligman et al., 2005, p. 410).

The basic premises of positive psychology have been subject to criticisms. For instance, it has been suggested that positive psychology places too strong an emphasis on the positive, without fully integrating negative characteristics (Wood & Tarrier, 2010). In doing this, it appears to establish a positive-centric approach to scientific enquiry much in the same way that it criticised the focus of post-WWII psychology on negative characteristics. Focusing solely on positive or negative aspects of well-being is detrimental to the advancement of scientific psychological enquiry. As stated by Aspinwall and Tedeschi (2010), establishing such divisions can create barriers in communication, therefore hindering the development and progression of theoretical models, research and interventions. This is because what is considered positive or negative is contextually specific and motivationally dependent (Wood & Tarrier, 2010). Wood and Tarrier (2010) highlight this point using the example of anger, which is often considered a negative state or emotion. In certain contexts, such as when individuals have confrontational goals, anger can be the most appropriate, useful and beneficial emotion to experience. Similarly, support for this contextual specificity has emerged from the study of 'positive' traits such as

optimism, which can prove problematic when optimists are engaged in situations involving unwinnable tasks (Carver, Scheier & Segerstrom, 2010). In these instances optimists are far less likely to disengage from the task and this can have considerable real-world implications, for instance in a gambling context (Carver et al., 2010). There is therefore strong theoretical and empirical support for the importance of context specificity for the 'positivity' or 'negativity' of experienced states and traits.

2.3 Examining Positive and Negative States and Traits along a Continuum

An additional challenge arising from the study of states and traits is the likelihood that they operate along a continuum (Peterson & Seligman, 2004; Wood et al., 2010). In positive psychological research this has been demonstrated in the construction of the taxonomy of Character Strengths and Virtues (CSV) (Peterson & Seligman, 2004). In developing the CSV Peterson and Seligman adopted the criterion that strengths and virtues required an obvious negative antonym to merit inclusion in the taxonomy. Thus, kindness would have as an antonym unkindness, fairness would be opposite to unfairness, hope to hopelessness. Taken together these strengths and virtues and their antonyms are said to operate as opposite poles along the same continuum. For instance, a person can be more or less kind or hopeful, and it is conceivable that contextual and situational specificity will influence which end of the continuum is experienced. A similar view can be taken of happiness and depression, particularly when considering the use of well-validated measures of these constructs. The Centre for Epidemiological Studies Depression (CES-D) Scale (Radloff, 1977) for instance, assesses depression in part through the use of reverse scored positive items. A factor analytic examination of the usefulness of evaluating depression in this way indicated that scores on the CES-D formed a single

continuum ranging from happiness to depression (Wood, Taylor & Joseph, 2010). This continuum model fit better than a model in which happiness and depression were two separate factors (Wood et al., 2010). Brown (2002) also argues for conceptualising depression as a unitary construct, the onset and intensity of which is influenced by context and life events. Viewing depression and happiness in this way highlights the importance of contextual and situational factors in the understanding of psychological states and traits.

Investigating aspects of well-being in a more holistic manner avoids creating arbitrary delineations between positive and negative characteristics. This has the potential to strengthen the research field in terms of predicting risk and improving well-being (Wood & Tarrier, 2010). Previous research has highlighted the need to integrate aspects of positive and negative well-being (Fredrickson & Losada, 2005; Linley, Joseph, Harrington & Wood, 2006; North, Pai, Hixon & Holahan, 2011). This is particularly important as the absence of positive factors, more so than the presence of negative factors, has been shown to be a robust independent risk factor for distress. This does not undermine the important predictive capabilities of negative states and traits but highlights the importance of studying positive characteristics in conjunction with these. Furthermore, positive states and traits can act as buffers between negative events and subsequent distress by promoting careful, systematic and efficient decision-making in the management of real and hypothetical risks (Isen & Means, 1983). They can also encourage approach-oriented forms of coping strategies in response to threat (Aspinwall & Tedeschi, 2010). Studies on biomarkers of well-being have also found that the inducement of positive affect, following negative affect, can facilitate a faster return to baseline cardiovascular

activity than the presentation of a subsequent neutral stimulus (Fredrickson et al., 2000).

2.4 Effects of Positive States and Traits

Laboratory based tests have been commonly implemented to evaluate the effect of positive states and traits on well-being and have consistently demonstrated beneficial effects. Examinations of positive thinking for instance, in the form of thinking about one's best possible self, has demonstrated increases in positive affect and positive future expectations (Peters, Flink, Boersma & Linton, 2010). Longitudinal studies have also examined the effect of positive psychological interventions on psychological and physical well-being. Sin and Lyubomirsky (2009) conducted a meta-analysis of 51 positive psychology intervention studies, including interventions based on optimism, (Lyubomirsky et al., 2011); forgiveness, (Freedman & Enright, 1996); positive psychotherapy (Seligman et al., 2006); Cognitive Behaviour Therapy, (Fava et al., 1998); gratitude (Emmons & McCullough, 2003), and mindfulness (Grossman et al., 2007). They found that these interventions can significantly improve well-being and decrease depressive symptoms (Sin & Lyubomirsky, 2009). A more recent meta-analysis conducted by Bolier et al. (2013) also found evidence that positive psychology interventions can enhance well-being, and reduce depression. Bolier et al. examined 39 studies, which included interventions based on gratitude, positive coaching, optimism, and acts of kindness. Small to moderate effect sizes were observed for all outcome variables and effects were sustained from 3 to 6 months. These findings, although derived from diverse intervention types, provide evidence for the potential benefits of positive interventions for well-being. Bolier et al. do note the presence of publication bias for

all outcome measures however, and so intervention effects should be interpreted in light of this finding.

Gratitude and mindfulness, in particular, are two constructs that have gained increased research and practitioner interest in recent years due to their robust, positive and consistent associations with well-being (Keng et al., 2011; Wood et al., 2010). Furthermore, the beneficial effects of engaging in mindfulness and gratitude interventions have been shown in longitudinal (Anderson, Lau, Segal & Bishop, 2007; Emmons & McCullough, 2003) and laboratory based studies (Broderick, 2005; Rash, Matsuba & Prkachin, 2011). This review will now introduce the theoretical and empirical backgrounds of gratitude and mindfulness research. Following this, the usefulness of an as yet understudied biomarker of well-being in positive psychology, cortisol, will be discussed.

2.5 Mindfulness

Mindfulness is a positive psychological construct that has demonstrated benefits for psychological and physical well-being (Keng et al., 2011). It is the intentional and non-judgmental awareness of experience in the present moment; this includes, but is not limited to, thoughts, feelings and sensations. Baer (2003) defines mindfulness as "the non-judgmental observation of the on-going stream of internal and external stimuli as they arise" (p.125). It has consistently been associated with positive well-being in diverse populations, including clinical and non-clinical groups (Fjorback et al., 2011; Keng et al, 2011). For instance, mindfulness has been associated with higher levels of life satisfaction (Brown & Ryan, 2003; Shapiro et al., 2005), quality of life (Grossman, et al., 2010; Koszycki et al., 2007), optimism (Brown & Ryan, 2003), happiness (Bogels et al., 2008; Carson et al., 2004; Choi,

Karremans & Barendregt, 2012), empathy (Shapiro, Schwartz & Bonner, 1998) and positive affect (Anderson et al., 2007; Brown & Ryan, 2003). It is associated with better sleep quality (Howell et al., 2008), sleep functioning (Howell, Digdon & Buro, 2010), and reduced levels of insomnia symptoms and pre-sleep cognitive and somatic arousal (Cincotta et al., 2011). Mindfulness is also associated with lower levels of depression (Brown & Ryan, 2003; Ma & Teasdale, 2004; Sephton et al., 2007; Teasdale, Segal & Williams, 1995), anxiety (Brown & Ryan, 2003; Monti et al., 2006; Shapiro et al., 1998), stress (Carlson et al., 2001; Shapiro et al., 2005; Speca et al., 2000), rumination (Raes & Williams, 2010) and negative affect (Collard, Avny & Boniwell, 2008; Duncan & Bardake, 2010; Giluk, 2009; Schroevers & Brandsma, 2010).

2.5.1 Eastern and Western mindfulness. An understanding of how mindfulness may function to improve well-being comes from an examination of its roots in Buddhism and its progression as a Western clinical intervention. Originating from Eastern spiritual practice, in the context of Buddhist teaching, mindfulness is traditionally included in a system of practices that incorporate aspects of change, impermanence and non-self into the moment-to-moment awareness of experience (Carmody, 2009). These practices aim to cultivate positive virtues and attributes, such as ethical and virtuous behaviour (Mikulas, 2011), and to aid in enlightenment and release from suffering (Keng et al., 2011). Thoughts and physical sensations are not delineated within the Buddhist approach; external and internal stimuli are instead considered one and the same (Grabovac, Lau & Willet, 2011). The content of awareness therefore tends to be focused introspectively, with the main focus of this approach on impermanence, suffering and not-self (Grabovac et al., 2011).

In the West, mindfulness emerged as an area of interest during the 1970's due to a rise in the popularity of meditation practice, such as Zen meditation, in both cultural and clinical contexts (Keng et al., 2011). The work of Kabat-Zinn (1982) was particularly important in highlighting the usefulness and efficacy of mindfulness in clinical settings. His Mindfulness Based Stress Reduction (MBSR) program was instrumental in increasing scientific research attention on the benefits of incorporating Eastern mindfulness practices in Western settings. Adapting mindfulness as a means to maintain and enhance well-being in a Western context has inevitably altered aspects of the traditional Buddhist approach (Carmody, 2009). One difference between approaches is the refocusing of awareness on internal and external stimuli as distinct in Western mindfulness practice (Carmody, 2009); this broadens the scope of awareness beyond the introspection characterising Buddhist mindfulness. Perhaps the most notable difference between approaches is that, in Western practice mindfulness is engaged in independently of a set of religious beliefs or practices. As a result there is less emphasis on the elements of impermanence and the non-self that characterise Buddhist mindfulness. This distancing from religious and spiritual elements may account in part for its rise in popularity in increasingly secularised, Western contexts. For instance, for individuals less inclined and willing to engage in religious practices, these changes broaden the accessibility of mindfulness to more diverse groups. Western mindfulness approaches also tend to require less of a time commitment than their eastern counterparts (Carmody, 2009). For this reason western mindfulness approaches and programs may be preferable for individuals unable or unwilling to engage in more time consuming practices.

It is argued that the incorporation of elements of traditional practice into Western practice has been done without full consideration of their original purposes and usefulness (Carmody, 2009, Grabovac et al., 2011). The potential loss of context that emerges from distinctions between traditional and Western mindfulness is suggested by Grabovac et al. (2011) to result in limited understanding of the mechanisms by which mindfulness operates. I argue that this is not necessarily the case because the central tenets of Eastern mindfulness are present in both Eastern and Western approaches. The emphasis on impermanence and non-self for instance, are present regardless of cultural context in the two main components of mindfulness practice. These components are the self-regulation of attention and adopting an orientation to experience that is characterised by openness, acceptance and curiosity (Baer, 2003; Bishop et al., 2004; Keng et al., 2011). Both orientation to experience and the ability to regulate attention can be considered interdependent in the theory and practice of mindfulness. This suggests that the context in which mindfulness is engaged in does not affect the focus or aims underpinning mindfulness practice.

2.5.2 Orientation to experience. Orientation to experience involves an attitude of openness and acceptance to all mental, physical and external stimuli that arise in the present moment (Keng et al., 2011). It is common in mindfulness practice for thoughts, feelings and sensations to occur and there is a focus on experiencing these stimuli actively and openly, regardless of whether the focus of attention in the mindfulness practice is on these stimuli. Carmody (2009) states that the emphasis on the importance and relevance of all experience delineates mindfulness from other meditation practices, which aim to achieve a relaxed state through the inhibition or suppression of experience. It could be suggested that this orientation to experience

engenders distraction or rumination by focusing on acknowledging all experience; however Bishop et al. (2004) argue that the aim of this orientation is the opposite. Although all stimuli are acknowledged and experienced, the focus of attention in mindfulness is constantly brought back to the original point of focus in the present moment. This is said to foster a perceptual state in which stimuli and experience are approached without prior belief, conceptions, worry or rumination because these aspects need not be present when focusing on the current moment (Bishop et al., 2004).

By mindfully acknowledging and refocusing awareness, it is possible that mental and physical events can be better dealt with as they are not seen to reflect uncontrollable, objective, external reality. This in turn could reduce the likelihood that mental and physical events would become problematic or result in habitual, potentially adverse response patterns. The focus of Mindfulness Based Cognitive Therapy (Teasdale et al., 1995) for instance, is on minimising the risk of depressive episodes by addressing such habitual responses to distress. Observed beneficial effects of MBCT on well-being support this potential mechanism for the effects of mindfulness. In order to achieve and foster this orientation to experience however, attentional skills must be utilised to approach and direct awareness between stimuli in an adaptive manner (Mikulas, 2011).

2.5.3 Regulating awareness. The switching of awareness between stimuli is a skill that can be developed through mindfulness (Bishop et al., 2004; Keng et al., 2011). In mindfulness practice, attention is typically brought to a point of focus with neutral affectivity, such as the breath. When attention wanders from the breath, any thoughts, feelings or sensations that arise are non-judgmentally acknowledged and

attention is brought back to the breath. Directing awareness to the breath, or another point of focus in this way requires sustained attention on the stimuli, as well as the ability to switch between stimuli. One example is the ability to switch from a physical sensation, such as a source of pain, back to the breath. For this reason a technique known as the Body Scan is often introduced early in mindfulness practice, as it includes a focus on neutral breath sensations (Carmody, 2009). During the Body Scan, these breath sensations are readily and immediately available, providing an easily accessible 'anchor' for attention (Carmody, 2009). Unsurprisingly therefore, participants tend to report that focusing on the breath is the most commonly used and maintained skill over time (Kabat-Zinn, 1982).

Cultivating mindful attention, using techniques such as the Body Scan, brings directed awareness to the component of experience attention is currently focused on. This focuses awareness on the present moment, without getting caught up in it. By bringing attention to the here and now in a very direct way it is argued that mindfulness can result in stability, clarity and self-regulation of attention (Semple, 2010). All stimuli are experienced without any secondary elaborative processing; worry and rumination, brought about by elaborative processing, do not therefore occur (Carmody, 2009, Grabovac et al., 2011). Thus perceptions and cognitions are experienced as transient, intrapsychic events, from which attention can be shifted and refocused (Linehan, 1993). It also allows maladaptive responses to thoughts, feelings and sensations to be attended to and corrected (Bishop et al., 2004; Carmody, 2009). The processes by which these effects come about are exemplified by what occurs when attention is undirected, or mindless.

Undirected, mindless attention is considered to be at the opposite end of the spectrum to mindfulness (Semple, 2010). It is typically characterised by distraction

and inconsistent focus, which is predominantly on the past or future. In this type of attention, awareness of an experience, thought, feeling or sensation is associated with a conditioned association process (Damasio, 2003). According to Damasio (2003) attention to one aspect automatically leads to attention on another. This can be maladaptive when a threat is involved, as attention to this threat initiates a conditioned cycle characterised by negative thoughts, feelings and sensations. The cycle functions as a closed loop, thus perpetuating and maintaining feelings of distress and associated levels of arousal that are associated with the perceived threat. However, when attention is focused mindfully, awareness can be directed to the relevant component of experience, the thought, feeling or sensation. This facilitates an ease of recognition of where attention is at the current moment, that it can be directed voluntarily, what components make up the experience and how they are related to one another (Carmody, 2009; Grabovac et al., 2011). As a result, individuals can feel a sense of control in their ability to effortfully and voluntarily deal with distress, and more effectively cope with maladaptive and ruminative cycles and behaviours. Breaking negative and maladaptive cycles of experience in this way is of central importance to mindfulness practice and the associated beneficial outcomes (Carmody, 2009; Grabovac et al., 2011).

Additionally, continually directing and refocusing awareness in the present moment can broaden one's attentional focus to include more aspects of awareness and moment-to-moment experience. This leads to the effortful refocusing and redirecting of attention, which is often considered a form of meta-cognitive awareness (Bishop et al., 2004; Carmody, 2009; Grabovac et al., 2011). Bishop et al. (2004) propose a conceptual model of meta-cognitive mindfulness awareness in which the practitioner has the ability to shift attention from the subjective content of

perceptions and cognitions to thoughts, feelings and sensations as objects or events in the mind. In this model the practitioner becomes decentred from the perceptions and cognitions and does not engage in elaborative processing of the content of these. Furthermore, given that the focus of attention in mindfulness is often redirected to the breath, which is a neutral stimulus, arousal levels associated with the subjective content are also reduced because arousal and tension stay at a neutral sensation level (Carmody, 2009). This is supported by findings that heart rate variability, a physiological indicator of self-regulation, is higher during a mindful breathing intervention (Burg, Wolf & Michelek, 2012). In addition, mindfulness practitioners demonstrating increases in attentional awareness also demonstrate higher immunoreactivity and decreased levels of stress-related cortisol (Tang et al., 2007). Such findings are discussed in depth shortly, in the context of biomarkers of well-being.

The role of cultivating attention in mindfulness has been exemplified in a number of studies that demonstrate higher levels of sustained and self-directed attention for mindfulness practitioners than non-practitioners (Chambers, Lo & Allen, 2008; Moore & Malinowski, 2009; Semple, 2010; Valentine & Sweet, 1999). This observable improvement in meditators is not mediated by practice effects or relaxation (Semple, 2010). Neuropsychological research has also supported the effects of mindfulness meditation practices on attention. Tang (2010) and Tang et al. (2012) found that engaging in a form of mindfulness practice, integrative body-mind training (IBMT) resulted in altered neural activity in the anterior cingulate cortex (ACC). It also improved connectivity of the ACC to other brain areas and these findings were observed in healthy American (Tang, 2010) and Chinese (Tang et al., 2012) undergraduate students after 2 and 4 weeks of mindfulness practice

respectively. Furthermore, the positive effects on attention were not limited to experienced practitioners but have been found even after brief meditation training (Tang, 2010). The ACC is associated with self-regulation of attention and attentional focus (Posner, Rothbart, Sheese & Tang, 2007; Tang et al., 2012) and so increased activity and connectivity of this area as a result of mindfulness highlights the role of attention in mindfulness practice. Furthermore, the ACC is involved in conflict resolution (Tang & Posner, 2009) and dysregulation can lead to ruminative and maladaptive attention that contributes to depression (Farb, Anderson & Segal, 2012). Thus the role of mindful attention in well-being is further supported.

Despite the relatively consistent support for the importance of attention in mindfulness, comparisons between existing research studies must be made tentatively. Many studies utilise different research methodologies, mindfulness practices and measures. For instance, the type of mindfulness investigated, state or trait, will determine the form of measurement used (Bishop et al., 2004; Keng et al., 2011). The focus of mindfulness measures can also range from evaluating general tendencies toward mindfulness (Brown & Ryan, 2003) to examining mindful approaches to distressing stimuli (Chadwick et al., 2008). Additionally, the focus of individual studies will differentiate the approaches taken to evaluate mindfulness. These approaches include the use of longitudinal mindfulness interventions (Farb et al., 2010; Ma & Teasdale, 2004; Shapiro et al., 2005), experimentally induced mindfulness 'moments' (Arch & Craske, 2006; Broderick, 2005) and examinations of correlations between trait mindfulness and well-being variables (Baer, Smith & Allen, 2004; Baer et al., 2006; Brown & Ryan, 2003). These varying approaches to mindfulness evaluation address diverse aspects of mindfulness and mindfulness practice, and provide a robust understanding of how mindfulness functions to

influence well-being at different levels. However the research must be delineated in terms of focus, as findings emerging from each approach are applicable only to that approach. One cannot, for instance assume the findings of a month-long mindfulness intervention will be applicable to an isolated mindfulness practice of ten minutes or to general population levels of mindfulness. Due to the different forms of interventions in different research studies, findings cannot be generalised to all mindfulness practices and interventions.

2.5.4 Mindfulness interventions. The efficacy of a number of different mindfulness interventions has been examined. These include interventions that are either solely mindfulness based, such as Mindfulness Based Stress Reduction (MBSR), or which incorporate elements of mindfulness, such as Mindfulness Based Cognitive Therapy (MBCT). MBSR and MBCT are of particular interest as they are two of the most widely known, used and researched mindfulness interventions and have guided much of the research in the area. As a result, a considerable proportion of the empirical findings associating mindfulness with positive well-being have emerged from studies utilising these interventions. Evaluating the benefits of mindfulness practice therefore involves a simultaneous evaluation of these interventions.

2.5.4.1 MBSR. MBSR was initially developed by Kabat-Zinn (1982) for the treatment of individuals with chronic pain. It is now widely used in both clinical and non-clinical populations and focuses on training people in mindfulness meditation with the aim of fostering acceptance and non-judgmental observation (Keng et al., 2011). MBSR generally consists of an eight to ten week course, with weekly group

sessions lasting from two to two-and-a-half hours; there is also an additional daylong intensive mindfulness session. During the sessions, mindfulness meditation skills instruction and training are conducted. Participants are also expected to conduct at-home mindfulness meditation exercises, lasting about 45 minutes, six days a week. These exercises involve a range of activities intended to cultivate focused attention on a target of observation; activities include the Body Scan and attention on the breath, hatha yoga postures and mindfulness in everyday activities. The central tenets of mindfulness are integral to these practices. Therefore an ability to non-judgmentally observe thoughts, feelings and sensations, and an ability to bring attention back to the object of observation whenever the mind wanders, is developed through these activities.

In a review of RCTs examining the effects of MBSR, Keng et al. (2011) found that in both clinical and non-clinical populations MBSR can reduce a number of negative and pathological aspects of well-being, such as anxiety (Shapiro et al., 1998) stress (Williams et al., 2001) and rumination (Anderson et al., 2007), while increasing positive aspects such as satisfaction with life (Grossman et al., 2010) and positive affect (Anderson et al., 2007).

2.5.4.2 MBCT. MBCT is an alternative mindfulness intervention that was developed by Teasdale et al. (1995) to help prevent relapse of major depressive episodes. When individuals with a history of major depression experience mild dysphoria, negative thoughts may be activated that are associated with the depressive state. This can increase an individual's depressed mood and the likelihood of another depressive episode (Bishop et al., 2004; Carmody, 2009; Teasdale et al., 1995). MBCT therefore operates on the theory that in a depressive state negative thoughts

arise, which can become associated with the depressive state, initiating a closed, conditioned cycle. This maintains levels of distress by perpetuating thoughts, feelings and sensations associated with distress (Carmody, 2009). MBCT was developed specifically in an attempt to address these maladaptive habitual response patterns.

MBCT programs typically consist of an eight-week group intervention, involving weekly sessions lasting 2 hours each. Although largely based on the MBSR program, MBCT is also strongly based in cognitive therapy. However, while in cognitive therapy people are encouraged to adopt a decentred approach to the content of their thoughts (Keng et al., 2011), in MBCT people are encouraged to change their relationship to and awareness of their thoughts (Teasdale et al., 2000). By encouraging non-judgmental observation of thoughts and feelings, and an awareness of the transience of these mental events, it is believed that relapses of depression can be avoided. This works on the premise that through MBCT, individuals can become aware that negative affective states are neither permanent nor reflections of reality (Baer, 2003). In a review of several RCTs examining the effect of MBCT, Keng et al. (2011) found that MBCT reduces rates of relapse for people with three or more previous experiences of depressive episodes. They also found that MBCT can improve a number of symptomatic and psychosocial outcomes, such as quality of life, depression, anxiety and social phobia, for remitted depressed patients (Keng et al., 2011).

2.5.5 Intervention limitations. Both established mindfulness interventions, MBSR and MBCT, clearly demonstrate beneficial effects for individual's well-being. MBSR has demonstrated efficacy and beneficial effects for diverse groups

(Keng et al., 2011), while MBCT demonstrates benefits for a vulnerable population (Teadale et al., 1995). Despite their beneficial effects, these interventions are not without practical and conceptual limitations. One of the main practical limitations to both approaches is the considerable time commitment required to complete the programs. The duration of the MBSR program is considered shorter than traditional Eastern mindfulness practices (Carmody, 2009) and was designed to provide participants with enough time to understand mindfulness and engage in and self-regulate through mindfulness practice (Kabat-Zinn, 1982). In this sense, the eight-week MBSR program focuses on a specific time period utilised for skill development. The duration of MBSR programs and weekly sessions, although shorter than traditional practice, may still limit its accessibility to individuals with little available free time. In addition to attending weekly mindfulness training, the adjunct mindfulness practice to be conducted at home also involves a considerable time commitment. These demands on participants' time could function as an obstacle or even deterrent to participation for some clinical and non-clinical groups. Thus, observed outcomes for individuals who engage in MBCT or MBSR could represent quite a specific population. The likelihood of appropriately generalising the findings of MBSR and MBCT trials to a population of low-income, working, single mothers for instance is low. In less extreme instances, such as general student populations, the standard MBSR or MBCT programs can still be considered too great a strain for individuals who already have busy work-life schedules with existing time commitments (Carmody & Baer, 2009). Support for this comes from Minor et al. (2006) who found that the length of a MBSR program was an important reason for individuals choosing to participate or not. In addition to the time commitment necessary for standard programs of MBSR and MBCT, is a potential financial

commitment. Participation in such programs in a 'real-world' setting can incur costs, particularly if one considers the implications of a daylong mindfulness retreat or 'intensive session'.

Associated with the problematic nature of committing to frequent and prolonged training sessions, is the social nature inherent in these sessions. The influence of this social aspect could confound research outcomes, as social support has been found to impact on overall well-being both directly and indirectly (Collins et al., 1993; Uchino, 2009). The potential implications of the influence of social support for interpreting intervention efficacy are considerable but have received scant attention in the literature. This issue does mirror a larger debate raised by Keng et al. (2011) however, who suggest that the involvement of numerous elements in mindfulness practice can create difficulties in determining how individual components contribute to treatment effects. In order to gain a thorough understanding of how these interventions work, it is necessary to examine them both as a whole and in terms of their individual components. As considerable work has been done on existing mindfulness program 'packages', examining individual aspects of mindfulness interventions, such as the Body Scan, would prove beneficial in furthering our understanding in this area. This is particularly so as the Body Scan can be completed in isolation from potential confounding factors. Adopting a more compact, individualised focus in mindfulness interventions could also help address practical issues of time and financial constraints that characterise the established intervention programs, and could potentially increase levels of participation.

2.5.6 Intervention formats. In their reviews of positive interventions, Bolier et al. (2013) and Sin and Lyubomirsky (2009) investigated possible differences

between intervention formats, although mindfulness was not examined as an independent construct. The results of their meta-analyses indicated significant differences in the effectiveness of positive psychology interventions, depending on the format used. Individual therapy was found to be most efficacious (Bolier et al., 2013, Sin & Lyubomirsky, 2009), followed by group-administered interventions, followed by self-administered interventions (Sin & Lyubomirsky, 2009). Longer duration interventions tend to result in more beneficial effects for well-being (Bolier et al., 2013; Sin & Lyubomirsky, 2009). The findings of these meta-analyses lend support to the use of group sessions in standard mindfulness training, as they may be more effective than at-home practice. However, it is also necessary to take into account the impact of the administrator or facilitator of these sessions. As has been demonstrated in other areas, such as counselling, the role of the counsellor or facilitator, in terms of their personality, competence and behaviour can all have a significant impact on client or participant outcomes (Alexander & Luborsky, 1986; Luborsky et al., 1997). It is therefore unclear how findings regarding the usefulness of group or individual sessions facilitated by different individuals, can be compared across intervention studies. Additionally, the broad nature of the interventions included in Sin and Lyubomirskys meta-analysis require additional care in interpretation of these findings. Different forms of self-administered interventions were included in a broad self-administered category and so it is necessary to delineate between the different types of these interventions to gain a better understanding. While informative, the findings of this meta-analysis do not distinguish between interventions and do not specifically examine the usefulness of an altered, shortened format of mindfulness practice.

A number of studies and reviews of the literature do provide support for the use of altered mindfulness interventions. For instance, studies have found evidence that a shorter duration MBSR program can lead to similar outcomes to the full duration program (Jain et al., 2007; Klatt, Buckworth & Malarkey, 2008; Speca, Carlson, Goodey & Angen, 2000). A review of 30 published MBSR trials by Carmody and Baer (2009) also found support for this. The studies reviewed involved sessions ranging in number from 4 to 10 with 43% of these including an all-day mindfulness session. Carmody and Baer found no evidence that shorter versions of MBSR were less effective than their longer counterparts. There was no significant relationship between the number of class hours involved in the MBSR program and outcome measures of psychological well-being. Carmody and Baer also found that more at-home self-report mindfulness practice was associated with higher levels of self-reported mindfulness; this in turn mediated changes in well-being.

Thus it appears that at-home mindfulness exerts a greater influence on outcomes than weekly sessions, although these findings are limited to the MBSR program. In order to examine the effect of the amount of general at-home practice on program-related changes and clinical outcomes, Vettese et al. (2009) conducted a review of 98 mindfulness studies. This review was not limited to studies examining MBSR. They found that nearly half of the studies failed to find the expected associations between amount of at-home practice and outcomes, with the remaining studies finding partial support for an association. These findings are inconsistent with the findings of Carmody and Baer (2008) and may reflect the broader inclusion criteria used for mindfulness studies in the review by Vettese et al. (2009). Furthermore, Vettese et al. suggest that the type of people involved in the mindfulness interventions may influence intervention outcomes. Participants “acculturated to the concept of

mindfulness" (Vettese et al., 2009, p. 219) may be more likely to demonstrate the expected outcomes; therefore the sample used may determine the findings. This raises the potentiality of expectancy effects and volunteer bias, which is supported by the work of Sin and Lyubomirsky (2009). They found that participants who elect to take part in positive psychology interventions tend to demonstrate greater gains for depression and well-being than non-self-selected individuals. Despite this potential limitation, the findings of the aforementioned reviews on the effects of at-home practice must be interpreted carefully. In both reviews, the at-home mindfulness practice occurred in tandem with on-going mindfulness programs, all of which had group sessions and many retained the intensive full-day session.

Thus, it appears that the usefulness and potential benefits of at-home mindfulness practice, removed from the social element involved in training sessions, have yet to be fully explored. Given the strong and consistent associations between mindfulness and well-being (Keng et al. 2011), it is expected that a shorter at-home intervention should demonstrate similar effects.

2.6 Gratitude

Gratitude is a positive psychological construct that can be defined as a tendency toward appreciating the positive in life. It has been consistently positively associated with well-being in previous research with diverse populations (Emmons & McCullough, 2003; Froh, Yurkewicz & Kashdan, 2009; Wood et al., 2009b). For instance, a review of controlled trials by Wood et al. (2010) found robust, positive associations between gratitude and well-being. In these trials, and in a number of cross-sectional studies, gratitude is associated with positive affect (Emmons & McCullough, 2003; Froh, Sefick & Emmons, 2008; Froh et al., 2009; McCullough,

Emmons & Tsang, 2002; Watkins et al., 2003), life satisfaction (Wood et al., 2008a; Wood et al., 2009b), social support (Wood et al., 2008a), happiness (Macaskill, 2012; Seligman et al., 2005; Toepfer, Cichy & Peters, 2012; Wood et al., 2010), health behaviours (Emmons & McCullough, 2003) and prosocial behaviour (Froh et al., 2008). It has been associated with increased sleep quality and duration (Emmons & McCullough, 2003; Wood et al., 2009a), as well as lower levels of sleep latency and daytime dysfunction (Wood et al., 2009a). Gratitude has also been negatively associated with stress (Wood et al., 2008), depression (Park et al., 2004; Wood et al., 2008a), anxiety (Kendler et al., 2003), and physical symptoms (Froh et al., 2009). Furthermore, Wood, Joseph and Maltby (2009) found that gratitude is associated with life satisfaction above any of the Big Five personality traits. Longitudinal research (Gordon, Arnette & Smith, 2011; Peterson & Seligman, 2003; Wood et al., 2008a) also found associations between gratitude and increased marital satisfaction (Gordon et al., 2011), increased social support and decreased stress and depression (Wood et al., 2008), and increased gratitude levels (Peterson & Seligman, 2003).

2.6.1 Definitions of gratitude. Gratitude can be defined in two distinct, yet complementary ways. Traditionally gratitude has been defined as an interpersonal emotion. It is said to arise when people perceive themselves to have received some benefit from another. A beneficiary, a benefit and a benefactor are therefore required for gratitude to occur. This form of gratitude can be considered state gratitude. Roberts (2004) argues that for state gratitude to occur an interaction must involve "a concern-based construal" (p.61) where the beneficiaries view themselves as having received a benefit from another and view the benefactor as having effortfully provided the benefit. According to Roberts, gratitude therefore involves four main

components: the beneficiary, the benefit, the benefactor and the attitudes and perceived attitudes of both parties involved. The emphasis in this conception is clearly on the importance of the interpersonal interaction; "to be grateful is to be grateful to *someone*" (Roberts, 2004, p.61). This view of gratitude has been consistently reported throughout the literature for a number of decades (Bartlett et al., 2012; Emmons & McCullough, 2003; Solomon, 1977).

In Fredrickson's (2004) broaden and build theory, experiencing gratitude also involves a beneficiary, benefactor and benefit and leads to the thought-action tendency to behave pro-socially to others. According to this theory, prosocial and reciprocal actions and reflections resulting from gratitude build and strengthen social relationships, partnerships and friendships. Fredrickson's theory argues that gratitude can build resources, in the form of interpersonal skills for showing appreciation and even love, which can be used again at a later date, in times of need. Fredrickson cites empirical support for an interpersonal, beneficial conceptualisation of gratitude from Trivers (1971), who found that that gratitude is associated with reciprocal altruism. Further support comes from Bartlett et al. (2006; 2012), who found evidence of reciprocally beneficial relationship formation resulting from gratitude in lab-based settings. Associations between gratitude and social support have also been identified in college students (Wood et al., 2008a), adolescents (Froh et al., 2009), co-habiting couples (Algoe, Haidt & Gable, 2008), and long-term married couples (Gordon, Arnette & Smith, 2011). Thus, the theoretical and empirical literature indicates the important role of interpersonal interactions, both as they influence feelings of gratitude and are influenced positively by it.

2.6.1.1 Limitations of an interpersonal definition. Despite strong support for associations between social support, social factors and gratitude, it is limiting to define gratitude solely in interpersonal terms. It is probable that gratitude can result from non-interpersonal sources and as such it should not be seen solely as the result of an interaction between people. Fredrickson (2004) acknowledges this possibility with the view of gratitude as a social emotion, stating that people can feel gratitude even if they know that they cannot repay it. This can relate to instances when a beneficiary is not in a position to reciprocate or when there is no benefactor to repay. Feeling grateful for "the gift of the planet" (Fredrickson, 2004, p. 151) is one example where the perceived benefit does not come from an identifiable benefactor.

Roberts (2004) adopts this latter line of reasoning in his discussion of interpersonal versus non-interpersonal sources of gratitude. He argues that, in some instances when people express gratitude for non-interpersonal sources they are personifying the source; for instance, they are personifying the weather as someone who has provided sunshine for a picnic or, in the example above, they personify god as an entity that provided the earth. While this may be a viable possibility it does not stand up to scrutiny in light of previous research findings of non-interpersonal sources of gratitude (Emmons & McCullough, 2003). For instance, Chapter 10 discusses a number of non-interpersonal sources of gratitude that emerged from a thematic analysis of pregnant women's experiences. Women expressed gratitude for things such as getting a good night sleep, which clearly cannot be construed in terms of a benefactor. Additionally women expressed gratitude for their own actions, such as cooking a good meal. In this instance the subject is both benefactor and beneficiary, it is a closed circle that does not involve interpersonal interaction with an external other.

Roberts (2004) attempts to overcome such problems by stating that when people espouse gratitude for non-interpersonal sources they are using the term gratitude loosely or inappropriately. The person is, according to Roberts, 'glad' or 'happy' rather than grateful. This misconstrual argument suggests that people do not understand what they are grateful for, their own feelings about subjective experiences, or what gratitude actually is. Further, the argument justifies a process whereby individual's reported sources of gratitude are evaluated against predetermined inclusion criteria that are based on a singular model. It is unscientific to approach such examples of lived experienced with a closed view of the issue at hand and designate or categorise the experience according to preconceptions about the construct. A good exemplar of the unfeasibility of this approach is the example of a good night's sleep mentioned above. During pregnancy a good night sleep can be perceived as a considerable blessing due to the myriad of physical and psychological issues that can impact on sleep and well-being. It therefore appears to reflect a true source of non-interpersonal gratitude that clearly elicits gratitude rather than contentment. Adopting deductive approaches to experience such as Roberts suggests, is particularly detrimental in terms of a positive construct gaining importance in a newly emergent field of enquiry. Re-evaluating the emphases of gratitude definitions is essential for a broader understanding of gratitude.

Re-assessing existing conceptualisations of gratitude is one way to do this. The 6-stage model proposed by Roberts (2004) is one conceptualisation of gratitude that could function equally well with the emphasis redirected from social aspects of gratitude. In his model, Roberts states that for gratitude to occur you must first receive something of benefit. Second, you must believe that someone else acted well and gave you the benefit. Third, in bestowing the benefit you must perceive the other

person to have gone out of their way in terms of what they owe you and that you are in their debt, although you do not mind. Fourth, you must also believe the other person acted benevolently in giving the benefit and, fifth, the fact that they gave you the benefit shows that they are good. Finally you must want to give back to the other person to show your indebtedness. Within a social context this is a concise model that clearly outlines the requirements for gratitude to occur in an interpersonal context. As not all sources of gratitude are interpersonal, a broader model is necessary to provide a general understanding. An alternative non-interpersonal model need not necessarily replace the interpersonal model but rather complement it. In this alternative model you must first receive something of benefit. Second, this benefit must be perceived as more than you are owed, deserve or were expecting. Third, you must be happy to receive the benefit. Fourth, receipt of the benefit shows that the source of it is good. Finally, you must want to give back, as a result of the benefit, to show your indebtedness (See Appendix A for model).

This 5-stage revised model follows the same basic structure as the social model (Roberts, 2004) but removes any overt attributions to interpersonal sources of gratitude. It also maintains the underlying elements of gratitude proposed in much of the literature, including construal of the benefit as 'good' and the desire to give back and reciprocate as a result of experiencing gratitude. While the literature tends to focus on gratitude resulting in prosocial behaviour towards other people (Bartlett et al., 2012, Gordon et al., 2011), this model broadens that reciprocity toward nature, community and the self. This could increase awareness of the importance of these factors in studies of gratitude, in addition to social relationships. Support for reciprocity toward non-social sources was found by Naito et al. (2010), who demonstrated that in a Japanese context gratitude is associated with pro-

environmental intent. This is the intention to perform responsible behaviours towards nature and the environment in recognition of positive outcomes that come from nature.

Reciprocal acts toward non-person sources as a result of gratitude may be understudied, however Seligman et al. (2005) and Wood et al. (2010) have previously suggested a broadened view of gratitude. For instance, according to the Character Strengths and Virtues: A Handbook and Classification (Peterson & Seligman, 2004), gratitude can be described as being conscious of and thankful for good things that happen in life. Wood et al., discuss gratitude as a dispositional worldview toward noticing and appreciating the positive in life. This dispositional model supports a definition of gratitude that is not solely based on social interaction but is instead comprised of eight facets. The eight facets are: individual differences; awe; a focus on what one has; behaviours expressing gratitude; appreciating others; understanding that life is short; focusing on the present; and engaging in positive social comparisons. Support for these facets comes from factor analytic work conducted by Wood et al. (2008b), who investigated the existence of a higher order gratitude factor by assessing three scales designed to measure gratitude and appreciation. These were the GQ-6 (McCullough et al., 2002), the Appreciation Scale (Adler & Fagley, 2005) and the Gratitude, Appreciation, and Resentment Scale (Watkins et al., 2003). The diversity evident in the lower order facets of gratitude in this model may stem from the inclusion of measures of appreciation, rather than assessing measures solely focusing on gratitude. It is conceivable that appreciation would encompass a broader range of experiences and events than gratitude, as based on the interpersonal model. In a sense this would fit with Roberts (2004) criticism of a misattribution of emotion and feeling. However, appreciation and gratitude are not

mutually exclusive and, as evidenced by the findings of Wood et al. (2008b), the combination of facets present in the scales clearly indicates that each sub-scale forms part of one higher order factor. This is not to say that any two of the lower facets are identical but that they exist below a higher order factor of gratitude. According to the dispositional model of gratitude, in order to have a grateful disposition people must experience each of the eight facets. Furthermore to score highly on levels of dispositional gratitude these facets must be experienced frequently, intensely and be elicited by a wide range of stimuli. This model therefore overcomes issues that arise when gratitude is considered a solely interpersonal interaction; it provides an understanding for reports of gratitude toward non-interpersonal sources (Emmons & McCullough, 2003). This model also broadens our understanding of what gratitude is and how it is experienced.

Further theoretical support for a broadened, dispositional model comes from attribution theory. As discussed by Wood et al. (2010), people who tend to attribute success and benefits to causes beyond their control, such as the actions of other people, tend to have low levels of well-being. Thus if gratitude only involved being grateful towards other people, having high levels of gratitude could actually be detrimental to well-being because individuals would always attribute successes to another. Given relatively consistent findings that gratitude is associated with increased levels of well-being (Wood et al., 2010), this does not appear to be the case. Thus, this thesis adopts a broadened, life orientation view of gratitude that is not solely interpersonally based. While attribution theory gives some indication of how a solely interpersonal approach to gratitude is less likely to lead to improved well-being, it is important to consider the mechanisms by which gratitude has been posited to function.

2.6.2 How gratitude works. A number of mechanisms have been proposed to account for how gratitude can improve well-being. These include coping, cognitive and physiological theories, as well as the broaden and build theory of positive emotions (Fredrickson, 2001). According to the coping hypothesis (Wood et al., 2007), gratitude is related to more positive reinterpretations of situations, as well as to lower levels of self-blame and behavioural disengagement. This functions to mediate the relationship between gratitude and stress; the more positive your coping appraisals, in terms of cognitive interpretations of the situation, the less stress you will experience. This idea is supported by Lazarus & Folkman's (1984) model of stress, in which stress is dependent both on objective aspects of a situation and how these are appraised by the individual. This model therefore includes two levels of appraisal. Primary appraisal of how one views life events that occur is followed by secondary appraisal relating to the availability of resources, such as social support, to cope with these events. When primary appraisals of a threat exceed secondary appraisals of how to cope with it, stress occurs. Therefore positive, coping-based, primary appraisals can directly reduce stress. They can also indirectly reduce stress by allowing one to implement coping strategies that involve approaching and dealing with the problem (Wood et al., 2010). Although the coping hypothesis presents a clear stressed-based theoretical model of gratitude; it does not extend to the interactions of gratitude with other factors of well-being.

The schema hypothesis of gratitude may explain the role of gratitude in a broader range of well-being outcomes. According to this hypothesis, how people view the receipt of benefits influences the amount of gratitude they experience as a result. This model is consistent with a construal-based model of gratitude (Roberts, 2004).

In such a model, the perception that a benefit was received in a high-cost and value situation will elicit more gratitude than if the situation was perceived to be low cost and value. Wood et al. (2008c) found support for this, as people with higher levels of gratitude tended to have schematic biases towards perceiving others as more helpful. People's subjective construals, their schemas and perceptions of experiences and situations, will therefore influence their levels of gratitude as a result, regardless of the objective elements of the situation. The problematic issue with this model is that it only explains how the presence of a grateful schema will work to elicit more gratitude; it does not attempt to explain further how this gratitude influences well-being. Furthermore, the model seems limited to help giving situations rather than the wider range of sources that are included in the broader dispositional model.

Although also linked to ideas of interpersonal interaction, the broaden and build theory of positive emotions (Fredrickson, 2001) provides a useful framework for understanding how gratitude can improve well-being. This theory has been discussed predominantly in terms of social support; gratitude resulting from interpersonal interactions is said to strengthen and build relationships, and build up resources which can be used at a later date. However, as noted, Fredrickson (2004) has suggested that gratitude can also extend beyond interpersonal parameters. Fredrickson's conceptualisation of gratitude falls within her broader theory of social emotions (Fredrickson 2001). According to this theory, emotions are about personally meaningful events or experiences that begin when someone evaluates the personal meaning of an event. This evaluation or assessment leads to subjective and physiological response tendencies.

Fredrickson (2004) argues that while tendencies for negative emotions, such as fear, have been fairly well articulated in the literature, the same is not true of positive

emotions. She further states that positive emotions can have the opposite effect to negative emotions. Negative emotions narrow individual's thought-action repertoires to enable them to react quickly and appropriately. This form of reaction is not necessary for positive emotions, which do not occur in threatening situations, and so positive emotions such as gratitude can broaden people's momentary thought-action repertoires. They can lead to thought-action tendencies to behave pro-socially to others; this is a broadened thought-action tendency because people tend to think and act creatively when attempting to repay and reflect their gratitude. Through this, people can build resources for use at a later stage; these resources are said to be durable as "they outlast the transient emotional states that led to their acquisition" (Fredrickson, 2004, p. 149). Positive emotions, such as gratitude, can therefore undo the effects of negative emotions as outlined above, which narrow thought-action repertoires. They do this by operating in an upward spiral where they broaden thought-action repertoires and help enhance well-being, which in turn facilitates the experience of positive emotions, and so on. Positive emotions, such as gratitude, are therefore incompatible with negative emotions because one's thought-action repertoire cannot be simultaneously broad and narrow (Fredrickson, 2004).

Furthermore, Fredrickson proposes that the effects of positive emotions accumulate over time, building the resources that increase the likelihood of experiencing positive emotions later on. For example, Fredrickson and Joiner (2002) found that people's baseline levels of 'broad-mindedness' predicted their future increases in levels of positive emotions and that increases in positive emotions subsequently predicted increases in levels of broad-mindedness at a later date. Similarly, people's levels of baseline positive emotions predicted increases in broad mindedness and these improvements in broadmindedness similarly predicted

increases in positive emotions at a yet later date. These findings clearly support the idea of an upward spiral of positive emotions, which would include gratitude. In this sense, positive emotions such as gratitude, can lead to optimal functioning and well-being, as a result of experiencing a higher number, intensity and frequency of positive emotions. They can therefore help make people "more creative, knowledgeable, resilient, socially integrated and healthy" (Fredrickson, 2004, p. 153). The more positive emotions that are experienced the more likely it is that an individual can achieve optimal psychological and physical functioning.

Physiological mechanisms have also been proposed to account for the effects of gratitude and positive emotions. For instance, negative emotions tend to be associated with higher levels of cardiovascular activity (Fredrickson, 2004; McCraty & Childre, 2004) and so positive emotions, operating on the opposite end of a spectrum, should reduce this activity. This idea is consistent with the broaden and build theory of the 'undoing' effects of positive emotions. Fredrickson et al. (2000) found that inducing positive emotions after negative emotions results in a faster return to baseline levels of cardiovascular activity than inducing neutral or negative emotions. Inducing positive emotions after a resting baseline did not result in any changes in cardiovascular activity however. This indicates that positive emotions only exert an influence on cardiovascular activity when experienced after negative emotions, in which case they essentially 'undo' the effects of the negative emotion. Previous research has also provided indications that gratitude more directly, may influence physiological processes, including cardiovascular activity (McCraty & Childre, 2004; Rash et al., 2011). Rash et al. (2011) conducted a brief grateful reflection intervention to investigate the effect of gratitude on physiological entrainment or coherence. This is a positive physiological response, thought to result

from increased activation of the parasympathetic nervous system and reduced activation of the sympathetic nervous system. The dual, but inversely related, activation of these systems brings them into equivalence. This is proposed to result in lower levels of stress, improved regulation of regenerative bodily processes and is generally associated with well-being. Rash et al. found that the intervention demonstrated the predicted effect on physiological responding in terms of cardiac coherence. The study by Rash et al. is, to the author's knowledge, the only empirical research to directly examine physiological correlates of gratitude following the use of a gratitude intervention.

2.6.3 Gratitude interventions. A number of studies using gratitude interventions, which can take the form of experimental manipulations or longitudinal interventions, have demonstrated benefits for psychological and physical well-being (Emmons & McCullough, 2003; Seligman et al., 2005; Watkins et al., 2003; Wood et al., 2010). The three most commonly used gratitude interventions are the gratitude visit, grateful contemplation or the gratitude list. The gratitude visit involves participants writing a letter to someone they are grateful for, outlining why they are grateful, and then delivering the letter to the person; in some instances the letter is read aloud. In an examination of the effect of a number of wellness interventions, Seligman et al., (2005) found that the gratitude visit was associated with lower levels of depression and higher levels of happiness over time. Grateful contemplation involves thinking about something(s) for which one is grateful for a period of time. It has been demonstrated to increase positive affect and decrease negative affect in students (Watkins, Grimm & Kolts, 2004) and to increase life satisfaction, self-esteem, and physiological entrainment relative to control conditions (Rash et al., 2011).

Lyubomirsky, Sousa & Dickerhoof's (2006) propose that this is because thinking about pleasant events, without having to engage in the processing of these events can result in increased levels of well-being. The gratitude list involves writing a list of things for which you feel grateful. It is the most commonly studied gratitude intervention and has been associated with increased levels of gratitude (Emmons & McCullough, 2003; Froh et al., 2008), satisfaction with life (Emmons & McCullough, 2003; Froh et al., 2008), positive affect (Emmons & McCullough, 2003; Watkins et al., 2003), pro-social behaviour (Froh et al., 2008), amount and quality of sleep, and exercise (Emmons & McCullough, 2003). It has also been associated with reduced levels of negative affect (Watkins et al., 2003), depression (Seligman et al., 2005) and physical complaints (Emmons & McCullough, 2003). These effects have been found in non-clinical, student, and clinical populations, including individuals with neuromuscular disease (Emmons & McCullough, 2003) and women with metastatic breast cancer (Algoe & Stanton, 2012).

Furthermore, Seligman et al. (2005) have found the gratitude list intervention to have longer lasting effects on well-being factors than other wellness interventions. Despite findings of beneficial effects of gratitude on psychological well-being, the effects of gratitude on health are quite understudied (Wood et al., 2010). The area of health could significantly benefit from the use of a short wellness intervention to improve well-being. One of the main limitations in comparing and assessing the usefulness of gratitude interventions to date is that the components and administration of these interventions differ between studies. Some studies involve listing things for which one is grateful on a daily basis over a period of time, while others involve singular occurrences of gratitude listing. Furthermore, control conditions used in many gratitude intervention studies are flawed (Wood et al.,

2010). Some studies utilise listing 'daily hassles' as an appropriate control because it is expected to result in the opposite effect to gratitude. The problem with using such negatively valenced controls is that they can create expectancy effects, and can impact on the interpretation of findings and differences between conditions. For instance, listing daily hassles could elicit a strong negative emotional response, potentially reducing well-being. As a result, this could exaggerate the beneficial effects of gratitude interventions. Utilising appropriate control groups in research investigating the effects of gratitude interventions is essential to gain an understanding of how these interventions influence psychological and physical well-being. Examining the physiological effects and correlates of gratitude, as a result of gratitude interventions, will also provide a more thorough investigation of how gratitude functions to improve well-being.

2.7 Biomarkers of Well-being

This review has demonstrated that both gratitude and mindfulness have strong and consistent associations with well-being outcomes in clinical and non-clinical populations (Keng et al., 2011; Wood et al., 2010). However, the majority of this research has utilised self-report measures of well-being, which can be open to distortion, resulting from social desirability, individual differences or anxiety. Self-reports can also be limited by retrospective recall bias (Bauhoff, 2011). It is therefore unsurprising that discrepancies exist between physiological measures and psychological perceptions of affective states (Clow, Thorn, Evans & Hucklebridge, 2004; Fries, Dettenborn & Kirschbaum, 2009; Matousek, Dobkin & Pruessner, 2010). Using objective markers of psychological states and traits in addition to self-report measures can strengthen empirical research on well-being. This is because

objective measurements, such as physiological states and biomarkers, are less susceptible to the biases, which affect self-report measures. They are also particularly useful for investigating the associations between psychological, physical well-being and health outcomes. In a recent review of the literature, Steptoe et al. (2009) found consistent associations between various health outcomes and positive affect. Adopting positive affect as a term referring to a range of positive aspects and affective states, they report associations with respiratory infections (Cohen et al., 2003; Cohen et al., 2006) and coronary heart disease (Kubzansky & Thurston, 2007). Furthermore, in a meta-analysis of prospective studies, Chida and Steptoe (2009) found associations between positive affect and mortality in both healthy individuals and individuals with existing illnesses. These associations remained even after controlling for negative affect, indicating the importance of positive affect for objective health outcomes.

2.7.1 Cortisol. An important mediator between psychological states and health related outcomes is cortisol, a particularly useful and widely used biophysiological marker of psychological stress. Cortisol is a glucocorticoid that is produced as an end product of hypothalamic pituitary adrenal (HPA) axis functioning (Kacsoh, 2000). The HPA axis is a control and regulatory system that connects the hormonal and nervous systems and helps to maintain physical stability and functioning in a process of allostasis. As part of this process, cortisol regulates the immune system, cardiovascular system and affective and cognitive processes. It also supports a range of somatic processes such as energy release and metabolism, growth, and reproductive function (Egliston, McMahon & Austin, 2007). Cortisol also helps to regulate the stress response.

Recognition of a stressor activates the HPA axis and induces the release of corticotropin releasing hormone (CRH) from the paraventricular nucleus in the hypothalamus. CRH then travels to the pituitary gland and adrenocorticotropin hormone (ACTH) is secreted into the blood stream. ACTH eventually reaches the adrenal cortex, where it binds to receptors that stimulate secretion of cortisol into the blood stream. This stress responding system functions optimally for regulating stress when a quick onset is required, followed by a quick termination once threat has passed (Kudielka & Kirschbaum, 2005; Lovell, Moss and Wetherall, 2011). This process can be altered however when faced with chronic and/or prolonged stress. Such instances can involve chronic elevations of cortisol leading to "cumulative wear and tear" for cells and organisms (Lovell et al., 2011, p. 301). Alterations of HPA axis functioning can have adverse physical and psychological implications. HPA hyperactivity for instance is associated with major depression, susceptibility to disease and cardiovascular problems (Kudielka et al., 2012). Conversely, hyporeactivity is associated with autoimmune processes such as lupus, M.S. and chronic fatigue (Kudielka & Kirschbaum, 2005). Optimal functioning of the HPA axis and cortisol secretion in response to stress therefore has important physical and psychological well-being implications.

Typically, cortisol follows a distinct diurnal pattern. Levels of cortisol begin to rise just prior to or at waking and peak about 30 to 45 minutes later; this peak is followed by a steady decline throughout the day. The rise in cortisol levels from waking to peak is known as the cortisol awakening response (CAR). It was first established by Pruessner et al. (1997) as a useful marker of change in cortisol levels in the first hour after waking. As a marker of HPA axis functioning, the CAR is particularly useful because it occurs naturally. Waking is a consistent, robust and

sufficient stimulus that is necessary for the CAR to occur (Adam & Kumari, 2009; Clow et al., 2010; Kudeilka et al., 2012). The CAR is not strongly associated with cortisol levels for the rest of the day (Chida & Steptoe, 2009; Dockray & Steptoe, 2010); this has been supported by twin studies demonstrating separate genetic influences on the CAR and daytime cortisol levels (Wust et al., 2000). However both the CAR and overall diurnal patterns of cortisol levels have been associated with psychological and physical well-being factors. For instance flatter diurnal slopes and higher diurnal cortisol output have been associated with perceived stress in healthy adults (Clow et al., 2004; Lovell et al., 2011; Wust et al., 2000). The magnitude of cortisol released has also been associated with stress processes and health outcomes, such as depression and Type 2 diabetes (Steptoe et al., 2009). Furthermore, in a review of the empirical literature, Chida and Steptoe (2009) found that the CAR is positively associated with job stress and general life stress. It is also negatively associated with fatigue, burnout, depression, post-traumatic stress disorder and positive psychological states and traits (Chida & Steptoe, 2009). It is possible that some of these negative associations may be due to hypocortisolism or disrupted sleep patterns, which characterise disorders such as depression (Chida & Steptoe, 2009). They may also be the result of neocortical network programming, which is partly supported by evidence that the CAR is absent in individuals with memory disorders caused by brain damage (Buchanan et al., 2004). The negative associations between cortisol levels and positive psychological factors is not entirely unexpected however, particularly if one considers positive and negative factors to operate along a continuum (Wood & Tarrier, 2010). Positive factors would therefore have opposite biological correlates to negative affective responses and thus positive affect would

be negatively associated with waking cortisol and cortisol output during the day, as found by Lai et al. (2005) and Steptoe, Wardle and Marmot (2005).

2.7.2 Measuring cortisol. A number of practical and methodological issues must be taken into consideration when attempting to correctly measure cortisol levels. These considerations relate to the types of samples collected, timing and frequency of sample collection, and participant adherence.

2.7.2.1 Salivary cortisol. Salivary cortisol measures can provide useful information about cortisol levels and changes over short periods of time, including the CAR (Chida & Steptoe, 2009; Halpern, Whitsel, Wagner & Harris, 2012; Kudielka et al., 2012). It can also provide information over longer periods, using repeated sample collections over a number of days (Hellhammer et al., 2007; Kudielka et al., 2012). Further, salivary cortisol is considered comparable (Kirschbaum & Hellhammer, 1989; Matousek et al., 2010) or superior (Hellhammer, Wust & Kudielka, 2009) to plasma measures of cortisol. Salivary cortisol levels are strongly related to the free unbound fraction of cortisol in plasma and are therefore an accurate reflection of the biologically active concentrations of cortisol found in blood. Salivary cortisol can therefore provide detailed diurnal information about cortisol levels as it captures the dynamics of daily life (Kudielka et al., 2012).

Saliva samples are collected by allowing saliva to pool in the mouth and then, in one method, absorbing the saliva using an absorbent cotton or synthetic swab. They can be collected at home as participants engage in their regular routine, with minimum intrusion to daily life. Alternative methods of saliva sample collection include the use of filter paper (Neu et al., 2007), as well as collecting saliva by

expectorating into a tube. Plastic tubes are suitable for this latter purpose and are more useful than glass tubes, which can pose problems in transport (Kudielka et al., 2012).

Collection of salivary cortisol samples by these methods can be impacted by a number of factors including smoking, consuming certain types of food, and medication (Kudielka et al., 2012). Participants are often asked to refrain from collecting samples at times coinciding with the occurrence of these factors as they can affect the validity and interpretability of samples. A number of additional factors, beyond participant control, can also confound interpretations of both the CAR and daytime cortisol levels by either increasing or decreasing observed levels. For instance, Clow et al. (2004), Kudielka et al. (2009) and Kudielka et al. (2012) discuss a number of factors that influence the CAR, including time of waking, the day of the week, seasonal effect, pregnancy, socio-economic status, disease, medication and drug consumption, and the sleep-wake schedule. Similarly, daytime cortisol levels are influenced by time since waking, sleep-work pattern, age, pregnancy, health, personality factors and socio-demographic factors, among other factors. In order to accurately assess cortisol levels, such covariates or confounders must be controlled for. This can be done by clearly outlining protocol instructions to avoid samples being collected when they may be influenced by confounding variables. The use of clear exclusion criteria can also help to control for factors such as smoking, disease and pregnancy. Although stringent exclusion criteria can reduce the generalisability of findings it can also ensure a more robust examination by minimising the impact of potential confounds.

Collecting sufficient saliva samples at pre-specified time points is also needed to enable a thorough investigation of cortisol levels because intra-individual differences

can be equal to inter-individual differences and the CAR is biased by situational and context effects (Hellhammer et al., 2007; Powell & Schlotz, 2012; Stalder et al., 2010). As Kudielka et al. (2012) note, the number of sample collections required can be influenced by feasibility and cost constraints. However, sample collection should be designed to capture the CAR and diurnal cortisol variation. Participants should therefore collect multiple samples over a number of days to capture this variation (Hellhammer et al., 2007; Matousek et al., 2010; Powell & Schlotz, 2012). The times at which samples are collected during these days in a naturalistic setting can also vary. In order to capture the CAR and overall waking cortisol output however it is necessary to sample at waking and then 30 and 45 minutes later. Inclusion of a 45 minute sample to capture the CAR is particularly important in investigations of women's cortisol levels because women can experience a peak later than men (Clow et al., 2004). Collection throughout the day is needed to capture the full diurnal pattern and so sampling can also be conducted during the day, early evening and night-time. Using this type of fixed occasion design allows for examinations of cortisol levels between subjects, groups or between days within subjects (Kudielka et al., 2012).

When multiple daily samples are required, over a number of days, participant adherence to sampling protocols becomes extremely important (Clow et al., 2004; Halpern et al., 2012; Thorn et al., 2006). This is particularly true for samples collected in the first hour after waking (Smyth, Clow, Thorn, Hucklebridge & Evans, 2013), although it is less so for the remainder of the day (Kudeilka et al., 2012). This is because inaccurate collection of samples on waking and thereafter can result in a blunted or flat CAR (Kudielka Broderick & Kirschbaum, 2003; Kunz-Ebrecht et al., 2004; Kupper et al., 2005); thus an observed absence of the CAR may simply be the

result of measurement error (Kudielka et al., 2003). Participant compliance and adherence to research protocols are therefore of critical importance in cortisol research. Adherence can be enhanced using electronic methods, such as track caps for saliva sampling devices. These create a date and time-stamp each time a storage device is used and have been shown to significantly increase compliance (Kudielka et al., 2003), even when 'dummy' caps are used. An alternative method of controlling and evaluating compliance is to use compliance checks, such as requiring participants to accurately record when samples were collected (Jacobs et al., 2005). Although open to more subjective biases than electronic tagging devices, such compliance checks have considerable cost benefits, while maintaining an emphasis on the importance of accurate collection.

Appropriate storage of saliva samples is essential to minimise effects on cortisol concentrations and data interpretability. Although findings regarding appropriate storage methods demonstrate differing effects of storage (Garde & Hansen, 2005; Groschl et al. 2001), the most recent recommendation is to store saliva samples at -20C or lower on the day of collection (Kudielka et al., 2012). Strict adherence to storage protocols by participants and researchers ensures that thorough analysis can be conducted.

Research examining positive intervention efficacy can benefit greatly from including assessments of biomarkers, such as cortisol, that can capture the specificity of responding in terms of diurnal variations and variations between people and groups over time. A number of previous studies have examined the effects of various well-being interventions on cortisol levels. The effects of mindfulness interventions on cortisol levels over time have also been previously examined and although there

do appear to be potential beneficial effects, findings have been inconsistent (Matousek et al., 2010; O'Leary et al., 2015); this is discussed in full in Chapter 3.

Examinations of positive interventions, such as mindfulness, that adhere to robust methodological criteria and rigorous protocols are essential to facilitate a better understanding of effects. In addition, mindfulness appears to be one of very few positive states or traits in the literature that has been examined using both subjective and objective measures of well-being. No work has yet been published on the associations between, or effects of gratitude on cortisol levels for instance. As gratitude has demonstrated significant benefits for psychological and physical well-being in terms of self-report (Wood et al., 2010) and has demonstrated tentative benefits for cardiovascular functioning (Rash et al., 2011), it is plausible that it should demonstrate a similar effect for cortisol levels. Furthermore examining gratitude using cortisol as an objective biomarker of well-being would strengthen research in this emergent area.

2.8 The Current Research

To summarise, the research to date has demonstrated consistent findings of the benefits of gratitude and mindfulness for psychological and physical well-being in clinical and non-clinical populations (Keng et al., 2011; Wood et al., 2010). Gratitude has been associated with increased levels of positive affect (Froh et al., 2009), perceived social support (Wood et al., 2008), life satisfaction (Wood et al., 2009), improved sleep (Emmons & McCullough, 2003) and reduced levels of depression and stress (Wood et al., 2008a). Mindfulness has been associated with higher levels of positive affect (Brown & Ryan, 2003), life satisfaction (Brown & Ryan, 2003), and lower levels of depression (Ma & Teasdale, 2004; Sephton et al.,

2007), anxiety (Shapiro et al., 1998) and stress (Williams et al., 2001). The use of mindfulness and gratitude-based interventions has been limited by methodological and practical considerations, including intervention length and the use of inappropriate control groups (Fjorback et al., 2011; Wood et al., 2010). Furthermore little research has been conducted on associations between health outcomes and biomarkers of well-being, such as cortisol.

Thus the question of whether two new wellness interventions, based on mindfulness and gratitude, can enhance psychological and physical well-being in terms of subjective and objective measures is a valid one. Both interventions are comprised of aural and written components to strengthen their comparability and facilitate an investigation of their efficacy in a randomised controlled trial design. This will allow a robust and thorough exploratory investigation of the effects of the mindfulness and gratitude interventions on psychological and physiological well-being primarily in a group of non-pregnant women (Study 3), followed by an examination of intervention effects with a pregnant group (Study 5).

Chapter 3

Study 1: A systematic review of the effects of mindfulness interventions on cortisol

Mindfulness is the intentional and non-judgemental awareness of experience in the present moment. As discussed in Chapter 2, it is consistently associated with health and well-being in diverse clinical and non-clinical populations (e.g. Fjorback et al., 2011; Keng et al, 2011). Examinations of the effects of mindfulness on biomarkers of wellbeing are in their infancy. A recent overview highlighted the usefulness of cortisol as an outcome measure in mindfulness research (Matousek et al., 2010). It did not systematically evaluate the effects of mindfulness interventions on cortisol outcomes however or the appropriacy of current research approaches. Thus, studies examining the effects of mindfulness on cortisol have not yet been systematically evaluated.

MBSR and MBCT, discussed in full in Chapter 2, are two of the most widely used mindfulness interventions and have guided much of the research in the area. Two reviews of randomised controlled trials (RCTs) examining the effects of MBSR and MBCT (Keng et al., 2011; Sedlmeier et al., 2012) reported improvements in psychosocial outcomes, such as quality of life, depression, anxiety and stress. MBCT and MBSR have also been found to improve markers of health, such as chronic pain, fibromyalgia and psoriasis (Baer, 2003). The reviews do not include evaluations of biomarkers of wellbeing, or measures of biological outcomes. They instead focus on studies using self-report indices of health and wellbeing, which have guided the majority of research in the area. Incorporating standardised markers of health and wellbeing allows for more rigorous investigations of the pathways between

psychological and physical well-being, and health outcomes. Cortisol is one such example of a useful biomarker of psychological well-being, and is involved in physiological regulation of the stress response. As discussed in Chapter 2, disregulation of cortisol functioning can have detrimental effects for well-being. Examining the effects of mindfulness on the CAR and diurnal patterns of cortisol is therefore important to contribute to models of mindfulness effects on health and wellbeing.

A number of studies have demonstrated reductions in cortisol subsequent to mindfulness interventions (Galantino et al., 2005; Kang & Oh, 2012; Lengacher et al., 2012; Lipschitz et al., 2013). Brand, Holsboer-Trachsler, Naranjo and Schmidt (2012) found that participating in an MBSR program decreased the CAR for both experienced and novice meditators. In clinical populations, changes in cortisol levels have been observed for individuals who have completed cancer treatment (Matousek, Pruessner & Dobkin 2011), current cancer patients (Carlson et al., 2004, Lengacher et al., 2012) and their caregivers (Lengacher et al., 2012). For instance, in a group of breast and prostate cancer outpatients, Carlson et al. (2004) found significant decreases in morning and evening cortisol following an MBSR intervention. These decreases were specific to participants with higher levels of baseline mean daily cortisol. Participants with low or potentially blunted baseline cortisol demonstrated increases over time, suggesting a normalisation of cortisol levels in this group.

In a RCT of a 3-week mindfulness meditation intervention with cancer survivors, Lipschitz et al. (2013) failed to find significant changes in cortisol levels. Similarly Bowden et al. (2012) did not find significant differences in cortisol levels between mindfulness and two other wellness interventions. Both studies utilised active

controls however and did not include a no-treatment control against which the effects of the interventions could be compared. More robust examinations of MBSR (Matchim, Armer & Stewart, 2010) and a low-dose MBSR program (Klatt et al., 2009) also failed to demonstrate significant changes over time between the interventions and no-treatment control groups for working adults (Klatt et al., 2009) or early stage breast cancer survivors (Matchim et al., 2010). Matchim et al. (2010) did observe a significant decrease in cortisol following a mindfulness intervention for the intervention condition only, similar to effects observed in other within-subjects designs (Carlson et al., 2004; Galantino et al., 2005; Lengacher et al., 2012). While these findings suggest that mindfulness interventions only demonstrate within-subjects effects, Lynch et al. (2011) found no significant changes over time for university students following a mindfulness meditation intervention. In addition to not finding within-participants effects in a sample of college students, Lynch et al. also failed to find significant differences between the intervention and control groups over time.

The inconsistent and contrary findings of mindfulness effects on cortisol, coupled with its increasing incorporation into studies of mindfulness, indicate a need to take stock of the value of cortisol measures in examinations of mindfulness interventions. As this is a rapidly growing field of enquiry, a review of the literature is essential to investigate whether mindfulness does demonstrate beneficial effects on cortisol. An evaluation of current research design, sampling protocols and cortisol measurement in mindfulness research is pressing; without it there is the potential for perpetuation of inappropriate research practices when combining two research areas which have been examined independently until recently. The primary aim of this review is therefore to systematically evaluate the effect of mindfulness interventions on

salivary cortisol levels. A secondary aim is evaluate current research approaches in the area of mindfulness effects on cortisol levels.

3.2 Methods

3.2.1 Study Eligibility Criteria

Eligibility criteria included examination of mindfulness interventions, 6 to 8 weeks duration, published in English. Interventions were required to involve training and teaching of mindfulness techniques, emphasising systematic practice. Studies were required to include salivary cortisol measures of the CAR and/or diurnal slope as an outcome variable. Both within-subject studies and RCTs were included if measurements were collected pre and post intervention. Studies including participants with psychotic illnesses or bipolar disorder were excluded due to disturbances in cortical regulations that may influence interpretation of intervention outcomes (Chida & Steptoe, 2009).

3.2.2 Search Strategy

A systematic search of the literature was conducted using Medline, Academic Search Complete, PsycArticles, PyscInfo, CINAHL, Web of Science and Science Direct. The search terms “mindfulness”, “cortisol”, “cortisol awakening response” and “awakening cortisol response” were used and the search was not limited by date of publication.

3.2.3 Study and Data Collection Process

Prior to study commencement ethical approval was obtained from the appropriate University Ethics Committee. The researcher designed the search strategy and both the researcher and a collaborator executed it. The two assessors independently reviewed titles and abstracts of all identified articles and independently evaluated

each full text article. Reference lists of retrieved articles were hand searched for further potential studies. This resulted in retrieval of 71 papers in total. Disagreements were resolved by consensus. The 71 potential papers were assessed using the inclusion and exclusion criteria; this resulted in 12 papers remaining for quality assessment.

3.2.4 Quality Assessment

Study quality was assessed by evaluating six types of bias using Review Manager 5.2. Papers were considered to have high risk of bias if inadequate information about randomisation and blinding (if any) was provided or if groups were not randomly assigned. High risk of bias was also associated with unclear study design, unaccounted for attrition rates, and inadequate measures of cortisol. Inadequate cortisol measures included baseline cortisol after intervention commencement or use of single cortisol samples. Following quality assessment, six papers remained, all with sample sizes ranging from 21 (Marcus et al., 2003) to 186 (Malarkey et al., 2013); total n= 378. When studies only provided descriptive statistics, effect sizes were calculated using the medians and ranges. A power analysis for meta-analysis was conducted to assess the feasibility of conducting a meta-analysis. The power analysis was conducted using means and standard deviations; where these were unavailable, effect sizes were calculated from median scores and ranges. The power analysis resulted in an estimated power of .08, indicating that the studies demonstrated lower than desirable power to examine significant effects. Due to the low power and the weak effect sizes of the included studies a systematic review was deemed most appropriate.

3.3 Results

A summary of all studies examining the effects of mindfulness interventions on cortisol levels is shown in Table 1. Two studies utilize within-subjects designs (Marcus et al., 2003, Matousek et al., 2011). These studies demonstrate high methodological quality and their lack of control conditions can be considered ethically sound, as they include vulnerable populations. The remaining studies utilise RCT designs. As design is a potential contributor to differences in results, the findings will be presented by research design.

