POSITIVE PSYCHOLOGY AND SLEEP:

THE INFLUENCE OF AN INTERNET-BASED EXERCISE

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others

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ABSTRACT

Associations between psychopathology and poor sleep have been well established by previous research. This has been motivated by the drive to uncover and undo pathology. An alternative approach offered by positive psychology considers whether those who have good sleep quality (SQ) show high levels of subjective well-being (SWB). Evidence is limited, but recent findings have linked good sleep with constructs that are central to SWB, including trait gratitude; how orientated people are to the positive things around them. *Aims:* The main aim of this thesis is to examine the effect of a gratitude intervention on SQ. A secondary aim is to explore the relationships between SQ, SWB and pre-sleep cognitions. *Design:* A total of 300 participants took part in the cross-sectional study. These were classified as having high (n = 138) and low SQ (n = 162) according to the Sleep Impairment Index (SII). Groups were compared on measures of Satisfaction With Life (SWLS), gratitude (GQ-6) and pre-sleep cognitions (SST:60). Hypotheses were guided by the one piece of research that has previously explored these constructs. Individuals with low SQ were then invited to participate in a novel intervention study (N = 51). Participants were randomized into a self-guided Three Good Things in Life gratitude intervention (n = 25) or events listing control intervention condition (n = 26) that ran across 7days. Repeated measures analysis of variance was used to assess change in SQ and pre-sleep cognitions between baseline and follow-up. Hierarchical linear modelling (HLM) was used to explore daily measurements of sleep and affect. *Results:* Results supported previous work in finding positive relationships between high SQ and measures of SWB, including trait gratitude. Those completing the gratitude intervention reported significantly improved SQ according to the Pittsburgh Sleep Quality Index (PSQI), compared to the control condition. A higher proportion of participants in the gratitude intervention fell on or below the clinical threshold of >5 on the PSQI after the intervention (n = 11), compared to those in the control intervention condition (n = 3). The effect of intervention on pre-sleep cognitions between baseline and follow-up was approaching significance. No significant mediational influences were found using HLM. *Conclusions:* This research demonstrates the relationship between SWB and gratitude in relation to SQ and the outcome of the intervention suggests that it could be employed to improve public health in relation to sleep.

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ABBREVIATIONS

BPS	British Psychological Society
DARS	Daily Affective Rating Scale
GQ-6	6-Item Gratitude Questionnaire
IPIP	International Personality Item Pool
IPIPE	International Personality Item Pool Extraversion
IPIPA	International Personality Item Pool Agreeableness
IPIPES	International Personality Item Pool Emotional Stability
IPIPC	International Personality Item Pool Conscientiousness
IPIPO	International Personality Item Pool Openness
PSQI	Pittsburgh Sleep Quality Index
PSQI SSQ	Pittsburgh Sleep Quality Index Sleep Quality component
PSQI HSE	Pittsburgh Sleep Quality Index Habitual Sleep Efficiency component
PSQI SOL	Pittsburgh Sleep Quality Index Sleep Onset Latency component
PSQI Duration	Pittsburgh Sleep Quality Index Sleep Duration component
PSQI Dist	Pittsburgh Sleep Quality Index Sleep Disturbance component
PSQI Dys	Pittsburgh Sleep Quality Index Daytime Dysfunction component
PSQI Med	Pittsburgh Sleep Quality Index Sleep Medication component
SE	Sleep Efficiency
SOL	Sleep Onset Latency
SII	Sleep Impairment Index
SQ	Sleep Quality
SSQ	Subjective Sleep Quality
SST:60	Self-statement Test
SST:60 +ve	Factor measuring positive pre-sleep cognitions on SST:60
SST:60 –ve	Factor measuring negative pre-sleep cognitions on SST:60
SST:60 SOM	States of mind ratio from SST:60
SWB	Subjective Well-being
SWLS	Satisfaction with Life Scale
TST	Total Sleep Time

CHAPTER ONE

Literature Review

The following thesis is grounded in positive psychology. The main aim is to establish whether an intervention that promotes gratitude can improve sleep quality. A secondary aim is to explore subjective well-being and trait gratitude in relation to sleep behaviour.

Given the relative infancy of positive psychology, the review will begin with an introduction to the field. Subjective well-being and gratitude will be described in order to consider the potential for positive psychology within clinical psychological research and practice.

1.1 Positive Psychology

1.1.1 A brief history of positive psychology

There are culturally embedded ideas about the influence of well-being on health; however, the empirical study of this has only gained momentum over the past decade. The positive psychology movement grew out of the seminal work of Martin E.P. Seligman. In his presidential speech to the American Psychological Association (Seligman, 1999) Seligman reflected on the progress of psychology and underlined the close alliance the discipline had formed with disease and illness models. Positive psychology was quick to gain momentum and in 2006 celebrated the first journal dedicated to research within the area. The Journal of Positive Psychology includes a succession of scientific advances in areas that have previously been neglected (Gable and Haidt, 2005).

1.1.2 What is Positive Psychology?

Definitions of positive psychology vary depending on emphasis and interpretation (Linley, Joseph, Harrington and Wood, 2006). At an individual level, relevance is placed on the subjective experience of well-being (section 1.1.4). This includes how certain personality characteristics enable people to experience positive emotion, engagement, purpose and

accomplishment. These more pragmatic concerns are influenced by the core values of positive psychology, as illustrated in the quote below:

> *"The aim of positive psychology is to begin to catalyse a change in the focus of psychology from preoccupation only with repairing the worst things in life to also building positive qualities."*
>
> *(Seligman and Csikszentmihalyi, 2000, p. 5)*

As these meta-psychological aims are central to the work of positive psychology, they will be briefly introduced below.

1.1.2.1 Meta-psychological overview of positive psychology

Positive psychology aims to broaden the focus within clinical psychology and health so that it includes a more balanced breadth of human experience (Duckworth, Steen and Seligman, 2005; Peterson and Park, 2003; Masten, 2001). Studies have underlined the bias that psychology has tended to have towards negative states. In one analysis, negative terms outweighed positive by 2:1 when dialectic pairs (e.g. happiness-sadness) were used to search psychology publications (Rand and Snyder, 2003). Of some relevance to this thesis is the finding that there are many more studies on reactions to negative emotions, such as anger, than there are on the emotions we feel when others do good (Haidt, 2003). Some argue this comes from the greater weight we attribute to negative events, and our predisposition to process them more thoroughly (Baumeister, Bratslavsky, Finkenauer and Vohs, 2001; Rozin and Royzman, 2001). The reality is that positive events actually occur far more frequently (Diener, Sandvik and Pavot, 2009). We could, therefore, theoretically expect them to present more opportunities for our subjective well-being to be influenced.

There have been a number of barriers that have prevented positive psychology becoming established more widely. The term 'positive psychology' has itself been a source of controversy (Held, 2004; Lazarus, 2003) even for those within the field (Linley et al., 2006). There are strong cultural discourses regarding the meaning of 'positive' and 'negative'. How we understand each is influenced by our personal values. A further aim for positive psychology has been to qualify what is understood by the term 'positive'. To do this, the field has developed empirically grounded frameworks concerned with the many levels of positive human experience (Seligman, Steen, Park and Peterson, 2005). The Values in Action (VIA) Classification of Strengths includes 24 characteristics e.g. curiosity, vitality and

kindness alongside criteria for assessing each. The VIA has been validated on large samples (n=200,000), and has been found to have good reliability (α >.70) and test-retest correlations (*r* >.70) (Park and Peterson, 2005; Peterson and Seligman, 2004). As well as providing a complementary classification system to the Diagnostic and Statistical Manual (DSM), the VIA has been essential for promoting a shared language and structured approach across positive psychological research. Indeed, some have argued it is one of the greatest accomplishments to date within positive psychology (Linley et al., 2006).

The emphasis on *promoting* and *advancing* research is an important one, as positive psychology is not a 'new' perspective nor does it claim to be a 'solution' to the past preoccupations with pathology (Linley et al., 2006). Humanistic psychology (Rodgers, 1951) and theories of self-efficacy (Bandura, 1989) have each brought to our attention the need to understand well-being as more than just the absence of disorder. Positive psychology credits this work (McCullough and Snyder, 2000); despite some arguing that this has not been done sufficiently well (Tennen and Affleck, 2003). An additional aim has been to influence research so that our understanding of well-being can be integrated in a systematic way. In many ways this final aim parallels those set out within this thesis.

1.1.3 Clinical Applications of Positive Psychology

Clinical psychology has made significant progress in identifying proximal causes of mental illness and treating those already ill. However, the 'fix-what's-wrong' approach has fuelled a misguided assumption that the absence of disease or disorder necessarily equates to being healthy (Duckworth et al., 2005; Seligman, 2008). Cognitive behavioural therapy (CBT) for example, teaches individuals to notice and challenge *negative* automatic thoughts. While the effectiveness of CBT for the relief of numerous conditions cannot be questioned (National Institute of Clinical Excellence, 2007a,b; Roth and Fonagy, 2005), little *systematic* work has considered the role of positive states.

An added complication is an assumption that positive and negative states are dichotomous. Studies of bipolarity have revealed that positive and negative states show a functional separation (Bradburn 1969; Diener, Lucas and Oishi, 2002; Russell and Carroll 1999). To illustrate, individuals who show no symptoms of depression or anxiety can often have concomitantly low well-being indices (Ryff, Singer and Love, 2004). Furthermore, positive states appear to be important over and above the absence of negative states in

predicting psychological and physical health (Steptoe, O'Donnell, Marmot and Wardle, 2008). For example, genuine smiles in yearbooks have been linked to higher rates of marital satisfaction (Harker and Keltner, 2001), and higher positive emotional content in autobiographies has been associated with longer life expectancy (Danner, Snowdon and Friesen, 2001).

Subjective well-being has also been linked to a reduced risk of stroke, functional disability and mortality in older populations (Blazer and Hybels, 2004). Although underlying mechanisms are poorly understood, there are numerous models that could help to explain this. Negative psychological states are associated with health compromising behaviours such as smoking (Jarvis, 2002) and reduced physical activity (Biddle and Mutrie, 2001). Therefore subjective well-being could theoretically be associated with behaviours that are health promoting, such as good sleep. Evidence is emerging to support these relationships, which will be discussed later within section 1.4.

1.1.4 Subjective Well-being: A theoretical overview

In view of the potential benefits above, it has been important to define what is understood by the term 'well-being'. Models within positive psychology can be broadly defined in terms of two related but distinct states of eudaimonic and hedonic well-being. Eudaimonic well-being is concerned with processes of self-actualization, and the personal growth that enables individuals to find purpose and meaning within their lives (Seligman, 2002). This has also been termed psychological well-being (PWB). Hedonic well-being relates more closely to the content of this thesis, and what is commonly referred to as subjective well-being (SWB). Although PWB and SWB are correlated, they each form distinct aspects of well-being. This can be conceptualised in terms of 'pleasant' versus 'engaged' and 'meaningful', although each of these is not exclusive or exhaustive (Duckworth et al., 2005).

There are three defining features of SWB, that it is (i) a *subjective* experience, (ii) not merely the absence of negative, but a positive measure of positive emotions and pleasures relating to the past, present and/or future, and (iii) a global construct (Diener, 1984). Within this, emotions are best conceptualized as multifaceted responses, beginning with a personal appraisal of some event (Lazarus, 1991). With respect to this, emotions differ from moods in the sense that they are directed towards some object or event.

Although emotions also differ from traits, people can be predisposed towards experiencing particular emotions (Rosenberg, 1998). Therefore as well as SWB being understood as an *affective* state, it is also studied as an *effective* trait in terms of the strengths that can bias individuals towards any given emotion. These personality variables are far better predictors of SWB than demographic characteristics such as age, gender or material resources (Myres, 2000).

1.2 Gratitude

Gratitude appears to be strongly linked to SWB. Some have gone further in claiming that gratitude is fundamental to all human virtues, and may even have a causal influence in SWB (Emmons and McCullough, 2003; Wood, Maltby, Gillett, Linley and Joseph, 2008). This is discussed more comprehensively in section 1.2.2. In spite of this gratitude has received little attention within clinical research. While this could reflect the oversight of positive emotion more generally (Averill, 1980; Fredrickson, 1998), it may also underline some ambivalence around how gratitude should be conceptualized (Emmons, 2004; McCullough, Kilpatrick, Emmons, and Larson, 2001).

1.2.1. Meaning of Gratitude

"To be grateful" indicates that somebody is orientated towards the positive things in their environment, including material possessions and social relationships (Wood, Maltby, Stewart and Joseph, 2008; Wood, Joseph and Linley, 2007). Although conceptualizations shift depending on context and culture, the Classification of Strengths defines gratitude as being aware and thankful for the good things that happen (Park and Peterson, 2005). As such, gratitude is often described as a positive and affective reaction in response to a received benefit (McCullough et al, 2001). Gratitude tends to be 'others-directed' in the sense that it relies on the actions of other people and the interpretation of these. It can therefore be viewed as a complex attribution-dependent state, comprised of both affect and cognition (Emmons and McCullough, 2003). It therefore fits well with the more general models of emotion proposed by Lazarus (1991). However, gratitude is also influenced by moral, personal, social and spiritual factors. As a result, individual thresholds for gratitude can vary (McCullough et al., 2002), which is why gratitude is also defined as a

trait characteristic. Therefore for any individual, day-to-day experiences of gratitude can vary depending on intensity, frequency, span[1] and density[2] (McCullough et al., 2002).

1.2.2 Gratitude and Subjective well-being

As well as higher trait gratitude being associated with more frequent experiences of grateful affect (McCullough, Tsang and Emmons, 2004), grateful people have a more positive outlook on their environments (Wood, Maltby, Stewart, Linley and Joseph, 2008), show other positive traits e.g. agreeableness (McCullough, Emmons and Tsang, 2002, Wood, Joseph and Maltby, 2009) and use more positive coping strategies (Wood, Joseph and Linley, 2007). Higher trait gratitude has recently been associated with better sleep (section 1.4.3; Wood, Joseph, Lloyd and Atkins, 2009).

Gratitude is not without some negative connotations, however. Research suggests gratitude has the potential to increase the sense of needing to reciprocate acts of good and that pressures of obligation can lead to resentment and even hatred (Elster, 1999). In spite of this gratitude more often shows protective psychological correlates.

It has been confirmed across studies that gratitude forms a significant component within SWB, with happier people tending to be grateful people (Watkins, 2004). In one study hope, love and gratitude were the strongest predictors of life satisfaction compared to other strengths e.g. creativity (Park, Peterson and Seligman, 2004). The Satisfaction with Life Scale (SWLS) is one of the most frequently used measures of SWB (Diener, Emmons, Larsen and Griffin, 1985). Both measures of dispositional gratitude, including the Gratitude Questionnaire (GQ-6; McCullough, Emmons and Tsang, 2002) and the Gratitude, Resentment and Appreciation Test (GRAT; Watkins, Porter and Curtis, 1997) have reliable associations with it (GQ-6 r = .53; McCullough et al., 2002; GRAT r = .49, Watkins et al., 1997). As the SWLS was originally designed to measure cognitive judgements made in relation to life circumstance, comparable studies have also tested the relationship gratitude has with the affective components of SWB. McCullough et al. (2002) found the GQ-6 to have strong associations with the Subjective Happiness Scale (r = .50; Lyubomirsky and Lepper, 1999), while the GRAT has been positively correlated with the Fordyce Happiness Scale (r = .49; Fordyce, 1988, Watkins, Grimm and Hailu, 1999). Both show

[1] Span refers to the number of specific circumstances that one may feel grateful for
[2] Density refers to the number of people that any positive outcome is attributed to

strong and positive associations with positive affectivity measured by the Positive and Negative Affect Scale (PANAS; Watson, Clark and Tellegen, 1988).

Importantly, gratitude appears to predict SWB over and above the influence of other personality variables (Wood, Joseph and Maltby, 2009). One explanation for this is that gratitude can help to ensure the daily appreciation of events, thereby avoiding the "hedonistic treadmill" where individuals adapt rapidly to positive change but then return to baseline levels of happiness quickly (Lyubomirsky, Sheldon and Schkade, 2005).

1.2.3 Understanding the influence of Gratitude

Much of the research presented so far has been cross-sectional. Some of the strongest evidence regarding the influence of gratitude has come from intervention studies. As well as demonstrating that improving gratitude is beneficial for SWB, these have provided some evidence that gratitude may counteract and undo disorder itself (Duckworth et al., 2005).

1.2.3.1 Gratitude Interventions and Subjective well-being

In a series of three studies presented in the same paper, Emmons and McCullough (2003) found participants randomly assigned to a gratitude intervention condition reported higher positive affect and less negative affect compared to participants in both a hassles and events listing control condition (Emmons and McCullough, 2003). Those who completed the gratitude exercise at the end of each week reported feeling better about their lives, more optimistic and more connected at the end of a 10 week period (Emmons and McCullough, 2003). The gratitude exercise was based on the Three Good Things in Life exercise. Interestingly, in an attempt to explain carry-over effects, it was suggested that the gratitude exercise may have been self-reinforcing (Emmons and McCullough, 2003). A similar study using the Three Good Things in Life exercise over a shorter time-frame of 6wks provided further evidence that the exercise could improve happiness compared to a no-treatment control (Lyubomirsky, Sheldon and Schkade, 2005). However, these effects were only seen in the group who completed the exercise once, compared to a group who completed it three times each week (Lyubomirsky et al., 2005). Therefore in contrast to the previous study, findings indicated that 'less was more' and that the effects of the gratitude exercise may habituate (Lyubomirsky et al., 2005).

In a large randomly assigned trial completed online (n = 471), five positive interventions were compared to a placebo control exercise (Seligman, Steen, Park and Peterson, 2005). Two of these were based on participants identifying their own character strengths according to the VIA; one was writing a 'You at your best' narrative; the second a 'Gratitude visit' and a third the Three Good Things in Life gratitude exercise. A 'Gratitude visit' was found to have the greatest short-term effects, increasing happiness by 10% (Seligman et al. 2005). Importantly however, participants within an 'early-memory' control condition were also happier and less depressed immediately post-intervention. Although these participants returned to baseline levels 1-week later, the finding underlines the need for appropriately controlled experimental research. Longer-lasting effects on happiness were seen after 'Using Your Strengths' and the Three Good Things in Life exercise. Despite them only being completed at the end of each day across a 1-week period, effects were evident 6 months post-intervention (Seligman et al., 2005). Participants in both of these conditions also reported fewer symptoms of depression at 6 months. Although none of the sample had a clinical diagnosis of depression, this finding has substantial therapeutic implications as it suggests that building more positive emotion may counteract the effects of pathology (Seligman et al., 2005).

1.2.3.2 Mediators of the effects of gratitude on Health

An important consideration is how interventions such as the Three Good Things in Life exercise are effective. Research into gratitude is in its infancy, and therefore broader models of positive emotion need to be considered.

Attempts have been made to model positive emotion on similar theoretical frameworks to negative emotions (Lazarus, 1991). However, much of this has been focussed on linking positive emotion with specific action tendencies such as the fight-flight response seen as a result of fear. By definition, models of negative emotion tend to emphasize a narrowing of attention so that quick and decisive action can be taken in life-threatening or fearful situations (Fredrickson, 2004).

In contrast to this, more recent conceptualizations of positive emotions, such as gratitude, have considered 'broaden-and-build' models (Fredrickson, 1998, 2001). Rather than a narrowing of action tendencies, emphasis is placed on positive emotion broadening thought-action processes, and building personal resources (Fredrickson, 2004). Following

the September 11th terrorist attacks, higher levels of gratitude and other markers of resilience were found to buffer depressive reactions (Fredrickson, Tugade, Waugh and Larkin, 2003). This was a powerful study in that it provided evidence that gratitude could occur in the face of adversity.

Given that people with increased gratitude are more likely to notice help, and reciprocate this at a later date (Wood et al., 2007), it could theoretically be predicted that gratitude interventions exert their effects indirectly. The Three Good Things in Life gratitude exercise relies on translating experiences into written language. This process in itself is thought to be therapeutic, although no single theory has effectively explained how or why (Pennebaker, 1997; Slatcher and Pennebaker, 2006). It has been suggested that cognitions play an important role within positive interventions (Wood, Joseph, Lloyd and Atkins, 2009), which would partly support the expressive writing paradigm. Depression, as an example, is often characterized by rigid patterns of thinking. According to the broaden-and-build theory, increased positive emotions could be therapeutic in broadening cycles of ruminative thinking. Positive psychological theory explains this in terms of the 'undoing effect'; where positive emotions counter and dissipate the effect of negative emotions, at both a psychological and physiological level (Tugade and Fredrickson, 2004). This would explain why resilient individuals tend to show more positive emotions (Tugade and Fredrickson, 2004), and why positive emotions can buffer the impact of negative events (Folkman and Moskowitz, 2000; Tugade and Fredrickson, 2004).

1.2.4 Summary

The review has so far presented a broad overview of the key components within positive psychology. It has outlined how constructs such as SWB and gratitude are clinically relevant to health. The review has provided an overview of the theory used to define SWB and gratitude and a detailed description of the standardized measures used to measure each. Intervention work within positive psychology offers some evidence that improving gratitude may not only be beneficial for SWB in general but also for physical and psychological health. There has, however, been little research to consider whether or not those who display more gratitude have better psychological profiles with respect to important processes such as sleep. The review will now consider sleep, and why this is such a relevant area for positive psychological research.

1.3 Sleep: The clinical picture

Sleep disruption is one of the most frequently reported health complaints within clinical practice, and is known to be associated with a higher incidence of psychological difficulties. Sleep disruption, as a result of the negative impact on quality of life, has inevitably become an important issue within public health. The aim of the following section is to provide a justification for why sleep merits specific attention within the context of clinical research. It will then present an overview of how sleep problems are classified, and prevalence rates with respect to these definitions.

1.3.1 Nature of Sleep

Despite spending approximately one third of our life sleeping (Sejnowski and Destexhe, 2000), the exact function of sleep remains unclear. This is perhaps because the processes underlying sleep are so complex. The sleep-wake cycle follows a circadian periodicity, which is governed by internal 'clocks' as well as external time-markers (Morin, 1993). As a result, sleep is vulnerable to the influence of numerous physiological and psychological processes, as well as to direct and/or indirect environmental demands. Sleep also has a reciprocal influence on these processes including metabolic adjustment and regulation, protection from infection and recovery from stress (Sejnowski and Destexhe 2000; Bonnet and Arand, 1996). Different stages of sleep are known to serve distinct functions. For example, Non-REM sleep contributes to physical restoration, while REM sleep is more crucial for cognitive processes such as memory (Hobson and Pace-Schott, 2002).

In view of the complex influences above, it is easy to understand how each of us could experience interrupted sleep at some point across our lifetime. While the effects of this can pass unnoticed, they also have the potential to interfere with important social, behavioural, learning and developmental processes (Smedjie, Broman and Hetta, 2001). Chronic sleeplessness has been documented as resulting in death within Fatal Familial Insomnia. This condition has only been found in 50 families worldwide, and is inherited via a defective gene for the prion protein (Medori, Tritschler, LeBlanc, Villare, Manetto, Chen, Xue, Leal, Montagna, Cortelli, et al., 1992). Although this example is extreme, it typifies the trend within research to understand sleep from a pathological perspective. The review will consider some of this literature before outlining a need to move beyond pathology.

1.3.2 Impact of Sleep Disruption on Well-being

During acute sleep deprivation, sleep-awake cycles can become impaired, commonly resulting in daytime sleepiness. Although chronic sleep loss is rare, a cumulative loss over time can lead to a 'sleep-debt' that significantly interferes with quality of life (Leger, Scheuermaier, Philip, Paillard, and Guilleminault, 2001). Consequences include a higher incidence of psychological difficulties, such as depressive and/or anxious moods, excessive worrying/ruminations, internalization of conflict and preoccupation with health (Fredricksen, Rhodes, Reddy and Way, 2004; Oginska and Pokorski, 2006).

Evidence suggests a U-shaped association between sleep and mortality, with optimal sleep duration around 7hrs (Hammond, 1964; Kripke, Garfinkel, Wingard, Klauber, and Marler, 2002; Patel, Ayas, Malhotra, White, Schernhammer, Speizer, Stampfer, and Hu, 2004; Tamakoshi, and Ohno, 2004; Youngstedt and Kripke, 2004). Since this was first reported over 40yrs ago, an additional 20 epidemiological studies have provided evidence to support this link (Youngstedt and Kripke, 2004). In a recent study where participants were categorised as having either short (<7) or long (>10) sleep, there was a significantly increased risk of mortality for both groups (Hublin, Partinen, Koskenvuo and Kaprio, 2007). This contradicts a common assumption that longer sleep is necessarily beneficial.

1.3.3 Classification of Sleep-Difficulties

The representation of sleep disorders within the Diagnostic and Statistical Manual 4th edition (DSM-IV-TR; American Psychiatric Association (APA), 2000) acknowledges the significant impact sleep disruption can have on quality of life. For a sleep disorder to be diagnosed, the DSM-IV-TR requires pathological sleep to cause clinically significant distress or impairment in social, occupational, or other important areas of functioning (APA, 2000). For insomnia, this includes difficulties falling or remaining asleep, early morning awakenings, or reports of non-restorative sleep. Clinical significance is based on reports of severity, frequency, duration and daytime consequences. A diagnosis of insomnia requires difficulties to occur during 3 or more nights per week over at least a 6 month period. Sleep-onset latency and wake after sleep should be greater than 30min and sleep-efficiency (defined below) is required to fall below 85% (Morin, 1993).

$$\text{Sleep efficiency} = \frac{\text{Time asleep}}{\text{Time in bed}}$$

Classifications serve to provide a common language across research and clinical practice. However, the reality is that individuals tend to be aligned to prototypical-categories best representing their clinical symptoms. Medical investigations into sleep are so costly that diagnosis is frequently based on subjective reports rather than actual symptoms. A problem here is that the criterion for clinical significance tends not to correlate well with symptomology (Spitzer and Wakefield, 1999). Also, sub-threshold symptoms tend to be given little attention, and atypical symptoms ignored (Maser and Patterson, 2002). Diagnosis is confounded further as a result of sleep disruption being frequently associated with concomitant conditions. This means that Insomnia is often treated as a symptom of other underlying factors (Billard and Bentley, 2004). Primary-secondary distinctions are one way that the DSM attempts to cope with this. These differentiate between primary insomnia, insomnia that is secondary to a mental health problem, and insomnia stemming from a general medical condition (APA, 2000). The relevance of this and the issues raised above will now be considered so that the prevalence of sleep disruption within the general population can be fully understood.

1.3.3.1 Epidemiology of Sleep-Difficulties

Epidemiological research has been useful for evaluating the prevalence and typical course of sleep disorders within the general population. As well as guiding health provision, the data can also have important nosological implications (Neale and Kendler, 1995).

Prevalence rates of insomnia vary depending on the definitions used, and one complexity within sleep research is the lack of consistency with regards to this. Despite attempts to provide standardized classifications for insomnia, resource and time implications means that these are rarely used. Where they have been employed successfully, rates of Primary Insomnia are between 2% and 4% and Secondary Insomnia between 1% and 3% within the general population (Ohayon, 1997). Of specific relevance to this research are those studies in which individuals are asked to make a subjective self-assessment of their sleep. Here it is common for around 30% of adults to describe at least one symptom of insomnia, such as difficulties initiating or maintaining sleep, or non-restorative sleep (Morin, LeBlanc, Daley, Gregoire and Merette, 2006; Ohayon, 2002). However, when studies include

daytime consequences as a defining feature, rates tend to drop to around 10% (Hoffmann, 1999; Hetta, Broman and Mallon, 1999).

Epidemiological research has also been central for identifying sociodemographic trends in prevalence rates. For example, rates will often increase with age and are higher amongst females and the unemployed (Morin et al., 2006). As was briefly mentioned above, people with insomnia frequently report more medical problems and tend to use more medication compared to good sleepers (Foley, Ancoli-Israel, Britz and Walsh, 2004; Yaggi, Araujo and McKinlay, 2006). Insomnia is also consistently associated with increased levels of psychological difficulties, including anxiety and depression (Fredricksen et al., 2004; Oginska and Pokorski, 2006; Taylor, Lichstein, Durrence, Riedel and Bush, 2005). One difficulty however, has been establishing the causal influence and temporality of these associations.

1.3.4 Course of Sleep Difficulties

Understanding the aetiology of insomnia is essential for understanding what may help to alleviate it. Insomnia develops through various stages and each of these in turn is influenced by predisposing, precipitating and perpetuating factors. Alongside the sociodemographic risk factors introduced above, people may also be predisposed to insomnia as a result of certain personality characteristics (Johnson, Roth, Schultz and Breslau, 2006). Insomniacs display heightened emotional reactivity, and show greater levels of anxiety, worry and neuroticism (Basta, Chrousos, Vela-Bueno and Vgontzas, 2007). These emotional correlates show patterns of association across adolescence and adulthood (Price, Coates, Thoresen and Grinstead, 1978).

There are various models that consider the course of sleep difficulties, many of which are complementary. However, given that the hyper-arousal of any system is incompatible with sleep, most models tend to focus on emotional, cognitive or physiological hyper-arousal as at least maintaining factors (Morin, 1993). In particular, cognitive models are receiving an increasing amount of support (Espie, 2007). Cognitive disturbance is ten times more likely than somatic disturbance to be identified as a leading cause of sleep disruption (Harvey, 2002). The initial appraisal of a sleep-disturbance is known to have huge prognostic implications and can determine the course of future difficulties (Edinger and Means, 2005).

With respect to these two findings, insomnia can become a self-fulfilling prophecy; with the consequences of sleeplessness becoming the causes.

1.3.4.1 Cognitive Arousal and Content

Research specifically looking at the role of cognitive arousal within insomnia provides further support for cognitive models. In an early study, participants who were told that they were required to perform a speech the next day took significantly longer to fall asleep (Gross and Borkovec, 1982). Intrusive cognitions relating to stressors have also been found to delay sleep onset, and disrupt sleep in the latter part of the night (Hall, Buysse, Reynolds, Kupfer and Baum, 1996). Interestingly, there is evidence to suggest that the mediated effects are not simply a result of cognitive hyper-arousal. The content of cognitions is also important. For example, one study found that although a mathematical task delayed sleep onset in healthy subjects, when presented to insomniacs the same task actually improved sleep onset latency. It was suggested that the experimental manipulation may have created a distraction from usually sleep-laden cognitions (Espie, 2007; Haynes, Adams and Franzen, 1981).

Evidence from various sources suggests that the content of cognitions is indeed a crucial mediating factor within insomnia (Espie, 2007). People with insomnia tend to show a greater degree of negative thought content in the pre-sleep period. In fact, a consistent finding across research is that one of the best predictors of delayed sleep is excessive rumination about sleep itself (Fichten, Libman, Creti, Amsel, Tagalakis and Brender, 1998; Wicklow and Espie, 2000). In one study, open-ended thought listings were used in a sample of 160 older adults to evaluate thought content. Good sleepers and those who reported minimal distress despite having insomnia had a greater frequency of positive compared to negative pre-sleep cognitions. The opposite was true for those who were highly distressed poor sleepers (Fitchen et al., 1998). With respect to these findings, a useful index is the states-of-mind (SOM) ratio, which offers a ratio of positive and negative thinking (Schwartz and Garamoni 1986, 1989). Those with higher SOM ratios are considered as having more adaptive pre-sleep cognitions (higher positive and lower negative content) (Fitchen et al., 1998).

1.3.4.2 Treatment of sleep difficulties

One of the greatest sources of support for cognitive models of insomnia comes from outcome studies. Although relaxation-based interventions aimed at lowering physiological arousal show many clinical benefits, the association between process and outcome is not as strong as those seen with cognitive-based interventions (Edinger and Means, 2005). Specifically, there is a vast literature supporting the efficacy of interventions that target cognitions for improving sleep (Espie, 2007; Sadeh, 2005). There is growing evidence that Cognitive Behavioural Therapy (CBT) can even be more effective than medication (Jacobs, Pace-Schott, Stickgold, and Otto, 2004). Recent meta-analyses have reported large effect sizes for reducing sleep onset latency and improving sleep quality (Edinger and Means, 2005). However, CBT is considered expensive despite the many therapeutic benefits maintained beyond therapy compared to medication (Morin, Hauri, Espie, Spielman, Buysse and Bootzin, 1999). As non-pharmacological interventions are increasingly preferred (Morin, Hauri, Espie, Spielman, Buysse, and Bootzin, 1999) and available guidelines recommend them as the first-line of treatment for sleep difficulties (Kotagal and Pianosi, 2006) self-help resources are increasingly relied upon. Recent findings suggest that the Internet may provide a valuable medium for such interventions (Strom, Pettersson and Andersson, 2004)

1.3.5 Summary

This section has discussed how the drive to understand the causes and risks factors underlying sleep disruption has resulted in the development of particular preventative and management strategies. Research, however, has so far been dominated by theoretical models seeking to uncover what is 'wrong' with individuals. For example, the insights above have generally come from research looking at unusual sleep patterns, as opposed to average or typical sleep. As the links between sleep and psychological distress is well-established across research, there is a need for more work to consider the positive antecedents of sleep. The work that has been done in this area will now be considered in the final section of the review.

1.4 Positive Psychology and Sleep

In line with the broad aims of positive psychology, this section will have an important role in integrating what has been discussed so far so that it can provide a positive psychological perspective on sleep.

1.4.1 Review of the literature

A systematic search of journal databases was conducted to find any research pertaining to positive psychology and sleep[3]. The few publications that were relevant highlighted a lack of research in the area (Linley, Hendrickx and Osborne, 2009). For example, although females have a greater predisposition to develop sleep difficulties (Johnson et al., 2006), it is also the case that males tend to show a more flexible circadian system (Natale and Danesi, 2002). Such protective influences are rarely at the forefront of sleep behaviour research.

1.4.2 Positive emotion, sleep and pathology

The review has detailed how positive content within pre-sleep cognitions can be conducive for sleep (section 1.3.4.1). The condition of narcolepsy has also provided an important opportunity to consider emotional processes involved in sleep. Amongst people who have this condition, emotion can be a powerful trigger of cataplexy[4]; particularly emotions such as elation and joy (Lammers, Overeem, Tijssen and van Dijk, 2000). Animal studies have linked cataplexy and sudden neurological activity within reward systems that regulate positive emotion, such as the limbic system (Mignot, 2000).

Negative emotion appears to be increased during night-time sleep and at wake-sleep transitions for those with narcolepsy (Fosse, Stickgold and Hobson, 2002). In one study looking at these processes, 15 participants with narcolepsy were asked to describe their emotional experiences during sleep-onset rapid eye movement sleep (SOREM) and compare these to night-time REM. Those with narcolepsy showed more frequent and intense emotionality during SOREM, compared to 9 healthy controls. Importantly, higher

[3] PsycInfo (1806-June 2010) and Medline (1996-June 2010) were searched for articles published in the English language. They revealed 33 articles, of which 10 were relevant. The search terms were: positive, positive psychology, well-being, wellness, gratitude, grateful, thankful, appreciative, sleep and insomnia.

[4] Cataplexy is a sudden episode where there is a loss of muscle tone.

levels of positive emotions during this period were associated with more stable REM sleep subsequently (Fosse, Stickgold and Hobson, 2002).

Inverse associations have also been found between positive affect and other physiologically explained sleep disturbances (Moore, Bardwell, Ancoli-Israel and Dimsdale, 2001; Fosse, Stickgold and Hobson, 2002). In one study looking at health related quality of life (HRQoL) and obstructive sleep apnea (OSA), total sleep time was positively correlated with well-being and positive affect on the medical outcome scale (Moore, Bardwell, Ancoli-Israel and Dimsdale, 2001). Although there was a significant relationship between the number of arousals and health distress ($r = -.481$, $p < .005$), many of the predicted relationships of increased arousal with poor physical and psychological health were unsubstantiated (Moore et al., 2001).

1.4.2.1 Positive emotion and sleep within the general population

The findings above have been restricted to a samples defined as having sleep difficulties that are intertwined with medical conditions. More relevant within the context of this thesis are those sleep disturbances linked to non-physiological factors that are independent of psychological distress. In one study, sleep showed significant associations with a number of measures relating to eudaimonic well-being. Women with higher environmental mastery were found to have longer sleep duration ($r = .22$, $p < .05$), longer REM sleep ($r = .19$, $p < .05$) and faster onset of REM-sleep ($r = -.28$, $p < .05$) compared to those without (Ryff et al., 2004). Among the oldest women within the sample (>75), those who scored higher on positive relations had longer REM-sleep ($r = .32$, $p < .05$) and showed reduced body movement during sleep ($r = -.35$, $p < .05$) (Ryff et al., 2004). A strength of this design was the use of eye sensors to provide objective measures of sleep. However, as the study only included women over the age of 65, the sample was limited. Also, some of the findings relating well-being to sleep may not have been indicative of a positive relationship. For example, those women with higher levels of environmental mastery tended to spend a longer time in bed (Ryff et el., 2004).

More recently, sleep has been considered in relation to positive affect as well as eudaimonic well-being (Steptoe, O'Donnell, Marmot and Wardle, 2008). Findings supported those from Ryff et al. (2004) in that eudaimonic well-being was related to good sleep ($\beta = -.36$, $p < .001$) as measured by the Jenkins Sleep Problems Scale (Jenkins,

Stanton, Niemcryk and Rose, 1988). Positive affect was measured using ecological momentary assessment methods at 2.5, 8 and 12hrs post-waking and again at bedtime. This was preferable to the previous design used by Ryff et al. (2004), as it limited the impact of mood and retrospective bias that can influence reporting on one-off measures (Kahneman and Krueger, 2006). Although positive affect was associated with good sleep ($\beta = -.17$, $p < .001$), this relationship was less strong compared to eudaimonic well-being. Ratings of positive affect may not have been robust as they were only taken across one day and limited to 3 affect terms (happy, excited and content) (Steptoe et al., 2008). An important finding from this study was that positive affect was related to sleep over and above other psychological factors that had the potential to influence both, such as depression. The associations were also independent of self-rated health, age and gender, each of which have been linked to sleep difficulties within previous research (Foley, Ancoli-Israel, Britz and Walsh, 2004; Moore, Adler, Williams and Jackson, 2002; Strine and Chapman, 2005). Moreover, when eudaimonic and positive affect were included in the regression model, the strengths of the effects between chronic life stress, poor relationships, psychological distress and sleep were all between 20.8% and 73.5%. This suggested that positive psychological states modify the relationship between psychosocial risks and poor sleep, so that the individual was protected from the impact of stress and adversity (Steptoe et al., 2008). This would make theoretic sense according to broaden-and-build model of positive emotion that was introduced earlier (section 1.2.3.2; Fredrickson, 2004). However, other research has failed to find any significant associations between positive affect and sleep in those without sleep apnea (Bardwell, Berry, Ancoli-Israel and Dimsdale, 1999) or the general population (Jean-Louis, Kripke and Ancoli-Israel, 2000). Although the restorative functions of sleep may have had a reciprocal influence on measures of well-being (Ryff et al., 2004; Sejnowski and Destexhe, 2000), these are novel findings.

1.4.3 Gratitude in relation to sleep theory

Wood et al. (2009) performed the first study to consider gratitude in relation to sleep quality, which has only been conducted recently. Gratitude was measured using the GQ-6 (McCullough et al., 2002), and sleep behaviour, using the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman and Kupfer, 1989). The Self-Statement Test was

also used to assess the frequency of positive and negative pre-sleep cognitions (SST:60; Fichten et al., 1998). Higher scores on the GQ-6 were inversely associated with lower sleep quality. This included total scores on the PSQI (r = -.29), as well as the seven components of subjective sleep quality (r = -.25), sleep onset latency (r = -.20), sleep duration (r = -.14), habitual sleep efficiency (r = -.11) and daytime dysfunction (r = -.27) as measured by the PSQI (Wood et al., 2009). After total PSQI scores, the strongest association was between GQ-6 scores and subjective sleep quality. The GQ-6 was also related to more adaptive pre-sleep cognitions, as defined by a higher frequency of positive pre-sleep cognitions (r = .21) and a lower frequency of negative pre-sleep cognitions (r = -.11) (Wood et al., 2009). A mediational analysis was used to demonstrate that gratitude predicted better sleep over and above the effects of other personality factors, and that this was mediated by pre-sleep cognitions (Wood et al., 2009). Despite this research highlighting the important role of gratitude and positive pre-sleep cognitions in relation to sleep, the cross-sectional design did not allow any causal influences to be made.

1.4.3.1 Intervention Research

Two previous studies described in the same paper used an experimental design to test the effects of a gratitude intervention on general health behaviours (Emmons and McCullough, 2003). Two items related directly to sleep, (i) number of hours slept, and (ii) sleep quality, which was based on the ease of getting to sleep and how refreshed participants were upon awakening. In one of the studies, participants who completed daily gratitude forms over 13 days did not show any differences in the amount and quality of sleep obtained compared to participants who completed a daily hassles form. A second study, however, included participants with congenital adult-onset neuromuscular disorders, and found that writing about daily gratitude over 21 days did improve self-reported satisfaction with sleep compared to a waiting list only control condition (Emmons and McCullough, 2003). These positive effects were mediated by experiences of gratitude, rather than a general increase in positive affect. Moreover, the daily gratitude exercise appeared responsible for more potent effects as the standard mean difference was larger (d = .88) compared to the previous study where the exercise was completed weekly (d = .56) (Emmons and McCullough, 2003).

1.5 Conclusion

This review has considered the emerging field of positive psychology and how SWB can be measured and influenced by positive psychological interventions. It has offered justifications based on prevalence and impact for why symptoms of sleep disruption merit specific attention within research. Sleep disruption is one of the most frequently reported health complaints and is likely to affect everyone at some point in their life. Clinically, this is important as sleep disruption can impact on both psychological and physical health. While evidence has highlighted the benefits of self-help interventions that specifically target sleep *problems*, there is a clinical need for approaches to support the NHS to expand beyond the relief of symptoms alone. With respect to this, positive psychology has made good progress in understanding the role of positive experiences and strengths that can buffer against disorder and ill health at a psychological and physiological level (Tugade and Fredrickson, 2004). A common argument is that positive states are simply polar opposites. However, research indicates that positive emotions represent more than this. Individuals can have no symptoms of psychopathology but still score low on well-being measures (Ryff, Singer and Love, 2004). Moreover, positive emotions can be protective; counteracting the effects of negative emotions at a psychological and physiological level (Tugade and Fredrickson, 2004).

Sleep is thought to be one process through which positive emotions can mediate their effects on SWB. While positive states *appear* to be important over and above the absence of negative psychological states in predicting good sleep (Steptoe et al., 2008), few studies have actually considered positive states separate from physical illness or psychopathology.

Two studies only have explored the specific construct of gratitude (Emmons and McCullough, 2003; Wood et al., 2009). Wood et al. (2009) suggested that our pre-sleep cognitions are central for understanding the relationship between gratitude and sleep (Wood et al., 2009). This would support cognitive models of sleep disruption that implicate cognitive activity and content as maintaining factors (Espie, 2007). However, a key weakness of this work was an assumption that the mediational chain was correctly arranged (Wood et al., 2009). In particular, the cross-sectional design limited what could be said about the direction of the relationship between gratitude and sleep.

Emmons and McCullough (2003) provided tentative evidence that improving gratitude may actually be beneficial for sleep. However, the parameters that were used to reflect sleep behaviour were restricted. In addition, this research did not consider the influence of personality differences on the effects of the gratitude intervention. Given the lack of research in the area, additional work is needed to strengthen findings (Linley et al., 2009).

CHAPTER TWO

Aims

The main aim of this thesis was to examine the potential for a positive psychological intervention, namely gratitude to improve the sleep of individuals with low sleep quality (SQ). These individuals were selected from a cross-sectional study that examined the relationships between various sleep parameters and subjective well-being. This thesis describes both a cross-sectional and a prospective intervention study.

2.1 Cross-sectional study

There is only a small amount of literature that has considered the relationship between positive states and sleep (Linley et al., 2009), and only one study that has explored the specific construct of gratitude (Wood et al., 2009). According to this study, people with higher trait gratitude tend to show more superior sleep quality and pre-sleep cognitions appear to be a key explanatory variable in this relationship (Wood et al., 2009).

The cross-sectional study aimed to extend the findings of Wood et al. (2009) described in section 1.3.3, whose findings were based on a one-off global assessment of sleep (PSQI). The research presented in this thesis supplements a one-off global measure with sleep diary data over a period of upto 7 days (Polk, Cohen, Doyle, Skoner and Kirschbaum, 2005).

The cross-sectional study asks the following research question:

- In what ways do participants with high versus low SQ differ with regards to their subjective well-being, trait gratitude and pre-sleep cognitions?

2.1.1 Cross-sectional Study aims

i) To determine whether participants with high versus low SQ can be differentiated with respect to measures of subjective well-being, trait gratitude and pre-sleep cognitions.

ii) To determine whether associations or differences between high versus low SQ participants on the Sleep Impairment Index can also be identified using 7day sleep diaries.

iii) To identify participants with low SQ who meet the inclusion criteria for the intervention study (section 5.1.3).

2.1.2 Cross-sectional Study Hypotheses

- It was hypothesised that higher sleep quality would be associated with higher levels of subjective well-being and trait gratitude, and more adaptive pre-sleep cognitions.
- It was hypothesised that when participants were stratified on the basis of their sleep quality, the high SQ group would score significantly higher on subjective well-being and trait gratitude, and report more adaptive pre-sleep cognitions compared to the low SQ group.

The cross-sectional study assessed SQ, subjective well-being, trait gratitude and pre-sleep cognitions using a questionnaire administered to an opportunity sample of the general population via the internet. The method and findings of this study are described in Chapter 3 and Chapter 4.

2.2 Intervention study

The intervention study aimed to examine whether the Three Good Things in Life gratitude exercise could improve sleep in a sample characterized as having low SQ. This study builds upon the work of Emmons and McCullough (2003), which provided tentative evidence that using this daily exercise could be beneficial for sleep albeit with restricted indices of sleep parameters (total sleep time and sleep quality) in participants with substantial medical conditions (see section 1.4.3.1, Emmons and McCullough, 2003). Furthermore, the intervention study considers the role of pre-sleep cognitions. Specifically whether the gratitude exercise can promote more adaptive pre-sleep cognitions, which would help to explain any relationship between gratitude and sleep (Wood et al., 2009).

The intervention study asks the following research question:

- Can a gratitude exercise improve global sleep quality and daily sleep parameters in participants who report low sleep quality?

2.2.1 Intervention Study aims

i) To conduct an intervention study in which the Three Good Things in Life gratitude exercise is compared to an events listing control condition.

i) To determine whether there is any improvement in sleep quality between baseline and follow-up 2wks later following the Three Good Things in Life gratitude exercise, compared to an events listing control condition.

ii) To determine whether there is any improvement in pre-sleep cognitions between baseline and follow-up 2 weeks later following the Three Good Things in Life gratitude exercise, compared to an events listing control condition.

iii) To use hierarchical linear modelling on global measures and daily measures of affect and sleep to explore the influence of mediating variables on the gratitude-sleep relationship.

2.2.2 Intervention Study Hypotheses

- It was hypothesised that the gratitude intervention would improve sleep quality reflected by PSQI scores for participants with low sleep quality, relative to a control condition.
- It was hypothesised that the gratitude intervention would lead to more adaptive pre-sleep cognitions measured by the SST:60 for participants with low sleep quality, relative to a control condition.
- It was hypothesised that HLM would identify intervention as predicting variance in daily measures of affect and sleep, and that daily gratitude would be a moderating variable between level 2 and level 1 variables.

The intervention study used an experimental design that compared the Three Good Things in Life with an events listing control condition in participants with low SQ. The method and findings of this study are described in Chapter 5 and Chapter 6.

CHAPTER THREE

Methodology for the cross-sectional study

The following chapter will outline the various stages involved in the cross-sectional study presented in this thesis. The procedural stages will be described in detail including ethical clearance, how participants were recruited and what they were asked to do. Specific attention will be paid to the measures that were used, and how analyses were planned in order to address research questions.

3.1 Design

The cross-sectional study conforms to both a between-subjects and within-subjects design. The aim was to compare participants with high and low SQ on measures of subjective well-being and pre-sleep cognitions (between subjects comparison), and to corroborate the classification of high and low SQ using repeated 7day diaries (within-subjects profiling) with high and low SQ being compared on their average prospectively assessed sleep parameters. Hence, the between-subjects factors were SQ and the dependent variables were subjective well-being, trait gratitude, pre-sleep cognitions and sleep parameters measured repeatedly using daily sleep diaries.

3.1.1 Recruitment

The cross-sectional study was widely advertised with posters but the predominant recruitment strategy employed was email distribution. These were distributed opportunistically, as well as across two recruitment databases at the University of Leeds. The first database included university-wide staff and students who had registered an interest in participating in research. The second database was a Participant Pool scheme within the Institute of Psychology. Recruitment was enhanced with a snowball technique, whereby the website itself encouraged people to pass on the research details to friends and family.

3.1.2 Cross-sectional Study Participants

Participants who completed the cross-sectional questionnaire were required to be at least 18yrs of age, with regular daily access to the internet. The 300 participants were 70 males and 230 females recruited from the general population, with ages ranging from 18 to 67 years. This opportunistic community sample was considered to be representative for the objectives of the cross-sectional study in offering individuals with a wide range of well-being and SQ. It was also an attempt to lessen some of the biases introduced by clinical samples that often self-refer themselves to sleep clinics.

Of the 300 participants, 209 went on to complete the 7day sleep diaries and adhered to the compliance criteria (section 3.4.1) (please see Figure 1, section 3.3.2 for more details).

3.2 Measures

This section will outline the measures that made up the cross-sectional questionnaire. Where required, permission was obtained from the authors of specific measures.

3.2.1 Demographics

The questions that were used to gather demographic information were based on those routinely used by the Human Appetite Research Unit at the University of Leeds. Participants were asked their age, gender, occupational and health status. It was important to identify any sub-groups who may have had impaired sleep as a result of their work, and so participants were specifically asked for details of shift work or unsociable working hours. A general health Likert scale, where 1 was 'not at all healthy' and 6 was 'extremely healthy', was administered. Participants were also asked to detail any psychological and/or physical health complaints, as well as details of any current medication use. These were central for applying inclusion and exclusion criteria for part two (section 5.1.3).

3.2.2 Subjective Well-being

Subjective well-being was assessed using the 5-item Satisfaction with Life Scale (SWLS, Appendix 1), one of the most commonly used measures of SWB (Diener et al., 1985). It primarily taps into the cognitive component of SWB requiring individuals to provide a satisfaction judgement for how contented one is with one's life as a whole. This includes

any discrepancies between wants and needs, as well as accomplishments (Diener et al., 1985). The measure indicates potential areas of strength and resource (Lubin and Whitlock, 2004). The SWLS has been found to correlate well with other satisfaction scales (around r = .80) for the domains of expert ratings, experience sampling measures, memory for positive versus negative events, reports of friends and family, and amount of smiling (Sandvik, Diener and Seidlitz, 1993).

The 6-item Gratitude Questionnaire was used as a measure of trait gratitude (GQ-6; Appendix 1, McCullough et al., 2002). Compared to other measures, the GQ-6 has an emphasis on the emotional component of gratitude, as opposed to moral reciprocity that is often taken into consideration (McCullough et al., 2002). It considers intensity, frequency, span and density towards experiences of gratitude. Evidence suggests that the scale is positively correlated with optimism, life satisfaction, forgiveness and prosocial behaviour, and negatively correlated with depression, anxiety, materialism and envy. The GQ-6 has been shown to have good internal reliability ($\alpha = .82 – \alpha = .87$), showing convergent validity with peer reports (McCullough et al., 2002) and high test-retest reliability (Wood et al., 2008).

3.2.3 Global Sleep Assessment

The Sleep Impairment Index (SII; Appendix 2, Morin, 1993) was used as standardised measure of global sleep disruption. It provides information regarding subjective perceptions of sleep, which is an important consideration according to cognitive models of sleep (Bastien, Vallieres and Morin, 2001). The SII is widely used, and has been designed to assess a range of symptoms associated with Insomnia in terms of (i) severity, (ii) distress and (iii) impairment. Scores are based on 7-items that measure the severity of sleep-onset and sleep-maintenance difficulties, early-morning awakening, sleep-satisfaction, interference of functioning and degree of concern attributed to the problem. Each item is scored on a 5-point scale (1-5) giving a total score range of 5-35. Out of a total score of 35, scores of 0-14 are considered “good sleepers”, $\geq$15 as Insomnia and >20 as severe Insomnia (Smith and Trinder, 2001). Research has shown that the cut-off score of $\geq$15 can effectively discriminate between good versus poor sleepers, and that the SII has has good

sensitivity[5] (94%) and specificity[6] (94%) for detecting Insomnia (Smith and Trinder, 2001). It takes less than 5min to complete.

For a thorough evaluation of sleep behaviour a combination of several strategies is recommended (Morin, 1993). For this reason, electronic sleep-diaries were used over 7days to supplement the one-off assessment of sleep quality described above (Appendix 3). As the SII has been shown to have adequate concurrent validity when compared to sleep diary data (r=0.65; Morin, 1993), consistency between these measures was anticipated to be one way of monitoring accuracy.

3.2.4 Pre-sleep Cognitions

The Self Statement Test:60 (SST:60; Appendix 3, Fichten et al., 1998) was used to measure experiences of positive versus negative pre-sleep cognitions during periods of wakefulness prior to sleep-onset. The scale contained three factors relating to generalized positive (17 items) and negative cognitions (17 items), as well as cognitions relating to sleep within each of these factors. Participants were asked to rate each item on a 5-point scale (0-4) where 0 was indicative of 'hardly ever' and 4, 'very often'. From a potential score range of 0-68 for both factors, a states-of-mind (SST:60 SOM) ratio was generated to reflect the balance between positive and negative pre-sleep cognitions (positive/(positive+negative); Schwartz and Garamoni, 1986, 1989). Higher SST:60 SOM ratios are indicative of more adaptive pre-sleep cognitions.

The SST:60 is considered to have good content validity as statements were originally generated through open-ended thought listings (Fitchen et al., 1998). Although it was developed using a large, older adult sample (N = 160), it is felt to be broadly representative and has been used on other populations (Wood et al., 2009). Internal consistency is good for both positive (α = .90) and negative (α = .89) subscales, and test-retest correlation coefficients have been found to be significantly correlated following 1 month. The subscales also appear to have good criterion-related, convergent and discriminant validity, showing significant differences between contrasted groups (Fichten et al., 1998).