Table 1

Characteristics of Included Studies

Study	Year	Design	Population	Intervention (*N*)	Control (*N*)	Sampling protocol	Cortisol measurement	Intervention	Outcome
Marcus et al.	2003	Within subjects	Therapeutic community for substance abuse	21		1 day pre- and post-intervention, waking, +30, +45, +60	CAR	8-week MBSR	$p = .03$
Matousek et al.	2011	Within subjects	Breast cancer patients	33		3 days pre- and post-intervention, waking, +30, +45	CAR	8-week MBSR	$p = .05$
Gex-Fabry et al.	2012	RCT	Patients remitted with recurrent depression	30 (28)	30 (28)	Six collections: pre- and post-intervention and 3-, 6-, 9-, and 12-month follow-up. Waking, +15, +30, +45, +60, 3 p.m., 8 p.m.	CAR and diurnal slope	8-week MBCT	CAR $p = .73$; slope $p = .36$
Oken et al.	2010	Pilot RCT	Community dwelling caregivers	10 (8)	21 (17)	1 day pre- and post-intervention, +5, +35 and bedtime	CAR	7-week MBCT	+5 minutes $p = .615$; +35 minutes $p = .175$; bedtime $p = .209$
Daubenmier et al.	2011	RCT	Overweight and obese women	24	23	4 days pre- and post-intervention, waking, +30, bedtime	CAR and diurnal slope	9-week combination of MBSR, MBCT and MB-EAT	CAR $p = .15$; slope $p = .58$
Malarkey et al.	2013	RCT	University faculty and staff	93 (84)	93 (86)	3 days pre- and post-intervention, +20, 5 p.m., bedtime	Diurnal slope	8-week MBI-ld	$p = .61$

Note. CAR: cortisol awakening response; RCT: randomised controlled trial; MBSR: Mindfulness-Based Stress Reduction; MBCT: Mindfulness-Based Cognitive Therapy; MB-EAT: Mindfulness-Based Eating Awareness Training; MBI-ld: Mindfulness Based Intervention- low dose.

3.3.1 Within-subjects Examinations of Mindfulness Effects

The two within-subjects examinations of mindfulness intervention effects included in this review (Marcus et al., 2003, Matousek et al., 2011) focus exclusively on the CAR. Notably, these are the only studies reviewed that demonstrate changes in cortisol levels over time. The earliest of these studies was conducted by Marcus et al. (2003).

Marcus et al. (2003) conducted a pilot study of a standard MBSR program with 21 members of a therapeutic community for substance abuse. Salivary cortisol was measured using samples collected on the first morning pre-intervention and again at post-intervention at the following times: waking, +30, +45, and +60 minutes. No information is given regarding time of waking or whether variability in participant waking times was accounted for; this can have a significant impact on the CAR (Clow et al., 2004; Federenko et al., 2004; Kudielka & Kirschbaum, 2003; Kudielka et al., 2012). Information regarding the time frame between completing the intervention and collecting post-intervention saliva samples is also unclear. In addition, sample collection on a single day pre and post intervention is problematic, as multiple sampling days are required to rigorously measure cortisol levels (Hellhammer et al., 2007; Powell & Schlotz, 2012). Marcus et al. (2003) calculated the CAR as area under the curve (AUC) using the trapezoid method with four time points. The analysis only included data from a small subsample of 12 subjects who provided complete data; additional information about this subgroup, such as sociodemographic variables, is not provided. Despite this, Marcus et al. found a significant reduction in the CAR from pre-test to post-test, even with a small sample

size of 12 participants. One interpretation of this is that there is a strong effect of mindfulness on the CAR; however it is possible the findings are attributable to a lack of rigour in timing of samples.

Matousek et al. (2011) also conducted a within-subjects examination of the effects of MBSR on the CAR for 33 women who had completed medical treatment for cancer. Salivary cortisol measures were collected three times a day for 3 consecutive days pre and post intervention; samples were collected at waking, +30 minutes and +45 minutes. Cortisol measures were collected within five days preceding and following the intervention, further specific information is not given. It is unclear whether participants collected samples on weekdays and/or weekends; the CAR is influenced by the day of the week and can differ between work and non-work days (Hellhammer et al., 2007; Kudielka et al., 2012; Kunz-Ebrecht et al., 2004; Schlotz et al., 2004). Matousek et al. examined the effect of sampling day in terms of stability of sampling within each sampling period and found no significant effect of day of sample collection on cortisol levels. The CAR was calculated as AUC with respect to increase (AUC_i) (Pruessner, Kirschbaum, Meinlschmid & Hellhammer 2003). Cortisol levels were also transformed into a single value for correlational analyses by calculating the AUC for each day and then calculating the mean for the individual day values. While this approach has its merit it also loses information regarding intra-individual differences across days by removing potential effects of individual days for individual participants. Matousek et al. found a significant difference in the CAR from pre to post-test; the CAR increased following intervention completion, with prolonged increases at post-test measures. This

indicates that the MBSR program significantly increases the CAR and that observed increases are influenced by depressive symptomatology in women who have completed breast cancer treatment.

3.3.1.1 Summary of within-subjects findings. The two within-subjects examinations of mindfulness intervention effects included in the current review demonstrate significant changes in the CAR. Directionality of effects differed between studies, perhaps indicating differing mechanisms of mindfulness in different groups. For members of a therapeutic community treated for substance abuse, a reduction in cortisol levels was observed (Marcus et al., 2003). Individuals who had completed medical treatment for cancer demonstrated an increase in cortisol levels (Matousek et al., 2011). It is important to note that due to the lack of a control condition our interpretation of these findings is limited.

3.3.2 RCT Examinations of Mindfulness Effects

A number of RCTs have examined the effect of mindfulness interventions on cortisol levels, in comparison to control groups. Oken et al. (2010) conducted one such examination in a pilot RCT of 31 healthy adults providing care for a family member with dementia. Two control conditions were used. The first, Powerful Tools for Caregivers, involved weekly sessions on topics including stress management and decision-making. The second was a respite only condition with respite care 3 hours weekly, for 7 weeks. Experimental conditions were not compared to caregivers maintaining usual routines. Inclusion criteria specified providing 12 hours minimum

caregiving assistance weekly and having ‘high enough’ (p. 1032) baseline stress levels. The latter criterion potentially denies benefits to people below this cut-off and presupposes intervention utility in high stress cases only. As this is a newly developed intervention based on MBSR and MBCT, such a presupposition may also artificially inflate intervention effects; high baseline levels may result in greater decreases. Single day samples were collected within 3 weeks pre and post intervention and information on standardization of collection days is absent; this allows for variability between participants (Clow et al., 2004; Hellhammer et al., 2007; Powell & Schlotz, 2012; Stalder et al., 2010). Saliva samples were collected at three time points: within 5 minutes of waking, 30 minutes later and at bedtime (approximately 10-11pm). No further information on sampling times is provided, such as variations in the waking or bedtime samples. This lack of specificity can result in inaccurate measurement of intervention efficacy. In addition morning cortisol levels can peak between 30 to 45 minutes after waking and several factors can influence this morning peak (Clow et al., 2004). For instance the CAR peak can occur later in females and most participants in this study were female. Thus the sampling times used by Oken et al. may explain the lack of a significant effect in this study.

Gex-Fabry et al. (2012) also found no significant effect of a mindfulness intervention on the CAR or diurnal slope of 60 patients remitted from depression, following an MBCT intervention. Salivary cortisol samples were collected at baseline, intervention completion, and at 3-month intervals for one year. Single day sample collection was used; samples were collected at waking, +15 minutes, +20

minutes, +45 minutes and +60 minutes, 3pm and 8pm. Analysis of the CAR was conducted using AUC according to the trapezoid rule (Pruessner et al., 2003). No significant changes were observed in comparison to a treatment as usual (TAU) control group at post intervention or follow-up. The use of single day samples may contribute to the absence of observed effects. Similarly no significant effect on diurnal slope was observed at post-intervention or follow-up. The diurnal slope was calculated using the difference between first and last samples divided by the time interval between samples. Absence of a bedtime sample limits analysis of the overall diurnal pattern. AUC for overall day levels was calculated using the trapezoid rule, with differences in sampling interval normalized to the median 13-hour sampling period. The use of a median value of 13 does not take into account individual variations in sampling times and it is unclear why differences in sampling interval are not allowed for (Pruessner et al., 2003). Despite this, the use of a TAU control group is a strength, indicating that mindfulness interventions may not be as beneficial when compared with TAU for such samples.

Daubenmier et al., (2011) examined the effects of mindfulness on cortisol for 47 overweight and obese women, BMI between 25 and 40. The intervention used, Mindfulness Based Eating Awareness Training (MB-EAT), was based on MBSR and MBCT. It lasted 9 weeks and incorporated practices before and during meals. The wait-listed control group engaged in a 2-hour nutrition and exercise session halfway through the study. The rationale for this is unclear, as it provides neither a comparative level of engagement nor the relative neutrality of a TAU group. Samples were collected over four work days, pre and post-test; they were collected at

waking, +30 minutes, and bedtime. The bedtime sample was reported as "just prior to bedtime" (p.4), without further clarification. The use of a +30 minute sample may also miss a CAR peak occurring later for women (Clow et al., 2004). Significant reductions in the CAR were observed for obese women in the treatment condition that were not observed for obese women in the control condition. Significant differences were not found for overweight women in either condition. This suggests potential benefits for the obese subgroup only. No changes in diurnal pattern were found for obese or overweight women in the study. MB-EAT does not therefore demonstrate an effect on the CAR or diurnal pattern in overweight and obese women in comparison to a control group; some within-subjects benefits are apparent for obese women.

In a RCT of 186 University faculty and staff, Malarkey et al. (2013) examined the effect of mindfulness on biological measures of inflammation and chronic stress, including diurnal cortisol. An 8 week long intervention was used; the intervention was characterised as low dose because the duration of weekly group sessions and at-home practice was reduced from standard MBSR and MBCT programs. The daylong mindfulness retreat was also replaced by a 2-hour retreat. A lifestyle education control condition spent a comparable amount of time engaging with study exercises. Salivary cortisol was collected for three consecutive days at 2 weeks pre-intervention and 2 weeks post-intervention. Samples were collected at the following times: 20 minutes after waking, noon, 5pm and bedtime. No further information is given for waking and bedtime sample collection, such as variance within and between participants. It is also unclear if rising and bedtime occurred at pre specified times or

were determined by participants. The primary cortisol outcome, the average of three cortisol measurements (noon, dinner and bedtime) across three days, provides afternoon and evening cortisol information only. The morning sample provides little information about cortisol at waking or the CAR however as it is taken at a time unassociated with either. The difference between the +20 minutes sample and the average of the 5pm and bedtime levels was used in a sensitivity analysis. No significant differences in cortisol levels between the two groups following intervention completion were found.

3.3.2.2 Summary of RCT findings. No significant effects of mindfulness interventions were observed for the CAR or diurnal slope in comparison to control conditions. No significant effects were observed for dementia caregivers (Oken et al., 2010), individuals remitted from depression (Gex-Fabry et al., 2011), working adults (Malarkey et al., 2013) or obese and overweight women (Daubenmier et al., 2011). When a subgroup of obese women in the latter study was examined as a within-subjects group, a reduction in the CAR was observed (Daubenmier et al., 2011). Issues of sampling strategies, intervention use and differential control groups may contribute to inconsistent findings.

3.4 Discussion

This systematic review evaluated the effect of mindfulness interventions on cortisol. Examinations of mindfulness effects on biomarkers of well-being are in their infancy and have not yet been subject to a rigorous review. The current paper highlights some potential effects of mindfulness interventions on cortisol levels. Significant changes in the CAR have been observed using within-subjects designs in diverse groups, such as members of a substance abuse community (Marcus et al., 2003), obese women (Daubenmier et al., 2011) and individuals who have completed medical treatment for cancer (Matousek et al., 2011). In research designs utilising control conditions, mindfulness does not demonstrate significant effects on the CAR or diurnal slope for people remitted from depression (Gex-Fabry et al., 2011), dementia caregivers (Oken et al., 2011), obese and overweight women (Daubenmier et al., 2011) or working adults (Malarkey et al., 2013). The inconsistent findings of mindfulness effects on cortisol indicate the need for caution in interpreting the research findings. They also highlight the importance of robust research design in studies of mindfulness and biology.

3.4.1 Mindfulness Optimises HPA Functioning

A recurrent issue in the cortisol literature is that the direction of change observed for the CAR differs between studies (Fries et al., 2009). Inconsistent cortisol patterns have been found in association with a wide range of well-being variables across numerous studies (Mikolajczak et al., 2010). Mikolajczak et al. (2010) posit that

examining cortisol flexibility, rather than increases or decreases in cortisol levels, may account for these inconsistencies and provide a more consistent account of cortisol functioning over time and across studies. In an examination of the influence of protective psychological factors, such as high happiness and low stress, Mikolajczak et al. found that people exhibiting these factors demonstrated a more flexible CAR. These participants had increased reactivity to challenge as a result of transitioning from weekend to weekday; individuals with dysregulated and less flexible CAR did not respond as well. In line with this flexibility hypothesis (Mikolajczak et al., 2010) mindfulness can function as a protective psychological factor to optimise cortisol functioning to induced or naturally occurring stressors. Mindfulness does not simply reduce stress in the moment or over time.

The flexibility hypothesis explains findings that mindfulness influences differential changes in cortisol based on baseline functioning (Carlson et al., 2004). It may also explain the findings of significant increases in the CAR from pre to post-intervention for women who had completed breast cancer treatment (Matousek et al., 2011). Cancer patients may have had blunted CAR at baseline because the CAR is negatively associated with depression, fatigue and post-traumatic stress disorder (Chida & Steptoe, 2009); these outcomes can result from stressful cancer related experiences and treatments. Matousek et al. (2011) provide support for blunted cortisol in their study, as their participants demonstrated lower cortisol levels than those found for healthy controls (Wust et al. 2000). Mindfulness therefore functions to improve responding in this instance by increasing and thereby normalising cortisol levels.

Gex-Fabry et al. (2012) failed to find similar increases in cortisol levels following MBCT for patients remitted from depression. They expected a normalisation of blunted cortisol levels, as the CAR is negatively associated with depression; this did not occur. The use of MBCT, designed to reduce depressive symptomatology rather than stress, may explain the lack of a significant effect. Similarities between MBSR and MBCT presuppose the utility of both interventions to influence stress; hence the inclusion of both in this review. It is possible that baseline effects on cortisol over time result from noise variables, such as health behaviours and sociodemographic factors (Adam & Kumari, 2009) that are present at baseline but may differ by follow-up. To fully investigate this, robust examinations of mindfulness interventions that incorporate such variables are needed.

3.4.2 Direct Effects of Mindfulness on Cortisol

Depression adversely influences cortisol levels (Chida & Steptoe, 2009) and mindfulness interventions demonstrate reductions in levels of depression (Brown & Ryan, 2003; Goyal et al., 2014; Monti et al., 2006). It could be assumed that a mindfulness-induced reduction in depression leads to lower cortisol levels but there is little evidence to support this. It is equally possible that HPA functioning influences depression. This latter possibility is supported by the lack of a significant reduction in cortisol over time following MBCT (Gex-Fabry et al., 2012), despite observed reductions in depression in the original paper (Bondolfi et al., 2010). Reductions in cortisol in people with depression do not therefore appear to result from improvements in depressive symptomatology. The findings of this review

suggest that reductions in cortisol occur through a direct mechanism that is not moderated by depression. Further support for this conclusion comes from the lack of association between cortisol and depression in a mindfulness trial in a sample of healthy adults (Malarkey et al., 2013). Additionally, Matousek et al. (2011) found that changes in the CAR following intervention use were more pronounced after controlling for depression. This indicates that depression does not moderate mindfulness effects, and suggests direct effects of mindfulness on cortisol levels.

3.4.3 Mindfulness Interventions in Different Subgroups

It is possible that mindfulness results in different effects on cortisol levels for different participant groups. For instance, within-subjects mindfulness effects were observed for a group of obese women that were not observed in overweight participants in the same study (Daubenmier et al., 2011). Cortisol secretion differs between obese and overweight women (Kumari et al., 2010; Rutters et al., 2010) but these findings suggest that obese individuals receive more benefit from mindfulness interventions. This may extend to other groups demonstrating pervasive or clinically meaningful disease statuses. A heightened level of underlying stress and/or physical symptomatology may elicit a greater cortisol response to mindfulness. This would explain the lack of change in cortisol levels in the healthy, non-clinical populations included in this review: caregivers (Oken et al., 2010) and university faculty and staff (Malarkey et al., 2013). Previous research has also suggested that lack of effects are due to relatively normal baseline cortisol (Lipschitz et al., 2013) or a lack of

room for further change due to significantly lowered cortisol toward the end of intervention use (Lengacher et al., 2012).

3.4.4 Methodological Issues

A number of methodological issues may explain any observed intervention effects. The studies included in the current review use inconsistent approaches to cortisol sampling, research design, and intervention adherence and attrition monitoring. The number of studies existing but excluded from this review highlight the pressing need for improvement in the methodological quality of examinations of mindfulness effects on cortisol.

3.4.4.1 Cortisol sampling. Implementation of appropriately structured sampling protocols is essential to accurately measure cortisol levels. This is because cortisol can be influenced by time of sampling and incorrect sampling (Adam & Kumari, 2009; Clow et al., 2004; Kudielka & Kirschbaum, 2003; O'Connor et al., 2009b). Frequency and duration of sampling is often influenced by feasibility and cost but sample collection protocols must still be adequate to capture variability in cortisol levels. In the current paper, incomplete information on timing of night-time samples (Daubenmier et al., 2011; Oken et al., 2010) limits our interpretation of the accuracy and meaningfulness of intervention effects on diurnal slope. It also reduces the standardisation of sampling times across participants within studies. Similarly, incomplete information for some waking times (Marcus et al., 2003) also allows for variability between participants. As time of waking and sampling during the early

morning rise period can have a significant effect on the CAR (Clow et al., 2004; Kudielka & Kirschbaum, 2003), accurate CAR sampling is essential.

Additionally some time points included are ill suited to capture intended cortisol outcomes. For instance some studies do not sample for the CAR beyond 30 minutes after waking (Daubenmier et al., 2011; Oken et al., 2010). It is well accepted that cortisol can peak between 30 and 45 minutes post waking, with this peak tending to occur later in women (Clow et al., 2004). Using a shorter sampling period for the CAR may miss this peak, thereby contributing to the absence of an effect. Restrictive sampling times for diurnal patterns were also noted, with some studies failing to adequately capture overall diurnal secretion (Malarkey et al., 2013). Restrictive duration of sampling periods, in terms of single day samples, was also found (Gex-Fabry et al., 2012; Marcus et al., 2013; Oken et al., 2010). Multiple sampling days at each time point are necessary to adequately measure cortisol levels and minimize the influence of contextual and situational effects (Hellhammer et al., 2007; Powell & Scholtz, 2012). Not accounting for potential differences across days and within subjects provides an incomplete and inaccurate measure of cortisol.

Conversely, multiple day measures must be standardised across all participants. Some studies in the current review do not indicate whether sampling occurred on weekdays and/or weekends (Matousek et al., 2010), allowing for variation across participants (Hellhammer et al., 2007; Kudielka et al., 2012; Mikolajczak et al. 2010; Schlotz et al., 2004). Potential variation may also occur when participants are instructed to collect samples within a certain time period pre and post intervention, without specific sampling days used (Marcus et al., 2013; Matousek et al., 2010;

Oken et al., 2010). Future research on mindfulness effects must include standardised collection days and times to reduce potential variation between participants. Adequate sampling protocols that collect sufficient samples over a sufficient duration must also be implemented.

3.4.4.2 Population groups and research designs. The majority of studies included in this review have low sample sizes, raising the possibility that these studies may be underpowered to detect a significant effect. Additionally, the diverse populations examined present challenges for coherently interpreting the effects of mindfulness interventions. Goyal et al. (2014) recently highlighted this issue in a review and meta-analysis of meditation programs for psychological well-being. Mikolajczak et al. (2010) have also highlighted that, due to inconsistencies between studies, no clear guideline is available for what a healthy CAR should look like. Therefore, interpretations of effects on cortisol levels are limited. Similarly here we cannot gauge what an acceptable or healthy cortisol response to a mindfulness intervention is, due to the diversity of populations examined.

A further issue of note is the use of within and between subjects research designs. When studying vulnerable or clinical patients it is not often ethically sound to conduct RCTs due to potential denial of benefits. Within-subjects designs lack a useful control group however against which intervention effects can be compared. Interestingly, the only significant effects observed in the current review are in within-subjects designs, suggesting that mindfulness is useful only in implementing change over time within the participant. When control groups are utilised effects are

not observed but this issue is less clear in the instances when control groups utilise alternative forms of intervention but do not include a non-intervention group. Mindfulness interventions may therefore be efficacious for within-subjects changes but less so when compared with other interventions.

3.4.5 Conclusion

Mindfulness demonstrates some potential effects on cortisol levels, although caution in interpreting the findings of extant results is warranted. Inconsistent findings in the literature may be explained by the mechanisms of mindfulness but problems with methodological inconsistencies are likely to contribute to inconsistent findings across studies. Future research in the area must adhere to robust methodological standards in terms of control groups, sampling protocols and intervention use. This is essential to facilitate a better understanding of effects, and the development of efficacious mindfulness interventions.

Chapter 4

Methodology

In the current studies intervention effects were examined using a randomised controlled trial (RCT) design. Originally predominantly used in medical research, the RCT is now widely used in social, educational and social sciences research. RCTs are currently considered the gold standard for investigating the effects and efficacy of interventions, which can be used in practice (Schulz et al., 2010; Sibbald & Roland, 1998; Stolberg, Norman & Trop, 2004). RCTs are one of the most powerful forms of experimental study (Christensen, 1994; Cochrane, 1972; Sibbald & Roland, 1998; Stolberg et al., 2004) because they provide robust means to investigate and attribute cause-effect relationships between interventions and outcomes (Greenland, 1990; Sibbald & Roland, 1998). According to Stolberg et al. (2004), RCTs are the only experimental approach that comes close to demonstrating causality, through the use of control groups and random allocation to experimental conditions.

Random assignment of participants to experimental conditions is a key component of RCTs. Randomisation facilitates rigorous comparison of intervention effects between experimental groups because the groups are balanced in all aspects, except the treatment they receive. This ensures that groups do not systematically differ on any known or unknown factors that could influence outcomes. Accidental bias can still occur, for instance by chance, but adequate randomisation minimises the potential for bias based on selection, sample characteristics and differential history of participants. A number of approaches to randomisation can be used, such

as simple randomisation, block randomisation or stratified randomisation. Block randomisation, as used in the current study, ensures comparability between groups and prevents imbalances in participant numbers in groups; this is particularly useful in trials with small sample sizes. Regardless of randomisation approach, when implemented appropriately and thoroughly it provides a means to isolate and quantify the effects of interventions while controlling for other factors. No other research design allows for confidence in inferences that differences in outcomes are attributable to the intervention rather than any external factor (Jadad & Rennie, 1998; Stolberg et al., 2004).

Another key component of RCTs is the use of a control condition to which participants are randomly assigned, and against which the intervention is compared. Control groups can involve an active control, wait-list, or treatment as usual (TAU). Issues of differential expectations and engagement with the research study and researchers that may arise can be negated using active control groups. Active control conditions involve participants engaging in a separate activity or intervention of comparable length and engagement to the study intervention. TAU groups do not include such activities but instead allow a comparison of an intervention relative to standard care; this is particularly useful in healthcare contexts. TAU can be problematic however if an aspect of standard care contributes to the outcome; this is less of a concern with groups not currently suffering health issues or illness, such as pregnancy. Wait-list control groups are provided with access to the study intervention either during the study or at study completion. While awareness of receiving the intervention at a later date could contribute to expectancy effects, wait-

list groups avoid possible ethical issues such as denial of benefits should the intervention prove efficacious (Psychological Society of Ireland, 2011). In the current study, a TAU wait-list control is used as it allows an examination of intervention effects relative to standard care, while still ensuring that all participants receive intervention access at study completion.

A further important consideration in RCTs is the level of blinding used in random allocation and analysis. The 2010 CONSORT statement advises against the use of certain terminology relating to blinding (Schulz et al., 2010) but the terms 'double-blind' and 'singe-blind' will be used here for clarity. Blinding refers to whether the participant and/or researcher is aware of the experimental condition to which they have been randomly assigned. In double-blind trials neither the researcher nor the participant knows which condition has been allocated. The researchers cannot therefore unintentionally differ between participants based on allocation; resulting in a minimisation of potential bias (Christensen, 1994). Double-blind trials are not always feasible due to time and resource availability however (Christensen, 1994) and so single-blind trials provide a practical alternative. In single-blind trials the participant is unaware of the experimental condition to which they have been assigned but the researcher does know the details of random allocation. Single-blind trials retain the benefit of minimising the possibility of a placebo effect or respondent bias, as participants do not know if they are in the intervention or control condition. They also allow for a more practical approach in instances where the researcher must be aware of group assignment to administer interventions or treatment. The current study employs this latter approach to blinding because

double-blind allocation is not feasible given the scale of the study. Wait-list participants in the study are informed they will begin the intervention at 3 weeks but are not made aware that the intervention group begin the intervention immediately; similarly, the intervention condition is unaware of the control group. Although single-blind randomisation can be considered less robust than double-blind randomisation, it is the most feasible and practical approach for the current study.

Therefore the benefits of utilising a single-blind RCT with a TAU wait-list control group in the current study clearly outweigh potential challenges. The implementation of careful randomisation and blinding will enable a robust examination of relationships between the intervention and outcome variables. It is thus the ideal approach for examining the effect of a positive psychological intervention on well-being in pregnant and non-pregnant groups.

Chapter 5

Study 2: Intervention Development and Evaluation

Positive psychology interventions are defined as "treatment methods or intentional activities that aim to cultivate positive feelings, behaviours, or cognitions" (Sin & Lyubomirsky, 2009, p. 468). As discussed in Chapter 2, positive psychological interventions are consistently associated with beneficial effects for well-being (Keng et al., 2011; Seligman et al., 2005; Sin & Lyubomirsky, 2009; Wood et al., 2010). Two recent meta-analyses of positive interventions have further demonstrated potential benefits for well-being (Bolier et al., 2013; Sin & Lyubomirsky, 2009). Both meta-analyses found that intervention types and formats can have differential effects on well-being; Sin and Lyubomirsky (2009) also found support for the use of a "shotgun approach" (p. 483) to positive psychological interventions. This proposes that incorporating a number of different forms of intervention in one may prove more effective that completing one intervention or component in isolation.

The current pilot study aims to combine components of gratitude and mindfulness interventions in two novel gratitude and mindfulness interventions respectively. Gratitude interventions tend to involve single component exercises, such as writing or thinking about things for which you are grateful. Mindfulness interventions often take the form of multi-faceted group based sessions. Research has yet to examine the effects of at-home, dual component mindfulness and gratitude interventions on well-being. This pilot study will develop and examine the effect of two dual component

interventions for use in larger randomised controlled trials described in Chapters 6 and 9.

5.1 Intervention Development

5.1.1 Gratitude Intervention

Development of a gratitude intervention for use in the current study is based on a thorough review of the existing literature. Three main forms of gratitude interventions have been examined in previous research; gratitude diaries, grateful reflection and a gratitude visit. As discussed in Chapter 2, the gratitude diary has been found to have a sustained impact on well-being (Emmons & McCullough, 2003; Seligman et al., 2005). In addition to its impact on well-being, the gratitude list is relatively quick, easy to complete, non-intrusive and does not require on-going contact with a researcher or an intervention facilitator. The previously reported beneficial effects of the gratitude diary intervention, coupled with its ease of use, establish it as a practical and theoretically sound choice for use in the current study.

The diary used was adapted from the Counting Your Blessing work conducted by Emmons and McCullough (2003). Diary instructions emphasise the importance of participants *truly feeling* grateful for items they list in their diaries. This emphasis is in place to elicit a truly grateful response each time participants use their diaries. There is no way to ascertain whether such grateful feelings arise during diary use but the emphasis aims to increase the likelihood of this occurring. The importance of participants choosing their own sources of gratitude when using the diary is also highlighted. Participants are not required to work within predetermined parameters and although a variety of examples are given in the instructions to aid participants, these are provided solely as a guide. Additionally participants are instructed that it is

not essential to write something each day if they find it difficult to do so. As well as upholding participants' entitlements, this reflects the necessity for the contents of the diary to truly elicit gratitude. Recording items for which participants do not feel genuinely grateful would defeat the purpose of the intervention. See Appendix B for diary instructions.

In addition to the gratitude diary, a gratitude reflection is included in the intervention. Grateful reflection or contemplation has previously demonstrated positive effects on well-being (Rash et al., 2011; Watkins et al., 2003). Lyubomirsky et al., (2006) suggest that this may be due to the increased beneficial effects of thinking about positive experiences versus writing about them. However, Lyubomirsky et al. (2006) focused on differences between positive and negative experiences, rather than gratitude, thus interpretations of this finding are limited in the context of gratitude. Inclusion of the gratitude reflection in the current intervention therefore allows an examination of its effects on well-being.

The researcher developed the text for the gratitude reflection for the purposes of this study (see Appendix C). This goes beyond the instructions of the gratitude diary and actively guides participants in thinking about the things they are grateful for. The guided audio for the reflection focuses on bringing people's awareness to the feeling, meaning, effect and experience of what they are grateful for. Two experiences or sources of gratefulness are focused on to develop an intervention of comparable duration to the mindfulness Body Scan in the mindfulness intervention, and to avoid redundancy or boredom resulting from including more sources. The overall length of

the gratitude reflection audio is 6 minutes 43 seconds. Taken together, both elements of the intervention take approximately 10-15 minutes to complete.

5.1.2 Mindfulness Intervention

Development of the mindfulness intervention was also guided by a thorough review of the literature. Potential issues with existing mindfulness interventions, such as MBSR and MBCT, including time commitments and social components are discussed in full in Chapter 2. As a result of these, a shorter format intervention was developed for at-home use; this is supported by previous research demonstrating the usefulness of shorter duration mindfulness interventions (Carmody & Baer, 2009).

The mindfulness meditation used in the study is the guided Body Scan. As discussed in Chapter 2, the Body Scan is often taught at the beginning of mindfulness practice (Carmody, 2009), and involves individuals focusing and directing awareness to the breath and progressive sections of body. The ability to shift awareness between aspects of the body and back to the breath is an inherent part of the Body Scan. The instructions for the Body Scan were adapted, with permission, from those developed by Oystein Vorland, (www.meditation-techniques-for-happiness.com). Instructions were adapted from the original to direct participants' attention from one part of the body to another in a more fluid manner, as it is important that participants gain a sense of coherence in the awareness of their bodies. Thus, attention is directed from the toes up through the body to the top of the head, with a focus on the whole body toward the end of the audio. See Appendix D for Body Scan instructions. The guided Body Scan used is 9 minutes and 19 seconds

in duration. This is longer than the gratitude reflection audio but, due to the nature and content of each intervention, this difference in duration could not be reduced further.

In addition to the Body Scan, a mindfulness diary was included in this intervention. This increases the comparability of the mindfulness intervention with the gratitude intervention, and allows for an investigation of the usefulness of a previously unexamined form of mindfulness intervention. Instructions for the mindfulness diary focus on simply recording thoughts, feelings and sensations as they occur, without elaborating on them; see Appendix E. The importance of recording these stimuli without dwelling on them arises from the non-elaborative, non-judgmental focus on moment-to-moment stimuli, which characterizes mindfulness practice (Baer, 2003). As with the gratitude diary, participants are informed that they do not need to complete the diary every day if they are experiencing difficulty doing so. Unlike the gratitude diary it is expected that participants will experience less difficulty completing this diary, as thoughts, feelings and sensations can be considered more readily accessible. Together the components of the intervention take 10-15 minutes to complete.

5.1.3 Practical Considerations

A number of practical considerations also guided intervention development. As already noted, elements of each intervention were designed to increase comparability; these were the Gratitude Reflection and the Mindfulness Diary. Comparing the efficacy of two distinct actions, listening in the form of a guided

mindfulness meditation versus writing in the form of a gratitude diary, would have proved neither useful nor informative in the current study. The nature and features of these components, in isolation, are dissimilar to each other. Thus including the two new components in each intervention increases the comparability of the interventions and allows for a more appropriate approach to assessing which intervention is most efficacious. As the interventions developed for use in the current studies are novel, the aim of the pilot study is to assess the duration of the interventions necessary to have an effect on levels of gratitude, mindfulness, positive affect and negative affect. An additional aim is to evaluate usability of the interventions. This will allow an evaluation of the usefulness and requisite length of the interventions for improving well-being.

5.2 Methods

5.2.1 Participants

The participants for the pilot study were 10 females, aged 23 to 40 (*M*= 26.6, *SD*= 4.88). A convenience sample, recruited in person by the researcher, was used. Seven of these participants were in postgraduate education, and one participant was in undergraduate education, in University College Cork. The remaining two participants were not in higher-level education; one of these participants was in fulltime employment, the other participant was a stay-at-home mother of two children.

5.2.2 Materials

5.2.2.1 Interventions. Gratitude intervention participants used the gratitude diary and grateful reflection audio. Paper-format diaries were used, which contained instructions for listing up to 5 things daily that elicited gratitude. The guided Grateful Reflection audio was emailed to participants.

Mindfulness intervention participants used the mindfulness diary to list thoughts, feeling or sensations experienced in the current moment. The diary was identical to the gratitude diary with the exception of the instructions for use. The guided Body Scan meditation was also emailed to all participants.

Both audio interventions were recorded in the School of Applied Psychology, using a Sony Voice Recorder, Model No ICD-UX200. The voice recordings for each intervention were conducted in a single sitting by a trained voice artist, Ms. Fiona

Lucia McGarry. The background music for the interventions, *Svalbard*, was written by Ken Cremin and is available online at http://kencremin.bandcamp.com/. This music was not composed for the purpose of this study but written permission was obtained for its use. The sound editing program Audacity® was used to combine the audio and music for each intervention to create audio interventions of suitable quality. This involved combining spoken and music elements of each intervention and adjusting the lengths and volume levels of each component until an audio clip of suitable audio quality was created.

5.2.2.2 Measures.

Gratitude Questionnaire (GQ-6; McCullough, Emmons & Tsang, 2002). This is a 6-item scale, which assesses the grateful disposition using items such as "I have so much in life to be thankful for". Items are rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The GQ-6 has good discriminant and convergent validity. It also has an internal consistency coefficient of .82 (McCullough et. al., 2002).

Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003). This is a 15-item scale assessing the mindful disposition that uses a 6-point Likert scale ranging from 1 (almost always) to 6 (almost never). Items include "I find it difficult to stay focused on what's happening in the present" and "I rush through activities without being really attentive to them". The MAAS has been found to have an

internal consistency coefficient of between .82 and .87; it also has good test-retest reliability (Brown & Ryan, 2003).

Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988). The PANAS consists of two 10-item scales, designed to assess positive and negative affect. Participants are asked to indicate the extent to which they have experienced twenty different emotions over a specified period of time. Positive emotions include "excited" and "strong"; negative emotions include "afraid" and "nervous". Items are rated on a 5-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). The positive affect scale has previously demonstrated an internal consistency of between .86 and .90; the negative affect scale has internal consistency of between .84 and .97 (Crawford & Henry, 2004).

Intervention use. Participants were invited to respond to questions assessing how often they used the intervention in the last week, whether they used both intervention components equally, and if not, which component they used more frequently. Participants were asked if they found the intervention easy to use, to provide reasons they did or did not enjoy doing the intervention, and if they had any suggestions for improvements.

5.2.3 Procedure

Ethical approval was obtained from the Ethics Committee of the School of Applied Psychology. All participants were informed of the aims of the study, confidentiality of responses and their right to withdraw at any stage of the study and

all participants provided written informed consent before study commencement. Further, participants were informed that the pilot study would last maximum 8 weeks but that it may finish before then. As the main aim of the pilot study was to evaluate intervention duration it was decided that once a sustained improvement in well-being was observed, the study would finish.

Ten participants were recruited and randomly assigned to either the mindfulness or gratitude intervention group. Randomisation was conducted by flipping a coin; when 5 participants had been allocated to one condition the remaining participants were automatically allocated to the other condition. Participants were provided with information leaflets and a paper-format diary relevant to their intervention condition. Participants also received a web link to the online study questionnaire, and the audio component of the intervention. Participants used their intervention 4 times a week, on Sunday, Monday, Wednesday and Thursday, for 6 weeks. Participants completed baseline (Time 1) self-report measures before commencing the intervention. For the remainder of the study, participants completed the self-report measures each Monday. From Time 2, this questionnaire included questions about intervention use.

Two participants did not provide full, weekly data and so were excluded from analysis. This left 4 participants in each condition.

5.2.4 Approach to Analysis

Due to the sample size used in the current pilot study, inferential statistics are not appropriate. Instead, the trends of the means on outcome measures for each group were examined to determine the necessary length of the interventions. A change in

the levels of outcome measures in the expected directions that were maintained or continued to increase over a period of 2 weeks, were considered adequate as a marker of intervention length. It was expected that the mindfulness and gratitude interventions would increase levels of mindfulness and gratitude respectively, over time. Thus changes in levels of mindfulness and gratitude were evaluated. Changes in levels of positive and negative affect were also assessed to determine if the interventions influenced well-being. It was hypothesised that gratitude, mindfulness and positive affect would increase over time and that negative affect would decrease.

5.3 Results

The aim of this study was to evaluate the duration necessary for the mindfulness and gratitude interventions. Intervention duration was considered sufficient when trends of the means indicated changes in the expected directions that continued or were maintained for 2 weeks or longer.

5.3.1 Gratitude Levels

An examination of changes in gratitude levels, for both the gratitude and mindfulness interventions, was conducted initially. See Table 2 for mean gratitude values over time.

Table 2

Means and Standard Deviations for Gratitude by Intervention Condition

	Mindfulness		Gratitude	
	M	*SD*	*M*	*SD*
Time 1	32.50	5.07	34.75	5.56
Time 2	30.75	1.89	33.50	5.80
Time 3	30.50	2.65	35.50	5.80
Time 4	34.25	2.99	36.00	4.55
Time 5	34.50	2.38	36.00	5.66
Time 6	34.00	1.41	35.50	6.61

As seen in Figure 1, participants in the gratitude and mindfulness interventions demonstrated slight increases in gratitude levels during the study. A decrease was observed from Time 1 (baseline) to Time 2, with a slight decrease also occurring

between Time 5 and Time 6. Similarly, mindfulness participants demonstrated an initial drop in gratitude levels from Time 1 to Time 2. This decline was followed by a subsequent increase, and then a slight decline in gratitude levels again between Time 5 and Time 6. Mindfulness intervention increases were unexpected, as increasing gratitude levels was not an explicit aim of the mindfulness intervention condition. However, as demonstrated in Table 1, the magnitudes of these changes were minimal.

Both intervention conditions demonstrate similar patterns over time, with increases by Time 6. Time 5 demonstrates the highest level of sustained gratitude for the mindfulness group although, as stated, increasing gratitude was not an intended outcome of this intervention. For the gratitude intervention condition, times 4 and 5 demonstrate the highest levels of sustained gratitude.

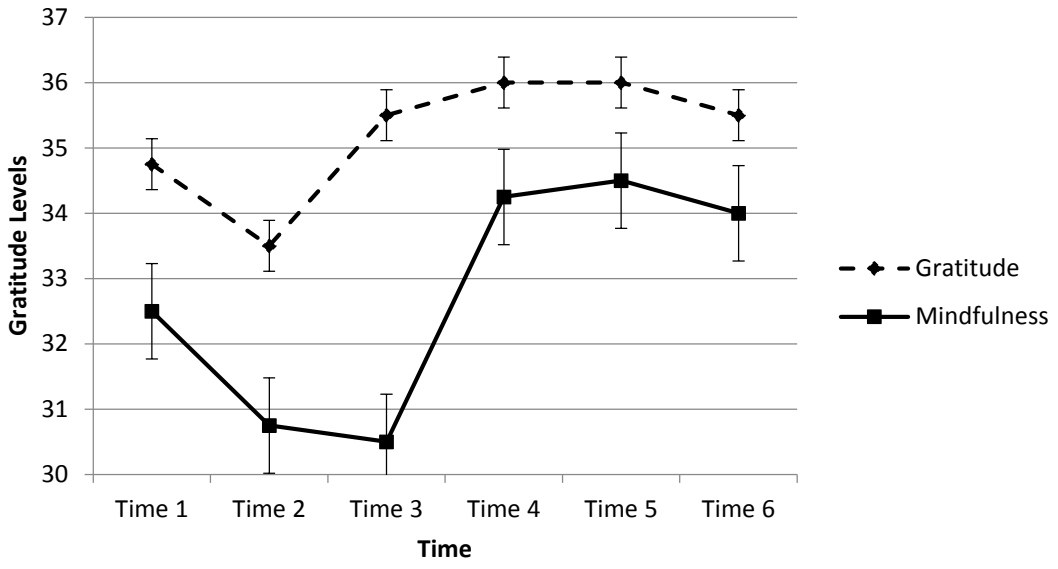

Figure 1. Gratitude and mindfulness participants' gratitude levels across 6 time periods.

5.3.2 Mindfulness Levels

Changes in mean mindfulness levels over time were also examined for the mindfulness and gratitude conditions (see Table 3).

Table 3

Means and Standard Deviations for Mindfulness by Intervention Condition

	Mindfulness		Gratitude	
	M	*SD*	*M*	*SD*
Time 1	3.28	0.56	3.77	1.19
Time 2	3.17	0.34	3.93	0.85
Time 3	3.42	0.39	4.19	1.21
Time 4	3.53	0.60	4.55	0.95
Time 5	3.61	0.42	4.55	1.00
Time 6	3.75	0.31	4.53	1.03

As seen in Figure 2, mindfulness intervention participants demonstrated an initial decline in mindfulness levels from Time 1 to Time 2. Following this, slight increases in mindfulness levels were observed across the remaining time points. Levels of mindfulness in the gratitude intervention condition demonstrated a small increase from Time 1, which began to level off from Time 4 onwards. The magnitude of these changes were also minimal but do provide an indication of mindfulness patterns.

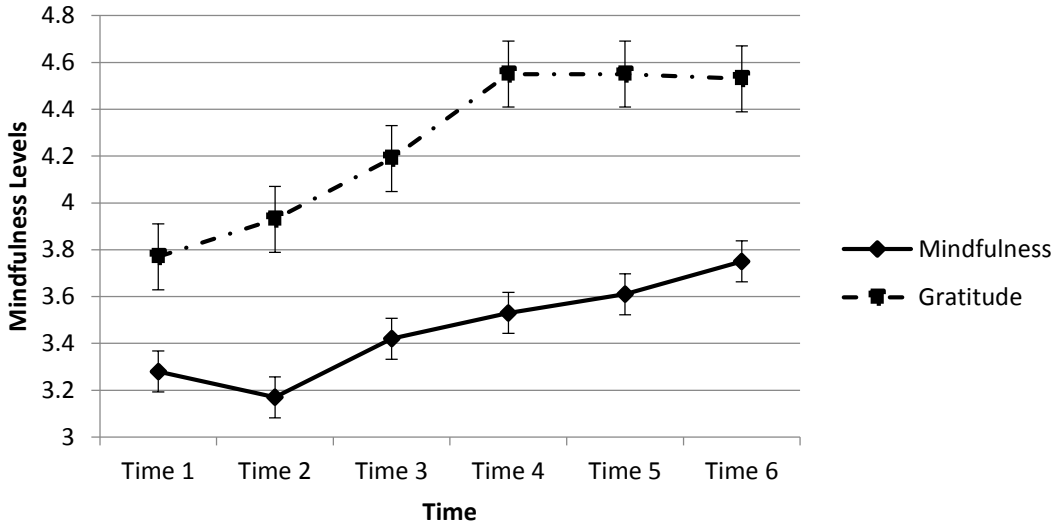

Figure 2. Gratitude and Mindfulness participants' mindfulness levels across 6 time periods.

5.3.3 Positive Affect

To examine intervention effects on well-being, changes in levels of positive affect over time were examined, see Table 4.

Table 4

Means and Standard Deviations for Positive Affect by Intervention Condition

	Mindfulness		Gratitude	
	M	*SD*	*M*	*SD*
Time 1	26.50	5.07	34.50	5.56
Time 2	31.50	1.89	33.00	5.80
Time 3	28.50	2.65	38.50	5.80
Time 4	33.25	2.99	37.00	4.55
Time 5	29.25	2.38	36.25	5.66
Time 6	29.75	12.61	34.75	2.22

The gratitude condition demonstrated an initial decrease in levels of positive affect, followed by an increase from Time 2 to Time 3 (See Figure 3). This was followed by a decrease in positive affect from Time 3; levels of positive affect at Time 6 remain just above baseline. Mindfulness condition participants demonstrated an unusual pattern of positive affect over time; alternating increases and decreases were observed from baseline to Time 5. Despite the fluctuating pattern observed, levels of positive affect at Time 6 are higher than baseline levels. Overall, both conditions demonstrate a slight increase in positive affect from Time 1 to Time 6 although patterns are inconsstent and changes are small. The highest levels of positive affect are observed at Time 3 for the gratitude condition and at Time 4 for the mindfulness condition.

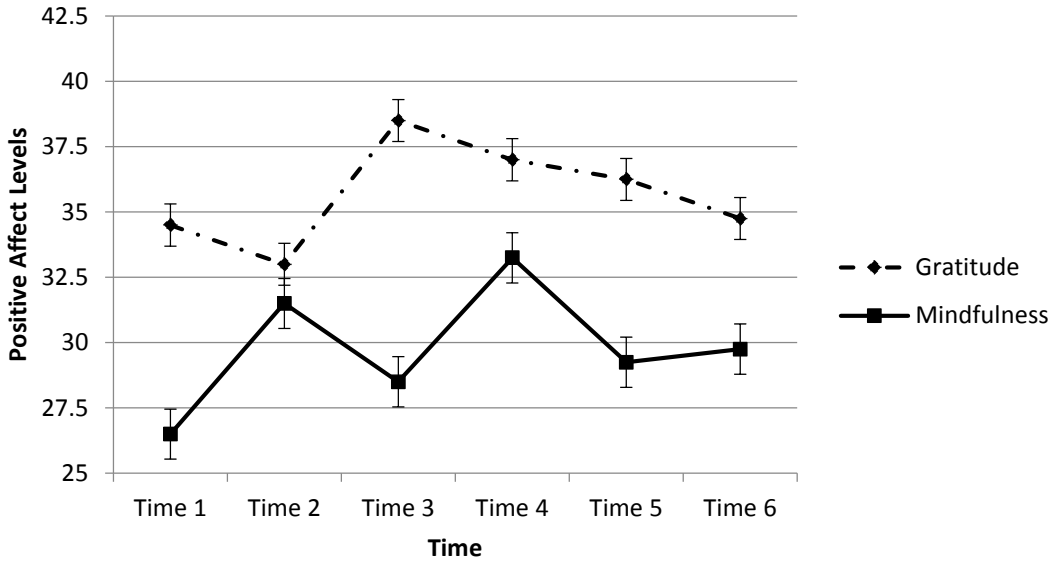

Figure 3. Gratitude and Mindfulness participants' positive affect levels across 6 time periods.

5.3.4 Negative Affect

Changes in levels of negative affect over time were also examined for both intervention conditions (see Table 5).

Table 5

Means and Standard Deviations for Negative Affect by Intervention Condition

	Mindfulness		Gratitude	
	M	*SD*	*M*	*SD*
Time 1	30.00	5.07	18.25	5.56
Time 2	29.75	1.89	17.50	5.80
Time 3	26.75	2.65	15.50	5.80
Time 4	25.75	2.99	15.25	4.55
Time 5	26.00	2.38	15.25	5.66
Time 6	28.00	5.10	17.25	5.19

Participants in the mindfulness condition demonstrate small decreases in levels of negative affect over time, with a slight increase between Time 4 and Time 6 (See Figure 4). Participants in the gratitude condition also demonstrate a slight decrease in levels of negative affect across the first 5 time points, with an increase from Time 5 to Time 6. Overall, participants' lowest levels of negative affect are reported at Time 4 for both conditions; levels of negative affect in the gratitude condition remain stable from Time 4 to Time 5. Despite a difference in baseline levels of negative affect between the conditions, and minimal evidence of substantial change in negative affect, both groups demonstrate the same trajectory over time.

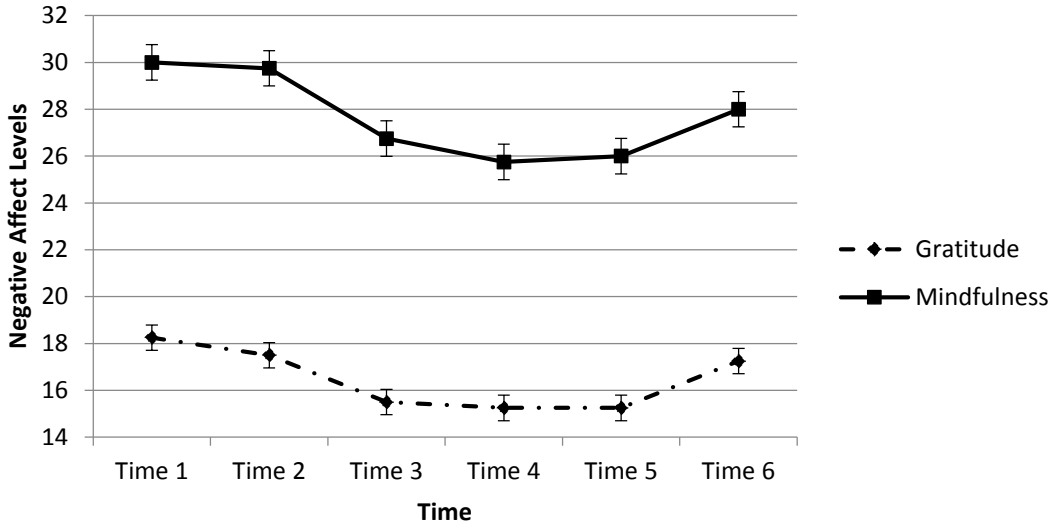

Figure 4. Gratitude and Mindfulness participants' negative affect levels across 6 time periods.

5.3.5 Intervention Use

Engagement with, and use of, the interventions was also examined. As seen in Table 6, frequency of intervention use was comparable between the two intervention groups.

Table 6

Frequency of Intervention Use by Intervention Condition.

	Gratitude	Mindfulness
	M(*SD*)	*M*(*SD*)
Time 2	2.75(0.96)	3.20(0.96)
Time 3	3.50(0.58)	3.00(1.15)
Time 4	3.00(0.82)	3.25(0.96)
Time 5	3.00(1.41)	2.75(0.50)
Time 6	3.50(0.58)	2.75(0.50)
Total use	18.00(4.24)	17.50(3.41)

Further information about participants intervention use is presented in Table 7. Participants in both groups did not use the intervention components equally, the majority derived some enjoyment from the intervention, and most participants found the intervention easy to use.

Table 7

Participant Feedback on Intervention Use

	Gratitude (*n*)	Mindfulness (*n*)
Equal component use		
Yes	1	1
No	3	3
Component most used		
Diary	3	2
Audio	1	2
Enjoyed intervention		
Kind of enjoyed it	2	2
Enjoyed it	2	1
Neutral	0	1
Intervention easy		
Yes	3	3
No	1	1

5.4 Discussion

The aim of this study was to evaluate the duration of the mindfulness and gratitude interventions required to influence levels of the outcome variables. The usability of each intervention was also assessed.

5.4.1 Intervention Duration

The trends of the means for gratitude, mindfulness, positive affect and negative affect were examined to assess appropriate intervention duration. The criterion for intervention length was an observed change in levels of the outcome measures that was maintained or continued in the expected direction for at least 2 weeks.

Changes in levels of the outcomes variables were small, indicating no real change in well-being levels; the lack of inferential statistics in the current study further limits the ability to evaluate the meaningfulness of any changes. Despite this, examining the trends of the data provides useful information for further intervention development. In the gratitude intervention condition, gratitude levels demonstrated a sustained increase from Time 1 to Time 5, with a peak at Time 4 (3 weeks). This indicates that 3 weeks is an appropriate duration for the gratitude intervention for maximum effect. Mindfulness participants' levels of mindfulness demonstrated a sustained increase from Time 2 onwards, supporting the usefulness of a 3-week mindfulness intervention. A peak in mindfulness levels was observed at Time 6 (5 weeks) for the mindfulness condition but participant feedback suggests an increased time burden and potential for attrition with this duration. As a result, a more

conservative estimate is taken, particularly as 3 weeks of intervention use demonstrates a sustained change in both mindfulness and gratitude levels.

Patterns of positive affect are inconsistent with no maintained or continued changes in the expected directions observed during the study. Despite this, gratitude participants' levels of positive affect peak at Time 3 and levels of positive affect for mindfulness participants peak at Time 4. Levels of negative affect in the gratitude and mindfulness conditions are lowest at Time 4.

The patterns observed in all measures therefore indicate that a relatively short intervention demonstrates slight changes in levels of mindfulness, gratitude, positive affect and negative affect. Utilising the criterion that changes in outcome variables be sustained over a 2 week period, 4 time periods is a sufficient and appropriate length for the interventions. Thus, the intervention duration for both mindfulness and gratitude, will be 4 time periods or 3 weeks. This duration is in keeping with existing gratitude intervention research (Wood et al., 2010) but is considerably shorter than the majority of mindfulness interventions examined in the empirical literature (Keng et al., 2011). These findings lend some support to the idea that regular mindfulness practice is a more important component of mindfulness than the session requirements common in existing interventions (Carmody & Baer, 2009; Vetesse et al., 2009).

5.4.2 Intervention Effects

Despite consistent evidence for the required duration of the interventions in the current study, the significance of changes in outcome measures is not statistically

examined due to the small sample size used. Previous research has consistently found significant positive effects of gratitude (Wood et al., 2010) and mindfulness (Keng et al., 2011) on well-being. In the current study changes were observed for gratitude and mindfulness levels in both intervention conditions over time. Interestingly, participants in both conditions demonstrated some, albeit minimal, increases in levels of the outcome measure for the alternative intervention. When engaging in a mindfulness intervention one's attention is thought to become more focused on the present moment (Baer, 2003), facilitating a broadening of awareness. This may result in an increased or broadened awareness of things that elicit gratitude, thus increasing levels of gratitude. Similarly, participants in the gratitude condition may experience a shift in attention due to the refocusing of attention toward things they are grateful for. This may result in a broader awareness of thoughts, feelings and emotions that occur, which would explain gratitude participants' maintained increase in mindfulness levels over time. If this is the case, future research should investigate the mechanisms by which these interventions have an effect.

In addition to elucidating how certain aspects of gratitude and mindfulness interventions may operate, these findings also provide support for the "shotgun approach" proposed by Sin & Lyubomirsky (2009). This approach suggests that incorporating a number of forms of interventions in one may prove beneficial, which appears to be the case in this study. Despite these positive indications, participant feedback must also be accounted for when considering implementing these interventions in future work.

5.4.3 Intervention Use

It was found that the majority of participants reported not using both components of the intervention equally. In the mindfulness condition, preference for the diary and audio components was evenly distributed among participants. Using the mindfulness diary more frequently than the audio could be problematic *if* the Body Scan is considered to be the main active component of the intervention. This may not be the case however, as the diary requires a focus on thoughts, feelings and sensations in the current moment. It thus involves a focused direction of awareness, which is one of the core elements of mindfulness (Carmody, 2009), and was an important reason for including the mindfulness diary in the mindfulness intervention. Additionally, one participant stated that they felt the diary was useful for increasing awareness, even in the absence of the audio. It is possible that listing your thoughts, feelings and sensations in the current moment creates a similar and/or equivalent effect to the meditation.

In the gratitude condition, the main preference was for diary use; 3 out of 4 participants reported using the gratitude diary more frequently than the gratitude reflection. The preference for the diary element is not entirely surprising as this element is one of the main focuses of existing gratitude intervention research (Wood et al., 2010). It does raise questions about the usefulness of the gratitude reflection audio, particularly as participants reported it to be repetitive and boring. Similar instructions are used in the audio for focusing on two separate sources of gratitude; this repetition may have deterred participants from fully engaging with the intervention.

In addition to influencing intervention use, the 'boring' nature of the gratitude audio was expressly stated as a reason for not fully enjoying the intervention. Similarly, in the mindfulness condition, the length of the mindfulness audio was cited as a reason for reduced enjoyment. Not all participants found these aspects boring but it is interesting that this criticism was directed solely at the audio components of the intervention and not the diaries. Participants in both groups stated that the diaries were the most useful aspects, although this was not universally reported in the mindfulness condition.

In both intervention conditions participants felt that the requirement to complete the intervention 4 times a week led to it feeling like a chore. This is problematic as it could increase attrition rates in future research, particularly studies utilising longer interventions. However, intervention duration will be half that of the pilot study (3 weeks versus 6 weeks) in the larger RCTs and so this chore-like aspect may not be as prevalent. Additionally, completing the intervention 4 times a week was specified in the instructions with the awareness that not all participants would use the diary 4 times during the week. Poor protocol adherence is a common problem in longitudinal controlled trials (Dawes, 2005; Hall et al., 2011; Johnson & Remien, 2003; Larson et al., 2009) and so participants were expected to use the intervention 2 to 3 times a week. This frequency is supported by Emmons and Mishra (2012), who state that less frequent intervention engagement can result in greater effects than more frequent use. This may be due to a minimisation of participant burden or fatigue when using the intervention. Participants in the current study did report using their interventions the full 4 times and this may have led to a reduction in enjoyment.

Shortening the amount of intervention practices however, could increase the risk of participants using their interventions significantly less than is needed to create an effect. A provision is made in the instructions for occasional reductions in frequency of intervention use, which may alleviate potential participant burden (See Appendices B and E); this aspect of the instructions could be made more prominent.

Two participants, one from each condition, found the intervention difficult to complete. One participant found the audio tiresome, which influenced her motivation to use it. The other participant found it difficult to find time to be alone and complete it. Both of these participants had young children and it is possible that this may have influenced their engagement and perceived usability of the interventions. Existing commitments and lack of time to engage with intervention protocols are commonly posited as reasons for poor trial adherence (Dawes, 2005). Therefore existing commitments, such as already having children, could be considered a factor in whether or not participants engage with the intervention.

Despite these issues, participants reported enjoying the intervention overall; only one participant self-reported neutral on this. Reasons stated for enjoying the intervention included that it allowed time to pause and reflect on positive experiences; that the act itself was enjoyable; and that aspects of the intervention practice carried over to real-life stressful situations and proved useful in dealing with them. However, there were a number of suggestions for how enjoyment, utility and appeal of the interventions could be improved. In terms of practical aspects, one participant suggested making the intervention available online and adapting it for mobile devices. A research website will be in place for the RCTs; this will contain

the interventions and questionnaire, and will be accessible via mobile devices. This has the potential to increase usage and engagement with the interventions and will provide an accurate measure of adherence, in terms of how frequently participants use and engage with the intervention.

A further reason for situating the interventions online is that funding restricts the ability to produce large volumes of good quality, paper-format diaries. Production of low quality diaries is not advisable, as this could reduce participant interest and subsequent use of the intervention. In an examination of recruitment of prenatal mothers to a longitudinal trial for instance, Wardle et al. (2010) found that attractive presentation of information and resources improves participant recruitment; this may also apply to participant retention. In the current study, developing an attractive, user-friendly online diary is significantly more cost-effective. A similar issue arises when considering distribution of the audio components of each intervention. Using an online format, both audio components can be presented in an online location, accessible at any time. Alternatives, such as creating individual CDs for participants, would be too costly and increases the likelihood that participants could misplace this aspect of the intervention. The same is true of the diaries. Thus, the online forum for both components of each intervention overcomes what could otherwise be significant practical implications.

Shortening the length of the audio for both conditions was suggested; for instance it was suggested to remove the gratitude audio. Halving the length of this audio may be more appropriate; participants would then only reflect on one thing they feel grateful for and the audio would last less than 5 minutes. In the mindfulness

condition, participants also suggested shortening the audio, particularly in terms of flow and refocusing attention on various aspects of the body. An additional recommendation specific to the mindfulness audio was to allow more freedom in when the intervention is completed. Guidelines for completion are provided in participant instructions but more freedom of completion time could be emphasised.

Additional feedback indicated that participants often forgot to do the intervention at the appropriate time or at all. Forgetting to do the intervention would be problematic if it were frequent and recurrent across participants. Ways to account for this would be to send email and/or text reminders to participants to complete the intervention. Another approach would be to assess how often participants used their diaries, although this is open to response bias. For this reason, the online nature of the interventions in future research will be invaluable, as it will provide an objective measure of how engaged participants are with the intervention by recording times and dates of intervention completion.

5.4.4 Conclusion

In conclusion, the findings of this pilot study indicate that 3 weeks is an appropriate duration for the mindfulness and gratitude interventions in future research. The interventions demonstrate expected patterns of change for mindfulness, gratitude and negative affect; tentative support for usefulness with positive affect is found. Based on participant feedback it is necessary to revisit the audio aspects of both interventions with a view to improving them. This will involve shortening and rerecording the audio for both groups. Shortening the length of the

audio has the potential to decrease the likelihood of high attrition rates and to increase the accessibility of the intervention to a greater number of people. Given the findings of this pilot study, the interventions and instructions will be clarified and adapted, and the interventions will be used for a period of three weeks in the RCTs.

Chapter 6

Study 3: Gratitude, Mindfulness and Well-Being Study

Findings of Study 1 (Chapter 3) and Study 2 (Chapter 5), in addition to the review of the literature presented in Chapter 2, highlight the potential benefits of mindfulness and gratitude for psychological and physical well-being. While previous research has demonstrated relatively consistent findings of mindfulness and gratitude research for self-report outcomes, less research has been conducted on biomarkers of well-being. The inconsistencies found in previous examinations of mindfulness effects on cortisol (O'Leary et al., 2015) indicate the need to utilise robust research protocols when examining the effects of positive psychological interventions on cortisol levels. Thus, these findings will be incorporated in the current study, which aims to examine the effects of the mindfulness and gratitude interventions on psychological and physiological well-being in a non-pregnant group. This examination will enable a more rigorous and well-informed examination to then be conducted with a pregnant group.

6.1 Hypotheses

It is hypothesised that the gratitude and mindfulness interventions will enhance psychological and physiological well-being in a number of ways:

1. Both interventions will increase perceived social support, life satisfaction, happiness, positive affect, and sleep quality in comparison to a control condition.
2. The interventions will reduce self-reported levels of depression, stress and negative affect, in comparison to a control condition.
3. The interventions will optimise cortisol functioning, in comparison to a control condition. Changes will presumably be observed as reductions in cortisol levels as the study will use a general healthy population.
4. Changes in well-being will differ in magnitude between the intervention groups.
5. Changes in well-being will be mediated by increases in gratitude and mindfulness in the gratitude and mindfulness interventions respectively.

6.2 Method

6.2.1 Participants

Study participants (*N*=62) were women aged 18 to 46 years (*M*= 28.35, *SD*=6.65). Participants were required to be female, over 18 years of age and able to communicate in English. They were also required to not be currently pregnant, to not have received a diagnosis of depression, anxiety or other well-being issues in the last 2 years or to currently be taking asthma or thyroid medication. These factors can impact on observed cortisol levels.

6.2.1.1 Sampling and recruitment. An initial minimum sample size of 175 was calculated using power calculations with G*Power 3 (Faul, Erdfelder, Lang & Buchner, 2007). Calculations were conducted for a mixed between-within subjects design; estimates of effects were derived from previous work on the effect of a brief mindfulness intervention with pregnant women (Vieten & Astin, 2008), as the overall aim of the research is to establish intervention efficacy with this group. Vieten and Astin (2008) reported moderate to large effects (Cohen's d = 0.70) on several aspects of wellbeing including anxiety and positive affect. However, intervention effects on cortisol levels are expected to be low to moderate (Cohen's d = 0.30), and so a conservative power analysis approach was adopted. Results of this analysis indicated that a sample size of 35 per group is sufficient to detect a 15% difference in cortisol, with a 45% change in aspects of wellbeing with a power level greater than .95, and alpha at 0.05.

Participant recruitment was conducted using internal email services in University College Cork for all registered students (*n*=18,000 approx.) and staff (*n*=2000 approx.). Recruitment posters were placed throughout the campus of University College Cork and in a number of locations in Cork City. Recruitment was conducted from April 2012 to December 2012 inclusive. During this time participants registered for the study via the research website registration form.

6.2.2 Design

This study used a mixed between-within subjects randomised control trial (RCT) design. The within-subjects independent variable was time, with 3 levels; baseline, Time 2 (3 weeks), Time 3 (5 weeks). The between subjects independent variable was experimental condition, with 5 levels. The dependent variables were mindfulness, gratitude, perceived social support, subjective happiness, satisfaction with life, positive and negative affect, perceived health, sleep quality, depression, perceived stress, and cortisol outcomes (CAR, waking cortisol, +30 minutes cortisol, AUC).

6.2.3 Materials

6.2.3.1 Self-report measures.

Participant characteristics. Participants provided details regarding age, nationality, religion, education level, relationship status, weekly disposable income, weekly hours worked, household structure and cigarette consumption.

Gratitude Questionnaire (GQ-6; McCullough, Emmons & Tsang, 2002). This 6-item scale assesses the grateful disposition using a 7-point Likert scale, ranging from

1 (strongly disagree) to 7 (strongly agree). Items include "*I am grateful to a wide variety of people"*. The GQ-6 has been found to have good discriminant and convergent validity and an internal consistency coefficient of .82 (McCullough et. al., 2002). In the current study the GQ-6 had an internal consistency coefficient of α=.61; the scale also demonstrated good test-retest reliability at 3 weeks (α= .80) and at 5 weeks (α= .71).

Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003). This 15-item scale assesses the mindful disposition using a 6-point Likert scale ranging from 1 (almost always) to 6 (almost never). Sample items include *"I rush through activities without being really attentive to them"* and *"I snack without being aware that I'm eating*". The MAAS has been found to have an internal consistency coefficient of between .82 and .87; it also has good test-retest reliability (Brown & Ryan, 2003). In the current study the MAAS had an internal consistency coefficient of .88, and demonstrated good test-retest reliability at 3 weeks (α= .89) and at 5 weeks (α= .91).

Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988). The PANAS consists of two 10-item scales, designed to assess positive and negative affect. Participants indicate the extent to which they have experienced twenty different emotions over a specified period of time, including feeling *"proud"*, *"inspired"*, *"afraid"*, and *"irritable"*. Items are rated on a 5-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). A recent psychometric evaluation found the positive affect scale to have internal consistency of between .86

and .90; the negative affect scale has internal consistency of between .84 and .97 (Crawford & Henry, 2004). In the current study the positive affect scale had an internal consistency coefficient of .89 and good test-retest reliability at 2 weeks (α=. 89) and 5 weeks (α=. 92). The negative affect scale had an internal consistency coefficient of .89 and good test-retest reliability at 3 weeks (α=.91) and 5 weeks (α=.91).

Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden & Sagovsky, 1987). This scale was initially developed for postpartum depression screening but has been validated in a wide variety of samples including men and non-childbearing women (Bergink et al., 2011). Ten items are rated on a 4-point scale; items 3, 5, 6, 7, 8 9 & 10 are reverse scored. Items include *"Things have been getting on top of me"* and *"I have felt scared or panicky for no very good reason"*. The EPDS has an internal consistency coefficient of .87 (Cox et al., 1987). In the current study the EPDS had an internal consistency coefficient of 82. Good test-retest reliability was also observed at 3 weeks (α=.88) and at 5 weeks (α=.88).

Perceived Stress Scale (PSS; Cohen, Kamarck & Memelstein, 1983). The PSS is the most widely used measure for perceived stress. It measures the extent to which individuals perceive situations in their lives as stressful. An example item is *"In the last month, how often have you felt nervous and "stressed"?"*. The 10 items of the scale are measured on a 5-point scale, from 0 (Never) to 4 (Very Often), with items 4, 5, 7 & 8 reverse scored. This scale has recently been found to have an internal consistency coefficient of .82 (Roberti, Harrington & Storch, 2006). In the current

study the PSS had an internal consistency coefficient of .90 and good test-retest reliability at 3 weeks (α=.92) and 5 weeks (α=.93).

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen & Griffin, 1985). This 5-item scale assesses satisfaction with life as a whole using a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Scale items include *"I am satisfied with my life"* and *"The conditions of my life are excellent"*. The SWLS has previously demonstrated good test-retest reliability and an internal consistency coefficient of .87 (Diener et al., 1985). In the current study the SWLS had an internal consistency coefficient of .85. The scale demonstrated good test-retest reliability at 3 weeks (α=.91) and 5 weeks (α=.91).

Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999). This is a 4-item scale that assesses subjective happiness using a 7-point Likert scale. Items 1 and 2 ask participants to characterise themselves using absolute ratings and ratings relative to peers. Items 3 and 4 ask participants to read statements describing happy and unhappy individuals and then rate how well they feel this characterises them. For instance one item asks, *"Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?"* The SHS previously demonstrated internal consistency coefficients ranging from .79 to .94 and has been found to have good convergent reliability and good test-retest reliability (Lyubomirsky & Lepper, 1999). In the current study the SHS had an internal consistency coefficient of α=.91; the

internal consistency coefficient at 3 weeks was α=.91 and at 5 weeks was α=.93, demonstrating good test-retest reliability.

Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet & Farley, 1988). This is a 12-item scale that assesses perceived social support, related to three subscales: family, friends and significant other. Items include "*My family really tries to help me*", and are rated on a 7-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). The MSPSS has a high internal consistency coefficient of α=.91, with coefficients of .90, .94 and .95 for the family, friends and significant other subscales respectively (Dahlem et. al., 1991). In the current study the MSPSS had an internal consistency coefficient of .90. The scale demonstrated good test-retest reliability at 3 weeks (α=.93) and 5 weeks (α=.93).

Jenkins Sleep Questionnaire (JSQ; Jenkins, Stanton, Niemcryk & Rose, 1988). This 4-item scale assesses participants' quality of sleep in terms of frequently of sleep difficulties over the previous month. These difficulties include having trouble falling asleep, trouble staying asleep, waking up several times per night and waking up after a usual amount of sleep yet still feeling tired. Items are rated on a 6-point scale, from 0 (Never) to 5 (22-31 days of the month). This scale has been found to have an internal consistency coefficient of .79 (Jenkins et al., 1988). In the current study the JSQI had an internal consistency coefficient of .83. It also demonstrated good test-retest reliability at 3 weeks (α=.80) and 5 weeks (α=.89).

6.2.3.2 Salivary cortisol measures.

Cortisol sampling procedure. Participants collected salivary cortisol samples at three sampling periods during the study: baseline, 2 weeks later and 4 weeks later. Participants were instructed to use the passive drool technique, allowing saliva to pool in the mouth and then collecting the saliva in a plastic Eppendorf ® 1.5ml lidded vial. Each sampling period lasted 3 consecutive days, with 9 days of saliva sampling in total during the study. Samples were collected 6 times per day at the following times: immediately on waking, 30 minutes after waking, 45 minutes after waking, midday, 6pm (18.00) and bedtime. See Figure 5 for daily collection times. Participants were instructed to rinse their mouth with water 10 minutes before all samples, except the waking sample; to avoid dairy 20 minutes before collection and teeth brushing 45 minutes before collection. They were also instructed not to eat a main meal 60 minutes before collecting samples or to smoke or drink alcohol 12 hours before sample collection. These factors can impact on cortisol concentrations and quality of collected samples. Participants were also required to record actual collection times on self-report time cards provided. In total, each participant was required to collect 54 saliva samples during the study. All samples were stored in storage collection bags in the participant's domestic freezer until study completion. At study completion, samples were collected from participants by the researcher. All samples were stored at -20C until assay.

Figure 5. Sample collection times.

Cortisol assay procedure. Once thawed, samples were centrifuged at 2000 x g at 10°C for 10 minutes. Cortisol levels were determined from saliva samples using a commercial enzyme-linked immunoassay (ELISA, Salimetrics, Suffolk, UK). For duplicate analysis, 100 µl of saliva were used, controls representing high and low salivary levels were included, and all values were averaged across assessments. Intra- and interassay coefficients of variation (CV) were 9% and 18.7%.

CAR response was calculated as the difference between +30 minutes and waking cortisol concentrations (Dressendorfer et al., 1992; Polk et al., 2005). Total morning cortisol secretion was calculated as area under the curve with respect to the ground (AUC_G) using the trapezoid formula (Pruessner et al., 2003)

6.2.3.3 Interventions. Two dual-component interventions were used in the current study; a gratitude intervention and a mindfulness intervention. Due to the dual-component nature of the interventions, order of component completion was counterbalanced. This resulted in two gratitude conditions (G1 and G2) and two mindfulness conditions (M1 and M2). All intervention conditions began the intervention on the week following baseline self-report and physiological measure

completion. They continued to use the intervention 4 times a week for 3 consecutive weeks.

Gratitude intervention. The gratitude intervention involved a guided online gratitude reflection and gratitude diary. In the G1 condition participants completed the gratitude reflection first, followed by gratitude diary. In the G2 condition, participants completed the gratitude diary first, followed by the gratitude reflection.

a) Gratitude diary: Participants completed their diaries by listing up to 5 things they were grateful for that day. All diary entries were automatically sent to the researcher via the research website. See Appendix B for gratitude diary instructions.

b) Gratitude reflection: Participants listened to a guided gratitude reflection, using audio provided on the research website. This involved participants reflecting on one experience for which they are grateful, that happened in the last 24 hours. The gratitude reflection lasted 3 minutes and 3 seconds. See Appendix F for Gratitude Reflection text.

Mindfulness intervention. The mindfulness intervention involved an online mindfulness diary and mindfulness body-scan meditation. In the M1 condition participants completed the mindfulness body-scan meditation first, followed by the mindfulness diary. In the M2 condition, participants completed the mindfulness diary first, followed by the mindfulness body-scan meditation.

a) Mindfulness diary: Participants completed their diaries by listing any thoughts, feelings or sensations they were experiencing in the present moment. See Appendix E for mindfulness diary instructions.
b) Mindfulness meditation: Participants listened to an online mindfulness Body Scan technique using audio provided on the research website. This involved guided focusing on the breath and progressive sections of the body. The mindfulness meditation lasted 5 minutes and 43 seconds. See Appendix G for the text of the mindfulness Body Scan.

6.2.3.4 Research website. A research website was developed by the researcher for the purposes of the study. The website had 6 distinct sections relating to each of the 5 experimental conditions, as well as a general information section. All potential participants initially accessed the study information, informed consent form and registration form, in that order, on the research website. Registration was completed online. Once registered and randomised to one of the five experimental conditions, participants were provided with a web address specific to their experimental condition. Each of these five webpages contained a link to the self-report questionnaire, information about collection of physiological measures, a link to the intervention (for participants assigned to an intervention group) and contact details for the researcher. Only the research team had access to details provided by participants on the research website.

6.2.4 Procedure

A small pilot test was conducted to investigate the intervention duration required to cause a positive and sustained increase in gratitude, mindfulness and well-being levels (see Chapter 4). The results of this pilot test indicated that 3 weeks was a suitable duration for intervention use in the main study.

Once participants registered for the study online they were randomly assigned to one of the five experimental conditions using restricted block randomisation. Blocks of 5 were used, as there are 5 experimental conditions, with a ratio of 1:1:1:1:1. Once randomised, participants received participant packs that contained collection kits for saliva samples, including time cards for recording saliva collection times. Packs also included a day planner outlining the duration of the study, an information leaflet reiterating the study description and a web address for the research website corresponding to the assigned experimental condition.

All participants began the study on a Monday by completing the online baseline self-report measures and collecting their first saliva samples. Saliva sampling was conducted for the first 3 days of the week (Monday, Tuesday, Wednesday). Intervention participants began using their online interventions the following week, on Monday, and continued to use them four times a week for 3 weeks. At 3 weeks (Time 2) and 5 weeks (Time 3) all participants again completed self-report measures on the Monday and collected saliva samples on the first 3 days of the week. See Figure 6 for trial flowchart. All participants received email reminders about saliva collection before each collection period. Intervention participants received an email reminder the day they were due to begin using their intervention.

Upon study completion all participants were given access to the alternative intervention to prevent denial of benefit. Participants in the control condition were given access to both interventions.

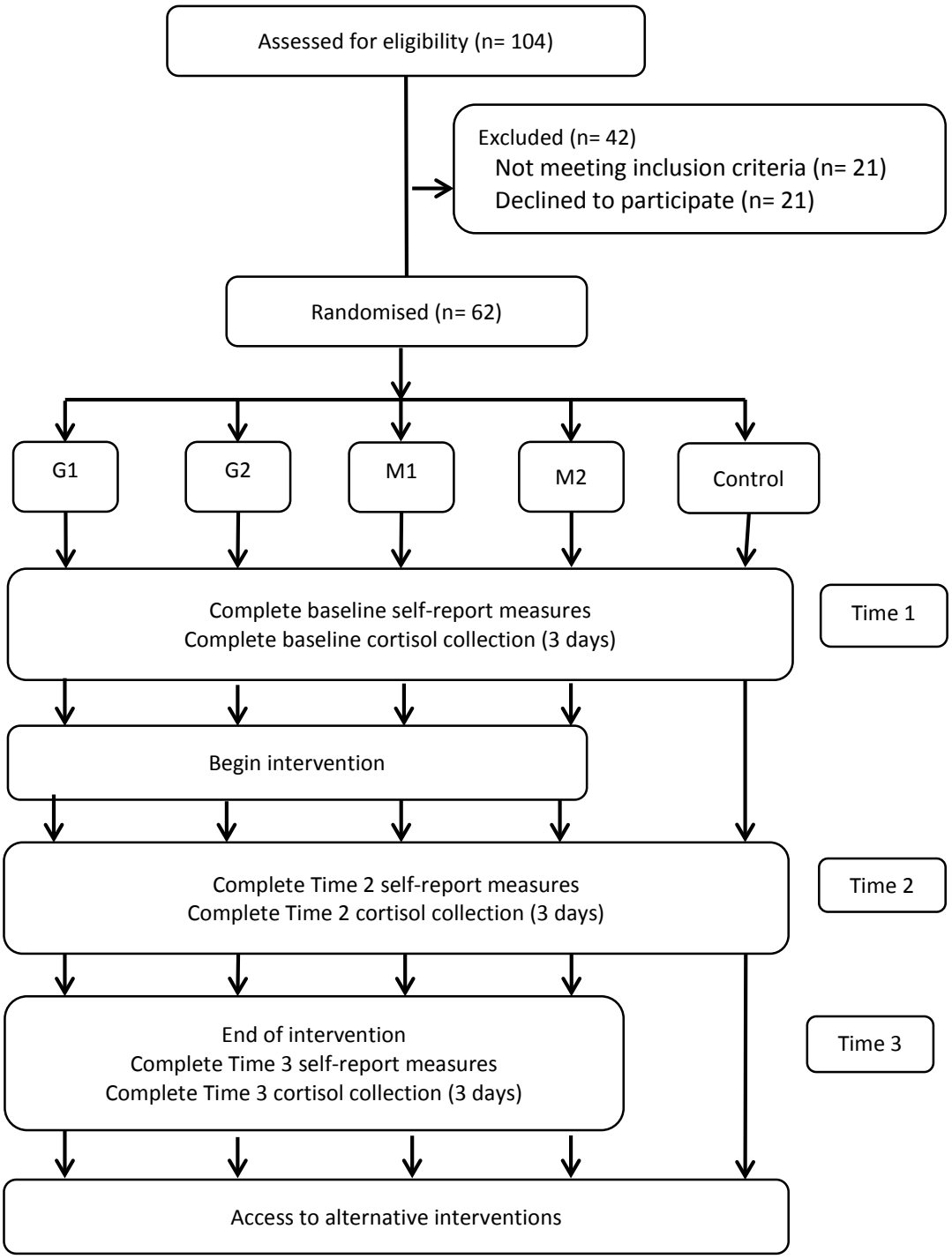

Figure 6. Gratitude, mindfulness and well-being RCT protocol.

6.2.5 Ethical Considerations

Informed consent. All participants received full information and consent forms on the research website; hardcopies of consent forms were available at the participant's request. These detailed the nature of the study, any potential risks or benefits, confidentiality issues and alternatives. Upon recruitment and randomisation, participants received this information again in the form of information leaflets in their participant pack. At each stage all participants were fully informed of their right to withdraw from the study at any time without consequence.

Confidentiality. All records and participant data were only accessible to the research team. Data from online questionnaires at each time point were entered into the SPSS statistical program on the researcher's computer for analysis. This information was stored on both an external hard drive and the researcher's computer. Data collected from the gratitude and mindfulness diaries were also stored on an external hard drive and the researcher's computers. Saliva samples were stored securely in the BioAssay laboratory in the School of Applied Psychology until analysis and data from this analysis were stored securely, as described above. Data stored electronically were stored in password-protected files, on password protected computers and external hard drives. Hard copy data were stored in locked cabinets in locked rooms in the School of Applied Psychology.

Denial of benefits. This relates to the fact that it is unethical to deny a control group access to any intervention, which may have beneficial effects (Psychological Society of Ireland, 2011). Denial of benefits does not occur in the current study as all groups are given access to the alternative interventions, and the control group are

given access to both interventions, upon study completion. Denial of benefits also relates to the ethical consideration of deceit, which did not occur in this study as all participants were given full information about the purpose of the study.

Ethical approval. Ethical approval was required and obtained from the Applied Psychology Research Ethics Committee (APREC) and the Research Ethics Committee of the Cork Teaching Hospitals (CREC).

6.2.6 Approaches to Data Analysis

Data analysis was conducted using SPSS Version 22.0 statistical program (SPSS Inc., Chicago IL). The data were examined for errors and completeness initially. Descriptive statistical analyses were then conducted.

Baseline differences between the experimental conditions were examined using a Chi-square test of independence for categorical demographic data, and Univariate between groups analysis of variance (ANOVA) for continuous demographic and baseline self-report measures.

A manipulation check was conducted to investigate the effects of the five experimental conditions on levels of the intervention constructs, gratitude and mindfulness. This was done using two 3x5 way mixed between-within subjects ANOVAs; gratitude and mindfulness levels at 3 times points were the dependent variables. Only data from participants who were fully compliant to the study protocol (n= 35) were included in this analysis. Potential effects of the experimental conditions on self-report outcomes were examined using a series of 5x5 way mixed-between within subjects ANOVAs. Differences in patterns of change over time

between intervention groups and within interventions based on the same construct were noted. When these occurred, a 3x3 way mixed-between within subjects ANOVA was conducted using three intervention groups; the control, a single gratitude group, and a single mindfulness group. This was done to establish if the differences in patterns of change over time were related to the construct used. Due to poor adherence to the cortisol sampling protocol, inferential statistics could not be conducted; an examination of trends of the means for participants in each condition was instead conducted.

Potential differences in participant intervention use were examined using a Chi-square test of independence. Factors influencing attrition were also examined; participant data were grouped according to time point completed and descriptive statistics were conducted for each group. Differences were investigated using Chi-square tests of independence for categorical variables; univariate between groups ANOVAs were conducted for continuous variables. The influence of randomisation to experimental condition on participant retention was also investigated using a univariate between groups ANOVA.

6.3 Results

6.3.1 Participant Characteristics

Preliminary descriptive analyses were conducted on the full dataset (*N*=62) to assess participant characteristics. Participants were predominantly Irish (80.6%).The majority were in a relationship, married or cohabiting (67.7%), had a post-secondary level of education (82.3%), and were non-smokers (74.2%). See Table 8.

Table 8

Descriptive Characteristics of Full Dataset (n=62)

	%	***n***	
Nationality			
American	1.6	1	
European	14.4	9	
Brazilian	1.6	1	
Irish	82.2	51	
Education			
Up to Leaving Cert	17.7	11	
Undergraduate degree	32.3	20	
Higher Diploma	19.4	12	
Masters	25.8	16	
Doctorate	4.8	3	
Relationship			
Single	32.3	20	
In a relationship	43.5	27	
Married	6.5	4	
Co-habiting	17.7	11	
Income			
Less than €10	1.6	1	
€10 to€50	32.4	20	
€50 to €100	30.7	19	
More than €100	32.3	20	
Smoke			
Yes	22.6	14	
No	74.2	46	
	M	***SD***	**Range**
Age	28.35	6.65	18-46
Work hours	26.65	16.95	0-60
Daily cigarettes	4.21	5.48	0-20
Number of people living with	1.9	1.34	0-5

Only participants who completed self-report measures at all three time points (*n*= 35) were included in subsequent inferential analyses. Participant characteristics for this group are shown in Table 9.

Table 9

Participant Characteristics of Sample Used in Inferential Examination (n=35)

	%	***n***	
Nationality			
European	19.9	7	
Brazilian	2.9	1	
Irish	77.2	27	
Education			
Up to Leaving Cert	17.1	6	
Undergraduate degree	31.4	11	
Higher Diploma	11.4	4	
Masters	34.3	12	
Doctorate	5.7	2	
Relationship			
Single	25.7	9	
In a relationship	48.6	17	
Married	5.7	2	
Co-habiting	20	7	
Income			
Less than €10	2.9	1	
€10 to€50	31.4	11	
€50 to €100	25.8	8	
More than €100	37.1	13	
Smoke			
Yes	17.1	6	
No	29	82.9	
	M	***SD***	**Range**
Age	27.91	6.96	18-46
Work hours	25.83	15.45	0-45
Daily cigarettes	4.79	7.65	0-20
Number of people living with	1.86	1.36	0-5

6.3.2 Differences between Experimental Conditions

Prior to examining intervention effects on outcome measures over time, potential differences between experimental conditions at baseline were investigated. Analyses were conducted to examine potential differences between the five experimental groups (G1, G2, M1, M2 and control), and between three experimental groups: a single mindfulness intervention, a single gratitude intervention, and a control condition.

6.3.2.1 Differences between five experimental groups. Chi-square tests for independence were conducted to examine differences between groups on categorical variables. Results indicated a significant difference was for nationality, χ^2 (32, *n*= 35) = 48.27, *p*=.03, phi= 1.17; the G1 condition had the highest proportion of Irish participants (25.7%); the M2 had no Irish participants. No significant difference was found for religion, χ^2 (28, *n*= 35) = 31.54, *p*=.29, phi= .95, or relationship status, χ^2 (12, *n*= 37) = 19.79, *p*=.07, phi= .75.

A series of one-way between groups ANOVA were also conducted to investigate potential differences for demographic variables and baseline levels of self-report well-being measures. Examinations of assumptions indicated that the assumption of homogeneity of variances was violated for satisfaction with life and negative affect at baseline; as a result, Robust Tests of Equality of Means are consulted for inferential statistics. No statistically significant differences were observed for any outcome variable, with the exception of cigarette consumption; see Table 10. The

control group (*M*=20.00, *SD*= 0) smoked more cigarettes daily than any other condition but this was attributable to a single person.

Table 10

Differences between Five Experimental Groups for Continuous Baseline Variables

Variable	*p*	ηp^2
Age	0.42	0.12
Work Hours	0.38	0.13
Cigarettes smoked daily	.046	0.97
Gratitude	0.20	0.17
Mindfulness	0.25	0.16
Satisfaction with Life	0.35	0.11
Happiness	0.44	0.06
Positive Affect	0.38	0.13
Perceived Social Support	0.63	0.08
Stress	0.82	0.10
Negative Affect	0.49	0.11
Sleep Quality	0.77	0.06
Depression	0.62	0.62

6.3.2.2 Differences between three experimental groups. Potential differences between the three experimental conditions on categorical, demographic variables were examined using Chi-square tests for independence. These indicated a significant difference between experimental conditions for relationship status, χ^2 (6, *n*= 35) = 14.56, *p*=.02, phi= .65. Control participants were most likely to be cohabiting; mindfulness participants were more likely to be married or in a relationship; gratitude participants were more likely to be single. No significant

difference was found for nationality, χ^2 (16, *n*= 35) = 16.94, *p*=.39, phi= .70, or religion, χ^2 (14, *n*= 35) = 15.65, *p*=.34, phi= .67. One-way between groups ANOVAs were used to examine differences in continuous demographic variables. No significant differences were observed for age, *F*(2,34) = .43, *p*= .66, ηp^2= .03, or number of weekly work hours, *F*(2,34) = 1.01, *p*= .38, ηp^2= .06. A significant difference was found between the groups for the number of cigarettes smoked daily *F*(2,5) = 43.32, *p*= .006, ηp^2= .97. The control group (*M*=20.00, *SD*= 0) smoked more cigarettes daily than the gratitude condition (*M*=.92, *SD*= .95) or the mindfulness condition (*M*= 3.00; *SD*= 2.83).

A series of one-way between groups ANOVA were also conducted to examine differences between the three experimental conditions for levels of baseline self-report measures. Preliminary examinations of assumptions indicated that the assumption of homogeneity of variances was violated for daily cigarettes smoked consumption and satisfaction with life; as a result Robust Tests of Equality of Means are consulted for inferential statistics. No statistically significant differences were found between the three experimental groups for baseline levels of any self-report well-being measures; see Table 11.

Table 11

Differences between Three Experimental Groups for Continuous Baseline Variables

Variable	*p*	ηp^2
Gratitude	0.10	0.14
Mindfulness	0.21	0.09
Satisfaction with Life	0.10	0.06
Happiness	0.47	0.05
Positive Affect	0.14	0.12
Perceived Social Support	0.37	0.06
Stress	0.20	0.10
Negative Affect	0.17	0.10
Sleep Quality	0.45	0.05
Depression	0.92	0.01

6.3.3 Intervention Effects

As there were five experimental conditions and 3 time points, 3x5 way mixed between within subjects ANOVAs were conducted for all inferential analyses; self-report measures were the dependent variables. Preliminary assumption testing was conducted for all outcomes for normality, sphericity, homogeneity of variance and homogeneity of intercorrelations. It is important to note that the assumption of normality was violated for one gratitude time point and for other well-being outcomes, including NA, social support, depression and sleep. Data were not transformed for parametric statistics however because ANOVA can be considered robust enough to tolerate a violation of this assumption, particularly with sample sizes of approximately 40 (Field, 2013; Games, 1984). In addition, transforming the self-report means alters the construct from what was originally measured, and can

have consequences for interpretation of intervention outcomes (Grayson, 2004). Further assumption violations for outcome variables are noted where they occur.

6.3.4 Intervention Manipulation Check

An intervention manipulation check was conducted initially to determine if the gratitude and mindfulness conditions increased levels of gratitude and mindfulness respectively. This was done using two 3x5 way ANOVAs.

6.3.4.1 Gratitude. The assumption of sphericity was violated for gratitude levels, as a result multivariate statistics were examined for within-subjects effects. The mean gratitude scores for each condition across three time points are shown in Table 12; a visual representation is shown in Figure 7.

Table 12

Means and Standard Deviations for Gratitude by Five Experimental Conditions, across Three Time Points

Experimental condition	Gratitude Time 1	Gratitude Time 2	Gratitude Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	30.40 (6.91)	31.80 (8.35)	32.70 (6.96)
Gratitude 2 (*n*= 5)	31.60 (2.97)	32.20 (5.72)	33.40 (4.77)
Mindfulness 1 (*n*= 8)	36.00 (3.12)	34.88 (4.39)	36.00 (4.03)
Mindfulness 2 (*n*= 5)	33.00 (3.24)	34.40 (2.61)	32.40 (4.98)
Control (*n*= 7)	32.57 (4.43)	32.86 (2.61)	32.57 (5.06)

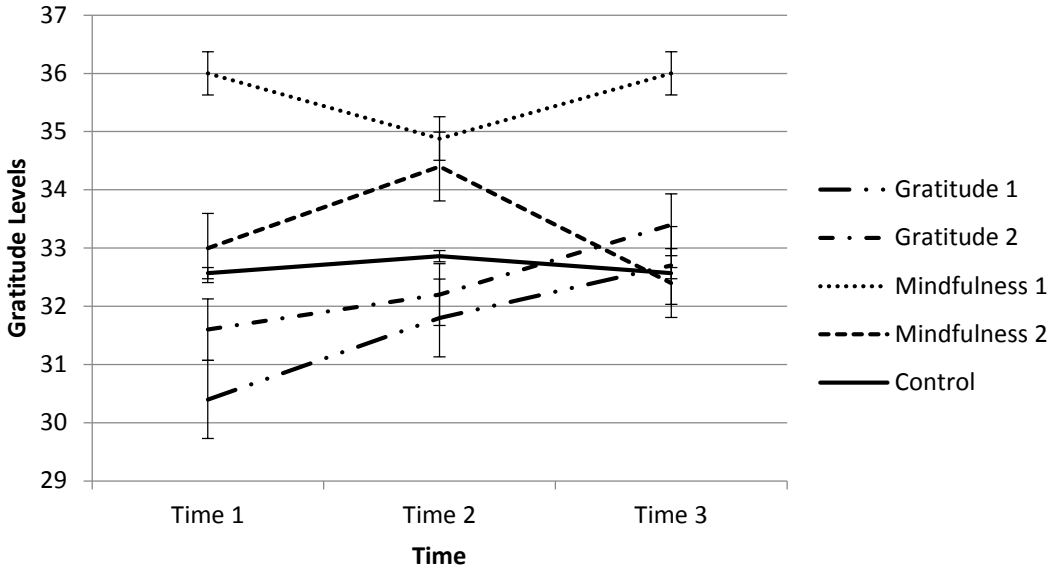

Figure 7. Gratitude by experimental condition across three time points. Error bars represent standard error.

The main effect comparing the five experimental conditions was not significant, $F(4,30) = .81$, $p = .53$, $\eta p^2 = .10$, observed power= .23. There was no significant main effect for time, Wilks Lambda= .97 $F(2, 29) = .43$, $p = .66$, $\eta p^2 = .03$, observed power= .11. There was no significant interaction between condition and time, Wilks Lambda= .81 $F(8, 58) = .82$, $p = .59$, $\eta p^2 = .10$, observed power= .34.

The two gratitude groups (G1 and G2) demonstrated sustained non-significant increases in gratitude levels across the 3 time points (see Figure 7). Increases in gratitude levels were expected but the lack of a significant intervention effect was unexpected. The two mindfulness conditions demonstrate distinct inverse patterns of change over time; these patterns differ from the two gratitude conditions. The Mindfulness1 (M1) group demonstrated an initial decline in gratitude levels followed by a return to baseline; the Mindfulness 2 (M2) group demonstrates an

initial increase followed by a decline past baseline. Non-significant differences in gratitude levels are therefore observed both between and within experimental conditions and constructs.

6.3.4.2 Mindfulness. The assumption of sphericity was violated for mindfulness levels and so multivariate statistics were examined for between subjects effects. The mean mindfulness scores for each condition across three time points are shown in Table 13; a visual representation is shown in Figure 8.

Table 13

Means and Standard Deviations for Mindfulness by Five Experimental Conditions, across Three Time Points

Experimental condition	Mindfulness Time 1	Mindfulness Time 2	Mindfulness Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	3.38(.25)	3.55(3.10)	3.66(.25)
Gratitude 2 (*n*= 5)	3.19(.35)	3.59(.31)	3.57(.36)
Mindfulness 1 (*n*= 8)	3.53(.27)	3.84(.25)	4.20(.28)
Mindfulness 2 (*n*= 5)	4.19(.35)	4.29(.31)	4.56(.36)
Control (*n*= 7)	3.82(.29)	3.81(.26)	3.82(.30)

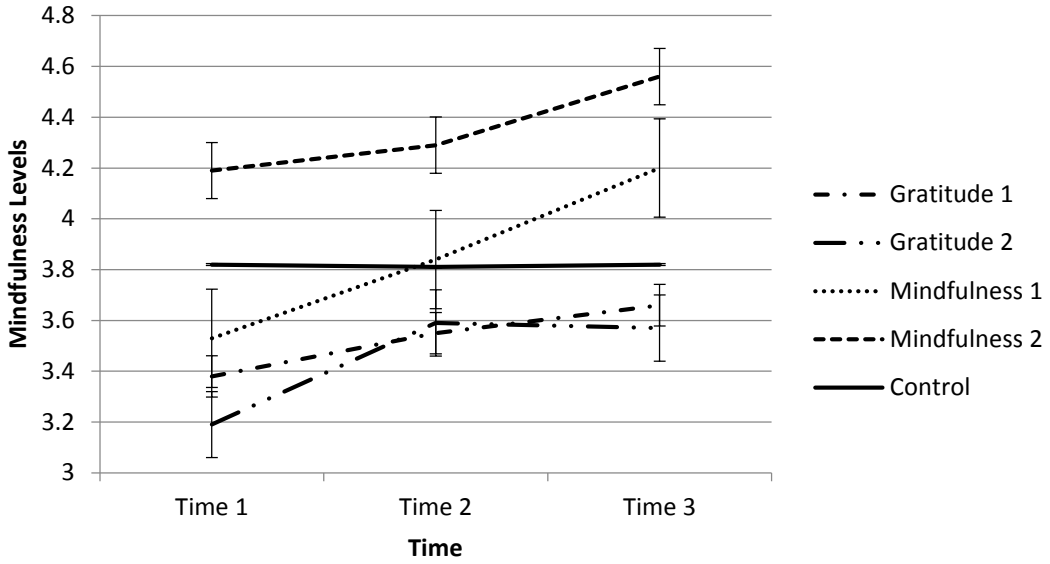

Figure 8. Mindfulness by experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, Wilks Lambda= .82 F(2, 29) =3.28, p= .05, ηp^2= .18, observed power= .58. There was no main effect of experimental condition, F(4,30) = 1.54, p= .22, ηp^2= .17, observed power= .42. There was no significant interaction between condition and time, Wilks Lambda= .81 F(8, 58) = .79, p= .61, ηp^2= .10, observed power= .33. Sustained increases in mindfulness levels in the mindfulness intervention conditions were expected. The lack of a significant intervention effect was unexpected, as was the finding of sustained increases for both gratitude conditions.

6.3.4.3 Summary. Significant changes over time were not observed for levels of gratitude or mindfulness in either experimental condition, although medium to large effect sizes were observed (See Table 14). Non-significant increases in gratitude and

mindfulness were observed following mindfulness intervention participation. The gratitude intervention also demonstrated non-significant increases in gratitude and mindfulness; increases in mindfulness were dependent on order of gratitude intervention completion however.

Table 14

Summary of Manipulation Check Main Effects and Interaction Effects for Five Experimental Conditions

	p value	ηp^2	Observed power
Gratitude			
Intervention Effect	.53	.10	.23
Time Effect	.66	.03	.11
Interaction Effect	.59	.10	.34
Mindfulness			
Main Effect	.22	.17	.42
Time Effect	.05	.18	.58
Interaction Effect	.61	.10	.33

6.3.5 Self-report Well-being Outcomes

6.3.5.1 Satisfaction with life. The mean SWL scores for each condition across three time points are shown in Table 15; a visual representation is shown in Figure 9. There was no significant main effect for time, $F(2, 60) = 1.00$, $p = .37$, $\eta p^2 = .03$, observed power= .22. The main effect of experimental conditions was not significant, $F(4,30) = .56$, $p = .70$, $\eta p^2 = .07$, observed power= .17, and there was no

significant interaction between condition and time, $F(8, 60) = .29$, $p = .97$, $\eta p^2 = .04$, observed power= .13.

Table 15

Means and Standard Deviations for Satisfaction with Life (SWL) by Five Experimental Conditions, across Three Time Points

Experimental condition	SWL Time 1	SWL Time 2	SWL Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	22.00(7.89)	22.90 (9.80)	22.40(10.04)
Gratitude 2 (*n*= 5)	22.60 (4.77)	24.00(6.12)	24.40(6.07)
Mindfulness 1 (*n*= 8)	26.63 (3.42)	25.75(5.82)	27.25(5.97)
Mindfulness 2 (*n*= 5)	25.00 (5.00)	26.00(6.89)	26.00(5.70)
Control (*n*= 7)	23.29 (3.73)	23.29(5.44)	24.29(4.27)

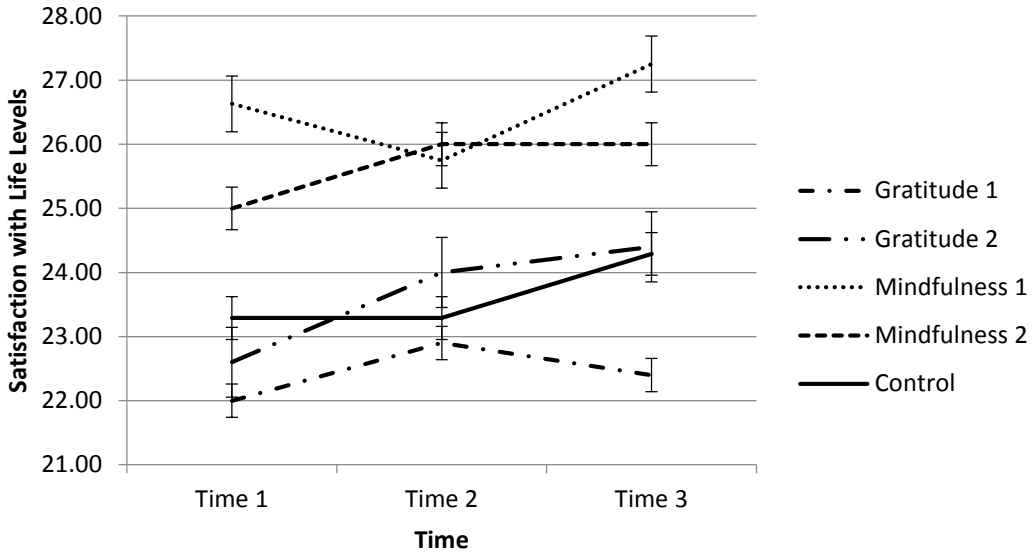

Figure 9. Satisfaction with life by experimental condition across three time points. Error bars represent standard error.

Non-significant changes in SWL scores demonstrate similar patterns over time for the gratitude conditions. The mindfulness conditions do not demonstrate similar patterns of change. M1 demonstrates an initial decrease in SWL followed by a return to baseline; M2 demonstrates an initial increase, which is maintained. The pattern of change for the M2 condition is most similar to the two gratitude conditions; M1 is most similar to the control group.

6.3.5.2 Happiness. Mean happiness scores for each condition across three time points are shown in Table 16; a visual representation is shown in Figure 10. A significant main effect was observed for time, $F(2, 60) = 7.56$, $p = .001$, $\eta p^2 = .20$, observed power= .93. There was no main effect for experimental condition, $F(4,30) = .95$, $p = .45$, $\eta p^2 = .11$, observed power= .26. There was no significant interaction between condition and time, $F(8, 60) = .79$, $p = .61$, $\eta p^2 = .10$, observed power= .33.

Table 16

Means and Standard Deviations for Happiness by Five Experimental Conditions, across Three Time Points

Experimental condition	Happiness Time 1	Happiness Time 2	Happiness Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	16.60 (6.77)	16.90 (8.00)	18.60 (7.23)
Gratitude 2 (*n*= 5)	18.00 (4.53)	18.40 (5.81)	19.40 (3.78)
Mindfulness 1 (*n*= 8)	18.38 (4.84)	20.25 (4.53)	21.50 (4.50)
Mindfulness 2 (*n*= 5)	19.00 (4.69)	19.40 (3.21)	22.80 (3.56)
Control (*n*= 7)	15.71 (3.68)	15.86 (3.13)	16.00 (4.40)

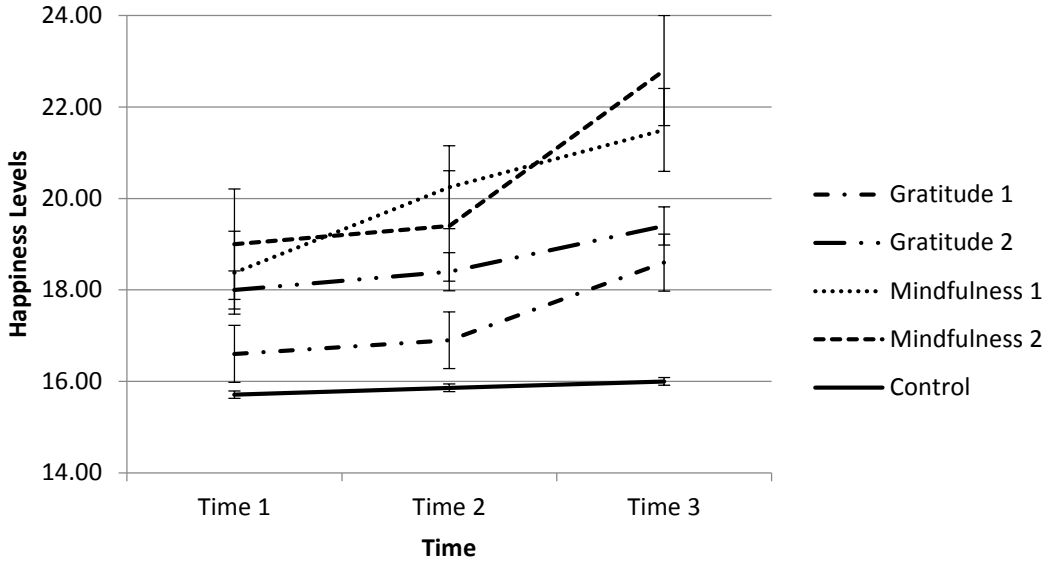

Figure 10. Happiness by experimental condition across three time points. Error bars represent standard error.

The lack of a significant intervention effect for happiness levels was unexpected. Increases in happiness over time were expected and intervention conditions demonstrated some small non-significant increases in happiness levels, with similar patterns observed within and between intervention types.

6.3.5.3 Stress. The mean stress scores for each condition across three time points are shown in Table 17; a visual representation is shown in Figure 11. There was a significant main effect for time, $F(2, 60) = 4.45$, $p = .02$, $\eta p^2 = .13$, observed power= .74. No main effect of condition was found, $F(4,30) = .92$, $p = .47$, $\eta p^2 = .11$, observed power= .26. There was no significant interaction between condition and time, $F(8,60) = .63$, $p = .75$, $\eta p^2 = .08$, observed power= .26.

Table 17

Means and Standard Deviations for Stress by Five Experimental Conditions, across Three Time Points

Experimental condition	Stress Time 1	Stress Time 2	Stress Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	30.70 (9.07)	27.10 (10.81)	26.90 (8.61)
Gratitude 2 (*n*= 5)	31.20 (5.76)	27.80 (4.02)	25.80 (3.90)
Mindfulness 1 (*n*= 8)	27.38 (5.76)	27.75 (5.78)	24.50 (7.17)
Mindfulness 2 (*n*= 5)	26.20 (6.30)	25.60 (5.77)	22.20 (8.32)
Control (*n*= 7)	32.43 (7.81)	30.86 (8.86)	32.14 (9.25)

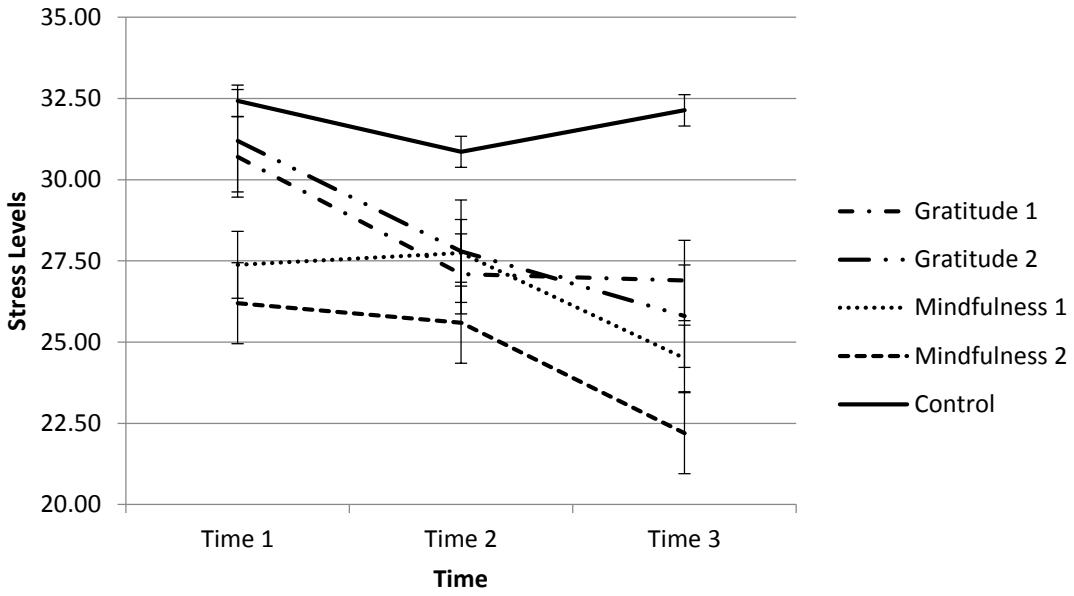

Figure 11. Stress by experimental condition across three time points. Error bars represent standard error.

The two mindfulness conditions demonstrated similar patterns of change over time. The gratitude groups also demonstrated similar patterns, although G1 demonstrates a levelling off at Time 2. All conditions demonstrated small decreases

in stress over time, but these changes were not signifcant. Differing patterns of change between the mindfulness and gratitude conditions was not expected.

6.3.5.4 Positive affect. The assumptions of homogeneity of variance, at Time 1 only, and sphericity were violated; multivariate statistics were examined for within-subjects effects. The mean PA scores for each condition across three time points are shown in Table 18; a visual representation is shown in Figure 12.

Table 18

Means and Standard Deviations for Positive Affect (PA) in Five Experimental Conditions, across Three Time Points

Experimental condition	PA Time 1	PA Time 2	PA Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	33.70 (9.50)	33.60 (8.53)	33.00 (8.72)
Gratitude 2 (*n*= 5)	35.80 (2.05)	36.80 (5.45)	37.20 (8.29)
Mindfulness 1 (*n*= 8)	36.75 (7.27)	35.88 (7.88)	36.75 (7.44)
Mindfulness 2 (*n*= 5)	38.00 (6.12)	36.80 (5.07)	37.60 (7.16)
Control (*n*= 7)	30.57 (5.50)	30.00 (4.80)	28.00 (6.40)

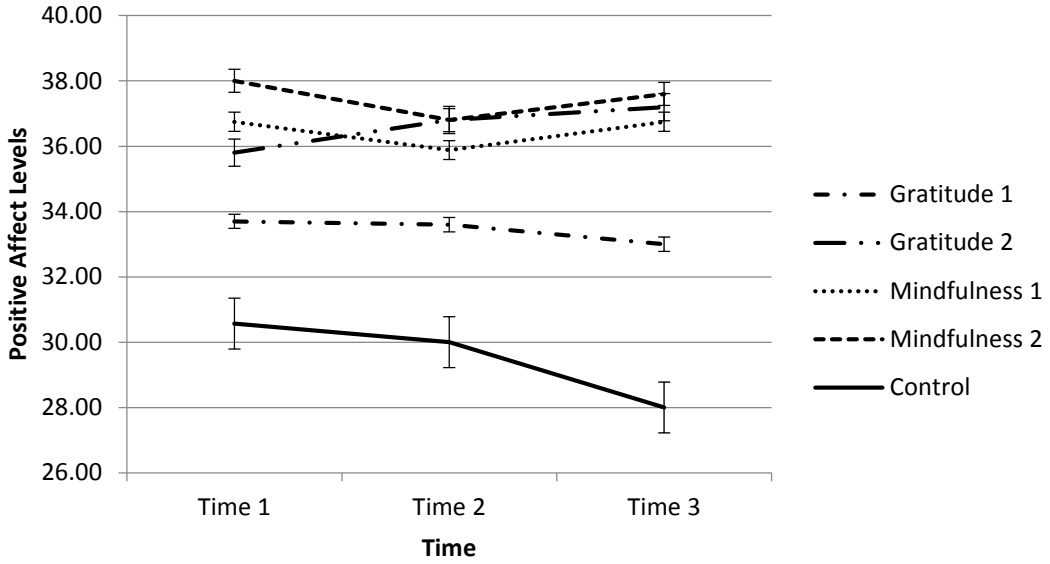

Figure 12. Positive affect by experimental condition across three time points. Error bars represent standard error.

There was no significant main effect for time, Wilks Lambda= .99 $F(2, 29) = .07$, $p = .93$, $\eta p^2 = .01$, observed power= .06. The main effect comparing the five experimental conditions was not significant, $F(4,30) = 1.69$, $p = .18$, $\eta p^2 = .19$, observed power= .46. There was no significant interaction between condition and time, Wilks Lambda= .92 $F(8, 58) = .29$, $p = .97$, $\eta p^2 = .04$, observed power= .13. The mindfulness conditions demonstrate similar patterns; an initial decrease is observed followed by a return toward baseline. The gratitude conditions demonstrate different non-significant trajectories.

6.3.5.5 Negative affect. The assumption of sphericity was violated and so multivariate tests were examined for within-subjects effects. The mean NA scores

for each condition across three time points are shown in Table 19; a visual representation is seen in Figure 13.

Table 19

Means and Standard Deviations for Negative Affect (NA) in Five Experimental Conditions, across Three Time Points

Experimental condition	NA Time 1	NA Time 2	NA Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	24.40 (7.37)	23.40 (10.73)	22.90 (8.81)
Gratitude 2 (*n*= 5)	26.00 (4.06)	23.00 (8.80)	19.00 (6.78)
Mindfulness 1 (*n*= 8)	22.38 (4.07)	20.25 (6.80)	18.50 (4.93)
Mindfulness 2 (*n*= 5)	23.20 (10.26)	21.40 (8.53)	17.20 (3.03)
Control (*n*= 7)	29.71 (11.74)	24.00 (10.18)	27.71 (12.65)

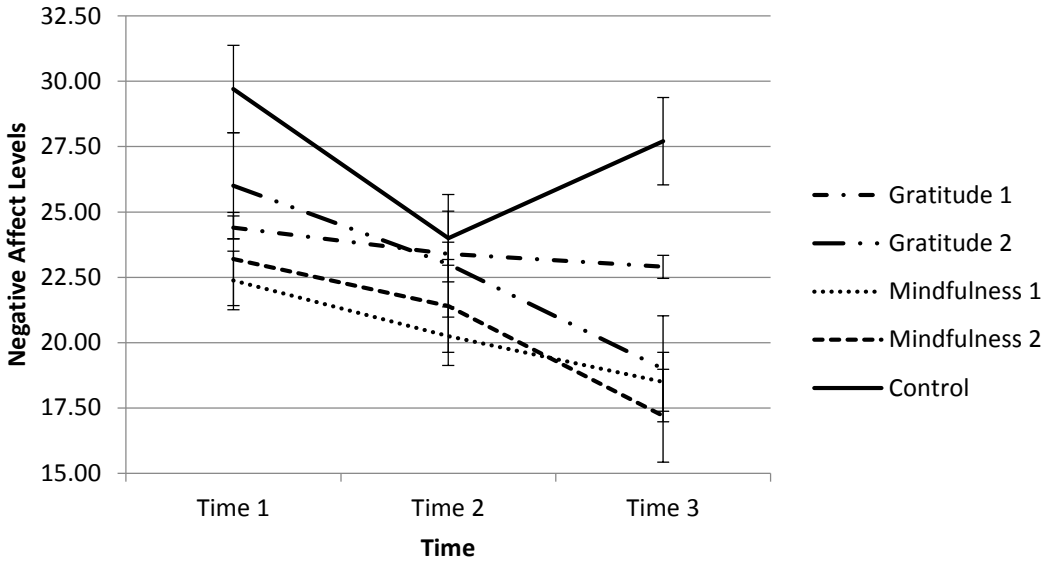

Figure 13. Negative affect by experimental condition across three time points. Error bars represent standard error.

A significant main effect was observed for time, Wilks Lambda=.68 $F(2, 29) = 6.83$, $p = .004$ $\eta p^2 = .32$, observed power= .89. The main intervention effect was not significant, $F(4,30) = .92$, $p = .47$, $\eta p^2 .11$, observed power= .26. There was no significant interaction between condition and time, Wilks Lambda= .73 $F(8, 58) = 1.23$, $p = .30$, $\eta p^2 = .15$, observed power= .51. All intervention conditions demonstrate slight non-significant decreases in NA.. Differences within and between intervention constructs were unexpected however. The G1 and M1 conditions demonstrate similar patterns and both conditions begins with the audio component. The G2 and M2 conditions also demonstrated similarities and both begin with the writing component.

6.3.5.6 Depression. The mean depression scores for each condition across three time points are shown in Table 20; a visual representation is shown in Figure 14. There was a significant main effect for time, $F(2, 44) = 5.53$, $p = .007$, $\eta p^2 = .20$, observed power= .83. The main intervention effect was not significant, $F(4,22) = .39$, $p = .82$, $\eta p^2 = .07$, observed power= .12. There was no significant interaction between condition and time, $F(8, 44) = .69$, $p = .70$, $\eta p^2 = .11$, observed power= .28.

Table 20

Means and Standard Deviations for Depression in Five Experimental Conditions, across Three Time Points

Experimental condition	Depression Time 1	Depression Time 2	Depression Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	19.56 (5.98)	19.78 (7.40)	18.33 (5.66)
Gratitude 2 (*n*= 5)	21.67 (1.15)	20.00 (2.65)	17.00 (3.61)
Mindfulness 1 (*n*= 8)	18.75 (2.75)	16.25 (3.30)	13.50 (1.73)
Mindfulness 2 (*n*= 5)	21.80 (4.94)	19.60 (7.44)	16.00 (3.46)
Control (*n*= 7)	20.17 (5.85)	19.33 (6.02)	19.67 (8.38)

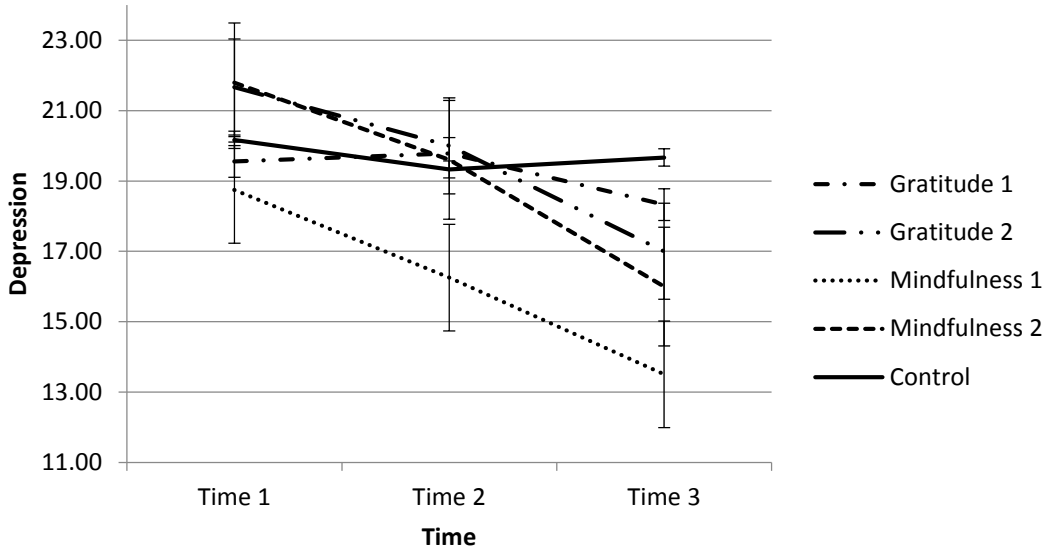

Figure 14. Depression by experimental condition across three time points. Error bars represent standard error.

The G2, M1 and M2 conditions demonstrated similar sustained, although non-significant, decreases across the three time points. This decrease over time was least

pronounced for the G1 group, who also demonstrated a slight initial increase in depression..

6.3.5.7 Sleep quality. The mean sleep quality scores for each condition across three time points are shown in Table 21; a visual representation is shown in Figure 15. Decreases in scores indicate improved sleep quality and reduced sleep disturbance.

Table 21

Means and Standard Deviations for Sleep Quality in Five Experimental Conditions, across Three Time Points

Experimental condition	Sleep Quality Time 1	Sleep Quality Time 2	Sleep Quality Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	9.60 (5.04)	8.50 (4.99)	7.90 (4.65)
Gratitude 2 (*n*= 5)	8.40 (3.44)	7.60 (2.30)	7.60 (2.97)
Mindfulness 1 (*n*= 8)	11.38 (5.01)	9.38 (3.93)	8.25 (2.76)
Mindfulness 2 (*n*= 5)	11.00 (1.87)	9.80 (3.90)	7.40 (2.88)
Control (*n*= 7)	11.00 (5.39)	11.00 (4.24)	11.14 (5.61)

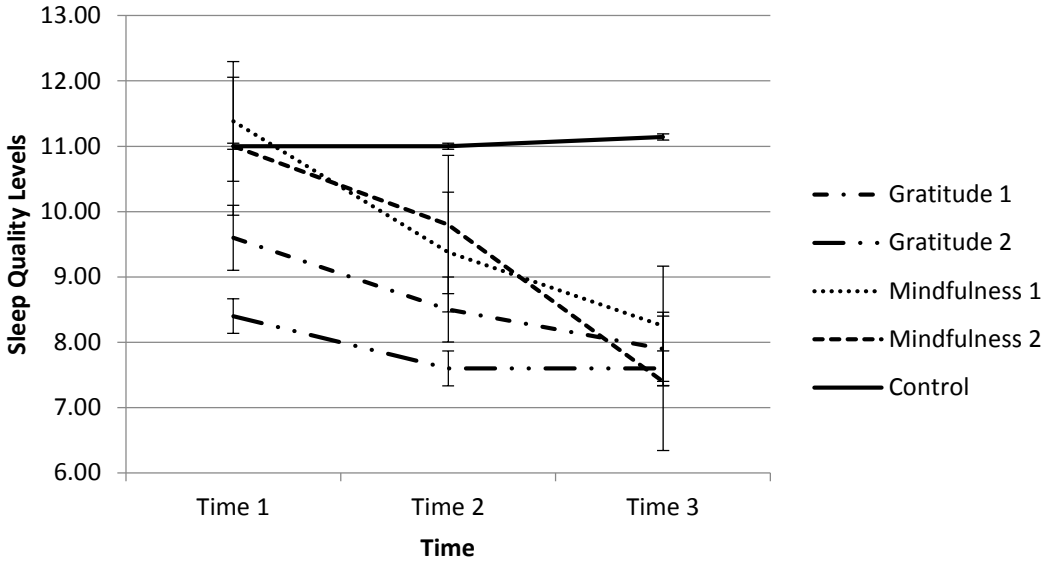

Figure 15. Sleep Quality by experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, $F(2, 60) = 4.50$, p=.02, ηp^2= .13, observed power= .75. The main intervention effect was not significant, $F(4,30) = .63$, p= .64, ηp^2= .08, observed power= .18. There was no significant interaction between condition and time, $F(8, 60) = .70$, p= .69, ηp^2= .09, observed power= .29. All intervention conditions demonstrated non-significant decreases over time, which are more pronounced for the mindfulness conditions than the gratitude conditions between Time 2 and Time 3.

6.3.5.8 Perceived social support. Mean perceived social support scores for each condition across three time points are shown in Table 22; a visual representation is shown in Figure 16.

Table 22

Means and Standard Deviations for Perceived Social Support in Five Experimental Condition, across Three Time Points

Experimental condition	Social Support Time 1	Social Support Time 2	Social Support Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude 1 (*n*= 10)	61.10 (14.90)	62.90 (21.02)	63.00 (19.07)
Gratitude 2 (*n*= 5)	66.40 (8.99)	67.00 (11.55)	70.40 (8.44)
Mindfulness 1 (*n*= 8)	69.13 (14.51)	70.63 (14.93)	70.00 (16.27)
Mindfulness 2 (*n*= 5)	67.40 (13.96)	63.80 (15.55)	63.60 (12.99)
Control (*n*= 7)	69.71 (7.30)	68.57 (7.68)	69.29 (7.16)

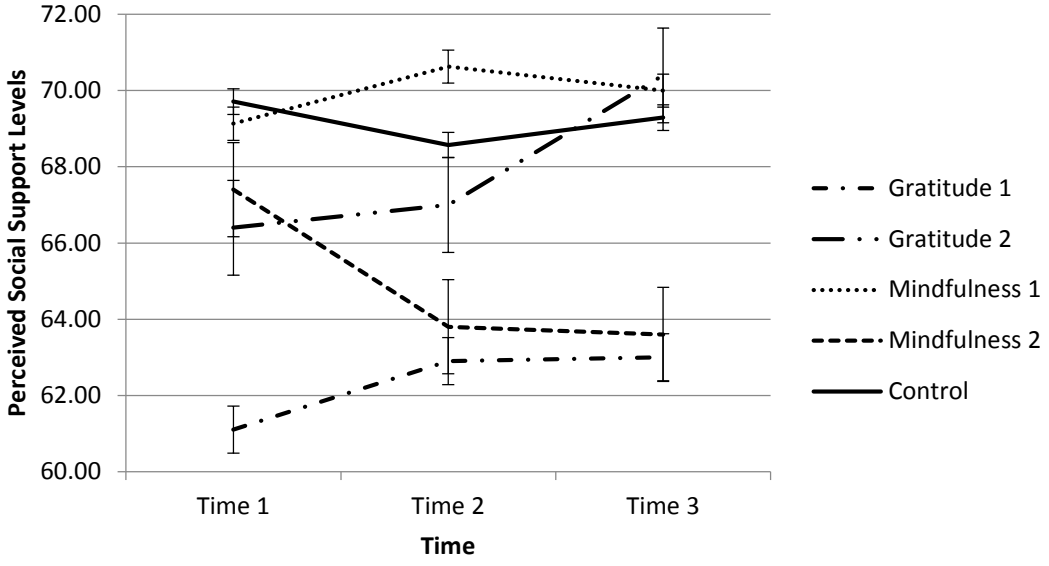

Figure 16. Perceived social support by experimental condition across three time points. Error bars represent standard error.

No significant main effect was observed for time, $F(2, 60) = .14$, $p = .87$, $\eta p^2 = .01$, observed power= .07. The main effect comparing the five experimental conditions

was not significant, $F(4,30) = .45$, $p = .77$, $\eta p^2 = .06$, observed power= .14. There was no significant interaction between condition and time, $F(8, 60) = .45$, $p = .84$, $\eta p^2 = .06$, observed power= .22. Perceived social support scores demonstrate a crossover between conditions, rather than similarities within intervention type. The M1 and M2 conditions demonstrate inverse patterns; the G1 and G2 conditions also demonstrate inverse patterns. Potential differences between and within experimental conditions are not signignifcant however.

6.3.5.9 Summary. Significant intervention effects were not observed between the five experimental conditions for levels of life satisfaction, happiness, stress, positive affect, negative affect, depression, sleep or perceived social support. Medium to large effect sizes were observed however (See Table 23). Order effects were observed for life satisfaction, stress, positive affect, negative affect, depression and perceived social support.

Table 23

Summary of Main and Interaction Effects for Five Experimental Conditions

	p value	ηp^2	Observed power
Life Satisfaction			
Condition Effect	.70	.07	.17
Time Effect	.37	.03	.22
Interaction Effect	.97	.04	.13
Happiness			
Condition Effect	.45	.11	.26
Time Effect	.001	.20	.93
Interaction Effect	.61	.10	.33
Stress			
Condition Effect	.47	.11	.26
Time Effect	.02	.13	.74
Interaction Effect	.75	.08	.26
Positive Affect			
Condition Effect	.18	.19	.46
Time Effect	.93	.01	.06
Interaction Effect	.97	.04	.13
Negative Affect			
Condition Effect	.47	.11	.26
Time Effect	.004	.32	.89
Interaction Effect	.30	.15	.51
Depression			
Condition Effect	.82	.07	.12
Time Effect	.01	.20	.83
Interaction Effect	.70	.11	.28
Sleep			
Condition Effect	.64	.08	.18
Time Effect	.02	.13	.75
Interaction Effect	.69	.09	.29
Social Support			
Condition Effect	.77	.06	.14
Time Effect	.87	.01	.07
Interaction Effect	.84	.06	.22

6.3.6 Construct Effects

Non-significant differences were observed between experimental conditions and within experimental constructs for the following variables: gratitude, satisfaction with life, stress, positive affect, negative affect, depression, and perceived social support. As a result, a series of 3 x 3 way mixed between-within subjects ANOVAs were conducted using a single mindfulness condition, a single gratitude condition and a control condition. This was done to examine overall effects of the mindfulness and gratitude constructs on outcomes. Self-report measures were the dependent variables for each ANOVA; time (3 levels) and experimental condition (3 levels) were the independent variables. Preliminary analyses confirmed that no differences exist between experimental conditions on any outcome variable at baseline; use of three experimental groups for analysis was therefore deemed appropriate.

6.3.6.1 Gratitude. Mean gratitude scores are shown in Table 24; a visual representation is shown in Figure 17. The main effect of experimental condition was not significant, $F(1,32) = 1.27$, $p = .30$, $\eta p^2 = .07$, observed power= .26. There was no significant main effect for time, $F(2, 64) = .44$, $p = .65$, $\eta p^2 = .01$, observed power= .12. There was no significant interaction between condition and time, $F(4, 64) = .77$, $p = .55$, $\eta p^2 = .05$, observed power= .23.

Table 24

Means and Standard Deviations for Gratitude in Three Experimental Conditions, across Three Time Points

Experimental condition	Gratitude Time 1	Gratitude Time 2	Gratitude Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	30.80 (5.80)	31.93 (7.36)	32.92 (6.15)
Mindfulness (*n*= 13)	34.85 (3.39)	34.69 (3.92)	34.62 (4.59)
Control (*n*= 7)	32.57 (4.43)	32.86 (2.61)	32.57 (5.06)

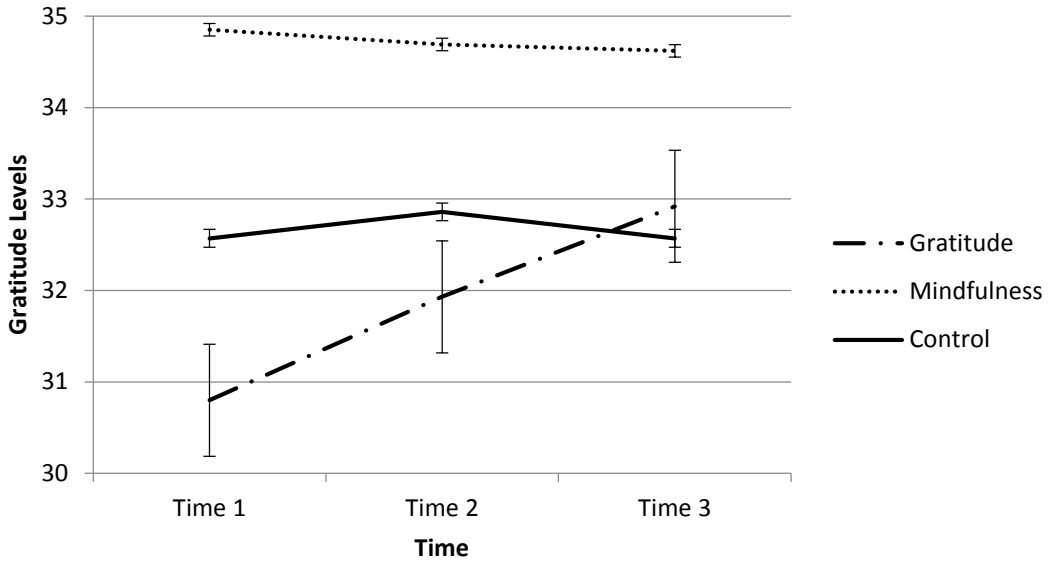

Figure 17. Gratitude by three experimental conditions across three time points. Error bars represent standard error.

The overall pattern of gratitude levels across three time points demonstrates no change over time for the mindfulness condition. Previously observed changes are therefore attributable to order effects. The single gratitude condition retains trajectory previously observed; this was expected given the similarity of the separate gratitude conditions previously (see Figure 17).

6.3.6.2 Satisfaction with life. Mean SWL scores for the three conditions across three time points are shown in Table 25; a visual representation is shown in Figure 18. Results indicated no significant main effect for time, $F(2, 64) = .87$, $p = .43$, $\eta p^2 = .03$, observed power= .19. The main effect for experimental condition was not significant, $F(2,32) = 1.08$, $p = .35$, $\eta p^2 = .06$, observed power= .23. There was no significant interaction between condition and time, $F(4, 64) = .27$, $p = .90$, $\eta p^2 = .02$, observed power= .11.

Table 25

Means and Standard Deviations for Satisfaction with Life (SWL) in Three Experimental Conditions, across Three Time Points

Experimental condition	SWL Time 1	SWL Time 2	SWL Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	22.20 (6.83)	23.27 (8.53)	23.07 (8.73)
Mindfulness (*n*= 13)	26.00 (3.98)	25.85 (5.97)	26.77 (5.66)
Control (*n*= 7)	23.29 (3.73)	23.29 (5.44)	24.29 (4.27)

The mindfulness condition demonstrated an overall increase in SWL; with a similar pattern to that of the control. The gratitude group demonstrated an inverse pattern with an initial increase in SWL levels followed by a slight decrease. These changes were not significant.

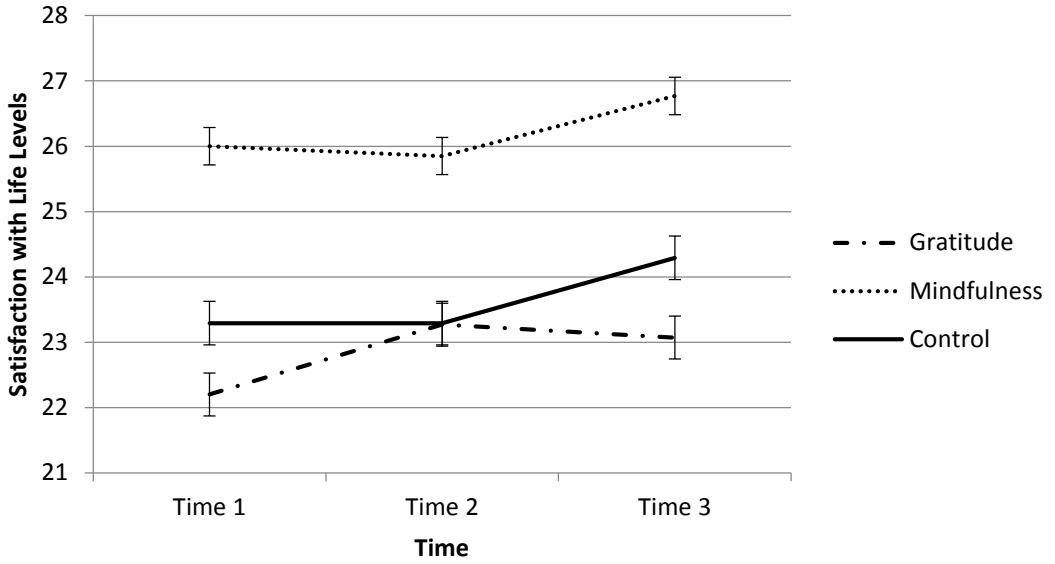

Figure 18. Satisfaction with life by three experimental conditions across three time points. Error bars represent standard error.

6.3.6.3 Stress. Mean stress scores are presented in Table 26; a visual representation is seen in Figure 19. No significant main effect was found for time, $F(2, 64) = 3.04$, $p = .06$, $\eta p^2 = .09$, observed power= .57. There was no main effect of experimental condition, $F(2, 32) = 1.83$, $p = .18$, $\eta p^2 = .10$, observed power= .35. There was no significant interaction between condition and time, $F(4, 64) = 1.21$, $p = .32$, $\eta p^2 = .07$, observed power= .36.

Table 26

Means and Standard Deviations for Stress in Three Experimental Conditions, across Three Time Points

Experimental condition	Stress Time 1	Stress Time 2	Stress Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	30.87 (7.90)	27.33 (8.93)	26.53 (7.23)
Mindfulness (*n*= 13)	26.92 (5.74)	26.92 (5.63)	23.61 (7.34)
Control (*n*= 7)	32.43 (7.81)	30.86 (8.86)	32.14 (9.25)

Both the mindfulness and gratitude conditions demonstrate slight reductions in stress. For gratitude there is an overall non-significant decline; for mindfulness there is no initial change but a non-significant decrease occurs from Time 2 to Time 3.

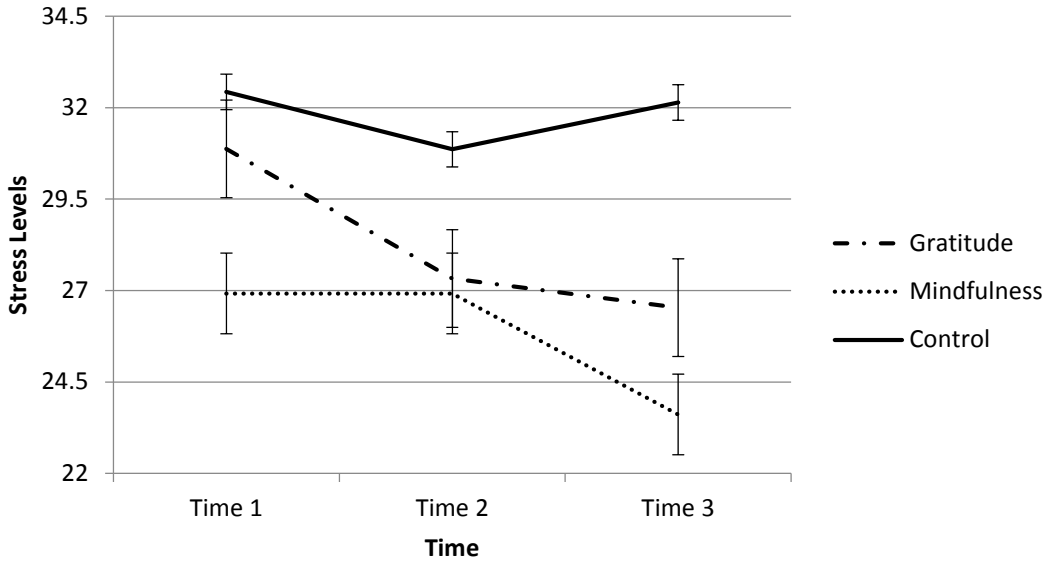

Figure 19. Stress by three experimental conditions across three time points. Error bars represent standard error.

6.3.6.4 Positive affect. The assumption of sphericity was violated for positive affect and so multivariate statistics were examined for within-subjects effects. Mean PA scores are presented in Table 27; a visual representation is seen in Figure 20.

Table 27

Means and Standard Deviations for Positive Affect (PA) in Three Experimental Conditions, across Three Time Points

Experimental condition	PA Time 1	PA Time 2	PA Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	34.40 (7.76)	34.67 (7.59)	34.40 (8.53)
Mindfulness (*n*= 13)	37.23 (6.61)	36.23 (6.67)	37.08 (7.04)
Control (*n*= 7)	30.57 (5.50)	30.00 (4.80)	28.00 (6.40)

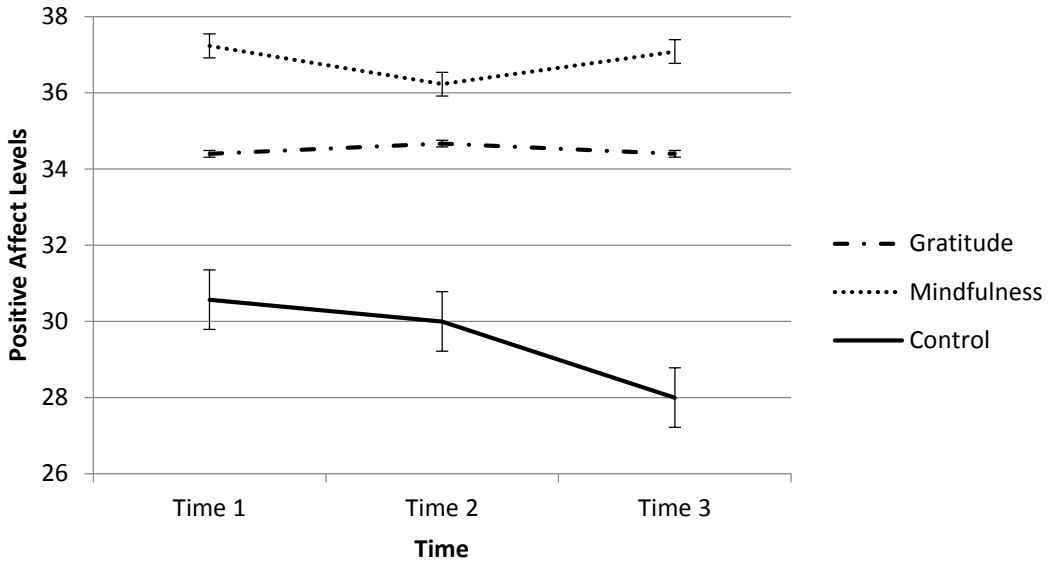

Figure 20. Positive affect by three experimental conditions across three time points. Error bars represent standard error.

There was no significant main effect for time, Wilks Lambda= .98 $F(2, 31) = .32$, $p = .73$, $\eta p^2 = .02$, observed power= .10. The main effect comparing the three experimental conditions was not significant, $F(2, 32) = 3.06$, $p = .06$, $\eta p^2 = .16$, observed power= .55. There was no significant interaction between condition and time, Wilks Lambda= .94, $F(4, 62) = .53$, $p = .71$, $\eta p^2 = .03$, observed power= .17. Changes in levels of PA for the single mindfulness and single gratitude groups are negligible. The control group demonstrated a decline in PA during the study, which was unexpected.

6.3.6.5 Negative affect. Mean NA scores are shown in Table 28; a visual representation is shown in Figure 21. There was a significant main effect for time, $F(2, 64) = 4.64$, $p = .01$, $\eta p^2 = .13$, observed power= .76. The main effect comparing experimental conditions was not significant, $F(2, 32) = 1.93$, $p = .16$, $\eta p^2 = .11$, observed power= .37. There was no significant interaction between condition and time, $F(4, 64) = 1.12$, $p = .35$, $\eta p^2 = .07$, observed power= .33.

Table 28

Means and Standard Deviations for Negative Affect (NA) in Three Experimental Conditions, across Three Time Points

Experimental condition	NA Time 1	NA Time 2	NA Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	24.93 (6.34)	23.27 (9.81)	21.60 (8.17)
Mindfulness (*n*= 13)	22.69 (6.70)	20.69 (7.18)	18.00 (4.20)
Control (*n*= 7)	29.71 (11.74)	24.00 (10.18)	27.71 (12.65)

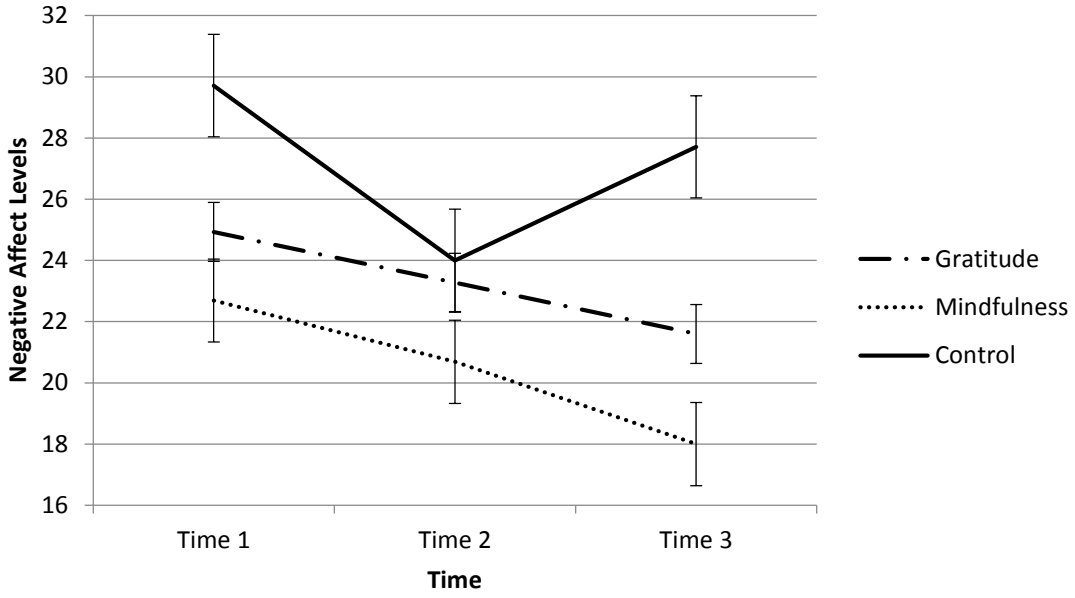

Figure 21. Negative affect by three experimental conditions across three time points. Error bars represent standard error.