[5] Sensitivity refers to how reliably the SII can detect insomnia in a group of people with insomnia
[6] Specificity refers to how reliably the SII can reject insomnia with a control group

3.2.5 Personality

Certain personality characteristics are known to be associated with sleep disruption, particularly neuroticism (Basta et al., 2007). Recent findings suggest that gratitude may explain a unique amount of variance in sleep beyond the effects of the Big Five (Wood, Joseph and Maltby, 2009). With this in mind, it was considered important to control for variation in personality so as to understand whether gratitude has a unique association with sleep beyond the effects of the Big-Five. The 50-item IPIP used within this thesis was based on Goldberg's (1999) markers for the Big-Five Factor structure (Appendix 4). It is comprised of 50 trait-descriptive adjectives that are thought to be broadly representative of personality; Extraversion (IPIPE), Agreeableness (IPIPA), Emotional Stability (IPIPES), Conscientiousness (IPIPC) and Openness (IPIPO) (Funder, 2001; Goldberg, 1999; International Personality Item Pool, 2010). Emotional stability is used as an opposite index to neuroticism. As well as being the dominant model of personality, the Five Factor Model is increasingly used to understand other disorders (Durrett and Trull, 2005; Goldberg, 1999). Individuals more sensitive to Axis 1 diagnoses have been shown to have higher than average Neuroticism (lower emotional stability), and lower than average Agreeableness, Extraversion and Conscientiousness (Bagby, Bindseil, Schuller, Rector, Young and Cooke, 1997; Bienvenu, Nestadt, Samuels, Costa, Howard and Eaton, 2001). The Mini-IPIP was a considered alternative, as it only contains 20-items (Donnellan, Oswald, Baird and Lucas, 2006). Although is has good test-retest reliability (between r = .68-.86), it was not thought to be sufficient sensitive for detecting variation in incremental validity between gratitude and the Big Five (Donnellan et al., 2006).

3.2.6 Electronic Sleep Diary

Daily diaries are an important way of capturing experiences as they unfold over time, reducing the impact of mood states and retrospective biases that can influence one-off reporting (Bolger, Davis and Rafaeli, 2003). Although sleep-diaries are prone to a degree of error (Affleck, Zautra, Tennen and Armeli, 1999), they are supported and extensively used within sleep research (Sateia and Nowell 2004; Sateia, Doghramji, Hauri and Morin, 2000). In particular, they are considered a reliable and valid way of supplementing self-report measures for the purpose of assessing symptoms of Insomnia, despite lacking the absolute

indices that can be generated from invasive measures such as polysomnography or actigraphy (Sateia et al., 2000).

Within the sleep diaries used within this research, participants were asked to record the time they went to bed, time they fell asleep, number of awakenings, total duration of awakenings, time of morning awakening and time out of bed (Appendix 5). These parameters were then used to calculate total wake-time (TWT; sleep latency + length of nightly awakenings + time of morning awakenings), sleep time (TST; time between lights being turned off and getting up – total wake time), sleep efficiency (SE; total sleep time/total bed time x 100) and sleep onset latency (SOL). A daily index of subjective sleep quality (SSQ) was also computed from four items relating to ease of getting to sleep, sense of being rested upon awakening, amount of sleep and subjective perceptions of sleep quality overall.

3.3 Procedure

3.3.1 Ethical Approval

Ethical approval was obtained from Leeds Institute of Health Sciences at The University of Leeds. In order that consent was fully informed, information regarding the nature of the study, the rationale and the potential consequences of participating were provided on the website. It was made clear that participants could withdraw at any time. No names were collected, and instead participants created unique codes consisting of their initials and date of birth for the purpose of matching questionnaire and diary data (section 3.3.2). Email addresses were needed, and stored in a manner appropriate for sensitive personal data.

Participants were given information on how they could access further support should they want or need to, including contact details for the researcher. This was provided at the point of consenting to take part, and reiterated when thanks and feedback were provided following their involvement.

As with any survey requiring self-reflection on mood, there was the potential for participants to be reminded of certain difficulties that could lead to negative affect. Evidence also suggests that appraising a sleep difficulty as 'problematic' can have implications for the course of future difficulties (Edinger and Means, 2005). Participants were informed of this at the point of consenting to take part. Research suggests that it is

more likely that participants will be positively affected by this self-reflection. Hence the potential for negative effects due to participation in the cross-sectional study were minimal.

3.3.2 Procedures

Figure 1 provides an overview of the cross-sectional study, which was entirely internet-based.

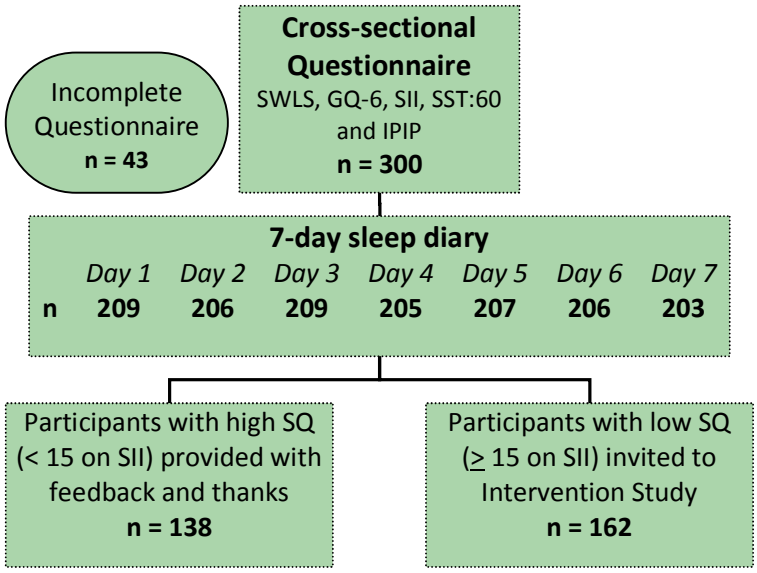


Figure 1: Diagrammatic representation of cross-sectional study

The study website included an information sheet, and the cross-sectional questionnaire. This was made available between November 2009 and March 2010. To be recruited into the study, each participant was required to read the study information sheet. As well as outlining what the cross-sectional study would entail, this informed participants that they could be one of a selection invited to participate in the intervention study.

Those who gave their consent were automatically filtered through to the cross-sectional questionnaire which comprised several measures (see section 3.2). All participants created their own unique ID code in registering to complete the online cross-sectional questionnaire. This comprised their date of birth and initials and was required for accessing each part of the study. This ID code ensured that cross-sectional data could be accurately matched to subsequent sleep diary data. The same ID codes were used to

access the baseline questionnaire and daily measures administered in the intervention study.

Once this was completed, a time-based design was employed so that each participant was emailed an electronic sleep-diary at 7am each morning for the following 7 consecutive days (Appendix 5). This began the day after they completed the cross-sectional questionnaire. Each sleep-diary took approximately 10min to complete, while the cross-sectional questionnaire took approximately 30min.

As the cross-sectional study identified and filtered through participants meeting the inclusion criteria for intervention study (see section 5.1.3), the ethical clearance and initial recruitment processes are relevant for both. The more specific procedural details for the intervention study are considered in chapter 5.

3.3.3 Piloting

Two stages of piloting were undertaken to assess the utility of the internet-based design. The first was a large scale pilot study that formed part of two undergraduate dissertations. This served two purposes. Firstly, it provided a large number of data sets that were used to test whether an online questionnaire broadly similar to the one to be used for this research, could code the relevant dependent variables and whether these variables could be manipulated within the available statistical package. Secondly, it allowed the researcher to conduct a feasibility check to assess whether participants would be sufficiently motivated to complete repeated measurements over several days. Of an initial sample of 123 who completed an online questionnaire, 104 completed the 7day sleep diary and met appropriate compliance checks (3.4.1). Of these 87 completed the full 7days, 12 completed 6days, 3 completed 5days and 2 completed 4days. Hence it was concluded that a sufficient proportion of respondents would complete the daily diaries. The frequencies of responses across the 7days are displayed below.

Table 1: Frequency table showing response rate to 7day diary in pilot study

Day		1	2	3	4	5	6	7
Frequency	n	100	101	102	104	101	100	96

The second stage of piloting included a series of exercises that extensively tested the internet package to be used for this study. These were carried out by the researcher, as well as volunteers. These pilot exercises served two additional functions. Firstly, they acted as a quality check for instructions to ensure each part of the research was clear. Secondly, they ensured that the running sequence of each stage was functioned properly with respect to the design. No data collected within either of the pilot stages was included in the data on which the final analyses were performed.

3.4 Approach to Data Analysis in Cross-sectional Study

3.4.1 Data Management

All raw data was transferred from a tab-delimited format to an SPSS database. The sleep diary data was grouped according to ID code. The electronic system time and date stamped all data in the format "yymmddhhmm". As a result, each data entry could be checked with reference to the compliance criteria, which was monitored using an excel database.

A priori compliance criteria were applied such that sleep diary days were removed from the analysis if they (i) were duplicated; (ii) completed on inappropriate days[7], or (iii) exceeded a 12hr time frame following the reminder email. Any delay beyond this was considered to have compromised the validity of the data due to the introduction of retrospective bias (Bolger, Davis and Rafaeli, 2003). Participants were required to complete at least 4 of the 7 sleep diaries in order to provide sufficient diary data for analysis, averaged according to the number of diaries completed.

3.4.2 Data Reduction

Scores were aggregated from the sleep diaries to provide composite measures of sleep-onset latency (SOL), total sleep-time (TST), sleep efficiency (SE) and subjective sleep quality (SSQ). Excel formulas were developed to calculate each of the relevant sleep parameters based on information provided in the sleep diaries. Outliers were checked and any obvious

[7] Some sleep diaries were completed on the appropriate day but were coded incorrectly as a result of the participant using the email link from the previous day's diary. Errors such as this could be identified by cross-checking the diary with the time stamp.

errors were corrected for example, values from the sleep diaries that had not been recorded in a 24hr format. Otherwise, data were coded as missing data.

3.4.3 Normality checks

The scores for each of the measures were checked to see if they met assumptions of normality. Frequency distributions were checked visually using histograms. For the cross-sectional data where the sample size was greater than 50, Kolmogorov-Smirnov test with Lilliefors correction was used (Foster, 1999). This confirmed that scores were non-normally distributed across the sample for the SWLS ($D(296) = .101$, $p < .001$); GQ-6 ($D(296) = .124$, $p < .001$); total SII ($D(296) = .085$, $p < .001$), as well as for each of the factors within the IPIP (all values < .05). Various log transformations were considered to correct for non-normality, however none could be found that were suitable for all score distributions. These violations should not affect multivariate parametric analyses within larger samples with at least 20 degrees of freedom (Stevens, 2002), therefore parametric analyses were deemed acceptable and run as planned for the main analysis.

3.4.4 Tests of Association

Chi-squared (χ^2) tests were used to compare categorical between-group data. Bivariate correlations were conducted to establish the relationship between each of the dependent variables. Where data was known to have violated assumptions of normality, Kendall's tau (τ) correlation was used. For completeness, both Pearson Product Moment Correlation Coefficient (r) and Kendall's test statistics are presented where appropriate. Kendall's tau was opted for over Spearman's correlation as it is a more conservative test in instances where scores are anticipated to share similar rankings (Howell, 1997).

3.4.5 Multivariate Analyses

To assess the differences between high versus low sleep quality participants, the dependent variables measured by the SWLS, GQ-6 and SST:60 were compared using a multivariate analysis of variance (MANOVA). This procedure should protect against the inflation of Type I error rates likely when multiple ANOVAs are performed (Huberty and Morris, 1989). However, power to detect effects also depends on the intercorrelation of

dependent variables as well as the effect size and pattern of differences expected (Cole, Maxwell, Arvey and Salas, 1994).

The assumption of multivariate normality cannot be tested using SPSS, therefore the assumption of univariate normality was verified for each of the dependent variables using Levene's test (Field, 2005). This was non-significant for each of the dependent variables, indicating that the assumption of univariate homogeneity had been met. While this is a necessary condition for MANOVA, it does not guarantee multivariate normality. Assumptions of equality of covariance were therefore checked using Box's M. This was significant for multivariate effects on SWLS, GQ-6 and factors on the SST:60 (M = 116.65, $F_{15,\ 333776} = 7.64$, $p<.001$), suggesting that the homogeneity assumption was violated. However, Box's M is recognized as being sensitive and frequently indicates that assumptions are violated as it is extremely susceptible to very minor violations of multivariate non-normality (Field, 2003). Hence, a significant Box's M test was not considered to be sufficient to preclude analysis using MANOA. Given that the cross-sectional sample can be considered large (n = 300), Tabachnick and Fidell recommend using Pillai Trace test statistic (Field, 2005; Tabachnick and Fidell, 2001). Pillai's Trace was used within all MANCOVAs as the most conservative estimate of F (Tabachnick and Fidell, 2001), and a significant multivariate main effect of 'group' was required before differences between the high and low SQ groups on the dependent variables were examined.

In order to control statistically for the effects of personality factors, the five personality factors were included as covariates in the ANOVA models. However, effects were only reported if the covariates were significant predictors of the sleep, well-being, pre-sleep cognitions or sleep parameter dependent variables.

CHAPTER FOUR

Sleep, subjective well-being and trait gratitude: Results from the cross-sectional study

4.1 Characterization of sample

Before examining the relationship between SQ and subjective well-being, it is important to characterize the sample in order to identify any demographic differences between the high and low SQ participants. Participants were split according to their scores being higher or lower than the clinical cut-off on the SII. This formed two groups: (i) those classified as having low sleep quality (SQ) ($\geq$15; n = 162), and (ii) those with high sleep quality (<15; n = 138). According to SII, the low SQ group scored above the clinical threshold for Insomnia. However, as this was not clinically diagnosed the groups are referred to here as high SQ and low SQ and their demographic information is compared below.

4.1.1 Age and Gender

The 300 participants who completed the cross-sectional questionnaire comprised 70 men and 230 females aged 18 to 67 years. The Kolmogorov-Smirnov test indicated that age was non-normally distributed across the sample ($D(296) = .162$, $p < .001$), with 92.2% of participants falling below the age of 50 years. Despite an apparent difference in mean age (low SQ: M = 31.01, SD = 11.88; high SQ: M = 29.49, SD = 8.68), a Mann-Whitney test indicated that this was not significantly different between the groups ($U = 11122$, $p = .941$), with a median (Mdn) age of 27 years for both high and low SQ groups. There was a slightly higher proportion of females in the low SQ group (79%) compared to the high SQ group (73.9%), however a chi-square test of the gender by SQ group association indicated that this was not significant ($\chi^2_1 = 1.08$, $p = .338$).

4.1.2 Occupational Status

Overall, 62.7% (n = 188) of the participants were employed and 32% (n = 96) were students. The remaining participants were retired (2.3%), unemployed (1.6%) or a house wife or husband (1.3%). Although occupational status was broadly similar across the

groups, there was a substantially higher proportion of students within the low SQ group. Students made up 37.7% (n = 61) of the low SQ group, compared to only 25.4% (n = 35) of the sample in the high SQ group. A chi-square test indicated that this difference was significantly greater than would be expected by chance (χ^2_4= 9.27, p = .045).

Fourteen participants reported that they were shift-workers. Although shift work is known to impact sleep quality, there was a relatively even distribution across the high SQ (n = 8) and low SQ groups (n = 6).

4.1.3 Health Status

In terms of general health, the sample as a whole rated themselves as being healthy on a 6pt scale (M = 4.47, SD = 0.88). Mann-Whitney U tests indicated that ratings of overall health were significantly different between the SQ groups (U = 8731.5, p < .001), with the low SQ group rating health lower (Mdn = 4) than the high SQ group (Mdn = 5).

In line with this was the finding that 27.2% (n = 44) of the low SQ group reported suffering from at least one medical condition compared to 25.4% (n = 35) in the high SQ group. However, a chi-square test indicated that this difference was no more than expected by chance (χ^2_1= .124, p = .793).

Table 2: Range and frequency of self-reported physical conditions for the high and low SQ groups

	Low SQ		High SQ	
Physical Conditions	n	%	n	%
Asthma	11	6.79	14	10.14
Allergies	4	2.47	4	2.90
Eczema	3	1.85	3	2.17
Diabetes	3	1.85	0	0
Hyperthyroidism	3	1.85	0	0
Migraine	0	0	4	2.90
Other Physical[8]	17	10.49	12	8.70

[8] Other physical conditions included Anemia, Blood disorder Deep vein Thrombosis, Degenerative hearing loss, Endometriosis, Gastro-esophageal reflux disease, Glaucoma, High blood pressure, Hormonal problems, Hypermobility Syndrome, IBS, Kyphoscoliosis, Myeloma, Non-sustained

Table 3: Range and frequency of self-reported psychological conditions for the high and low SQ groups

	Low SQ		High SQ	
Psychological Conditions	n	%	n	%
Anxiety Disorder	4	2.47	4	2.90
Depression	12	7.41	4	2.90
Sleep Disorder	2	1.23	0	0
Other Psychological[9]	3	1.85	0	0

As evident from Table 2 and Table 3, the low SQ group reported a higher number of physical and psychological conditions overall. Levels of co-morbidity were also higher in the low SQ group. A total of 9.88% (n = 16) of participants with low SQ reported two or more medical conditions, compared to 7.97% (n = 11) who had high SQ. However, this was not significant according to a chi-square test (χ^2_2= 1.64, p = .449).

As shown in Table 4, although rates of medication use within the low SQ group 32.7% (n = 53) appeared to be higher compared to the high SQ group 26.1% (n = 36), this association was not significant according to a chi-square test (χ^2_1= 1.57, p = .130).

Table 4: Range and frequency of medication use for the high and low SQ group

	Low SQ		High SQ	
Medication	n	%	n	%
Antibiotic	8	4.9	4	2.9
Antihistamine	5	3.1	7	5.1
Anti-depressants	8	4.9	3	2.2
Anti-anxiety	4	2.5	0	0
Asthma Medication	1	.61	9	6.5
Oral Contraception	12	7.4	7	5.1
Painkillers	6	3.7	4	2.9
Other[10]	5	3.1	6	4.3

Ventricular Tachycardia, Osteoporosis, Pregnancy, Raynaud's Disease, Recurrent coldsores, Ulcerative Colitis.

[9] Other psychological conditions included eating disorders, previous psychotic episodes and seasonal affective disorder

4.1.4 Personality differences between low and high SQ

There were some differences between the groups with respect to certain personality characteristics. Participants with low SQ scored lower on the personality factors of conscientiousness (low SQ: m = 32.44, high SQ: m = 35.49) and emotional stability (low SQ: m = 26.44, high SQ: m = 30.66) compared to those participants with high SQ. Both of these differences were significant according to a Mann-Whitney test (conscientiousness: U = 8356.50, p <.001, emotional stability: U = 7366.50, p < .001).

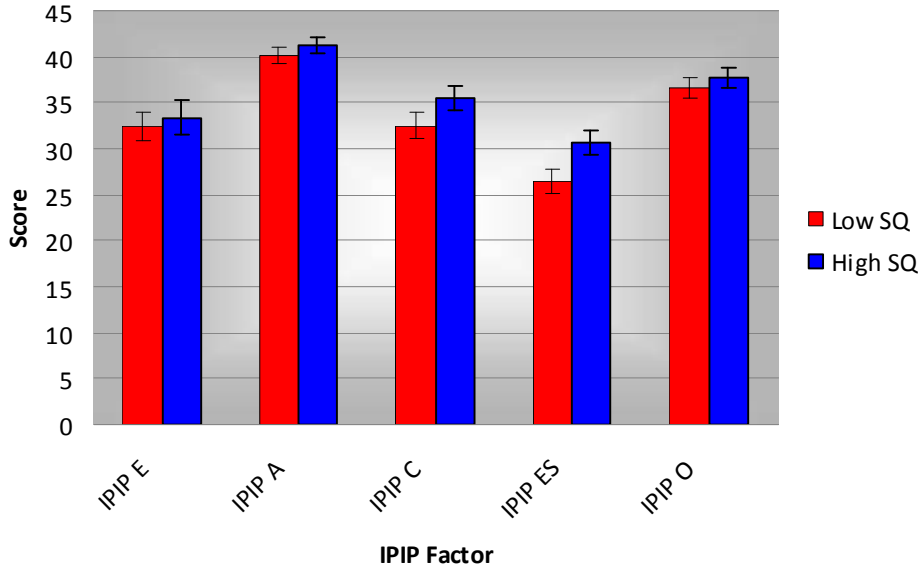


Figure 2: A bar graph showing mean (+SE) IPIP scores for the high and low SQ group

4.1.5 Summary

The high and low SQ groups did not differ significantly with respect to age or gender. Both groups self-reported a comparable number of physical and psychological conditions, and medication use was broadly similar. There were a significantly higher proportion of students in the low SQ group, and participants with low SQ rated their overall health as being lower than those with high SQ. As a result, overall health ratings were controlled for within subsequent analyses. The low SQ group scored significantly lower on conscientiousness and emotional stability compared to the high SQ group. Therefore scores on these personality factors were considered as covariates.

[10] Other medications included Amlodipine, Azathioprine, Buscopan, Eye drops, Folic acid, Hormone Replacement Therapy, Immunosuppressant, Insulin, Loperomide, Omeprazole, Primidone and Thyroxine.

4.2 Results: Correlational analyses

4.2.1 Correlational analyses of measures within cross-sectional questionnaire

A summary of the correlations for the cross-sectional measures, including the SII, SWLS, GQ-6, SST:60 and each of the IPIP factors can be seen in Table 5.

4.2.1.1 Global Sleep Quality, subjective well-being and trait gratitude

To determine the relationship between SQ and subjective well-being, the SII was correlated with the SWLS and GQ-6. Across the whole sample, lower scores on the SII (indicative of higher SQ) were significantly associated with higher scores on the SWLS ($\tau = -.184$, $p < .001$) and the GQ-6 ($\tau = -.162$, $p < .001$). Therefore, high SQ was related to higher levels of subjective well-being and trait gratitude.

4.2.1.2 Pre-sleep cognitions, subjective well-being and trait gratitude

To determine the relationship between subjective well-being, trait gratitude and pre-sleep cognitions, the SWLS and GQ-6 were correlated with factors on the SST:60. Higher scores on the SWLS and the GQ-6 were inversely correlated with scores on the negative factor of the SST:60 (SWLS: $\tau = -.259$, $p < .001$, GQ-6: $\tau = -.192$, $p < .001$). Therefore, higher satisfaction with life and trait gratitude was related to lower frequencies of negative pre-sleep cognitions. In line with this, the SWLS and GQ-6 were positively associated with more adaptive SST:60 SOM ratios[11] (SWLS: $\tau = .224$, $p < .001$, GQ-6: $\tau = .190$, $p < .001$).

4.2.1.3 Global Sleep Quality and Pre-sleep cognitions

To determine the relationship between SQ and pre-sleep cognitions, the SII was correlated with factors on the SST:60. Higher scores on the SII were significantly correlated with higher scores on the positive and negative factors of the SST:60. This relationship was especially strong for negative pre-sleep cognitions (SST:60 –ve; $\tau = .354^{**}$, $p < .001$). Higher SQ was associated with more adaptive SST:60 SOM ratios ($\tau = -.238$, $p < .001$). The SWLS and GQ-6 were positively and strongly correlated ($\tau = .377$, $p < .001$).

[11] States-of-mind (SOM) ratio reflects the balance between total negative and total positive pre-sleep cognitions.

Table 5: Pearson's *r* and Kendall's τ correlation coefficients for SII, SWLS, GQ-6, SST:60 and IPIP factors

		SWLS	GQ6	SST:60 +ve	SST:60 -ve	SST:60 SOM	IPIPE	IPIPA	IPIPC	IPIPES	IPIPO
		n = 300		n = 298			n = 296				
SII	*r*	-.294**	-.246**	.119*	.503**	-.340**	-.103*	-.091	-.190**	-.309**	-.031
	τ	-.184**	-.162**	.090*	.354**	-.238**	-.067*	-.037	-.133**	-.226**	-.035
SWLS	*r*		.544**	.038	-.375**	.336**	.152**	.178**	.216**	.325**	-.018
	τ		.377**	.024	-.259**	.224**	.070*	.141**	.158**	.220**	-.018
GQ-6	*r*			.042	-.307**	.283**	.278**	.431**	.224**	.279**	.052
	τ			.037	-.192**	.190**	.204**	.319**	.160**	.195**	.049
SST:60 +ve	*r*				.246**	.547**	.197**	.035	.038	.049	-.105*
	τ				.178**	.374**	.141**	.003	.003	.036	-.089*
SST:60 -ve	*r*					-.658**	-.062	.000	-.142**	-.583**	-.015
	τ					-.465**	-.020	-.013	-.106**	-.404**	-.019
SST:60 SOM	*r*						.190**	.011	.158**	.530**	-.059
	τ						.121**	.027	.101**	.359**	-.050

*p < .01, ** P < .001

4.2.2 Correlational analyses of cross-sectional measures with 7 day sleep diary

Participants completed sleep diaries for 7 days following the cross-sectional questionnaire. Data were analyzed from those participants who completed at least 4 days during this week and who met the compliance checks (section 3.4.1). Sleep parameters used in the correlation analyses were averaged from the diaries completed across the 7 days for each SQ group (high SQ: n = 100, low SQ: n = 112).

Table 6: Pearson's *r* and Kendall's τ correlation coefficients for Sleep diary parameters, SWLS, GQ-6 and SST:60

		SII	SWLS	GQ-6	SST:60 +ve	SST:60 -ve	SST:60 SOM
				n = 212			
SOL	*r*	.418**	-.176**	-.155*	.124*	.264**	-.119*
	τ	.278**	.-.094*	-.081	.093*	.171*	-.082
TST	*r*	-.171*	.072	-.023	.076	.040	.038
	τ	-.099*	.045	.010	.008	.030	.002
SE	*r*	-.427**	.207**	.084	-.008	-.189**	.162*
	τ	-.284**	.125**	.051	-.061	-.130**	.069
SSQ	*r*	-.543**	.201**	.208**	-.039	-.329**	.245**
	τ	-.382**	.107*	.145**	-.036	-.209**	.169**

*p < .01, ** P < .001

4.2.2.1 Global Sleep Quality and sleep diary parameters

As shown in Table 6, the SII as a global measure of SQ was significantly associated with the Sleep diary parameters in the expected direction. Those participants with higher scores on the SII (lower SQ) had longer SOL, and reduced TST, SE and SSQ across the 7day Sleep diary.

4.2.2.2 Subjective well-being, trait gratitude and sleep diary parameters

Measures of subjective well-being and trait gratitude were significantly correlated with most of the sleep parameters obtained from the sleep diaries (Table 6). SWLS was negatively correlated with SOL, and positively correlated with SE and SSQ. The GQ-6 was

significantly and positively correlated with SSQ, but not with SOL[12] or SE. Neither the SWLS nor the GQ-6 showed any significant correlations with TST.

4.2.2.3 Pre-sleep cognitions with Sleep Diary parameters

The SST:60 –ve showed a higher number of significant associations with the sleep parameters. Higher reports of negative pre-sleep cognitions were positively correlated with increased SOL, and inversely correlated with SE and SQ. Interestingly, the SST:60 +ve only showed a significant correlation with SOL. Therefore, higher reports of positive and negative pre-sleep cognitions were both associated with longer SOL.

4.3 Results: Multivariate analyses

4.3.1 Differences between high and low SQ groups

The mean (SD) for the SII, well-being measures and factors from the SST:60 are presented in Table 7. These have been split into high (< 15) or low SQ groups (≥15) according to scores on the SII.

Two separate MANOVAs were run to explore differences between high and low SQ groups in terms of responses to the well-being measures (SWLS and GQ-6) and the factors on the SST:60 (SST:60 +ve, SST:60 –ve and SST:60 SOM). The univariate ANOVAs that followed these multivariate F tests are presented in Table 7 and considered in further detail below.