The mindfulness and gratitude groups both demonstrate a non-significant downward trend in levels of NA. This indicates that when examined at a construct level, no differences are observed between constructs and conditions.

6.3.6.6 Depression. Mean depression scores are shown in Table 29; a visual representation is shown in Figure 22. A significant main effect was found for time, $F(2, 48) = 3.75$, $p = .03$, $\eta p^2 = .14$, observed power= .66. The main intervention effect was not significant, $F(2, 24) = .37$, $p = .70$, $\eta p^2 = .03$, observed power= .10. There was no significant interaction between condition and time, $F(4, 48) = 1.18$, $p = .33$, $\eta p^2 = .09$, observed power= .34. The mindfulness and gratitude conditions demonstrated similar non-significant patterns, with the magnitude of change larger for the mindfulness group.

Table 29

Means and Standard Deviations for Depression in Three Experimental Conditions, across Three Time Points

Experimental condition	Depression Time 1	Depression Time 2	Depression Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	20.08 (5.21)	19.83 (6.41)	18.00 (5.10)
Mindfulness (*n*= 13)	20.44 (3.94)	18.11 (5.90)	14.89 (2.98)
Control (*n*= 7)	20.17 (5.85)	19.33 (6.02)	19.67 (8.38)

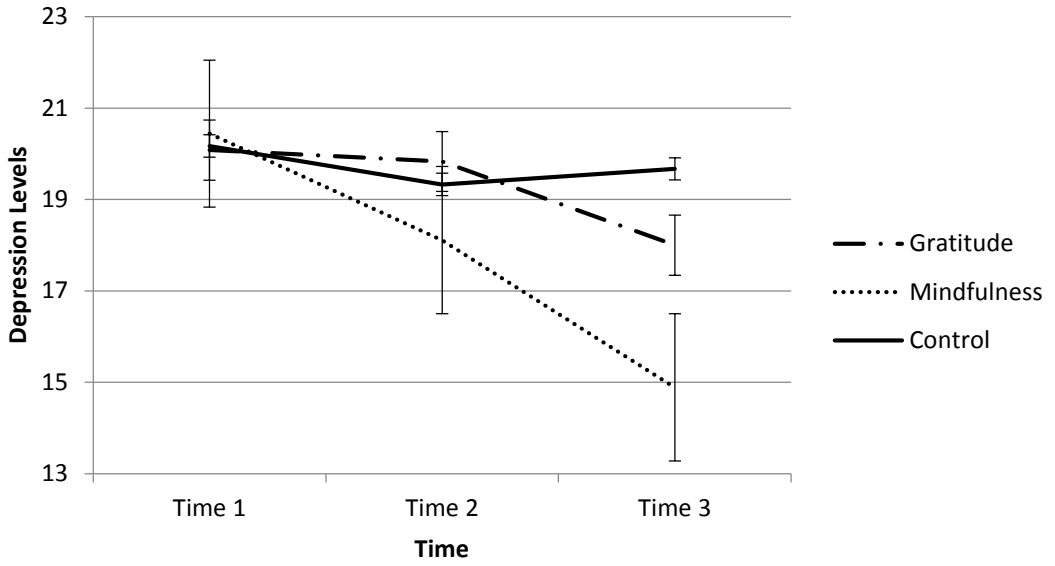

Figure 22. Depression by three experimental conditions across three time points. Error bars represent standard error.

6.3.6.7 Perceived social support. Mean perceived social support scores are shown in Table 30; a visual representation is shown in Figure 23. There was no significant main effect for time, $F(2, 64) = .08$, $p = .93$, $\eta p^2 = .002$, observed power= .06. The main effect for experimental condition was not significant, $F(2,32) = .43$, $p = .65$, $\eta p^2 = .03$, observed power= .11. No interaction effect was observe for

experimental condition and time, $F(4, 64) = .46$, $p = .77$, $\eta p^2 = .03$, observed power= .15. The gratitude and mindfulness conditions demonstrate non-significant differences across the three time points.

Table 30

Means and Standard Deviations for Perceived Social Support in Three Experimental Conditions, across Three Time Points

Experimental condition	Social Support Time 1	Social Support Time 2	Gratitude Time 3
	M(SD)	*M(SD)*	*M(SD)*
Gratitude (*n*= 15)	62.87 (13.14)	64.27 (18.06)	65.47 (16.82)
Mindfulness (*n*= 13)	68.46 (13.73)	68.00 (14.92)	67.54 (14.87)
Control (*n*= 7)	69.71 (7.30)	68.57 (7.68)	69.29 (7.16)

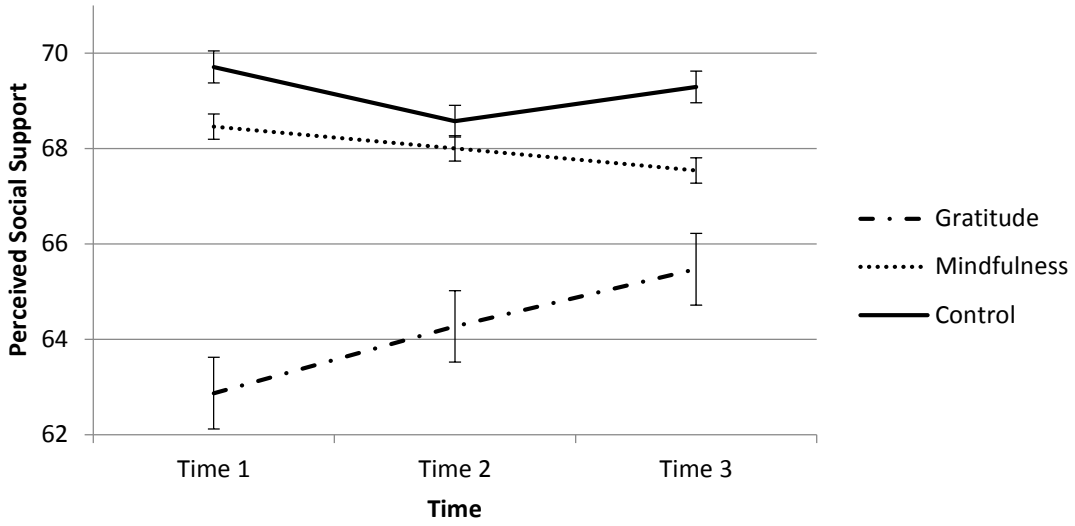

Figure 23. Perceived social support by three experimental conditions, across three time points. Error bars represent standard error.

6.3.6.8 Summary. When examining gratitude and mindfulness at a construct level, significant changes were not observed between the three experimental conditions for gratitude, life satisfaction, stress, positive affect, negative affect, depression, or perceived social support (see Table 31). Non-significant differences between gratitude and mindfulness were observed for most outcome measures. Potential differences previously observed in analyses with five experimental groups are removed when the outcome variables are examined at a construct level, highlighting the role of order effects.

Table 31

Summary of Main and Interaction Effects for Three Experimental Conditions

	p value	ηp^2	Observed power
Gratitude			
Condition Effect	.30	.07	.26
Time Effect	.65	.01	.12
Interaction Effect	.55	.05	.23
Life Satisfaction			
Condition Effect	.35	.06	.23
Time Effect	.43	.03	.19
Interaction Effect	.90	.02	.11
Stress			
Condition Effect	.18	.10	.35
Time Effect	.06	.09	.57
Interaction Effect	.32	.07	.36
Positive Affect			
Condition Effect	.06	.16	.55
Time Effect	.73	.02	.10
Interaction Effect	.71	.03	.17
Negative Affect			
Condition Effect	.16	.11	.37
Time Effect	.01	.13	.76
Interaction Effect	.35	.07	.33
Depression			
Condition Effect	.70	.03	.10
Time Effect	.03	.14	.66
Interaction Effect	.33	.09	.34
Social Support			
Condition Effect	.65	.03	.11
Time Effect	.93	.002	.06
Interaction Effect	.77	.03	.15

6.3.7 Cortisol

Cortisol concentrations for this study were not normally distributed, demonstrating a positive skew. As a result, all raw cortisol values were log-transformed prior to analysis; raw values are reported in all tables and figures below.

6.3.7.1 Descriptive statistics. Cortisol concentration means and standard deviations for the full sample, by sampling time, are shown in Table 32. A visual representation for each sampling day is shown in Figure 24. All days demonstrate the expected CAR pattern with a peak in cortisol concentrations at 30 minutes after waking.

Table 32

Means and Standard Deviations for Cortisol Concentrations for each Sampling Time for the Full Sample (n=35)

	Day 1	Day 2	Day 4	Day 5	Day 7	Day 8
Waking	24.86(4.11)	22.16(4.78)	21.77(5.42)	22.34(6.16)	21.36(5.41)	22.66(3.28)
Wake + 30mins	28.84(8.72)	27.41(7.51)	24.97(6.74)	27.74(6.92)	26.08(7.78)	28.49(8.24)
Wake + 45mins	19.99(6.20)	20.66(7.06)	19.57(4.80)	20.68(6.16)	21.65(7.50)	21.93(5.20)

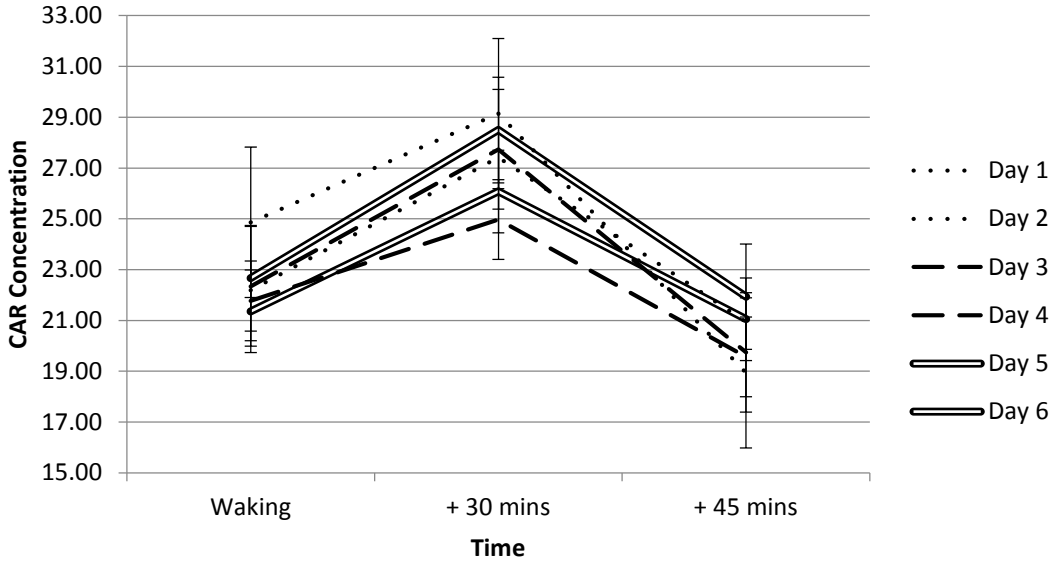

Figure 24. CAR concentrations for each sampling day.

6.3.7.2 Participant trajectories of change. Due to insufficient samples provided by a large number of study participants, the number of usable samples for inferential statistics was low. For instance no Gratitude 2 participants provided sufficient samples for examination and the majority of Gratitude 1 participants provided insufficient samples. As a result, it is not suitable to conduct inferential statistics. Instead the trends of the means are presented by participant ID, and are interpreted as participant and condition means where appropriate. Descriptive statistics for participants examined below (n=8), are provided in Table 33. Visual representations of the morning cortisol patterns for each participant are shown in Figures 25- 32.

Table 33

Means for Cortisol Concentrations for each Sampling Time, by Participant

	ID5 C	ID24 M2	ID38 M1	ID48 M1	ID49 M2	ID70 C	ID77 M1	ID91 G1
Day 1, Sample 1, Wake	26.16	25.92	20.76	23.29	23.70	22.23	21.93	20.99
Day 1, Sample 2, + 30mins	22.78	27.16	17.38	36.43	45.32	32.16	29.32	34.27
Day 1, Sample 3, + 45mins	16.33	15.89	12.56	28.90	26.82	25.32	16.78	17.52
Day 2, Sample 1, Wake	24.57	11.90	23.78	23.72	22.74	21.30	21.06	21.93
Day 2, Sample 2, + 30mins	34.09	15.42	16.55	26.32	21.05	23.01	32.55	29.32
Day 2, Sample 3, + 45mins	28.18	8.92	14.11	16.78	19.82	20.33	29.75	14.18
Day 4, Sample 1, Wake	18.74	16.33	16.40	18.54	18.12	18.40	23.58	25.78
Day 4, Sample 2, + 30mins	28.82	22.21	17.52	21.14	23.45	16.38	35.99	20.96
Day 4, Sample 3, + 45mins	22.38	19.02	19.94	19.81	21.09	12.85	26.57	18.45
Day 5, Sample 1, Wake	22.23	23.29	18.74	19.87	23.70	13.87	14.40	23.78
Day 5, Sample 2, + 30mins	32.16	36.43	32.19	32.85	45.32	28.78	16.78	17.05
Day 5, Sample 3, + 45mins	24.32	28.90	25.32	26.54	26.82	17.90	12.70	15.89
Day 7, Sample 1, Wake	21.30	23.57	22.56	15.82	21.01	21.52	13.40	21.70
Day 7, Sample 2, +30mins,	23.01	28.75	34.86	28.95	24.52	22.40	15.78	22.01
Day 7, Sample 3, + 45mins	20.33	28.18	27.19	24.52	21.33	25.81	12.67	22.31
Day 8, Sample 1, Wake	23.70	22.56	16.78	19.78	19.44	22.23	29.12	22.74
Day 8, Sample 2, + 30mins	45.32	34.86	12.08	13.54	29.84	31.65	32.16	21.05
Day 8, Sample 3, + 45mins	26.82	28.8	11.98	11.23	22.36	19.85	25.32	19.82

Control condition participants. Participant 5 demonstrated generally normal cortisol patterns, although days 1 and 8 appear to have missed the CAR peak. The CAR peak is also missed for participant 70 for day 2 and day 4; the pattern of day 7 is also unusual, demonstrating an increase in cortisol from +30 minutes to +45 minutes.

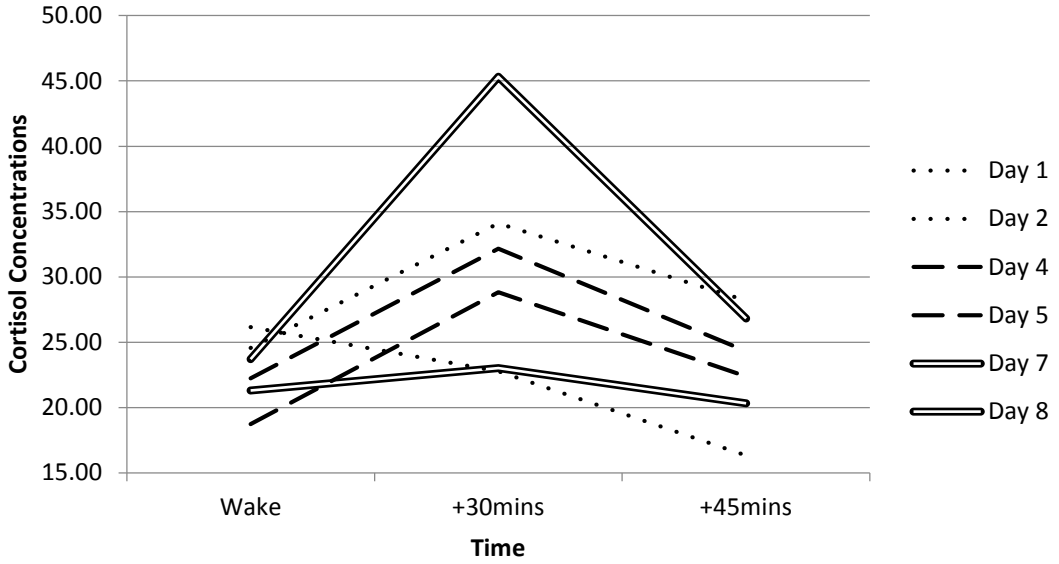

Figure 25. Cortisol concentrations for each sampling day for ID5 (Control condition).

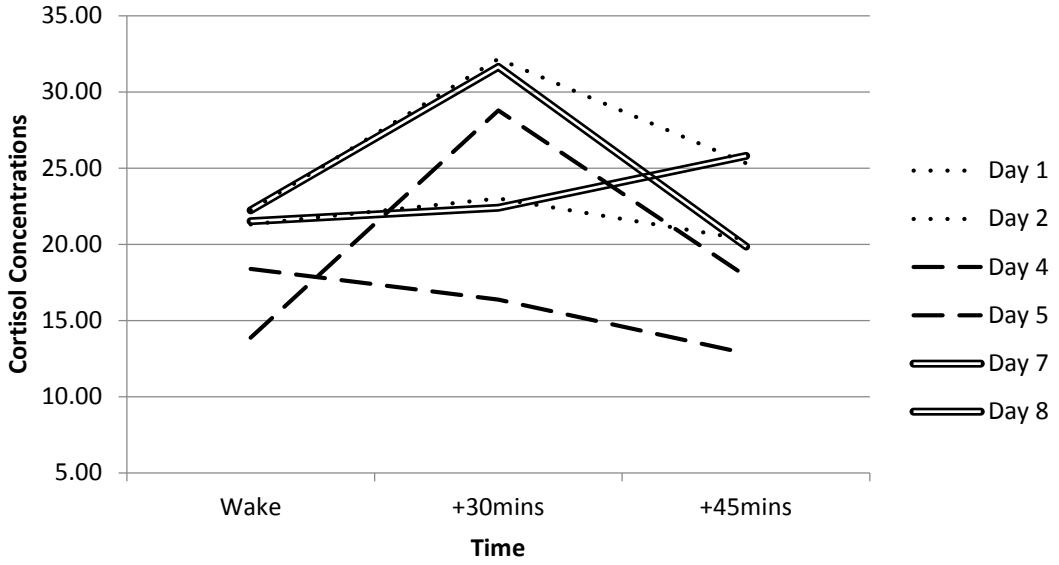

Figure 26. Cortisol concentrations for each sampling day for ID70 (Control condition).

Mindfulness 1 condition. Unusual patterns of morning cortisol are observed for participant 38; declines in cortisol are observed for days 1, 2 and 8, while day 4

displays an unusual steady increase in cortisol levels. For participant 48 no real peak is observed for day 4 and the peak also appears to have been missed for day 8. For participant 77, days 2, 7 and 8 demonstrate declines from Time 2 to Time 3 but these are small declines, suggesting the peak morning cortisol has been missed.

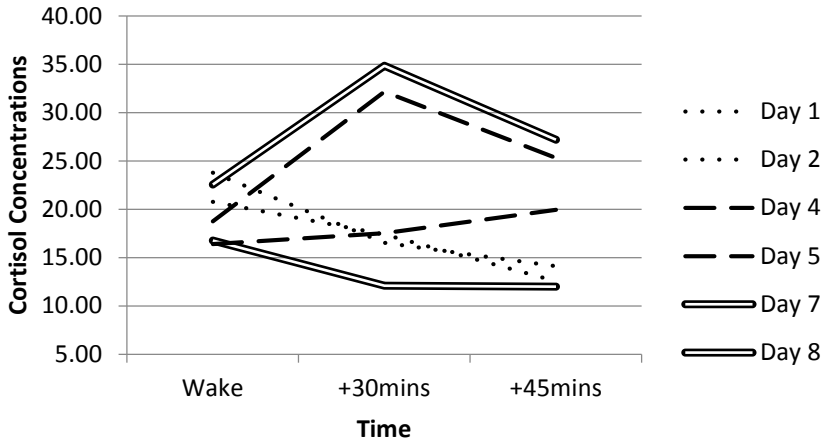

Figure 27. Cortisol concentrations for each sampling day for ID38 (Mindfulness1 condition).

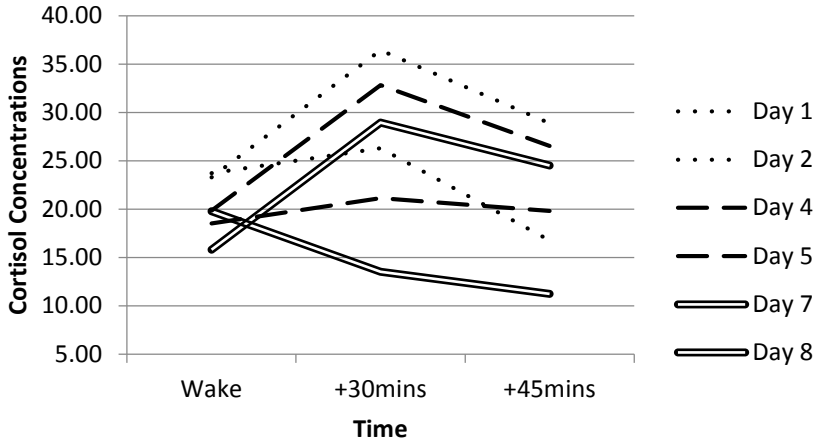

Figure 28. Cortisol concentrations for each sampling day for ID48 (Mindfulness1 condition).

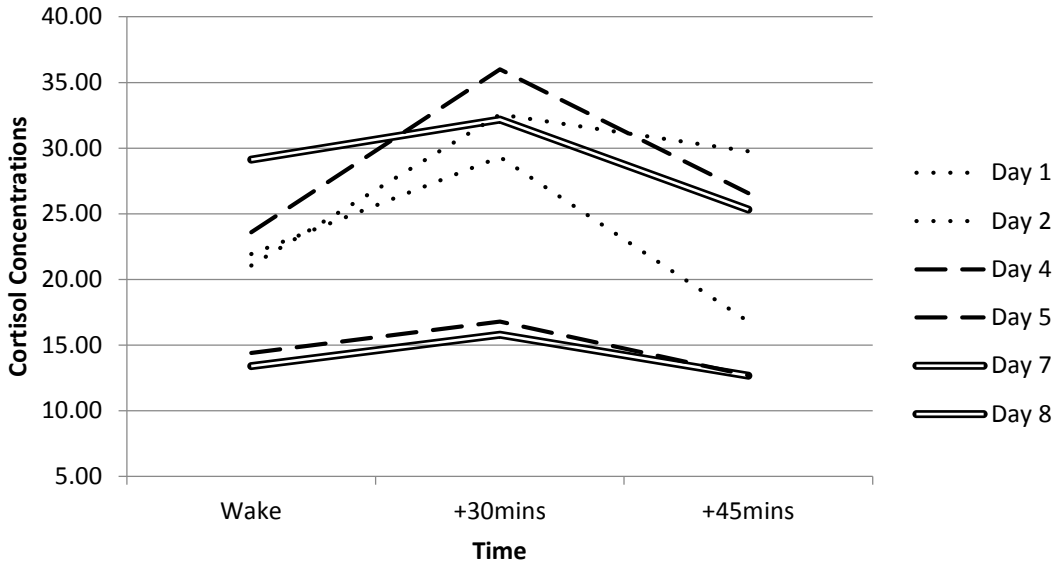

Figure 29. Cortisol concentrations for each sampling day for ID77 (Mindfulness 1 condition).

Mindfulness 2 condition. Participant 24 demonstrates a missed cortisol peak for day 1 and an unexpected plateau for day 7. For participant 49, days 2, 4 and 7 all demonstrate a lack of morning peak in cortisol secretion.

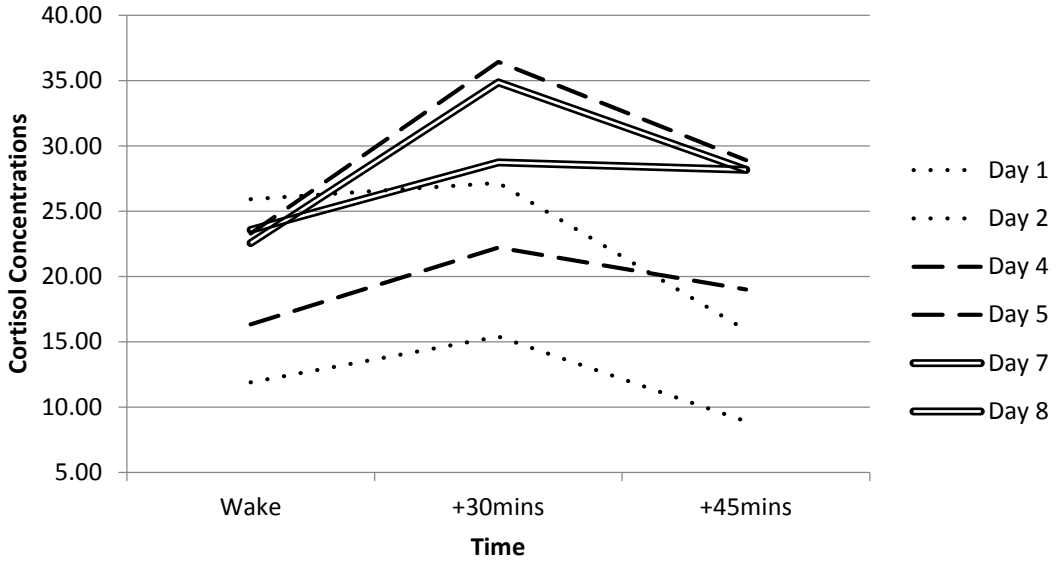

Figure 30. Cortisol concentrations for each sampling day for ID24 (Mindfulness2).

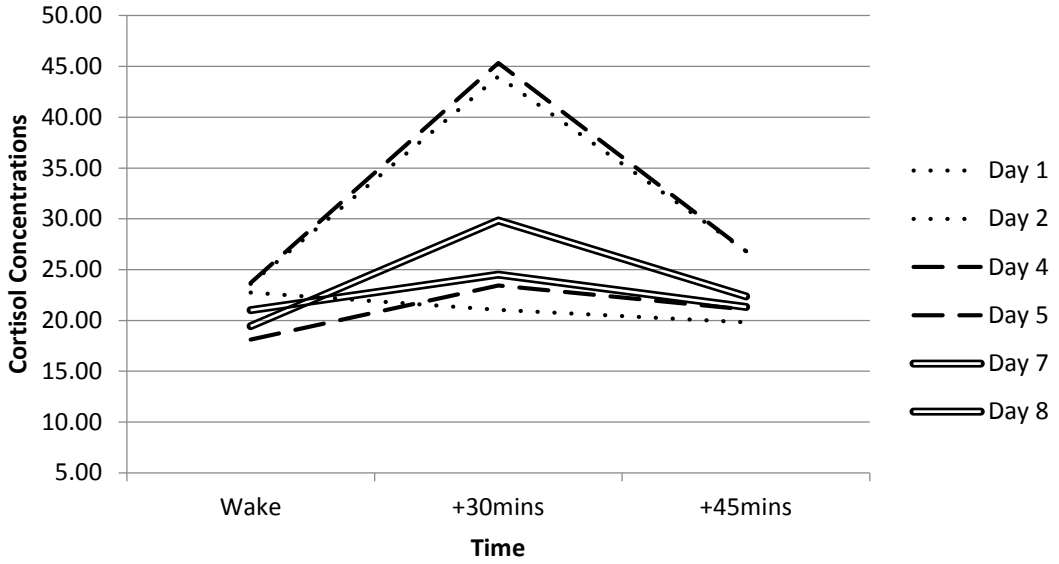

Figure 31. Cortisol concentrations for each sampling day for ID49 (Mindfulness2).

Gratitude 1 condition. The gratitude 1 participant demonstrates a missed cortisol peak for day 7, with an unusual pattern of decline in cortisol apparent for days 4, 5, and 8.

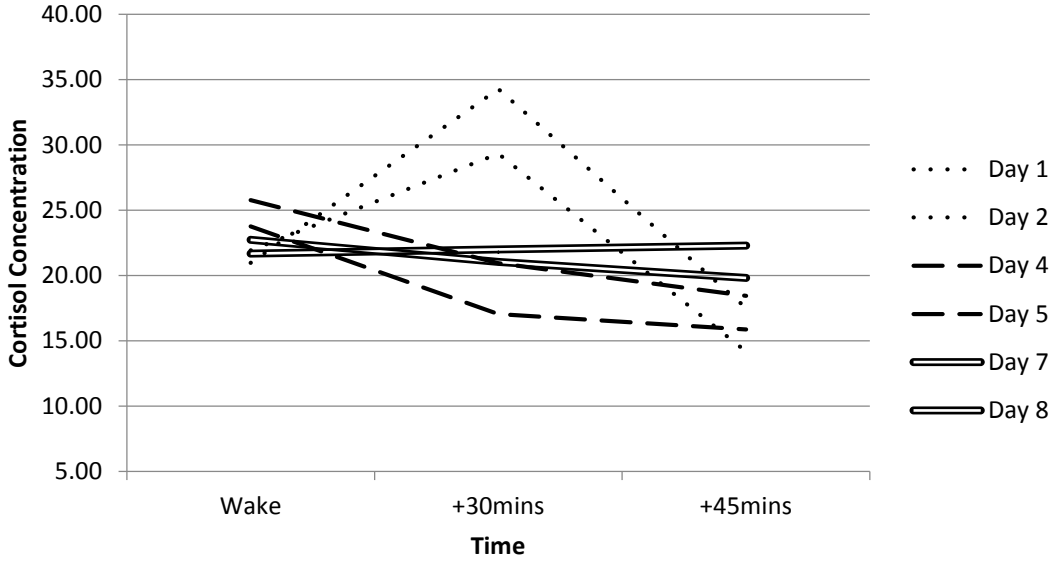

Figure 32. Cortisol concentrations for each sampling day for ID91 (Gratitude1).

6.3.7.3 Cortisol awakening response (CAR). CAR concentrations over time for each participant were examined using the trends of the means. The mean CAR scores for each participant are shown in Table 34; a visual representation of change over time is shown in Figure 33. For the CAR and all other outcomes, participants demonstrating the same line pattern are drawn from the same experimental condition.

Table 34

Mean CAR values for each Participant across 3 Time Points

	M(*SD*)		
	Time 1	Time 2	Time 3
ID5 (Control)	3.07	10.00	11.67
ID70 (Control)	5.82	6.45	5.15
ID38 (Mindfulness 1)	-5.31	7.29	3.80
ID48 (Mindfulness 1)	7.87	7.79	3.45
ID77 (Mindfulness 1)	9.44	7.40	2.71
ID49 (Mindfulness 2)	9.97	13.48	6.96
ID24 (Mindfulness 2)	2.38	9.51	8.74
ID91 (Gratitude 1)	10.34	-5.78	-0.69

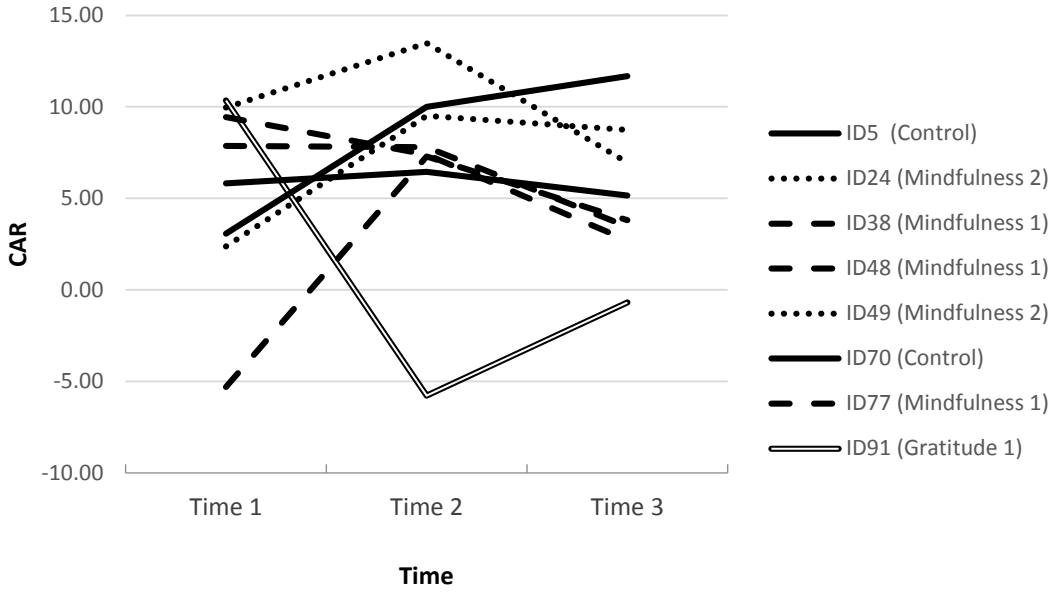

Figure 33. CAR across 3 time periods for each participant.

Participants in the Mindfulness 1 condition all demonstrate different trajectories of change from Time 1 to Time 2; ID38 demonstrates an increase, ID 48 demonstrates little change: ID 77 demonstrates a decrease. At Time 2 all Mindfulness 1 participants display similar CAR concentrations and proceed to decrease from Time 2 to Time 3 in a similar manner. Both participants in the Mindfulness 2 condition demonstrate initial increases followed by decreases in CAR concentrations of varying degrees. The Gratitude 1 participant demonstrates an initial decline, followed by an increase. The Control condition participants demonstrate different patterns of change, with either little change or a sustained decrease.

6.3.7.4 Waking cortisol. Waking cortisol concentrations over time for each participant were examined using the trends of the means. Mean waking cortisol

levels for each condition are shown in Table 35; a visual representation is shown in Figure 34.

Table 35

Mean Waking Cortisol Concentrations for each Participant across 3 Time Points

	M(*SD*)		
	Time 1	Time 2	Time 3
ID5 (Control)	25.36	20.49	22.50
ID70 (Control)	21.77	16.13	21.88
ID38 (Mindfulness 1)	22.27	17.57	19.67
ID48 (Mindfulness 1)	23.50	19.21	17.80
ID77 (Mindfulness 1)	21.50	18.99	21.26
ID49 (Mindfulness 2)	23.22	20.91	20.22
ID24 (Mindfulness 2)	18.91	19.81	23.06
ID91 (Gratitude 1)	21.46	24.78	22.22

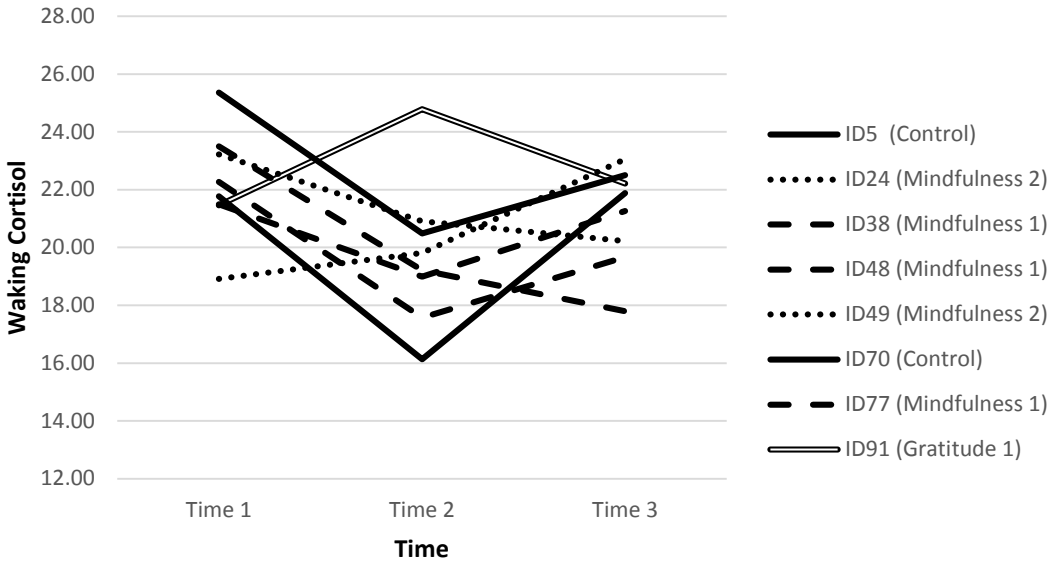

Figure 34. Waking cortisol across 3 time periods for each participant.

All participants in the Mindfulness 1 intervention demonstrated initial decreases; ID48 maintained this decline but the other two participants demonstrated comparable increases. Mindfulness 2 participants demonstrated inverse patterns of change over time. The Gratitude 1 participant demonstrates an initial increase in cortisol, followed by a decline. Control participants both demonstrate similar initial increases followed by declines in waking cortisol.

6.3.7.5 + 30 minutes cortisol. Changes in cortisol concentrations at 30 minutes after waking were examined using the trends of the means. The mean +30 minutes cortisol levels for each condition are shown in Table 36; a visual representation is shown in Figure 35.

Table 36

Mean Wake +30 Minutes Cortisol Concentrations, for each Participant, across 3 Time Points

	M(*SD*)		
	Time 1	Time 2	Time 3
ID5 (Control)	28.44	30.49	34.17
ID70 (Control)	27.59	22.58	27.02
ID77 (Mindfulness 1)	30.94	26.39	23.97
ID38 (Mindfulness 1)	16.97	24.85	23.47
ID48 (Mindfulness 1)	31.38	29.99	21.25
ID49 (Mindfulness 2)	33.18	34.38	27.18
ID24 (Mindfulness 2)	21.29	29.32	31.81
ID91 (Gratitude 1)	31.80	19.01	21.53

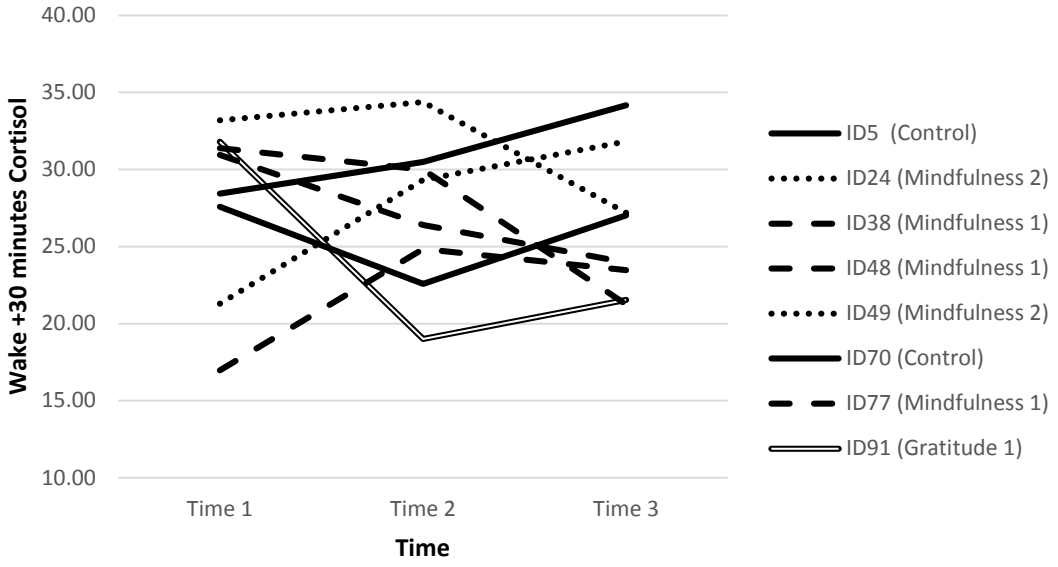

Figure 35. Wake + 30 minutes cortisol across 3 time periods for each participant.

As with the CAR, participants in the Mindfulness 1 condition demonstrated different patterns of change from Time 1 to Time 2; all Mindfulness 1 participants demonstrated a decrease from Time 2 to Time 3. Mindfulness 2 participants demonstrated increases of varying degrees initially, followed by inverse patterns of change from Time 2 to Time 3. The Gratitude 1 participant demonstrated an initial decrease followed by a slight increase in cortisol concentration. The control condition demonstrated changes in opposite directions from Time 1 to Time 2 but both demonstrated increases from Time 2 to Time 3.

6.3.7.6 Area under the curve (AUC). The AUC over time for each participant was examined using the trends of the means. The mean CAR scores for each condition are shown in Table 37. A visual representation of change over time is shown in Figure 36.

Table 37

Mean AUC values for each participant, across 3 Time Points

	M(*SD*)		
	Time 1	Time 2	Time 3
ID24 (Mindfulness 2)	8.56	11.37	12.73
ID38 (Mindfulness 1)	16.58	13.32	12.11
ID77 (Mindfulness 1)	23.32	13.53	22.30

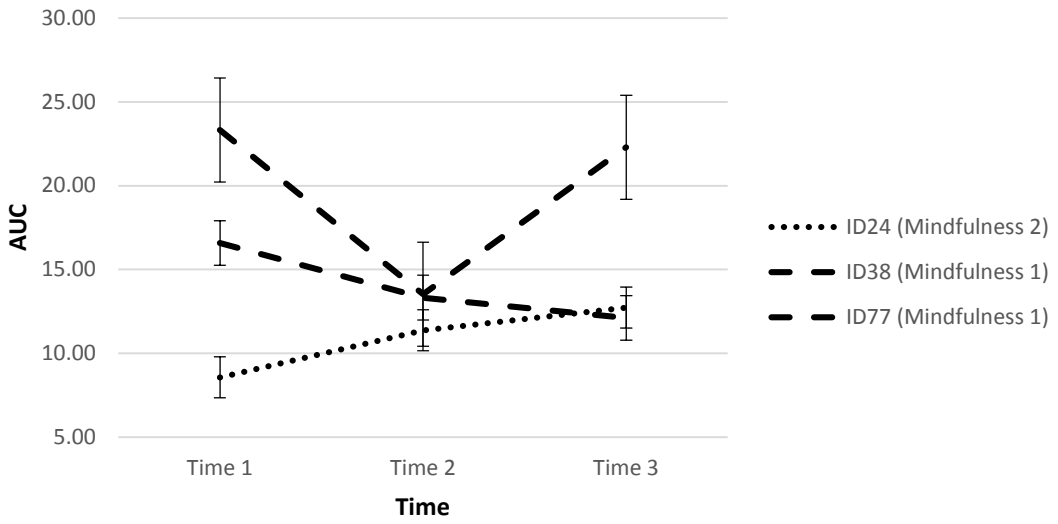

Figure 36. AUC across 3 time periods for each participant.

For the AUC, all participants demonstrated different patterns of change over time. As can be seen in Table 37 and Figure 36, only data from 3 participants were usable in this examination. These participants were one Mindfulness 2 participant and two Mindfulness 1 participants. As such, conclusions cannot be drawn here due to the low numbers, and the lack of an alternative intervention and the lack of control group against which to evaluate changes.

6.3.8 Cortisol Sampling

6.3.8.1 Sampling Times. Potential differences in cortisol sampling for the full group were examined using a series of one way between groups ANOVAs. Self-reported sampling times, in decimal format, for each sampling day were the continuous dependent variable; experimental condition with five levels was the independent variable. No significant differences were observed between experimental conditions for sampling times; see Table 38

Table 38

Sampling Times in Decimal Format for 5 Experimental Conditions.

	Mean (*SD*)				
	Gratitude 1	Gratitude 2	Mindfulness 1	Mindfulness 2	Control
Day 1, Sample 1, Wake	8.14(1.22)	7.91(1.81)	8.61(1.69)	8.65(1.43)	7.35(1.27)
Day 1, Sample 2, + 30mins	8.65(1.27)	8.41(1.78)	9.32(1.55)	9.23(1.51)	7.87(1.27)
Day 1, Sample 3, + 45mins	8.93(1.24)	8.68(1.78)	9.60(1.60)	9.49(1.57)	8.16(1.27)
Day 2, Sample 1, Wake	8.00(1.07)	7.14(1.14)	8.01(1.41)	7.44(.79)	7.46(1.10)
Day 2, Sample 2, + 30mins	8.55(1.06)	7.81(1.11)	8.53(1.39)	8.01(.75)	7.85(1.15)
Day 2, Sample 3, + 45mins	8.86(1.01)	8.10(1.12)	8.88(1.54)	8.66(1.10)	8.20(1.19)
Day 4, Sample 1, Wake	8.61(1.55)	12.51(15.01)	8.20(1.75)	8.28(1.72)	7.52(1.14)
Day 4, Sample 2, + 30mins	9.19(1.68)	8.17(1.60)	8.71(1.74)	8.33(1.45)	8.08(1.13)
Day 4, Sample 3, + 45mins	9.48(1.73)	8.47(1.61)	9.00(1.74)	9.05(1.74)	8.32(1.13)
Day 5, Sample 1, Wake	8.54(.96)	7.44(1.02)	8.73(1.74)	7.42(.99)	7.23(1.48)
Day 5, Sample 2, + 30mins	9.13(1.03)	7.93(1.01)	9.25(1.75)	7.94(.96)	7.80(1.47)
Day 5, Sample 3, + 45mins	9.30(.96)	8.24(1.06)	9.52(1.75)	8.21(.95)	8.06(1.48)
Day 7, Sample 1, Wake	8.17(1.12)	7.76(1.23)	8.56(1.93)	7.78(2.03)	6.88(.65)
Day 7, Sample 2, + 30mins	8.77(1.02)	8.25(1.25)	9.06(1.93)	8.32(1.99)	7.34(.69)
Day 7, Sample 3, + 45mins	9.21(1.20)	8.51(1.24)	9.37(1.95)	8.58(1.99)	7.69(.70)
Day 8, Sample 1, Wake	7.77(.54)	7.97(1.30)	8.60(1.78)	7.45(1.43)	7.23(1.04)
Day 8, Sample 2, + 30mins	8.27(.62)	8.55(1.27)	9.15(1.81)	7.99(1.52)	7.83(1.04)
Day 8, Sample 3, + 45mins	8.63(.51)	9.17(1.34)	9.42(1.76)	8.30(1.57)	8.10(1.04)

6.3.8.2 Sampling Time Lapses. Potential differences in time lapses between sampling times (decimal format) were also examined using a series of one way between groups ANOVA. Time lapse between each sampling time point were the dependent variables; experimental condition with three levels was the independent variable. A significant difference was observed for the time lapse between the wake +30 and wake +45 samples on Day 7, $F(4,35)=5.93$, $p=.001$, partial eta squared= .43.

6.3.9 Intervention Use

The potential influence of intervention use on well-being outcomes was examined. Intervention use was measured as number of diary entries completed, as audio use was not recorded on the research website. A one-way between groups ANOVA was conducted; preliminary checks indicated no violations of assumptions. No significant differences were observed between the four intervention groups for the number of diary entries completed: $F(3, 25)= .33$, $p= .81$, $\eta p^2= .20$. This indicates no differences between the groups in terms of intervention use (see Table 39).

Table 39

Diary Entries from Participants who Completed Three Self-report Time Points

Condition	*M* (*SD*)
G1 (*n*= 10)	8.20 (2.94)
G2 (*n*= 5)	9.20 (1.79)
M1 (*n*= 8)	7.88 (1.64)
M2 (*n*=6)	9.00 (4.29)

6.3.10 Participant Retention and Adherence

The current study demonstrated a notable rate of attrition. Sixty-two participants completed Time 1; 46 participants completed Time 2; 37 participants completed all 3 time points (see Figure 37). Forty-two participants provided some salivary cortisol samples for the three time points during the study, although not all of these participants provided all required saliva samples. As a result of the large dropout rate, factors influencing participant retention to the study were examined. Retention was defined as the number of time points completed by participants.

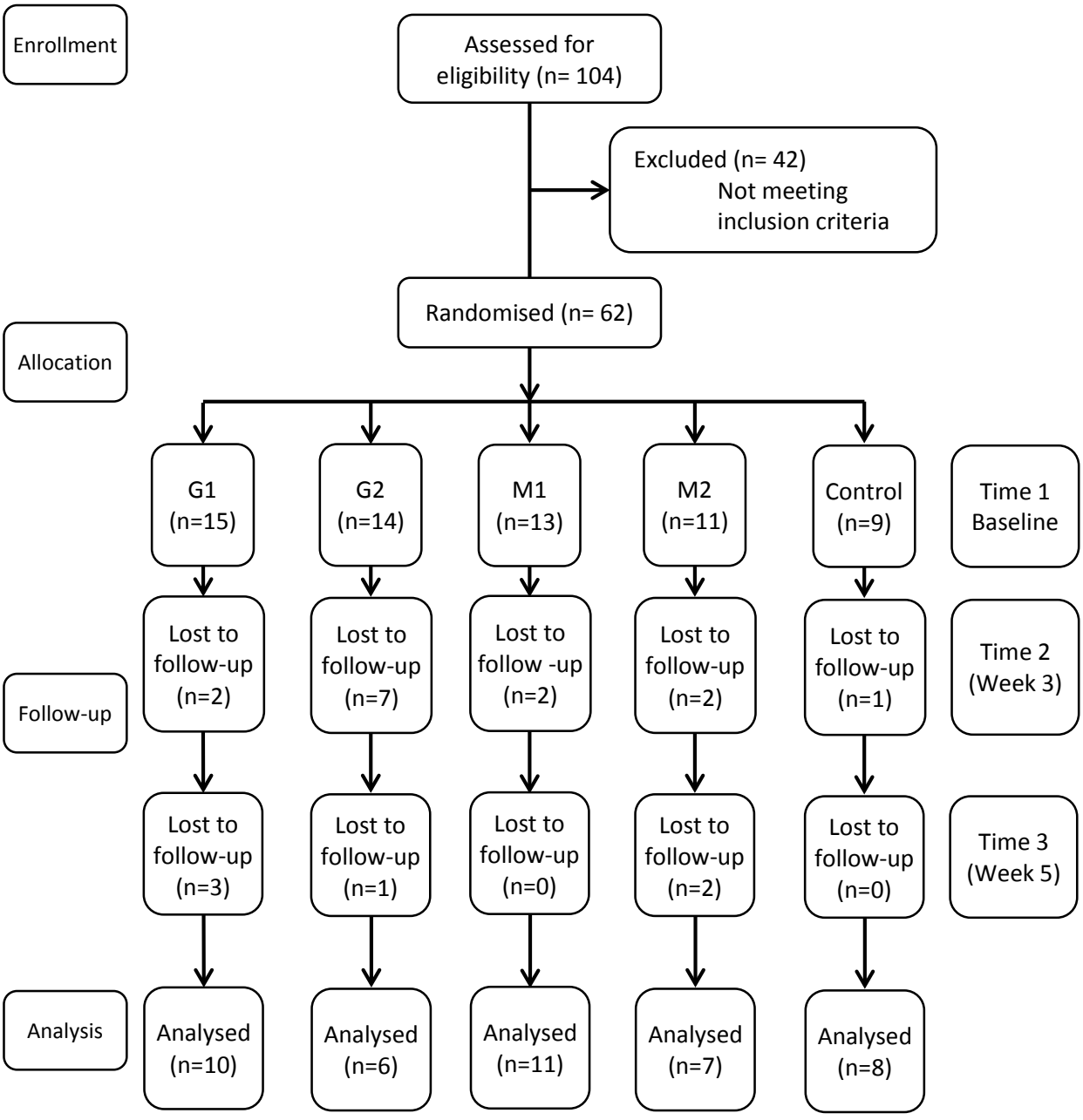

Figure 37. Flowchart of participant adherence over 3 time points.

6.3.11 Factors Influencing Participant Retention

6.3.11.1 Baseline differences. Chi-square tests of independence were conducted for categorical variables. No significant differences were observed; see Table 40.

Table 40

Chi-square Analysis Results for Differences in Baseline Categorical Variables

	Chi-square	*p*
Nationality	14.92	0.78
Religion	21.36	0.26
Education level	7.69	0.47
Relationship status	6.93	0.33
Income level	27.70	0.12
Smoke (y/n)	2.05	0.36

One-way between groups ANOVAs were also conducted to examine if differences exist between the groups for levels of continuous demographic variables and baseline self-report measures. As noted previously, the assumption of homogeneity of variances was violated for SWL and NA at baseline; as a result, Robust Tests of Equality of Means are consulted for inferential statistics. A significant difference between groups for baseline levels of SWL was found, $F(2,59) = 5.43$, $p=.007$, $\eta p^2= .28$; participants who completed Time 1 only had significantly lower levels of SWL. No significant differences were found for any other well-being or demographic variables, see Table 41.

Table 41

Means, Standard Deviations and Differences between Continuous Variables at Baseline, by Time Points Completed

	Time 1 only (*n*=16)	Time 2 only (*n*=9)	Time 3 only (*n*=37)	
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*p value*
Age	29.63(6.14)	27.91(6.75)	27.91(6.96)	.68
Weekly work hours	27.71(18.50)	22.15(20.84)	25.83(15.45)	.73
Daily cigarette consumption	4.64(4.51)	2.33(1.16)	4.79(7.65)	.82
No. cohabiting	1.63(1.03)	2.45(1.64)	1.86(1.36)	.28
Gratitude	32.00 (4.70)	33.78 (4.55)	32.57 (4.85)	.79
Mindfulness	52.50 (10.17)	53.44 (15.48)	51.16 (2.24)	.88
Satisfaction with Life	18.25 (6.43)	24.56 (6.25)	23.70 (5.53)	.007
Happiness	16.50 (6.58)	18.78 (5.31)	17.49 (5.07)	.54
Stress	31.87 (6.72)	30.67 (6.71)	29.65 (7.44)	.63
Positive Affect	32.40 (8.24)	33.56 (5.25)	34.73 (7.58)	.61
Negative Affect	25.40 (8.07)	25.22 (8.67)	25.11 (7.87)	.99
Depression	21.80 (5.63)	19.86 (3.18)	19.79 (4.68)	.40
Sleep Quality	12.33 (6.07)	9.33 (4.39)	10.19 (4.40)	.22
Perceived Social Support	61.25 (16.32)	69.56 (10.90)	65.95 (12.30)	.37

6.3.11.2 Experimental condition. Potential effects of the randomly assigned experimental condition on participant retention were also examined. A one-way between groups ANOVA was conducted, with experimental condition as the independent variable and time completed as the dependent variable. Preliminary checks were conducted to ensure assumptions of normality, homogeneity of variance, homogeneity of intercorrelations; these were not violated. No significant difference was found between experimental conditions; $F(4, 57)=2.28$, $p=.07$, $\eta p^2= .14$. The mean rates of trial completion (see Table 42) indicate that the G2 condition

demonstrate the lowest levels of retention. The control group, as expected due to the lower participant burden, demonstrated the highest levels of participant retention. Dunnett's test was therefore used to examine if adherence rates for the control group would be significantly higher than all other groups. The only significant difference observed was between the G2 condition and the control condition (mean difference= -.99).

Table 42

Time Points Completed for each Condition

Condition	*M* (*SD*)
G1 (*n*= 15)	2.53 (.74)
G2 (*n*= 14)	1.79 (.97)
M1 (*n*= 13)	2.46 (.78)
M2 (*n*=11)	2.18 (.87)
Control (*n*= 9)	2.67 (.71)

Finally, differences were examined between the control group and a single intervention group to investigate if the additional burden of intervention use resulted in lower adherence levels than cortisol sampling alone. Potential differences were examined using an independent samples t-test. Preliminary checks indicated that the assumption of homogeneity of variance was violated; as a result, equal variances were not assumed when interpreting inferential findings. No significant difference was observed, $t(12.57)= -1.59$, $p= .14$, r= .04.

6.3.11.3 Summary. No significant differences were observed between intervention conditions for intervention use. High attrition rates were observed during the study. No significant differences for sociodemographic variables or random allocation to experimental condition were found between participants who completed Time 1 only, Time 2 only or all three time points. Significant differences for adherence were not found for baseline levels of self-report measures, with the exception of satisfaction with life. Participants who completed Time 1 only had significantly lower levels of satisfaction with life.

6.3.12 Overall Summary

No significant changes over time between experimental conditions were found for the following variables: gratitude, mindfulness, life satisfaction, happiness, stress, positive affect, negative affect, depression, sleep, perceived social support or cortisol (wake, +30 minutes, CAR, AUC). Medium to large effect sizes were observed for many of these outcome variables, while observed power to detect a significant effect was often low. Non-significant order effects were observed for a number of variables. Participant attrition was high in the current study. Examination of differences between participants based on the stage of study completed demonstrated no significant differences in a range of factors, with the exception of satisfaction with life.

6.4 Discussion

This chapter will interpret and critically evaluate the findings of the current study. The aim of the study was to investigate the effects of two novel interventions, one based on mindfulness and one based on gratitude, on psychological and physical well-being using a randomised control trial (RCT). Firstly, the effects of the interventions on their constituent constructs, mindfulness and gratitude, will be addressed. The effects of the interventions on levels of happiness, satisfaction with life, positive affect, negative affect, stress, depression, sleep quality and perceived social support will then be discussed. The influence of order effects, and issues surrounding timing, effect sizes and power will then be discussed with reference to the empirical literature. This will be followed by a discussion of recruitment, adherence and retention problems, and the practical implications of these issues. Finally, implications for future intervention development and research directions will be discussed.

6.4.1 Manipulation Check

Increases in well-being, subsequent to mindfulness and gratitude interventions may be mediated by increases in mindfulness and gratitude levels respectively (Emmons & McCullough, 2003; Shapiro et al., 2008). It was therefore expected that the interventions used in the current study would result in increases in levels of mindfulness and gratitude, and that these increases would mediate any changes in well-being. For this reason, a manipulation check was initially conducted to examine intervention effects on the constructs upon which they are based.

6.4.1.1 Gratitude. Participating in either gratitude intervention condition did not result in significant changes in gratitude levels. This was unexpected and differs from previous research (Emmons & McCullough, 2003; Froh et al., 2008), which found increases in gratitude following gratitude interventions with diverse groups, including adolescents (Froh et al., 2008), students (Emmons & McCullough, 2003) and individuals with neuromuscular disease (Emmons & McCullough, 2003). The interventions used in previous work tend to be comprised of a single component, such as the gratitude diary (Emmons & McCullough, 2003, Froh et al., 2008). The difference observed between the current findings and previous work may be due to the dual component nature of the intervention in this study. The gratitude intervention conditions did demonstrate non-significant, sustained increases across the three time periods; with a similar pattern of change observed for both counterbalanced conditions. This indicates that the order in which actions are completed in a dual-component intervention does not influence gratitude levels over time.

The two mindfulness conditions demonstrated non-significant inverse patterns of change, indicating the potential presence of order effects. The non-significant differences in the trajectories of mindfulness levels from Time 2 to Time 3 between the groups also highlights the importance of such order effects when utilising longitudinal interventions. Notably across the three time points, engaging in the mindfulness writing component first was detrimental to gratitude levels. The mindfulness writing exercise involves listing thoughts, feelings and sensations in the current moment. If these are negatively valenced, their salience and proximity to the

listening exercise may influence the experience of this subsequent component and the intervention as a whole. Despite the emphasis on non-judgmental awareness in mindfulness, continuous engagement with an activity that flags up negative aspects of experience may ultimately reduce gratitude. Interestingly, when the writing component is completed first, negative aspects and experiences, such as tiredness or physical pain are reported more frequently than when the listening component is completed first. This may be because of a greater guided emphasis on non-judgemental awareness in the listening exercise; subsequently writing about thoughts, feelings and sensations may not then have the same negative valence.

When mindfulness order effects are removed, there is no change in gratitude levels over time. This is unsurprising, as an effect of mindfulness on gratitude levels was not expected, and suggests that mindfulness is incompatible with increasing gratitude levels. This may be because mindfulness involves a strong focus on the present in a non-judgmental manner (Baer, 2003); as a result stimuli are experienced neither positively nor negatively. Gratitude however, tends to involve appraisals of experiences or events as positive and beneficial (Roberts, 2004; Wood et al., 2008). Furthermore, there is often an element of retrospection when thinking about previous experiences that elicited gratitude (Emmons, 2013). In this sense, mindfulness may be incompatible with the basic tenets of gratitude. This is the first study to examine the effect of mindfulness interventions on levels of gratitude over time. Findings indicate that mindfulness interventions may only impact on gratitude at the level of order effects; the overall construct of mindfulness does not appear to influence

gratitude levels. The gratitude interventions demonstrate similar although not significant increases in gratitude levels.

6.4.1.2 Mindfulness. The gratitude and mindfulness interventions in the current study did not result in significant differences in levels of mindfulness over time. For both mindfulness intervention conditions, non-significant increases in mindfulness levels were observed across the three time periods, which were expected. Although the patterns for both conditions are similar, participants who completed the listening component first demonstrated greater increases in mindfulness. This may occur for similar reasons to those discussed in relation to gratitude levels. Potentially negative thoughts, feelings and sensations experienced immediately before engaging in the mindfulness meditation, may carry over to the subsequent listening exercise. It may also be that the action of writing about thoughts, feelings and sensations is not fully compatible with the central tenets of mindfulness as it involves a level of secondary processing when engaging in the listing exercise (Carmody, 2009; Grabovac et al., 2011).

Interestingly, both gratitude conditions also demonstrate non-significant increases in mindfulness over time. This was not expected and highlights the tentative potential of a shared pathway between gratitude and mindfulness for increasing mindfulness levels. Order effects may also play a role for the gratitude conditions; engaging in the writing component first, results in a levelling off of mindfulness from Time 2 to Time 3 that is not seen in the alternate condition. As noted, listing things you are grateful for involves recalling past experiences and events, and

appraising them as positive. This order may therefore lead to past focused attention that is not be compatible with the non-judgmental approach of mindfulness (Baer, 2003; Carmody, 2009; Grabovac et al., 2011), and is not conducive to enhancing mindfulness levels. The gratitude listening exercise also incorporates a degree of retrospection but contains a strong, guided emphasis on feeling gratitude in the present moment, rather than solely recalling instances of gratitude. Engaging in the listening component first may therefore result in more present-focused, non-judgmental attention that carries over to the subsequent writing component. Thus the gratitude conditions may be differentiated in terms of order effects.

Both gratitude and mindfulness interventions demonstrate some potential to increase levels of mindfulness over time. The order in which components are completed may influence intervention efficacy, with engaging in the listening exercise first potentially more effective for both constructs. This may be due to a present-moment focus in both the grateful reflection and mindfulness Body Scan. It is important to note that, to the author's knowledge, this is the first study to examine the effects of gratitude on mindfulness levels. Furthermore, previous research has not examined the order effects of activities in mindfulness interventions. Existing programs such as MBSR and MBCT involve multiple components and are usually examined as stand-alone interventions (Anderson, 2007; Grossman et al., 2010; Teasdale et al., 2000). The multi-component nature of existing mindfulness interventions has been previously highlighted as problematic (Keng et al., 2011), as it is unclear whether differences exist between individual aspects of the interventions that could influence well-being outcomes. The influence of individual components

has received scant attention in the empirical literature; the current study indicates that the order in which activities are engaged in may influence mindfulness levels over time.

6.4.1.3 Association between mindfulness and gratitude. The findings of the manipulation check suggets that the gratitude intervention can lead to non-significant increases levels of mindfulness over time, while the mindfulness intervention does not affect levels of gratitude. This is the first investigation of the effects of mindfulness and gratitude interventions on levels of mindfulness and gratitude. Previous research has examined the associations between aspects of mindfulness and gratitude however (Ahrens, Breetz & Forbes, 2011; McIntosh, 2007; Rothaupt & Morgan, 2007). Rothaupt and Morgan (2007), examined mindfulness experiences of six counsellors who self-identified as mindfulness practitioners (Rothaupt & Morgan, 2007). They found that a main emergent theme related to outcomes of mindfulness was ‘abundant gratitude’. Some participants discussed how the mindfulness approach of being non-judgmental and open to all experiences could lead to a grateful and appreciative view of the world. This implies that mindfulness practices can lead to increased gratitude but Rothaupt and Morgan (2007) emphasise a reciprocal and mutually reinforcing nature of the relationship between mindfulness and gratitude. This removes the focus on directionality and repositions the explanation toward a general reported association between the two constructs. The current study found less evidence for a reciprocal relationship, due to the lack of observed effect of the mindfulness intervention on gratitude levels.

Ahrens et al. (2011) found that baseline levels of mindfulness predicted baseline levels of trait gratitude and levels of gratitude during a 14-day gratitude diary exercise. Furthermore, individuals with higher levels of baseline mindfulness were more grateful in their diary entries and had increased tendencies toward prosociality. These findings suggest that mindfulness influences the outcome of participating in a gratitude intervention, while the current study indicates that the mindfulness intervention has no effect on gratitude levels. The study by Ahrens et al. utilised a single-component gratitude intervention and does not report the effect of the intervention on levels of mindfulness at study completion. It is thus limited in examining the interaction between mindfulness and gratitude, and how participation in an intervention based on one construct can influence levels of the alternate construct.

Another study, conducted by McIntosh (2007), adopted a more integrated approach to examining the effects of gratitude and mindfulness. In this study, participants completed one of two experimental conditions for a period of 5 minutes, or completed a neutral control condition that involved writing about their living room. One experimental condition involved a gratitude listing exercise similar to that used in the current study. The other experimental condition contained aspects of gratitude and mindfulness. It involved participants thinking of something they were grateful for, writing a word that reminded them of that thing and then imagining or tapping into emotions or feelings association with the item they listed. They were requested to do this several times during the 5 minute intervention, and were requested to maintain attention on the task at all times. These activities were

preceded by a guided breathing exercise. Incorporating mindfulness into the latter experimental condition enabled an investigation of the effects of a dual-component approach in comparison to a gratitude or neutral condition. McIntosh found that both interventions increased levels of positive affect and decreased levels of negative affect better than the control group. Levels of empathy moderated the effects of the interventions; the interventions performed similarly well for high empathy participants but the mixed gratitude-mindfulness intervention performed better for low-empathy individuals. These findings demonstrate the potential of dual-component interventions to improve well-being relative to a control, particularly for individuals displaying low levels of positive personality variables. They also indicate the importance of considering moderating variables in observed effects. The study is limited in that it does not consider order effects when completing the mixed intervention however; these have been shown to be important in the current study. Further potential confounds in the mixed intervention condition involve the additional activities required in comparison to the gratitude intervention. The inclusion of additional elements, requiring the participant to engage more with the intervention, may influence the study outcomes.

Previous research on gratitude and mindfulness, although scarce, suggests some association between the two constructs. The current research adopts a thorough approach to examining the interaction of these two constructs and highlights the importance of potential order effects not examined in previous work. Dual-component interventions demonstrate potential beneficial effects for levels of

mindfulness and gratitude but order effects and moderating variables must be taken into account.

6.4.2 Intervention Effects on Well-being Variables

6.4.2.1 Satisfaction with life. There were no significant differences between experimental conditions for levels of satisfaction with life (SWL). This was unexpected, as previous research has demonstrated positive associations between gratitude and SWL (Emmons & McCullough, 2003; Froh et al., 2008; Wood et al., 2009b), and mindfulness and SWL (Brown & Ryan, 2003; Grossman et al., 2010; Shapiro et al., 2005). Despite this, all intervention conditions demonstrated some non-significant increases in levels of SWL; with each intervention condition demonstrates a unique pattern over time.

The two gratitude conditions demonstrate the greatest similarities over time, however potential non-significant order effects are still apparent. Potential order effects are also observed for the mindfulness conditions. In addition, when examined as a single construct, mindfulness demonstrates an inverse pattern of change to gratitude. Further, the findings indicate that when participants engage in the writing component first they experience immediate, although non-significant, increases in SWL that are maintained over time, regardless of construct. When participants engage in the listening component first, the construct rather than the order may be more influential for potential changes over time. At a construct level, there is potential for non-significant immediate increases for gratitude and delayed increases

for mindfulness. Thus, order and construct effects may exist for SWL over time, which must be taken into consideration.

6.4.2.2 Happiness. There were no significant differences between the experimental conditions for levels of happiness, although all intervention groups demonstrated increases in happiness over time. While increases in happiness following intervention use were expected, the lack of a significant change over time was unexpected. Gratitude has previously been found to predict happiness levels (Macaskill, 2012), and gratitude interventions have been associated with increased levels of happiness over time (Seligman et al., 2005; Toepfer, Cichy & Peters, 2012). Previous studies tend to utilise single component gratitude interventions; the current study demonstrates differences between the gratitude intervention conditions, suggesting the presence of order effects. Potential order effects are also observed for changes over time in the mindfulness interventions. These changes were not significant however, which was unexpected as mindfulness has been associated with happiness in terms of observer reports (Choi et al., 2012), in self-reports of children with externalising disorders (Bogels et al., 2008), and in general population samples (Carson et al., 2004).

In the current study the gratitude intervention conditions demonstrate the potential to result in slight increases in happiness when used over a longitudinal period; negligible increases are observed initially for both conditions. Greater potential order effects are observed for the mindfulness conditions. When participants engaged in the mindfulness listening component first they demonstrated sustained increases over

time. When participants engaged in the mindfulness writing component first they demonstrated the greatest overall increase in happiness but this was only apparent between Time 2 and Time 3. While these findings are not significant, they suggest the potential for the order of activities to influence the pattern by which mindfulness impacts on happiness levels over time. An interesting similarity between intervention conditions is that the conditions beginning with the more established intervention components, the Body Scan and gratitude diary (Carmody, 2009; Emmons & McCullough, 2003), demonstrate the largest non-significant increases in happiness levels from Time 2 to Time 3. The similarity in magnitude of change between these two groups indicates the importance of these intervention components for happiness levels over time. Overall the findings suggest that mindfulness has greater potential for sustained increases in happiness over time but that order of intervention activities may influence the observed patterns of change.

6.4.2.3 Positive affect. Significant differences between experimental conditions over time were not observed. This was unexpected, as previous research has demonstrated the beneficial effects of both mindfulness (Anderson et al., 2007; Brown & Ryan, 2003) and gratitude (Emmons & McCullough, 2003; Froh et al., 2009; McCullough et al., 2002; Watkins et al., 2003) for positive affect (PA). In the current study both mindfulness conditions demonstrated the same pattern over time, suggesting the possibility that the order of mindfulness intervention activity may not influence the pattern of PA outcomes. An initial decline observed in both conditions may be due to a practice effect, as indicated in relation to other findings in the

current study. However the interventions, and mindfulness as a single construct, do not demonstrate real improvement for levels of positive affect.

A non-significant difference is observed between the gratitude intervention conditions suggesting order effects. Engaging in writing first demonstrates a greater potential increase in positive affect, while engaging in the listening exercise first demonstrates sustained, albeit non-significant, decreases in positive affect. The magnitude of change is small and when gratitude is examined as a single construct, no change is observed over time for levels of positive affect. The results indicate that neither gratitude nor mindfulness increased levels of positive affect. Further, order of activities does not influence changes in positive affect mindfulness interventions but is a consideration for gratitude interventions.

6.4.2.4 Negative affect. No significant differences were observed between the experimental conditions for levels of negative affect (NA). This is unexpected as there is consistent evidence in the empirical literature for the beneficial effects of mindfulness (Collard et al., 2008; Duncan & Bardake, 2010; Giluk, 2009; Schroevers & Brandsma, 2010) and gratitude (Froh et al., 2008; Froh et al., 2009; McCullough, Emmons & Tsang, 2002; Watkins et al., 2003) for reducing levels of NA. All intervention conditions demonstrated some non-significant decreases in negative affect over time. Interestingly the patterns of change observed differed within constructs but were similar across orders; suggesting the possible importance of order effects within constructs for NA.

For both mindfulness and gratitude, the intervention conditions beginning with the writing component demonstrated sustained non-significant decreases, following the same pattern over time.. The intervention conditions beginning with the listening component maintained a similar pattern but demonstrated a lower magnitude of change overall. Similarities are therefore observed between the constructs and between the orders. Completing the writing component first may therefore be more beneficial and may represent an appropriate means of reducing levels of negative affect in future positive psychological interventions. Focusing on the order of activities shifts the focus away from the importance of intervention construct for negative affect. This is supported by the non-significant similarities between mindfulness and gratitude as constructs when order effects are removed; indicating that, at a construct level, they do not differ in the way they influence negative affect over time.

6.4.2.5 Stress. No significant differences were observed between experimental groups for levels of stress in the current study. This was particularly unexpected as there is strong empirical evidence to support the usefulness of mindfulness for reducing stress over time (Carlson et al., 2001; Williams et al., 2001). The MBSR program demonstrates consistent reductions in stress levels for mindfulness practitioners (Tsang et al., 2009). Similarly, gratitude interventions consistently demonstrate reductions in levels of stress for college students (Wood et al., 2008), cancer patients (Carlson et al., 2001), and general population (Williams et al., 2001) samples. Despite failing to reach a statistically significant effect, all experimental

conditions demonstrate non-significant reductions in levels of stress. Both mindfulness intervention conditions demonstrate similar patterns across the three time periods; there is initially no change, followed by a small decline from Time 2 to Time 3. This indicates that potential effects of mindfulness on stress levels over time may be due to a longitudinal, rather than an immediate effect.

Similarities in the patterns of stress levels are also observed for the gratitude intervention conditions. Both gratitude conditions demonstrated an immediate non-significant decrease in stress levels; this is sustained when participants engage in the writing activity first but levels off when participants engage in the listening exercise first. This provides tentative support for an immediate effect of gratitude, with the order of activities in the gratitude intervention determining the trajectory of any potential change. Engaging in the writing component first also demonstrates greater decreases in stress; although these decreases are not statistically significant and are observed for both conditions. These findings indicate that when attempting to reduce levels of stress, the constructs used may influence stress levels differently. There is some support for an immediate impact of gratitude that can be maintained, while mindfulness may require sustained longitudinal practice for an effect to occur. The order of activities is only a potential consideration for the effect of gratitude on stress.

6.4.2.6 Depression. Levels of depression also demonstrated no significant changes over time or between the experimental conditions. This was again unexpected due to previous findings that mindfulness (Brown & Ryan, 2003; Ma &

Teasdale, 2004; Sephton et al., 2007; Teasdale et al., 1995) and gratitude (Park et al., 2004; Seligman et al., 2005; Wood et al., 2008a) demonstrate reductions in depression. Despite failing to reach a statistically significant effect, all experimental groups demonstrate some decreases in depression levels across three time points. The patterns for both mindfulness conditions over time are the same; non-significant differences are observed between the two gratitude conditions however. In the gratitude conditions, when participants engage in the writing component first they demonstrate a larger, sustained decrease in depression than in the alternate condition. This decrease is comparable to the slight non-significant patterns of change observed for both mindfulness conditions. When participants engaged in the listening aspect of the gratitude intervention first, there was a delayed non-significant effect on depression levels; this latter pattern differs from the other three intervention conditions.

The findings suggest that mindfulness may be a more beneficial construct for reducing depression, as order effects. Potential differences between gratitude and mindfulness may be due to mindfulness being more effective for reducing depressive symptomatology. Mindfulness has consistently demonstrated the ability to reduce levels of depression (Keng et al., 2011); the MBCT program was established specifically to help prevent relapse of depressive episodes (Teasdale et al., 1995). Mindfulness is proposed to encourage non-judgemental observation of negative thoughts or feelings that arise, which may lead to and/or perpetuate depressive states (Carmody, 2009; Teasdale et al., 1995). This orientation to experience of negative feelings and thoughts may contribute to the sustained decrease in levels of

depression observed in the current study. It may also explain the more immediate benefit observed in the mindfulness groups in comparison to the gratitude groups. In mindfulness the focus is on changing the relationship and awareness to thoughts (Teasdale et al., 2000) and so the effects of mindfulness in the current study may be observed more quickly. The effects of gratitude may be more evident longitudinally because the benefits of focusing on things you are grateful for might have a cumulative positive effect over time. Thus engaging in gratitude over a longer period may be necessary to have an effect on depression.

6.4.2.7 Social support. Significant differences were not observed between the experimental conditions for levels of perceived social. Previous research on gratitude has demonstrated that social support is positively associated with levels of gratitude (Bartlett et al., 2012; Wood et al., 2008). The traditional conceptual basis of gratitude and the more recent dispositional model (Wood et al., 2010) also involve an interpersonal element of gratitude; in this sense social interactions are seen to elicit and be supported by gratitude. The non-significant findings of this study do not appear to support previous associations between gratitude and social support. Less attention has been given in the literature to associations between mindfulness and social support; however there is evidence to suggest that programs such as MBCT can help improve psychosocial outcomes, such as social phobia (Keng et al., 2011). Mindfulness has also been associated with increased marital satisfaction (Burpee & Langer, 2005). Furthermore, the inherent social nature of many mindfulness programs, although not yet fully explored in the literature, may contribute to

improved well-being. In the current examination, mindfulness was not found to significantly influence social support levels.

Non-significant differences were observed between constructs, between conditions within constructs, and between order types in the current study. At a construct level, gratitude has greater potential to increase levels of social support over time. Possible order effects are observed for the gratitude conditions, with an immediate increase observed when the listening exercise is completed first and a delayed increase noted for the alternate condition. Order effects may also influence intervention effects for the mindfulness conditions. Engaging in the writing exercise leads to an initial non-significant increase that is maintained with continued practice; engaging in the listening exercise first leads to an initial increase followed by a return to baseline.

Gratitude therefore may be more beneficial than mindfulness for improving levels of social support; however order effects may play a role for both constructs. Additionally, intervention conditions beginning with the listening component for both constructs demonstrate the potential for similar initial increases. This indicates some similarities between orders. The range of differences and similarities between and within constructs and orders, and the lack of a statistically meaningful effect, limits the conclusions that can be drawn about the effect of the interventions used on levels of perceived social support.

6.4.2.8 Sleep quality. The current study failed to detect significant differences between experimental conditions for levels of sleep quality. Previous research has

demonstrated associations between gratitude and increased sleep quality and duration, and lower levels of sleep latency and daytime dysfunction (Emmons & McCullough, 2003; Wood et al., 2009a). Mindfulness has also been associated with improved sleep quality (Howell et al., 2008), sleep functioning (Howell et al., 2010), and reduced insomnia symptoms (Cincotta et al., 2011). Despite the lack of significant findings in the current study, all intervention conditions demonstrated some improvements in levels of sleep quality over time.

For gratitude, improved sleep has been suggested to result from positive pre-sleep cognitions, with gratitude interventions increasing the likelihood of positive pre-sleep thoughts rather than negative or worrying thoughts (Wood et al., 2009a). Wood et al. (2009a) also found that gratitude can predict sleep quality above the effects of the Big Five personality traits. In the current study, participants were requested to complete the intervention in the evening, which may have contributed to some of the non-significant improvements in sleep. Similarly mindfulness has been suggested to improve sleep by reducing arousal-producing processes (Howell et al., 2008; Howell et al., 2010). These processes include negative and ruminative thoughts, worry and maladaptive sleep related beliefs (Cincotta et al., 2011; Howell et al., 2010). Cincotta et al. (2011) found support for this, as mindfulness reduced pre-sleep arousal over an 8-week period. It is suggested that mindful attention, fostered through mindfulness practice, can increase awareness to sleep cues and increase the ability to manage sleep inhibiting cues, as well as increased acceptance of physical and mental stimuli, leading to improved self-reported sleep quality (Cincotta et al., 2011; Howell et al., 2010). Reduction and acceptance of pre-sleep cognitive and physical arousal as a

result of mindfulness practice may also explain the observed improvements in the current study.

Trajectories of sleep quality were similar for all intervention conditions, with a sustained non-significant improvement observed for all conditions. For mindfulness, the increase in sleep quality was greatest between Time 2 and Time 3. This was possibly due to a longer duration of intervention use by Time 3. Cincotta et al. (2011) previously found that there is a cumulative effect of mindfulness practice on pre-sleep cognitive arousal, which in turn influences sleep quality and duration. These findings indicate increased benefits for perceived sleep quality are observed in the mindfulness intervention conditions with sustained practice. Continued gratitude practice does not appear have the potential to lead to further large improvements in the same manner as the mindfulness conditions. This difference may be because continued mindfulness practice can result in further increases in the ability to increase awareness and acceptance of sleep cues and physical and cognitive stimuli over time. Pre-sleep cognitions resulting from gratitude may not share the same upward trajectory longitudinally, but instead effect immediate change, and this change is maintained. Furthermore, although significant differences are not observed for the intervention conditions, they demonstrate considerably different patterns of change over time to the control condition, which remained stable throughout.

Unlike other outcome variables, sleep quality demonstrates quite similar patterns across all groups at all time points. As discussed, a potential reason for this is the idea that gratitude and mindfulness influence pre-sleep cognitions and minimise ruminative thoughts and worry (Cincotta et al., 2011; Wood et al., 2009). If both

constructs operate in a similar way to influence sleep quality it is logical that patterns of change will reflect this similarity. Secondly, although sleep-quality is assessed as a self-report measure in the current study it could be considered a more objective measure than, for instance, happiness. The items comprising the Sleep Quality Index (Jenkins et al., 1988) focus on experiences associated with sleep, such as how many days participants had trouble falling asleep, rather than on attitudes or feelings. Thus, responses on the Sleep Quality Index may represent more objective accounts of recent behaviours and/or experiences. Such responding could be less influenced by response bias and issues associated with retrospective recall. For instance, participants may be more likely to more accurately recall the number of nights they experienced poor sleep than the frequency with which they experienced aspects of stress in the last week. If this is the case, order effects could also be minimised for sleep quality and so similarities between the constructs would be increased. The implications of this may mean that the type and order of interventions and components respectively, would have more influence on measures of latent psychological traits and states than on reports of behaviour and experience.

6.4.3 The Effect of Time on Self-report Measures

Although no significant effects of the intervention condition were observed for the outcome variables in the current study, main effects were observed for time for a number of outcome variables. These included mindfulness, happiness, stress, NA, depression and sleep quality. The patterns of change over time for levels of these variables were all in the expected directions. This indicates that over time

participants became more mindful and happy, with improved sleep quality. They also became less depressed, stressed and displayed lower levels of negative affect as a result of time. Variables such as stress, NA, depression and sleep quality, represent state-like aspects of well-being that can fluctuate over time. The measurement tools used to evaluate them in the current study, such as the Perceived Stress Scale (Cohen et al., 1983) and the Edinburgh Depression Scale (Cox et al., 1987), reflect this. Such scales use time-based reference points for participant recall; it is not then necessarily surprising that these state-like variables may change as a result of time.

As measured in the current study, mindfulness and happiness can be considered traits rather than states. The Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) used is a trait-like measure as it assesses individual's general dispositions toward happiness. It is important to remember that although an argument has been made for a set-point of happiness (Lykken & Tellegen, 1996), levels of happiness can significantly increase or decrease over time. Headey (2008) argues strongly against the immutability of the set-point theory based on findings that life goals and life events can all significantly alter individuals' original levels of happiness. Lyubomirsky et al. (2011) also argue that people can significantly improve their happiness over time by consistently engaging in happiness-increasing activities. With regard to the trait-like nature of mindfulness, as measured by the Mindfulness Awareness Attention Scale (Brown & Ryan, 2003), levels of mindfulness assessed using this scale have previously demonstrated changes over time (Birnie, Speca & Carlson, 2010; Nyklicek & Kuijpers, 2008; Shapiro et al., 2008). Although the observed increases in mindfulness as measured by the MAAS tend to result from

participating in mindfulness programs such as MBSR or MBCT, they do suggest the overall capacity for mindfulness levels to demonstrate fluctuations. Thus despite the trait-like nature of mindfulness and happiness it is not unexpected that levels may change over time.

An additional finding regarding the main effects for time is that there appears to be a relationship between time effects, patterns of change over time, and the whether the type of variables examined are positive or negative. For instance, mindfulness, happiness and sleep quality can be considered positive variables, reflecting positive aspects of well-being. For these three variables there is a main effect for time and the patterns of change over time are the same or similar across all intervention groups. The variables stress, NA and depression can be considered negative variables, as they represent negative aspects of well-being. There are main effects for time for each of these variables but the patterns of change over time are different across the experimental conditions. Levels of stress demonstrate differences between the mindfulness and gratitude conditions in terms of the onset of observed changes. For NA there is a difference between and within groups based on the order of actions engaged, although there is an overall decrease with time for all groups. For depression there are differences between the experimental condition and intervention construct in terms of patterns of change over time. These findings suggest that when main effects for time occur, intervention constructs demonstrate similar patterns of change over time for positive variables. For negative variables main effects for time are accompanied by increased complexity of patterns of change in terms of order effects and differences between and within intervention types. This may indicate that

there is no difference between mindfulness and gratitude for positive aspects of well-being but that the interventions could exert differential influences on negative aspects over time. Slightly higher effect sizes for the negative variable interaction effects than for the positive variables provide some support for the interaction between experimental condition and time for negative variables.

6.4.4 Overall Intervention Effects for Self-report Measures

Several mixed between within subjects ANOVAs were conducted to examine intervention effects on outcome variables. Although application of Bonferroni corrections is recommended subsequent to utilising multiple comparisons, to account for possible Type I error, no formal correction was applied in the current study. As noted by Papousek et al. (2010), Bonferroni corrections can result in large loss of power, particularly when effect sizes are small. As previously noted, only small effect sizes were observed for all outcome measures in the current study. Had Bonferroni corrections been applied to the present findings, values would need to be extremely high to be considered significant (Cohen, 1990). Further, at the given significance level, significant values were not observed. Papousek et al. (2010) suggest that a sufficient strategy to account for risk of Type I error is to only attribute importance to consistently observed results. This strategy was adopted in the current study through the interpretation of findings related to individual interventions, intervention constructs and order effects. Therefore the findings of the current study were retained without the application of formal corrections.

The findings of this study indicate that the mindfulness and gratitude interventions did not result in significant changes in levels of gratitude, mindfulness, happiness, satisfaction with life, positive affect, negative affect, stress, depression, sleep quality or perceived social support. There are a number of potential reasons for this, including insufficient power to detect change. This can be seen in the consistently low levels of observed power obtained in the study, ranging from .12 to .46, which are below the desired value of .80. The majority of outcome variables examined in this study demonstrated tentative support for beneficial effects of the interventions, with small non-significant increases observed for levels of positive well-being variables and decreases observed for negative variables. This suggests that had the study been sufficiently powered, significant differences may have been observed between the experimental conditions. The medium to large effect sizes obtained for all outcome variables in the current study also supports this. The main reason the study lacked sufficient power may be due to the low number of participants fully complying with study protocol and completing measures of well-being. Sample size calculations indicate that, using the average effect size obtained for all outcome variables (.25) in the current study, 65 participants were required to confidently detect a significant effect. As only 35 participants provided full self-report data, it is clear that participant numbers were insufficient to detect a significant effect of the gratitude and mindfulness interventions. Similar issues of adherence were observed for cortisol outcomes; issues of recruitment, adherence and retention will be discussed shortly.

6.4.5 Cortisol Outcomes

The low number of participants who contributed sufficient samples for cortisol analysis in the current study limits interpretation of the effects of the interventions. As a result of the low numbers, data could not be examined by experimental condition and were instead examined by individual participant. Thus the current discussion addresses changes in cortisol secretion in terms of participant levels and observable patterns in the data. An initial examination of the data indicated variability in cortisol levels across sampling days for all participants. Each participant demonstrated at least 2 sampling days in which the morning cortisol peak appears to have been missed. This is evident in patterns where little to no changes are observed across the three time points, or where cortisol levels decrease from the waking sample. As discussed by Smyth et al. (2013) and O'Connor et al. (2009), such patterns of cortisol secretion occur when participants do not collect their waking samples immediately upon waking. Delays of 5 to 15 minutes have been argued to significantly impact on waking cortisol (Dockray et al., 2008; Okun et al., 2010; Smyth et al., 2013) and appear to have influenced cortisol levels in the current study. Participants did not self-report delays in collecting waking samples and so accurate inferences of lapses in sampling cannot be made. Had electronic monitoring devices for sampling been used these would allow for a more accurate record of the timing of morning sample collections; such devices require resources beyond the scope of those available in the current study however. Regardless of the lack of accurate data on exact lapses between waking and sample collection, we can confidently infer that for all participants, the sampling protocol was not adhered to at

all time points. The lack of adherence for participants included in the analysis, and for all study participants, hinders our capacity to address the study research question. This is because incorrect sampling adversely impacts on cortisol (Adam & Kumari, 2009; Clow et al., 2004; Kudielka & Kirschbaum, 2003), limiting our ability to draw conclusions about change over time between intervention groups.

In addition to issues of incorrect sampling, individual differences in such a small sample may contribute to variability observed between participants in the current study. As discussed by Stalder et al. (2009; 2010) in an extensive case study approach, the CAR demonstrates considerable day-to-day variability. They found an inverse association between prior day emotional state and cortisol $AUC_{i,}$ and a positive association between expectations for the coming day and AUC_i (Stalder et al., 2010). Stalder et al. (2009) also observed a strong relationship between changes in waking and changes in the waking sample and the CAR. These findings were based on data that was collected by rigorously adhering to study protocols however, unlike data in the current study that demonstrates a lack of adherence. Thus, state variability of cortisol (Hellhammer et al., 2007; Stalder et al., 2009; 2010) coupled with poor or non-adherence to sampling protocols can result in inconsistencies and inaccuracies in cortisol levels over time.

In the current study such inconsistencies can be observed for all cortisol study outcomes. For the CAR no consistent patterns of change are observed within groups or across participants. Half of the participants demonstrate overall decreases in the CAR however; each of these participated in an intervention condition. Those participants who do not demonstrate decreases in the CAR demonstrate inaccurate

sample collection across sampling time periods during the study. For instance participant 24, in the Mindfulness 2 condition, demonstrates very small CARs and/or missed peaks for days 1, 2, 4 and 7, indicating consistent non-adherence. Such unusual and unexpected patterns of cortisol secretion, most likely resulting from non-adherence, may contribute the lack of consistency between or within conditions and participants in the current study.

This can also be seen for the two individual morning samples analysed, waking cortisol and cortisol at +30 minutes. For waking cortisol, initial declines are mostly observed for intervention condition participants. Only two participants, participants 48 and 49, demonstrate sustained declines in waking cortisol, while others demonstrate a return toward or past baseline. This latter pattern is opposite to that of the two control participants. For waking cortisol, participant 24 is the only participant to demonstrate a consistent increase in cortisol levels but, as discussed, this may be attributable to a consistent lack of adherence to sampling protocols. The +30 minutes samples also demonstrate considerable variability in cortisol levels over time across participants, in a similar manner observed to that of the CAR. Despite the lack of consistent patterns of change, the majority of intervention condition participants demonstrate some decreases in the CAR, with the exception of participant 24 and participant 38. The two control condition participants demonstrate little to no change for waking cortisol. For the AUC_G, participant 24 also demonstrated an unexpected sustained increase in cortisol; participant 70 demonstrated no change. All other conditions demonstrated decreases in the AUC_G, although this was approaching baseline for participant 77.

Examining the trends of the means for all cortisol outcomes, and taking into consideration the limitations of non-adherence, it is clear that an interpretation of intervention effects cannot be confidently made in the current study. Participant 24 has been used as an example of potentially consistent effects of poor adherence across cortisol outcomes but, as noted previously, all participants demonstrated some instances of apparent non-adherence. The lack of confidence that samples accurately reflect specified time points is a limitation of the current study. A further limitation is the lack of participants overall who could be included in analyses of cortisol outcomes. Previous research has consistently highlighted poor adherence of participants to sampling protocols, even of low burden (Halpern et al., 2012). Thus while some level of non-adherence was expected the amount experienced in the current study was not. The small numbers who could be included in analyses removes the robustness of the RCT method and removes the ability to perform robust inferential examinations of intervention effects. The usefulness of intention-to-treat analyses was considered to overcome the statistical limitations of such a small sample size but was found not to meaningfully contribute to analyses to warrant its use in the current study. Future research could incorporate more frequent reminders of sampling, accompanied by reminders of the importance of sampling accuracy, close monitoring of sample times and electronic caps to address poor adherence. Despite these issues however, some promising trends are observed in the data when examined at the level of individual differences. Intervention participants often demonstrate expected overall decreases in cortisol levels individually and in comparison to control condition participants. Thus incorporating cortisol outcome

measures into future research on intervention effects is worthwhile. Consideration of individual and state variability and of adherence and retention must be taken into account in such examinations however.

6.4.6 Participant Recruitment, Adherence and Retention

6.4.6.1 Sample size issues. The low overall participant numbers at intervention completion was problematic and exacerbated by issues with participant recruitment, retention and adherence to trial protocol. It is possible that the low numbers of fully compliant participants influenced the ability to examine cortisol outcomes and to detect a significant effect of the experimental conditions on self-report variables. Increased risk of a Type II error as a result of low sample sizes is a commonly cited issue with randomised control trials and randomised clinical trials (Brierley, Richardson & Torgerson, 2012; Mills et al., 2011; Peters-Lawrence et al., 2012; Watson & Torgerson, 2006). Small sample sizes in randomised trials can also have additional effects in terms of the ability to accurately interpret study findings, cost implications, and availability and collection of biological samples (Yu et al., 2012). As such, the ability to adequately recruit the required number of participants can determine the success of a trial such as conducted in the current study. The required sample size for the current study was based on sample size calculations for a mixed between-within subjects design and drew on a review of previous research in the area. Results of this analysis initially indicated that a total sample size of 200 participants would be necessary to detect differences in cortisol levels and self-report measures of well-being.

The required sample size was not achieved in the current study despite extensive recruitment. There were 938 views of the research website, with 104 women subsequently contacting the researcher to participate. These 104 women represent 11.09% of those who viewed the study details online; indicating a considerable initial drop-off in numbers signing up to the study. It is important to note that each website view does not necessarily mean an individual potential participant; some views may have been repeat visits to the research website. Despite this, the proportion of participants enrolling at this stage was lower than expected. In a review of cohort trials, McDonald et al. (2006) reported similar findings. They found that 63% of 114 trials reported slower recruitment than expected in the first quarter of the allocated recruitment period. In the current study 62 participants from the initial sample of 104 were successfully recruited to the trial; this represents 59.62% of potential participants who enrolled. This figure also represents 31% of the required sample size as indicated by sample size calculations. Reviews of randomised trials have consistently found similar problems with low recruitment rates. McDonald et al. (2006) for instance found that of the 114 trials reviewed, 69% failed to recruit their required sample size, with a number of trials ceasing enrolment before the end of the recruitment period due to poor recruitment progress. In a review of trials published in the Lancet and British Medical Journal, Puffer and Torgerson (2003) also found that nearly 60% of trials failed to meet their recruitment target.

Furthermore, the findings of a meta-analysis conducted by Roberts & DelVecchio (2000) indicate that the average attrition rate for longitudinal trials is 42%. This is reflected in the attrition rate observed in the current study between baseline measures

and study completion. Fully compliant participants were considered to be those who adhered to the full study protocol, including completing self-report measures and sampling, at all three time points. Of the 62 participants successfully recruited to the trial, 35 participants (56.45%) were fully compliant. This indicates an attrition rate of 43.55%. Notably in the current study the largest number of dropouts was observed between Time 1 and Time 2, with a lower number of people dropping out from Time 2 to Time 3. Participants who dropped out initially generally stated that they were too busy to fulfil the study requirements. Of the participants who were not fully compliant from Time 2 to Time 3 there was a discrepancy between the number of sampling days completed and self-report completion. Unexpectedly, the majority of participants who did not complete self-report measures from Time 2 to Time 3 did provide some cortisol samples. This suggests either misunderstanding of study instructions, or that the online study questionnaire was too burdensome for completion. This latter possibility is counterintuitive to our understanding of adherence to cortisol collection protocols.

Typically participants involved in ambulatory salivary cortisol collection tend to experience difficulty or do not fully comply with study protocol due to the burden of the sampling protocol. This can be seen in sampling non-compliance of participants in protocols requiring the collection of continuous salivary cortisol samples (Broderick et al., 2004; Kudielka et al., 2003). Halpern et al. (2012) for instance found that even in a low burden saliva collection protocol, involving 3 samples collected over one day that retention and adherence levels were low. They found that, in a considerably shorter protocol than conducted in the current study, only

approximately one third of participants fully adhered to the sampling requirements (Halpern et al., 2012). It would be expected that longer durations would increase problems with adherence (Kudielka et al., 2007), as seen in the current study. Adherence can be improved using strategies such as electronic monitoring devices (Broderick et al., 2004; Halpern et al., 2012; Kudielka et al., 2003) but these devices are expensive and given the overall attrition rate in the current study may not be the most cost-effective manner of determining adherence; self-reported timings of saliva collection were instead used.

6.4.6.2 Barriers and enhancers to recruitment and retention. Potential reasons for slow and low levels of recruitment and poor levels of adherence have been previously examined. McDonald et al. (2006) cite reasons including less people agreeing to participate than expected, eligible participants missed, funding issues or procedural and/or intervention issues. Although we cannot ascertain why a large number of the research website views did not lead to subsequent recruitment in the current study, it is possible that issues such as those cited by McDonald et al. (2006) may have deterred people from participating. The protocol requirements in the current study may have also contributed to the low sample size. This is supported by the reasons provided by the 21 potential participants who declined to participate following recruitment and randomisation. These participants cited the study requirements and lack of sufficient time for not participating. The study was therefore seen as being too burdensome to engender participation for some women. The exclusion of a further 21 women prior to randomisation due to failure to meet

inclusion criteria also reflects additional reasons for the observed low levels of participant recruitment (Peters-Lawrence et al., 2012). In the current study, age requirements and medication use influenced participant eligibility. The main reason for inability to participate in the current study was age, with most of the excluded participants being older than the required age.

The short duration of the recruitment period in the current study may have also influenced participant recruitment. Having a short recruitment period has been previously identified as a barrier to adequate recruitment (Peters-Lawrence et al., 2012). In the current study participants were recruited over a nine-month period. This was expected to be of adequate duration and had been extended beyond an initial duration of 6 months due to slower than expected recruitment in the early stages. A longer recruitment period may have resulted in a larger sample size that would have been better suited to evaluating intervention efficacy. Given the attrition rate of 43.55% and the required sample size of 65 outlined previously, it would be necessary to recruit 115 participants overall to achieve an adequate sample size. On average approximately seven participants were recruited per month in the current study (62 in nine months). Thus it would be necessary to recruit for up to 17 months to achieve the required sample size in the current study. The potential of being randomised to a control condition in the current study may have also influenced participant recruitment. In the current study a wait-list control condition was used to thoroughly evaluate the effect of the interventions. Caldwell et al. (2010) have previously found that participants are less likely to sign up to a trial when they know they may be offered a placebo instead of the active intervention. Although the wait-

list condition was not labelled as a placebo or control group to participants, the use of such a condition in the current study may have deterred participants from taking part. This suggests the potential recruitment benefits of using within-subjects designs in future research. However, in the context of the current research the RCT design has the potential of maximising our ability to draw robust inferences of intervention efficacy from the study findings. Including an adequate control condition, such as a no-treatment waitlist group, allows us to clearly determine whether the interventions used have an effect compared to no treatment (Wood et al., 2010). Thus, while the use of a control condition may impact recruitment and retention (Caldwell et al., 2010), its inclusion in the current examination of positive psychological interventions is a clear methodological strength of the current study.

Pro-active measures were taken to increase participant recruitment and adherence, including clear and concise provision of study information, the development of a user-friendly research website to present this information, and widespread advertising. While these can be viewed as beneficial, the presentation of participant information has not been found to significantly influence recruitment in previous research (Brierley at al., 2012; Caldwell et al., 2010). Additionally, in a systematic review of randomised controlled trials, Caldwell et al. (2010) found that increased publicity does not lead to increased recruitment. In terms of advertising and presentation of information, it is important to note that increasing participants' awareness of the area under examination can lead to enhanced recruitment and retention (Caldwell et al., 2010). This can be easily incorporated into future research but was not fully exploited in the current study in an attempt to maintain a level of

blinding to trial objectives and to maintain brevity in participant recruitment material. As already stated, the length and format of participant information was not found to influence recruitment in previous research (Brierley et al. 2012) and so should not pose an issue in future research. Furthermore, providing an increased level of understanding of the focus of the research need not necessarily invalidate study outcomes and could enhance trial enrolment (Peters- Lawrence et al., 2012). Such information could be more clearly presented to potential participants in future research, for instance on the research website.

Development of the research website interface for the current study focused on ease of participant registration, questionnaire completion and intervention use, all of which were only available online. Access to online interventions is no longer considered a barrier to participation or a limitation in terms of sample heterogeneity and generalizability, due to the widespread use of internet technology (Denissen, Neumann & van Zalk, 2010). The fact that the research intervention could only be accessed online can also be considered a clear strength in the study; McDonald et al. (2006) previously found that recruitment levels increase when interventions are only made available to participants enrolled in a trial. Utilising online questionnaires and interventions also provides a means to evaluate participant engagement with protocol requirements. Although engagement did not differ between groups in the current study or influence study outcomes, it is important to measure because engagement with positive psychological interventions is positively related to intervention efficacy (Lyubomirsky et al., 2011). Despite the low level of overall recruitment and retention, the study did not perform significantly worse than other longitudinal

studies (Roberts & DelVecchio, 2000). Furthermore there are a number of additional factors that are involved in choosing to participate in and complete a longitudinal, intervention-based study. These include interest in the research itself, the influence of other important people in the participant's life and the outcome they perceive they will gain as a result of the study (Bierley et al., 2012). These factors were not evaluated in the current study and may have explained overall participant numbers.

6.4.6.3 Factors influencing adherence. Due to the large decreases in fully compliant participants during the study a number of potential differences between those who did and did not complete the study were examined. Significant differences between groups may imply volunteerism and self-selection bias in those who completed the study. Volunteerism is a problematic issue in both positive psychological interventions (Seligman et al., 2005) and RCTs more generally (Dawes, 2005; Mihalko et al., 2004). The presence of a self-selection bias in the current study would indicate that those who completed the study represent a specific group.

Satisfaction with life. A significant difference was observed between groups, based on time point completed, for levels of satisfaction with life (SWL). Participants who only completed baseline measures had significantly lower levels of SWL than participants who completed Time 2 or the full study. This suggests that individuals with high levels of life satisfaction are more likely to complete positive psychological interventions. Individuals already experiencing low levels of SWL

may not fully engage with such interventions as they may lack the motivation or confidence in their abilities to do so.

This finding is problematic as it suggests that those participants who comply with positive psychological intervention trials already experience higher levels of positive well-being than individuals who do not comply. Seligman (2005) has suggested that people who take part in positive psychology interventions are biased toward wanting to become happier. Thus, the potentially beneficial effects of the interventions may be less pronounced because those individuals who would most benefit from them have already discontinued participation. This has implications for the individual's well-being, interpretation of the study findings, and also implementation of future interventions. It appears that future interventions should target individuals demonstrating low levels of well-being and attempt to maximise adherence in this group to fully investigate the effects of the interventions.

Experimental condition. No differences were found between randomly allocated experimental groups for the number of time points completed during the study. Despite the lack of any significant differences there were some interesting trends in the data. For instance the gratitude intervention group that completed the writing exercise first, followed by the listening component demonstrated the highest attrition rates in the study. The higher rate of dropout for this group may have been due to the order of activities in the intervention. Actively constructing a list of events and experiences may lead to a lower inclination to subsequently engage in the more passive listening exercise. The converse order of activities may therefore prove more

amenable for gratitude intervention completion. A similar pattern was observed for the mindfulness condition, supporting increased usefulness of using the listening component first for enhancing adherence rates. As indicated previously the order of components can also have diverse effects on well-being outcomes. Thus, these findings support the use of counterbalancing in the current study and suggest the importance of considering order effects in future intervention development.

Potentially increased participant burden resulting from intervention use was also not found to influence adherence. No significant differences were found between the control condition and a single intervention condition; collapsing the four intervention conditions formed the single intervention group. This indicates that while the order of intervention activities can impact on participant retention, the additional burden of completing the interventions does not affect participant adherence. This is important as the current study provides one of the first examinations of the use of measures of physiological well-being in combination with self-report measures of well-being in a positive psychological trial. Previous research has tended to focus on the use of self-report measures in isolation for mindfulness (Bishop et al., 2004; Keng et al., 2011) and gratitude (Emmons & McCullough, 2003; Seligman et al., 2005; Wood et al., 2010). This study demonstrates how additional measures of biomarkers of well-being can be usefully implemented in trial protocols without adversely impacting on participant retention in the evaluation of positive psychological interventions.

Furthermore, the number of diary entries completed by fully compliant participants tended to be in the medium to high range but were lower on average than the required number outlined in participant instructions. This indicates that

participants were not fully compliant with the intervention aspect of the study, possibly due to participant burden. An additional point to note is that intervention adherence was only measured by diary entries contributed, which is a limitation of the current study as it does not account for the listening aspect of the interventions. If participants did not engage with both components equally, this would not have been recorded on the intervention website. It is possible that this did occur, as the conditions beginning with the listening exercises demonstrated lower levels of participant adherence to the intervention than those beginning with the writing component. Given the current study resources, it was not possible to maintain a record of participants' use of the intervention listening component. Future research with greater resources should better record full intervention compliance to gain a better understanding of intervention engagement and subsequent effects. However, it must still be noted that the method used in the current study provides a useful estimation of engagement with the experimental interventions.

6.4.7 Future Intervention Development

Due to the inability to detect significant effects in the current study, and the problematic nature of participant retention, it is necessary to re-evaluate the usefulness of the interventions for future research. A number of factors are important in this evaluation. In terms of the efficacy of the interventions on well-being outcome variables, effects differ across the intervention conditions. Despite some differences in the trends of means over time, when mindfulness and gratitude are examined at a construct level, no significant differences were observed. Where non-

significant differences do occur for outcome variables, mindfulness appears to demonstrate more beneficial effects than gratitude. However, mindfulness does not consistently perform better than gratitude for levels of well-being variables over time. For variables such as social support, gratitude results in larger increases over time than mindfulness. For variables such as SWL or positive affect, timing of effects exerts a greater influence than the construct used. These findings highlight the importance of including aspects of both mindfulness and gratitude in future interventions. In addition to the effects of the interventions on the well-being variables, it is important to consider the effect of the interventions on levels of mindfulness and gratitude over time. This is particularly important as changes in levels of gratitude and mindfulness are posited to mediate the changes observed in well-being (Emmons & McCullough, 2003; Shapiro et al., 2008). Differences observed between gratitude and mindfulness for the effects of the interventions are observed at a higher order construct level as well as at the level of the order of intervention component completion. This indicates potential conceptual similarities and differences, as well as practical applications for the interventions.

Based on the current findings and the existing literature, there appears to be a relationship between the two constructs. In the current study, the effects of the interventions on well-being outcomes demonstrate comparability between the two constructs. Removing either gratitude or mindfulness may be detrimental to both improving well-being and rigorously examining the effect of mindfulness and gratitude interventions. While it is clear from the results of the current study that the existing interventions are not fit for use as stand-alone interventions in future work,

it does not appear suitable to develop future interventions based on a singular construct. Including aspects of mindfulness and gratitude would address the observed importance of both for well-being outcomes. Combining gratitude and mindfulness in a future stand-alone intervention is therefore the most appropriate direction for future research.

The order of completion of intervention components is also of importance, with different orders achieving different outcomes. Further, this analysis appears to suggest that given the similarities and differences across interventions and constructs, including a writing and a listening intervention component is as important for effecting change as the construct upon which the intervention is based. The differences between construct effects and the observed order effects further highlight and justify the importance of counterbalancing when examining the effects of interventions in future research. Utilising future interventions comprised of two components, counterbalanced to create two intervention conditions, would allow for a more refined analysis of order effects in positive psychological interventions. For this reason, including the gratitude diary and the mindfulness Body Scan meditation appears to be the most practical and logical choice, with counterbalancing addressing the issues of order effects.

Chapter 7

Well-being during Pregnancy Literature Review

Prenatal maternal well-being encompasses psychological states and traits, as well as physiological health. It can have far reaching effects for both the expectant woman and developing foetus. A considerable focus in the empirical literature has been on physical health and health behaviours during pregnancy. For instance, there is a large body of research highlighting the adverse effects of negative health behaviours, such as cigarette smoking (Hackshaw, Rodeck & Boniface, 2011; Lee & Lupo, 2013; Pineles, Park & Samet, 2014), heavy alcohol consumption (Patra et al., 2011), and poor diet (Wen, Simpson, Rissel & Baur, 2013). There is also a growing body of literature examining indicators and consequences of poor physical well-being during pregnancy. This includes, but is not limited to, obesity (Ramachenderan, Bradford & McLean, 2008; Sarwer, Allison, Gibbons, Markowitz & Nelson, 2006; Van Lieshout, Taylor & Boyle, 2011), fatigue (Chien & Ko, 2004), preeclampsia (Grill et al., 2009; Jido & Yakaso, 2013; Thangaratinam et al., 2011) and gestational diabetes mellitus (Hadar & Hod, 2009; Hartling et al., 2014; Kim, England, Sharma & Njoroge, 2011; Wendland et al., 2012). Physical aspects of well-being undoubtedly contribute to prenatal and birth outcomes but the effects of psychological well-being can have an equal or greater impact on maternal, foetal and clinical outcomes. For instance, stress has been found to be a strong predictor of birth outcomes, even after controlling for medical and obstetric risks (Dunkel Schetter, 2011). The transitional nature of pregnancy (Lundgren & Wahlberg, 1999;

Lundgren, 2004), during which women often adopt new roles and experience physiological changes, can result in it being experienced as a time of stress and upheaval. Thus pregnancy is no longer accepted as an unproblematic time for pregnant women. It is now more widely acknowledged that pregnancy can influence fluctuations in mood that can impact on well-being (Jomeen & Martin, 2005).

Low well-being during pregnancy and its subsequent effects have been extensively examined and documented (Beydoun & Saftlas, 2008; Dunkel Schetter, 2011; Gurung, Dunkel Schetter, Collins, Rini & Hobel, 2005; Littleton, Bye, Buck & Amacker, 2010; Lobel et al., 2008). Low prenatal well-being can have significant negative physical and psychological outcomes including pre and post-natal depression (Brummelte & Galea, 2010), pregnancy complications (DaCosta et al., 1998), preterm delivery and low birth weight (Lobel et al., 2008). Low maternal well-being is typically characterised by low levels of happiness, positive affect, self-esteem and life satisfaction; it is also characterised by high levels of depression, anxiety and stress. These factors can occur in isolation or in tandem with other indicators of low prenatal well-being; they are not therefore separate constructs but can be viewed in the context of multidimensional facets of well-being. As a result, prenatal well-being should be viewed as multidimensional, and appropriate attention should be given to a range of well-being variables that can co-occur at different points during pregnancy. This multidimensional approach to prenatal well-being is adopted in the current study. There will be separate discussion of each facet of well-being for clarity, but where associations and overlaps exist they will be noted. Some well-being constructs, such as stress and depression, have been researched more

extensively than others, such as happiness, and so in order to provide a full review of the literature the current discussion at times reflects this focus

7.1 Antenatal Depression

The antecedents and consequences of postnatal depression (PND) have been extensively studied (Chen, Tsai & Lin, 2011; Eastwood, Phung & Barnett, 2011; Glasheen et al., 2013; Murray et al., 2011; Williamson & McCutcheon, 2004; Zajicek-Farber, 2009). There is also currently an increased focus on antenatal depression (AND) due to its effects on maternal, clinical, foetal and infant outcomes. According to Osborne and Monk (2013), perinatal depression, encompassing AND and depression immediately postpartum, affects approximately 15% of women in the developed world, and 20-40% of women in the developing world. In countries with high birth rates this is associated with a large number of women experiencing low levels of well-being during their pregnancies. This is an important concern in Ireland, which has a current rate of over 75,000 births a year, the highest rate in Europe (Central Statistics Office, 2014).

Osborne and Monk (2013) found that AND is one of the main contributors to maternal morbidity and mortality. In a review of meta-analyses and prospective studies, Robertson et al. (2004) also found that AND is one of the strongest predictors of postpartum depression, which can subsequently have far reaching effects on maternal (Jomeen, 2004; Robertson et al., 2004), foetal and infant well-being (Alder, Fink, Bitzer, Hosli & Holzgreve, 2007; Jomeen, 2004). In a review of 35 studies, Alder et al. (2007) found that AND is associated with obstetric

complications (Kim et al., 2013; Qiao, Wang, Li & Wang, 2012), such as physical symptoms and healthcare visits (Andersson et al., 2004; Larsson, Sydsjo & Josefsson, 2004), pre-eclampsia (Kurki et al., 2000), preterm labor (Dayan et al., 2002; Ehsanpour et al., 2012), type of delivery and pain relief use during pregnancy (Alder et al., 2007; Andersson et al., 2004). It is also associated with foetal and neonatal outcomes, including foetal activity (Field et al., 2001), birth-weight (Dunkel Schetter, 2011), gestational age (Chang et al., 2014; Uguz et al., 2013), and admission to the neonatal care unit (Alder et al., 2007; Chung et al., 2001).

It is important to note that some inconsistencies exist in the prenatal depression literature but these may be attributable to methodological issues, as noted by Alder et al. (2007). For instance, differences exist between studies for the number of time points at which depression is measured, as well as the timing of measurements, with studies collecting data differentially across trimesters. Additionally, not all examinations of AND effects conceptualise AND as distinct from other constructs, such as stress, and these constructs can overlap (Alder et al., 2007). Similarly, AND is strongly associated with anxiety, worry, quality of life and sleep (Jomeen, 2004). The relationship between AND and stress during pregnancy in particular is cyclical, as it can be caused by stressful life events but is itself a stressor (Alder et al., 2007). As such, depression and stress are highly related during pregnancy and should be examined together. This is further supported by evidence that antenatal stress and depression are both strongly associated with and predictive of birth outcomes (Alder et al., 2007; Dunkel Schetter, 2011; Grigoriadis et al., 2013; Jomeen, 2004; Littleton et al., 2010; Lobel et al., 2008; Loomans et al., 2012). Such associations support the

multidimensional nature of prenatal wellbeing; examining factors like AND and stress in isolation limits our interpretation of empirical findings (Alder et al., 2007).

7.2 Prenatal Stress

Stress during pregnancy is pervasive and it is suggested that 25% of all pregnant women experience prenatal stress (Yali & Lobel, 1999). In a large-scale multi-ethnic birth cohort of 7740 women, Loomans et al. (2012) found that 30% of women sampled were at risk of poor birth outcomes due to psychosocial stress factors. Prenatal stress can be caused by numerous psychological, biomedical, environmental, psychosocial and socioeconomic factors (Dunkel Schetter, 2011; Gurung et al., 2005; Littleton et al., 2010). It can occur as a result of physical symptoms, bodily changes, and worries about parenting and the birth (Lobel et al., 2008; Yali & Lobel, 1999). The number of previous pregnancies and/or children (DiPietro et al, 2004), family stressors, current health, socio-economic status and inadequate psychosocial resources are also associated with prenatal stress (Dunkel Schetter, 2011). In addition, work strain (Chen et al., 2000; Dunkel Schetter, 2011; Oths, Dunn & Palmer, 2001) and social support, including partner support (Byrd-Craven & Massey, 2013; Duman & Kocak, 2013; Glazier, Elgar, Goel & Holzapfel, 2004; Gourounti, Anagnostopoulos & Sandall, 2014; Lobel et al., 2008;) are important predictors of prenatal stress.

A broad range of factors contribute to stress during pregnancy but given the number of pregnancy-related concerns that characterise it, this review argues that prenatal stress must be conceptualised as a pregnancy-specific construct. Such a

conceptualisation is supported by the fact that pregnancy presents unique challenges and changes, thus representing a unique stressor in and of itself (DiPietro et al., 2004). Pregnancy-specific stress is therefore conceptually distinct from more general stress due to its contextual specificity (Alderdice et al., 2012; Lobel et al., 2008), even though both forms can occur together. The timing at which stress occurs during pregnancy is also an important consideration when conceptualising prenatal stress (Littleton et al, 2010). There is evidence to suggest that events occurring early in pregnancy are experienced as more stressful than events occurring later in pregnancy (Glynn et al., 2001; 2004). This could be due to the novelty and inherent changes, both physical and psychological, which occur during early pregnancy. It could also be attributable to attenuation of the response to psychological stress, if stress occurring in early pregnancy primes the stress response in later pregnancy. This is particularly important as prenatal stress is more robustly related to foetal development and birth outcomes than general stress (Alderdice et al., 2012; DiPietro et al., 2004).

Examinations of prenatal stress have also shown it to be consistently associated with adverse effects for the expectant woman and developing foetus (Brummelte & Galea, 2010; Christian, 2012; Coussons-Read, Okun & Simms, 2003; DiPietro et al., 2004; Glover, 2014; Littleton et al., 2010; Reece & Harkless, 1998; Terry, Mayocchi & Hynes, 1996; Whiffin, 1988; Witt, Litzelman, Cheng, Wakeel & Barker, 2014). For pregnant women, prenatal stress is a precursor for prenatal and postpartum depression (Brummelte & Galea, 2010; Terry et al., 1996, Whiffin, 1988), as discussed in terms of the association between stress and AND. It is also associated

with an increased risk of engaging in adverse health behaviours, such as cigarette smoking during pregnancy (DiPietro et al., 2004, Lobel et al., 2008), and early cessation of breastfeeding postpartum (Li et al., 2008).

Prenatal stress is also associated with an increased risk of caesarean section, as well as labour and delivery complications (Saunders et al., 2006). It is consistently associated with poor obstetric outcomes, including low infant birth weight (Dunkel Schetter, 2011; Littleton et al., 2010; Lobel et al., 2004, 2008; Witt et al., 2014), shorter length of gestation (Dunkel Schtter & Glynn, 2010; Glynn et al., 2001; Lobel 2004; Roesch et al., 2004; 1et al., 2004), and risk of preterm labour or delivery (Alderdice et al., 2012; ; Dole et al., 2013; Dunkel Schetter & Glynn, 2010; Dunkel Schetter, 2011; Kramer et al., 2009; Lobel, 2004; Lobel et al., 2008; Orr et al., 2007). As preterm delivery and low birth weight are two leading causes of infant mortality, morbidity and later health problems (Christian, 2012; Dunkel Schetter, 2011; Lobel et al., 2008), this latter association is particularly concerning. Further, a number of the associations between prenatal stress and obstetric outcomes remain even after controlling for factors such as medical and obstetric risk (Christian, 2012; Kramer et al., 2009). This highlights the importance of examining psychological constructs, in addition to medical and obstetric factors, during pregnancy.

Beyond obstetric outcomes, prenatal stress can influence foetal neurobehavioural development, emotion regulation and cognitive functioning in infancy and childhood (Entringer et al., 2009; Gunnar & Barr, 1998; Talge, Neal & Glover & Pre, 2007). Huizink, de Medina, Mulder, Visser and Buitelaar (2003) for instance, found that prenatal stress is associated with poorer mental development at 8 months. Early

morning prenatal maternal cortisol, a physiological indicator of stress, was also associated with reduced mental and motor development at 3 months and reduced motor development at 8 months (Huizink et al., 2003). In addition, prenatal maternal physiological stress was associated with difficult behaviour at 2 years (Gutteling et al., 2005) and increased cortisol levels in offspring at 5 years (Gutteling et al., 2004).

7.3 Cortisol during Pregnancy

An in-depth discussion of cortisol, including mechanisms and associations between stress and cortisol, is provided in Chapter 2. The focus on cortisol here relates directly to the effects of cortisol during pregnancy and the potential mediating factors by which stress and cortisol may impact on maternal, foetal and obstetric outcomes. During pregnancy the cortisol awakening response (CAR) and circadian rhythm are preserved (Buss et al., 2009; deWeerth & Buitelaar, 2005a; Giesbrecht et al., 2012). However prenatal maternal cortisol levels progressively increase during pregnancy (Allolio et al., 1990; Cheng & Pickler, 2010; deWeerth & Buitelaar, 2005a; deWeerth & Buitelaar, 2005b; Entringer et al., 2010; Giesbrecht et al., 2012; Harville et al., 2007). This increase begins from approximately 25 weeks gestation (Allolio et al., 1990) and levels can increase 2 to 4 fold by the third trimester (Buss et al., 2009). Giesbrecht et al. (2012) found a 3.6% increase in cortisol levels for each progressive week of pregnancy, although the rate of increase decelerates from the 33rd week of gestation (DiPietro et al., 2011). This deceleration may be due to the fact that maintaining such a rate could increase the risk of adverse outcomes such as spontaneous birth, due to excessive cortisol levels (Sandman et al., 2006).

During pregnancy cortisol is produced by both the maternal HPA axis and the placenta; it is an important factor for foetal maturation and labour (Dunkel Schetter, 2009; Kacsoh, 2000). Placental cortisol is produced via activation of corticotropin releasing hormone (CRH) in the placenta. Increases in maternal cortisol levels can lead to increases in placental cortisol levels due to activation of a positive feedback loop that signals to the foetus that the mother is threatened. Placental CRH production is therefore increased to shorten gestation and increase the likelihood of foetal survival (Sandman et al., 2006). CRH produced by the placenta also has a strong regulating effect on maternal HPA axis functioning through the positive feedback loop between the placenta and maternal HPA axis (Voegtline et al., 2013). In addition, maternal cortisol production is involved in a negative feedback loop with the maternal central nervous system, such that maternal physiological responses to external stressors become attenuated during pregnancy (Voegtline et al., 2013). This is especially evident in attenuated cortisol responding in later pregnancy (Buss et al., 2009). As such, placental CRH modulates both foetal and maternal pituitary adrenal functioning, while being regulated by the maternal and intrauterine environment (Wadhwa et al., 2001). Thus increases in maternal cortisol, due to prenatal maternal stressors, can disregulate placental CRH production, with adverse effects for foetal development and later outcomes.

It is important to note that pregnant women do not necessarily exhibit hypercortisolism as a result of increasing levels of maternal and placental cortisol, because the negative feedback loop maintains maternal cortisol within the normal range (Kirschbaum & Hellhammer, 1989). Similarly, large increases in maternal

cortisol are not transferred directly to the foetus due to the protective effects of the placenta. The foetus is protected from excessive cortisol levels by the placental enzyme 11β-hydroxysteroid-dehydrogenase type 2 (11βHSD2) (Reynolds, 2013), which metabolises up to 90% of maternal cortisol into inactive cortisone (deWeerth & Buitelaar, 2005a; Egliston et al., 2007; Voegtline et al., 2013). As a result of this process, foetal cortisol is 13 times lower than that of maternal cortisol but maternal cortisol levels are still suggested to account for up to 40% of the variance in foetal levels (Gitau et al., 2001). Therefore even small increases in maternal cortisol can increase, and potentially double, foetal amounts (deWeerth & Buitelaar, 2005a). Thus, chronic and/or acute stressors experienced by pregnant women can result in elevated cortisol levels that are passed on to the developing foetus.

Research on the effects of elevated cortisol levels on foetal outcomes has consistently demonstrated adverse effects. For instance high cortisol levels have been associated with an increased risk for short gestational age and complicated deliveries (deWeerth & Buitelaar, 2005b), and low birth weight (deWeerth & Buitelaar, 2005b; Diego et al., 2006; Field et al., 2006; Kivlighan et al., 2008). Coussons-Read et al. (2003) found that preterm labour and delivery are associated with higher plasma cortisol and CRH before labour. Sandman et al. (2006) also found that increased cortisol levels had an effect on preterm delivery when elevated at 15 and 19 weeks gestation. Therefore the timing of any cortisol increases, potentially resulting from external prenatal stressors, appears to play a role in birth outcomes. Timing of stress may also be linked to infant and child outcomes, as Rieger et al. (2004) found that elevated basal cortisol in later pregnancy, at 30 to 34

weeks gestation, was associated with increased difficulties in habituating to new or adverse stimuli in infancy. Further, Gutteling et al. (2005) found that increased cortisol is associated with difficult child behaviours at 2 years (Gutteling et al., 2005) and behavioural problems at 4 years (O'Connor et al., 2002). As noted previously, Huizink et al. (2002; 2003) also observed associations between cortisol and mental and motor development difficulties at 3 and 8 months.

It is suggested that cortisol can influence such foetal and infant outcomes through a programming effect (Barker, 1998; Egliston et al., 2007; Pluess et al., 2010). This is supported by two comprehensive reviews of the literature by deWeerth and Buitelaar (2005a) and Glover, O'Connor and O'Donnell (2010). These reviews highlight the importance of the intrauterine environment and experiences within that environment for foetal and postnatal development. According to the programming hypothesis, changes in the structure and functioning of the physiological systems controlling foetal behaviour and outcomes can be impacted by experiences during sensitive developmental periods (Barker et al., 2002; Egliston et al., 2007). A large body of animal research has demonstrated support for this, including findings that maternal stress in pregnant animals is associated with long term changes in the HPA axis regulation of offspring (deWeerth & Buitelaar, 2005b; Egliston et al., 2007; Glover et al., 2010). Prenatal maternal stress is also associated with brain function, immune function, and social and emotional behaviour in animal models (deWeerth & Buitelaar, 2005a). In human pregnancy, deWeerth and Buitelaar (2005a) observed that from 24 to 36 weeks there is stability in maternal and foetal reactions to stress, indicating that the foetus responds consistently to natural cues or experiences in the

mother's daily routine. Thus maternal experiences consistently and routinely impact on the foetus, exhibiting longitudinal effects on foetal responding in the form of programming.

The negative outcomes associated with increased cortisol outlined previously, also provide support for the applicability of this programming model in humans. De Weerth and Buitelaar (2005a) suggest that such outcomes are most likely the result of a combination of three cortisol mechanisms that operate concurrently. These are that stress increases cortisol, which then passes into the placenta; that the HPA-axis stimulates increased placental cortisol production; and that reduced uteroplacental blood flow due to increased cortisol and catecholamines influences outcomes. An additional potential mechanism may relate to the association between stress and depression. Alder et al. (2007) found evidence that depression is associated with hormonal changes in both mother and foetus, including reduced levels of foetal dopamine and serotonin, and increased levels of foetal and maternal cortisol. Alder et al. suggest that adverse obstetric outcomes may be influenced by an increase in cortisol levels caused by AND that reduces the protective effect of 11βHSD2.

Inherent in the programming hypothesis is the importance of stress occurring at sensitive periods, such as periods of rapid foetal developmental growth (Entringer et al., 2010). For instance, O'Connor, Heron, Golding and Glover (2002) found that anxiety in later pregnancy has a strong association with developmental outcomes. Glover et al. (2010) acknowledge that outcomes most likely vary by gestational ages or periods of vulnerability. Similarly, Van den Bergh, Mulder, Mennes and Glover (2005) discuss the variability of the effects of gestational age on outcome, suggesting

that different mechanisms may be operating at different stages. Thus examinations of associations between stress and foetal and birth outcomes must account for potential variability across stress sensitive periods. It is also important to consider that the effects of stress occurring in later pregnancy are influenced by the attenuation of the physiological stress response as pregnancy progresses. For instance, Entringer et al. (2010) suggest that changes in maternal biology are attenuated in later pregnancy and these changes can influence physiological and psychological stress responses that impact variation in foetal effects. Stress responses in early pregnancy are not attenuated and Sandman et al. (2006) found some support for the effect of early pregnancy stress responses on birth outcomes. They found that high cortisol levels at 15 and 19 weeks gestation predicted CRH at 31 weeks and were associated with preterm delivery; elevated cortisol at later stages were not. Sandman et al. suggest that this reflects a priming effect on the foetus in early pregnancy; this is not evident in later pregnancy. Such findings may be due to the fact that as pregnancy progresses, cortisol levels rise naturally (Allolio et al., 1990) and in later pregnancy the negative feedback loop attenuates maternal physiological responses to stressors (Voegtline et al., 2013). Despite the attenuation of cortisol in later pregnancy, inter-individual variability still allows for examinations of associations between psychosocial variables and pregnancy responding (deWeerth & Buitelaar, 2005a).

Taken together, the programming hypothesis and the attenuation of cortisol responding suggest that stress experienced in early stages of pregnancy may have a significant impact on the developing foetus and that this effect may be greater than that of stress experienced at a later stage. This is because responses to stressors are

not attenuated in early pregnancy and the foetus is in a sensitive period of rapid development. Examining cortisol reactivity in early pregnancy is therefore of importance; partly because a large body of research to date has tended to focus on the 3rd trimester (deWeerth & Buitelaar, 2005b) but also because associations between cortisol and well-being outcomes during pregnancy have demonstrated support for the usefulness of an early pregnancy focus due to attenuated responding observed in later pregnancy. However it is important to note that a large body of research has demonstrated associations in later pregnancy, suggesting that attenuation should not provide the sole rationale for examining early pregnancy. For instance, Giesbrecht et al. (2012) found evidence for the absence of an effect of attenuation. They failed to find any effect of attenuation in a longitudinal intra-individual examination of associations between cortisol and psychological distress from 6 to 37 weeks gestation. Additionally Pleuss et al. (2010) suggest that associations between cortisol and well-being in later pregnancy may be more difficult to detect due the natural rise in cortisol levels after 25 weeks gestation, rather than attenuation.

Despite such inconsistencies in research findings, a number of studies have demonstrated associations between cortisol levels and/or the CAR, and anxiety in pregnancy (Field & Diego, 2008; Kivlighan et al., 2008; Pluess et al., 2010; Voegtline et al., 2013). In one examination, Glover, Bergman, Sarkar and O'Connor (2009) found that state and trait anxiety are associated with an observed relationship between maternal and amniotic fluid cortisol. Cortisol has also been linked with prenatal stress (Kalra et al., 2007; Suglia et al., 2010; Obel et al., 2005), negative life

events (Pluess et al., 2010), negative mood (Giesbrecht et al., 2012), and depression (Field & Diego, 2008; Voegtline et al., 2013). However these associations tend to be small and other studies have found no significant associations between cortisol and well-being in terms of stress (Bolten et al., 2011; Himes & Simhan, 2011; Wadhwa et al., 1996), distress (Harville et al., 2009) or depression (Cheng & Pickler, 2010; Hellgren, Akerud, Skalkidou & Sundstrom-Poromaa, 2013; Salacz, Csukly, Haller & Valent, 2012), although the latter finding demonstrated a non-significant change in the expected direction. These inconsistent findings may be attributable to methodological differences between studies. These include, but are not limited to, varying durations and frequencies of cortisol sampling, populations studied, conceptualisations of stress, and gestational age. As previously noted, a considerable amount of research has been conducted in the later stage of pregnancy, during which women are less sensitive to psychological distress (Glynn et al., 2001, 2004, 2008). Thus, the lack of observed associations may be due to the stage at which examinations are conducted during pregnancy. Further issues that have been highlighted in the literature are the reliance on clinic or lab-based studies, often involving acute stressors (Giesbrecht et al., 2012), which may not reflect a natural assessment of ambulatory daily cortisol during pregnancy (Jones et al., 2006). As such, a more standardised approach is needed to robustly examine associations between negative aspects of psychological well-being, such as stress and depression, and cortisol levels over time during pregnancy.

7.4 Positive Well-being in Pregnancy

Incorporating positive aspects of prenatal well-being can provide a lens through which more thorough examinations of cortisol during pregnancy can be conducted. Research examining potential benefits of positive aspects and protective factors of well-being on cortisol outcomes during pregnancy is scarce. In one study of 41 women in late pregnancy, Cheng and Pickler (2010) found that prenatal CAR was significantly correlated with prenatal happiness but not with prenatal stress or depression. Similarly, Wadhwa et al. (1996) found an association between cortisol and social support at 28 weeks, but failed to find a significant association with self-reported stress. Such findings may explain inconsistencies between studies that focus solely on negative facets of well-being; as positive and negative constructs may demonstrate different physiological effects during pregnancy. They also highlight the importance of positive facets of well-being in examinations of physical functioning during pregnancy. Incorporating negative aspects only may increase the risk of Type II errors based on a narrow conceptualisation of prenatal well-being. In a thorough investigation of prenatal well-being with 60 pregnant women, Pluess et al. (2012) examined whether positive and negative life events predicted 3rd trimester cortisol. They found that while negative life events were not associated with cortisol, positive life events significantly predicted lower morning cortisol in later pregnancy; further, women who scored highly on positive life events had significantly lower morning cortisol than those who scored lower for positive life events (Pluess et al., 2012). The authors suggest that their findings support the Lazarus and Cohen (1977) Transaction Model of Stress and Coping; positive experiences function as a psycho-social

resource to diminish or remove the effects of negative influences. It may be reductionist to consider positive life events as solely psychosocial however; such events may not necessarily involve social components. This could be especially evident in the context of pregnancy-specific positive experiences that, as discussed in Chapter 8, relate to aspects of the pregnancy or the self. It is plausible that positive life events, regardless of context, are associated with positive emotions and that this association could result in an attenuation or elimination of adverse effects from negative influences. Support for this comes from the findings that exposure to stimuli that elicit contentment or amusement results in faster recovery from anxiety-induced cardiovascular activity than exposure to neutral or negative stimuli (Fredrickson et al., 2000). Thus while Fredrickson et al. (2000) have demonstrated this 'undoing' effect in a laboratory setting, the findings of Pluess et al. may extend to a longitudinal naturalistic context. This offers tentative support for the importance of focusing on early pregnancy experiences that can influence later pregnancy outcomes.

7.5 Prenatal Social Support

The effects of potentially protective factors during pregnancy, such as social support, on cortisol have also been neglected in the literature. A recent study by La Marca-Ghaemmaghami et al. (2013) examined the influence of social support on levels of cortisol, cortisone and the ratio between cortisol and cortisone as a marker of 11βHSD2 activity, in the 2nd trimester. Using amniocentesis as a pregnancy-specific stressor, the authors found that social support does not influence cortisol or

cortisone levels. Social support was the strongest predictor of increased 11βHSD2 activity however, demonstrating a moderate positive association; higher support was related to increased metabolisation of cortisol. Additional factors, including education and whether the pregnancy was planned, were highly significant negative predictors of the cortisol and cortisone ratio. Thus while this finding is promising, future research is needed to further investigate the potentially complex relationship between cortisol and support. This is particularly important given the role of social support for general prenatal well-being and birth outcomes. For instance, social support has been associated with higher birth weight and a decreased likelihood of lower birth weight (Feldman et al., 2000; Hedegaard et al., 1996; Oakley, Rajan & Grant, 1990), more optimal foetal movement (Dunkel Schetter, 2011), reduced risk of preterm birth and short gestational age (Dejin-Karlsson et al., 2000; Pryor et al., 2003), and better labour process and healthier babies (Collins et al., 1993). Randomised controlled trials have also found evidence that receiving support during pregnancy and labour is associated with reduced labour length and birth complications (Kennell et al., 1991), increased birth weight, more frequent spontaneous onset of labour and vaginal delivery, and less use of epidural analgesia (Oakley et al., 1990).

Social support can be a considered a psychosocial resource that enhances and maintains positive well-being. The consistently demonstrated beneficial effects of support for birth outcomes, in conjunction with tentative physiological findings, highlight its importance during pregnancy. Further, it highlights the potential usefulness of incorporating positive constructs into our investigations of well-being.

The focus of research on prenatal maternal well-being overall has been dominated by an emphasis on negative aspects of psychological and physiological well-being. This is easily seen in the literature, particularly when one compares the number of articles examining prenatal stress, depression and anxiety, to examinations of happiness, life satisfaction and social support during pregnancy. The disparity between investigations of positive and negative aspects of well-being is also highlighted by examinations of cortisol during pregnancy. The predominant focus may be due in part to the association between cortisol secretion, in pregnant and non-pregnant individuals, and stress. It is important to note however that inconsistencies exist between studies in terms of the association between maternal psychological stress and physiological stress responses (Giesbrecht et al., 2012; Harville et al., 2009). This would suggest that, although stress is the strongest psychological correlate of cortisol, as regulated by HPA axis functioning, a bias toward negative well-being factors is not warranted. This is especially relevant in light of the benefits attributable to positive factors, such as gratitude and mindfulness during pregnancy and the consistent findings observed in the non-pregnant literature (see Chapter 2).

7.6 Mindfulness

A number of recent studies examining the effects of mindfulness interventions on well-being during pregnancy have been conducted. The majority of these studies have demonstrated beneficial effects for prenatal well-being in terms of reduced levels of depression (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik, Hamilton, Rosenblum, Waxler & Hadi, 2012), anxiety (Duncan &

Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Guardino, Dunkel Schetter, Bower, Lu & Smalley, 2014; Vieten & Astin, 2008), negative affect (Duncan & Bardacke, 2010; Vieten & Astin, 2008), stress (Beddoe, Yang, Kennedy, Weiss & Lee, 2009; Dunn et al., 2012), and pain in the 3rd trimester (Beddoe et al., 2009). Improvements in positive affect (Duncan & Bardacke, 2010), mindfulness (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik et al., 2012), self-compassion (Dunn et al., 2012; Goodman et al., 2014), and maternal-foetal attachment (Muzik et al., 2012) have also been noted. In addition, one study conducted by Beddoe, Lee, Weiss, Kennedy and Yang (2010) found that participation in a mindfulness intervention resulted in improved sleep as measured by self-report and actigraphy. Sleep improvements were only observed in participants who began the intervention in the 2nd trimester, while women in the 3rd trimester demonstrated poorer sleep quality. This may be because sleep quality reduces as pregnancy progresses (Greenwood & Hazendonk, 2004) and thus such an intervention is only effective when introduced early in pregnancy. Few other studies have adopted objective measures of physiological markers of well-being.

Therefore while the intervention study findings have provided useful information, they tend to rely primarily on self-report indicators of intervention effects. In addition to potential limitations of self-report, including recall and response biases, such self-reports may be influenced by the participant groups used. It is common with positive psychological intervention studies for individuals to participate and complete interventions based on personal motivation or preference (Schueller, 2010). It is therefore important to consider the importance of self-selection to positive trials

(Lyubomirsky et al., 2011), such as those using mindfulness interventions. Lyubomirsky et al. (2011) argue that not only is this self-selection a determinant of participation and adherence but it can also influence outcomes, with more highly motivated participants receiving greater benefits. In the majority of studies noted above, with the exception of Vieten and Astin (2008), participant attrition occurred; this suggests that the final participant samples may represent a particular group of pregnant women who self-selected to participate and adhere to intervention requirements. In addition the sample sizes for all studies are low, ranging from 10 to 39 participants, although it must be noted that attrition is a contributing factor to these sample sizes. Not all examinations of mindfulness during pregnancy to date have adopted RCT designs and a number utilised within subjects designs (Beddoe et al., 2009, 2010; Duncan & Bardacke, 2010; Goodman et al., 2014; Muzik et al., 2012). The study by Vieten and Astin (2008) does contain a control group but only within-subjects changes are observed for any outcome measures in the intervention group (n=13). Within subjects studies provide useful information about the effects of mindfulness interventions over time but the lack of control groups, such as standard antenatal care, against which intervention effects can be compared is a limitation of these studies.

A further limitation is the broad range of gestational criteria for studies on mindfulness effects during pregnancy. As discussed previously, prenatal experiences and facets of prenatal well-being can fluctuate and be influenced by stage of pregnancy. The majority of current studies do not take this into account and include broad ranging gestational ages, such as 12 to 25 weeks (Guardino et al., 2014), 26

weeks (Muzik et al., 2012), 27 weeks (Duncan & Bardacke, 2010), 30 weeks (Vieten & Astin, 2008) or 32 weeks (Beddoe et al., 2009, 2010). The most recent study by Goodman et al. (2014) includes eligibility criteria of 1 to 27 weeks. Such broad variation between and within studies is therefore problematic for understanding mindfulness effect on prenatal well-being. This is particularly true for stress, given the association between psychological stress and cortisol and the fact that cortisol rises from 25 weeks gestation. Thus, any observed effects of mindfulness on stress may be confounded by naturally occurring changes in physiological stress responding. Accounting for stage of pregnancy and gestation must be considered in future examinations of effects of mindfulness interventions on well-being, particularly those incorporating stress measures. The use of both subjective and objective measures should also be included to allow an examination of associations between self-report and physiological stress effects, and to provide a deeper understanding of how mindfulness works on overall prenatal well-being.

A handful of studies have incorporated biomarkers of health and well-being in examining mindfulness effects during pregnancy. Youngwanichsetha, Phumdoung and Ingathawornwong (2014) conducted an examination of the effects of a mindfulness intervention on blood sugar levels in a group of pregnant Thai women with gestational diabetes mellitus (GDM). They found a significant decrease in three biological markers of blood sugar levels (fasting plasma glucose, 2-h postprandial blood glucose, and haemoglobin) following intervention use; this indicates potential benefits for glycaemic control during pregnancy. In the Beddoe et al. (2009) research, they failed to find any change in morning cortisol as a result of the

mindfulness intervention. In addition to methodological limitations of the research, previously noted, the lack of a significant effect may be due to the use of an ambiguously timed 'morning' sample collected across three consecutive days at baseline and post-intervention. Exact timing of sampling is not given and this is essential to accurately measure and interpret cortisol levels, particularly the CAR. Additionally, the use of single samples of cortisol is not sufficient to account for within person variability and contextual specificity (Hellhammer et al., 2007; Powell & Schlotz, 2012). This latter point is particularly important in the case of morning cortisol due to the progressive rise of cortisol levels during the space of up to an hour after waking in the CAR, and the vast number of factors that can influence it (Clow et al., 2004). Despite such limitations, the findings to date suggest potential benefits of mindfulness interventions for prenatal maternal well-being. Tentative benefits have been demonstrated for more general mindfulness programs (Dunn et al., 2012) and those tailored to specific groups, such as women experiencing high anxiety (Goodman et al., 2014), and those with a specific focus on pregnancy and parenting (Duncan & Bardacke, 2010; Vieten & Astin, 2008). In addition benefits have been observed for diverse groups of pregnant women including those with GDM (Youngwanichseth et al., 2014) and women experiencing high stress (Beddoe et al., 2014), anxiety (Goodman et al., 2014) and depression (Muzik et al., 2012).

In a review of mind-body interventions, Beddoe and Lee (2008) noted similar findings to those of the mindfulness research. The authors reviewed studies examining mind-body interventions including psycho-educational interventions, relaxation, and yoga and meditation. Despite similar methodological issues such as

inadequate control groups, varying timing of measurement and differing forms of interventions, Beddoe and Lee (2008) found some support for the usefulness of mind-body interventions during pregnancy. For instance, such interventions are associated with reduced fear and worry about birth (Saisto, Salmela-Aro, Nurmi, Kononen & Halmesmaki, 2001; Saisto, Toivanen, Salmela-Aro & Halmesmaki, 2006), reduced experience of stressful life events and psychological distress (Affonso, De, Korenbot & Mayberry, 1999), reduced anxiety (Teixeira, Martin, Prendiville & Gloverland, 2005), and reduced depression and increased mood (Urizar et al., 2004). Mind-body interventions also demonstrate an association with lower morning cortisol levels (Urizar et al., 2004) and serum cortisol, as well as maternal heart rate (Texeira et al., 2005). Reduced labour time (Saisto et al., 2001), increased birth weight and reduced likelihood of caesarean section (Bastani, Hidarnia, Kazemnejad, Vafaei & Kashanian, 2005) were also associated with intervention use. Notably, meditation and yoga based mind-body interventions demonstrated reduced risk of preterm birth and intrauterine growth restriction (Narendran, Nagarathna, Narendran, Gunasheela & Nagendra, 2005) and decreased perinatal mortality and morbidity (Narendran et al., 2005). These latter findings are interesting as yoga and meditation are often incorporated into mindfulness practice and none of the prenatal mindfulness studies discussed previously have examined effects of mindfulness on birth outcomes; they have focused instead on maternal well-being. Examining the effects of such interventions on a range of prenatal outcomes, utilising robust measurement protocols and research designs, is essential to better understand their effects.

Given the initial promising findings of mindfulness and mind-body interventions on prenatal and birth outcomes, as well as the demonstrated effects of protective factors, such as social support, it is expected that other positive factors could demonstrate similar positive effects during pregnancy. For instance, the findings of Study 3 (Chapter 6) suggest that gratitude interventions may have the capacity to increase mindfulness and, as discussed in Chapter 2, gratitude demonstrates comparable improvements to mindfulness in diverse non-pregnant populations. It is conceivable that, in the same way as mindfulness, such beneficial effects would also be applicable in pregnancy. No research has yet been published on the effects of gratitude during pregnancy; similarly no research has directly examined effects of gratitude on biomarkers of well-being such as cortisol. Combining a well-established gratitude intervention that has consistently demonstrated beneficial effects (Emmons, 2013; Emmons & McCullough, 2003; Seligman et al., 2005) with a well-established element of mindfulness practice allows for a robust investigation of a novel approach to well-being improvement. This approach incorporates mind and body aspects, while still maintaining a rigorous scientific focus on accurate outcome measurement. In addition, utilising this novel intervention will allow more in-depth examination of individual components of such interventions as completed at home as part of participant's daily routines.

Chapter 8

Study 4: Measuring Positive Prenatal Well-being: Developing a Gratitude during Pregnancy Scale and Evaluating the MAAS in Pregnancy

The traditional idea of pregnancy as a wholly joyful period for women is no longer universally accepted (Gurung et al., 2005). A range of social, psychological, bio-medical and demographic factors can result in pregnancy being experienced as distressing for women, and can lower prenatal well-being (Dunkel Schetter, 2011; Gurung et al., 2005). Pregnancy-specific experiences can also result in lower levels of well-being. Such experiences include inadequate social support during pregnancy (Collins et al., 1993), fears about healthcare experiences, labour and birth, physical symptoms, and worries about the baby's health (Affonso, Liu-Chang & Mayberry, 1999). The influence of these factors on well-being is particularly pertinent given current high birth rates; as noted in Chapter 7, Ireland is currently experiencing its highest birth rates for decades. As birth rates increase so too does the probability of more women experiencing low prenatal well-being.