Table 7: Means (SD) for the SII, SWLS, GQ-6 and SST:60 for high and low SQ groups

	High SQ n = 138		Low SQ n = 162		ANOVA	
	Mean	(SD)	Mean	(SD)	$F_{1, 296}$	p
SII	11.05	(2.17)	20.16	(4.23)	517.18	<.001
SWLS	24.65	(5.61)	22.18	(5.98)	13.58	.001
GQ-6	35.13	(4.59)	33.39	(5.35)	8.63	.004
SST:60 +ve	38.65	(9.53)	41.14	(8.74)	5.00	.026
SST:60 -ve	39.43	(10.75)	49.83	(10.11)	71.66	<.001
SST SOM	49.67	(7.68)	45.31	(6.69)	28.67	<.001

[12] As scores on the GQ-6 were non-normally distributed, Kandall's τ was used for a conservative interpretation.

4.3.1.1 Differences in subjective well-being and trait gratitude

A MANOVA was run to explore differences between high and low SQ groups in terms of their responses to the well-being measures of SWLS and GQ-6. The between-subjects factor of SQ group had two levels, which were high SQ and low SQ. The dependent variables were scores on the SWLS and GQ-6. There was a significant multivariate main effect of SQ group on the linear combination of the dependent variables according to Pillai's trace ($F_{5, 292} = 15.89$, $p < .001$). The univariate ANOVAs that followed this multivariate F test could therefore be examined.

As shown in Table 7, the univariate ANOVAs revealed a significant main effect of SQ group on SWLS ($F_{1, 296} = 13.58$, $p > .001$) and the GQ-6 ($F_{1, 296} = 8.63$, $p = .004$). Each groups average score on the SWLS placed them within the 'slightly satisfied' range in terms of life satisfaction. However, consideration of the estimated marginal means indicated that the high SQ scored significantly higher on this index relative to the low SQ group. The GQ-6 is a more specific measure of trait gratitude. Given the potential to yield a maximum score of 42, both groups scored highly on trait gratitude (Table 7). However, those in the high SQ group scored significantly higher on the GQ-6 compared to those in the low SQ group.

4.3.1.2 Differences in pre-sleep cognitions

A MANOVA was run to explore differences between high and low SQ groups in terms of responses to the SST:60. The between-subjects factor of group had two levels, which were high SQ and low SQ. The dependent variables were scores on each of the factors on the SST:60, including SST:60 +ve, SST:60 –ve and SST:60 SOM. There was a significant multivariate main effect of SQ group on the linear combination of the dependent variables according to Pillai's trace ($F_{5, 292} = 15.89$, $p < .001$). The univariate ANOVAs that followed this multivariate F test could therefore be examined.

As shown in Table 7, univariate ANOVAs revealed a significant main effect of SQ group on each of the factors on the SST:60, including SST:60 +ve ($F_{1, 296} = 5.00$, $p = .026$), SST:60 -ve ($F_{1, 296} = 71.66$, $p < .001$.) and also for the SST:60 SOM ($F_{1, 296} = 28.67$, $p < .001$). Consideration of the marginal means indicated that participants in the low SQ group reported significantly higher frequencies of positive *and* negative pre-sleep cognitions compared to those with high SQ (Table 7). Importantly however, those in the high SQ

group showed significantly higher SST:60 SOM ratios such that the frequencies of positive pre-sleep cognitions were higher relative to the frequencies of negative pre-sleep cognitions.

4.3.1.3 Discriminant Function Analysis for differences in pre-sleep cognitions

In order to determine whether SQ group could be predicted on the basis of scores on the cross-sectional measures, a discriminant function anaysis was performed. This aided interpretation of the univariate ANOVAs. The predictor variables were scores on the SWLS, GQ-6 and each factor on the SST:60. The SST :60 –ve had the highest canonical correlation coefficient (-.943), followed by SST:60 SOM (.597), SWLS (.411) and GQ-6 (.327). Higher correlations contribute most to group separation and therefore represent the relative contribution of each dependent variable to the prediction of group membership (Bargman, 1970). Hence the SQ groups were best discriminated based on their scores on the SST:60 -ve, with low SQ scoring higher than high SQ.

4.3.2 Differences between high and low SQ groups on 7day sleep diary

A MANCOVA was run to explore differences between high and low SQ groups in terms of the sleep diary parameters. The between-subjects factor of SQ group had two levels, which were high SQ and low SQ. The dependent variables were reports on each of the sleep diary parameters of SOL, TST, SE and SSQ. There was a significant multivariate main effect of SQ group on the linear combination of the dependent variables according to Pillai's trace ($F_{4, 206}$= 18.11, p < .001). Emotional Stability was a significant multivariate covariate ($F_{4, 206}$= 3.74, p < .001). The univariate ANCOVAs that followed these multivariate F tests are presented in Table 8.

Table 8: Means (SD) for sleep diary parameters averaged across 7days

	High SQ n = 100		Low SQ n = 112		ANCOVA	
	Mean	(SD)	Mean	(SD)	$F_{1, 209}$	p
SOL	29.25	(17.68)	47.87	(33.49)	20.40	<.001
TST	7.39	(.689)	7.04	(1.17)	12.65	<.001
SE	86.09	(6.37)	80.51	(18.55)	11.76	.001
SSQ	14.37	(2.04)	11.90	(2.13)	66.86	<.001

4.3.2.1 Differences in sleep diary parameters between high and low SQ

As can be seen in Table 8, there was a significant main effect of SQ group on SOL, TST, SE and SSQ. IPIP ES was a significant covariate for TST ($F_{1, 209}$= 12.24, p < .001) and SE ($F_{1, 209}$= 5.42, p < .021). The low SQ group reported significantly longer SOL, shorter TST, reduced SE and lower SSQ. Each of the differences was in the predicted direction, with participants in the low SQ group tending to show less functional sleep parameters.

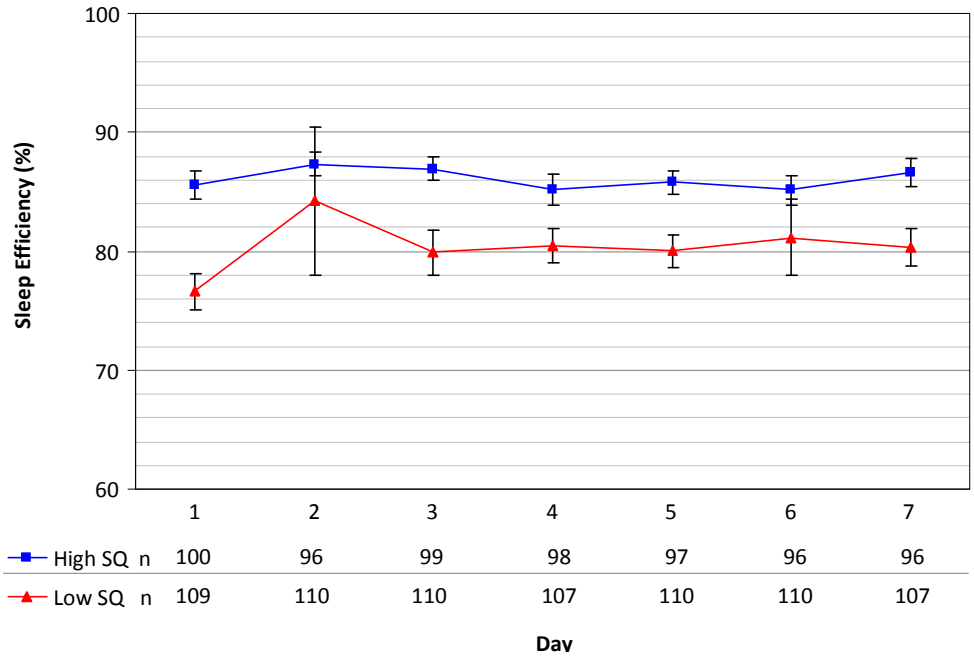


Figure 3: Mean Sleep Efficiency (±SE bars) for the high and low SQ groups across 7days

Sleep Efficiency that is lower than 85% is often used as a diagnostic criterion for insomnia. Higher SE is indicative of longer TST relative to the time spent in bed and is therefore indicative of less disturbed sleep. Figure 3 shows how the mean (±SE) for the low SQ group consistently fell below this criterion across the 7 days (Table 6: M = 79.24%, SD = 10.39), while the high SQ group exceeded it (Table 6: M = 86.10%, SD = 6.29). Similarly, Table 8 shows how those with low SQ exceeded the 30min SOL that is also used as a marker for Insomnia (M = 46.94, SD = 31.25), whereas those with high SQ did not (M = 29.73, SD = 18.01). Both groups showed a comparable response rate across the 7 days (Figure 3). Although marginally fewer diaries were completed by the high SQ group as the week progressed, this was unlikely to be substantial enough for boredom effects to impact on results.

4.4 Summary of Key Findings

The main findings of the cross-sectional study can be summarized as follows:

- Higher scores on the SII (indicative of low SQ) were inversely correlated with both measures of well-being, including the SWLS and GQ-6. Therefore, lower SQ was associated with lower satisfaction with life and lower trait gratitude.
- Both measures of subjective well-being were inversely related to the negative pre-sleep cognitions factor (SST:60 -ve) on the SST:60. Therefore, participants reporting higher satisfaction with life and higher trait gratitude reported lower frequencies of negative pre-sleep cognitions. Although both measures were associated with more adaptive SST:60 SOM ratios, neither showed significant associations with the SST:60 +ve.
- As a prospective measure of sleep the 7day sleep diaries provided further support for the above associations between sleep and the SWLS, GQ-6 and factors on the SST:60. The sleep parameters measured by the 7day sleep diaries correlated well with the global measure of sleep.
- High and low SQ groups showed significant differences with respect to both measures of subjective well-being, including SWLS and trait gratitude. High and low SQ groups also showed significant differences on the SST-60 +ve and SST:60 -ve.
- The high and low SQ group could be best discriminated based on their scores on the SST:60 -ve.
- The high and low SQ groups also showed significant differences in their sleep diary data, the including sleep parameters of SOL, TST, SE and subjective SQ.

CHAPTER FIVE

Methodology for the Intervention Study

5.1 Design

The intervention study employed a prospective design. It was concerned with changes in low SQ following the completion of daily exercises across 7days. Participants were selected from the cross-sectional study on the basis of having low SQ, which was defined by scores reaching or exceeding the clinical cut-off of ≥15 on the SII. The design is experimental and compared the Three Good Things in Life gratitude exercise (gratitude intervention) to an events listing control condition (control intervention). Outcome variables of sleep, subjective well-being, gratitude and pre-sleep cognitions were assessed at baseline and again at two follow-up periods (1day and 1month post-intervention).

5.1.1 Power Analysis

The intervention study aimed to evaluate the effects of the gratitude and control interventions in their capacity to induce changes in sleep quality in persons who met a threshold for clinical significance according to the SII. The study needed to be powered to detect an effect size that was large enough to indicate a clinically relevant difference. Effect sizes for sleep research interventions generally fall in the medium (d = 0.5) to large (d = 0.8) range (Morin, 2003). Only one previous study which has examined a gratitude intervention found a significant difference between an experimental (M=7.58) and control condition (M=7.08) with respect to total number of hours spent asleep (Emmons et al., 2003). A power analysis was performed for this intervention study using G-Power software (Faul and Erdfelder, 1992), with the data from Emmons et al., (2003) used as the effect size estimate. For the current study to have adequate power (d = 0.8) for a two-condition independent subjects design, G-power returned a total sample size of at least 70, equating to 35 per group. Hence, the required sample to be drawn from the cross-sectional study was achievable since 162 participants in the cross-sectional study met the clinical cut-off for low SQ.

5.1.2 Intervention Study Participants

A total of 162 participants were eligible for inclusion within the intervention study based on their scores on the SII. While over half of these opted-in to the intervention study by completing the baseline questionnaire (59.3%, N = 96), a high proportion did not meet the required compliance checks (see previous section 3.4.1). Of these participants, 13 did not complete any of the daily measures that were required. This left 83 participants who completed the baseline questionnaire and at least one sleep diary or daily affective rating scale within the baseline week. However, 17 of these did not continue through into the experimental week. Of the 66 remaining participants, a total of 15 were excluded from the analyses as they did not fulfill one or more of the criteria within the compliance checks (section 3.4.1). A second recruitment drive was conducted in February 2010; however, this did not provide substantially more participants. Hence 51 participants (9 male, 42 female) aged between 18-61 years completed the intervention study.

A number of strategies were considered in response to this, for example; a series-case design. However, within this kind of design only tentative conclusions can be drawn about the influence of the intervention as any comparison is limited to a forecast from the baseline data (Barlow, Nock and Hersen, 2009). Research has suggested that a large number of repeated measures will compensate for a smaller sample size, and this was expected to be achieved through the use of the daily measures (Curran and Muthén, 1999). Response rates to the daily measures are shown in Figure 4 (section 5.3).

5.1.3 Inclusion and Exclusion Criteria

A prerequisite for inclusion within the intervention study was that individuals had already participated in the cross-sectional study. This enabled the design to recruit those who had previously self-assessed themselves as having low SQ. With respect to this, a prime inclusion criterion was that participants had reported symptoms relating to insomnia that yielded a score of 15 or greater on the SII (Morin, 1993). This included reports of difficulties (i) falling asleep (sleep onset), (ii) wakening through the night (sleep maintenance) or (iii) waking too early. They may have also indicated that they were dissatisfied with their sleep, that it interfered with daily functioning (e.g. fatigue, concentration or memory), that their difficulties were noticeable to others, or that they were generally concerned about their sleep.

Exclusion criteria were put in place to screen out any sleep problems that might have been related to significant environmental demands, or a result of physiological or psychological disturbances; including sleep apnea, related respiratory problems, restless leg syndrome, or a mental health diagnosis. Specific information pertaining to the exclusion criteria was collected so that anybody violating them could be excluded from the analyses. This was intended to recruit participants who would be randomised to produce two highly homogenous groups, and assess the effects of the intervention on SQ no confounded by other health conditions. However, the incidence of co-morbid presentations within each condition was high (section 6.1.3, control: 38.5%, gratitude: 36%). Therefore it was not feasible to exclude them from the analyses since this would have reduced the sample size in each intervention condition substantially.

5.2 Measures

5.2.1 Baseline and follow-up Measures

The baseline questionnaire used within the intervention study was broadly similar to that used within the cross-sectional study (section 3.2). It included the GQ-6, SWLS, SST:60 and the IPIP. The utility of the SST:60 was especially relevant for the intervention study. As well as assessing modifiable cognitions, it has also been used to evaluate the impact of interventions that alter them (Fichten et al., 1998). In this respect it was anticipated to provide valuable information on influencing variables between gratitude and seep.

5.2.1.1 Global sleep assessment

It was necessary to use a different scale to the SII to measure any changes in SQ. This was due to the potential for regression to the mean if an outcome measure has previously been used to categorise participants. A number of issues were taken into account when deciding what instrument would be best as an alternative to the SII. Following guidance from relevant reviews, measurement priorities included intervention responsivity, continuous measurement scaling, transparency of scoring and broad symptom coverage (Moul, Hall, Pilkonis and Buysse, 2004). The Pittsburg Sleep Quality Index was selected (PSQI, Appendix 6; Buysse et al., 1989). This included 19 items, with responses based on experiences recalled from the previous month. A total score was generated from the combination of seven subscales; subjective sleep quality, latency, duration, efficiency,

disturbance, use of sleep medication and daytime dysfunction. This total can be used as a diagnostic or continuous index with higher scores being indicative of more impaired sleep. The PSQI also has sensitivity and specificity that is >85% to discriminate between healthy and non-healthy sleepers (Buysse et al., 1989), although it is less reflective of actual sleep parameters (Grandner, Kripke, Yoon and Youngstedt, 2006).

5.2.2 Sleep Diaries

The intervention study used the same sleep diaries as those employed in the cross-sectional study (section 3.2.6). They served a similar function in providing very specific baseline and outcome data in relation to sleep behaviours. They were used in a slightly different way to the cross-sectional study in that they were anticipated to highlight any of the more subtle changes in sleep that might not be detected by the global sleep measure.

5.2.3 Daily affective rating scale

Daily affective rating scales (DARS) were used to measure variations in daily affect (Appendix 7). Similar to the sleep diaries they were time-specified to arrive at the same time each day. Participants were emailed daily reminders at 7pm each evening, with a link to the DARS for that day.

The DARS that were used within the intervention study were the same as those employed by Emmons and McCullough (2003). These were based on the PANAS (Watson et al., 1988); however, the DARS included additional items specifically relating to gratitude (grateful, thankful and appreciative) (Emmons and McCullough, 2003). The 30 affect terms were interested, distressed, alert, irritable, sad, stressed, ashamed, happy, grateful, tired, upset, strong, nervous, guilty, joyful, determined, thankful, calm, attentive, forgiving, hostile, energetic, hopeful, enthusiastic, active, afraid, proud, appreciative and angry. Participants were asked to provide an indication of the frequency they had experienced each affective state during the day on a Likert scale between 1 (not at all) and 5 (extremely). The three items relating to gratitude have been found to be highly correlated, with internal consistency reliability ranging between .86 to .92 (Emmons and McCullough. 2003).

5.3 Procedures

Figure 4 provides an overview of the Intervention Study, which was entirely internet-based. Participants who qualified for inclusion within the intervention study (section 5.1.3) were notified on the last day of the sleep diary within the cross-sectional study that they were invited to participate. Here, there was a partial disclosure regarding the aims of the intervention study in that participants were not aware that the criteria used to recruit was based on measures designed to identify low SQ. Informing subjects that they were being recruited on the basis of having poor sleep was anticipated to influence response to intervention. In particular, it may have unfairly impacted their perceptions and appraisal of their sleeping behaviour, thereby affecting the validity of the research.

For those who agreed to participate, the intervention study commenced two weeks after the completion of the cross-sectional questionnaire. It therefore ran across a comparable time period to the cross-sectional study, between November 2009 and March 2010. Individual time-frames varied depending on when the cross-sectional questionnaire was completed in the cross-sectional study.

For every participant, the intervention study began with the completion of a baseline questionnaire (section 5.2.1). Precautions were taken to ensure that only those who were eligible to take part could access the website. An algorithm was generated that could recognise those who were eligible, and appropriate error messages given to those who did not qualify for inclusion.

The baseline questionnaire was followed by a 14 day period, made up of one baseline week (section 5.3.1) and one intervention week (section 5.3.2). Each day had scheduled participant responding that was interval contingent, a sleep diary each morning and a DARS each evening (section 5.2.2.2). Time specified diaries were felt to be the best method for increasing motivation and encouraging compliance. To aid compliance, a reminder email for each part was sent to each participant by an automated system. Taken together these were intended to minimise participant burden, which in itself can increase compliance (Green, Rafaeli, Bolger, Shrout and Reis, 2006). The first of two follow-up questionnaires was completed on day 15, and the second, 1 month following this.

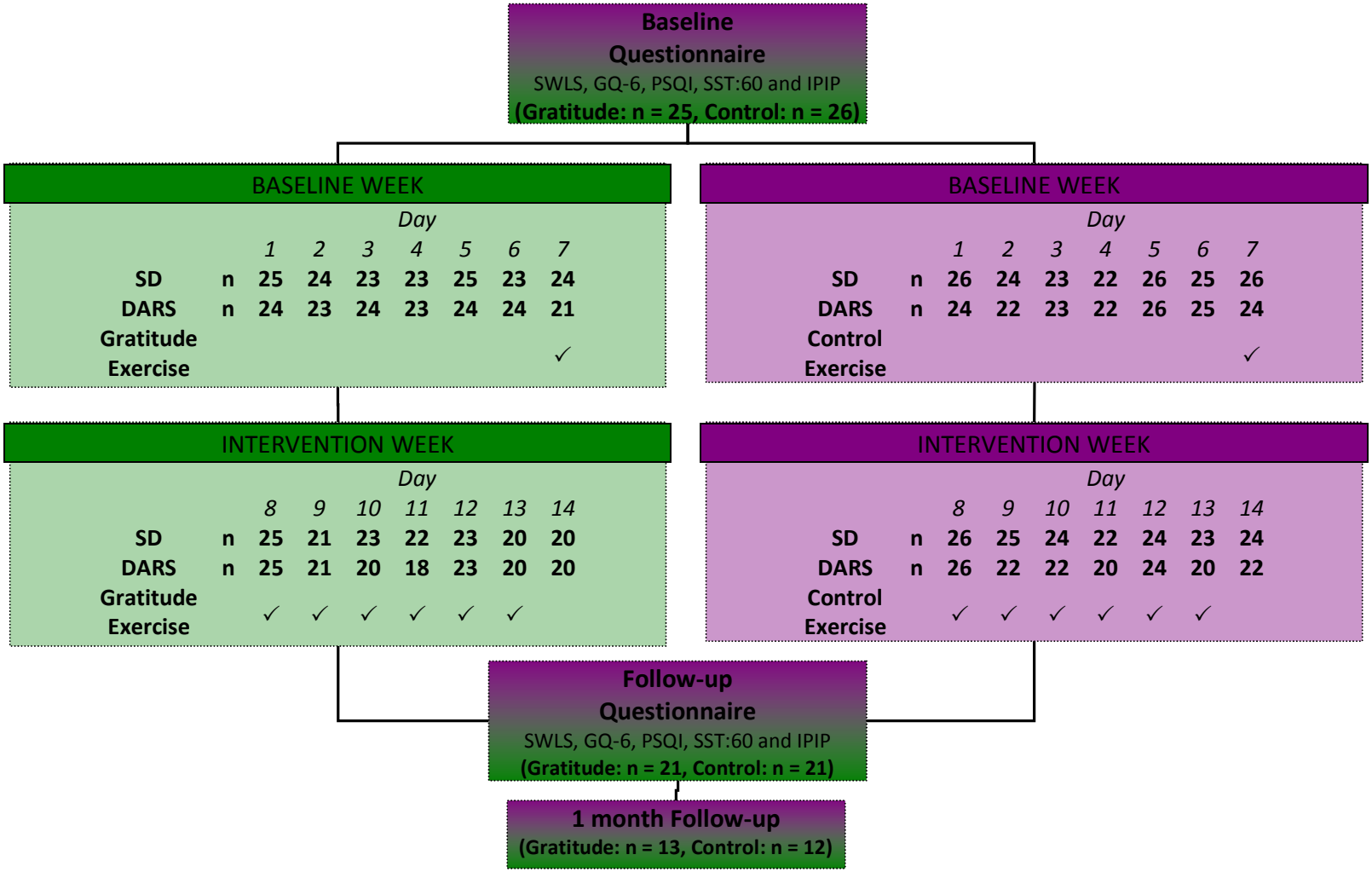


Figure 4: Diagrammatic representation of stages of the intervention study for gratitude and control intervention participants.

(No. of completions made at each stage are indicated)

5.3.1 Baseline week

The baseline week was an initial 7 day period of observation prior to the introduction of any exercise. This was intended to serve two functions. The first was to encourage participants to develop a routine for responding to the daily measures. The second was to gather data that would describe the natural occurrence of the various sleep parameters and daily affect prior to any intervention. In the event that the sample was too small to detect an effect, this phase was anticipated to offer a standard against which the control and gratitude intervention could be evaluated.

5.3.2 Randomization into gratitude or control intervention condition

Participants were randomized into either the gratitude or control intervention condition. The experimental week began on the completion of the first evening exercise on day 7. This was attached as an additional page to the DARS. Instructions for each of the exercises were provided on the day that participants were required to start it. The gratitude exercise was the Three Good Things in Life exercise (Appendix 8), which is claimed to be one of the most effective interventions for improving gratitude (Seligman et al., 2005). Every night during the experimental week participants in the experimental group were asked to write three things that had gone well for them that day, for which they had been grateful. The control exercise was an events listing exercise (Appendix 9), where participants were asked to list three things that had impacted them during the day (see section 5.3.2.1 for a detailed discussion).

5.3.2.1 Control Group rationale

The effects of the gratitude exercise were compared with an active events listing control condition, where participants were asked to list 3 things that had impacted them during the day. The aim of this was to create a neutral condition that was not associated with either positive or negative affect. As a quality check, the events reported within the results of this thesis were coded as pleasant, unpleasant and neutral. Overall, 31.20% of the events were pleasant, 35.47% were unpleasant and 33.33% were neutral. In view of this balance, it was felt that the control condition was relatively neutral.

In deciding on what would be most appropriate control condition for this thesis, guidance was taken from work looking specifically at control conditions within intervention research as well as the preceding work for gratitude interventions specifically (Kirsch, 2005). As intervention work with gratitude is in its infancy, it was particularly important for this thesis to be able to make at least some comparisons to other seminal work in the area. One difficulty was that there are no widely accepted or standardized paradigms for what best represent an appropriate control condition. The 'events' control condition that was decided upon was modelled exactly from one used by Emmons and McCullough (2003). Here, comparisons were made between (a) listing things to be grateful for on a daily basis, (b) listing hassles on a daily basis, and (c) an events condition.

There has been much research to suggest that listing hassles has the potential to mediate separate, and potentially opposite effects, relative to the gratitude exercise and therefore it was not felt to provide the best comparison condition. A waiting list only control that didn't include any exercise was considered. However, it was anticipated that this may have an adverse impact on compliance rates across the 14 days if no additional exercise was provided. As a result, the events condition was felt to be justifiable as an appropriate control condition.

5.4 Approach to Data Analysis

5.4.1 Data Management

Compliance checks were performed on the data in the same manner described in section 3.4.1. The same compliance rules were extended across both weeks and to data from the DARS as well as data from the daily sleep diaries. The sleep diary data was coded in the same manner as described in the cross-sectional study (section 3.4.2). Composite affect scores were calculated from the DARS. A total daily gratitude score was derived by summing ratings on three adjectives relating to gratitude (grateful, thankful and appreciative) (Emmons et al., 2008). The total daily gratitude score could then be averaged across the number of days that were completed (at least 4 to a maximum of 7). Composite scores were also created for daily positive affect (interested, alert, happy, strong, joyful, determined, calm, attentive, forgiving, hopeful, energetic, enthusiastic, active, proud) and

daily negative affect (distressed, irritable, sad, stressed, ashamed, affect, tired, upset, nervous, guilty, hostile, afraid and angry) (based on Emmons et al., 2003).

5.4.2 Parametric Checks

The scores for each of the dependent variables at baseline were checked to see if they met assumptions of normality. Frequency distributions were checked visually using histograms, and the Sharpio-Wilks statistical test was used to check normality assumptions (Foster, 1999). This confirmed that scores for the gratitude intervention condition were non-normally distributed for the GQ-6: D(25) = .920, p = .05 and PSQ Total: D(25) = .859, p = .003. The control intervention data were also non-normally distributed for these variables (GQ-6: (D(26) = .862, p = .002, PSQ Total: D(26) = .910, p = .027). Various log transformations were considered to correct for non-normality, however none could be found that were suitable for all score distributions. Since these violations should not affect multivariate parametric analyses with larger samples with at least 20 degrees of freedom (Stevens, 2002), parametric analyses were run as planned.

The scores for each of the dependent variables at baseline were compared to check that the variance between the two intervention conditions were roughly equal. Levene's test for Equality of Variances was non-significant for each of the dependent variables (all values >.05). Therefore, equal variances could be assumed for both the gratitude and control intervention conditions.

5.4.3 Multivariate Analyses

Prior to the main analysis, a manipulation check was run using a MANOVA to ascertain whether the two levels of intervention condition resulted in different daily gratitude, positive and negative affect ratings during the intervention week compared to baseline (see 5.4.1).

To assess the effects of the intervention on measures of sleep, subjective well-being and pre-sleep cognitions a series of 2 (condition) x 2 (time) mixed ANOVAs were performed. Each included time as a within subjects factor with 2 levels (baseline and follow-up) and condition as a between subjects factor with 2 levels (gratitude versus control). A total of 16% (n=4) of the gratitude and 19.2% (n=5) of the control intervention participants did not

complete any follow-up questionnaires. Therefore these cases were excluded from the analyses comparing measures at the two time points.

In order to examine the influence of personality factors on responses to the intervention, the five personality factors were included in the ANOVA models. However, in no instances were personality factors significant covariates and hence the analysis without these covariates is reported.

5.4.4 Hierarchical Linear Modelling Analyses

Hierarchical linear modelling (HLM) software was used to conduct a mediational analysis on the daily measures (section 5.4.4.1; Raudenbush and Bryk, 2002; Raudenbush, Bryk, Cheong and Congdon, 2004). Daily measures can be prone to a great deal of day to day and within person variation. HLM can control for missing data and the effects of serial dependency, and has the advantage of modeling variance-covariance directly from observed data, rather than using each participant as the unit of analysis (Raudenbush et al., 2004). It has the further advantage that persons with missing data are not excluded from analyses. Thus HLM was used so that participants who missed a proportion of the daily ratings could still be included. Participants were still required to meet compliance checks and there was therefore a minimum criterion that was acceptable. If conventional ANOVA models had been employed with time as a within subjects factor, SPSS would have included only those with compete data. This would have substantially reduced the sample sizes within the gratitude (n = 8) and control intervention conditions (n = 9).

Within this design daily sleep parameters (SOL, TST, SE and SSQ) and daily affect (Positive, Negative and Gratitude) (Level 1 variables) were nested within each of the between-person variables (e.g. intervention condition, SST:60 scores) (Level 2 variables). The Level 2 variables were chosen on the basis of being most relevant with respect to the aims. The function of HLM software is to use regression equations to explain the variance in the dependent variable, as predicted by Level 1 and Level 2 variables. At the simplest level (intercept only model) a mean for the outcome variable e.g. sleep quality (β_0) is derived for each participant, according to the formula:

$Y_i = \beta_0 + \beta_1 X_i + r_i$

Y_i – outcome for participant i

β_0 – average outcome within/across group (explains intercept)

β_1 – average effect of predictor on outcome (explains slope)

X_i – Participant i's IV (independent variable)

r_i – unique effect for participant i (error term).

For each of the models tested within the HLM analyses, the assumption of an unrestricted Level 1 variance-covariance structure fitted the data best according to Deviance statistics[13]. Variables were centered around the grand, as opposed to the group mean[14], so that the mean was subtracted for the entire sample from each observation. Appropriate guidance was used to aid these decisions (Hofmann and Gavin, 1998; Raudenbush and Bryk, 2002). The test statistics presented as an index of effect size are the unstandardized (*b*) coefficients offered by HLM6, as well as the standardized (β) coefficients calculated using procedures outlined by Hox (2002).

To ascertain whether HLM was appropriate for the data presented in this thesis, an intercept-only (unconditional) model was created for the data from the sample as a whole, as well as for each intervention condition. The Intraclass correlation coefficient (ICC) was calculated for each of the sleep parameters to establish which sample observations were more similar to each other, relative to the sample as a whole (Var between groups (intercept) / (var between + var within)) (Snijders and Bosker, 1999). As ICC was greater than >.05 for each of the sleep parameters, the use of HLM was justified on empirical grounds (Snijders and Bosker, 1999).

5.4.4.1 Mediational Analyses

The HLM analyses will be used to explore the relationship between intervention condition (Level 2 variable) and the daily measures of affect and sleep (Level 1 variables). Previous work by Emmons and McCullough (2003) and Wood et al. (2009) used Baron and Kenny's three mediational steps and a Sobel test to statistically test the effects of gratitude and pre-sleep cognitions as mediators (Baron and Kenny, 1986). However, this was not appropriate for the data within this thesis due to the hierarchical nature of HLM (MacKinnon, Lockwood,

[13] Deviance statistics within HLM provide a measure of the lack of fit between any generated model and the data. The lower the deviance statistic, the better the fit between the model and the data (Raudenbush and Bryk, 2002). For data within this thesis, the unrestricted variance-covariance structure was compared to 1st order autoregressive and homogenous Level 1 structure. A consequence of the model chosen is that random variation (error terms) are not explicitly expressed at level-2, although this is modeled.

[14] Within group mean centering the mean for each group is subtracted from each member of group, therefore the level-1 intercept is equal to the between person variance in the outcome measure.

Hoffman, West and Sheets, 2002). Repeated daily measurement of sleep parameters and affect were nested within each individual, such that the independence assumption was essentially violated (MacKinnon et al., 2002). In addition to this, mediators can reside at various levels. Therefore the mediation analysis for this data was conducted using a series of iterative steps, following guidance from MacKinnon et al. (2002). Model testing was conducted in 4 phases: intercept-only models, random-regression coefficients models, means-as-outcome models and the intercepts- and slopes-as-outcomes models. Each of these assumes that causal effects are fixed and equal for all Level 2 variables. If the analyses identify condition or SST:60 factors (Level 2) and daily gratitude (Level 1) as significant predictors of daily sleep parameters (Level 1), it is appropriate to explore mediational effects of daily gratitude further. Upper level mediation can be concluded if the effects of the Level 2 variables on a Level 1 variable are mediated by another Level 2 variable. Lower level mediation when the effect of the Level 2 variable on a Level 1 variable is mediated by another Level 1 variable (MacKinnon et al., 2002).

CHAPTER SIX

Impact of a gratitude versus a control intervention on sleep quality: Results from the Intervention Study

6.1 Characterization of sample

The analysis of the intervention study presented below is based on 51 participants (n = 25 in gratitude condition and n = 26 in control condition) who completed the prescribed exercises and daily measures as shown previously (section 5.3). As participants were randomized to one of two intervention conditions it was important to ascertain whether there were other sources of variance besides the experimental manipulation that would impact on sleep outcome as measured by the PSQI, for example between subject differences in personality. Randomization was used to ensure that potential confounding variables were distributed randomly across intervention conditions. Statistical tests were then conducted to check that randomization had been successful such that the two intervention groups did not differ on demographics or other characteristics.

6.1.1 Age and gender

The gratitude intervention condition was comprised of 20 females and 5 males with an age range of 18 to 61 years (M = 31.4, SD = 12.5). The control intervention condition was made up of 22 females and 4 males, with age range of 19 to 56 years (M = 30.7, SD = 10.2). The two groups did not differ with respect to age ($t(49) = -.222$, $p = .825$). The proportion of females was slightly lower in the gratitude intervention condition (80%) compared to the control intervention condition (84.6%), but a chi-square test for condition by gender was non-significant ($\chi^2(1) = .187$, $p = .474$).

6.1.2 Occupational Status

The employment status for the participants in each of the groups is shown in Table 9. None of the participants were shift workers, although a proportion from the control intervention condition (n = 2) and slightly more in the gratitude intervention condition (n = 4) reported working unsociable hours.

Table 9: Employment status for participants in the gratitude and control intervention condition

	Gratitude		Control	
	n	%	n	%
Employed	15	60	16	61.5
Student	7	28	10	38.5
Retired	2	8	0	0
Unemployed	1	4	0	0

6.1.3 Health Status

In terms of general health, the gratitude intervention group rated themselves as being marginally more healthy (M = 4.36, SD = 0.70) than the control intervention group (M = 4.19, SD = 1.02). However, a t-test indicated that overall health rating did not significantly differ between the groups (t(49) = -.682, p = .499). No objective measures of psychopathology were employed in addition to the PSQI. Self-reported conditions are presented in Table 10.

Table 10: Self-reported Physical and Psychological conditions for gratitude and control intervention groups

	Gratitude		Control	
Condition / medication	n	%	n	%
Asthma	2	8	2	7.7
Other Physical[15]	3	12	4	15.4
Total Physical	5	20	6	23
Anxiety	0	0	2	7.7
Depression	3	12	0	0
Co-occurring Anxiety/Depression	0	0	2	7.7
Other Psychological[16]	1	4	1	3.3
Total Psychological	4	16	5	18.7

[15] Other physical conditions included gastro-reflux, phlebitis, Chron's disease, arthritis, eczema, hypertension, diabetes, thyroid problems and scoliosis.
[16] Other psychological conditions included one previously diagnosed eating disorder and one previous psychotic episode

A slightly higher proportion of participants in the control intervention group (38.5%) reported at least one medical condition, compared to the gratitude intervention group (36%). A chi-square test indicated that this difference was not significant (χ^2_1= .033, p = .543). Table 10 indicates that participants from both groups self-reported a similar number of physical and psychological conditions. Rates of anxiety were slightly higher for the control intervention group (7.7%), while depression was more frequently reported within the gratitude intervention group (12%).

Over half of the gratitude intervention group reported using medication (56%), which was higher than reported in the control intervention group (38.5%). There were few differences between the two groups in terms of the types of medication used. The range and percentages for each kind of medication is included in Table 11.

Table 11: Current medication use across the gratitude and control intervention groups

	Gratitude		Control	
Medication	n	%	n	%
Antibiotic	2	8	1	3.8
Antihistamine	0	0	1	3.8
Anti-depressants	3	12	1	3.8
Anti-anxiety	0	0	2	7.7
Oral Contraception	8	2	3	11.5
Painkillers	4	1	2	7.7
Other[17]	24	6	5	19.2

Of the four participants in the control intervention group who suffered with anxiety, two were taking anti-anxiety medication and a third reported that the anxiety was very mild. One of the two participants with co-occurring anxiety and depression was taking anti-depressant medication. All three participants who reported suffering from depression in the gratitude intervention group were taking anti-depressant medication.

[17] Other medications included Folic acid, Hormone Replacement Therapy, Immunosuppressant, Insulin, Omeprazole, Lanzoprazole and Vitamin supplements.

6.1.4 Personality Characteristics

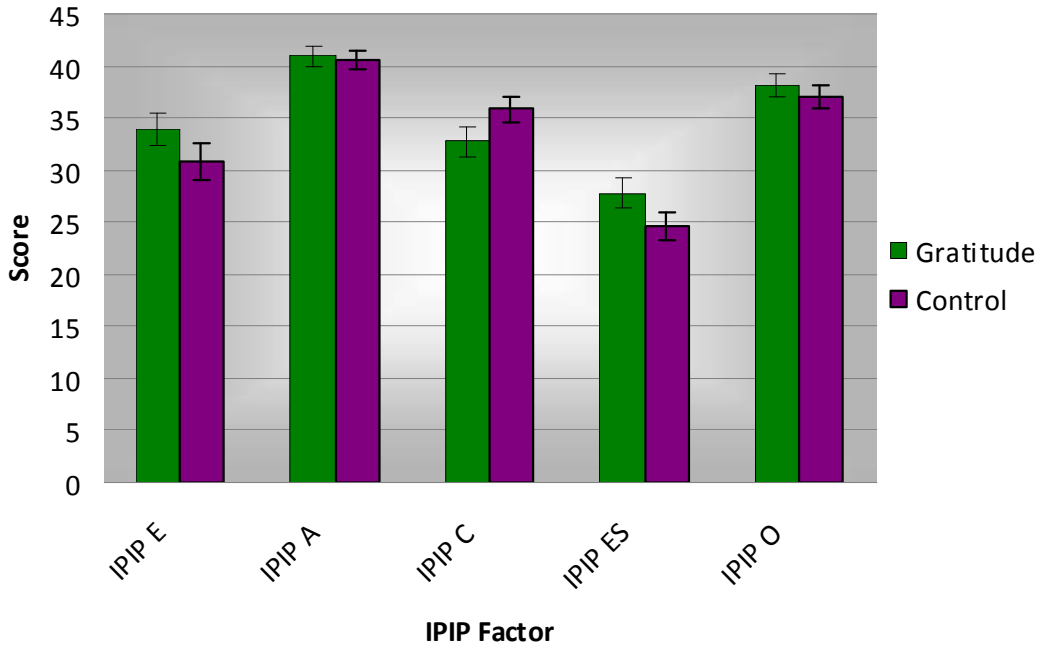


Figure 5: A bar graph showing mean (+SE) IPIP scores for the gratitude and control intervention groups

The profiles of scores on the IPIP are shown in Figure 5. A series of t-tests indicated that the gratitude and control intervention groups did not differ with respect to any of the factors on the IPIP.

6.1.5 Sleep Behaviour

As participants in both groups had already completed the SII to confirm their eligibility for inclusion within the intervention study, preliminary data on their sleep quality was available. Both groups scored similarly on the SII (gratitude intervention group: M = 20.12, SD = 4.49, control intervention group: M = 20.13, SD = 3.88). As this index was from the original cross-sectional questionnaire, it provides evidence that randomization was effective. Importantly, the SII measures the extent to which various factors, such as cognitive disturbance, somatic complaints, bad sleep habits or age contribute to sleep problems. On a scale where 1 was 'none' and 5 was 'much', cognitive disturbances were rated similarly by participants randomized into the gratitude intervention (M = 3.72, SD = 1.73) and control intervention (M = 3.69, SD = 1.12) conditions ($t(49) = -.086$, $p = .932$).

6.2 Results: Multivariate Analyses

6.2.1 Manipulation check

The average daily affect ratings[18] were used to conduct a manipulation check that the two groups randomized into gratitude and control intervention condition did not differ at baseline and that the intervention condition did elicit differential amounts of daily gratitude in the gratitude versus control intervention condition during the intervention week. Figure 6 provides an illustration of the changes in daily gratitude across the baseline and intervention week for the gratitude intervention and control intervention conditions.

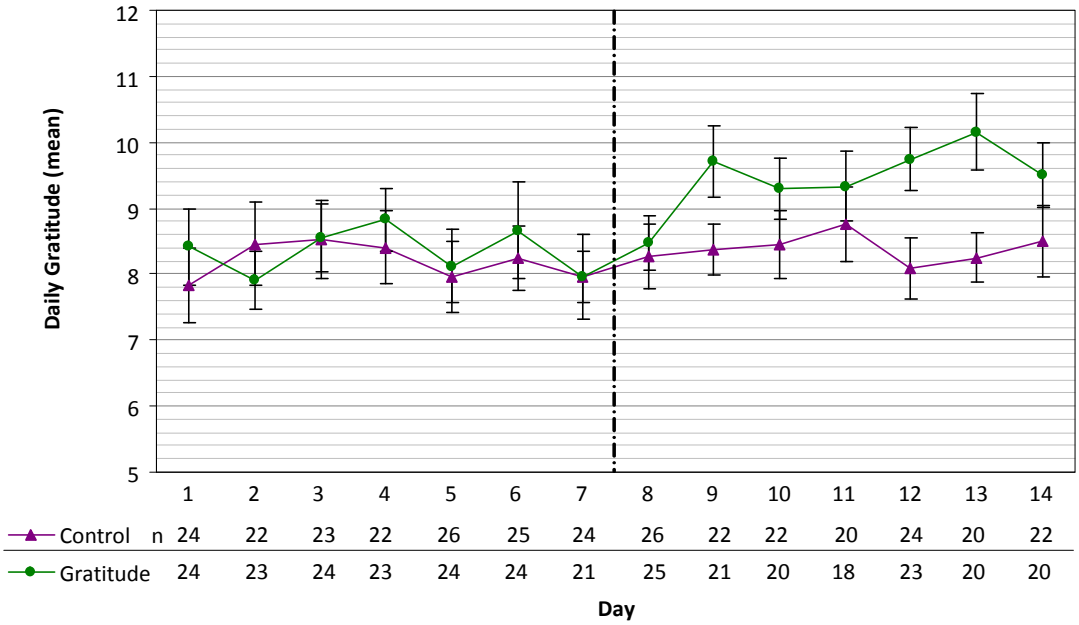


Figure 6: Mean daily gratitude ratings during baseline and intervention week

A MANOVA was performed to examine any differences between condition and the three dependent variables measured by the DARS during the baseline week. The two levels of condition were gratitude and control, and the dependant variables were daily gratitude, and daily positive and negative affect ratings from the baseline week. The multivariate effect of condition on daily affect ratings was non significant ($F_{3, 47} = .156$, $p = .925$). Therefore the groups did not significantly differ on daily affect ratings at baseline.

[18] The affect ratings were averaged over the 7days during (i) the baseline week, then (ii) the intervention week.

A MANOVA was performed to examine any differences between condition and the three dependent variables measured by the DARS during the intervention week. The two levels of condition were gratitude and control, and the dependant variables were daily gratitude, and daily positive and negative affect ratings from the intervention week. There was a significant multivariate main effect of condition on daily affect ratings ($F_{1, 47} = 4.70$, p = .006). Therefore the univariate analyses could be explored further and are presented in Table 12.

Table 12: Effects of Intervention Condition on average daily ratings of gratitude, positive and negative affect reported during the intervention week

Dependent Variable	Gratitude		Control			
	Mean	(SD)	Mean	(SD)	$F_{1, 49}$	p
DARS Gratitude	9.40	(2.38)	8.31	(2.29)	11.95**	.001
DARS Positive Affect	44.94	(9.15)	42.16	(8.58)	3.57	.065
DARS Negative Affect	25.14	(8.52)	26.54	(10.01)	.540	.466

Levene's test was non-significant for each of the aggregated scores, therefore homogeneity of variance could be assumed. As shown in Table 12, there was a significant main effect for intervention condition such that the gratitude intervention elicited higher levels of gratitude across the intervention week ($F_{1, 49} = 11.95$, p = .001). The difference between gratitude and control intervention groups approached significance for positive affect ($F_{1, 49} = 3.57$, p = .065). Participants in the gratitude intervention condition did not differ significantly from participants in the control intervention condition with respect to daily negative affect. This is explored further by a mediational analysis in section 6.3.4.

6.2.2 Primary analysis: difference from Baseline to Follow-up in Gratitude and Control Intervention conditions

The aim of this section will be to present findings from the cross-sectional measures at baseline and follow-up. A summary of the results from the baseline and follow-up measures are presented in Table 13.

Table 13: Table showing baseline, follow-up 1 and follow-up 2 scores on PSQI, SWLS, GQ-6 and SST:60

	Gratitude						Control					
	Baseline n = 21		Follow-up 1 n = 21		Follow-up 2 n = 13		Baseline n = 21		Follow-up n = 21		Follow-up 2 n = 12	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
PSQI Total	7.90	(2.30)	6.24	(2.90)	7.31	(2.72)	8.24	(2.00)	7.90	(2.14)	7.75	(2.93)
PSQI SSQ	1.33	(.658)	.90	(.62)	1.23	(.599)	1.76	(.539)	1.62	(.669)	1.33	(.651)
PSQI SOL	1.76	(1.04)	1.71	(1.06)	1.46	(1.198)	1.62	(.865)	1.81	(.873)	1.42	(.996)
PSQI Duration	.71	(.717)	.48	(.680)	.54	(.519)	.90	(.768)	.81	(.602)	.75	(.622)
PSQI HSE	.76	(.944)	.29	(.561)	1.00	(1.08)	.81	(.873)	.76	(.768)	1.08	(1.08)
PSQI Disturbance	1.38	(.498)	1.38	(.669)	1.15	(.376)	1.52	(.512)	1.38	(.498)	1.42	(.515)
PSQI Medication	.62	(.973)	.33	(.730)	.69	(1.032)	.33	(.658)	.38	(.669)	.67	(1.23)
PSQI Dysfunction	1.33	(.577)	1.14	(.479)	1.23	(.439)	1.29	(.561)	1.14	(.478)	1.08	(.289)
SST:60 +ve	23.95	(9.16)	25.76	(6.12)	22.00	(9.10)	23.67	(8.63)	23.52	(8.21)	23.50	(8.20)
SST:60 –ve	31.00	(8.82)	29.19	(10.63)	30.15	(9.87)	30.19	(10.88)	30.05	(10.84)	30.08	(11.91)
SST:60 SOM	42.78	(11.71)	47.86	(9.47)	41.89	(15.20)	44.23	(13.45)	43.87	(14.66)	44.89	(14.40)
SWLS	23.38	(6.87)	24.71	(6.45)	24.69	(7.63)	22.24	(5.86)	22.71	(6.87)	21.92	(6.67)
GQ-6	35.43	(5.51)	35.43	(4.78)	35.92	(4.31)	32.33	(7.38)	32.76	(7.56)	31.08	(8.14)

6.2.2.1 Difference between baseline to follow-up 1 on the PSQI in response to intervention

The mean ratings for the PSQI and the seven PSQI components are shown in Table 13. All of the participants in both conditions could be classified as poor sleepers according to the standard cut-off point of > 5 for their total PSQI scores at baseline.

A 2 (time) x 2 (condition) mixed ANOVA was performed to examine any differences between condition, time and PSQI total score. The two levels of condition were gratitude and control, and the two levels of time were baseline and follow-up 1. There was a significant interaction between time and condition on PSQI total scores ($F_{1, 40} = 4.63$, p = .038). Therefore, the way in which PSQI total scores were affected over time was different between the gratitude intervention and control intervention conditions. Consideration of the estimated marginal means revealed that the gratitude intervention participants had lower PSQI total scores at follow-up 1 (indicative of higher SQ), compared to the control intervention participants. However, the mean difference was relatively small (PSQI total: M = 1.62, SD = 2.16). This is illustrated in figure 7.

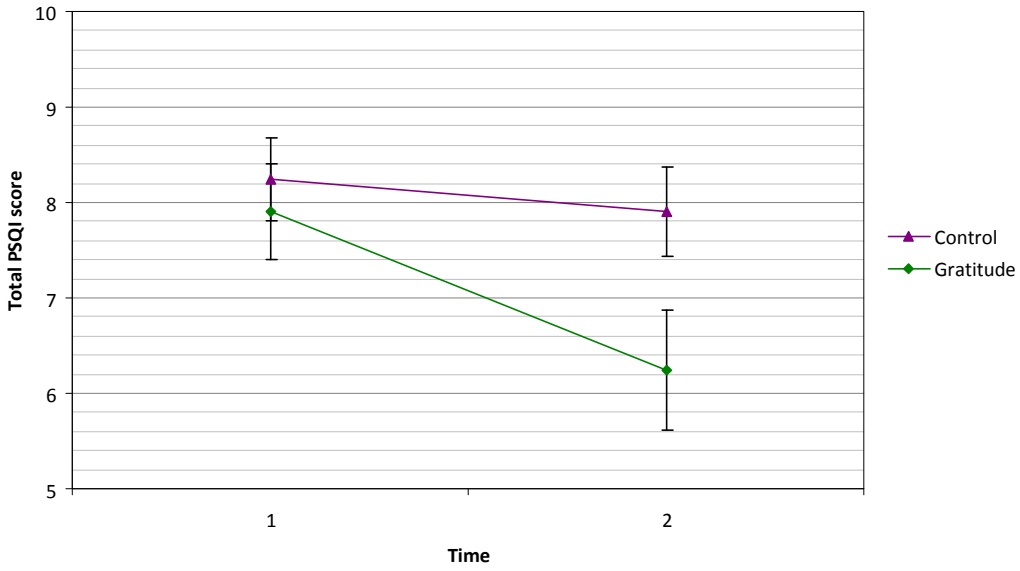


Figure 7: Means plot (+SE) for total PSQI scores at time 1 (baseline) and time 2 (follow-up 1) for gratitude and control intervention conditions

There was a significant effect of time on PSQI total scores ($F_{1, 40} = 10.41$, p = .002). The main effect of condition on PSQI total scores was not significant ($F_{1, 40} = 2.10$, p = ns).

With respect to the PSQI clinical threshold, a substantial proportion of participants within the gratitude intervention condition fell either on (n = 6) or below (n = 5) the cut-off score of >5 at follow-up. A smaller proportion of the participants in the control intervention condition also fell on (n = 2) or below (n = 1) the clinical cut-off at follow-up, again indicating that the gratitude intervention reduced PSQI total scores to below clinical levels.

6.2.2.1.2 Difference from baseline to follow-up 1 on the PSQI component scores

PSQI total represents the sum of seven component scores there are seven dependent variables of PSQI SSQ, PSQI SOL, PSQI Duration, PSQI HSE, PSQI Disturbance, PSQI Medication and PSQI Dysfunction, which could have been influenced by the intervention. A series of 2 (condition) x 2 (time) ANOVAs were performed to examine any differences between baseline and follow-up 1 PSQI component scores. Results are shown in Table 14.

Table 14: Table showing 2x2 ANOVAs for baseline and follow-up 1 PSQI component scores

	Time		Condition		Condition x Time	
	$F_{1, 40}$	p	$F_{1, 40}$	p	$F_{1, 40}$	p
PSQI Total	10.41	.002	2.10	ns	4.63	.038
PSQI SSQ	6.96	.012	12.83	.001	1.74	.195
PSQI SOL	.354	ns	.008	ns	.984	ns
PSQI Duration	4.02	.052	1.76	.192	.738	ns
PSQI HSE	4.40	.042	1.51	ns	2.95	.094
PSQI Disturbance	.682	ns	.241	ns	.682	ns
PSQI Medication	1.38	ns	.316	ns	2.43	.127
PSQI Dysfunction	3.95	.054	.029	ns	.081	ns

As shown in Table 14, across the seven components there were no significant interactions between intervention condition and time. Figures illustrating each of these component scores can be found in Appendix 10. However, there was a trend for a condition by time interaction for PSQI HSE ($F_{1, 40} = 2.95$, $p = .094$). This is illustrated in Figure 8.

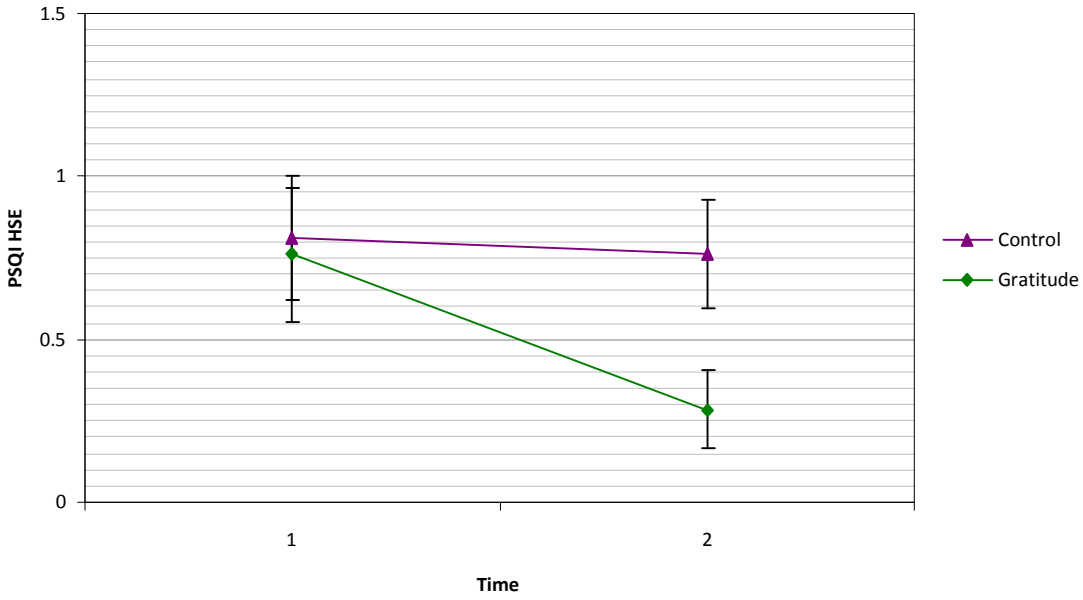


Figure 8: Means plot (+SE) for PSQI HSE component score at time 1 (baseline) and time 2 (follow-up 1) for gratitude and control intervention conditions

It is evident from Figure 8 that while both groups show similar scores for PSQI HSE at baseline, the gratitude intervention group shows a decline in this score at follow-up 1. This is indicative of improved global reports of PSQI HSE compared to the control intervention condition whose PSQI HSE remains at baseline levels.