8.1.1 Well-being Measures

Low levels of prenatal maternal well-being are characterised by a number of inter-related factors, such as high levels of stress, depression, negative affect and anxiety. As discussed in Chapter 7, low maternal well-being can have adverse effects on both mother and developing infant (Dunkel Schetter, 2011). Given the importance of maternal well-being for predicting maternal and foetal outcomes it is necessary to

effectively measure aspects of prenatal well-being as they occur. A number of scales have been developed to measure specific aspects of prenatal maternal well-being, such as stress (Yali & Lobel, 1999). The Prenatal Distress Questionnaire (PDQ; Yali & Lobel, 1999) for instance is a 12-item scale developed to measure stress during pregnancy. The PDQ assesses the degree to which participants are worried or upset about a number of pregnancy related factors including medical issues, physical symptoms, bodily changes, the health of the baby and labour and delivery. Pregnancy-specific stress, as measured by the PDQ, is a more robust predictor of birth outcomes (Lobel et al., 2008) than latent factors relating to state anxiety, life event stress or perceived stress. The inability of general stress measures to adequately evaluate pregnant women's stress levels (Lobel et al., 2008) highlights the utility and need for a pregnancy-specific measure.

The predominant focus in the empirical research however, has been on measuring and evaluating the effects of negative aspects of well-being (DiPietro et al., 2004). This has resulted in the neglect of positive aspects, which may foster and improve well-being during pregnancy. Enhancing positive aspects of well-being during the prenatal period could have significant benefits, particularly as the effects of maternal well-being extend to the developing foetus (Dunkel Schetter, 2011). Two positive constructs that have shown good potential for improving well-being are gratitude and mindfulness, which as discussed in Chapter 2, consistently demonstrate significant benefits for well-being in diverse, non-pregnant groups (Keng et al., 2011; Wood et al., 2010). A requirement when evaluating the efficacy of gratitude and mindfulness interventions for improving prenatal well-being is the ability to adequately measure

levels of the constructs. This is essential as increases in gratitude and mindfulness, resulting from intervention participation, are posited to mediate improvements in well-being (Emmons & McCullough, 2003; Shapiro et al., 2008).

There is some inconsistency in the literature regarding changes over time as a result of participation in mindfulness interventions. A number of studies have found significant increases in mindfulness following intervention participation (Duncan & Bardacke, 2010; Goodman et al., 2014; Guardino et al., 2014; Muzik et al., 2012). Two studies failed to find significant increases despite improvements in well-being (Dunn et al., 2012; Vieten & Astin, 2008). Inconsistent empirical findings may result from differing measurements of mindfulness or mindfulness intervention formats. This is unclear as yet due to the absence of an investigation of psychometric properties of measures of mindfulness in pregnancy. For instance, although robust reliability and validity data have been published for the Mindfulness Awareness Attention Scale (MAAS) in non-pregnant groups (Brown & Ryan, 2003), data indicating its suitability during pregnancy is currently unavailable. It therefore remains unclear how reliable the MAAS is for measuring mindfulness during pregnancy.

Similarly, the usefulness of existing gratitude scales for measuring gratitude during pregnancy is unclear, given the dearth of research in this area. Three main gratitude scales have been developed that demonstrate good reliability and validity with non-pregnant groups. They are the Gratitude Questionnaire 6 (GQ-6; McCullough et al., 2002), the Appreciation Scale (Adler & Fagley, 2005), and the GRAT (Watkins et al., 2003). These scales have yet to be thoroughly investigated in

pregnancy. One study conducted by O'Leary, Di Blasi and O'Sullivan (2012) assessed the reliability of the GQ-6 in a sample of pregnant Irish women (*n*=72) and found the GQ-6 to be an unreliable measure of gratitude during pregnancy (α = 0.39). This may be because the GQ-6 does not adequately capture pregnancy-specific experiences of gratitude in the same manner that measures of prenatal stress (Yali & Lobel, 1999) are designed to tap into pregnancy-specific stress levels. The GQ-6 is better suited to more general populations due to the lack of contextual specificity of its constituent items. As a result it cannot adequately evaluate constructs and experiences that occur in specific contexts, such as pregnancy.

8.1.2 Pregnancy Specific Experience

The possibility that general scales are ill suited for use during pregnancy is supported by the distinct transitional nature of pregnancy, with well-defined beginning and end points, during which women's experiences can be contextually specific. This specificity is manifest in previous analyses of women's prenatal experiences, which highlight the importance of antenatal care and interactions with healthcare professionals during pregnancy and birth (Rådestad et al., 2011; Sapountzi-Krepia et al., 2011). For instance, Rådestad et al. (2011) conducted a context-specific content analysis of the subjective, retrospective gratitude of 799 Swedish women, for care provided by medical staff after a stillbirth. From their analysis the researchers found that mothers experienced gratitude for health professionals' emotional, practical and informative support, which was reported as being appropriately responsive and sensitive to the needs of both parents at the time.

This highlights the importance of the support and actions of others for eliciting gratitude in a medical context. Furthermore, the work by Rådestad et al. represents one of very few qualitative studies of gratitude and, to the author's knowledge, the only qualitative study of gratitude in a health or pregnancy-related context.

Social support also influences women's subjective experience of pregnancy (Blanchard et al., 2009; Dunkel Schetter, 2011; Nelson, 2003; Sapountzi-Krepia et al., 2011). Women's relationships with their partners for instance, can influence depressive symptoms and perceptions of their pregnancies (Blanchard et al., 2009). Family and friends are reported to provide emotional, tangible, and informative support during pregnancy (Blanchard et al., 2009; Nelson, 2003). In contrast, acquaintances and colleagues provide more material support (Blanchard et al., 2009). Prenatal healthcare professionals can also provide caring and informative support (Blanchard et al., 2009) and this in turn can enhance women's positive experiences of pregnancy, labour and childbirth (Rådestad et al., 2011; Sapountzi-Krepia et al., 2011). When these forms of support are absent, women report negative experiences, leading to feelings of anger or embarrassment, indicating the importance of social support in prenatal healthcare interactions (Sapountzi-Krepia et al., 2011). The beneficial effects of prenatal social support are particularly important in the context of gratitude, as gratitude is consistently associated with higher levels of perceived social support in non-pregnant groups (Wood et al., 2010; Wood et al., 2008a) and in female, clinical populations such as women with metastatic breast cancer (Algoe & Stanton, 2012).

Additional areas of importance that have emerged from qualitative studies of the experience of pregnancy relate to an increased sense of responsibility, resulting from choosing to have or keep the baby (Nelson, 2003). Responsibility is reinforced by pregnancy milestones or 'time moments', which tend to be reported positively by women (Sapountzi-Krepia et al., 2011), such as telling people about the pregnancy and seeing the baby on the ultrasound scan. Responsibility for the pregnancy and baby also involves a need to be prepared for the birth and the baby (Nelson, 2003). It is arguable that experiencing pregnancy milestones and becoming prepared can lead to a sense of safety in terms of one's own health, the health of the baby, and the knowledge, competence and behaviours of healthcare professionals with whom women interact (Rådestad et al., 2011; Sapountzi-Krepia et al., 2011). Women's experiences of physical changes are another important aspect of the subjective experience (Chang et al., 2006; Earle, 2003) as they encompass naturally occurring physiological changes and women's subjective experiences of these.

Thus pregnancy reflects a contextually specific period in which pregnancy-related experiences have the potential to influence well-being. These experiences are not often reflected in measures of prenatal well-being, with some notable exceptions (Cox et al., 1987; Rini et al., 1999; Yali & Lobel, 1999), and are absent in measures of positive prenatal well-being. The absence of such aspects and their importance in pregnancy, as demonstrated in the empirical literature, provides support for the suggestion that scales, such as the GQ-6, are too general to tap into gratitude in the specific context of pregnancy. It may also explain inconsistencies in findings of mindfulness changes in pregnancy.

Evaluating and developing mindfulness and gratitude scales respectively, for use in pregnancy, is essential to investigate the efficacy of gratitude and mindfulness interventions on well-being in the perinatal period. The primary aim of this study is therefore to develop a pregnancy-specific gratitude scale, the Gratitude during Pregnancy Scale (GDP), in a sample of pregnant women and to examine its psychometric properties. The second aim is to evaluate the reliability and factor structure of the MAAS in a pregnant sample to assess its usefulness during pregnancy. Given the dual nature of the study aims and the inclusion of a preliminary qualitative component in GDP scale development, the qualitative and quantitative components will be presented separately in terms of methods, results and discussions.

8.2 Thematic Analysis of Expressions of Gratitude during Pregnancy

No research to date has been conducted on gratitude during pregnancy, and so what women feel grateful for in the months leading up to delivery has not been fully evaluated. The aim of this preliminary thematic analysis is to examine what women express gratitude for during their pregnancy. This will inform the development of a scale to adequately measure gratitude during pregnancy. This preliminary analysis utilises a longitudinal gratitude diary design to gather data during pregnancy, thus providing rich and contextual information. Using a thematic analysis approach enables a flexible yet rigorous approach to analysis, and allows for an in-depth evaluation of gratitude in specific contexts such as pregnancy. As few studies have expressly aimed to investigate the subjective experience of gratitude, doing so will provide insights into mechanisms, potential interventions, effects and sources of gratitude. Such a focus can also inform future research with specific populations, as gratitude may be experienced differently depending on culture, socio-demographic status, health or mental status. In the context of this study, developing an understanding of the experience of gratitude will inform the use of a measurement tool to assess gratitude levels within a specific population, that of pregnant women.

This preliminary investigation will therefore examine pregnant women's lived experiences of gratitude during pregnancy, as recorded in gratitude diaries during a 4-week period. It is anticipated that important aspects of subjective prenatal gratitude will emerge from an examination of the experience of gratitude in this context.

8.2.1 Method

8.2.1.1 Participants

Participants were recruited to a larger RCT from the antenatal outpatient department of Cork University Maternity Hospital (CUMH). Eligibility criteria included being over 18 years of age, between 14 and 32 weeks pregnant at recruitment, and good English comprehension. Written informed consent was received from all participants.

Seventy-two women, aged 20 to 41 years of age (*M*= 30.63, *SD*= 5.41), were recruited. The mean gestational age at recruitment was 22.62 weeks (*SD*= 6.58). Fourteen participants, aged 27 to 39 (*M*=32.43, *SD*= .84) completed the full study. Five participants contributed diary entries upon completion of the study. These 5 participants were aged between 27 and 39 (*M*=32.43, *SD*= 3.13) and all were Irish. They were also more likely to have planned their pregnancy, were very excited about it, were married to or living with their partner and did not smoke. See Tables 43 and 44 for participant demographics.

Table 43

Characteristics of Continuous Variables for Participants, Grouped by Level of Study Completion

	Diary Contributors *n*=5	**Study Completers** *n*=14	**All Participants** *n*=72
	M(SD)	*M(SD)*	*M(SD)*
Age	33.40(2.07)	32.43(3.13)	30.62(5.41)
Weeks pregnant	23.40(5.46)	21.00(5.08)	22.62(6.58)
Number of children	0.80(0.84)	1.21(1.19)	1.01(0.99)
Gratitude Time 1	12.00(1.23)	12.79(1.42)	12.83(1.21)
Gratitude Time 2	13.40(0.89)	13.64(0.63)	13.36(0.79)
Gratitude Time 3	13.20(0.84)	13.50(0.76)	13.50(0.76)

Table 44

Characteristics of Categorical Demographic Variables (%) for Participants, Grouped by Level of Study Completion.

	Diary Contributors *n*=5	**Study Completers** *n*=14	**All Participants** *n*=72
Intervention group	80%	57.10%	50.70%
High risk	60%	50%	39.70%
First child	40%	35.70%	31.50%
Planned pregnancy	100%	71.40%	68.50%
Very excited about pregnancy	100%	85.70%	55%
Married or cohabiting	100%	100%	93.10%
Exercise at Time 1	40%*	50%*	46.60%
Non-smoker at Time 1	100%*	100%*	84.90%
Drink alcohol at Time1	100%*	92.9%*	84.90%

Note. *= maintained at Time 3

8.2.1.2 Procedure

Ethical approval was obtained from University College Cork and the Department of Obstetrics and Gynaecology in the Cork University Maternity Hospital. Seventy-two participants were then recruited to take part in a randomised controlled trial (RCT) of a gratitude diary intervention. This RCT was conducted as part of the author's Master's Thesis and the analysis of the quantitative data has been reported elsewhere (O' Leary et al., 2012). Intervention participants began the intervention at recruitment and continued for 4 weeks. Wait-list participants began the intervention 2 weeks later and used it for 2 weeks. Fourteen women completed the full 4-week intervention. Five participants forwarded diary entries for thematic analysis.

8.2.1.3 Intervention

The gratitude intervention used was a daily gratitude diary. Diary methods provide contextually relevant information related to experiences as they occur in everyday situations. They remove issues of retrospection arising from alternative methods of data collection, such as interview (Bolger, Davis & Rafaeli, 2003). This method is optimal for examining context-specific expressions of gratitude over time.

8.2.1.4 Approach to Analysis

Data were qualitatively analysed using an iterative process of thematic analysis to inductively generate components or themes (Braun & Clarke, 2006). Analysis began with careful reading and initial coding of the data to identify interesting features. An iterative process of constant comparison was then used to compare codes and

generate emergent themes. Through this process basic themes were reviewed, refined and defined, resulting in main, over-arching themes. Five main themes of gratitude during pregnancy were identified representing the most important components of pregnant women's expressions of gratitude.

8.2.2 Results

Five main themes emerged from a thematic analysis of the data. These included gratitude for the baby, support from friends and family, aspects of daily life, medical experiences, and being pregnant. These themes were organised by importance according to the frequency with which they are reported in the data and are presented as such here. Themes and subthemes represent what women feel grateful for during their pregnancies and are explained with quotations from participant's diary entries. Example quotations are labelled by diary entry to preserve anonymity.

8.2.2.1 The Baby

The first main theme explores how pregnant women felt grateful for their babies in terms of 'feeling and seeing' the baby, experiencing the 'baby as a person', and 'looking ahead' to a future with the baby.

Feeling and seeing the baby. The women in this study expressed gratitude for three interrelated aspects of being able to feel and see their unborn babies. Firstly, they reported gratitude for their awareness of the baby as a tangible presence they could see on ultrasound scans and feel within the womb.

"Thankful that the baby moved" (1)
"Feeling my first kick" (6)

Second, experiencing the baby as a tangible presence in this way was identified as having associated implications for the health of the baby. The association between feeling and seeing the baby, and perceiving it to be growing healthily was recurrent in the data and emerged as an important source of gratitude.

> *"I am grateful the baby looks healthy on the scan" (9)*

The third source of gratitude emerging from feeling and seeing the baby was due to a sense of reassurance provided by the baby's presence and related perceptions of health. The small movements, and opportunities to see the baby on scans, provide reassurance that the baby is growing, moving and the pregnancy is progressing. The consistent expressions of gratitude for feeling and seeing the baby, in combination with aspects of the baby's health and a sense of reassurance, affirm the importance of this interrelationship.

> *"I am grateful when I feel the baby move as I find it reassuring" (40)*

Baby as a person. Relating to expressions of gratefulness for feeling and seeing the baby was a feeling of gratitude for experiencing the baby as a person, with personal attributes and characteristics. Perceptions of the baby as a person provide an interesting distinction because personal attributes are connected to perceived 'real-world' constructs that could provide participants with a sense of 'who' the baby is and will be.

"Finding out it's a boy" (5)

"I am grateful that [the baby] showed us a little of her personality" (21)

It is not only the presence of the baby as something that can be felt and seen, but also the presence of the baby as someone, as a person, which evokes gratitude.

Looking ahead. The women in this study also expressed gratitude for being able to plan for and think about the future with the baby. Planning ahead relates to practical planning and concrete preparatory actions taken, such as being prepared for the labour ward and buying things for the baby.

"I am grateful that I have my bag [for the labour ward] packed and ready" (28)

Thinking about the future is less concrete and more anticipatory in focus. Thinking about the baby in the future tense, as reported in this study, is thinking about an undefined future rather than a specific event.

"I am grateful that next year the baby will be here too" (36)

Each aspect of looking ahead therefore takes a different perspective and orientation. The emotional and tangible preparations for the baby are future focused and both are self-driven; it is the women themselves who are looking to the future and making plans for it. This results in gratitude for one's own actions, a

responsibility for these actions, and gratitude toward an anticipated future with the baby.

8.2.2.2 Having support from family and friends

Gratitude for social support from family and friends during pregnancy was another main theme that emerged consistently in the data. Two forms of social support, supportive presence and supportive actions, emerged as particularly important sources of gratitude.

Supportive presence. Supportive presence is characterised by women's awareness of the existence of support provided by partners, siblings, parents and friends. It is not predicated on actions or events but emerges from the participant's awareness of support networks in place during their pregnancies.

> "*Things are great too with fantastic spousal support and family support" (7)*
> "*I am grateful for my Dad's unconditional support" (26)*
> "*I am grateful that my boyfriend is so supportive of me" (42)*

Supportive actions. Supportive actions are more clearly defined by participants and involve talking to and spending time with people. Active supportive involvement therefore provides an additional source of gratitude during pregnancy.

> "*I am grateful that my friends are calling up for coffee later on" (10)*
> "*I am grateful for all my friends' support via text" (32)*
> "*I am grateful that me & [my partner] had some time to ourselves today" (17)*

Supportive actions of others during pregnancy also enable engagement in a reciprocal, supportive process. Pregnant women can 'give back' to those supporting them by engaging in the same forms of supportive interactions, as well as pregnancy-specific interactions, such as sharing the sight of the baby on an ultrasound scan. Engaging and repaying support in these ways is also experienced as a source of gratitude.

"I am grateful that we all saw [the baby] yawning on the scan" (20)

8.2.2.3 Daily Life

Participants often expressed gratitude for aspects of daily life, for the 'little' or 'everyday' aspects of day-to-day living. The consistency with which such items are stated as sources of gratitude in the diary entries indicates that gratitude can frequently arise from commonplace or ordinary factors of life. This theme also suggests that not all sources of gratitude during pregnancy are pregnancy focused or interpersonal in nature. The examples comprising this theme are based exclusively on self-focused or outwardly focused sources of gratitude.

"Thankful that my day at work went well" (3)
"I'm grateful for the Spring Sunshine" (39)
"I am truly grateful that my home made Cornish Pasties worked!" (44)

8.2.2.4 Medical experiences

Participants experienced gratitude for two related aspects of prenatal care. These included having good medical experiences and the absence of bad news. Both sub-

themes appear to demonstrate gratefulness that the pregnancy is progressing without problematic issues, as viewed by the participants in terms of their medical experiences.

Good medical experiences. The women in this study tended to express gratitude for positive medical experiences and outcomes, which had already occurred or were due to occur. This indicates gratitude for the smooth progression of their prenatal care in terms of the procedures and processes in place to assist this progression.

"*Thankful that everything went ok with my appointments in the Doctors/Hospital" (2)*

The context in which medical processes and procedures occur during pregnancy is particularly important in how this progression is interpreted. This is evidenced by one participant's gratitude for being admitted to hospital early. This woman was experiencing pregnancy complications and so early admittance was a positive step toward mitigating these complications. It therefore implies that the medical process is proceeding in the best interest of the mother and child.

"I am grateful to be admitted to hospital for observation" (27)

Absence of bad news. The absence of bad news is an additional source of gratitude; participants tended to express gratitude that negative medical events or experiences did not occur. Not receiving bad news indicates the absence of any

medical problems or difficulties. This relates back to the idea that the pregnancy and medical processes involved are progressing as intended, without problems.

> *"I am grateful that the hospital didn't phone as it means my blood tests must be OK this week" (11)*

One woman expressed gratitude for not having to do a caesarean section (c-section), which she describes as an un-wanted medical procedure. The absence of a medical procedure or outcome, rather than its presence, is seen as a source of gratitude here with context remaining an important consideration.

> *"I am grateful that they pulled back from doing a c-section at the last minute" (30)*

8.2.2.5 Being Pregnant

The final main theme that emerged was gratitude for being pregnant. Participants reported that the pregnancy itself was a source of gratitude, without detailing specific aspects of the experience.

> *"I am truly grateful for being pregnant" (43)*

Some women also engaged in a form of social comparison regarding their pregnancy. They felt lucky or privileged to enjoy an experience that is not always experienced positively; the awareness of this position led to gratefulness.

> *"I am grateful that I enjoy being pregnant- not everyone does" (19)*

Although not reported as frequently as other themes in the data, being pregnant is significant as it is associated with these previous themes. For instance, gratefulness for daily life is related to being pregnant as the two co-occur during this period and positive experiences of one can enhance experiences of the other. Gratitude toward the baby emerges as a direct result of being pregnant, support discussed is specific to the support received during the pregnancy and medical experiences relate solely to prenatal care. Thus gratitude for being pregnant is an integral component of overall gratitude during pregnancy.

8.2.3 Discussion

There has been little empirical research on the subjective experience of gratitude, and gratitude during pregnancy is particularly understudied. The aim of this study was to examine sources of gratitude experienced by pregnant women. Gratitude during pregnancy was found to be a multi-dimensional construct that arises from many aspects of the experience of pregnancy, both general and pregnancy-specific. The women in this study reported being grateful for their baby, social support, aspects of daily life, medical experiences, and being pregnant. As far as the researcher is aware, this is the first qualitative investigation of gratitude during pregnancy.

Previous studies have shown the importance of psychosocial support during pregnancy for women's well-being and experiences of pregnancy (Blanchard et al., 2009; Collins et al., 1993; Dunkel Schetter, 2011; Nelson, 2003). Previous research has also demonstrated that social support is strongly associated with experiences of gratitude (Algoe & Stanton, 2012; Wood et al., 2010; Wood et al., 2008a). It is therefore unsurprising that social support emerged as an important theme in the data. Gratitude was reported for a wide range of interpersonal sources of support, including the supportive actions of others and an awareness that social support exists. Gratitude for supportive actions, emotional, practical and informative support was consistently reported, as has been found in previous research (Blanchard et al., 2009). Partners, family and close friends were the only reported sources of this support in the current study; support was not expressed for a broader circle of

acquaintances or work colleagues. Previous research has found that these latter sources are more frequently reported to provide material forms of support (Blanchard et al., 2009), which were also absent from the findings of this study. This suggests that material support is not as salient or important for women in terms of expressions of gratitude during pregnancy. These findings may also reflect the position of family and friends to provide more frequent, diverse and perhaps higher levels of interpersonal support. During pregnancy women may be more likely to actively seek such support from these close relationships than from a broader social circle. Fredrickson's (2004) Broaden and Build theory lends support to this. As a social emotion, gratitude could function to build and maintain social relationships with those closest during pregnancy, as it is these individuals who will provide additional support and resources after the birth. Providing information and increasing awareness among individuals closest to pregnant women about the importance of psychosocial support during pregnancy can therefore lead to better pre and postnatal well-being (Collins et al., 1993).

Prenatal medical experiences and healthcare were also expressed as sources of gratitude. Participants expressed gratefulness for their medical experiences in terms of the processes and procedures in place to monitor and care for both them and their baby. Unlike previous work (Rådestad et al., 2011; Sapountzi-Krepia et al., 2011), the women in this study did not explicitly express gratitude for healthcare professionals involved in their care. The attitudes and behaviours of healthcare professionals during pregnancy have been identified as important aspects of women's experiences of pregnancy and can lead to positive or negative emotions

(Rådestad et al., 2011; Sapountzi-Krepia et al., 2011). Negative encounters with healthcare professionals can lead to negative emotions that are incompatible with gratitude (Fredrickson, 2004), in the current study negative experiences with healthcare professionals may have resulted in an absence of gratitude toward them. Only 5 participants provided qualitative data however and it is unlikely that each participant experienced negative interactions in their prenatal care, which could have influenced their expressions of gratitude. This is particularly so as it is healthcare professionals who advise and often make decisions on the processes and procedures which pregnant women experience, and the participants expressed gratitude for these. It is more likely that during pregnancy, women experience gratitude for all aspects of their prenatal care. It is therefore necessary for an increased awareness among professionals of the importance and effects of their interactions with pregnant women.

The sense of safety and reassurance that emerged from aspects of prenatal care in this study has also been reported in previous research (Sapountzi-Krepia et al., 2011). Women in this study reported that being able to feel and see the baby in both a personal and medicalised context elicited a sense of safety and gave reassurance that the pregnancy is progressing smoothly. In a study of pregnant women, Sapountzi-Krepia et al. (2011) found that this sense of safety can extend beyond medical experiences to experiencing the pregnancy positively as a whole. In addition, seeing and feeling the baby not only engenders a sense of safety but also relates to experiencing important pregnancy milestones (Nelson, 2003; Sapountzi-Krepia et al., 2011). In the current study gratitude for such milestones was reported

by participants in terms of feeling the first kick or discovering the baby's gender. The findings of this study further support the idea that these moments can lead to a sense of responsibility, and to a need for women to be emotionally and practically prepared for the baby's arrival (Nelson, 2003). For instance, women were grateful that they could plan ahead for the arrival of the baby with concrete actions. The capability to plan ahead highlights a self-focused source of gratitude for one's own actions and abilities; this extends beyond inter-personal and medical sources of gratitude. Fostering and encouraging a sense of capability in pregnant women during prenatal care has the potential to elicit gratitude and enhance well-being via more positive experiences of antenatal, intrapartum and postnatal periods.

An additional source of gratitude reported by women in the study was toward non-interpersonal and non-pregnancy related experiences. This draws attention to the importance of maintaining a sufficiently broad view of the construct and supports a dispositional model of gratitude (Wood et al., 2010). However, the predominantly pregnancy-specific themes, including a theme defined entirely by the experience of being pregnant, also asserts the need to also adopt a focus on how gratitude is experienced in particular contexts and life experiences. The contextual specificity of many of the sources of gratitude expressed in this study may indicate why general scales such as the GQ-6 (McCullough, Emmons & Tsang, 2002) do not adequately capture individual's experiences during pregnancy. Developing and validating a multi-dimensional, pregnancy-specific gratitude scale is therefore necessary if further research on gratitude during pregnancy is to progress. The themes that

emerged in this thematic analysis will prove useful in informing a potential item-pool for development of a pregnancy specific gratitude scale.

Despite its original contribution to knowledge, this study was not without its limitations. The number of participants who completed the trial was small (14 out of 72, 19%) and only five of the 14 participants (36%) provided diary entries. These participants tended to be older, had fewer children, and were more likely to have planned the pregnancy, to be living with their partner and less likely to be engaged in unhealthy behaviours. Additionally, diary entries were self-selected by participants who volunteered to participate in this part of the study thus increasing potential for volunteerism bias. One participant also provided a large number of diary entries and, as she was experiencing pregnancy complications, the analysis may be influenced by this. Medical experiences did emerge as an important theme in the experience of gratitude during pregnancy, however it was not an all-encompassing theme as may have been expected if the analysis was biased by this participant's contribution. Prenatal care was instead one of a number of important themes that emerged inductively from the data and that was checked against all other emergent themes for frequency of expression both within and between participants. This participant's increased contribution of diary entries could instead be interpreted as indicative of potentially increased benefits of using a gratitude diary when experiencing pregnancy complications, which can involve high stress. The quality and variability in the data provides confidence in the findings of this thematic analysis, over and above potential limitations of data quantity mentioned. The collection of longitudinal data, detailing gratitude for recent events, is a further strength of the current research.

The women in this study were grateful for a range of aspects of their pregnancies, daily lives and antenatal care. These sources of gratitude were all experienced positively and can be seen to improve women's experiences of their pregnancies. It is necessary to take these pregnancy-specific aspects into account in both future research and scale development in order to enhance our understanding of the role of gratitude during pregnancy.

8.3 Development and Evaluation of the GDP and MAAS

Mindfulness and gratitude scales that are appropriate for prenatal use are essential to evaluate the efficacy of mindfulness and gratitude interventions for fostering and enhancing well-being. The aim of this study is primarily to develop and validate a pregnancy-specific gratitude scale, the gratitude during pregnancy scale (GDP). This will be done by utilising the preliminary thematic analysis findings, coupled with salient pregnancy-related factors identified previously (see Chapter 7), to generate an initial item pool. Factor analysis and reliability testing will then be conducted to refine and validate the scale for use in a pregnant population. Secondly, the mindfulness awareness attention scale (MAAS) will be evaluated using factor analysis and reliability testing. These examinations will provide useful information regarding the applicability of these measurement tools during pregnancy.

8.3.2 Method

8.3.2.1 Participants

The participants in this study were 375 pregnant women aged 19 to 42 (*M*= 32.3, *SD*=4.46). Participants were predominantly Irish (74.7%), with smaller representations from Britain (19.3%), North America, Eastern Europe, Western Europe, Australasia and Barbados. The mean gestational length at questionnaire completion was 25.55 weeks (*SD*= 8.74), with a range of 4 to 45 weeks. Seventy-one percent of women were multiparous. Sixty-eight percent of participants had not experienced pregnancy complications in the current pregnancy, although 43.5% of women reported complications in previous pregnancies. The majority of participants were married or were in relationships (97.6%); only 6 women were single at the time of questionnaire completion (1.6%). Overall, women reported 'a lot' of excitement about the pregnancy.

8.3.2.2 Measures

Gratitude during Pregnancy (GDP) scale. Gratitude during pregnancy was measured using items that assessed how grateful participants felt for a number of aspects and experiences of their pregnancy and their life. Development of the initial item pool resulted from a literature review of empirical findings relating to gratitude and pregnancy, as well as findings of the thematic analysis of pregnant women's reported sources of gratitude, presented previously.

Questionnaire items were written to capture the meaningfulness of experience relevant to each of the identified concept areas. Once a full list of potential items was

developed, judges (academic experts in positive psychology and scale construction) independently assisted in refining and selecting appropriate items. This resulted in an item pool of 48 questions, which had face validity and demonstrated minimal overlap (see Appendix H).

Responses on the measure were made by participants indicating how grateful they felt for each item using a 5-point scale. The scale ranged from 1 (not at all) to 5 (extremely). Scoring involved computation of the intensity (sum of scores) of gratitude reported; a higher score indicates greater gratitude. One item, item 6, was reverse scored. Sample items include 'I am grateful for being pregnant' and 'I have a lot to be thankful for'.

Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003). This is a 15-item scale that uses a 6-point Likert scale ranging from 1 (almost always) to 6 (almost never). The MAAS assesses the mindful disposition using items such as "*I find it difficult to stay focused on what's happening in the present*". In non-pregnant samples, the MAAS has been found to have an internal consistency coefficient of between .82 and .87, with good test-retest reliability (Brown & Ryan, 2003). The reliability of the MAAS in the current study was α =.88.

Gratitude Questionnaire 6 (GQ-6; McCullough, Emmons & Tsang, 2002). This 6-item scale assesses the grateful disposition using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Sample items include "*I am grateful to a wide variety of people"*. The GQ-6 has good discriminant and convergent validity. It also has an internal consistency coefficient of .82 in non-

pregnant groups (McCullough et. al., 2002). Despite low observed reliability for the GQ-6 in a previous pregnant sample, α=.39 (O'Leary et al., 2012), it is included in the current study as a well validated measure of gratitude against which new gratitude measures can be assessed. In the current study the GQ-6 demonstrated a higher internal consistency coefficient of α = .71.

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen & Griffin, 1985). This 5-item scale assesses people's satisfaction with their lives as a whole. This is done by rating items, such as *"so far I have gotten the important things I want in life"*, on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The SWLS has been found to have good test-retest reliability and an internal consistency coefficient of .87 (Diener et al., 1985). The internal consistency coefficient was α = .87.

8.3.2.3 Procedure

Participant recruitment occurred via online discussion forums for pregnancy related topics. Forums were identified by searching three pregnancy and parenting websites. The websites used were http://www.mumsnet.com, http://www.rollercoaster.ie and http://www.babycenter.co.uk. Following forum guidelines, a request for participants was posted on forum message boards. The request outlined the nature of the research and contained a web link to the study questionnaire. The first page of the questionnaire contained full information regarding the nature of the study. It informed participants that by filling out the questionnaire they were consenting to participate and for their data to be used in the

research study. It also informed participants that they could withdraw from the study at any point during questionnaire completion by selecting an option that automatically exited the survey and cleared all responses. Before study commencement, ethical approval was obtained from the Research Ethics Committee of University College Cork.

8.3.2.4 Approach to Analysis

GDP development and validation. Exploratory Factor Analysis (EFA), using Principal Component Analysis (PCA), was used in the current study. All statistical analyses were conducted using SPSS v. 22. PCA was initially run on the full set of 48 items generated through the literature review and thematic analysis. PCA reduces large numbers of variables to smaller combinations of linear variates or factors. This allows for the maximum amount of variance in the data to be explained by the smallest number of constructs. As a result, factors emerging from PCA represent underlying latent variables; thus simultaneously enabling the development and refinement of a measurement scale with a simpler factor structure (Kline, 1994) that accounts for an adequate amount of variance in gratitude during pregnancy.

Kaiser's criterion was used for factor extraction but as there are some disputes over the robustness of Kaiser's criterion (Nunnally & Bernstein, 1994), Cattell's scree plot (1966) was also examined. Parallel analysis was also conducted to robustly evaluate the number of factors to be extracted. Oblique (direct oblimin) rotation was used to facilitate interpretation, as the factors of the GDP were expected to be related. Decisions regarding item retention were based on conceptual and

statistical rationale. Internal consistency of the GDP and its subscales was investigated using Cronbach's alpha coefficient.

The factor structure of the GDP was also investigated by stage of pregnancy. Early pregnancy was considered as up to 20 weeks; late pregnancy is from week 28. A PCA with oblique (direct oblimin) rotation was conducted by group. Factor loadings and the total variance explained were examined for each group to determine if the overall factor structure was retained. Cronbach's alpha coefficients were calculated to examine reliability in each group.

Convergent validity of the GDP with other measures of positive psychological states and traits, general gratitude (GQ-6), mindfulness (MAAS) and satisfaction with life (SWL) was also examined using bivariate correlations.

MAAS validation. Exploratory Factor Analysis (EFA), using Principal Component Analysis (PCA), was used to examine the stability of the MAAS factor structure in pregnancy. The same steps of analysis as outlined for the GDP were conducted with the MAAS. Internal consistency of the MAAS and its subscales was investigated using Cronbach's alpha coefficient.

8.3.3 Results

8.3.3.1 Development of the Gratitude during Pregnancy (GDP) Scale

Construct validity. An exploratory principal components analysis (PCA) was conducted on the original 47 items of the GDP. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, KMO= .93. Bartlett's test of sphericity indicated that the correlation matrix was significantly different from an identity matrix, X^2 (1081) = 9311.31, $p < .001$. Eigenvalues greater than 1, Cattell's Scree Plot and Parallel Analysis (Horn, 1965) were used to determine factor extraction. An examination of eigenvalues suggested the extraction of ten factors was appropriate. Parallel analysis and the scree plot indicated that four components were more appropriate. An examination of the constituent items for this factor structure also indicated that items loaded higher on the first four factors.

As a result, PCA was conducted on the 47 items of the GDP using an oblique (direct oblimin) rotation, specifying the extraction of four factors. This model explained a combined 48.27% of the variance; Factor 1= 31.34%; Factor 2= 7.27%; Factor 3= 5.40%; Factor 4= 4.27%. Factors loadings on each component were examined for item loadings below .55. Comrey and Lee (1992) suggest this stringent cut-off is appropriate, as estimated loadings in PCA tend to be higher than, for instance, principal factors. Communalities were also examined to determine the common variance of individual items, particularly in terms of items with values lower than .5 (50% shared variance). Examination of the factor loadings and communalities suggested the removal of twenty-nine items would help solidify the

construct; these included items such as gratitude for “The work the midwives do during pregnancy”, “The baby’s father’s involvement in the pregnancy” and “That my body is able to nurture a baby”. It had been anticipated that items indicating support from family members and antenatal staff would elicit gratitude during pregnancy, and so the weak contribution of these items to a factor was unexpected. It is possible that these items contribute to a positive prenatal experience but do not necessarily result in specific experiences of gratitude. As a result of the evaluation, the 29 items were removed.

PCA was rerun with the remaining 18 items, using an oblique (direct oblimin) rotation and a four-factor solution. The four factors explained 66.79% of the total variance, explaining 37.19%, 12.20%, 11.00% and 6.40% of the variance respectively. Factor 1, ‘General gratitude’, contained items that appear to reflect broad sources of gratitude in terms of both general gratitude and pregnancy-specific gratitude. Factor 2, ‘Physical changes’ represents changes that occur during pregnancy, such as weight gain. Factor 3, ‘Antenatal care’, relates to antenatal care procedures, such as ultrasound scans and checks that monitor the baby’s health. Factor 4, ‘Social support’, relates to interpersonal interactions; see Table 45. These factors and constituent items present a clearer conceptualisation of gratitude during pregnancy than the initial item pool.

Table 45

Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of GDP Items

Factor/ Item	Factor Loading			
	Factor 1	Factor 2	Factor 3	Factor 4
General Gratitude				
1. I have a lot to be thankful for	**.835**	-.100	.002	.342
2. There are many reasons for me to be thankful	**.823**	-.060	-.039	.378
3. I am thankful for my life	**.794**	-.066	-.048	.299
4. I count my blessings for the things that I have	**.776**	.029	.022	.267
5. I am grateful for being pregnant	**.694**	.171	.171	.256
6. I think it is important to enjoy the simple, 'everyday' things in life	**.674**	.065	.000	.459
7. I have moments when I really appreciate the experience of being pregnant	**.620**	.317	.061	.309
Physical Changes				
8. The extra weight my body is gaining during this pregnancy	-.037	**.912**	-.075	.177
9. The physical symptoms that come with pregnancy (morning sickness, tiredness)	-.048	**.813**	.012	.311
10. The opportunity to wear maternity clothes	-.034	**.803**	.051	.289
11. My changing body shape	.110	**.764**	-.050	.146
12. The 'baby-bump' that develops during pregnancy	.119	**.602**	.128	.408
Antenatal Care				
13. That I can see my baby on ultrasound scans	-.068	.043	**.880**	.120
14. Having the first ultrasound scan of the baby	.042	-.078	**.836**	.240
15. That my baby's health can be checked and monitored	.067	-.013	**.821**	.204
16. Availability of medical procedures during my pregnancy	-.018	.018	**.690**	.357
Social Support				
17. That my friends are there for me during the ups and downs of pregnancy	-.009	.035	.030	**.883**
18. Getting to spend time with my friends	.056	.024	.012	**.871**

Correlations among the factors were also examined and were found to be moderate in all cases; see Table 46.

Table 46

Inter-factor Correlations for Four GDP Factors

Factor	1	2	3	4
1. General gratitude	-	.45**	.39**	.45**
2. Physical Changes		-	.29**	.36**
3. Antenatal Care			-	.31**
4. Social Support				-

Note. ** p<.001

Reliability. The internal consistency of the 18-item GDP was examined using Cronbach's alpha coefficient and was found to be α = .89. The internal consistency of each subscale was also examined using Cronbach's alpha coefficient. The internal consistency coefficients for the four subscales are as follows: General gratitude α = .90; Physical changes α = .87; Antenatal care α = .83; Social support α = .73.

Validation of GDP factor structure by stage of pregnancy. The factor structure of the 18-item GDP was examined by pregnancy stage. This was done because it is expected that as pregnancy progresses, psychological and physical changes occur that can influence positive states and traits, such as gratitude. The influence of stage or progress of pregnancy on aspects of well-being is clearly seen with regard to negative states, such as psychological stress, which becomes attenuated in later

pregnancy (Glynn et al., 2001; 2004). Thus, it is important to examine potential changes or fluctuations in gratitude during pregnancy stages or trimesters to further a more thorough understanding of the construct in the full course of pregnancy.

A PCA with oblique (direct oblimin) rotation and a four-factor solution was run for each group, where group status was determined by stage of pregnancy. A PCA was first conducted with the early pregnancy subgroup (*n*= 111), defined as 0-20 weeks gestation. The KMO measure of sampling adequacy indicated an adequate sample size, KMO= .83. In this group the GDP explained 70.61 % of the variance. The four factors explained 36.08%, 14.76%, 11.68% and 7.54% of the variance respectively. A PCA was then conducted with the late pregnancy subgroup (*n*= 161), defined as 28+ weeks of gestation. The KMO measure of sampling adequacy indicated an adequate sample size, KMO= .85. In this group the GDP explained 64.74% of the variance. The four factors explained 37.63%, 11.33%, 9.16% and 6.62% of the variance respectively. The factor structure for the full data set was retained in both subgroups, with negative loadings observed for the physical changes and social support subscales in late pregnancy (see Table 47). The internal consistency of the GDP in both subgroups was examined using Cronbach's alpha coefficient. The reliability of the GDP in early pregnancy was α =. 88; in late pregnancy it was α =. 90.

Table 47

Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of GDP for Early (<20weeks) and Late (>28weeks) Pregnancy

	Early Pregnancy (*n*=111)				Late Pregnancy (*n*=161)			
Factor/ Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1								
1.	**.921**	-.045	-.107	-.064	**.860**	.103	-.003	.109
2.	**.886**	-.008	-.099	.074	**.786**	-.123	-.086	-.015
3.	**.827**	-.075	-.034	.135	**.762**	-.032	.095	.046
4.	**.795**	.017	.040	.065	**.640**	-.161	.083	-.044
5.	**.733**	-.078	.150	.114	**.532**	-.361	.004	-.144
6.	**.691**	.153	.267	-.092	**.527**	.103	.070	-.390
7.	**.652**	.289	.094	-.161	**.473**	-.090	.081	-.388
Factor 2								
8.	-.045	**.874**	-.113	.049	-.039	**-.931**	.006	.110
9.	-.055	**.857**	-.016	-.078	-.045	**-.776**	-.025	-.194
10.	-.032	**.829**	.077	.032	.081	**-.770**	-.010	-.080
11.	.078	**.764**	-.010	.072	.083	**-.766**	.058	.164
12.	.146	**.646**	.118	.130	.076	**-.596**	.128	-.263
Factor 3								
13.	-.052	.015	**.905**	-.149	-.109	.014	**.839**	-.007
14.	.068	.054	**.854**	-.169	-.132	-.160	**.777**	.051
15.	-.126	.058	**.691**	.323	.206	.060	**.695**	.012
16.	.177	-.103	**.691**	.240	.153	.061	**.656**	-.120
Factor 4								
17.	.028	.103	.017	**.839**	-.087	-.036	-.024	**-.915**
18.	.112	.076	-.014	**.794**	.059	-.038	.127	**-.737**

Convergent validity. Bivariate correlations were conducted for scores on the GDP, GQ-6, MAAS and SWLS. These measures were chosen as it is anticipated that gratitude, as a positive construct, would demonstrate associations with similar positive constructs. Scales measuring negative aspects of well-being, such as stress or depression, were not included in the analysis. This was because during pregnancy, it is possible that positive constructs co-exist with negative constructs as physical, behavioural and life changes could simultaneously cause distress and gratefulness.

Initial assumption testing indicated that the data are not normally distributed; therefore Spearman's rho was used in correlational analysis. As seen in Table 48, GDP was significantly positively associated with scores on the GQ6 and SWL. It was also positively associated with scores on the MAAS although this association was not significant. These results provide some support for the convergent validity of the GDP with other measures of positive psychological well-being.

Table 48

Convergent Validity Findings for the GDP, GQ-6, SWL, MAAS

Measure	1	2	3	4	*M*	*SD*
1. GDP	-	.428**	.377**	.085	71.60	10.08
2. GQ-6		-	.511**	.215**	34.46	5.34
3. SWL			-	.146*	26.07	5.93
4. MAAS				-	58.09	13.11

Note. GDP=Gratitude during Pregnancy. GQ-6= Gratitude Questionnaire. SWL= Satisfaction with Life. MAAS= Mindfulness Attention Awareness Scale. ** $p < .001$, * $p<.05$

8.3.3.2 Evaluation of the MAAS during Pregnancy

Internal consistency. The reliability of the MAAS during pregnancy was investigated by assessing the Cronbach's alpha coefficient. The internal consistency coefficient was $\alpha = .88$, indicating good reliability (Nunnally, 1978).

Psychometric properties. An exploratory principal components analysis (PCA) was conducted on the 15 MAAS items, see Figure 38 for analytic steps taken.

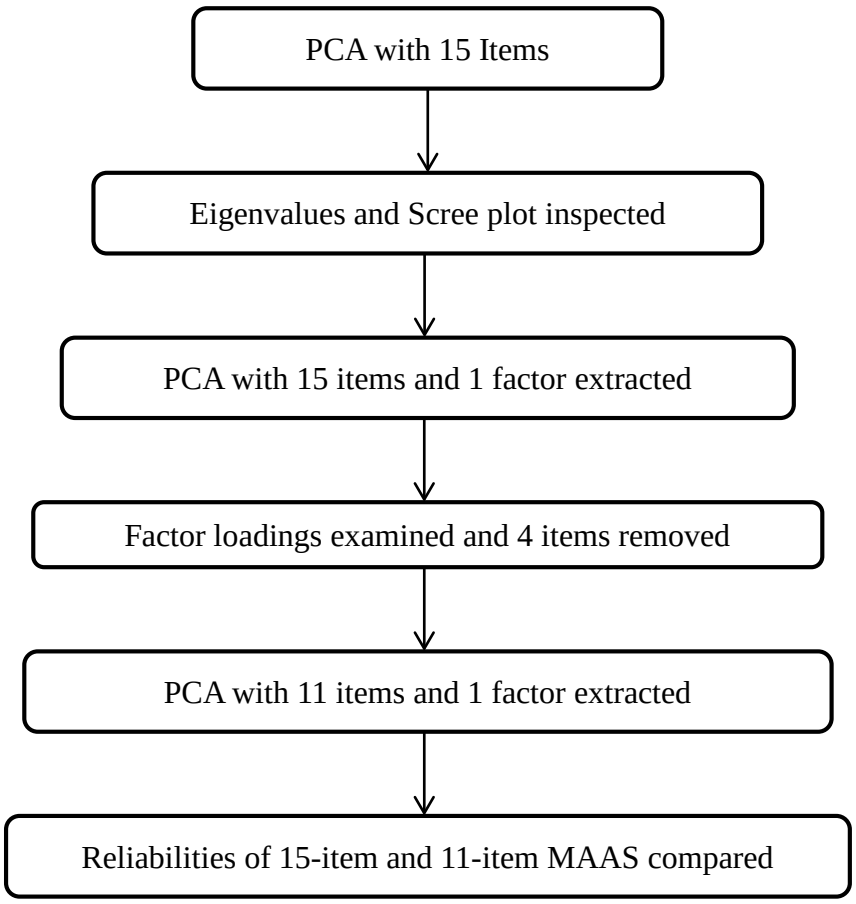

Figure 38. Flowchart of Mindfulness Awareness Attention Scale (MAAS) evaluation.

An initial analysis was conducted to obtain eigenvalues for each component in the data. Three factors had eigenvalues greater than Kaiser's criterion of one and explained a cumulative 55.89% of the total variance; 39.58%, 9.22% and 7.09% respectively. Examination of the scree plot and parallel analysis indicated one main mindfulness factor.

PCA was therefore conducted on the 15 items of the MAAS using an oblique (direct oblimin) rotation. It was specified in the analysis that only one factor be extracted. This factor explained a combined 39.52% of the variance in mindfulness. Factor loadings were examined for items loading below .5; these were considered low and were subsequently removed. Four items were removed as a result: item 5 "I tend not to notice feelings of physical tension or discomfort until they really grab my attention"; item 2 "I break or spill things because of carelessness, not paying attention, or thinking of something else"; item 6 "I forget a person's name almost as soon as I've been told it for the first time"; and item 1 "I could be experiencing some emotion and not be conscious of it until some time later".

PCA was rerun with the remaining 11 items, using an oblique (direct oblimin) rotation and a one-factor solution. The one factor solution explained 48.45% of the variance in mindfulness. The internal consistency coefficient for the 11 items of the MAAS was investigated using Cronbach's alpha coefficient and was found to be $\alpha = .89$. The increase in variance and reliability for the 11-item model was not deemed to be sufficient to warrant removal of the 4 items listed above. Use of the 15-item scale is instead recommended.

8.3.4 Discussion

The current study developed and validated a scale to measure gratitude during pregnancy. The Gratitude during Pregnancy (GDP) scale appears to be a reliable and valid instrument for measuring gratitude throughout the perinatal period. The results demonstrate that internal consistency values were high for the full GDP and for each of the subscales. Furthermore the GDP demonstrated high internal consistency values for early and late pregnancy groups. There is also evidence of good convergent validity with other measures of positive psychological states and traits, such as satisfaction with life. Construct validity of the GDP was shown using exploratory factor analysis, which yielded an 18-item scale with a four-factor structure.

The four components of the GDP (general gratitude, physical changes, antenatal care and social support) are conceptually distinct but provide insight into the factors that influence positive prenatal well-being. General gratitude is related to pregnancy and general sources but is not explicitly linked to an event, experience or interaction; it instead encompasses an overall feeling of gratitude during pregnancy. The items included in this subscale, such as “I have a lot to be thankful for”, reflect the dispositional view of gratitude proposed by Wood et al. (2010). This dispositional view sees gratitude as involving an appreciation of the good in life, which can arise from numerous sources. The inclusion of pregnancy-specific items in combination with general items is an important finding as it highlights the necessity of measuring constructs in a contextually sensitive manner during transitional life periods, such as

pregnancy. In light of this finding, the absence of pregnancy-specific sources of gratitude in the GQ6 (McCullough et al., 2002) explains the low reliability of the GQ6 with a pregnant group (O' Leary et al., 2012). Although the reliability of the GQ-6 was higher in the current study than previously reported with a pregnant group, it had weaker internal consistency than the GDP. This provides further support for the appropriateness and usefulness of a contextually relevant measure for pregnant women. The focus on aspects of pregnancy in the remaining items of this subscale strengthens the focus of the scale on the experience of pregnancy-specific, rather than general, gratitude.

The finding of gratitude for physical changes in the current study runs contrary to previous findings that associate prenatal bodily changes with worry and concern (Lederman, 1996). The high positive loadings of all items in this subscale indicate the positive influence of physical changes for eliciting gratitude during pregnancy overall. This may be because gaining weight and/or experiencing morning sickness can provide an outward indicator of the healthy growth and development of the foetus (Chang, 2006). Thus, the importance of physical indicators of pregnancy progression, rather than internal processes centred on thinking about unobservable events or experiences, is highlighted in this subscale. However, when the GDP is examined by stage of pregnancy, items on this subscale load negatively in late pregnancy. This may explain previously found negative associations of physical changes and well-being (Lederman, 1996). It also suggests that these negative associations are confined to late pregnancy, when pregnancy weight and physical strain may become more pronounced, and are experienced as a burden, rather than

confirmation of the pregnancy. In a similar manner to stress, as noted previously (Glynn et al. 2001; 2004), this finding could also represent a habituation of gratitude for certain aspects of experience later in pregnancy. This may be because the novelty of earlier experiences becomes attenuated, even within a short space of time. As the data examined here is cross-sectional, we cannot draw a strong conclusion on this however, further longitudinal research is needed to investigate if this is the case.

The finding of an antenatal care subscale in the current study is also related to the ability to view and monitor maternal and foetal health and the progression of the pregnancy. This finding is unsurprising, as previous research has indicated the importance of antenatal care as a source of gratitude for pregnant women (O' Leary et al., 2012). Similarly, interactions with healthcare professionals have been found to be an important aspect of antenatal care in previous studies (Sapountzi-Krepia et al., 2011). Surprisingly healthcare professionals were not found to elicit gratitude in the current study. This may be due to the focus of the subscale on antenatal care in terms of the health of the baby and the importance of this care for monitoring and promoting this health. The focus is therefore less on how interpersonal interactions that occur during antenatal care elicit gratitude; it is more on the medical processes and procedures that directly monitor maternal and foetal health.

A social support subscale emerged in the current study. This was unsurprising as social support is consistently and positively associated with gratitude (Bartlett et al., 2012) and prenatal well-being (Blanchard et al., 2009). The current study adds support to these findings and brings together the importance of support for both gratitude and pregnancy. Surprisingly, a number of aspects of interpersonal support

expected to elicit gratitude during pregnancy were deemed unsuitable during analysis. Such aspects included support from family members and the baby's father. Previous research (Dunkel Schetter, 2011) has indicated the importance of support from these sources during pregnancy, however only support from friends was found to elicit gratitude in the current study. This discrepancy may be understood in terms of perceived and received support. Perceived support is the idea that support is or will be available from others when it is needed, while received support relates to whether support was actually received when needed. Prenatal familial support may be an expected aspect of the relationship during pregnancy and so forms a large part of perceived support during the prenatal period. As such, received support resulting from these interactions is expected and would not be seen as a gift or benefit. As a result it would not elicit gratitude in the same way that less intimate relationships, such as friendships, might. This was not found to be the case for the preliminary thematic analysis however, where family and partners were reported to be sources of gratitude. Discrepancies may be explained by the samples and sample sizes used in the two studies; the thematic analysis presented data from a small group of pregnant women, while the scale construction involved a larger, perhaps more representative group. While the absence of support from family and partners may be a statistical artefact in the current study, it is also possible that the mechanisms associating gratitude and social support function differently in different groups and at different stages of pregnancy.

Interestingly, in late pregnancy social support from friends results in negative factor loadings. This may be because as women become more focused on

preparation for birth and motherhood in later pregnancy they attribute less focus to interpersonal interactions. This could lead to altered social networks and a reduced ability to engage supportive networks. As the items comprising social support in the current model relate to received support, which would result from social interactions with friends, this may be the case. Such an explanation is supported by the findings that friends and acquaintances are more frequently reported to provide material forms of support (Blanchard et al., 2009), and that gratitude for material support was absent in the preliminary thematic analysis. Items loading on this scale are positive in early and late pregnancy however, indicating that perhaps the role of support changes over time. As seen for physical changes in pregnancy, this could also result from a habituation of gratitude toward support received from friends during pregnancy; however there is little evidence to support this. These findings do not suggest a negative impact of social support in late pregnancy but instead indicate that social support during pregnancy is not a direct route to increased gratitude. Similarly, gratitude in late pregnancy is not a mediating factor for the effects of social support. Therefore despite the low number of items, this scale can be seen as indicative of interpersonal support relevant across the perinatal period.

Overall the current research demonstrates that gratitude during pregnancy is a multi-faceted, context-specific construct that remains stable across pregnancy. Examination of the usefulness of the MAAS during pregnancy however demonstrated that, unlike gratitude, mindfulness can be adequately measured during pregnancy using a general measure. The MAAS has previously been validated for use with non-pregnant groups (Brown & Ryan, 2003). The findings of the current

study suggest that mindfulness, as measured by the MAAS, is relatively unaffected by the contextual specificity of transitional periods such as pregnancy. This may be because the items comprising the MAAS relate to focusing and maintaining awareness in the present moment, a skill that is not influenced by the experience of pregnancy. Unlike gratitude, mindfulness is not dependent on events or experiences; it involves a focus on all stimuli that occur (Baer, 2003). As such the experiences of pregnancy would not be expected to alter it. Differences between gratitude and mindfulness during pregnancy are further supported by the lack of a significant correlation between the MAAS and the GDP. A significant correlation was observed between the MAAS and the GQ6 however. As the GQ6 is a more general measure of gratitude, suitable for non-pregnant groups, it strengthens the argument that changes observed in gratitude during pregnancy are not comparable to pregnant women's experiences of mindfulness. Regardless of the differences between prenatal mindfulness and gratitude, examination of the MAAS clearly demonstrates that it is a suitable and useful tool for measuring mindfulness during pregnancy. It demonstrates a strong single-factor structure, high reliability and good convergent validity with other measures of psychological states and traits. The findings of this study would recommend the use of the MAAS during pregnancy.

Despite their original contribution to knowledge the generalisability of the findings of the current study are limited by the characteristics of the sample used. The majority of participants were Irish, in a relationship and reported a 'lot' of excitement about their pregnancies; thus pregnant women from minority groups or those experiencing less positive pregnancies are not represented. A further limitation

of the current study was that women's level of engagement with medical or alternative antenatal care was not collected and it is possible that there may be differences in gratitude between women who opt for less medicalised or more holistic approaches to pregnancy and childbirth. Future research with these groups would therefore be beneficial to investigate the robustness of the current factor structure. In addition, the aim of the study was to develop a scale that would reliably measure levels of gratitude during pregnancy, rather than fluctuations in gratitude levels across the duration of pregnancy. As a result, changes across time were not evaluated in the current examination. Future work, conducting a longitudinal analysis of the GDP, would also allow the usefulness of the scale over time to be evaluated, this is necessary when assessing intervention effects.

In summary, the current research developed a reliable and valid measure of gratitude during pregnancy, the GDP. The 18-item GDP was found to be suitable for use in an overall pregnant group and in subsamples of pregnant women. The four factors of the 18-item GDP reflect general and pregnancy specific aspects of gratitude including general gratitude, physical changes, antenatal care, and social support. The current research highlights the importance of examining the structure of positive psychological constructs in specific contexts, such as pregnancy. Adopting contextually specific approaches to the measurement of positive psychological states and traits will enable more robust investigations of the role of these states and traits in prenatal maternal well-being. This will further allow the development and refinement of empirically based interventions aimed at improving and maintaining levels of prenatal well-being. The findings of the current study demonstrate that the

GDP and the MAAS are reliable and valid tools for evaluating the efficacy of such interventions.

Chapter 9

Study 5 Bundle of Joy Study

As discussed in Chapters 9 and 10, previous research demonstrates the potential usefulness of positive constructs during pregnancy. The consistency with which constructs, such as mindfulness and gratitude, have been associated with improved well-being in diverse groups suggests an alternative route to improving prenatal well-being. The detrimental effects of low prenatal well-being have been extensively studied but positive interventions that aim to improve well-being through fostering and maintaining prenatal psychological resources are in their infancy. The research to date is limited by methodological issues and so robust efficacy evaluation protocols, incorporating subjective and objective outcome measures, are essential. The current study will therefore examine the effect of a novel gratitude and mindfulness based intervention on maternal psychological well-being, cortisol levels and birth outcomes, in comparison to a treatment as usual control group.

9.1 Hypotheses

It is hypothesised that the intervention will enhance psychological and physiological well-being and birth outcomes in the following ways:

1. The intervention will increase life satisfaction, happiness, positive affect, perceived social support and sleep quality in comparison to a control condition.
2. The intervention will reduce self-reported levels of depression, prenatal stress and negative affect, in comparison to a control condition.
3. The intervention will optimise cortisol functioning, in comparison to a control condition. Changes will presumably be observed as reductions in cortisol levels.
4. Changes in well-being will be mediated by increases in gratitude and/or mindfulness in the intervention condition.

9.2 Method

9.2.1 Participants

The study participants (*N*=46) were pregnant women aged 27 to 40 years (*M*= 33.87, *SD*=3.04). Participants were required to be over 18 years of age, for consent purposes, and able to communicate in English. They were also required to be between 10 and 22 weeks pregnant at recruitment and not be taking asthma or thyroid medication. Participants must also not have received a diagnosis of depression, anxiety or other well-being issues in the last 2 years.

9.2.1.1 Sampling and recruitment. Sample size was determined using power calculations with G*Power 3 (Faul et al., 2007). Calculations were conducted for a mixed between-within subjects design. Estimates of effects were derived from the findings of Study 1, while maintaining a conservative approach to power analysis. Results of this analysis indicated that a total sample size of 141 participants is sufficient to detect a 15% difference in cortisol, with a 30% change in aspects of wellbeing with a power level of .95, and alpha at 0.05.

Participants were recruited in the antenatal outpatient department of Cork University Maternity Hospital (CUMH). Potential participants under the care of Dr Mairead O' Riordan, Professor Louise Kenny and Professor John Higgins were recruited from the Cork Obstetrics and Gynaecology Associates (COGA) in the Cork University Hospital Private Consultants Clinic. This involved fliers, in-person recruitment and telephone contact. Recruitment posters and leaflets were made available in various locations in Cork City, including general practitioner surgeries,

medical centres, prenatal yoga and pilates classes, and birth classes. Recruitment notices were also placed on the pregnancy forums of the websites www.rollercoaster.ie and www.mum2be.ie. Recruitment took place over a period of 12 months, form August 2013 to July 2014.

9.2.2 Design

This study used a mixed between-within subjects randomised control trial design (RCT). The independent variables were time, with three levels (baseline, 1.5 weeks and 3 weeks), and experimental condition, with three levels consisting of two intervention conditions and a control condition. The dependent variables were mindfulness, gratitude, depression, satisfaction with life, subjective happiness, perceived social support, sleep quality, prenatal stress, birth outcomes (gestational age, birth weight, birth complications, delivery type) and cortisol (CAR, waking cortisol, +30 minutes cortisol, evening mean, AUC).

9.2.3 Materials

9.2.3.1 Self-report measures.

Sociodemographic variables. Participants provided details regarding age, nationality, religiosity, education level, relationship status, weekly disposable income, weekly hours worked, household structure and cigarette consumption.

Gratitude during Pregnancy Scale (GDP; see Chapter 8). This is an 18-item scale, which assesses the grateful disposition during pregnancy. Items are rated on a

5-point Likert scale ranging from 1 (not at all) to 5 (extremely). The GDP has good discriminant and convergent validity. In the current study the GDP had an internal consistency coefficient of α= .89 and demonstrated good test-retest reliability at Time 2 (α= .88) and Time 3 (α= .94).

Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003). This 15-item scale assesses the mindful disposition using a 6-point Likert scale ranging from 1 (almost always) to 6 (almost never). Sample items include "*I forget a person's name almost as soon as I've been told it for the first time*". The MAAS has demonstrated good test-retest reliability with an internal consistency coefficient of between .82 and .87 in previous studies (Brown & Ryan, 2003). In a validation of the MAAS with pregnant women (Chapter 8), the MAAS was found to have an internal consistency coefficient of α=.88. In the current study the MAAS also had an internal consistency coefficient of α=.88. The scale demonstrated good test-retest reliability at 3 weeks (α= .94).

Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden & Sagovsky, 1987). Although initially developed as a measure of postnatal depression, the EPDS has been validated for use in diverse groups. In a large sample of pregnant women, Bergink et al. (2011) found the EPDS to demonstrate good test-retest reliability, and internal consistency coefficients of .82, .83 and .84 in the 1st, 2nd and 3rd trimesters respectively. Ten items are rated on a 4-point scale; items 3, 5, 6, 7, 8 9 & 10 are reverse scored. Items include *"I have blamed myself unnecessarily when things went*

wrong". In the current study the EPDS had an internal consistency coefficient of α=.82. Good test-retest reliability was also observed at 3 weeks (α= .77).

Prenatal Distress Questionnaire (PDQ; Yali & Lobel, 1999). This scale assesses pregnancy specific stress. Participants responded to 12 items on a 5-point Likert scale, from 1 (not at all) to 5 (Extremely). Items asked participants how frequently and intensely they experience pregnancy specific stress, worries and hassles (e.g. "*Emotional ups and downs during pregnancy annoy me*"). The scale has a high internal consistency coefficient of α=.81 (Yali & Lobel, 1999). In a review of measures of pregnancy related stress, Nast et al. (2013) also found the PDQ to be the most suitable measure based on psychometric criteria. In the current study the PDQ had an internal consistency coefficient of α=.87; it also demonstrated good test-retest reliability at 3 weeks (α= .84).

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen & Griffin, 1985). The SWLS uses five items to assess people's satisfaction with their life. Items are rated on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Scale items include *"In most ways my life is close to my ideal"*. Previous research has found the SWLS to have good test-retest reliability and an internal consistency coefficient of α=.87 (Diener et al., 1985). The only published evaluation of the usefulness of the SWLS in a pregnant group to date has been an examination of the Spanish version of the SWLS (Martinez et al., 2004). This was conducted with a sample of 588 Spanish women who were pregnant or in puerperium and demonstrated an internal consistency of α=.82. In the current study the SWLS had an

internal consistency coefficient of α=.77. The scale demonstrated good test-retest reliability at 3 weeks (α=. 89).

Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999). This 4-item scale assesses subjective happiness, using a 7-point Likert scale. Items 1 and 2 ask participants to characterise themselves using both absolute ratings and ratings relative to peers. Items 3 and 4 ask participants to read statements describing happy and unhappy individuals and then rate how well they feel this characterises them. For instance one item asks *"Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you?* The SHS has internal consistency coefficients ranging from α= .79 to .94 and has also been found to have good convergent reliability and good test-retest reliability (Lyubomirsky & Lepper, 1999). In the current study the SHS had an internal consistency coefficient of α=. 91; at 3 weeks the internal consistency coefficient was α=. 97.

Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet & Farley, 1988). This 12-item scale assesses perceived social support, related to three subscales: family, friends and significant other. Items include *"My family really tries to help me"* and are rated on a 7-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). During pregnancy the MSPSS has a high internal consistency coefficient of α=.92, with coefficients of .90, .94 and .90 for the family, friends and significant other subscales respectively (Zimet et. al.,

1990). In the current study the MSPSS had an internal consistency coefficient of α=. 90; the scale demonstrated good test-retest reliability at 3 weeks (α= 91).

Jenkins Sleep Questionnaire (JSQ; Jenkins, Stanton, Niemcryk & Rose, 1988). This 4-item scale evaluates sleep quality by asking participants to indicate how frequently certain sleep difficulties have occurred over the previous month. These difficulties include having trouble falling asleep, trouble staying asleep, waking up several times per night and waking up after a usual amount of sleep yet still feeling tired. Items are rated on a 6-point scale, from 0 (Never) to 5 (22-31 days of the month), with a lower score representing improved sleep quality and reduced sleep disruption. This scale has demonstrated good internal consistency, α=.79 (Jenkins et al., 1988). In the current study the JSQ had an internal consistency coefficient of α=. 76. It also demonstrated good test-retest reliability at 3 weeks (α=. 82).

9.2.3.2 Salivary cortisol measures.

C*ortisol sampling procedure.* Participants collected salivary cortisol samples at 3 sampling periods during the study. These were baseline (Time 1), 1.5 weeks later (Time 2) and 3 weeks later (Time 3). Each sampling period lasted 2 consecutive days, with 6 days of saliva sampling in total during the study. The first sampling period consisted of the first Monday and Tuesday of the study; the second sampling period was the second Thursday and Friday of the study; the third sampling period was the fourth Monday and Tuesday of the study. These days were chosen to

standardize sample collections to work days as significant differences in cortisol levels have been observed between work and non-work days (Clow et al., 2004).

Samples were collected 5 times per day at the following times: immediately on waking, 30 minutes after waking, 45 minutes after waking, midday and bedtime (see Figure 39). Participants were required to record actual collection times on time cards provided to indicate potential non-adherence to sampling times. Each participant was required to collect 30 saliva samples during the study. Samples were collected using Sarstedt Salivettes® with cotton swabs. Each Salivette® tube was colour coded, corresponding to the relevant sampling time (see Figure 39). Salivette® tubes were also labelled with the sample to be collected in words (e.g. 'waking' or 'bedtime'), to improve ease of use and adherence to the protocol. Participants were instructed to rinse their mouth with water 10 minutes before all samples, except the waking sample; to avoid dairy 20 minutes before collection, and teeth brushing 45 minutes before collection. They were also instructed not to eat a main meal 60 minutes beforehand or to smoke or drink alcohol 12 hours before sample collection.

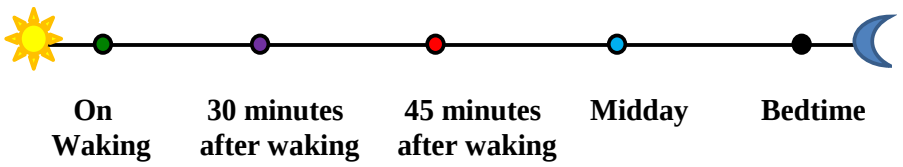

Figure 39. Sample collection times for each sampling day in Bundle of Joy study.

Once collected, samples were stored in storage collection bags in the participant's domestic freezer until study completion. They were then posted directly to the researcher and stored at -20°C until assayed.

Cortisol assay procedure. Once thawed, samples were centrifuged at 2000 x *g* at 10°C for 10 minutes. Cortisol levels were determined from saliva samples using a commercial enzyme-linked immunoassay kit (ELISA, Salimetrics, Suffolk, UK). Duplicate analysis was conducted using 100 µl; controls representing high and low salivary levels were included, all values were averaged across assessments. Intra- and interassay coefficients of variation were 7.6% and 13.2%. CAR response was calculated as the difference between +30 minutes and waking cortisol concentrations (Dressendorfer et al., 1992; Polk et al., 2005). Total cortisol secretion was calculated as area under the curve with respect to the ground (AUC_G) using the trapezoid formula (Pruessner et al., 2003). Due to insufficient samples provided by participants, AUC_G could not be included in inferential analyses.

9.2.3.3 Interventions. One dual component intervention was used in the current study. This involved a gratitude diary component and a mindfulness listening component. Due to the dual nature of the intervention, the order of component completion was counterbalanced between the two intervention groups. In the intervention 1 condition (I1) participants completed the listening component first; in the intervention 2 condition (I2) participants completed the diary component first. Both interventions were completed online, with diary data being sent directly to the researcher via the intervention website. Participants began the intervention on the

third day of the study, immediately after completion of the first sampling period. Participants then used the intervention four times a week for 3 consecutive weeks.

Gratitude diary. Participants completed their diaries by listing up to 5 things they felt grateful for during the previous 24 hours. Instructions for diary completion were similar to Study 1 but also made reference to an experience of pregnancy, *'feeling your baby move'*, as an example of something for which participants may feel grateful. See Appendix I for gratitude diary instructions.

Mindfulness meditation. The listening component of the intervention was the mindfulness meditation audio, the Body Scan. This involved a guided focus on the breath and progressive sections of the body. It was similar to the meditation used in Study 1 but incorporated a focus on the belly and presence of the baby. The mindfulness meditation was provided on the research website and lasted 6 minutes; see Appendix J for the mindfulness Body Scan instructions.

9.2.3.4 Research website. A research website was developed by the researcher for the purposes of the study. The website had 4 separate sections, one relating to each of the three experimental conditions and one general information section. The information website (www.bundleofjoystudy.com) provided full study information for all potential participants. This included information about the intervention, the questionnaires, saliva sampling, contact details, and the timeline of the study. The information website also contained the informed consent and registration forms. I1

participants accessed www.bundlestudy.com; I2 participants accessed www.pregnancystudy.com; control participants accessed www.BOJS.com. The websites for each experimental condition contained a web link to the self-report questionnaire, information about collection of saliva samples, a web link to the intervention (for participants assigned to an intervention group only), and contact details for the researcher. Only the research team had access to details provided by participants on the research website.

9.2.4 Procedure

The study procedure was altered from that outlined in Study 3 (see Chapter 6) as a result of the previous study findings. The duration of this study was reduced to 3 weeks. The frequency of sample collection was also reduced to five saliva samples collected across 2 days at each sampling period. These steps were taken to minimise participant attrition while maintaining a robust and rigorous approach to data collection.

All participants registered online to take part in the study. Participants were required to first indicate informed consent and then provide registration details in the form of their name, contact phone number and address. Once registered, participants were randomly assigned to one of the three experimental conditions using restricted block randomisation, using blocks of three with a ratio of 1:1:1. Following randomisation, participants received their Bundle of Joy Study participant packs. These contained a day planner outlining the study activities, an information leaflet reiterating the study description, and a web address for the research website

corresponding to the randomly assigned experimental condition. The packs also contained collection kits for saliva samples that included time cards for recording saliva collection times.

All participants began the study on a Monday by completing baseline saliva sampling and self-report measures. Sample collection continued for the first 2 days, Monday and Tuesday. Intervention participants began using their online intervention immediately after completing the first sampling period, on the first Wednesday. They continued to use the intervention, four times a week, for 3 weeks. All participants completed self-report measures and collected saliva samples again at Time 2 (1.5 weeks) and Time 3 (3 weeks). See Figure 40 for a visual representation of the protocol. All participants received text message reminders about saliva collection before each collection period. Intervention participants also received additional text message reminders on the day they were due to begin using their intervention each week. Upon study completion participants in the control condition were given access to the interventions.