There was a significant main effect of time for PSQI SSQ ($F_{1, 40} = 6.96$, $p = .012$) and PSQI HSE ($F_{1, 40} = 4.40$, $p = .042$). The effect of time was marginally significant for PSQI Duration ($F_{1, 40} = 4.02$, $p = .052$) and PSQI Dysfunction ($F_{1, 40} = 3.95$, $p = .054$). The figures shown in Appendix 10 suggest that these components improved in response to both the gratitude and control intervention condition, with only PSQI HSE showing a stronger effect following the gratitude intervention.

There was a significant main effect of condition for PSQI SSQ ($F_{1, 40} = 12.83$, $p = .001$). However, the interaction effect was non significant. Inspection of Figure 9 and the confidence intervals for post-intervention PSQI SSQ scores suggests that the gratitude and control intervention groups did differ at follow-up 1. Consideration of mean differences indicates that on average, the gratitude intervention participants improved from baseline to follow-up 1 on the PSQI SSQ and PSQI HSE components.

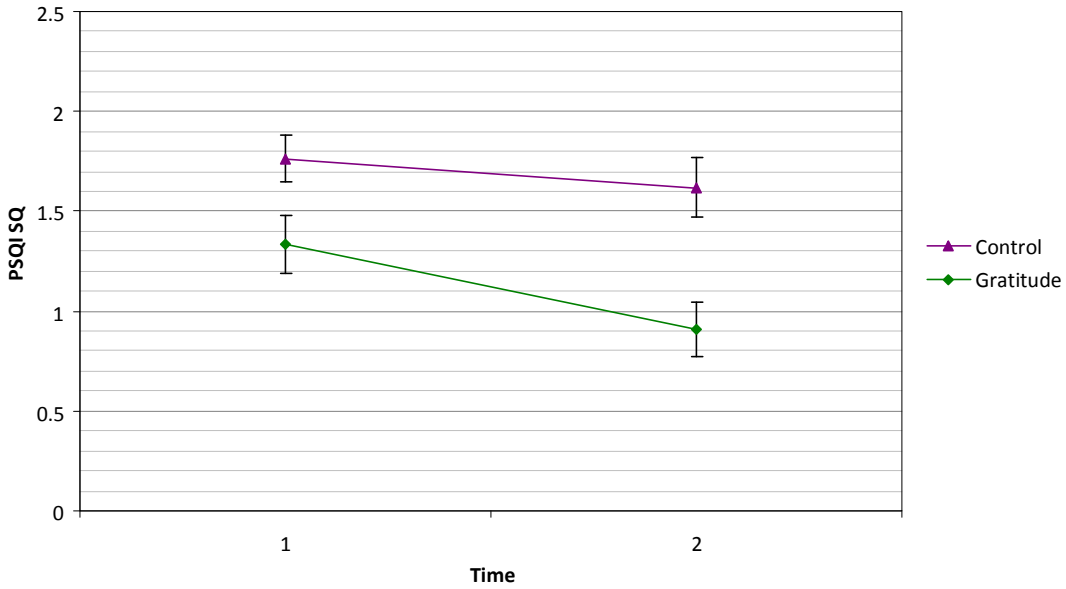


Figure 9: Means plot (+SE) for PSQI SQ component score at time 1 (baseline) and time 2 (follow-up 1) for gratitude and control intervention conditions

6.2.3 Difference from baseline to follow-up 1 on SST:60 factors in response to intervention

The mean ratings on the SST:60 are shown in Table 13. A series of 2 (condition) x 2 (time) ANOVAs was performed to examine any differences between intervention condition, time and condition by time interaction on each of the factors on the SST:60. The two levels of condition were gratitude and control, and the two levels of time were baseline and follow-up 1. The three dependent variables were SST:60 +ve, SST:60 –ve and SST:60 SOM. As can be seen in Table 15, overall there were no significant effects of condition, time or condition by time interaction on the SST:60+ve or SST:60-ve factors.

Table 15: Table showing 2x2 ANOVAs for baseline and follow-up 1 SST:60 factors

	Time		Condition		Condition x Time	
	$F_{1, 40}$	p	$F_{1, 40}$	p	$F_{1, 40}$	p
SST:60 +ve	.674	ns	.584	ns	0.926	ns
SST:60 –ve	.741	ns	.000	ns	.540	ns
SST:60 SOM	2.887	.097	.126	ns	3.829	.057

The SST:60 SOM ratio showed a marginally significant condition by time interaction ($F_{1, 40}$ = 3.83, p = .057), which is illustrated in Figure 10. This indicated that the gratitude

intervention did lead to a marginal increase in reports of more adaptive pre-sleep cognitions. Hence, there was a sufficient enough increase in frequencies of positive pre-sleep cognitions (SST:60+ve scores) and a sufficient enough reduction in frequencies of negative pre-sleep cognitions (SST:60-ve scores) for their relative magnitudes to move towards significance.

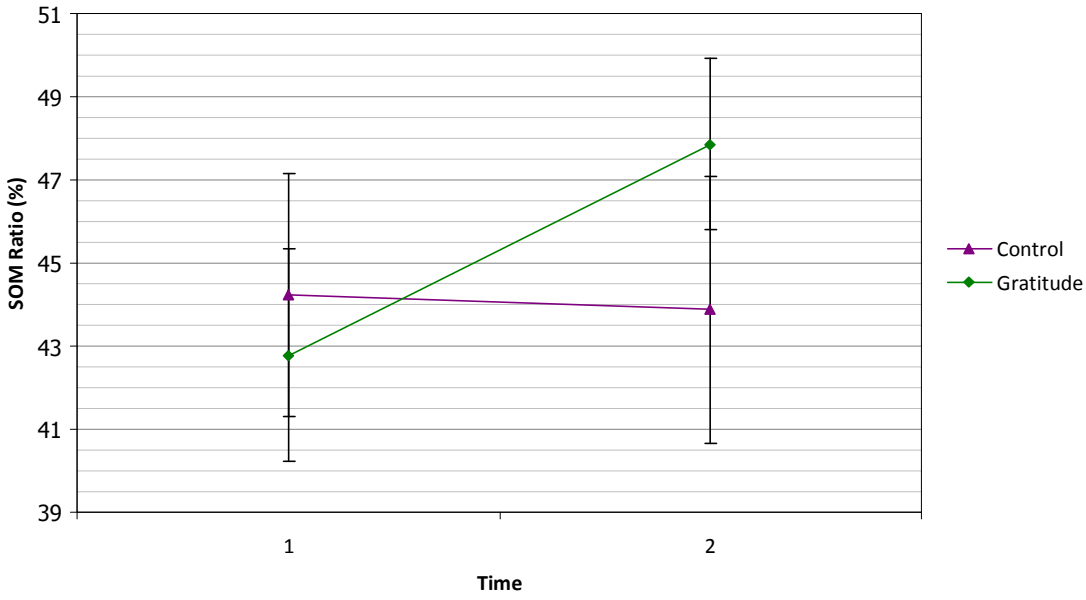


Figure 10: Means plot (+SE) for SOM ratio at time 1 (baseline) and time 2 (follow-up) for gratitude intervention and control intervention condition

6.2.4 Differences from baseline to follow-up 1 on subjective well-being and trait gratitude in response to intervention

The descriptive statistics for the SWLS and GQ-6 can be seen in Table 13. Two 2 (condition) x 2 (time) ANOVAs were conducted to examine the any differences between intervention condition, time and condition by time interaction on scores for each of the well-being measures. The condition by time interaction was not significant for either of these measures (SWLS: $F_{1, 40} = .485$, $p = .490$, GQ-6: $F_{1, 40} = .099$, $p = .755$). There were no significant effects of time on the SWLS ($F_{1, 40} = 2.16$, $p = .149$) or the GQ-6 ($F_{1, 40} = .099$, $p = .755$). There was also no significant effects of condition on global appraisals of life satisfaction or trait gratitude (SWLS: $F_{1, 40} = .671$, $p = .417$, GQ-6: $F_{1, 40} = 2.40$, $p = .128$).

6.2.5 One month follow-up

A reasonable proportion of participants from the gratitude (n = 13) and control (n = 12) intervention conditions completed the one month follow-up (follow-up 2). The descriptive statistics for the PSQI, SST:60, SWLS and GQ-6 at follow-up 2 can be seen in Table 13.

The same series of 2 (condition) x 2 (time) ANOVAs presented above were repeated to examine the effect of intervention condition, time and condition by time interaction on each of the outcome measures at follow-up 2. The two levels of condition were gratitude and control, and the two levels of time were follow-up 1 and follow-up 2. The dependent variables were PSQI total and each of the PSQI component scores; SST:60 +ve, SST:60 –ve and SST:60 SOM; and scores on the SWLS and GQ-6. The only significant finding was a significant interaction between time and condition on PSQI SSQ scores between follow-up 1 to follow-up 2 ($F_{1,23}$ = 7.78, p = .010). There was not a significant effect of time on PSQI SSQ scores ($F_{1, 23}$ = .176, p = .679). The main effect of condition on PSQI SSQ scores was significant ($F_{1, 23}$ = 4.05, p = .056).

Figure 11 illustrates the above finding. Interestingly, scores on PSQI SSQ appear to worsen for those in the gratitude intervention condition returning back towards baseline levels.

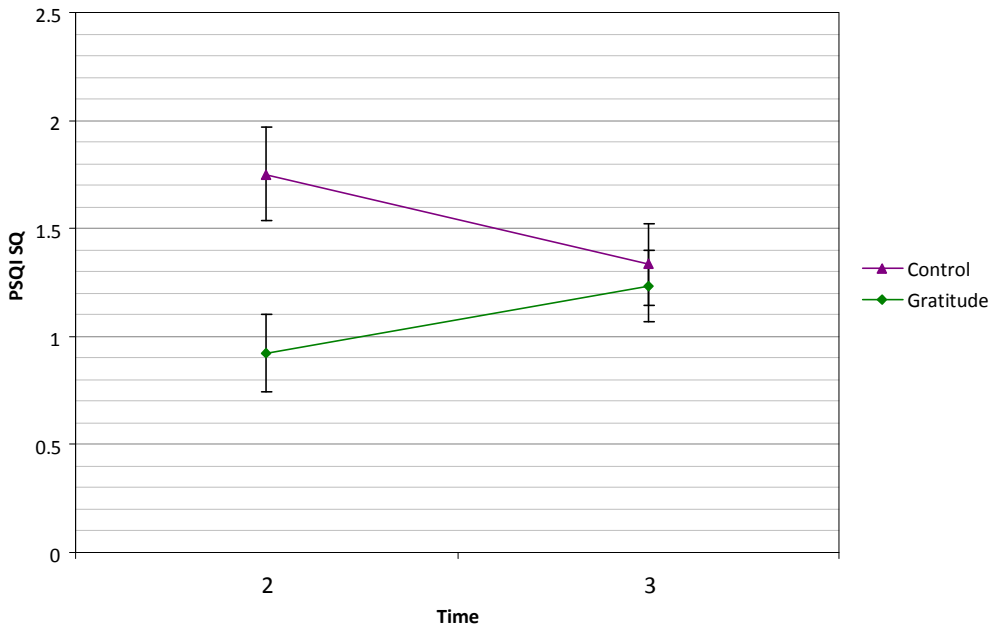


Figure 11: Means plot (±SE) for PSQI SSQ at time 2 (Follow-up 1) and time 3 (Follow-up 2) for gratitude intervention and control intervention condition

6.3 Results: Hierarchical Linear Modelling Analyses

The purpose of the following HLM analyses is to consider any mediational influences that may explain the influence of the gratitude exercise on the affect-sleep relationship. The first step is to investigate whether there are any significant Level 2 predictor variables i.e. condition and SST: 60 scores on daily gratitude and the sleep parameters measured by the sleep dairies.

6.3.1 Hierarchical linear Modeling

HLM was used to analyze the data where participants' daily measures (Level 1) were nested within the baseline measures (Level 2). Of specific interest was the relation between intervention condition and participants pre-sleep cognitions (level-2 predictor variables), with daily gratitude (level-1 predictor/mediator) and the daily sleep parameters; SOL, TST, SE and SSQ (level-1 criterion variables).

Table 16: Descriptive statistics for the level-1 variables across the experimental week

Outcome Variable	Gratitude n = 25		Control n = 26	
	Mean	(SD)	Mean	(SD)
SOL	39.94	(36.97)	42.46	(38.38)
TST	7.24	(1.85)	7.06	(1.93)
SE	80.91	(16.48)	78.72	(16.12)
SSQ	13.45	(3.26)	12.33	(3.76)
DARS Gratitude	9.40	(2.38)	8.31	(2.29)
DARS Positive Affect	44.94	(9.15)	42.16	(8.58)
DARS Negative Affect	25.14	(8.52)	26.54	(10.01)

The intra-class correlation coefficients from the intercept-only (unconditional) models were used to ascertain what proportion of variance could be explained by level-1 and level-2 variables. These revealed a large amount of variance between-classes for TST (41.7%) and SE (64.8%) as reflected in the daily process measures at level-1, although this was proportionally smaller for SOL (14.6%) and SSQ (12.8%). The remaining variance for each parameter could be explained by the between subject variables at level-2. As variance

existed at both levels, the first step was to individually add predictors to each level so that they could be modelled independently from each other.

6.3.2 Condition as a Level 2 predictor on Level 1 daily sleep parameters

To ascertain the impact of condition, the day to day within-person effects between sleep parameters (Y) (Level 1 variable) were modelled together with the impact of between-person factor of condition (Level 2 variable).

The general equation for this means-as-outcome model is shown below:

Level 1: $Y = \beta_0 + r$

Level 2: $\beta_0 = \tau_{00} + \tau_{10}(\text{condition})$

Table 17: Intercept and cross-level interaction models for condition with SOL, TST, SE and SQ

	γ	B	SE	β	p
Intercept: SOL	τ_{00}	42.73	4.381		<.001
Level 1 Slope: Group - SOL	τ_{10}	-3.11	5.855	-.0783	0.597
Intercept: Total Sleep	τ_{00}	7.04	0.227		<.001
Level 1 Slope: Group – TST	τ_{10}	0.165	0.374	.0873	0.661
Intercept: Sleep Efficiency	τ_{00}	78.60	2.178		<.001
Level 1 Slope: Group - SE	τ_{10}	1.95	3.588	.120	0.590
Intercept: Sleep Quality	τ_{00}	12.29	0.450		<.001
Level 1 Slope: Group – SSQ	τ_{10}	1.16	0.560	.325*	0.043

According to Table 17, the only sleep parameter that intervention condition was a predictor variable for was daily reports of SSQ. Importantly when Day was controlled for as a level-1 variable within a random-regression coefficients model, this significant effect was lost. Figure 12 provides an illustration of this based on the pooled averages of SSQ for both the gratitude and control intervention groups. The line graph illustrates the subtle differences across the baseline and intervention week. Despite an initial delay, participants in the gratitude intervention condition show higher levels of SSQ overall. This shows a more obvious difference on the morning of day 9, following the second gratitude exercise on day 8. Effects show signs of habituating across the remaining week.

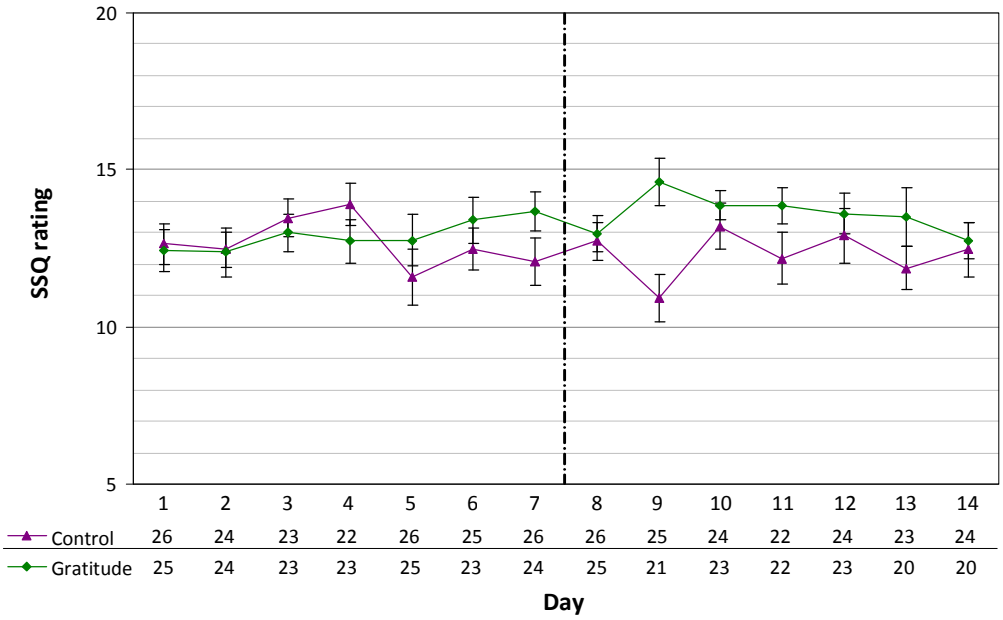


Figure 12: Mean daily SQ ratings (+SE) during baseline and intervention week

Interestingly, if we compare Figure 12 to a similar line graph showing the pooled averages for SE it becomes clear why the intervention condition may not have exerted a significant effect on the other sleep parameters. Specifically, relative to SSQ, the other sleep parameters showed greater variation across both weeks.

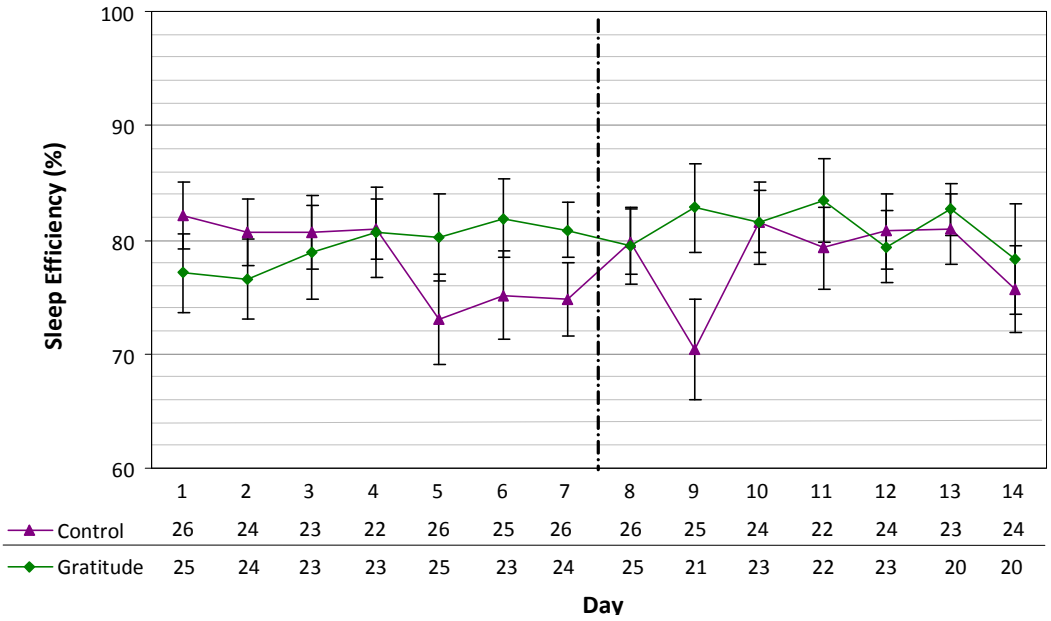


Figure 13: Mean daily SE (+SE) during baseline and intervention week

6.3.3 Pre-sleep Cognitions and effects on daily sleep parameters

To ascertain the impact of SST:60 scores, the day to day within-person effects between sleep parameters (Y_i) (level-1 variables) were modelled together with the impact of between-person variations in SST:60 factors (level-2 variable). The same means-as-outcome model presented above was used (section 6.3.2), but with SST:60 +ve, SST-60 –ve and SST:60 SOM added sequentially as level-2 predictor variables for each of the sleep parameters in turn. None of the SST:60 factors were identified as being significant predictor variables. However, for the gratitude intervention condition SST:60 SOM approached significance as being a predictor of daily SSQ ($\beta = .013$, $p = .067$).

6.3.4 Daily gratitude and mediated effects on daily positive affect

Previous analyses (section 6.2.1) indicated that the intervention condition exerted a significant effect on daily gratitude and approached significance for positive affect, but not negative effect. A mediational analysis was run to ascertain whether the effect of the intervention on positive affect was mediated by effect of intervention on daily gratitude, or vice-versa. Within the random-regression coefficients model, daily gratitude and then daily positive affect were used as the only predictor variables to explore fluctuations in each. An example of the equation used for this model was as follows:

Level 1: $Y = \beta_0 + \beta_1(\text{daily gratitude}) + r$

Level 2: $\beta_0 = \tau_{00}$

$\beta_1 = \tau_{10}$

Y = within subject variation in daily positive affect, β_0 = the intercept term, β_1 = the slope estimates for daily gratitude, and r = the error term, τ = the structural coefficients expressing level-1 variation.

As both were found to be predictors for each other, positive affect was regressed onto the intercept and slope as outcome model with group and daily gratitude simultaneously. Gratitude had a unique association with positive affect ($\beta = .053$, $p = .000$) as well as with intervention condition ($\beta = .410$, $p = .029$). Conversely, when gratitude was regressed on to the intervention effect and positive affect model simultaneously, positive affect had a significant and unique association with gratitude ($\beta = .208$, $p < .001$), but it no longer had a significant association with intervention condition ($\beta = .350$, $p = 0.083$). This provided

evidence that improved gratitude was a direct result of the intervention, rather than a more general consequence of the effect of the intervention on positive affect.

6.3.5 Daily gratitude and effects on sleep parameters

Table 18: Within-Person Associations of Gratitude with Sleep onset latency, Total Sleep, Sleep Efficiency and Sleep Quality in the gratitude intervention condition

	γ	B	SE	β	p
Intercept: SOL	τ_{00}	39.668	3.895		<.001
Level 1 Slope: Gratitude - SOL	τ_{10}	2.996	1.099	0.081	.124
Intercept: TST	τ_{00}	7.04	0.267		<.001
Level 1 Slope: Gratitude – TST	τ_{10}	0.091	0.054	0.049	.134
Intercept: SE	τ_{00}	80.53	2.869		<.001
Level 1 Slope: Gratitude - SE	τ_{10}	-.022	.331	-0.001	.948
Intercept: SQ	τ_{00}	13.45	0.334		<.001
Level 1 Slope: Gratitude – SSQ	τ_{10}	0.095	0.161	0.029	.562

To explore the effects of daily gratitude on the various sleep parameters of SOL, TST, SE and SSQ, the random-regression coefficients model (section 6.3.4) was run for each combination in turn for each intervention condition. The results for the above model as applied to each of the sleep parameters for the gratitude intervention condition are presented in Table 18.

Each of the daily sleep parameters was significantly different from zero (τ_{00}). However, the regression coefficients relating gratitude to sleep were not significant for any of the daily sleep parameters. Exactly the same models were run with daily positive and negative affect in place of daily gratitude as predictor variables. Daily positive affect showed a significant association with the total number of hours slept (β = .021, p = .028). That is, those in the gratitude intervention condition who experienced higher levels of daily positive affect reported sleeping for longer. Conversely, there was a significant negative association between daily negative affect and total number of hours slept (β = -.023, p = .046). Therefore, those who experienced higher levels of daily negative affect tended to report reduced number of hours asleep. The relationship between daily positive affect was approaching significance for daily SSQ (β = .019, p = .056).

Interestingly, when the same combination of models was run for the control intervention condition there were more significant outcomes with respect to daily negative affect. This showed significant and inverse associations with TST (β = -.3368, .001), SE (β = -.0259, .002) and SSQ (β = -.028, .004). That is, when those in the control condition experienced higher levels of daily negative affect they tended to report a reduced number of hours asleep, reduced sleep efficiency and lower subjective sleep quality.

6.3.6 Moderators of the gratitude-Sleep relationship

The final stage planned for the HLM analyses was to use the intercepts- and slopes-as-outcomes model to model the simultaneous impact of any significant moderators on the gratitude-sleep relationship. Although condition was a significant predictor of daily SSQ, daily gratitude was not a level-1 predictor for this parameter. Therefore it could not be included for consideration as a moderator. Scores on SST:60 did not predict variance within the level-1 variables, and as a result could not be included within any further analyses.

6.4 Summary of main findings

The main findings of the intervention study can be summarized as follows:

- A MANOVA confirmed that the gratitude intervention had a significant effect on average daily gratitude ratings across the intervention week, leading to improved gratitude for those participants in the gratitude intervention condition compared to those in the control intervention condition. HLM provided further evidence that improved gratitude was a direct result of the intervention, rather than a more general consequence of the effect of the intervention on positive affect.
- There was a significant interaction effect of condition and time on PSQI total scores. As the primary outcome measure of SQ, this indicated that participants completing the Three Good Things in Life gratitude exercise had improved SQ at follow-up 1 compared to those in the control condition. This was supported by some significant effects and trends on PSQI component scores, although these were not wholly consistent. The significant main effect of time on some components indicated that those in the control condition also showed signs of improvement.
- The interaction effect of condition and time on SST:60 SOM ratios between baseline and follow-up 1 approached significance. However, there were no significant interaction effects of condition and time on the frequencies of positive (SST:60 +ve) and negative (SST:60 –ve) pre-sleep cognitions when considered on their own.
- The global well-being measures did not show significant differences from baseline to follow-up 1.
- There was a significant interaction effect of condition and time on PSQI SQ scores between follow-up 1 and follow-up 2. Participants completing the Three Good in Life gratitude exercise moved back towards baseline levels on this component, suggesting effects of the intervention were not self-reinforcing.
- HLM identified condition as a level-2 predictor for daily SSQ (level-1); however, this was not significant when Day was controlled for. Gratitude did not predict change in daily SSQ and as such could not be considered as a mediating variable. The lack of significant findings here may relate to the variation that existed within the level-1 sleep parameters.

CH APTER SEVEN

Discussion

7.1 Aims of thesis

This thesis presents a detailed exploration of subjective well-being, including state and trait gratitude, in relation to sleep quality (SQ). The main aim of the intervention study was to establish whether an intervention that promotes gratitude could improve SQ in participants who self-assessed themselves as having low SQ. A secondary aim was to explore relationships of subjective well-being and trait gratitude in relation to SQ, which was done in the cross-sectional study. The findings from the intervention study are key. However, many of the relationships outlined by the cross-sectional study will help to frame the subsequent discussion. As such, the cross-sectional study is presented first.

7.1.1 Findings from the cross-sectional study

The cross-sectional study was an extension of recent work done by Wood et al. (2009), who conducted the first study to consider trait gratitude in relation to SQ. In a community sample (n = 401), higher scores on the GQ-6 were inversely associated with lower SQ measured by the PSQI (Wood et al., 2009). Higher trait gratitude was also related to more adaptive pre-sleep cognitions, with higher scores on the GQ-6 associated with higher frequencies of positive pre-sleep cognitions (SST:60+ve: r = .21) and lower frequencies of negative pre-sleep cognitions (SST:60-ve: r = -.11) (Wood et al., 2009). The cross-sectional study in this thesis enhanced the methodology used by Wood et al. (2009) by supplementing a one-off global measure of sleep with sleep diary data over a period of up to 7days.

7.1.1.1 Sleep, subjective well-being, gratitude and pre-sleep cognitions

- It was hypothesised that higher sleep quality would be associated with higher levels of subjective well-being and trait gratitude, and show more adaptive pre-sleep cognitions.

- It was hypothesised that when participants were stratified on the basis of their sleep quality, the high SQ group would score significantly higher on subjective well-being and trait gratitude, and report more adaptive pre-sleep cognitions compared to the low SQ group.

Both hypotheses were confirmed according to the findings from the cross-sectional questionnaire and 7day sleep diary. The global measure of sleep quality (SII) was positively associated with measures of SWB, including the SWLS and the GQ-6. Higher SQ was associated with more adaptive pre-sleep cognitions (higher frequencies of positive relative to negative pre-sleep cognitions) according to the SST:60. The measures of SWB were also associated with more adaptive pre-sleep cognitions. The second hypothesis was an extension of the first, and it enabled a more in-depth comparison of two groups stratified on the basis of having high or low SQ. As predicted, high and low SQ groups showed significant differences across all of the key measures including the SWLS, GQ-6 and factors on the SST:60. The data from the sleep diaries provided additional support for the above relationships.

Overall, findings parallel those presented by Wood et al. (2009). In contrast, however, associations between SQ and the GQ-6 were less strong and more infrequent. Of relevance, the global measure of sleep quality used within the cross-sectional study (SII) differed to that used by Wood et al. (2009) (PSQI). Findings may therefore reflect the different psychometric properties between the two measures (Buysse et al., 1987; Morin, 1993; Moul et al., 2004; Smith and Trinder, 2001). In addition, the cross-sectional study had a smaller sample (N = 300) compared to Wood et al. (N = 401, Wood et al., 2009).

Unlike Wood et al. (2009) trait gratitude was not found to correlate with higher frequencies of positive pre-sleep cognitions. There was, however, an association between trait gratitude and more adaptive pre-sleep cognitions overall, and an inverse relationship with negative pre-sleep cognitions. This replicates previous findings (Wood et al., 2009). In fact, the relationship between the GQ-6 and SST:60 –ve was stronger than that previously reported ($r = -.11$, $p<.001$; Wood et al., 2009). The SWLS and GQ-6 were strongly correlated, and this is comparable to previous work ($r = .53$; McCullough et al., 2002).

As a more robust measure of sleep, the GQ-6 was only correlated with subjective SQ on the daily sleep diaries. Interestingly, Wood et al., (2009) reported the GQ-6 to have strongest associations with the subjective SQ component on the PSQI. This is as interesting finding as *subjective* SQ relates most closely to appraisals made about sleep, rather than more objective parameters. The implications of this will be discussed later (section 7.2.2).

Interestingly, 54% of the sample within the cross-sectional study could be classified as having insomnia ($\geq$15) according to the SII. This was high compared to the 40% identified using the PSQI by Wood et al., (2009), as well as other population based surveys. Moreover, 50.6% of scores within the low SQ group fell above the threshold for severely disturbed sleep ($\geq$20); drawing attention to the significant prevalence of sleep difficulties within the sample. As well as the cross-sectional study identifying a low SQ sample for the intervention study, it illustrated important differences between the high and low SQ groups that the gratitude exercise had the potential to influence.

7.1.2 Findings from the Intervention Study

The intervention study provided novel data by considering the influence of the Three Good Things in Life gratitude exercise on SQ in a sample characterized as having low SQ. Emmons and McCullough (2003) provided provisional but noteworthy evidence that improving gratitude could be beneficial for sleep. However, the items used to measure changes in SQ were not robust and the sample was restricted to participants with significant physical health complaints. Wood et al. (2009) used the PSQI as a more robust measure of sleep to demonstrate that gratitude predicted better sleep over and above the effects of other personality factors, and that this was mediated by pre-sleep cognitions (Wood et al., 2009). However, a major limitation was that his cross-sectional design did not allow any causal inferences to be made. By using an experimental design the intervention study addressed key weaknesses and assumptions of previous work.

7.1.2.1 Impact on baseline and follow-up measures of sleep and pre-sleep cognitions

- It was hypothesised that the gratitude intervention would improve sleep quality reflected by PSQI scores for participants with low sleep quality, relative to a control intervention.

- It was hypothesised that the gratitude intervention would lead to more adaptive pre-sleep cognitions measured by the SST:60 for participants with low sleep quality, relative to a control intervention.

The first hypothesis was confirmed according to the findings from the intervention study. A key finding was that participants who completed the Three Good Things in Life gratitude exercise showed significant improvements on PSQI total scores from baseline to follow-up 1 compared those in an events listing control condition. Furthermore, a higher proportion in the gratitude intervention condition fell on or below the PSQI clinical threshold by follow-up. This finding was supported by a number of significant effects and trends on PSQI components scores. However, these outcomes were not wholly consistent. Participants in the control condition also showed some improvement, as evidenced by the significant main effects of time on some of the PSQI component scores. This suggests that although the control condition appeared to be 'neutral' (section 5.3.2.1), simply being part of a study and doing *something* had an effect on SQ. Therefore, there was a lack of sensitivity to detect the effects of the gratitude intervention. A waiting list only control condition may have offered a suitable alternative (Kirsch, 2005); however, there was a risk this would have led to additional drop-out.

The second hypothesis cannot be accepted, as findings did not completely support predictions. However, there was a marginally significant condition by time interaction on SST:60 SOM ratios. This suggested that the gratitude intervention led to enough of a increase in positive pre-sleep cognitions (SST:60+ve) and enough of a reduction in negative pre-sleep cognitions (SST:60-ve), for their relative ratio to move towards significance. Importantly these across-person analyses were only based on those participants who completed the follow-up questionnaire (experimental: n = 21, control: n = 21). Had there been a larger sample as outlined within the power analysis, the study may have had more power to detect an effect (section 5.1.1, n = 35 per condition). Implications of drop-out are discussed in section 7.4.1

Findings from the intervention study support those offered by Emmons and McCullough (2003); however, they provide even stronger evidence for the beneficial effects of the Three Good Things in Life gratitude exercise on SQ. Compared to the two indices used by Emmons and McCullough (2003) (amount of sleep and sleep quality), the intervention

study employed the PSQI as a standardized measure of SQ (Moul et al., 2004; Buysse et al., 1987). Hence measurement of SQ was more robust and covered a broader range of symptoms (Moul et al., 2004). In addition, although Emmons and McCullough (2003) used a daily measures design, compliance could not be checked in the same way that electronic methods have enabled this study to do.

The beneficial effects of the gratitude exercise were seen after only 7days compared to the 21day period used by Emmons and McCullough (2003). With respect to this finding, previous work has evidenced similar short-term benefits of the Three Good Things in Life exercise, although these were not related to sleep (Seligman et al., 2005). Seligman et al. (2005) found participants who completed the exercise over 7days were happier and less depressed immediately post-intervention. However, similar outcomes were also seen for participants in an 'early-memory' control condition. Taken alongside the findings from the intervention study, this again underlines the need for appropriately controlled experimental research into gratitude (section 7.5).

7.1.2.2 Mediational influences and daily process measures

A further objective for the intervention study was to use daily diary data to explore any moderating influences in the relationship between gratitude and SQ.

- It was hypothesised that HLM would identify intervention as predicting variance in daily measures of affect and sleep, and that daily gratitude would be a moderating variable between level 2 and level 1 variables.

The hypothesis above cannot be accepted. Although condition predicted variance within daily reports of subjective SQ, daily gratitude could not be a mediator within this relationship as it was not itself a level-1 predictor of subjective SQ or any other sleep parameters. Although there was evidence of other level-1 interactions, the study was unable to identify any mediators within the gratitude-sleep relationship. This does not mean to say that they do not exist. Rather, it is more likely that the within-person variation across only 7days of sleep diaries was too high for trends to become established. Importantly, HLM did provide evidence that improved state gratitude was a direct result of the gratitude intervention, rather than a more general consequence of the effect of the exercise on positive affect. When daily gratitude was modelled intercept and slope as

outcome model with condition and daily positive affect, positive affect no longer had a unique association with intervention condition.

7.1.3 Contribution of other factors to findings

The gratitude exercise may not have been the only thing to influence global reports of SQ. Research has outlined higher rates of co-morbidities (Fredricksen et al, 2004; Oginska and Pokorski, 2006; Taylor et al., 2005) and medication use (Foley et al., 2004; Yaggi et al., 2006) in those with poor sleep. An original aim for the intervention study was to have two homogenous groups so that findings were not confounded by the impact of other health conditions. However, the high frequency of self-reported medical conditions made this unfeasible (section 6.1.3, control: 38.5%, gratitude: 36%). Randomisation was successful in ensuring these were distributed evenly across conditions. However, as The Three Good Things in Life exercise has been shown to alleviate symptoms of depression (Seligman et al., 2005) and there were reports of anxiety and depression in both groups, there was the potential for it to mediate indirect effects on SQ via mood more generally. Had this been the case, we might have expected the exercise to predict some of the variance within reports of daily negative affect. As this was not found, it reduces the likelihood that changes in mood were a substantial explanation for the effects seen. However, the gratitude exercise has been shown to alleviate daily negative affect within other research (Emmons and McCullough, 2003). As recent longitudinal work also outlines insomnia as being predictive of depressive symptoms (Buysse, Angst, Gamma, Ajdacic, Eich and Rossler, 2008), this underlines a need to include additional measures of psychopathology e.g. depression, to assist with understanding here.

As measures of well-being were reliant on self-report, their validity with respect to "social desirability" influences needs to be considered. Positive psychology has provided evidence that this is unlikely to differ substantially compared to self-report measures looking at pathology (Park, and Peterson, 2005; Peterson and Seligman, 2004). Feedback from participants indicated that a high proportion enjoyed the gratitude exercise. While this is encouraging in itself, it introduces the possibility that the significant effects of the gratitude exercise were influenced by demand characteristics. If participants had adopted the 'good participant role', they may have adjusted reports to confirm hypotheses. However, to limit this, deliberate attempts were made to conceal these from participants. Specifically, they

were not told why they had been selected to participate in the intervention study until after it was completed. Nor did they realize that they were in one of two intervention conditions.

Evidence suggests that participants tend to be more honest in computer based research (Mathy, 2002). As there was no face-to-face contact the likelihood of participants wanting to please the researcher was reduced. Had demand characteristics been a factor, participants in the gratitude intervention condition may have shown a consistent pattern of responding on the PSQI, as well as on other measures. This was not seen, for example, reports on some of the PSQI components and the well-being measures were not significantly different at follow-up.

One consideration is whether similar effects would have been seen had the exercise asked for people to simply list positive things. Although gratitude does overlap with other positive states, the theory presented in Chapter 1 outlined the ways in which gratitude and positive affect are conceptually distinct. Of relevance, the practice of gratitude has been defined as a constant reminder for how good life is (Watkins, 2004). Therefore it serves as a diversion from the 'hedonistic treadmill' and habituation that can occur with other positive emotions (Lyubomirsky, Sheldon and Schkade, 2005; Watkins, 2004). There did appear to be subtle differences between gratitude listings and the positive events that were listed by the control group; however, further qualitative analyses are needed to explore this in more detail.

7.2 Theoretical Understanding of findings

The alternative explanations above do not adequately explain the findings of this thesis. The discussion will now consider theory that may help to understand these findings. Gratitude is itself a state comprised of both affect and cognition (Emmons and McCullough, 2003; McCullough et al., 2003), and the process of completing the Three Good Things in Life gratitude exercise was reliant on cognitive processes. Therefore the broaden-and-build model of positive emotion (Fredrickson, 2003, 2004) and cognitive models of sleep (Espie, 2007; Edinger and Means, 2005) are especially pertinent for consideration.

7.2.1 Findings in relation to cognitive theory

Participants identified cognitive factors as having the most significant contribution in sleep difficulties, over and above somatic disturbances, poor sleep habits and/or ageing. This offers some general support for cognitive models of sleep disruption (Espie, 2007; Edinger and Means, 2005; Harvey, 2002). Participants with low SQ reported a higher frequencies of positive and negative pre-sleep cognitions overall, compared to those with high SQ. As this is more indicative of higher levels of cognitive activity in the pre-sleep period, these findings support theories that incorporate cognitive hyper-arousal as a maintaining factor within sleep difficulties (Edinger and Means, 2005). However, the findings offer stronger support that the *content* of pre-sleep cognitions is important. The cross-sectional study suggested that low SQ and lower trait gratitude were associated with less adaptive SOM ratios i.e. lower positive and higher negative pre-sleep cognitions. Within the intervention study, the overall frequency of pre-sleep cognitions was not altered; however, the interaction effect of condition and time was approaching significance for improving SOM ratios. While these findings cannot conclusively support pre-sleep cognitions as *mediating* the relationship between trait gratitude and sleep quality (Wood et al., 2009), the associated improvement with SQ suggests that cognitive factors were influential.

7.2.2 Gratitude as Altering Appraisals of Sleep difficulties

It is interesting that research into gratitude and SQ has tended to demonstrate more reliable associations between gratitude and *subjective* sleep quality (Emmons and McCullough, 2003; Wood et al., 2009). This was evident in both studies within this thesis. Within the cross-sectional study trait gratitude was only associated with subjective SQ out of the parameters in the 7day sleep diary. Similarly, in the intervention study condition only predicted variance within daily reports of subjective SQ. Had affect been a source of bias, we might have expected it to only influence reports on the PSQI at follow-up, as one-off reports are more prone to influence from mood states (Bolger et al., 2003). However, the daily measures tend to limit reactivity as a result of habituation processes (Litt, Cooney, and Morse, 1998). Therefore it seems probable that those with higher trait gratitude appraise their sleep difficulties so that they are seen in a more favourable light. This can have significant prognostic implications (Espie, 2007; Edinger and Means, 2005), which will be outlined below.

7.2.3 Gratitude as 'broadening' away from maladaptive coping mechanisms

Cognitive models of sleep illustrate the biases that can exist for those with low SQ during acute periods before bed, as well as for their interpretations of sleep difficulties more generally (Edinger and Means, 2005). For example thought content is often negative, focused on stressful events from the day or the sleep problem itself. According to cognitive theory, specific pre-sleep cognitions ("I am never going to get to sleep") result when Information Processing systems are activated by underlying assumptions or schemas (Beiling and Kuyken, 2003; Padesky and Greenberger, 1995). As with the negativity bias within depression, these are often maladaptive within poor sleep ("I am a bad sleeper"). These can in turn influence information processing by facilitating how individuals perceive, interpret and attribute meaning about themselves and their sleep difficulty.

In the face of a stressful event, such as going to bed (i) maladaptive strategies have the potential to increase or worsen symptoms, and (ii) activation of maladaptive beliefs can lead to maladaptive coping strategies that attempt to reduce associated symptoms (Beck, 1995; Beiling and Kuyken, 2003). A clear illustration of this is when ruminative thinking about sleep difficulties can exacerbate the sleep problem; indeed, this is one of the best predictors of delayed sleep-onset (Fichten et al., 1998; Wicklow and Espie, 2000). The gratitude exercise could serve as a diversion from these maladaptive coping mechanisms by *broadening* cognitive activity, and therefore distracting from usual patterns of ruminative thinking. Findings from previous research illustrate a comparable process, whereby an arithmetic task reduced sleep onset latency in a group of poor sleepers as it served to distract them from usually sleep-laden cognitions (Espie, 2007; Haynes, Adams and Franzen, 1981).

7.2.4 Gratitude as 'building' more functional coping mechanisms

As a result of participants focusing on gratitude, the broaden-and-build model would postulate that as well as *broadening* their thought-action domain (see above), they are also *building* on durable psychological resources (Fredrickson, 2004). If people experience higher levels of gratitude, then they are more orientated towards the positive things in their environment (Park and Peterson, 2005). Where there are positive emotions, it is more likely that people feel safe and less threatened (Fredrickson, 2004). Therefore the experience of gratitude may encourage people to re-orientate their focus from

threatening/stressful things and, in relation to the cognitive theory presented above, develop more adaptive and flexible schemas about their sleep. Gratitude has been shown to predict lower levels of PTSD symptoms in trauma survivors (Masingale, Schoonover, Kraft, Burton, Waring, Fouad, Tracy, Phillips, Kolts and Watkins, 2001) and memory bias studies have suggested that higher gratitude can buffer the emotional impact of adverse events (Watkins, Grimm and Hailu, 1999). Evidence, therefore, would support higher levels of gratitude lessen the subjective impact of sleep difficulties and emotional events from the day which have the potential to impact upon sleep.

7.3 Strengths and Clinical Implications

As outlined in Chapter 1, constructs within positive psychology have only recently been incorporated into sleep theory. As a result there is only a small amount of literature concerned with positive states and sleep (Linley et al., 2009), and only one piece of research that has explored the specific construct of trait gratitude (Wood et al., 2009). The findings in this thesis have a number of important clinical implications to be set alongside the theory presented above.

The cross-sectional study draws further attention to trait gratitude as a positive antecedent of sleep. The intervention study is the first of its kind to provide evidence that improving state gratitude can alleviate symptoms for participants who self-assess themselves as having low SQ that meets criteria for insomnia. This has significant therapeutic implications, as it suggests that constructs of well-being merit specific attention and are not only relevant in the absence of psychopathology. It challenges the long held assumption that treating *deficits* should be the goal of therapy (Duckworth et al., 2005). Despite this, strengths and virtues have only recently been incorporated within clinical formulations that guide and inform therapy (Kuyken, Padesky and Dudley, 2008).

7.3.1 Constructs of positive psychology within therapy

By considering positive and protective emotional states such as gratitude, thinking can be broadened beyond the traditional focus on pathology and disorder (Duckworth et al., 2005; Fredrickson, 2001; Sloman, Gilbert and Hasey, 2003). This can serve to lessen the stigma that is associated with psychopathology, which can in turn build other strengths such as hope.

Specificity of treatment effects has been found to reduce when one treatment is compared to another, and to explain this some theorists have turned their attention to 'common factors' that can explain therapeutic outcome (Wampold, 2001, 2007). Many positive psychology researchers and theorists have started to make tentative links between the 'common factors' that predict psychotherapy outcome and the frameworks and strategies that underpin positive interventions. They suggest that positive psychology may already be implicit within effective therapy, through processes that can build strengths such as hope and optimism (Seligman, 2002; Seligman and Peterson, 2003; Snyder, Ilardi, Michael and Cheavans, 2000). Research has shown that consideration of protective factors can enhance the therapeutic alliance and promote resilience, which each have an important role in encouraging maintenance beyond therapy (Durham, Chambers, Power, Sharp, Macdonald, Major, et al., 2005; Kuyken et al., 2008).

7.3.2 The Three Good Things in Life exercise as an intervention for improving sleep

Over half of the cross-sectional sample could be classified as having insomnia. This underlines the substantial numbers who could benefit from interventions aimed at improving sleep. With respect to the high rates of medical conditions reported by those with poor sleep, this research reinforces the need to identify and manage symptoms of insomnia in spite of any temporal diagnostic distinctions.

Importantly, findings have demonstrated that gratitude can have a causal influence on psychopathology. This adds to the growing literature within the field of positive health psychology that has evidenced similar benefits from well-being interventions (Seligman et al., 2005). Low SQ can have significant consequences on psychological health, including depressive and/or anxious moods, excessive worrying/ruminations and preoccupation with health (Fredricksen et al., 2004; Oginska and Pokorski, 2006). However, although improvements in global sleep scores were statistically significant, they were in reality only small. Although the plotted graphs provided some evidence of an acute effect, there were signs that this habituated across the week and by follow-up 2. One previous study has suggested that a "less is more" approach may prevent habituation to the Three Good Things in Life exercise. Here, happiness was only improved for participants completing the

exercise only once during a week, compared to those completing it three times (Lyubomirsky, Sheldon and Schkade, 2005).

Based on the reported findings, scientific justifications for the Three Good Things in Life gratitude exercise as an intervention for sleep are lacking. As a result it cannot be advocated as an *alternative* to other more established interventions. CBT for example has been shown to have many therapeutic benefits that are maintained beyond therapy (Edinger and Means, 2005; Jacobs et al., 2004; Morin et al., 1999). Comparatively, however, the Three Good Things in Life exercise represents a minimal intervention that can offer *some* benefits including the potential to influence attributions made about *subjective* SQ. As outlined above, these can have substantial prognostic implications that are clinically meaningful.

7.4 Methodological issues and Limitations

To appraise whether the conclusions drawn are reliable and valid with respect to theory, a critique of the design will follow.

7.4.1 Sample

As participants in the intervention study were included on the basis of having low SQ, it was expected that overall PSQI scores would be higher than other comparable population surveys. This was confirmed with the sample as a whole having a group mean of M = 7.84, SD = 2.06 on the PSQI at baseline (M = 5.44, SD = 2.57, Wood et al., 2009; M = 4.55, SD = 3.71, Zeitlhofer et al., 2000). As participants were not recruited form a clinical setting, there was no corroboration that they did have insomnia meeting diagnostic criteria. This reflects a difficulty within sleep research more broadly (Billard and Bentley, 2004). Despite this, self-reports are as important as more objective measures of sleep for the reasons that have already been discussed.

Within the cross-sectional study rates of low SQ far outweighed what we might expect in the general population according to epidemiological estimates (Morin et al., 2006; Ohayon, 2002; Hoffmann, 1999; Hetta et al., 1999). This may have been a result of the recruitment strategy, or else a selection bias that those with low SQ are more motivated to participate in sleep research.

The limited sample may have reduced the power of the design to detect other significant effects such as alterations in pre-sleep cognitions. Power analyses suggested the design would need at least 35 participants within each group, and this was not achieved. The cross-sectional questionnaire did identify a sufficient number of participants who were eligible to be included within the intervention study and two-thirds of these opted-in by completing at least one part of the intervention study. Therefore the reduced sample was a result of non-compliance and drop-out. The implications of this will be discussed below.

7.4.2 Compliance and Implications of drop-out

As a result of using the internet, the study was able to monitor compliance during the intervention study by time-stamping data to check that exercises had been done on the appropriate day and within the specified time. This enabled the design to maintain strong internal validity. However, as a result of the stringent compliance checks, many diary days and participants had to be removed from the final analyses. This is an important illustration as to the cost and benefits of more objective monitoring and also to the risks that other studies make in assuming that participants who self-certify are necessarily compliant.

As rates of drop-out were high, it is important to consider why this might have been so. Participant burden was reduced by ensuring the daily process measures were time-specified and as brief as possible (Bolger et al., 2003). Reasons for non-compliance were more likely related to the accessibility of the internet at the necessary times of the day. Studies recommend that compliance may be improved if participants are presented with training as to why each of the relevant parts of research are important (Reis and Gable, 2000). This was not done in an attempt to lessen the impact of demand characteristics. However, it may be a consideration for future studies that rely on the internet.

Decisions made around whom to include in the final analyses were considered carefully. Research around intention to treat suggests that the exclusion of participants who do not begin an intervention is unlikely to lead to bias (Hollis and Campbell, 1999). However, to achieve reliable and valid data within diary studies, designs are required to achieve a level of participant commitment that is not required within one-off measures. Only a small proportion in the gratitude (n = 8) and control intervention condition (n = 9) completed everything that was required, and these were all female. Using only this full data may have

biased findings by breaking randomization and inflating type I errors (Hollis and Campbell, 1999). A justified compromise was reached and the decision was made to include those who provided evidence that they completed at least 4days worth of daily measurements and exercises (Bolger et al., 2003). With respect to this HLM emerged to be a highly useful and flexible tool. ANOVA would have had little use because of restrictive assumptions concerning missing data across time and the variance covariance structure of the repeated measurements (Raudenbush and Bryk, 2002).

7.4.3 Feasibility of internet-based research

This thesis has provided some valuable insights into the process of running an internet-based and self-guided intervention study. Although it is a contentious issue beyond the remit of this thesis, recent work does support the Internet as providing a good medium for such interventions (Strom, Pettersson and Andersson, 2004). The internet was an excellent research resource in terms of providing access to large cross-sectional sample. However, a by-product of this convenience was that data was not gathered under controlled conditions. There were some clear sources of extrinsic variability, including the time at which exercises were completed. Had compliance checks not screened for these, the validity of the design could have been threatened.

Internet research may be open to selection biases. In particular, there was the potential for various groups to be precluded on the basis that some inevitably have differential access to the internet. Reviews suggest that although on the whole, internet samples and non-internet samples tend to be very similar; internet samples are often younger and better educated (Best, Krueger, Hubbard and Smith, 2001; Mathy, 2002). Given the high proportion of students included within this study, there may have been some evidence for selection bias. Overall, more in-depth consideration of factors relating to socioeconomic status would have been useful. While literature suggests these are not strong predictors of gratitude, those with lower socioeconomic status do experience more sleep problems (Friedman, Love, Rosenkranz, Urry, Davidson, Singer and Ryff, 2007).

7.5 Future Research Directions

A number of important research directions could be taken based on the findings presented in this thesis. Alongside the suggestions that have been made already, the findings would

be strengthened if the design was repeated with a greater number of participants and over a longer time-frame. The variation observed within the diary data suggests that 7days was too short a time for the gratitude exercise to have substantial effects on more objective sleep parameters or pre-sleep cognitions. These habitual patterns are therefore likely to require longer intervention periods. This would enable a greater exploration of the temporal sequencing of events. Of relevance, the relationship between gratitude and sleep is likely to be bidirectional and therefore it would be important to demonstrate that earlier gratitude predicts later improvements in SQ.

There is a real need for research to begin to consider the mediational influence of gratitude more explicitly. More work is needed, in particular, around how to best construct a meaningful 'placebo' comparison condition, as these usually introduce very different psychological processes (Kirsch, 2005). Research has tended to find significant differences between a gratitude exercise versus a 'hassles' condition (Froh, Sefick and Emmons, 2008; Sheldon and Lyubomirsky, 2006). Some have argued, however, that the gratitude exercise may actually present a 'placebo' condition and that relative to this, listing hassles decreases well-being. It is also the case that control conditions can be effective in improving outcome, in which case they reflect an effective treatment that merits further understanding (Kirsch, 2005).

It would be interesting to see if those with a formal diagnosis of primary insomnia showed any substantial differences to the participants used within the intervention study. Similarly, internal validity would be greatly enhanced if future research could include comparison groups which were made up of homogenous samples. However, as positive emotions are less likely to occur in threatening situations (Fredrickson, 2004) it may be that the gratitude exercise has limited benefits for those showing high levels of psychopathology.

In light of the research suggesting that gratitude may buffer the impact of emotional events, it would be important for future research to consider *intensity* of daily affect, as well as frequency. Some have criticised the use of response scales that don't include options for both in appraisals of experienced emotion (Lucas, Diener and Larsen, 2003). In view of the cognitive theory presented, future work should also include other measures, alongside the SST:60, which can assess broader cognitive constructs. For example, the

Dysfunctional Beliefs and Attitudes about sleep scale (DBAS; Morin, 1993) may shine light on some of the *schemas* that can influence the activation of pre-sleep cognitions. The DBAS contains 30-items across five common cognitive styles in relation to sleep. However, although this has good psychometric properties for discriminating between high and low SQ, research suggests it has low internal consistencies for some of the factors (Espie, Inglis, Harvey and Tessier, 2000).