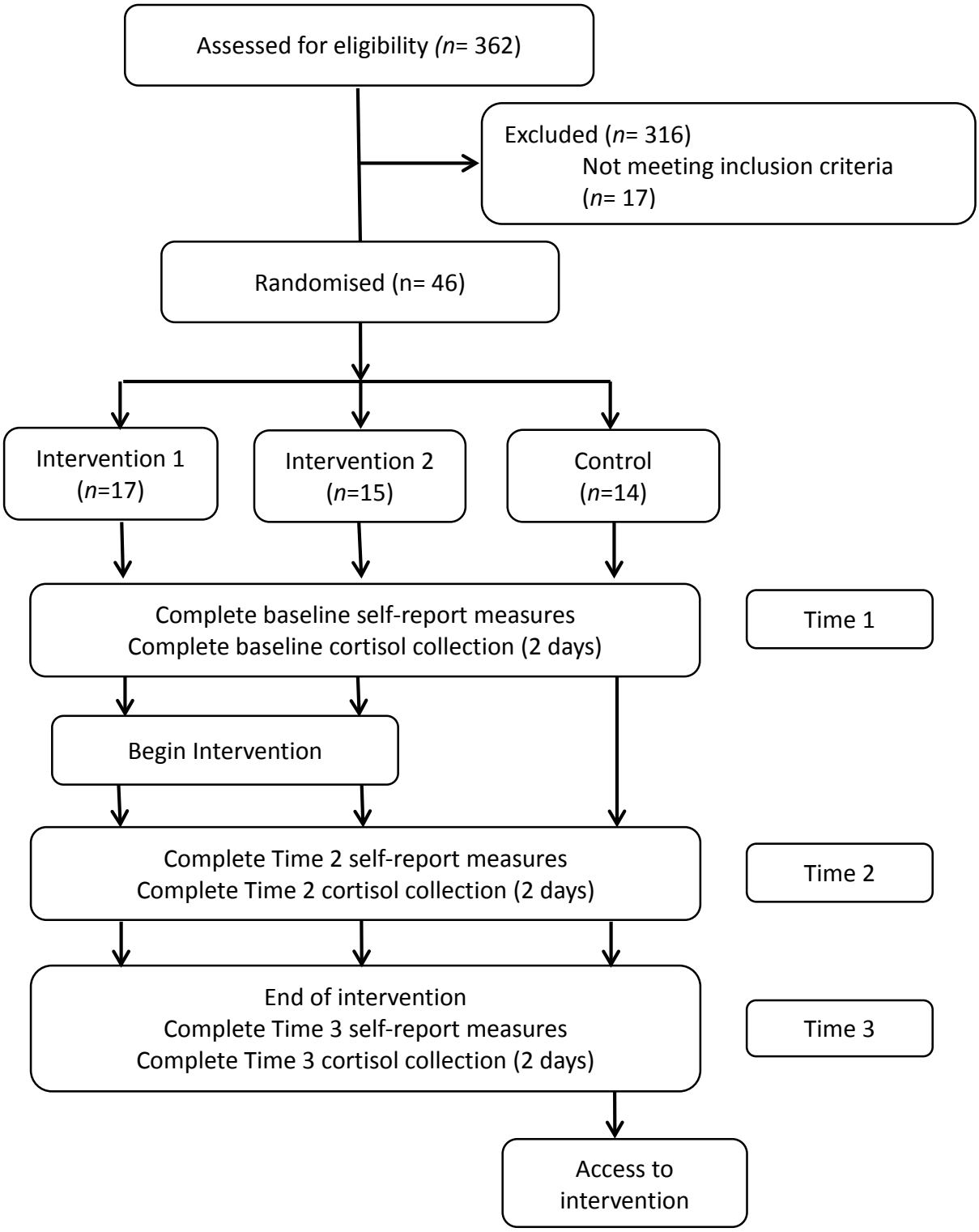

Figure 40. Flowchart of RCT protocol for Bundle of Joy Study.

9.2.5 Ethical Considerations

Informed consent. All participants in this study received full information on the research website and in the form of information leaflets. Consent forms were completed on the research website and hardcopies of consent forms were available at the participant's request. The consent forms detailed the nature of the study, any potential risks or benefits, confidentiality issues and alternatives. Upon recruitment and randomisation, participants received this information again in the form of information leaflets in their participant pack. At each stage all participants were fully informed of their right to withdraw from the study at any time without consequence. Emphasis was given to the fact that the study was being run independently of those delivering prenatal care and that not participating, or withdrawing from the study, would not influence their prenatal care.

Confidentiality. All participant records were only accessible to the research team. Participant contact information provided by the obstetric consultants for potential participants included only the participant's name and contact telephone number. This information was only made available to Karen O' Leary; it was destroyed once used. Data from online questionnaires at each time point were entered into the SPSS statistical program on the researcher's computer for analysis. This information was stored on both an external hard drive and the researcher's personal computer. Data collected from the gratitude diary were also stored on an external hard drive and the researcher's computer. Saliva samples were stored securely in the BioAssay laboratory in the School of Applied Psychology until analysis and data from this analysis were stored securely, as described above. Data

stored electronically were stored in password-protected files, on password-protected computers and external hard drives.

Denial of benefits. According to the Psychological Society of Ireland (2011), it is unethical to deny a control group access to any intervention that may have beneficial effects. This does not occur in the current study as the control condition is given access to the intervention upon study completion. Denial of benefits also relates to the ethical consideration of deceit, which did not occur in this study as all participants were given full information about the purpose of the study.

Ethical approval. Ethical approval for this study was obtained from the Applied Psychology Research Ethics Committee (APREC), the Research Ethics Committee of the Cork Teaching Hospitals (CREC) and the Clinical Directorate, Women and Children's services of the CUMH. Once all ethics applications were approved, individual permissions were given for participant recruitment from Dr Mairead O' Riordan, Professor Louise Kenny and Professor John Higgins in COGA.

9.2.6 Approaches to Data Analysis

Analyses were conducted using the SPSS Version 22 statistical program (SPSS Inc., Chicago IL). The dataset was initially examined for errors and completeness. Descriptive statistical analyses were then conducted.

Potential differences between the five experimental conditions at baseline were examined using Chi-square tests of independence for all categorical demographic data. Univariate between groups analysis of variance (ANOVA) were conducted to investigate differences in continuous demographic and baseline self-report measures.

Following this, a manipulation check was conducted to investigate the effects of experimental conditions on levels of the intervention constructs, mindfulness and gratitude. This was done using two 3x3 way mixed between-within subjects ANOVAS, with gratitude and mindfulness levels at 3 times points as the dependent variables. Only data from participants who completed self-report measures at all time points (*n*= 36) were included in this analysis. To investigate the effects of the experimental conditions on the self-report, cortisol and birth outcome measures, a series of 3x3 way mixed-between within subjects ANOVAs were conducted. Potential differences in sampling times and lapses between sampling times were also examined using a series of one-way between-groups ANOVAs.

Chi-square tests of independence were used to assess potential differences in intervention adherence across experimental groups. Factors potentially influencing participant retention were also examined to account for participant attrition in the current study. Participant data were grouped according to time point completed (Time 1 only, Time 2, or all 3 time points) and descriptive statistics were conducted for each group. Differences between these three groups were investigated using Chi-square tests of independence for categorical variables and one-way between groups ANOVAs for continuous variables. The potential effect of randomisation to experimental conditions on participant retention was also investigated using a one-way between groups ANOVA.

9.3 Results

Participant Characteristics

Preliminary descriptive analyses were conducted on the full dataset (*N*=46) to examine participant characteristics; these are presented in Table 49.

Table 49

Participant characteristics for full sample (n=46)

	n	%	
Nationality			
Irish	45	97.8	
Brazilian	1	2.2	
Relationship status			
In a relationship	4	8.7	
Married	42	91.3	
Education Level			
Up to leaving certificate	3	6.5	
Undergraduate Degree	19	41.3	
Higher Diploma	13	28.3	
Masters	11	23.9	
Cigarette Smoking			
Yes	0	0.0	
No	46	100	
Alcohol Consumption			
Yes	15	32.6	
No	31	67.4	
Planned Pregnancy			
Yes	42	91.3	
No	3	6.5	
Primigravid			
Yes	17	37.0	
No	28	60.9	
Antenatal Care			
Public	5	10.9	
Private	41	89.1	
High-risk pregnancy			
Yes	6	13.0	
No	39	84.8	
	M	***SD***	**Range**
Age	33.87	3.04	27-40
Weeks Pregnant	16.11	2.87	10-22
Previous pregnancies (*n*=28)	1.68	0.77	1-4
Weekly alcohol units (*n*=15)	4.21	4.02	1-15

Only participants who completed self-report measures at all three time points (*n*= 36) were included in inferential analyses. Participant characteristics for this group are shown in Table 50.

Table 50

Participant characteristics for sample used in inferential analyses (n=36)

	n	%	
Nationality			
Irish	35	97.2	
Brazilian	1	2.8	
Relationship status			
In a relationship	4	11.1	
Married	32	88.9	
Education Level			
Up to leaving certificate	3	8.3	
Undergraduate Degree	16	44.4	
Higher Diploma	7	19.4	
Masters	10	27.8	
Cigarette Smoking			
Yes	0	0.0	
No	36	100	
Alcohol Consumption			
Yes	13	36.1	
No	23	63.9	
Planned Pregnancy			
Yes	33	91.7	
No	3	8.3	
Primigravid			
Yes	12	33.3	
No	24	66.7	
Antenatal Care			
Public	5	13.9	
Private	31	86.1	
High-risk pregnancy			
Yes	4	11.1	
No	32	88.9	
	M	***SD***	**Range**
Age	33.81	2.53	30-40
Weeks Pregnant	16.15	2.88	10-22
Previous pregnancies (*n*=24)	1.75	0.79	1-4
Weekly alcohol units (*n*=12)	4.08	4.17	1-15

9.3.2 Examining Baseline Differences between Groups

Before examining intervention effects, differences between intervention conditions were examined for demographic variables and baseline levels of outcome variables. This was done to ensure no differences exist between the experimental conditions included in inferential examinations of intervention effects.

Chi-square tests for independence were conducted initially to examine potential differences between groups on categorical, demographic variables. No significant differences between groups were found for nationality, having planned the pregnancy, type of antenatal care, high-risk pregnancy, occupation, relationship status, education or alcohol consumption; see Table 51. Cigarette consumption was not included in analyses as no participants reported smoking.

Table 51

Chi-Square Results for Differences in Demographic Variables

Variable	Chi-Square	*df*	*p* value
Nationality	0.45	2	0.31
Planned Pregnancy	0.01	2	0.4
Primigravid	0.55	2	0.6
Antenatal Care	0.24	2	0.86
High-risk Pregnancy	0.02	2	0.1
Occupation	40.1	62	0.44
Relationship	0.06	2	0.19
Education	2.92	6	0.36
Alcohol consumption	0.96	2	0.85

A series of one-way between groups analyses of variance (ANOVA) were also conducted to investigate potential differences between the experimental conditions on levels of baseline self-report measures and continuous demographic variables. A

significant difference was observed for age, ($F(2,35) = 3.53$, $p = .04$, $\eta p^2 = .18$); participants in the control condition ($M = 32.42$, $SD = 2.54$) were younger than those in Intervention 1 ($M = 34.08$, $SD = 2.60$) or Intervention 2 ($M = 35.00$, $SD = 2.41$). No significant differences were found for any other baseline variable, see Table 52.

Table 52

Means, Standard Deviation and Differences between Continuous Baseline Variables

	Intervention 1 *M*(*SD*)	Intervention 2 *M*(*SD*)	Control *M*(*SD*)	*F*	*df*	*P*
Age	34.08(5.60)	35.00(2.41)	32.42(2.07)	3.53	2	0.04
Weeks pregnant	14.77(2.74)	17.18(2.04)	16.71(3.28)	2.65	2	0.09
Previous pregnancies	1.70(0.68)	2.14(1.07)	1.43(0.54)	1.52	2	0.18
Alcohol consumption	7.25(6.45)	2.50(1.00)	2.50(1.00)	2.07	2	0.06
Gratitude	69.46(12.71)	78.09(6.04)	77.50(7.34)	3.29	2	0.84
Mindfulness	4.17(0.89)	4.32(0.49)	4.33(0.77)	0.18	2	0.97
Satisfaction with Life	28.85(4.54)	28.36(4.11)	28.58(5.04)	0.03	2	0.24
Social Support	71.15(13.03)	75.36(7.20)	77.83(7.60)	1.48	2	0.53
Happiness	21.31(4.85)	21.73(4.50)	23.25(3.91)	0.65	2	0.07
Prenatal Stress	31.38(11.32)	26.82(5.88)	23.42(6.07)	2.89	2	0.66
Sleep Quality	9.31(4.31)	9.27(3.77)	12.25(4.49)	1.97	2	0.16

9.3.3 Intervention Effects

Only data from participants who completed self-report measures at three time points ($n = 36$) were used. As there were three experimental conditions and 3 time points, 3x3 way ANOVAs were conducted for all inferential analyses; self-report measures and cortisol outcomes were the dependent variables.

Preliminary assumption testing was conducted for all outcomes for normality, sphericity, homogeneity of variance, and homogeneity of intercorrelations. The assumption of normality was violated for some but not all gratitude time points, and for other well-being outcomes, including SWL, social support, happiness, depression and sleep. ANOVA can be considered robust enough to tolerate a violation, particularly with sample sizes of approximately 40 (Field, 2013; Games, 1984), and so data were not transformed for parametric statistics. Transforming the means of self-report measures can potentially alter these constructs from what was originally measured; this can have consequences for the interpretation of intervention outcomes (Grayson, 2004). This could be particularly problematic in the context of pregnancy where high levels of certain constructs may result in non-normal distributions, but these distributions are a reflection of the construct as experienced in pregnancy. Further assumption violations for outcome variables are noted where they occur.

9.3.4 Intervention Manipulation Check

Mixed between-within groups ANOVAs were conducted to examine the effect of the experimental conditions on levels of gratitude and mindfulness respectively, across three time periods

9.3.4.1 Gratitude. The mean gratitude scores for each condition are shown in Table 53; a visual representation is shown in Figure 41. The main effect of experimental condition was approaching significance, $F(2, 33) = 2.82$, $p = .07$, $\eta p^2 = .15$, observed power= .52. There was no significant main effect for time, $F(2, 66)$

=.53, p= .59, ηp^2= .02, observed power= .13. There was no significant interaction between condition and time, $F(4, 66) = .77$, p= .55, ηp^2= .04, observed power= .23.

Table 53

Mean and Standard Deviation for Gratitude by Experimental Condition, across Three Time Periods

Experimental Condition	Gratitude Time 1	Gratitude Time 2	Gratitude Time 3
	M(SD)	*M(SD)*	*M(SD)*
Intervention 1 (*n*=13)	69.46(12.71)	72.08(10.31)	70.46(13.01)
Intervention 2 (*n*=11)	78.09(6.04)	78.09(6.04)	78.27(5.10)
Control (*n*=12)	77.50(9.96)	77.25(6.59)	77.41(8.82)

The Intervention 2 and control conditions demonstrated similar trajectories, reflecting essentially no change over time. Intervention 1, involving the listening component followed by the diary component, demonstrated an initial increase in gratitude followed by a return toward baseline by Time 3.

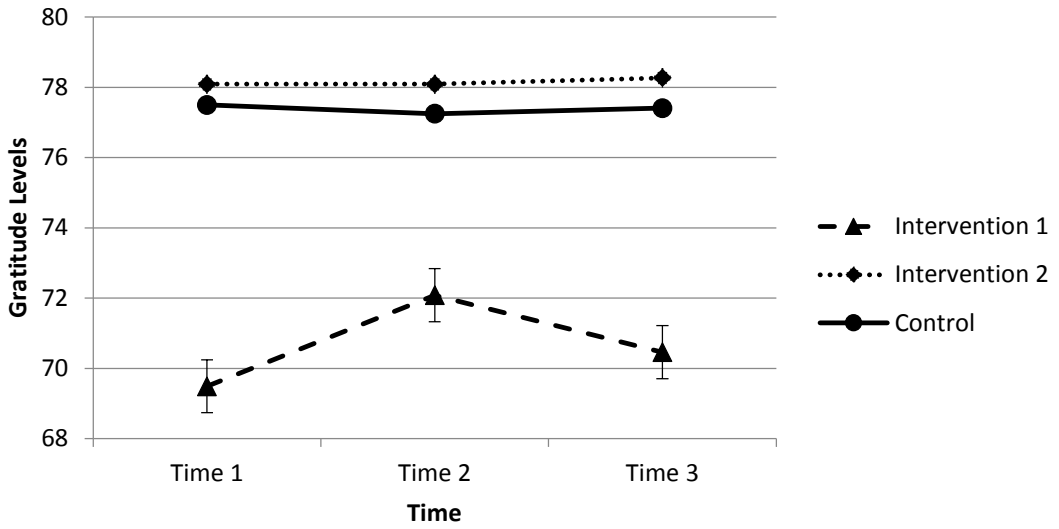

Figure 41. Gratitude for each experimental condition across three time points. Error bars represent standard error.

9.3.4.2 Mindfulness. The assumption of sphericity was violated for mindfulness levels and so multivariate statistics were examined for within-subjects effects. The mean mindfulness scores for each condition are shown in Table 54; a visual representation is shown in Figure 42.

Table 54

Means and Standard Deviations for Mindfulness by Experimental Condition, across Three Time Periods

Experimental Condition	Mindfulness Time 1 *M(SD)*	Mindfulness Time 2 *M(SD)*	Mindfulness Time 3 *M(SD)*
Intervention 1 (*n*=13)	4.17(.89)	4.39(.91)	4.62(.88)
Intervention 2 (*n*=11)	4.32(.49)	4.43(.76)	4.67(.73)
Control (*n*=12)	4.33(.73)	4.50(1.01)	4.46(1.10)

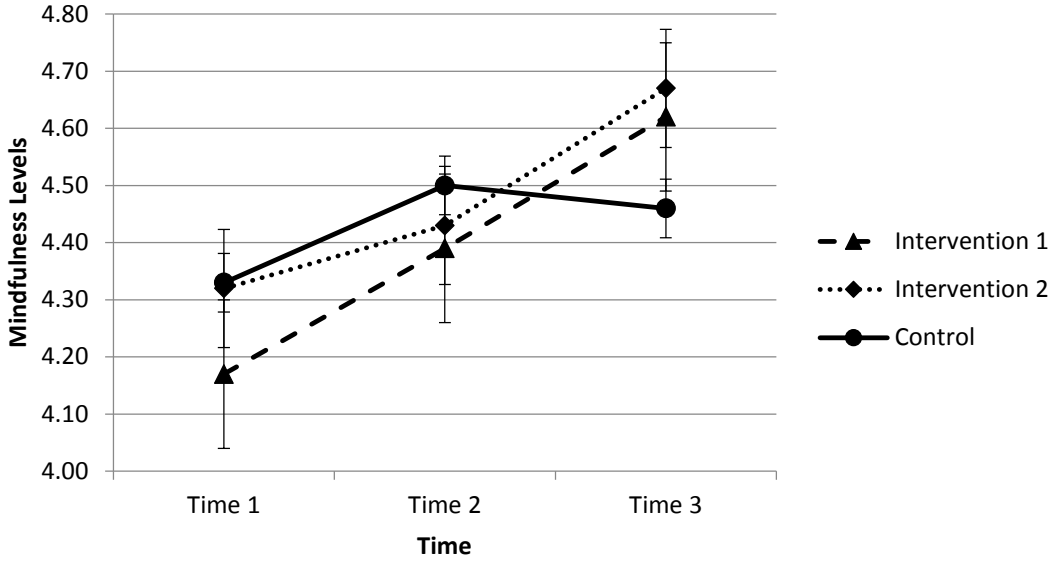

Figure 42. Mindfulness for each experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, Wilks' Lambda= .75 $F(2, 32) = 5.28$, $p = .01$, $\eta p^2 = .25$, observed power= .80. The main effect comparing the three experimental conditions was not significant, $F(2, 33) = .03$, $p = .97$, $\eta p^2 = .002$, observed power= .05. There was no significant interaction between condition and time, Wilks' Lambda= .88 $F(4, 64) = 1.07$, $p = .38$, $\eta p^2 = .06$, observed power= .32. Both intervention conditions demonstrate small, although non-significant sustained increases over time in mindfulness levels. This is in comparison to the control group, which demonstrates an initial increase followed by a subsequent decline in mindfulness levels.

9.3.5 Well-being Self-report Outcomes

9.3.5.1 Satisfaction with life. The mean SWL scores for each condition are shown in Table 55; a visual representation is shown in Figure 43. There was a significant main effect for time $F(2, 66) = 8.51$, $p = .001$, $\eta p^2 = .21$, observed power= .96. The main effect comparing the three experimental conditions was not significant, $F(1, 33) = .11$, $p = .90$, $\eta p^2 = .01$, observed power= .06. There was no significant interaction between condition and time, $F(4, 66) = .58$, $p = .68$, $\eta p^2 = .03$, observed power= .18.

Table 55

Means and Standard Deviations for Satisfaction with Life by Experimental Condition, across Three Time Periods

Experimental Condition	SWL Time 1	SWL Time 2	SWL Time 3
	M(SD)	*M(SD)*	*M(SD)*
Intervention 1 (*n*=13)	28.85(1.27)	30.08(.86)	29.85(1.22)
Intervention 2 (*n*=11)	28.36(1.38)	30.82(.94)	31.36(1.33)
Control (*n*=12)	28.58(1.33)	30.67(.90)	31.17(1.27)

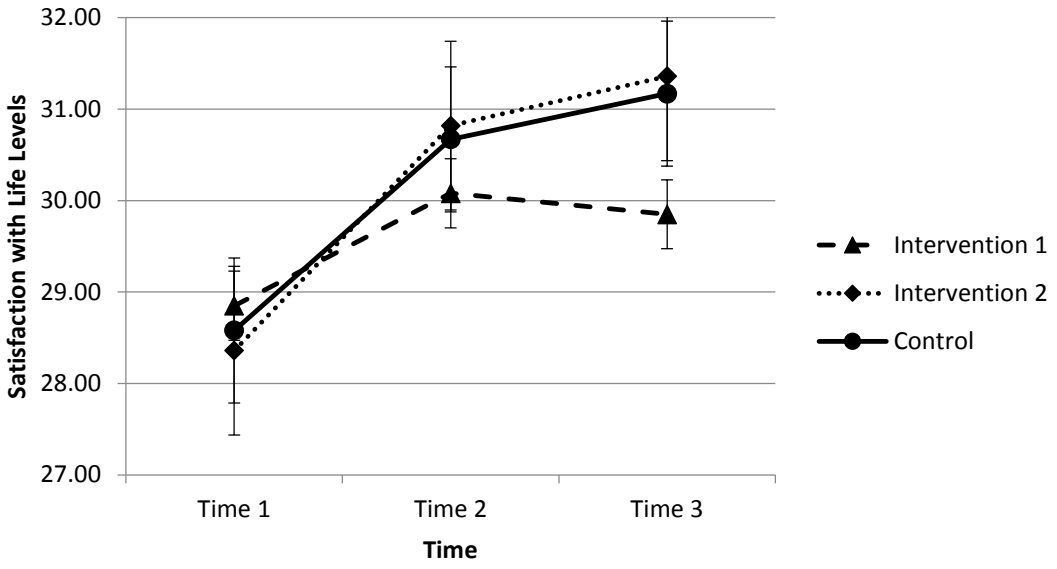

Figure 43. Satisfaction with Life for each experimental condition across three time points. Error bars represent standard error.

Across the three time periods participants' levels of SWL appear to increase as a function of time. The Intervention 2 and control conditions demonstrate similar patterns over time, which differ from the Intervention 1 condition. This suggests

potential, although non-significant, differences between the intervention conditions based on order effects.

9.3.5.2 Perceived social support. The mean MSPSS scores for each condition are shown in Table 56; a visual representation is shown in Figure 44. No significant main effects were observed for time, $F(2, 66) = .31$, $p = .74$, $\eta p^2 = .01$, observed power= .08, or experimental condition, $F(1, 33) = 2.16$, $p = .13$, $\eta p^2 = .12$, observed power= .41. There was no significant interaction between condition and time, $F(4, 66) = .58$, $p = .68$, $\eta p^2 = .03$, observed power= .18.

Table 56

Means and Standard Deviations for Perceived Social Support by Experimental Condition, across Three Time Periods

Experimental Condition	MSPSS Time 1 *M(SD)*	MSPSS Time 2 *M(SD)*	MSPSS Time 3 *M(SD)*
Intervention 1 (*n*=13)	71.15(13.03)	70.31(13.05)	70.85(12.48)
Intervention 2 (*n*=11)	75.36(7.20)	76.82(6.92)	76.36(8.47)
Control (*n*=12)	77.83(7.60)	78.83(5.99)	78.08(6.32)

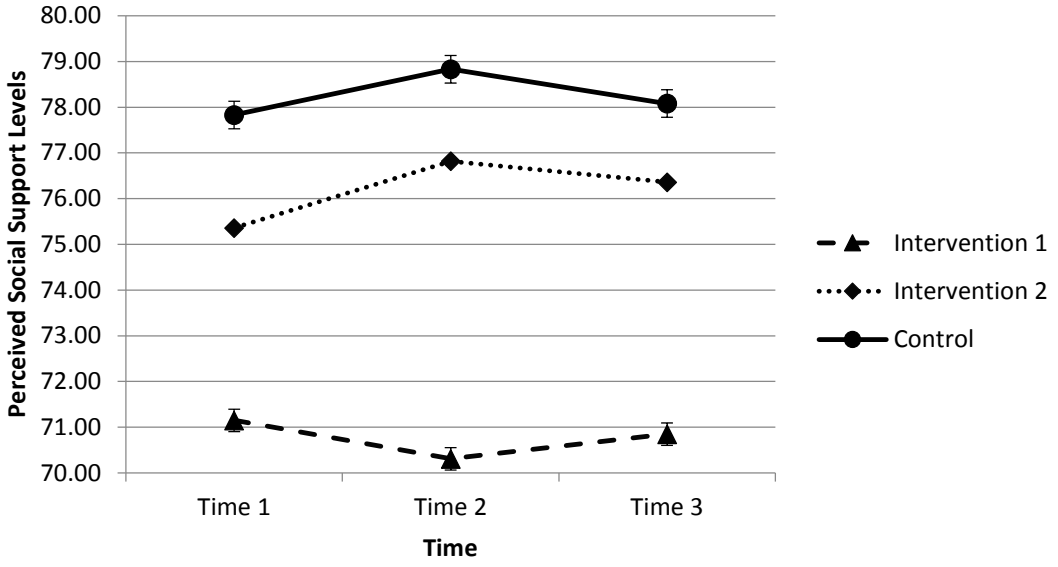

Figure 44. Perceived social support for each experimental condition across three time points. Error bars represent standard error.

MSPSS scores remained relatively stable throughout the study, with only small non-significant fluctuations observed. Slight non-significant differences between intervention conditions suggest the potential for order effects.

9.3.5.3 Prenatal stress. The mean PDQ scores for each condition are shown in Table 57; a visual representation is shown in Figure 45. A significant main effect for time, $F(2, 66) = 3.79$, $p = .03$ $\eta p^2 = .10$, observed power= .67, was observed. The main effect comparing the three experimental conditions was not significant, $F(1, 33) = 2.68$, $p = .08$, $\eta p^2 = .14$, observed power= .50. There was no significant interaction between condition and time, $F(4, 66) = .79$, $p = .53$, $\eta p^2 = .05$, observed power= .24.

Table 57

Mean and Standard Deviation for Prenatal Stress by Experimental Condition, across Three Time Periods

Experimental Condition	PDQ Time 1 *M(SD)*	PDQ Time 2 *M(SD)*	PDQ Time 3 *M(SD)*
Intervention 1 (*n*=13)	31.38(11.32)	28.69(8.62)	27.92(7.98)
Intervention 2 (*n*=11)	26.82(5.88)	27.00(6.69)	25.27(6.92)
Control (*n*=12)	23.42(6.07)	22.75(5.79)	22.17(5.98)

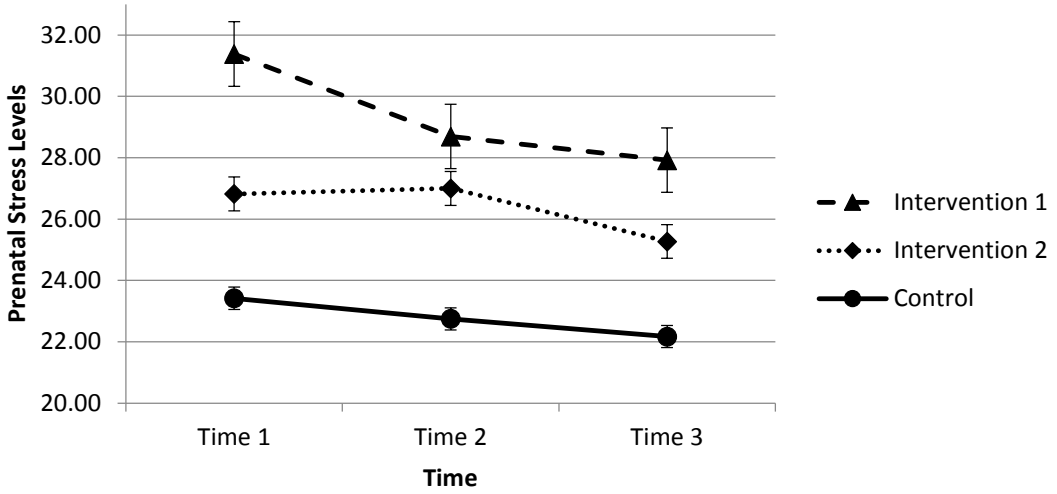

Figure 45. Prenatal stress for each experimental condition across three time points. Error bars represent standard error.

All experimental conditions demonstrated non-significant reductions in prenatal stress over time, however different patterns were observed for the two intervention conditions.

9.3.5.4 Happiness. The assumption of sphericity was violated and so multivariate statistics were examined for within subjects effects. Mean happiness scores for each condition are shown in Table 58; a visual representation is shown in Figure 46.

Table 58

Means and Standard Deviations for Happiness by Experimental Condition, across Three Time Periods

Experimental Condition	Happiness Time 1	Happiness Time 2	Happiness Time 3
	M(SD)	*M(SD)*	*M(SD)*
Intervention 1 (*n*=13)	21.31(1.23)	22.01(1.19)	19.23(.68)
Intervention 2 (*n*=11)	21.73(1.34)	22.55(1.30)	19.55(.74)
Control (*n*=12)	23.25(1.28)	23.83(1.24)	20.33(.71)

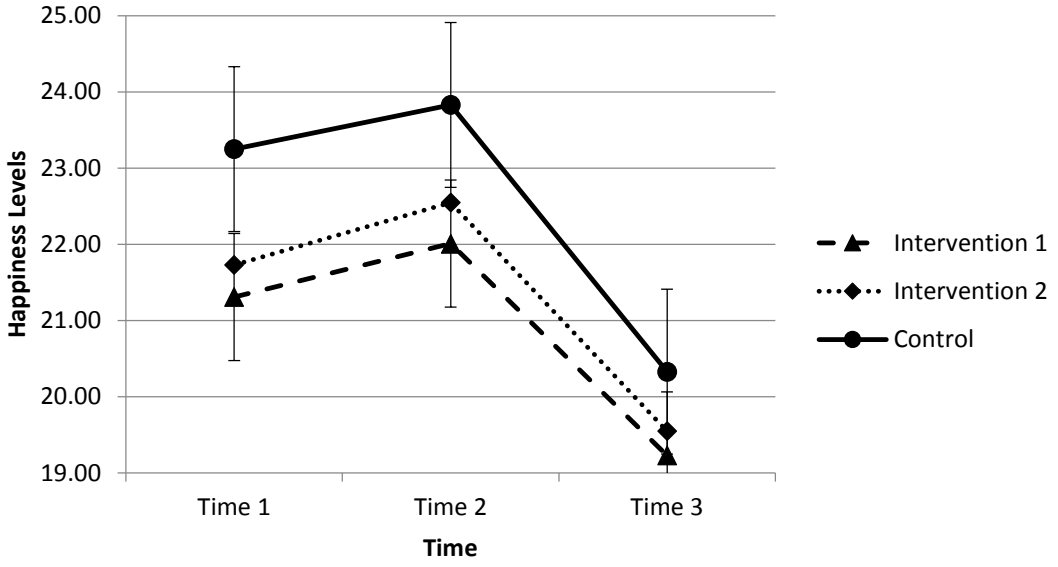

Figure 46. Happiness for each experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, Wilks' Lambda= .35 $F(2, 32) = 29.82$, $p < .001$ $\eta p^2 = .65$, observed power= 1.0. The main effect comparing the three experimental conditions was not significant, $F(1, 33) = .66$, $p = .53$, $\eta p^2 = .04$, observed power= .15. There was no significant interaction between condition and time, Wilks' Lambda= .98 $F(4, 66) = .16$, $p = .96$, $\eta p^2 = .01$, observed power= .08. All groups demonstrated initial non-significant increases in happiness, followed by sharp declines from Time 2 to Time 3.

9.3.5.5 Depression. The assumption of sphericity was violated and so multivariate statistics were examined for within subjects effects. Mean depression scores for each condition are shown in Table 59; a visual representation is shown in Figure 47.

Table 59

Means and Standard Deviations for Depression by Experimental Condition, across Three Time Periods

Experimental Condition	Depression Time 1	Depression Time 2	Depression Time 3
	M(SD)	*M(SD)*	*M(SD)*
Intervention 1 (*n*=13)	15.85(1.05)	15.39(1.03)	15.39(1.08)
Intervention 2 (*n*=11)	17.09(1.14)	15.46(1.12)	15.64(1.18)
Control (*n*=12)	17.00(1.09)	15.50(1.07)	15.08(1.13)

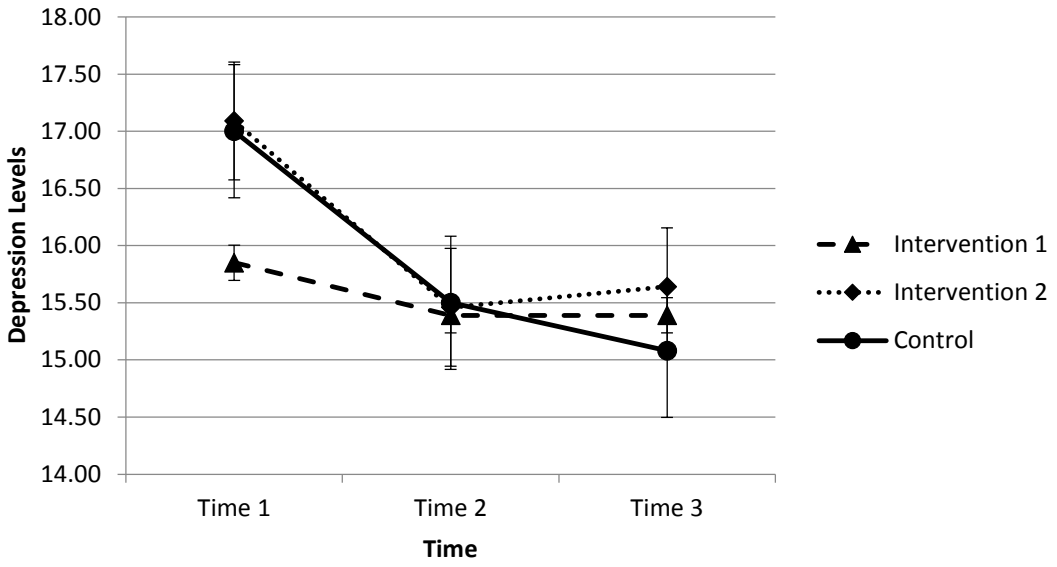

Figure 47. Depression for each experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, Wilks Lambda= .79 $F(2, 32) = 4.22$, $p = .02$ $\eta p^2 = .21$, observed power= .70. The main effect comparing the three

experimental conditions was not significant, $F(1, 33) = .08$, $p = .92$, $\eta p^2 = .01$, observed power= .06. There was no significant interaction between condition and time, Wilks' Lambda= .95 $F(4, 66) = .46$, $p = .77$, $\eta p^2 = .03$, observed power= .15. All conditions demonstrate non-significant decreases in depression over time, with the control group demonstrating the most pronounced and sustained decrease in depression over time.

9.3.5.6 Sleep quality. The assumption of sphericity was violated and so multivariate statistics were examined for within subjects effects. The mean sleep quality scores for each condition are shown in Table 60; a visual representation is shown in Figure 48.

Table 60

Means and Standard Deviations for Sleep Quality by Experimental Condition, across Three Time Points.

Experimental Condition	Sleep Quality Time 1	Sleep Quality Time 2	Sleep Quality Time 3
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
Intervention 1 (n=13)	9.31(4.30)	8.15(4.08)	7.54(3.45)
Intervention 2 (n=11)	9.27(3.77)	8.72(3.45)	8.36(2.98)
Control (n=12)	12.25(4.49)	12.50(5.23)	11.67(4.60)

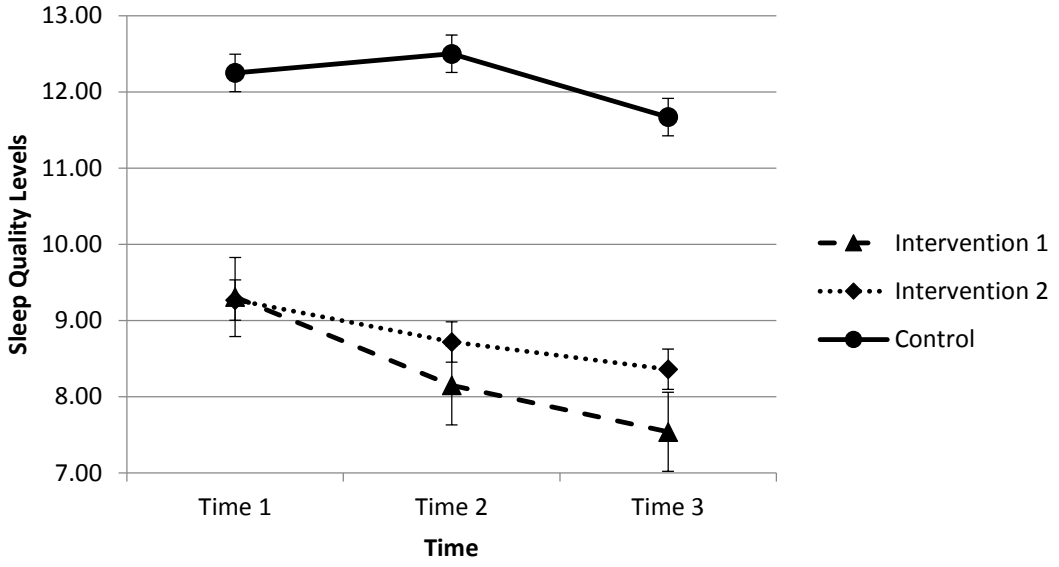

Figure 48. Sleep quality for each experimental condition across three time points. Error bars represent standard error.

There was a significant main effect for time, Wilks' Lambda= .82 F(2, 32) =3.42, p=.045 ηp^2= .18, observed power= .60. The main effect comparing the three experimental conditions was significant, F(1, 33) = 3.48, p= .04, ηp^2= .17, observed power= .61. There was no significant interaction between condition and time, Wilks Lambda= .94 F(4, 66) = .55, p= .70, ηp^2= .03, observed power= .18. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Intervention 1 condition was significantly lower than that of the control condition (see Table 59); the Intervention 1 reported significantly less sleep disturbance than the control group. Over time all experimental conditions demonstrate reductions in self-reported sleep disturbance. Both intervention conditions demonstrate relatively similar trajectories of change over time, with sustained reductions in reported sleep complaints, indicating improved sleep quality and reduced sleep disturbance.

However the Intervention 1 condition demonstrates a more pronounced decrease over time. These findings are in comparison to the control condition, which demonstrates a smaller magnitude of change over time, following an initial slight increase in sleep disturbance.

9.3.5.7 Summary. Significant effects of the intervention conditions were not observed for mindfulness, satisfaction with life, perceived social support, happiness, depression, and hours of sleep. Experimental condition effects were approaching significance for prenatal stress and gratitude; a significant effect of experimental condition was found for sleep quality. Order effects were observed for gratitude, satisfaction with life, perceived social support and prenatal stress. See Table 61 for summary of significance values, effect sizes and observed power for each outcome variable.

Table 61

Summary of Main and Interaction Effects for all Outcome Variables by Three Experimental Conditions

	p value	ηp^2	Observed power
Gratitude			
Condition Effect	.07	.15	.52
Time Effect	.59	.02	.13
Interaction Effect	.55	.04	.23
Mindfulness			
Condition Effect	.90	.002	.05
Time Effect	.01	.25	.80
Interaction Effect	.38	.06	.32
SWL			
Condition Effect	.90	.01	.06
Time Effect	<.01	.21	.96
Interaction Effect	.68	.03	.18
Social Support			
Condition Effect	.13	.12	.41
Time Effect	.74	.01	.08
Interaction Effect	.68	.03	.18
Prenatal Stress			
Condition Effect	.08	.14	.50
Time Effect	.03	.10	.67
Interaction Effect	.53	.05	.24
Happiness			
Condition Effect	.66	.04	.15
Time Effect	<.01	.65	1.0
Interaction Effect	.96	.01	.08
Depression			
Condition Effect	.92	.01	.06
Time Effect	.02	.21	.70
Interaction Effect	.77	.03	.15
Sleep Quality			
Condition Effect	.04	.17	.60
Time Effect	<.05	.18	.60
Interaction Effect	.70	.03	.18
Sleep Hours			
Condition Effect	.41	.05	.20
Time Effect	.29	.08	.26
Interaction Effect	.84	.02	.13

9.3.6 Birth Outcomes

The effects of experimental condition on birth outcomes were also examined in a subgroup of women (*n*=24) for whom birth outcome data were available. The effect of the intervention on gestational age and birth weight were examined using one way between groups ANOVAs. Effects of the interventions on type of delivery and birth complications was examined using Chi-squared tests for independence. The Chi-square tests for independence indicated no significant difference between experimental conditions for type of delivery $X^2(12, n=26) = 15.62$, $p=.21$, *phi*= .775, or birth complications $X^2(2, n=26) = .963$, $p=.62$, *phi*= .192.

A one-way ANOVA found no statistically significant difference for birth weight (in grams) between the Intervention 1 (*M*=3731.11, *SD*=422.38), Intervention 2 (*M*=3377.50, *SD*=500.22), and control groups (*M*=3658.89, *SD*=818.22); $F(2,25)=.784$, $p=.468$, eta squared= .06. A significant difference was found for gestational age (in weeks) between the Intervention 1 (*M*=39.33, *SD*=1.22), Intervention 2 (*M*=38.50, *SD*=1.60), and control groups (*M*=40.11, *SD*=.78); $F(2,25)=3.62$, $p=.04$, eta squared= .24. The Intervention 2 group demonstrated significantly shorter gestational age than the Control condition.

9.3.7 Cortisol Outcomes

Cortisol concentrations were not normally distributed and had a positive skew. As a result, all raw cortisol values were log-transformed prior to analysis. Raw values are reported in tables and figures below however.

9.3.7.1 Descriptive statistics. Means and standard deviations for cortisol concentrations by sampling time are shown in Table 62. A visual representation of the diurnal cortisol pattern for each sampling day is shown in Figure 49. All days follow the expected diurnal pattern of a morning peak at 30 minutes after waking, followed by a gradual decline in levels throughout the day; day 4 demonstrates a levelling off of cortisol levels from +45 minutes to noon however, which is not expected.

Descriptive statistics for the full sample were also examined by experimental condition. Means and standard deviations are shown in Table 63.

Table 62

Means and Standard Deviations for Cortisol Concentrations by Sampling Time for the Full Sample

	Mean (*SD*)					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Sample 1, Wake, ug/mL	16.64(8.77)	15.29(7.45)	12.26(7.91)	10.37(4.87)	14.09(6.53)	14.15(5.97)
Sample 2, + 30mins, ug/mL	22.77(13.10)	21.25(11.20)	21.26(7.91)	18.55(9.55)	16.53(10.62)	18.38(10.37)
Sample 3, + 45mins, ug/mL	12.67(5.64)	12.97(7.75)	9.38(5.54)	6.40(4.05)	9.38(5.75)	11.45(8.20)
Sample 4, Noon, ug/mL	8.55(4.12)	6.56(4.04)	5.81(3.06)	6.06(3.49)	6.83(2.74)	7.88(3.99)
Sample 5, Bedtime	3.16(4.10)	2.69(2.13)	3.18(3.38)	3.21(2.64)	1.40(1.46)	2.03(1.67)

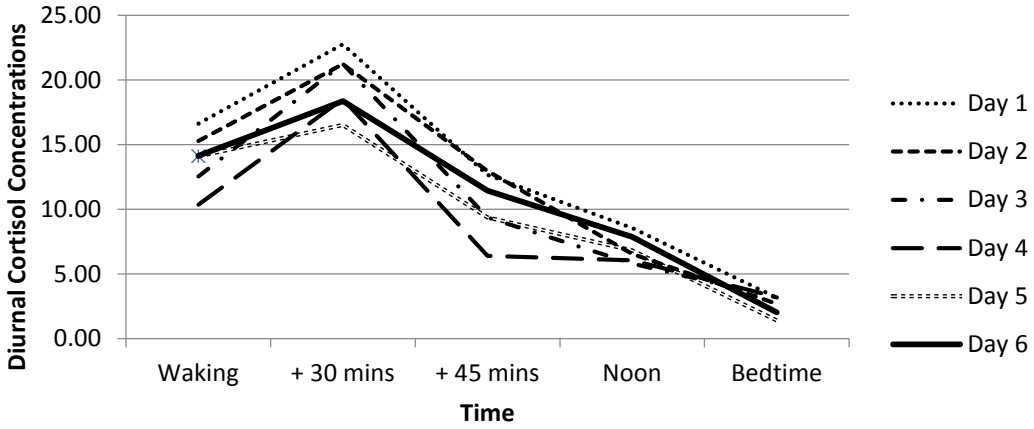

Figure 49. Diurnal cortisol concentrations for each sampling day.

Table 63

Means and Standard Deviations for Cortisol Concentrations by Sampling Time for each Experimental Condition

	Mean (*SD*)		
	Intervention 1	Intervention 2	Control
Day 1, Sample 1, Wake, ug/mL	19.61(7.64)	17.19(19.96)	13.49(7.37)
Day 1, Sample 2, + 30mins, ug/mL	27.01(16.01)	20.12(11.95)	20.53(10.27)
Day 1, Sample 3, + 45mins, ug/mL	15.86(5.57)	9.80(3.18)	11.04(5.68)
Day 1, Sample 4, Noon, ug/mL	7.40(3.01)	11.47(4.83)	7.27(3.44)
Day 1, Sample 5, Bedtime, ug/mL	2.73(2.15)	4.15(3.25)	2.77(5.99)
Day 2, Sample 1, Wake, ug/mL	17.46(9.41)	11.85(5.47)	16.08(5.75)
Day 2, Sample 2, + 30mins, ug/mL	21.79(12.55)	21.72(11.96)	20.11(9.91)
Day 2, Sample 3, + 45mins, ug/mL	13.51(7.08)	11.19(7.05)	14.37(9.70)
Day 2, Sample 4, Noon, ug/mL	6.78(3.43)	6.06(3.54)	6.81(5.38)
Day 2, Sample 5, Bedtime, ug/mL	2.21(1.68)	3.21(2.44)	2.78(2.35)
Day 3, Sample 1, Wake, ug/mL	14.59(6.85)	11.09(4.55)	11.91(3.88)
Day 3, Sample 2, + 30mins, ug/mL	21.39(8.25)	20.31(8.65)	21.95(7.75)
Day 3, Sample 3, + 45mins, ug/mL	11.92(5.84)	6.35(6.03)	8.11(3.78)
Day 3, Sample 4, Noon, ug/mL	5.76(2.95)	5.47(7.92)	6.19(4.20)
Day 3, Sample 5, Bedtime, ug/mL	2.62(2.97)	4.10(4.67)	2.86(2.39)
Day 4, Sample 1, Wake, ug/mL	10.87(6.50)	10.98(4.48)	9.20(3.25)
Day 4, Sample 2, + 30mins, ug/mL	18.09(10.95)	17.10(9.04)	20.07(9.56)
Day 4, Sample 3, + 45mins, ug/mL	6.35(3.96)	5.46(3.38)	7.26(4.86)
Day 4, Sample 4, Noon, ug/mL	5.60(2.96)	6.59(3.92)	6.05(4.04)
Day 4, Sample 5, Bedtime, ug/mL	4.28(3.29)	3.60(2.65)	1.75(.93)
Day 5, Sample 1, Wake, ug/mL	15.10(8.40)	11.93(5.54)	14.77(5.36)
Day 5, Sample 2, + 30mins, ug/mL	14.32(3.85)	14.25(7.36)	20.03(15.35)
Day 5, Sample 3, + 45mins, ug/mL	5.89(3.17)	8.06(4.43)	16.38(4.64)
Day 5, Sample 4, Noon, ug/mL	7.09(2.06)	6.41(3.09)	6.96(3.63)
Day 5, Sample 5, Bedtime, ug/mL	1.22(1.10)	1.14(1.48)	1.81(1.80)
Day 6, Sample 1, Wake, ug/mL	13.71(7.74)	13.51(4.08)	15.83(5.66)
Day 6, Sample 2, + 30mins, ug/mL	16.78(6.94)	14.83(6.78)	23.99(14.58)
Day 6, Sample 3, + 45mins, ug/mL	8.15(3.69)	10.98(6.54)	17.09(12.68)
Day 6, Sample 4, Noon, ug/mL	8.96(5.23)	7.28(3.17)	7.35(3.45)
Day 6, Sample 5, Bedtime, ug/mL	2.17(1.33)	1.67(1.68)	2.27(2.10)

Visual representations of the diurnal cortisol patterns for each sampling day for each experimental condition are shown in Figures 50-52. For Intervention 1, all days followed the expected diurnal pattern, with the exception of day 4. Diurnal cortisol patterns were more variable across sampling days for Intervention 2; Day 1 demonstrates an unexpected noon rise, while Day 4 again demonstrates a sharp decline and plateau from +45 minutes to noon. Diurnal declines in cortisol concentrations were also less gradual for the Control condition.

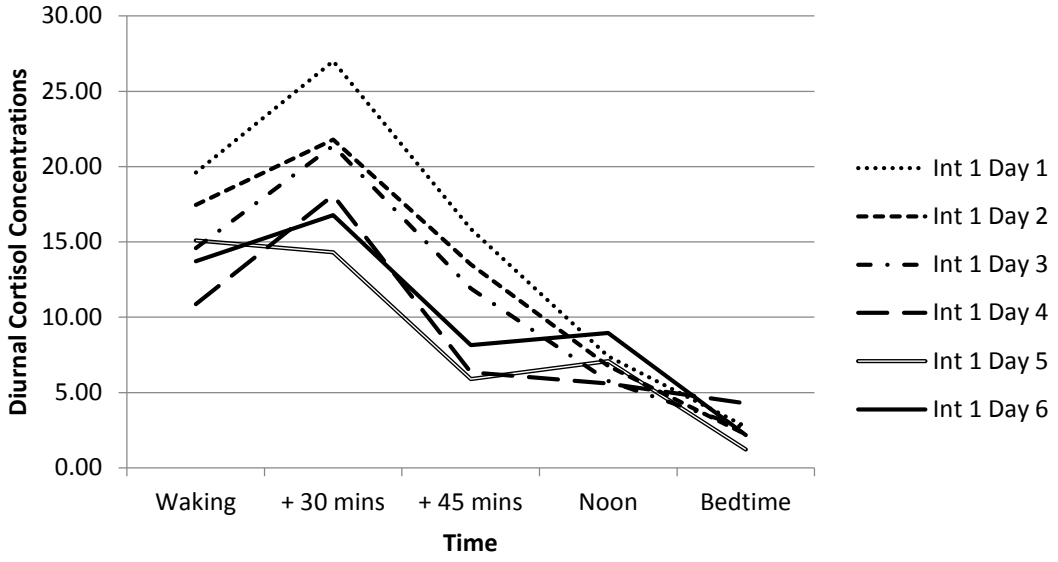

Figure 50. Diurnal cortisol concentrations for each sampling day for Intervention 1.

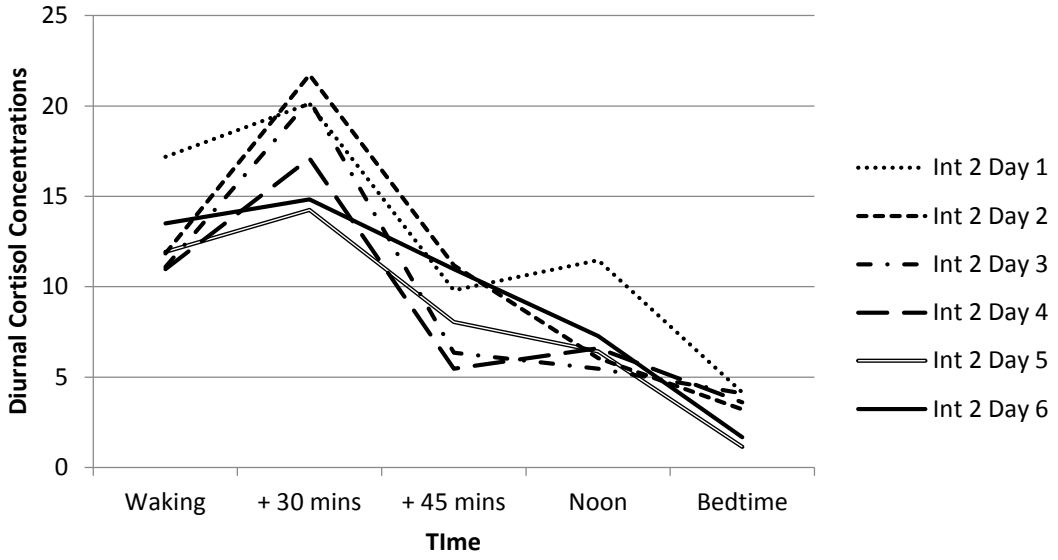

Figure 51. Diurnal cortisol concentrations for each sampling day for Intervention 2.

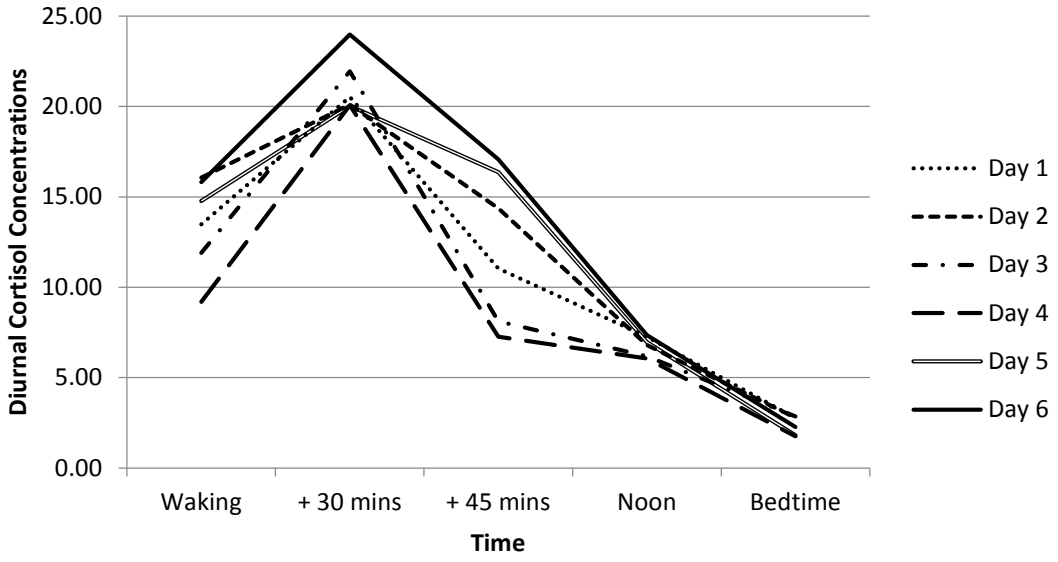

Figure 52. Diurnal cortisol concentrations for each sampling day for the control condition.

9.3.7.2 Cortisol awakening response (CAR). The mean CAR scores for each condition are shown in Table 64; a visual representation is shown in Figure 53. There was no significant main effect for time, $F(2, 26) = 2.89$, $p = .07$, $\eta p^2 = .18$, observed power= .52. The main effect comparing the three experimental conditions was not significant, $F(1,13) = .03$, $p = .97$, $\eta p^2 = .004$, observed power= .05. There was no significant interaction between condition and time, $F(4,26) = 1.04$, $p = .41$, $\eta p^2 = .14$, observed power= .28.

Table 64

Means and Standard Deviations for CAR, for each Experimental Condition, across 3 Time Points

	Mean (*SD*)		
	Intervention 1 (*n*=7)	Intervention 2 (*n*=5)	Control (*n*=5)
Time 1	3.61(8.87)	7.53(8.55)	4.67(8.31)
Time 2	6.12(8.96)	8.29(6.68)	11.57(7.18)
Time 3	5.02(7.12)	1.00(5.37)	1.83(7.11)

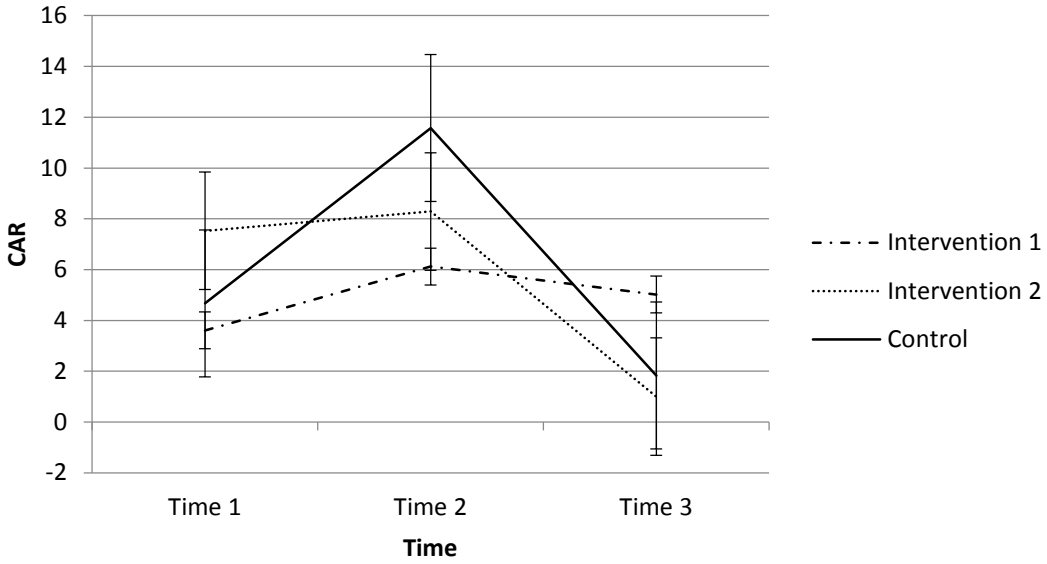

Figure 53. The CAR across 3 time periods for each experimental condition. Error bars represent standard error.

The Intervention 1 and Control conditions demonstrated initial non-significant increases in CAR from Time 1 to Time 2; the Intervention 2 condition demonstrated little change during this time. From Time 2 to Time 3 all groups demonstrated a non-significant decline in CAR concentrations, with the most substantial declines observed for the Control and Intervention 1 conditions.

9.3.7.3 Waking cortisol. The assumption of sphericity was violated for waking cortisol concentrations and so multivariate tests were examined for inferential statistics. The mean cortisol waking concentrations scores for each condition are shown in Table 65; a visual representation is shown in Figure 54.

Table 65

Means and Standard Deviations for Waking Cortisol Concentrations, for each Experimental Condition, across 3 Time Points

	Mean (*SD*)		
	Intervention 1 (*n*=7)	Intervention 2 (*n*=7)	Control (*n*=5)
Time 1	18.02(5.83)	13.75(4.39)	16.15(3.43)
Time 2	14.06(2.87)	10.43(2.29)	10.95(2.72)
Time 3	10.44(2.99)	12.87(3.54)	15.11(5.52)

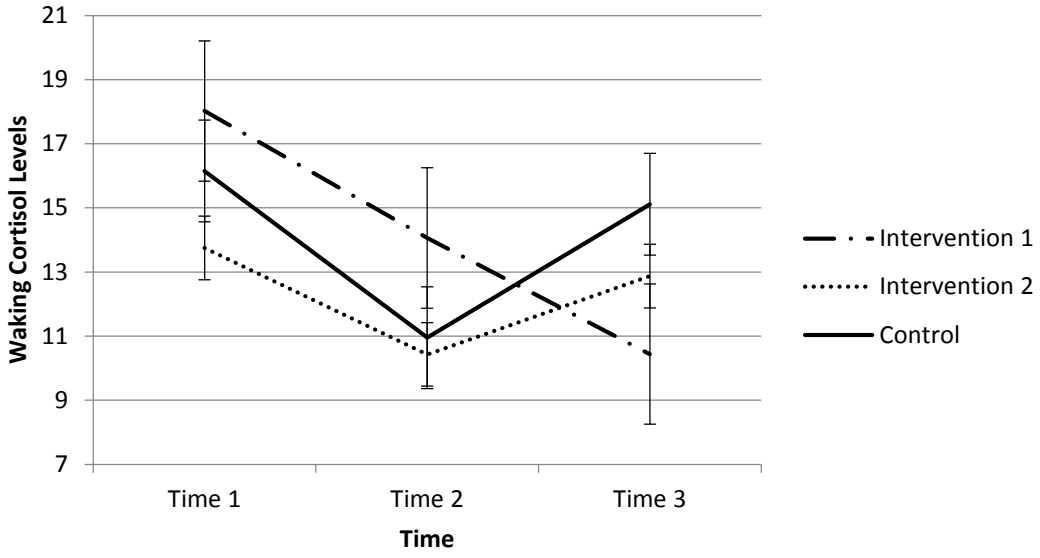

Figure 54. Waking cortisol across 3 time periods for each experimental condition. Error bars represent standard error.

There was a significant main effect for time, Wilks' Lambda= .38, $F(2, 14) = 11.44$, $p = .001$, $\eta p^2 = .62$, observed power= .98. The main effect comparing the three experimental conditions was not significant, $F(1,15) = 2.253$, $p = .14$, $\eta p^2 = .23$, observed power= .39. The interaction between condition and time was not significant, Wilks' Lambda $F(4, 28) = 1.20$, $p = .33$, $\eta p^2 = .14$, observed power= .33.

The Control and Intervention 2 conditions demonstrated initial decreases followed by increases in morning cortisol; the Intervention 1 condition demonstrated a sustained decrease in morning cortisol across 3 time periods. Any potential changes observed were not significant however.

9.3.7.4 + 30 minutes cortisol. The assumption of sphericity was violated for the +30 minutes cortisol sample and so multivariate tests were examined for inferential statistics. The mean cortisol concentrations at 30 minutes after waking for each condition are shown in Table 66; a visual representation is shown in Figure 55.

Table 66

Means and Standard Deviations for Wake +30 Minutes Cortisol Concentrations, for each Experimental Condition, across 3 Time Points

	Mean (*SD*)		
	Intervention 1 (*n*=7)	Intervention 2 (*n*=6)	Control (*n*=8)
Time 1	21.63(9.26)	19.30(9.48)	20.29(7.04)
Time 2	20.18(8.80)	19.18(7.69)	21.06(8.51)
Time 3	15.45(5.61)	12.65(7.49)	22.80(14.94)

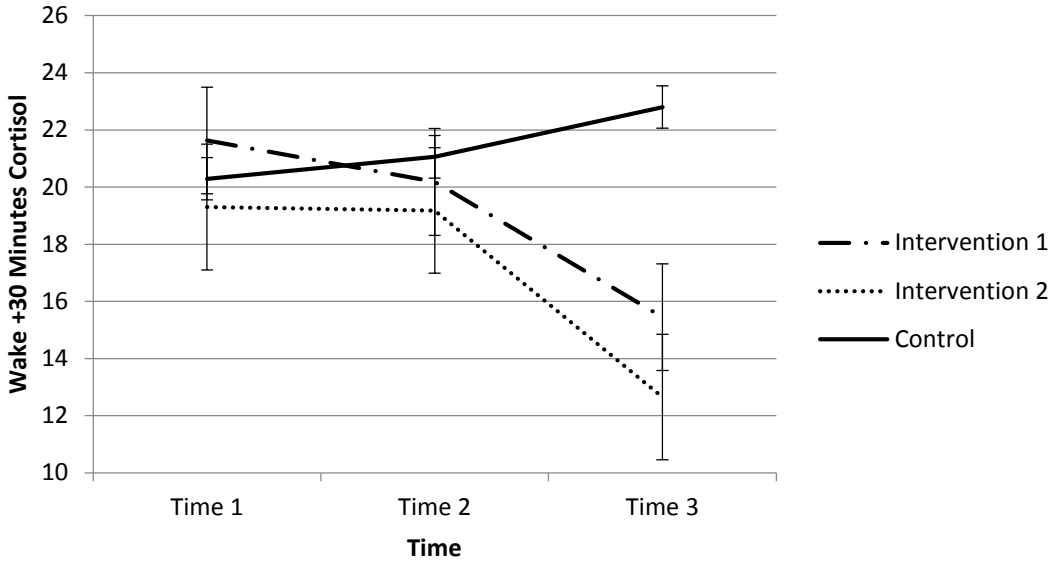

Figure 55. Wake + 30 minutes cortisol across 3 time periods for each experimental condition. Error bars represent standard error.

There was no significant main effect for time, Wilks' Lambda= .93, $F(2, 16) = .64$, $p = .54$, $\eta p^2 = .07$, observed power= .14. The main effect comparing the three experimental conditions was not significant, $F(1,17) = 1.22$, $p = .32$, $\eta p^2 = .13$, observed power= .22. The interaction between condition and time was not significant, Wilks' Lambda= .92, $F(4, 32) = .34$, $p = .85$, $\eta p^2 = .04$, observed power= .12. Both intervention conditions demonstrated non-significant reductions in 30 minute cortisol concentrations by Time 3; this decrease was delayed for Intervention 2. The Control condition demonstrated little change from Time 1 to Time 2, followed by an increase in cortisol concentrations from Time 2 to Time 3.

9.3.7.5 Evening mean cortisol. Mean evening cortisol concentrations scores for each condition are shown in Table 67; a visual representation is shown in Figure 56.

There was a significant main effect for time, $F(2, 32) = 9.61$, $p = .001$, $\eta p^2 = .38$, observed power= .97. The main effect comparing the two experimental conditions was not significant, $F(1,18) = .88$, $p = .36$, $\eta p^2 = .05$, observed power= .15. The interaction between condition and time was not significant, $F(4, 32) = .80$, $p = .54$, $\eta p^2 = .09$, observed power= .23.

Table 67

Means and Standard Deviations for Mean Evening Cortisol Concentrations, for each Experimental Condition, across 3 Time Points

	Mean (*SD*)		
	Intervention 1 (*n*=7)	Intervention 2 (*n*=7)	Control (*n*=6)
Time 1	10.31(2.26)	8.55(1.05)	10.72(2.99)
Time 2	7.73(1.13)	7.09(4.24)	6.60(1.82)
Time 3	7.67(2.53)	7.64(1.95)	9.24(3.83)

All conditions demonstrated a non-significant decrease in cortisol levels from Time 1 to Time 2. This was followed by a non-significant increase to Time 3 for the Control condition. The Intervention 2 condition demonstrated less increase from Time 2 to Time 3, while the Intervention 1 levels remained stable.

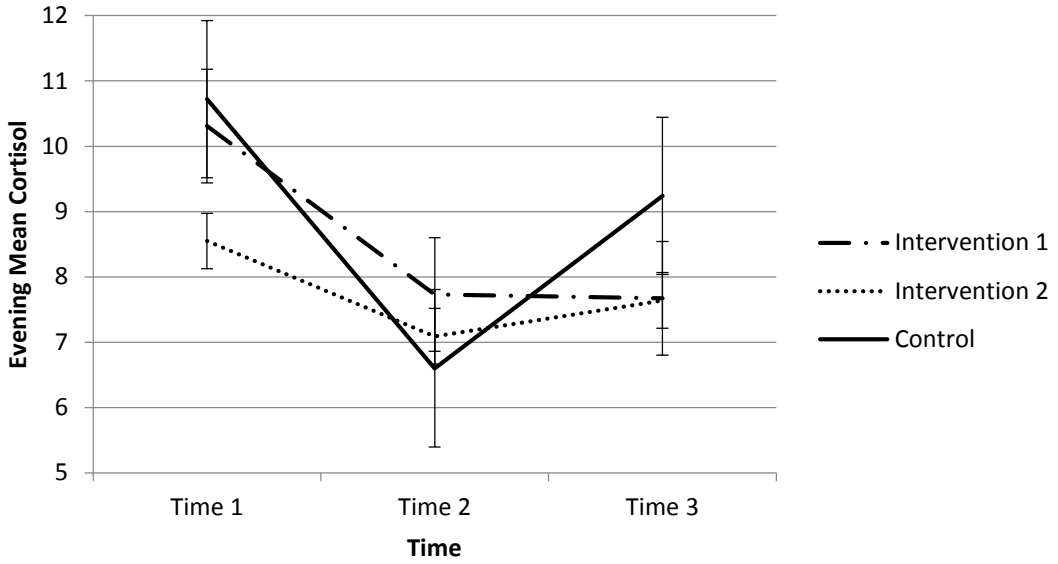

Figure 56. Mean evening cortisol across 3 time periods for each experimental condition. Error bars represent standard error.

9.3.7.6 Summary. No significant differences were observed between the experimental conditions for the CAR, waking cortisol, cortisol 30 minutes after waking or mean evening cortisol in the current study.

9.3.8 Cortisol Sampling

9.3.8.1 Sampling times. Potential differences between experimental conditions for sampling were examined using a series of one way between groups ANOVA. Self-reported sampling times, in decimal format, for each sampling day were the continuous dependent variable; experimental condition with three levels was the independent variable. Significant differences were observed between the Intervention 1 and Control conditions for a number of sampling times. In all

instances the Intervention 1 condition reported earlier sampling times than the control condition, see Table 68.