It would also be beneficial for research to incorporate some of the biomarkers that have been explored within other areas of positive psychology. Affective states may exert their influence through psychobiological processes. Research is limited, but preliminary work has uncovered that positive emotions are linked to quicker cardiovascular recovery following a stressful event (Tugade and Fridrickson, 2004) and that lower and higher happiness quintiles can predict differences in cortisol output (Lindfors and Lundberg, 2002; Steptoe, Wardle and Marmot, 2005). More encouragingly, these benefits are seen even when negative affect has been controlled for (Steptoe et al. 2005). The use of both psychological and physiological indices within the research would help with understanding around the co-variance of certain variables, and the more general effects of the intervention. One idea would be for sleep diaries to be supplemented with actigraphs during the intervention phase. Similarly, measurement of positive states needs more structured research. At the moment there is an assumption that positive states are by definition 'subjective' and whatever the individual defines it to be. If this is the case, then self-report stands as being the only appropriate measure. However, it could be that more behaviour based and domain specific assessment tools are needed.

7.6 Conclusions

The field of positive psychology has made significant progress in developing theory concerned with subjective well-being so that we can better understand the role of positive traits and emotions which can buffer against disorder and ill health. The two studies presented within this thesis contribute to this literature.

The cross-sectional study illustrated the considerable prevalence of sleep disruption within a community sample. Over half of the participants met criteria for insomnia according to the Sleep Impairment Index. Given the reciprocal influence sleep has within important psychological and physical processes the findings underline the value of sleep research

more broadly. Research, however, has been saturated by theory concerned with pathology. As such, the objectives within this thesis were clinically relevant with respect to the recent drive to integrate constructs of well-being into sleep research.

A large amount of data was generated from the cross-sectional study and a number of important findings contribute to the field of positive psychology. Firstly, participants with high sleep quality reported higher levels of subjective well-being. This was according to global appraisals of life satisfaction as a whole, as well as to gratitude, a trait that can predispose people to notice the positive things around them. The findings support the one previous study that has linked trait gratitude to sleep, although associations were less strong. Importantly, the cross-sectional study highlighted differences between participants with high and low SQ that would theoretically benefit from a gratitude exercise.

The intervention study was the first of its kind to consider the effects of the Three Good Things in Life gratitude exercise on sleep in a sample with low SQ. The findings are therefore pertinent. It provided evidence that the self-guided daily gratitude exercise over 7days could improve gratitude and global SQ according to the PSQI, compared to an events listing control condition. There was some evidence that the ratio of positive to negative pre-sleep cognitions improved following the gratitude exercise. As such, findings were considered with respect to the broaden-and-build model of positive emotion and cognitive theories of sleep. Gratitude may alter the subjective appraisals made about sleep which can have important prognostic implications for the course of sleep difficulties. In particular, experiencing gratitude may encourage more flexible thinking that can broaden and counteract ruminative patterns that are associated with poor sleep.

The studies presented within this thesis support the important role of subjective well-being and gratitude within research concerned with psychopathology. Furthermore, they provide evidence that well-being and psychopathology are not mutually exclusive entities. Findings contribute towards a more comprehensive understanding of gratitude in relation to sleep and can therefore inform more holistic formulations of sleep functioning. Further understanding is needed around the dynamic ingredients of the process and the impact of interventions that can improve gratitude at both theoretical and practical levels.

Satisfaction with Life Scale

Below are five statements that you may **agree** or **disagree** with.
Using the scale below, check the most appropriate box to indicate how much you agree or disagree with each of the following statements.
Please be **open** and **honest** in your responding.

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
In most ways my life is close to my ideal	○	○	○	○	○	○	○
The conditions of my life are excellent	○	○	○	○	○	○	○
I am satisfied with my life	○	○	○	○	○	○	○
So far I have gotten the important things I want in life	○	○	○	○	○	○	○
If I could live my life over, I would change almost nothing	○	○	○	○	○	○	○

Gratitude Questionnaire

Using the same scale, check the most appropriate box to indicate how much you agree or disagree with each of the following statements:

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
I have so much in life to be thankful for	○	○	○	○	○	○	○
If I had to list everything that I felt grateful for, it would be a very long list	○	○	○	○	○	○	○
When I look at the world, I don't see much to be grateful for	○	○	○	○	○	○	○
I am grateful to a wide variety of people	○	○	○	○	○	○	○
As I get older I find myself more able to appreciate the people, events and situations that have been part of my life history	○	○	○	○	○	○	○
Large amounts of time can go by before I feel grateful to something or someone	○	○	○	○	○	○	○

Sleep Impairment Index

These questions are about any difficulties you may be experiencing with your sleep.

Please rate the severity of your Insomnia problem (i.e. last 2 weeks).

	None	Mild	Moderate	Severe	Very
Do you have any difficulties falling asleep:	○	○	○	○	○
Do you have any difficulties staying asleep:	○	○	○	○	○
Do you have any problems waking up too early:	○	○	○	○	○

How satisfied/dissatisfied are you with your current sleep pattern:

	1	2	3	4	5	
Very Satisfied	○	○	○	○	◉	**Very Dissatisfied**

To what extent do you consider your sleep problem to interfere with your daily functioning? (e.g. daytime sleepiness, ability to function at work, concentration, memory, mood etc.)

	1	2	3	4	5	
Not at all	○	○	○	○	○	**Very much**

How noticeable to others do you think your sleep problem is in terms of impairing your quality of life?

	1	2	3	4	5	
Not at all	○	○	○	○	○	**Very much**

How worried or concerned are you about your current sleep problem?

	1	2	3	4	5	
Not at all	○	○	○	○	○	**Very much**

To what extent do you believe the following factors are contributing to your current sleep problem?

	None		Some		Much
	0	1	2	3	4
Cognitive Disturbances (e.g any difficulties with your thinking or with the content of your thoughts)	○	○	○	○	○
Physical Disturbances	○	○	○	○	○
Bad Sleeping Habits	○	○	○	○	○
Growing Old	○	○	○	○	○

After a poor night's sleep, which of the following problems do you experience the next day? (Tick any that apply.)

- ☐ Daytime fatigue: Tired, exhausted, washed out, sleepy
- ☐ Difficulty functioning: performance impaired at school, difficulty concentrating, memory problems
- ☐ Mood problems: irritable, tense, nervous, groggy, depressed, anxious, grouchy, hostile, angry, confused
- ☐ Physical symptoms: muscle aches/pains, light-headed, headache, nausea, heartburn, muscle tension
- ☐ None

Other _____

Self-Statement test: 60

When you are trying to fall asleep or get back to sleep, how often do you have each of the following thoughts?

You can have both pleasant and unpleasant thoughts about the same topics.

	Never	Rarely	Sometimes	Often	Very Often
How tense I am feeling	○	○	○	○	○
Something I enjoyed reading or watching on TV	○	○	○	○	○
Bad things happening in the world	○	○	○	○	○
Unpleasant thoughts about my activities (housework, projects, job, volunteer work, etc.)	○	○	○	○	○
How I'm going to get a really good night's sleep and feel refreshed tomorrow	○	○	○	○	○
Unhappy times I have had long ago	○	○	○	○	○
Good things happening to my family or friends	○	○	○	○	○
How soothing the sounds of my bedroom are	○	○	○	○	○
Generally pleasant, positive thoughts	○	○	○	○	○
Unpleasant thoughts about things I need to do during the next few days	○	○	○	○	○
How lucky I am to be in good health	○	○	○	○	○
Pleasant thoughts about my future (vacation plans, start of golf season, etc.)	○	○	○	○	○
Poor health of family members or friends	○	○	○	○	○
If I don't get to sleep soon, I will feel very tired tomorrow	○	○	○	○	○
Good things happening in the world	○	○	○	○	○
How quickly time passes when I'm trying to fall asleep	○	○	○	○	○
Positive thoughts about myself, in general	○	○	○	○	○
Unpleasant things I did during the past few days	○	○	○	○	○

Happy times I have had long ago					
How relaxed I am feeling					
Generally unpleasant, distressing thoughts					
How disturbing the sounds of my bedroom are					
Enjoyable things I did during the past few days					
When will I fall asleep?					
How fortunate my family or friends are to be in good health					
Upset about my own health					
How pleasant it feels to be drifting off to sleep					
Something unpleasant I read about or saw on TV					
Unpleasant thoughts about my future (how will I manage when I'm older, how long do I have to live, etc.)					
Pleasant thoughts about my activities (housework, projects, job, volunteer work, etc.)					
How time drags when I'm trying to fall asleep					
Negative thoughts about myself, in general					
Problems of family members or friends					
Pleasant thoughts about things I plan to do during the next few days					

IPIP

On the following page, there are phrases describing people's behaviors. Please use the rating scale below to indicate ***how accurately each statement describes you.*** Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. *So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence.*

Please read each statement carefully, and then fill in the bubble that corresponds to the number on the scale.

	Never	Rarely	Sometimes	Often	Very Often
Am the life of the party.	○	◉	○	○	○
Feel little concern for others.	○	○	○	○	○
Am always prepared.	○	○	○	○	○
Get stressed out easily.	○	○	○	○	○
Have a rich vocabulary.	○	○	○	○	○
Don't talk a lot.	○	○	○	○	○
Am interested in people.	○	○	○	○	○
Leave my belongings around.	○	○	○	○	○
Am relaxed most of the time.	○	○	○	○	○
Have difficulty understanding abstract ideas.	○	○	○	○	○
Feel comfortable around people.	○	○	○	○	○
Insult people.	○	○	○	○	○
Pay attention to details.	○	○	○	○	○
Worry about things.	○	○	○	○	○
Have a vivid imagination.	○	○	○	○	○
Keep in the background.	○	○	○	○	○
Sympathize with others' feelings.	○	○	○	○	○
Make a mess of things.	○	○	○	○	○

Seldom feel blue.					
Am not interested in abstract ideas.					
Start conversations.					
Am not interested in other people's problems.					
Get chores done right away.					
Am easily disturbed					
Have excellent ideas.					
Have little to say.					
Have a soft heart.					
Often forget to put things back in their proper place.					
Get upset easily.					
Do not have a good imagination.					
Talk to a lot of different people at parties.					
Am not really interested in others.					
Like order.					
Change my mood a lot.					
Am quick to understand things.					
Don't like to draw attention to myself.					
Take time out for others.					
Shirk my duties.					
Have frequent mood swings.					
Use difficult words.					
Don't mind being the center of attention.					
Feel others' emotions.					
Follow a schedule.					

Get irritated easily.	○	○	○	○	○
Spend time reflecting on things.	○	○	○	○	○
Am quiet around strangers.	○	○	○	○	○
Make people feel at ease.	○	○	○	○	○
Am exacting in my work.	○	○	○	○	○
Often feel blue.	○	○	○	○	○
Am full of ideas.	○	○	○	○	○

Sleep Diary, Day __

It is EXTREMELY important that you use the **24 hour clock** for **all time responses** (e.g. 10pm in the evening = 22:00, 11pm in the evening = 23:00, midnight = 00:00, 1am in the morning = 01:00). Thank you!

Sleep Duration

Time I went to bed: hrs : mins

Time I went to sleep: hrs : mins

Time I woke up: hrs : mins

Time I got out of bed: hrs : mins

Please try to approximate total hours slept. *Please exclude all periods of wakefulness from the total time you estimate*. (Write this amount in **hrs.min** format e.g. 8 hours and 30 minutes would be written as 8.30).

Sleep quality

	very low				very high
Ease of falling asleep					
Sense of being rested after sleep					

	not enough				right amount
Amount of sleep obtained					

	much earlier than intended				At the right time
Time of awakening					

Did you over-sleep this morning?

- Yes
- No

If yes, please give the reason for this

Awakenings during the main sleep

Did you awaken unintentionally during your main sleep last night?

- Yes
- No

How many times did you awaken during the night?

For approximately how long were you awake during the night?

Napping

Did you take a nap during the day yesterday?

If yes, at what time did you nap? hrs : mins

Duration of nap taken **minutes**

What woke you up this morning? (You may tick more than one)

	Yes	No
Woke up naturally	○	○
Alarm clock etc	○	○
Hunger / thirst	○	○
Toilet	○	○
Noise	○	○
Partner	○	○
Other		

Units of alcohol consumed yesterday (As a guide: half a pint of lager or a shot of spirit = 1 unit, medium glass of wine = 2 units).

In total through the day or up to 2 hrs before bedtime. ☐

Within 2 hours of going to bed. ☐

Cigarettes smoked yesterday

In total through the day or up to 2 hrs before bedtime. ☐

Within 2 hours of going to bed. ☐

Caffeinated drinks or products consumed yesterday (energy drinks, tea, chocolate, cola drinks etc).

In total through the day or up to 2 hrs before bedtime. ☐

Within 2 hours of going to bed. ☐

What were you doing during the 2 hours before you went to sleep?

This may include watching tv before going to bed or reading in bed. Please indicate the number of minutes spent doing each.

	Duration of activity (**in minutes**)
Bath / Shower	
Watching TV	
Academic Work	
Paid Work	
Reading for pleasure	
Exercise	
Meal	
Out socialising	
Other	

Pittsburgh Sleep Quality Index

The following questions relate to your **usual sleep habits** during the **past month only**. Your answers should indicate the **most accurate reply** for the majority of days and nights in the past month. Please answer all questions.

It is EXTREMELY important that you use the **24 hour clock** for **all time responses** (e.g. 10pm in the evening = 22:00, 11pm in the evening = 23:00, midnight = 00:00, 1am in the morning = 01:00). Thank you!

During the past month, what time have you usually gone to bed at night?

BED TIME: hrs : mins

During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES

During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME: hrs : mins

During the past month, how many hours of ACTUAL SLEEP did you get at night? (This may be different than the number of hours you spent in bed.)

HOURS OF SLEEP PER NIGHT

For each of the remaining questions, please check the best response. Please answer all questions.

During the past month, how often have you had trouble sleeping because you:

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Cannot get to sleep within 30 minutes	○	○	○	○
Wake up in the middle of the night or early morning	○	○	○	○
Have to get up to use the bathroom	○	○	○	○
Cannot breathe comfortably	○	○	○	○
Cough or snore loudly	○	○	○	○
Feel too cold	○	○	○	○
Feel too hot	○	○	○	○
Had bad dreams	○	○	○	○
Have pain	○	○	○	○
If other, please specify	○	○	○	○

During the past month, how would you rate your sleep quality overall?

- ○ Very Good
- ○ Fairly Good
- ○ Fairly Bad
- ○ Very Bad

During the past month, how often have you taken medicine to help you sleep? (prescribed or "over the counter")

- ○ Not during the past month
- ○ Less than once a week
- ○ Once or twice a week
- ○ Three or more times a week

During the past month, how often have you had trouble staying awake while driving, eating meals or engaging in social activity?

- ○ Not during the past month
- ○ Less than once a week
- ○ Once or twice a week
- ○ Three or more times a week

During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

- ○ No problem at all
- ○ Only a very slight problem
- ○ Somewhat of a problem
- ○ A very big problem

Do you have a bed partner or room mate?

- ○ No bed partner or room mate
- ○ Partner or room mate in other room
- ○ Partner in same room, but not in same bed
- ○ Partner in same bed

If you have a room mate or bed partner, ask him/her how often in the past month you have had..

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Loud snoring	○	○	○	○
Long pauses between breaths while asleep	○	○	○	○
Legs twitching or jerking while you sleep	○	○	○	○
Episodes of disorientation or confusion during sleep	○	○	○	○
If other, please describe	○	○	○	○

Daily Affective Rating Scale

Please look at the following list of emotions and/or reactions and rate the extent to which you have felt each today

These ratings should reflect your view of the **day as a whole.**

	Not at all		Sometimes		Extremely
interested	○	○	○	○	○
distressed	○	○	○	○	○
excited	○	○	○	○	○
alert	○	○	○	○	○
irritable	○	○	○	○	○
sad	○	○	○	○	○
stressed	○	○	○	○	○
ashamed	○	○	○	○	○
happy	○	○	○	○	○
grateful	○	○	○	○	○
tired	○	○	○	○	○
upset	○	○	○	○	○
strong	○	○	○	○	○
nervous	○	○	○	○	○
guilty	○	○	○	○	○
joyful	○	○	○	○	○
determined	○	○	○	○	○
Thankful	○	○	○	○	○
Calm	○	○	○	○	○
Attentive	○	○	○	○	○
Forgiving	○	○	○	○	○
Hostile	○	○	○	○	○
Energetic	○	○	○	○	○
Hopeful	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Active	○	○	○	○	○
Afraid	○	○	○	○	○
Proud	○	○	○	○	○
Appreciative	○	○	○	○	○
Angry	○	○	○	○	○

Daily Exercise

There are many things in our life, both large and small, that we might be grateful about.

Think back over the **past day** and write down in the boxes below **three things** in your life that you have been **grateful or thankful** for.

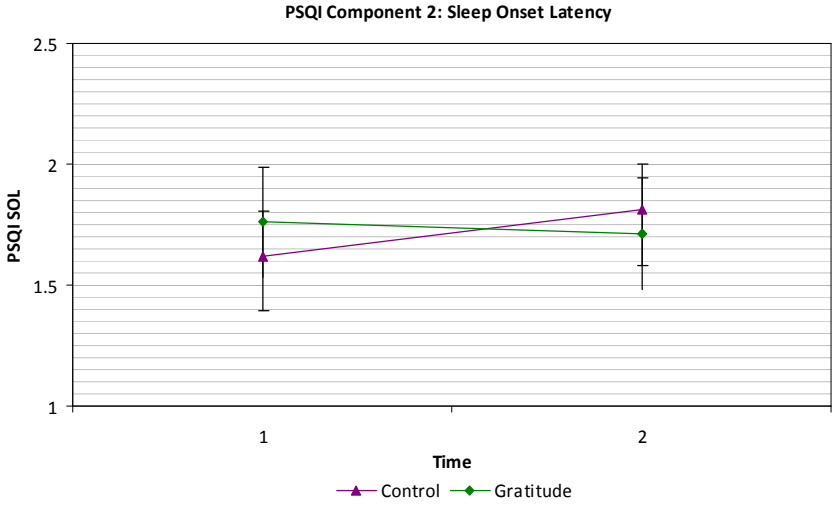
Also write **why** each happened.

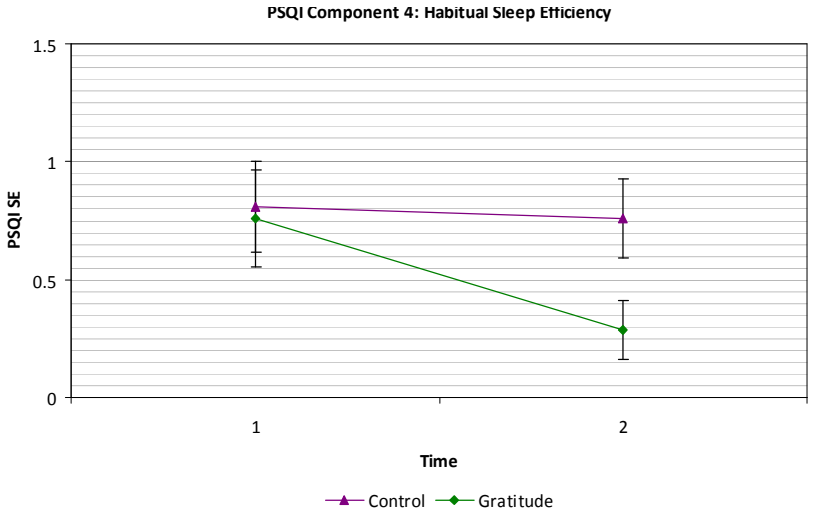
Daily Exercise

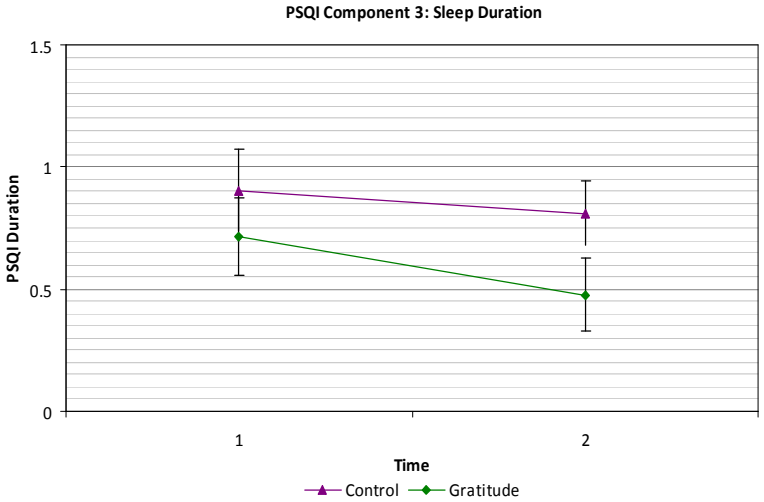
What have been some of the events or circumstances that have affected you today?

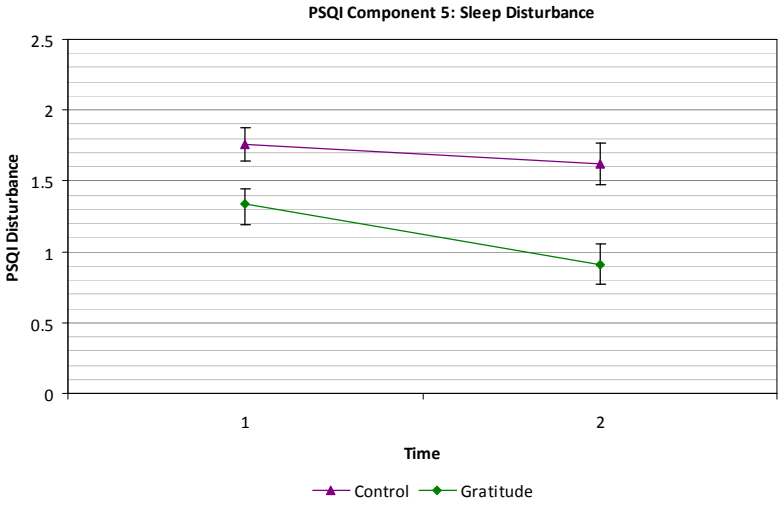
Think back over the **past day** and write down in the boxes below **three things** that have had an impact on you.

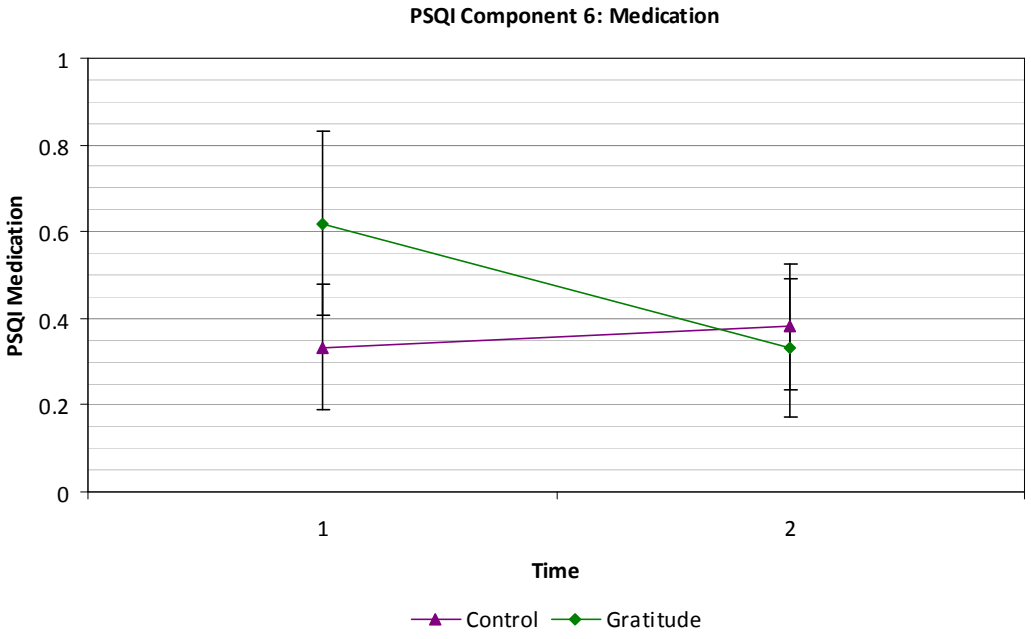
Also write **why** each happened.

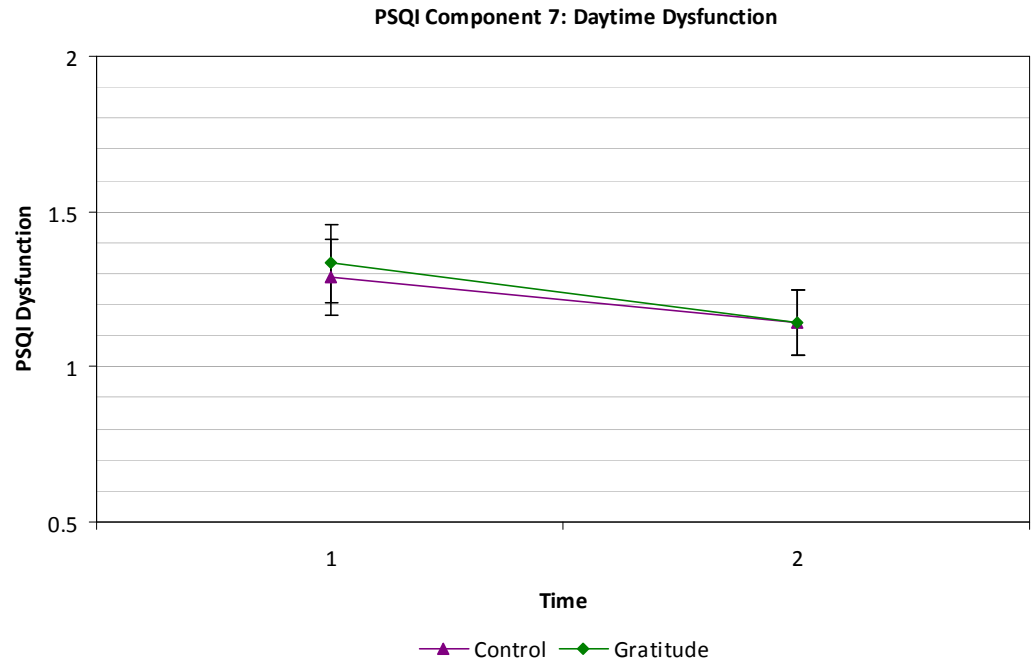

PSQI Component 2: Sleep Onset Latency
PSQI SOL
2.5
2
1.5
1
1
2
Time
Control
Gratitude


PSQI Component 4: Habitual Sleep Efficiency
PSQI SE
1.5
1
0.5
0
1
2
Time
Control
Gratitude


PSQI Component 3: Sleep Duration
PSQI Duration
1.5
1
0.5
0
1
2
Time
Control
Gratitude


PSQI Component 5: Sleep Disturbance
PSQI Disturbance
2.5
2
1.5
1
0.5
0
1
2
Time
Control
Gratitude


PSQI Component 6: Medication
PSQI Medication
1
0.8
0.6
0.4
0.2
0
1
2
Time
Control
Gratitude


PSQI Component 7: Daytime Dysfunction
PSQI Dysfunction
2
1.5
1
0.5
1
2
Time
Control
Gratitude

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