Table 68

Sampling Times in Decimal Format for each Experimental Condition

	Mean (*SD*)			
	Intervention 1	Intervention 2	Control	*P value*
Day 1, Sample 1, Wake	7.15(.75)	7.71(1.12)	8.06(1.34)	.18
Day 1, Sample 2, + 30mins	7.66(.76)	8.20(1.12)	8.55(1.34)	.16
Day 1, Sample 3, + 45mins	7.92(.77)	8.49(1.15)	8.85(1.40)	.16
Day 1, Sample 4, Noon	12.17(.22)	12.06(.10)	12.60(1.18)	.18
Day 1, Sample 5, Bedtime	22.31(.78)	22.50(.81)	22.54(.70)	.76
Day 2, Sample 1, Wake	7.16(.44)	7.52(.81)	8.00(1.12)	.07
Day 2, Sample 2, + 30mins	7.63(.47)	8.03(.80)	8.55(1.16)	.05
Day 2, Sample 3, + 45mins	7.94(.45)	8.29(.81)	8.78(1.18)	.08
Day 2, Sample 4, Noon	12.75(1.07)	12.12(.20)	12.67(1.18)	.27
Day 2, Sample 5, Bedtime	20.49(6.33)	18.02(9.45)	22.31(.60)	.33
Day 3, Sample 1, Wake	6.90(.43)	7.05(.84)	7.62(.67)	.04
Day 3, Sample 2, + 30mins	7.39(.44)	7.56(.83)	8.13(.69)	.04
Day 3, Sample 3, + 45mins	7.64(.44)	7.86(.84)	8.41(.73)	.04
Day 3, Sample 4, Noon	12.67(.62)	12.62(1.34)	12.41(.56)	.78
Day 3, Sample 5, Bedtime	18.75(8.74)	22.33(1.03)	22.22(.98)	.26
Day 4, Sample 1, Wake	7.04(.65)	7.25(.89)	7.80(.85)	.08
Day 4, Sample 2, + 30mins	7.53(.67)	7.74(.85)	8.30(.84)	.07
Day 4, Sample 3, + 45mins	7.80(.65)	8.04(.87)	8.48(.89)	.14
Day 4, Sample 4, Noon	12.70(1.01)	12.39(.51)	12.70(1.59)	.78
Day 4, Sample 5, Bedtime	18.85(8.73)	15.14(10.96)	20.36(6.79)	.42
Day 5, Sample 1, Wake	7.15.76)	7.31(.82)	8.01(.82)	.04
Day 5, Sample 2, + 30mins	7.64(.77)	7.81(.82)	8.54(.86)	.04
Day 5, Sample 3, + 45mins	7.95(.71)	8.15(.76)	8.96(.97)	.02
Day 5, Sample 4, Noon	12.74(1.01)	12.44(.92)	11.98(.39)	.12
Day 5, Sample 5, Bedtime	21.58(3.35)	22.28(1.16)	22.31(.56)	.66
Day 6, Sample 1, Wake	7.10(.58)	7.26(.84)	7.68(.88)	.19
Day 6, Sample 2, + 30mins	7.60(.58)	7.75(.82)	8.22(.89)	.15
Day 6, Sample 3, + 45mins	7.94(.52)	8.10(.79)	8.49(.90)	.21
Day 6, Sample 4, Noon	12.93(.86)	12.38(.93)	12.49(.89)	.60
Day 6, Sample 5, Bedtime	18.93(8.86)	22.74(.81)	22.48(.78)	.19

9.3.8.2 Sampling time lapses. Potential differences in time lapses between sampling times (decimal format) were also examined using a series of one way between groups ANOVA. Time lapse between each sampling time point was the dependent variables; experimental condition with three levels was the independent variable. No significant differences were observed for the time lapses between sampling times for the experimental conditions; all *p* values > .05.

9.3.9 Participant Retention and Adherence

Participant retention in the current study was quite high. Of 46 participants recruited, 36 participants completed all study requirements at Time 3 (see Figure 57). This represents a retention rate of 78.26%; the corresponding attrition rate is therefore 21.74%. Despite the high participant retention, factors contributing to attrition and adherence were examined to investigate potential differences between groups. For the purpose of this investigation only, data from all participants (*n*=46) were used.

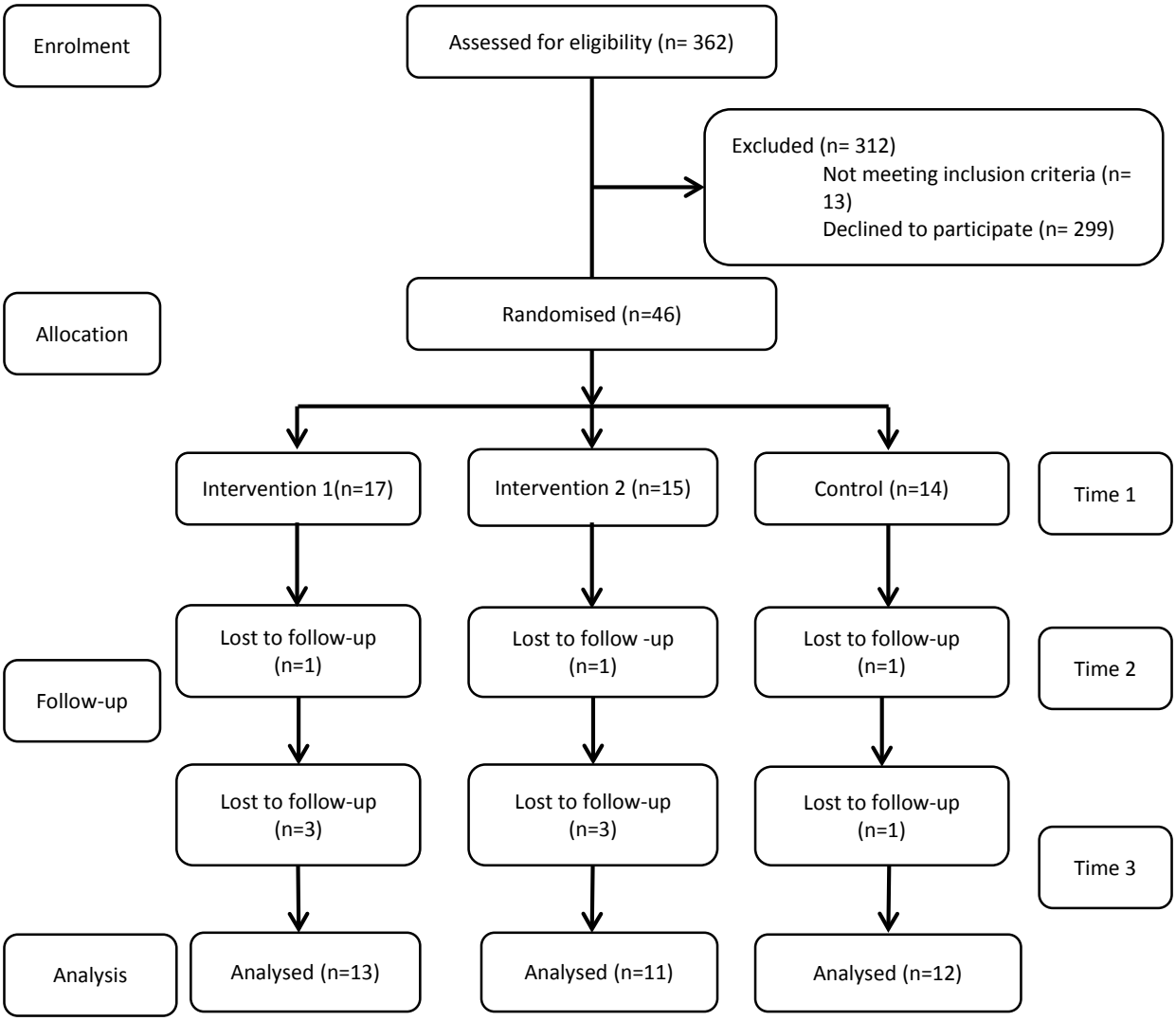

Figure 57. Flowchart of participant adherence at 3 time points.

9.3.9.1 Random allocation to experimental condition. The effect of random allocation to the three experimental conditions on study adherence was examined using two separate one-way between groups ANOVAS. Adherence to self-report measures was examined initially; no significant difference was found between

experimental conditions, F(2,45) = .15, *p*= .86, ηp^2= .01. Adherence to saliva sampling times was then examined; no significant differences were found between experimental groups, F(2,45) = .43, *p*= .74, ηp^2= .01.

Differences between the control condition and a single intervention condition were also examined to determine if attrition could be attributed to the increased burden of the intervention. An independent samples t-test was conducted; no significant differences were observed for self-report time points completed, t(44)= -.52, *p*= .61, r= .02. Similarly no difference was found for saliva time points completed, t(44)= -.50, *p*= .62, r= .02.

9.3.9.2 Participant demographic and well-being differences. Differences between groups based on time points completed were examined to determine potential differences for demographic and baseline well-being variables. Differences exist between the number of self-report time points completed and the number of saliva time points completed for some participants. For instance two participants completed all three self-report time points but did not provide saliva for any time point. As a result, separate analyses were conducted for self-report and saliva collection adherence.

9.3.9.3 Self-report adherence. Differences between participants who completed one, two or three self-report time points, were examined initially. Chi-square tests of independence were conducted to examine categorical variables. No significant differences were found between groups, see Table 69.

Table 69

Chi-Square Values and Significance Values for Categorical Variables

	Chi-square	*p*
Nationality	0.28	0.87
Planned Pregnancy	0.8	0.67
Gravidity	1.55	0.46
Antenatal Care	1.56	0.46
High Risk Pregnancy (y/n)	1.25	0.54
Occupation	0.41	0.41
Relationship Status	1.22	0.54
Education Level	8.88	0.18
Alcohol consumption (y/n)	1.27	0.53

One-way between groups ANOVAs were then conducted to examine if differences exist between the groups for continuous demographic factors and baseline self-report measures. Potential violations of assumptions were initially examined and are presented where they occur. There was a significant difference between groups for baseline levels of perceived social support, $F(2,45) = 3.21$, $p = .05$, $\eta p^2 = .13$; participants who completed Time 1 only had significantly lower social support than participants who completed Time 1 and Time 2. A significant difference was found for baseline prenatal stress, $F(2,45) = 4.26$, $p = .02$, $\eta p^2 = .17$. Participants who completed one time point only had significantly higher stress than participants who completed 2 or 3 time points. Significant differences were not observed for other baseline variables; see Table 70.

Table 70

Means, Standard Deviations and Differences for Continuous Variables by Self-report Time Points Completed

	Time 1 only (*n*=16) *M* (*SD*)	**Time 2 only (*n*=9) *M* (*SD*)**	**Time 3 only (*n*=37) *M* (*SD*)**	***p* values**
Age	34.00(3.46)	34.14(5.24)	33.81(2.53)	.96
Weeks Pregnant	15.33(1.16)	16.21(3.56)	16.15(2.88)	.89
Previous Pregnancies	1.00(0.0)	1.33(.58)	1.75(.16)	.47
Alcohol Consumption	2.00(0.0)	8.00(0.0)	4.08(0.0)	.59
Gratitude	71.00(5.29)	73.43(8.04)	74.75(9.96)	.77
Mindfulness	3.47(1.41)	4.04(.80)	4.27(.73)	.22
Satisfaction with Life	29.33(4.93)	29.86(3.18)	28.61(4.46)	.26
Happiness	18.67(7.23)	23.43(3.10)	22.08(4.40)	.31
Stress	42.00(7.00)	26.43(7.59)	27.33(8.76)	.02
Depression	20.33(4.04)	16.00(3.51)	16.61(3.71)	.22
Sleep Quality	15.67(2.52)	10.43(6.13)	10.28(.72)	.16
Perceived Social Support	61.67(10.69)	78.00(5.32)	74.67(9.97)	.06

9.3.9.4 Saliva adherence. Differences between participants who completed one, two or three saliva collection time points, were also examined. Chi-square tests of independence were conducted to examine categorical variables. No significant differences were found; see Table 71.

Table 71

Chi-Square Values and Significance Values for Categorical Variables

	Chi-square	*p*
Nationality	0.36	0.84
Planned Pregnancy	0.46	0.79
Gravidity	1.76	0.41
Antenatal Care	1.98	0.37
High Risk Pregnancy (y/n)	2.44	0.30
Occupation	69.41	0.69
Relationship Status	1.55	0.46
Education Level	8.62	0.20
Alcohol consumption (y/n)	1.11	0.57

One-way between groups ANOVAs were conducted to examine if differences exist between the groups for continuous demographic factors and baseline self-report measures. No significant differences were found between the groups for any variabe at baseline, see Table 72.

Table 72

Means, Standard Deviations and Differences for Continuous Baseline Variables by Saliva Time Points Completed

	1 Time Point	**2 Time Points**	**3 Time Points**	
	M(SD)	*M(SD)*	*M(SD)*	*p*
Age	33.85(2.60)	37.00(2.83)	33.30(4.24)	.30
Weeks Pregnant	16.19(2.94)	18.00(4.24)	15.45(2.50)	.50
Previous Pregnancies	1.78(.80)	1.00(0.00)	4.00(1.25)	.31
Alcohol Consumption	4.08(4.12)	8.00(0.00)	2.00(0.00)	.59
Gratitude	74.82(10.23)	76.50(14.85)	72.20(5.01)	.71
Mindfulness	63.59(4.59)	53.50(2.12)	61.50(15.20)	.49
SWL	28.59(4.59)	31.00(2.83)	29.30(3.30)	.70
Social Support	74.79(9.85)	77.50(7.78)	72.10(11.13)	.69
Prenatal Stress	27.82(8.65)	24.00(5.66)	30.10(11.43)	.64
Sleep Quality	10.50(4.34)	12.00(8.49)	10.90(5.55)	.11
Happiness	21.79(4.35)	26.50(2.12)	22.10(4.91)	.36
Depression	16.74(3.76)	13.00(1.41)	17.60(3.75)	.29

9.3.9.5 Intervention use. An examination of differences in intervention use between intervention conditions was also conducted. This was particularly important given the similarity of the Intervention 2 condition to the control group for a number of outcome variables, which may suggest a lower level of engagement with the intervention for this group. Diary entries were recorded online at the time participants used both the diary and audio components of the intervention. As a result, intervention use was examined in terms of differences in the number of diary entries contributed by participants, between the 2 intervention groups.

A one-way between groups ANOVA was conducted; number of submitted diary entries was the dependent variable, intervention condition was the independent variable. Participants in the Intervention 1 condition (M=8.08, SD= 2.96) provided more diary entries than the Intervention 2 condition (M=7.36, SD=4.20). This difference was not significant however, $F(1, 23)= 12.79$, $p= .28$, $\eta p^2= .01$.

9.3.9.6 Summary. No significant differences were found between intervention conditions for the number of diary entries completed; thus no significant difference in intervention adherence between the groups can be inferred. Participant characteristics based on adherence to self-report and saliva collection was also examined; adherence was defined as completing one, two or three time points. No significant differences between groups were found for any demographic or well-being variables for adherence to the saliva collection time points. Significant differences were found for prenatal stress, and approaching significance for perceived support, between the groups for self-report measures. This indicates that more highly stressed pregnant women, who perceived less social support, are less likely to engage with the study requirements.

9.3.10 Overall Summary

No significant differences between experimental conditions over time were found for mindfulness, satisfaction with life, perceived social support, happiness, depression, hours of sleep, gestational age, birth weight, delivery type, birth complications, the CAR, waking cortisol, cortisol 30 minutes after waking or mean

evening cortisol. The effect of experimental condition was approaching significance for prenatal stress and gratitude. A significant effect of experimental condition was found for sleep quality. No significant differences were found between intervention conditions for intervention engagement. No differences were found for participants, grouped by saliva collection time points completed, for any baseline or demographic variables. For number of self-report time points completed, only prenatal stress and perceived social support significantly differed between groups.

9.4 Discussion

This chapter will interpret and critically evaluate the findings of the current study. The aim of this study was to investigate the effects of a dual-component, gratitude and mindfulness, intervention on psychological and physical well-being and birth outcomes using a randomised control trial (RCT). The effects of the intervention on mindfulness and gratitude will be discussed, followed by a discussion of the effects of the intervention on satisfaction with life, perceived social support, prenatal stress, happiness, depression, sleep quality, birth outcomes, and cortisol outcomes (CAR, waking cortisol, +30 minutes cortisol, evening mean, AUC). A discussion of barriers and enhancers of recruitment, and retention and adherence of pregnant women in the current study is included. Implications and directions for future research are also discussed.

9.4.1 Manipulation Check

9.4.1.1 Gratitude. The lack of a significant intervention effect for gratitude was unexpected, as the gratitude listing exercise incorporated in the current study has previously demonstrated increases in gratitude levels over a comparable time frame (Froh et al., 2008). Gratitude listing interventions have yet to be examined in pregnancy however and the current study demonstrates no effect within this group. The intervention effect was approaching significance with a medium effect size. It is possible that had the study been more highly powered, with a larger sample size, an effect may have been detected. It is equally possible that no effect exists and there

are several possible explanations for this. The first is that as part of a dual-component intervention, the gratitude listing exercise may not have the same direct effects on gratitude as when used independently. This would be exacerbated if participants favoured the mindfulness component of the intervention over the gratitude component. Due to the manner of intervention completion online it was only possible to assess submitted diary entries, which were automatically emailed to the researcher. Data on frequency of the meditation use was not recorded; this precludes an examination of the dynamic of component use as it relates to gratitude effects.

The order of component use may have also influenced gratitude outcomes, with some support for this observed in the non-significant gratitude patterns of change over time for Intervention 1 and Intervention 2. When the gratitude listing exercise is used first, followed by the mindfulness meditation, no change in gratitude is observed over time. As the gratitude listing exercise is the active gratitude component and involves retrospection, subsequently engaging in present focused mindfulness may minimise the effects on gratitude overall. This may occur if focusing on the present reduces or inhibits a participant's capacity or motivation to reflect on past experiences. Chapter 6 suggests that engaging in the mindfulness exercise first may broaden awareness, leading to increased attention to positive aspects in life that induce gratitude. In this way, mindfulness may function as a priming mechanism for increased gratitude by broadening participant's scope of awareness only when used first. Participants in the Intervention 1 condition completed the mindfulness component first, followed by the gratitude exercise and a

non-significant increase in gratitude is observed. This increase is short-lived however and a return to baseline is evident by Time 3.

It may be that gratitude interventions are not particularly useful with a pregnant group, who already experience high levels of gratitude. For instance participant gratitude scores in the current study ranged from approximately 70 to 78, on a scale ranging from 18 to 90; indicating high levels of gratitude for all participants. Thus there may not have been room for meaningful change to occur in the study given the existing high levels of baseline gratitude. The small non-significant change that is observed in the Intervention 1 condition may be due to the lower levels of baseline gratitude in this group. This does not explain the subsequent decrease in gratitude levels, which may be better accounted for in terms of an expectancy effect at Time 2 that dissipates by Time 3. In conclusion, the intervention has little to no effect on gratitude levels over time. Observed changes are most likely due to potential order effects or baseline levels of gratitude that facilitate more meaningful change.

9.4.1.2 Mindfulness. No significant change in mindfulness was observed as a result of intervention participation in the current study. This was unexpected as previous examinations of mindfulness in pregnancy have demonstrated increases in mindfulness following mindfulness intervention participation (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik et al., 2012). Previous research tends to involve multi-component interventions however that are facilitated by a mindfulness instructor and are conducted in group sessions. As a result, there are potentially confounding social and time variables that may account for

intervention effects in previous studies that are absent here. As noted in Chapter 2 and argued by Keng et al. (2011), the multi-component nature of mindfulness interventions have yet to be fully examined and the effect of individual mindfulness components on well-being outcomes are still unclear. The current study attempts to examine this issue by including a single mindfulness component, the Body Scan, which is one of the most frequently taught and used techniques in mindfulness. The findings of this study suggest that the Body Scan, in conjunction with the gratitude intervention, does not exert a significant effect on mindfulness levels in pregnancy.

The two intervention conditions do demonstrate non-significant increases during the study; these increases are sustained even when the control condition begins to demonstrate a decrease in mindfulness levels. Increases in mindfulness were expected based on previous research in pregnant (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik et al., 2012) and non-pregnant (see Keng et al., 2011) groups. The changes can be accounted for by the effect of time however, which was found to be significant. This suggests that the most important factor observed in mindfulness increases during pregnancy is the passage of time rather than the intervention used. This raises further questions about previous empirical findings of the effects of prenatal mindfulness interventions. Previous studies have posited that it is intervention participation which results in increases in mindfulness and subsequent well-being (Carmody & Baer, 2009) but have not considered the effect of time. It is possible that an increase in mindfulness may occur as pregnancy progresses because pregnant women become more focused on physical changes and sensations of their pregnancy, as well as the daily experiences, including medical

aspects or diet. A direct focus on aspects of the prenatal experience in the present moment in this way is conducive to fostering a mindful approach to experience, thus resulting in increases in mindfulness over time.

Mindfulness may therefore naturally increase in pregnancy as a result of the experience itself, rather than intervention participation. If this is the case, improvements in prenatal well-being that have been previously attributed to mindfulness interventions (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik et al., 2012) may instead be attributable to a naturally occurring increase. This is because mindfulness is associated with improved psychological and physical well-being (Fjorback et al., 2011; Keng et al, 2011) and any increases could contribute to improved well-being regardless of intervention use.

9.4.2 Intervention Effects on Self-report Outcomes

9.4.2.1 Satisfaction with life. No significant changes over time were observed for SWL in the current study. It was expected, based on previous gratitude (Wood et al., 2008a; Wood et al., 2009b) and mindfulness research (Brown & Ryan, 2003; Shapiro et al., 2005) that a significant increase in SWL would result from intervention participation. Non-significant increases were observed for all conditions, with the Control and Intervention 2 conditions demonstrating the most similar patterns of change. Intervention 1 in contrast, demonstrated a non-significant decrease in SWL from Time 2. Any observed changes in SWL can be attributed to the significant main effect of time. This suggests that as pregnancy progresses

women become more satisfied with life, irrespective of intervention participation. Given the usefulness of SWL as a well-being outcome variable, a naturally occurring increase during pregnancy highlights the potential for naturally occurring patterns of change during pregnancy, which has the potential to be misconstrued as an intervention effects in future research if not properly accounted for.

9.4.2.2 Perceived social support. No significant changes in social support were noted in the current study, with very little change observed over time for any experimental condition. Previous research has demonstrated associations between gratitude and social support for adolescents (Froh et al., 2009), co-habiting couples (Algoe et al., 2008), married couples (Gordon et al., 2011), and college students (Bartlett et al., 2006; Bartlett et al., 2012; Wood et al., 2008). Fredrickson et al. (2004) argue that gratitude is a positive emotion that builds and strengthens social bonds in a reciprocal manner. Therefore, engaging in an intervention aimed at enhancing gratitude would be expected to increase perceptions of social bonds and support. As no significant increase in gratitude is observed in the current study however, this potential mechanism may not be available, explaining a lack of increased perceived social support. In addition to the lack of any meaningful change resulting from intervention use, the intervention conditions demonstrate inverse trajectories over time. The Intervention 1 condition demonstrates a slight overall decrease in social support; the Intervention 2 condition demonstrates a slight increase overall. Interestingly, as previously observed for SWL and gratitude, when participants engage in the writing component first, the observed patterns of change

are most similar to the control group. Potential order effects were also observed for social support across experimental condition in Study 1, although variability in these effects suggests that intervention order may be more influential for social support than for other constructs.

The lack of a significant effect in the current study indicates that the intervention does not influence perceived social support during pregnancy. Previous research has postulated that social support can function to buffer stress (Cohen, 1988), with a considerable body of research demonstrating the benefits of prenatal social support (Blanchard et al., 2009; Collins et al., 2003; Dejin-Karlsson et al., 2000; Dunkel Schetter, 2011; Feldman et al., 2000; Hedegaard et al., 1996; Pryor et al., 2003). During pregnancy however, pregnant women may have already established the parameters of their social support from family and friends, and that these are not likely to be influenced by slight changes in gratitude levels. If this is the case, it would explain why women's perceptions of support do not differ as a result of intervention use in the current study.

9.4.2.3 Prenatal stress. Previous research on mindfulness during pregnancy has demonstrated significant decreases in stress (Beddoe et al., 2009; Dunn et al., 2012); research has not yet been conducted on gratitude in pregnancy. No significant intervention effect was observed in the current study. This may be due to the dual component nature of the intervention, which differs from mindfulness interventions previously examined in terms of duration, content and structure. As noted in Chapter 2, the multi-component nature of standard mindfulness courses that take place in a

social setting could influence much of the existing empirical findings. The social nature of the intervention itself may function to reduce stress because, as noted previously, social support is consistently associated with reduced stress sand positive well-being in pregnancy (Blanchard et al., 2009; Collins et al., 2003; Dejin-Karlsson et al., 2000; Dunkel Schetter, 2011; Feldman et al., 2000; Hedegaard et al., 1996; Pryor et al., 2003).

An alternative explanation is that the multiple components of standard mindfulness practice are necessary to reduce levels of prenatal stress. However, previous research has tended to focus on measures of general stress (Lobel et al., 2008), rather than prenatal or pregnancy specific stress. As argued in Chapter 8, it is necessary to focus on the specific context in which stress occurs in pregnancy because the experience itself can result in unique stressors. The lack of a focus on pregnancy-specific stress in previous research may account for observed significant effects of mindfulness interventions. Mindfulness interventions consistently demonstrate reductions in stress in non-pregnant groups (see Keng et al., 2011) and so may function in a similar manner during pregnancy. In this way, mindfulness interventions in pregnancy may reduce general stress but not pregnancy-specific stress; this would explain the lack of a significant effect in the current study.

The current study did find a main effect for condition that was approaching significance. Coupled with a moderate effect size and a lower than desired level of power, it is possible that a significant effect may have been observed with a larger sample size. A significant main effect for time was observed, which was not unexpected, as participants tended to be on average 16 weeks pregnant during the

study. At this point in pregnancy, women are in the early stages of the 2nd trimester, during which many women report a lessening of vomiting and nausea (Niebyl & Briggs, 2014; Taylor, 2014) and a reduction is physical discomforts, such as fatigue (Shinkawa et al., 2012), that were more problematic in the first trimester. Previous research also supports the idea that women tend to report less stress in the middle of pregnancy (Green et al., 2003; Lubin, Gardener & Roth, 1975; Ohman et al., 2003;). Greater emotional distress is typically associated concerns about the pregnancy in early pregnancy and in late pregnancy greater emotional distress is associated with worries about the birth and caring for the child after the birth (Ohman et al., 2003). Thus a decrease in stress as a function of time rather than intervention, at the point in pregnancy accounted for in this study, is not unusual.

9.4.2.4 Happiness. No significant changes in happiness were observed for experimental condition in the current study. No published research exists to date on the effects of mindfulness or gratitude interventions on happiness during pregnancy but research in non-pregnant populations has demonstrated significant increases in happiness levels (Bogels et al., 2008; Carson et al., 2004; Choi et al., 2012; Macaskill, 2012; Seligman et al., 2005; Toepfer, Cichy & Peters, 2012; Wood et al., 2010). A significant effect was observed for time, with all three experimental conditions demonstrating an identical pattern of change over time. All conditions demonstrate an initial slight increase in happiness followed by a sharp decline in happiness levels. Such a decrease was unexpected given the finding of increases in happiness for all intervention conditions, irrespective of construct or component

order, in the non-pregnant group in Study 1. As scant research has been conducted on positive well-being during pregnancy, it is unclear if this is a common pattern in the larger population. A decrease at Time 2 may result from initial novelty or excitement of pregnancy in the 1st trimester dissipating, perhaps as women become more accustomed to their pregnancy. Such interpretations are limited however as the current study only examines a short period of time and does not lend itself to longitudinal inferences.

Interestingly happiness is the only positive well-being variable to demonstrate a downward pattern of change over time. This pattern is more similar to that observed for stress and depression and it is unclear why happiness follows this trajectory. It could be suggested that expectancy effects may have led to the initial increase in happiness observed from Time 1 to Time 2. This does not appear to be the case however as the pattern of change is uniform across all groups, including the Control. Thus there appears to be a significant time dependent decrease in happiness that is not attributable to any facet of intervention use. Further research is clearly needed to fully examine such patterns of change in happiness and other positive well-being constructs during pregnancy.

9.4.2.5 Depression. No significant effect of the intervention on depression was observed in the current study, which was unexpected. Previous research examining the effects of gratitude (Park et al., 2004; Wood et al., 2008a) and mindfulness (Brown & Ryan, 2003; Ma & Teasdale, 2004; Sephton et al., 2007; Teasdale et al., 1995) in non-pregnant groups has consistently demonstrated significant reductions in

depression levels. During pregnancy, mindfulness interventions have also demonstrated significant decreases in depression (Duncan & Bardacke, 2010; Dunn et al., 2012; Goodman et al., 2014; Muzik et al., 2012). As previously discussed, the format of standard mindfulness interventions may be more conducive to alleviating depression via social support or increased practice duration. In reviews of positive psychological interventions, Bolier et al. (2013) and Sin and Lyubomirsky (2009) found longer duration interventions to be more efficacious and so this may have had an effect in the current study. A significant effect was found for time, suggesting that participants became less depressed during the study irrespective of intervention use; this is further supported by a sustained decrease in depression levels for the control group. This may relate to the typically observed reduction in stress and distress during the middle of pregnancy (Green et al., 2003; Lubin et al., 1975; Ohman et al., 2003). Thus while the lack of an intervention effect was unexpected, the presence of a time effect is not necessarily unusual. In addition, the control group demonstrate a more pronounced and sustained decrease in depression than the intervention groups suggesting that the intervention performs worse than the no-treatment group in terms of depression.

9.4.2.6 Sleep quality. During the study, participants' sleep quality improved as a result of time. Previous research has suggested that sleep quality worsens as pregnancy progresses (Greenwood & Hazendonk, 2004; Wilson et al., 2011), and so this finding was unexpected. Greenwood and Hazendonk (2004) examined sleep quality in the 3rd trimester of pregnancy however, while the current study examined

women in the late 1st and 2nd trimesters. This effect of time in the current study may reflect similar processes to those observed for prenatal stress, whereby initial physical discomforts may lessen, allowing for improved sleep. Similarly, the wakefulness associated with increased foetal size and movements in later pregnancy (Baratte-Beebe & Lee, 1999; Mindell & Jacobson, 2000) is not yet being experienced. Further supporting this shared mechanism, is that the intervention conditions demonstrate similar trajectories of change when examined for sleep and stress only.

A significant effect of intervention was also observed in the current study, with the Intervention 1 condition demonstrating significantly better sleep than the control. Previous research by Beddoe et al. (2010) found significant improvements in sleep quality following a mindfulness-based intervention in the 2nd trimester of pregnancy, although sleep worsened for participants in the 3rd trimester; this further suggests differences in sleep across pregnancy trimesters. Unlike the current study, Beddoe et al. utilised a 7-week Mindfulness course, and did not attempt to account for potential order effects. The findings of this study are the first to suggest that order of intervention component use may influence sleep outcomes. Significant differences observed between the Intervention 1 condition and the Control condition suggest potential benefits of using the mindful meditation first followed by the gratitude exercise. The order of intervention completion may function to initially broaden awareness via mindfulness, allowing participants to subsequently feel more grateful for a greater variety of experiences. A mechanism by which the intervention exerts an influence on self-reported sleep may also relate to positive pre-sleep cognitions

for gratitude (Wood et al., 2009a) and reduced ruminative thoughts and maladaptive sleep related beliefs for mindfulness (Cincotta et al., 2011; Howell et al., 2010). In the current study participants were requested to use the intervention in the evening, prior to bedtime. There is evidence that the interventions were completed as instructed, thus the proximity of the intervention to bedtime may play a role in its efficacy via these pre-sleep mechanisms.

9.4.3 Intervention Effects on Birth Outcomes

No significant effects of intervention condition were observed for birth weight, delivery type or birth complications in the current study. In the context of the findings of the current study, this was not unexpected because high cortisol before labour can lead to adverse labour and delivery outcomes (Coussons-Read et al., 2003). Sandman et al. (2006) also suggest that elevated cortisol at 15-19 weeks gestation can increase risk of preterm delivery (Sandman et al., 2006). High levels of cortisol were not observed in the current study and so adverse birth outcomes were less likely to occur. Similarly, as the interventions did not result in significant reductions in cortisol, improvements in birth outcomes were also less likely to occur. Thus the intervention was expected to exert effects via cortisol changes and as these did not occur, no changes in birth outcomes were expected. However, a significant difference between groups for gestational age was observed. Surprisingly, the gestational age for the Intervention 2 condition was significantly shorter than the Control condition by approximately one week. While this appears to be an intervention effect, considerable care should be exercised in interpreting the result

because such an effect does not appear to be mediated by any changes in well-being or cortisol.

9.4.4 Intervention Effects on Cortisol Outcomes

No significant effects of experimental condition were found for the CAR, waking cortisol, + 30 minutes cortisol or mean evening cortisol in the current study. These findings were unexpected as previous research has observed some effects of mindfulness interventions on cortisol levels (Carlson et al., 2004; Galantino et al., 2005; Kang & Oh, 2012; Lengacher et al., 2012; Lipschitz et al., 2013). A recent review by O' Leary et al. (2015) highlighted a number of methodological limitations of the previous research however. In controlled trial designs, rather than within-subjects studies, mindfulness interventions were not found to influence cortisol (Daubenmier et al., 2011; Gex-Fabry et al., 2012; Malarkey et al., 2013; Oken et al., 2010). O' Leary et al. suggest that a possible explanation for these findings is a lack of rigorous cortisol sampling protocols in the existing literature. A rigorous protocol was implemented in the current study and it was anticipated that significant intervention effects would be observed as a result, particularly given the previously observed findings for psychological and physical well-being. However, as discussed in Chapter 7, little empirical research has focused on mindfulness effects on cortisol during pregnancy; no previous research examines prenatal gratitude effects on cortisol. The single pilot study conducted by Beddoe et al. (2009) failed to find any significant effect of a mindfulness-based intervention on morning cortisol concentrations in a sample of 15 pregnant women. The reason for a lack of a

significant effect in the Beddoe et al. study is possibly due to the ambiguously timed 'morning sample', which was not clearly time-specified and may have been influenced by sampling variability. The lack of an effect may also have also been due to the small sample sized used in the study, which is also a concern in the current research. Although no significant effects of experimental condition were observed in the current study, decreases were observed in one or both intervention conditions for mean evening cortisol concentrations, the +30 minutes cortisol sample, the CAR and the waking sample. In addition, the observed power for all cortisol outcomes was lower than desired to detect a significant effect, and the effect sizes for the waking and +30 minutes sample were moderate to large. This suggests that the current study may have been able to detect a significant effect had it been better powered, with a larger sample size.

In the context of the self-report findings in the current study, the lack of significant differences between experimental conditions is not necessarily surprising. There is an argument within the empirical literature for the important role of stress occurring at critical periods of growth during pregnancy for maternal HPA axis responding and foetal outcomes. As maternal HPA axis responding is not attenuated in early pregnancy it is expected that higher psychosocial stress could lead to increases in cortisol (Kalra et al., 2007; Obel et al., 2005; Suglia et al., 2010). In a similar manner, interventions that reduce stress would be expected to function to reduce cortisol levels. Changes in self-report outcomes could therefore mediate changes in physiological responding. As there is no evidence of an intervention effect on self-report stress or other well-being factors in the current study, this may

contribute to the lack of an effect for cortisol levels. As noted in Chapter 2, psychological well-being, and stress in particular, is not always directly associated with cortisol responding (Bolten et al., 2011; Himes & Simhan, 2011; Wadhwa et al., 1996). An effect on cortisol could therefore still occur in the absence of a change in self-report well-being. Thus the absence of intervention effects on self-report stress and well-being is not sufficient to explain the lack of an effect on cortisol levels.

9.4.4.1 Cortisol sampling. A more likely explanation for the lack of observed effects in the current study relates to participant adherence to sampling protocols. As can be seen in the diurnal cortisol profiles for the full sample and for each experimental condition, some non-adherence to sampling times is evident. For the full sample the majority of days demonstrate expected diurnal patterns, although Day 4 demonstrates a plateau from +45 minutes to midday. Such a plateau is not consistent with expected patterns or with patterns observed on other sampling days. When examined by experimental condition, the diurnal profiles for each sampling day demonstrate irregularities within and across groups. Irregularities include instances of plateaued cortisol concentrations between the +45 minute sample and midday, and instances of increases from the +45 minutes sample to midday. As cortisol follows a diurnal pattern of gradual decline, such patterns are not expected to occur and suggest that participants did not correctly adhere to sampling protocols. It is possible that participants collected midday samples earlier than noon, perhaps for convenience, which would explain the higher than expected values in some cases.

They may have also collected midday and the +45 minutes samples at the same time, explaining the observed plateaus.

Further irregularities can be seen in diurnal patterns that appear to miss the morning cortisol peak. In these cases cortisol levels are already quite high at the waking sample, resulting in a very small or absent peak, followed by a decline. This would occur when participants do not collect their waking samples immediately on waking but do so a few minutes later (O' Connor et al., 2009; Smyth et al., 2013). There are different recommendations in the literature for what constitutes a meaningful delay in collecting the waking sample. For instance a delay of over 15 minutes has been found to lead to increased waking sample concentrations and flatter CARs (Dockray et al., 2008; Okun et al., 2010). A recent paper by Smyth et al. (2013) however found that much shorter delays of 5 to 15 minutes can have a significant impact on waking cortisol and the CAR. Smyth et al. found that shorter delays can result in greater estimation of the magnitude of the CAR and earlier CAR peaks, explaining the lack of a distinct peak observed for some days in the current study. Thus inaccurate sampling at waking potentially impacts on waking cortisol and the CAR as a result of a sampling delay. It also has an impact on our ability to interpret the diurnal cortisol secretion because our measures of AUC and evening cortisol are anchored in the morning collection. Smyth et al. recommend calculating diurnal cortisol and AUC as separate to measures of CAR. Given funding constraints and concerns regarding participant burden, it was not feasible to collect and assay additional samples that would have facilitated this. In addition, those participants who were non-adherent demonstrate differential diurnal profiles to those who were

adherent, irrespective of CAR (Halpern et al., 2012), posing a problem for interpretation regardless of statistical considerations.

Inaccurate sampling therefore limits our ability to clearly interpret cortisol findings in the current study. A further limitation is that we cannot more accurately account for sampling delays at waking because participants self-reported time of waking and sampling. The use of electronic caps to automatically monitor sampling time, or actigraphy to account for actual waking, would enable a better understanding of potential discrepancies in waking and sampling time. Such methods require additional financial resources however that were beyond the remit of the current research. Examinations of delays between sampling time points for each group demonstrated few differences between the groups however. Where differences were observed they were not consistent within or across experimental conditions or sampling days. In addition, no differences were observed for time lapses between sampling times for any group. This indicates that even when morning samples were collected earlier for some groups, all groups followed a consistent timing schedule across the day. Thus patterns of change cannot be attributed to timing of samples throughout the day.

9.4.5 Recruitment, Adherence and Retention

9.4.5.1 Retention. Overall in the current study participants were generally quite compliant to study requirements, except for saliva sampling compliance, with a low level of attrition observed. The rate of attrition in the current study was 21.74%; this is below the attrition rate of 43.55% in Study 1 and the average attrition rate for

longitudinal trials of 42% observed by Roberts and DelVecchio (2000). The rate of retention in the current study, 78.26%, is also comparable to that of Coleman-Phox et al. (2013) who reported a completion rate of 87% in an 8-week behavioural intervention for pregnant women. It is important to note that Coleman-Phox et al. incorporated considerable recruitment and retention strategies that were far beyond the scope of the current study. These included a high level of information and engagement with over 200 healthcare providers; compensation and assistance for study participants in terms of transportation, childcare and groceries; reminders, check-in and catered meals for staff at hospital-based clinics to encourage engagement with recruitment; participant compensation for session attendance and study completion; and gift bags for women at time of birth to accompany follow up reminders. Given the extent of recruitment and retention strategies employed by Coleman-Phox et al. with a retention rate of 87%, the retention rate in the current study can be seen as a considerable strength.

One reason for improved retention in this study retention may be the increased use of technologies, including email and text message reminders to participants in relation to intervention use and cortisol sampling. These reminders may have functioned to increase engagement with the study beyond that observed in Study 3 (Chapter 6), as incorporating technology into trials during pregnancy has been shown to improve retention (Frew et al., 2014). Of those participants who withdrew from the study, well-being factors were found to contribute to the number of self-report time points completed. Participants low in social support and high in prenatal stress were significantly more likely to only complete baseline self-report measures. This

difference was only found between baseline and Time 2 measures however, suggesting that social support and stress do not function as factors that will increase participation to study completion but are instead factors that increase the likelihood of attrition. This is unsurprising as social support has previously been cited as a factor for reduced willingness to participate in trials during pregnancy (Frew et al., 2014). Van Delft et al. (2013) also found that 82% of women aged 18-30 reported that their husband's opinion was a significant reason for non-participation. Thus women with lower social support may have been disinclined to participate in the current study. Similarly, prenatal stress may have impacted on motivation and capacity to fully engage in study requirements. Women high in prenatal stress are expected to experience difficulties in domains including physical symptoms, concerns about the baby and birth, and emotions and relationship. The importance of this finding lies in the fact that it may be participants demonstrating low levels of these variables who would most benefit from potential intervention effects. As noted previously, lack of observed change for some outcomes may be attributable to lack of room for meaningful improvement due to existing high levels of well-being.

Had greater engagement and motivation of participants with lower levels of well-being been targeted in the study, significant intervention effects may have been observed. In addition, in the event of significant change and improvements in well-being, these participants would potentially reap the greatest benefit. Interestingly however, social support and prenatal stress were not factors in saliva sampling adherence. This suggests that it may be the process of answering questions related to these constructs that deters participants from engagement; perhaps this is due to

negative affect arising from explicitly focusing on aspects in which they are lacking, in terms of support, or in which they are experiencing distress. Future research on pregnancy should consider this possibility and should attempt to foster greater intervention engagement with participants experiencing low well-being during pregnancy.

9.4.5.2 Recruitment. Recruitment in the current study was conducted over a period of 1 year, during which only 46 participants commenced the RCT. This number falls below the required sample size, based on sample size calculations, of 141. As discussed in Chapter 6, a number of factors can contribute to slow and poor levels of recruitment. These include less people than expected agreeing to participate, missing eligible participants, funding constraints, and intervention issues (McDonald et al., 2006). These factors may have played a significant role in recruitment in the current study; for instance funding was not available to provide incentives to pregnant women, which has been shown to be a factor in increased participation (Booker, Harding & Benzeval, 2011; McDonald et al., 2006; Watson & Torgerson, 2006).

Similarly although the recruitment methods used in the current study can be considered robust and comprehensive, some eligible participants may have been missed during the recruitment phase. Recruitment was conducted in the private and public outpatient departments of Cork University Maternity Hospital (CUMH). CUMH is a large tertiary hospital, serving patients from Cork City and County, with a population of 520,000. The hospital itself has approximately 8,000 births annually,

thus a large number of potential participants are processed each year. Participants were approached at their booking appointment in the hospital and invited to participate; information leaflets were provided containing the website address. Where women wished to sign up in person, rather than online, participants signed informed consent forms and provided postage details for their intervention pack; otherwise participants signed up online. In addition, telephone recruitment was conducted to reach those participants who could not be contacted in the outpatient departments. Recruitment advertising was also conducted online via widely used pregnancy forums, www.rollercoaster.ie and www.mum2be.ie, as well as in various locations in Cork City, including general practitioner surgeries, medical centres, prenatal yoga and pilates classes. A research website and social media page (Facebook) were also set up to foster recruitment and retention. Thus the recruitment strategies are clearly seen to be as broad as possible in an attempt to recruit as many participants as possible. There is empirical support for increased recruitment efficacy of each of these approaches, including the usefulness of online self-enrolment (Gazmararian, Elon, Yang, Graham & Parker, 2014), mobile technology and social media (Shere, Zhao & Koren, 2014), and face-to-face recruitment (Frew et al., 2014) in pregnant groups. Therefore the means of recruitment used in the study can be considered a considerable strength.

A number of reasons may have contributed to the poor uptake of participants overall. One is that during pregnancy, women report a preference for engaging in research with which their healthcare providers are actively engaged (Frew et al., 2014; Kenyon et al., 2006). In the current study, various consultants and midwives

facilitated recruitment but were not actively engaged in the research due to existing research and workload commitments. Thus despite being conducted with the approval of the CUMH and all necessary ethical committees, this may have had a considerable impact on participants motivation to take part in the study. In addition, a number of research studies were running concurrently in the CUMH at the time of recruitment, some of which were being actively recruited for by clinical midwives. Participants may have been missed as a result if they had already signed up to one of these other studies; previous research has found that having trials operating in the same site can be a barrier to recruitment (Peters-Lawrence et al., 2012). Participant eligibility is also consistently identified as a barrier to recruitment in trials (Peters-Lawrence et al., 2012) and of the participants who were assessed for eligibility (*n*=362), some were ineligible due to use of asthma or thyroid medication (*n*=13). Others, (*n*=299) declined to participate due to lack of interest or time to commit to study requirements. Time commitments have been previously identified as deterrents to participation in RCTs (Barnett, Aguilar, Brittner & Bonuck, 2012) and were also an issue in Study 3 (Chapter 6). As a result, the intervention duration and sampling requirements were reduced in the current study to minimise participant burden and increase retention and adherence.

9.4.5.3 Adherence. In the current study, a reasonable level of adherence to study requirements was observed. With regard to intervention use, participants were required to use their intervention 11 times in total across the 3 weeks. As previously noted, only diary entry completion could be monitored in the current study and so

this serves as a proxy measure for full intervention use. This obviously has limitations as we cannot conclude with any degree of confidence that participants completing diary entries completed the mindfulness intervention equally. It is possible that participants with a preference for the mindfulness meditation may have completed this component only, and so our measure of diary entries would underrepresent intervention engagement. As this is the only measure of intervention use available in the current study, it will be interpreted here with caution. The average number of diary entries provided by intervention participants was 7.88; twenty-one participants provided six or more diary entries. This indicates a high level of engagement with the intervention, particularly as 4 days per week was recommended with the awareness that participants may not always achieve this.

No significant differences were found between intervention conditions in the current study and there was no difference in time points completed between the control condition and a collapsed intervention condition. This suggests that the additional requirement of intervention use was not a deterrent for participants in the current study, as it did not increase attrition. Similarly, there appears to be no effect of intervention component order on intervention use. This supports the usability of the intervention in a pregnant group and highlights an important point about participant motivation in the current study. It has been previously noted that participants with lower social support and higher prenatal stress were more likely to withdraw from the study, suggesting that higher levels of well-being may support participation in studies such as this. Further, it is possible that participants who took part, adhered to and completed all study requirements may represent a specific

group. The majority of participants in this study were Irish, highly educated, engaged in positive health behaviours, had planned, low-risk pregnancies and were in private antenatal care; all participants were also married or in a relationship.

As previously discussed, the sampling strategy employed in the current study was comprehensively designed in an attempt to achieve a diverse participant sample. Despite this, those who completed the study represent a reasonably homogenous group; similarly those who initially enrolled and subsequently withdrew share similar characteristics. Participants may have been more motivated to participate and adhere to study requirements due to these characteristics. The potential for participant bias in positive psychology has been previously noted in Chapter 6, with individuals who take part already being more motivated to improve their well-being and happiness (Lyubomirsky et al., 2011; Seligman et al., 2005). As a result it is likely that the current study missed participants who may have benefited more from the intervention due to the potential for poor well-being and adverse birth outcomes associated with lower socio-economic status (Miyake, Tanaka & Arakawa, 2012), being in less stable relationships, with lower education (Coelho et al., 2013), or being a member of a minority group (Malin & Gissler, 2009). It is therefore possible that while the intervention demonstrated no significant effects on the majority of outcome measures, intervention effects may have been observed within a more heterogeneous sample, or with a group of women with low well-being and/or less financial and emotional resources.

9.4.6 Conclusion

The intervention used in the current study demonstrated no significant effect on gratitude, mindfulness, satisfaction with life, social support, happiness, depression, birth outcomes or cortisol outcomes. Significant main effects of time and intervention on sleep quality were observed but no interaction effect was observed. These fidings therefore provide tentative support that interventions incorporating components posited to increase positive pre-sleep cognitions (Wood et al., 2009a) and minimise ruminative pre-sleep cognitions (Cincotta et al., 2011; Howell et al., 2010) may improve self-reported sleep, particularly when used prior to bed-time. The effect of the intervention on prenatal stress was approaching significance, possibly due to a non-significant difference in baseline levels of stress between groups. Coupled with evidence that participants with lower well-being were more likely to withdraw from the study, and that those who fully participated formed a distinct subgroup of pregnant women, this raises an important point regarding the use of particular samples in future research. Pregnant women with lower levels of well-being and/or with lower education and socio-economic statuses may benefit more from positive interventions such as this during pregnancy. Future research should focus on specifically targeting and retaining such women, or oversampling for them in research designs. This could however pose additional problems in sampling and intervention adherence, as such participants may be less likely to adhere to study protocols, resulting in increased attrition or incorrectly collected samples.

Therefore while the interventions did not significantly improve overall psychological, physiological wellbeing or birth outcomes, it does provide tentative support for the usefulness of such interventions with pregnant groups. Positive psychological interventions incorporating collection of biomarkers of well-being appear to be well received by at least a subgroup of pregnant women. Future research is clearly needed however to expand the reach of such interventions and examine their efficacy with more vulnerable populations.

Conclusion

The current research examined the effects of mindfulness and gratitude on psychological and physical well-being during pregnancy. Low prenatal maternal well-being has significant adverse consequences for the mother and developing foetus (Dunkel Schetter, 2011). This research adopted a positive psychological approach to well-being and functioning by using positive psychological interventions to enhance positive facets of functioning and improve prenatal well-being. Interventions were examined in terms of effects on self-report indicators of well-being, cortisol and birth outcomes. Five studies were conducted, each of which built upon the findings of the preceding studies as part of a comprehensive approach to address the research aim.

A systematic review of the effects of mindfulness on cortisol found that mindfulness may have direct effects on cortisol, rather than effects mediated by depression or other well-being factors. Significant effects were only observed in within-subjects designs however; effects are absent when control groups are used, suggesting the possibility of no true effect of mindfulness on cortisol. Interpretations of the findings are limited due to methodological issues, particularly in relation to cortisol sampling. The findings highlight the need for robust protocols in examinations of positive constructs, such as mindfulness, and psychophysiological markers. These findings informed the development and implementation of thorough protocols in the randomised controlled trials (RCT) presented in the current thesis.

The second study examined the suitability of two new dual-component interventions, based on mindfulness and gratitude. Findings indicated that short interventions of just 3 weeks have the potential to lead to non-significant increases in gratitude and mindfulness, and reductions in negative affect. Findings were less clear for positive affect, but some non-significant increases were observed. In addition, participant feedback about interventions was invaluable for refining and improving the interventions in terms of intervention length and online availability. These recommendations were incorporated into a RCT examination of intervention effects in a sample of non-pregnant women in Study 3. A non-pregnant group was used initially to determine efficacy before utilising the interventions with pregnant women.

The findings of Study 3 demonstrated no significant differences over time between the intervention conditions for gratitude, mindfulness, happiness, satisfaction with life (SWL), positive affect, negative affect, social support, stress, depression or cortisol outcomes. Non-significant changes in the expected directions were observed for all self-report outcomes but order effects often influenced these. The effects of the interventions on cortisol levels were less interpretable due to participant non-adherence. Overall, there was considerable variation in observed outcomes between intervention constructs, and between intervention conditions. Further, neither gratitude nor mindfulness demonstrated superiority in improving well-being; both demonstrated some benefits for different outcome variables. This demonstrated the importance of incorporating aspects of gratitude and mindfulness in future interventions, and of utilising counter-balancing to account for order

effects. Issues of recruitment and adherence to protocols in this study also highlighted the need to engage in rigorous recruitment and retention strategies when examining intervention effects with the pregnant group.

Before an examination of intervention efficacy in pregnancy could be conducted it was necessary to develop and validate gratitude and mindfulness measures, respectively, for use during pregnancy. Study 4 involved a preliminary thematic analysis that provided an insight into subjective gratitude during pregnancy and informed item development for a prenatal gratitude scale. This was followed by development and validation of the Gratitude during Pregnancy Scale (GDP) and validation of the Mindfulness Awareness Attention Scale (MAAS). Findings of the initial qualitative analysis indicated that gratitude during pregnancy is a contextually specific multi-faceted construct. Women were grateful for their baby, social support, aspects of medical care, daily life, and being pregnant. Each theme highlights important aspects of the prenatal experience, and is to the author's knowledge the first examination of subjective experiences of gratitude. Items for the GDP scale were developed from themes identified in the thematic analysis, and a thorough review of the literature. Using exploratory factor analysis, an 18-item 4-factor GDP scale was developed. The four factors were general gratitude, physical changes, antenatal care, and social support. This scale demonstrate good reliability (α = .89), which was retained for each subscale, and in both early and late pregnancy. A psychometric evaluation of the MAAS also demonstrated its suitability and reliability (α=.88) in pregnancy. These scales were used to assess the effects of the

interventions on their constituent components in a RCT of pregnant women in Study 5.

Findings of Study 5 indicated no significant effects on gratitude, mindfulness, SWL, happiness, positive affect, negative affect, stress, depression or social support. A significant main effect of intervention was found for sleep, which may be explained by mindfulness and gratitude effects on pre-sleep cognitions (Howell et al., 2010; Wood et al., 2009a). Time effects were observed for a number of variables. These may be explained by naturally occurring changes in prenatal well-being, such as an observed U-shaped pattern of distress in pregnancy. No research has been conducted on changes in positive well-being during pregnancy and the possibility of naturally occurring changes raises questions about the veracity of previous findings of prenatal mindfulness studies. No significant effects were found for most birth outcomes, except gestational age; care must be taken in interpreting this finding however. No significant effects were found for any cortisol outcomes in the study; this is most likely explained by poor adherence to sampling protocols. Despite poor protocol adherence, overall retention levels were good in the current study; those who discontinued participation were more likely to have higher stress and lower social support at study commencement. Thus, although robust recruitment and retention strategies were employed, it was with limited success. The challenge of future research to focus on engaging larger, more diverse and potentially vulnerable groups is significant. Overall the intervention demonstrates significant benefits for self-reported sleep in this sample of pregnant women, with the potential for more significant effects in larger, better-powered studies.

In conclusion the current research provides a solid theoretical and practical base for conducting future examinations of gratitude and mindfulness during pregnancy. Such research should adopt suitable intervention and cortisol sampling protocols. Appropriate strategies for maximising recruitment and retention of diverse research populations are also needed. Future examination and refinement of short, cost-effective interventions for use during pregnancy has the potential to significantly improve prenatal well-being.

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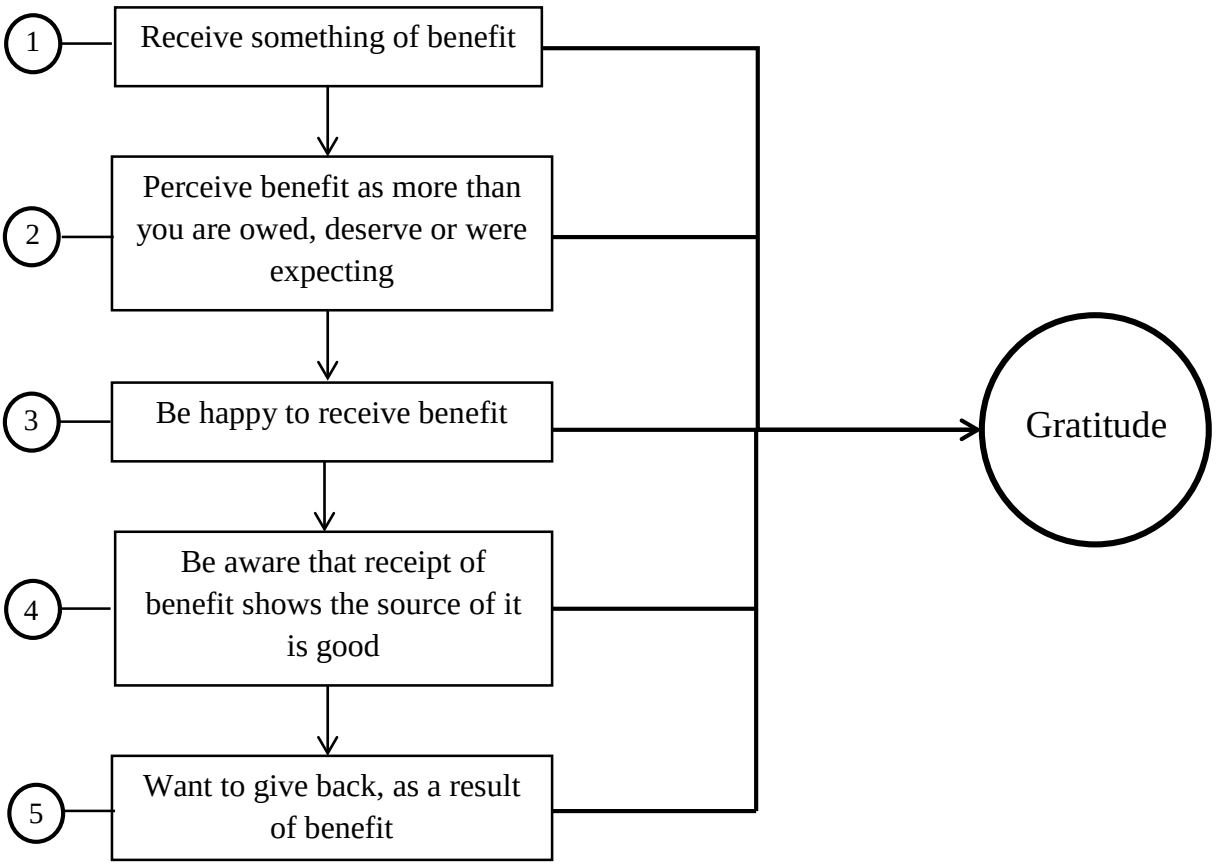
Appendix A

5-Stage Gratitude Model



Appendix B

Gratitude Diary Instructions

To use this diary simply list up to 5 things that you have felt grateful for during the day. Please do so 4 times a week, on Monday, Wednesday, Thursday and Sunday. Please continue to use your diary for the next 8 weeks.

The following instructions may help filling out the diary.

There are many things in our lives, both large and small, that we might be grateful for. They may be anything from meeting a friend for a coffee to getting an assignment in on time. 4 times a week, for the next 8 weeks please think back over your day and write down up to five things in your life that you feel grateful for. These things can reflect any part of your day.

When writing your list begin each sentence with ‘I am truly grateful for...’ or ‘Thank you for...’ and feel the feelings as deeply as possible within your heart.

Some days you may find it difficult to list what you are grateful for. If you cannot easily think of something you are grateful for you might find it useful to think of different life areas such as your family, friends, work, study or personal achievements. You do not need to create an item that you don’t truly feel grateful for, so if you cannot write anything down, don’t.

Just try again the next day.

Appendix C

Gratitude Reflection Instructions

Before we begin, adopt a comfortable position. You can lie on the floor, with your arms and legs spread slightly, or sit in a comfortable seat with both feet on the floor.

Allow your eyes to gently close.

Think of something you are grateful for that happened in the last 24 hours.

This thing can be an event or an experience… It can relate to people in your life… a personal achievement… or something you have seen… or done in the last day.

This thing can be simple or complicated, large or small.

[Pause]

Once you have brought your attention to something you are grateful for… feel this feeling of gratitude deep within your heart… Open yourself to the feeling of gratefulness.

Relax… breathe… and experience this feeling.

[Pause]

Bring your attention to what it is that you are grateful for… What have you received or experienced?

Think about this thing… all the while feeling the feeling of gratitude within you.

[Pause]

What does this thing mean to you? … What effect does it have?... All the while allow the feeling of gratefulness to stay in your heart.

[Pause]

Now relax and breathe…

Bring your awareness momentarily to your breath… focus on the rise and fall of your breath.

[Pause]

Now think of another event or experience for which you are grateful… Try and keep your focus on the last 24 hours.

Again this thing can relate to something you have been given… something you have seen… or experienced… or something you have done.

This thing can be simple or complicated, large or small.

[Pause]

Once you have thought of something, allow yourself to feel gratitude deep within your heart… Truly feel this gratefulness within you.

Relax, breathe and experience this feeling.

[Pause]

Bring your attention to what it is that you are grateful for... What have you received or experienced?

Think about this thing… all the while feeling the feeling of gratitude within you.

[Pause]

What does this thing mean to you? …What effect does it have? … All the while allow the feeling of gratefulness to stay in your heart.

[Pause]

Now relax and breathe…

Bring your awareness momentarily to your breath… focus on the rise and fall of your breath.

[Pause]

When you're ready, bring your attention back to the present moment…

Gently open your eyes… trying to maintain the feeling of gratitude.

Appendix D

Mindfulness Scan Instructions

Before we begin, adopt a comfortable position. You can lie on the floor, with your arms and legs spread slightly, or sit in a comfortable seat with both feet on the floor. Allow your eyes to gently close.

Breathe in s-l-o-w-l-y and deeply through your nose…

Feel your abdomen move outwards as your diaphragm contracts and draws air into your lungs…Your chest should not rise noticeably.

While breathing slowly, direct attention to your left foot. Feel your foot…Curl your toes once to fix your awareness to it. Now relax...

As you breathe in through your nostrils, slowly scan your left leg… from foot to knee… and up through your thigh.

As you breathe out, trace your leg down to your foot…

Direct your attention from your foot back up to your knee… and thigh...and now follow that path back down to the foot.

Now take your mind off your breath and remain with your foot…

Feel the sensations in your foot. Simply become aware of them…

Scan your left lower leg… Accept any tension or discomfort.

Scan slowly, up through your thigh now… If thoughts appear, that's fine… Gently come back to your breath, and shift awareness over to your right foot.

Slowly inhale while scanning through your right foot… calf…knee… and thigh...

Exhale and scan back down… S-l-o-w-l-y.

Now let go of your breath and remain with your foot… Scan for any sensation in your foot... calf... Thigh...

Simply accept all sensations and feel what happens. Relax...

Now bring your attention from your thighs up to your stomach. .. Feel it r-i-s-i-n-g as you breathe in… Sinking as you exhale… Nice and slow…

Your heart probably slows down. This is normal.

Remain aware of your stomach… your breath... up and down... Become aware of sensations… Relax...

Now, breathing in, bring your attention to your left arm. Feel your shoulder… arm… hand... Curl your fingers into your palm to direct your awareness to your hand… and release. Breathe…

As you breathe in scan up along the length of your arm… your elbow… your shoulder… to your chest.

Bring your attention to your chest… your collarbone… across to your right shoulder… then down your right arm to your right hand.

Remain there… Breathe…

Curl your fingers in and then release… feel your hand… your arm… your elbow… your shoulder… Relax...

Come back up to your chest… Continue scanning up along your neck… and to your face.

Gently clench your jaws and release. Feel the sensations in your jaws… your throat… your mouth…

Breathe and focus on your face… your cheeks… your forehead… the back of your head and neck…

Scan the top of your head… Relax...

Now detach from all body parts… Breathe...

Feel how everything is connected…. Just breathe and let any sensation come to you, Accept it as a part of you.

Return to your breathing. You are big; sensations are small parts of you. They fluctuate, come and go.

Just breathe and feel your body… Allow yourself to become present with your whole body in the present moment.

When you feel ready, slowly begin to wiggle your fingers and toes.

Gently open your eyes, trying to maintain the feeling of being fully connected to the present moment.

Appendix E

Mindfulness Diary Instructions

To use this diary simply list any thoughts, feelings or sensations you are experiencing right now. Please do so 4 times a week, on Monday, Wednesday, Thursday and Sunday. Please continue to use your diary for the next 8 weeks.

The following instructions may help filling out the diary.

We are constantly experiencing of thoughts, feelings and sensations. These may be physical or mental and may be pleasant or unpleasant. 4 times a week, for the next 8 weeks, please bring your awareness to these thoughts, feelings and sensations in the here-and-now. Do not judge them, compare them or evaluate them. Just experience them and acknowledge that they are occurring. As you do this please write them down in this diary. As these thoughts, feelings and sensations are always changing you may want to list a few things. You do not have to write a certain amount though, just whatever you notice in the present moment. You do not need to spend a long time doing this.

Some days you might find it difficult to record these thoughts, feelings and sensations. If you cannot write anything down don't. Just try again the next day.

Appendix F

Gratitude Reflection Instructions for Study 3

Before we begin, adopt a comfortable position. You can lie on the floor, with your arms and legs spread slightly, or sit in a comfortable seat with both feet on the floor.

Allow your eyes to gently close.

Think of something you are grateful for that happened in the last 24 hours.

This thing can be an event or an experience… It can relate to people in your life… a personal achievement… or something you have seen… or done in the last day.

This thing can be simple or complicated, large or small.

[Pause]

Once you have brought your attention to something you are grateful for… feel this feeling of gratitude deep within your heart… Open yourself to the feeling of gratefulness.

Relax… breathe… and experience this feeling.

[Pause]

Bring your attention to what it is that you are grateful for… What have you received or experienced?

Think about this thing… all the while feeling the feeling of gratitude within you.

[Pause]

What does this thing mean to you? … What effect does it have?... All the while allow the feeling of gratefulness to stay in your heart.

[Pause]

Now relax and breathe…

Bring your awareness momentarily to your breath… focus on the rise and fall of your breath.

[Pause]

Now think of another event or experience for which you are grateful… Try and keep your focus on the last 24 hours.

Again this thing can relate to something you have been given… something you have seen… or experienced… or something you have done.

This thing can be simple or complicated, large or small.

[Pause]

Once you have thought of something, allow yourself to feel gratitude deep within your heart… Truly feel this gratefulness within you.

Relax, breathe and experience this feeling.

[Pause]

Bring your attention to what it is that you are grateful for... What have you received or experienced?

Think about this thing… all the while feeling the feeling of gratitude within you.

[Pause]

What does this thing mean to you? …What effect does it have? … All the while allow the feeling of gratefulness to stay in your heart.

[Pause]

Now relax and breathe…

Bring your awareness momentarily to your breath… focus on the rise and fall of your breath.

[Pause]

When you're ready, bring your attention back to the present moment…

Gently open your eyes… trying to maintain the feeling of gratitude.

Appendix G

Mindfulness Body Scan Instructions for Study 3

Before we begin, adopt a comfortable position. You can lie on the floor, with your arms and legs spread slightly, or sit in a comfortable seat with both feet on the floor. Allow your eyes to gently close.

Breathe in s-l-o-w-l-y and deeply through your nose…

Feel your abdomen move outwards as your diaphragm contracts and draws air into your lungs…Your chest should not rise noticeably.

While breathing slowly, direct attention to your left foot. Feel your foot…Curl your toes once to fix your awareness to it. Now relax...

As you breathe in through your nostrils, slowly scan your left leg… from foot to knee… and up through your thigh.

As you breathe out, trace your leg down to your foot…

Direct your attention from your foot back up to your knee… and thigh...and now follow that path back down to the foot.

Now take your mind off your breath and remain with your foot…

Feel the sensations in your foot. Simply become aware of them…

Scan your left lower leg… Accept any tension or discomfort.

Scan slowly, up through your thigh now… If thoughts appear, that's fine… Gently come back to your breath, and shift awareness over to your right foot.

Slowly inhale while scanning through your right foot… calf…knee… and thigh...

Exhale and scan back down… S-l-o-w-l-y.

Now let go of your breath and remain with your foot… Scan for any sensation in your foot... calf... Thigh...

Simply accept all sensations and feel what happens. Relax...

Now bring your attention from your thighs up to your stomach... Feel it r-i-s-i-n-g as you breathe in… Sinking as you exhale… Nice and slow…

Your heart probably slows down. This is normal.

Remain aware of your stomach… your breath... up and down... Become aware of sensations… Relax...

Now, breathing in, bring your attention to your left arm. Feel your shoulder… arm… hand... Curl your fingers into your palm to direct your awareness to your hand… and release. Breathe…

As you breathe in scan up along the length of your arm… your elbow… your shoulder… to your chest.

Bring your attention to your chest… your collarbone… across to your right shoulder… then down your right arm to your right hand.

Remain there… Breathe…

Curl your fingers in and then release… feel your hand… your arm… your elbow… your shoulder… Relax...

Come back up to your chest… Continue scanning up along your neck… and to your face.

Gently clench your jaws and release. Feel the sensations in your jaws… your throat… your mouth…

Breathe and focus on your face… your cheeks… your forehead… the back of your head and neck…

Scan the top of your head… Relax...

Now detach from all body parts… Breathe...

Feel how everything is connected…. Just breathe and let any sensation come to you, Accept it as a part of you.

Return to your breathing. You are big; sensations are small parts of you. They fluctuate, come and go.

Just breathe and feel your body… Allow yourself to become present with your whole body in the present moment.

When you feel ready, slowly begin to wiggle your fingers and toes.

Gently open your eyes, trying to maintain the feeling of being fully connected to the present moment.

Appendix H

GDP Original Item Pool

1. I have a lot to be thankful for
2. I feel awe when I think of the baby growing inside me
3. I count my blessings for the things that I have
4. I am grateful for being pregnant
5. When I think about my baby I sometimes feel awestruck
6. It is my right to special treatment because I am pregnant
7. There are many reasons for me to be thankful
8. I have moments when I really appreciate the experience of being pregnant
9. I think it is important to enjoy the simple, 'everyday' things in life
10. I am thankful for my life
11. I am looking forward to experiencing childbirth
12. That I can see my baby on ultrasound scans
13. That I can have regular medical check-ups
14. Thinking about the baby growing inside me
15. That my baby's health can be checked and monitored
16. Support from my family
17. Availability of medical procedures during my pregnancy (blood tests, tests of blood pressure)
18. The information my friends provide during pregnancy
19. Getting to spend time with my friends

20. When someone helps me do something that I can no longer do because of my pregnancy (such as lifting or carrying things)
21. My changing body shape
22. My own health
23. Being able to get things ready for the baby ahead of time
24. The work the doctors in the hospital do during my pregnancy
25. The baby's father's involvement in the pregnancy
26. Thinking about the baby as a little boy or girl
27. The pregnancy information available (from the doctor, online, etc.)
28. Being able to have a bag packed for the labour ward
29. The information available about what to expect during labour
30. That my body is able to nurture a baby
31. Having helpful and understanding healthcare professionals (doctors, midwives)
32. Getting time to relax
33. Having the first ultrasound scan of the baby
34. When people treat me as an individual, without focusing on the pregnancy
35. When people understand my mood-swings
36. That pain control can be provided during the birth
37. The work the midwives do during my pregnancy
38. The work my GP does during my pregnancy
39. That I can choose whether or not to use pain control during birth
40. That I can look forward to the future with my baby

41. That I will be a mother to this baby
42. The physical symptoms that come with pregnancy (morning sickness, tiredness)
43. The extra weight my body is gaining during this pregnancy
44. The ‘baby-bump’ that develops during pregnancy
45. The opportunity to wear maternity clothes
46. That I have access to a range of baby supplies
47. That my friends are there for me during the ups and downs of pregnancy
48. That I can now eat for two

Appendix I

Gratitude Diary Instructions for Study 5

There are many things in our lives, both large and small, that we might be grateful for. They may include things like meeting a friend for a coffee or feeling your baby move. Four times a week, for the next 3 weeks please think back over your day and write down up to five things in your life that you feel grateful for. These things can reflect any part of your day.

When writing your list begin each sentence with ‘I am truly grateful for...’ or ‘Thank you for...’ and feel the feelings as deeply as possible within your heart.

Some days you may find it difficult to list what you are grateful for. If you cannot easily think of something you are grateful for you might find it useful to think of different life areas such as your family, friends, work, study or personal achievements. You do not need to create an item that you don’t truly feel grateful for, so if you cannot write anything down don’t. Just try again the next day.

Appendix J

Mindfulness Body Scan Instructions for Study 5

Begin by adopting a comfortable position. You can lie on the floor or sit in a comfortable seat with both feet on the floor. Allow your eyes to gently close. Become aware of your body: notice how your body feels and feel the weight of your body as it is supported by the floor or seat beneath you.

Bring your attention to your breath, do not try to change it, and just notice it. Feel your chest rise and fall with your breath. Feel your breath as it passes through your nostrils, fills your lungs, and continue to feel it as it makes it way out of the body when you exhale. If your mind starts to wander that's ok, just gently bring your attention back to the breath. Keeping this focus, bring your attention to your feet. Feel your feet, curl your toes, feel any sensations that occur in your right foot and your left foot. Now bring your attention from your toes to the balls of your feet, your ankles and slowly up your legs. Become aware of any sensations that occur. Bring your attention to your shins, your knees, your thighs. Remain open to and aware of any sensations. Bring your awareness to you pelvis now, your buttocks. If thoughts or emotions appear that's fine, notice them and gently bring your attention back to your body and your breath. Direct your attention up to your stomach, feel it rising as you breathe in, sinking as you exhale. Bring your awareness to the presence of your baby within your belly. You may feel the baby move as you breathe, or you may feel the baby be still as you breathe in and out. You may notice the beating of your heart, it may slow down, this is normal.

Bring awareness to your lungs and your ribcage and now to the back of your body, from the base of your spine up to your neck, your shoulders. Now direct you attention down your arms, to your elbows, your wrists and hands. Feel your hands; become aware of each finger, noticing any sensations. Bring your attention back up along your arms, from your fingers to hands, to elbows to shoulders. And now feel

you neck and throat, your jaw, your mouth. Bring your attention to your whole face, your cheeks, your forehead, the back of your head, and the crown of your head.

Bring your attention to your body as a whole, feel your baby within you, as a part of you. Feel how everything is connected. You are big; sensations are small parts of you. They come and go. If thoughts arise just bring your attention back to breath, allow yourself to become present with your whole body in the present moment and to feel complete and relaxed. When you feel ready gently open your eyes, trying to maintain this feeling of being completely connected to the present moment.