Sleep Self-Regulation: Understanding and Improving the Sleep Initiation Process in Daytime Employees

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Abstract

Sleep deprivation is a significant problem in the modern workplace and has negative consequences for employee health. There has been recent emphasis on the need to better understand principles of self-control and the study of sleep-related behaviour provides the perfect avenue to enlighten this area. Moreover, whilst the effects of sleep deprivation are becoming better understood, there remains few strategies to help non-clinical populations to sleep better. The focus of this thesis was on identifying factors associated with sleep loss in employees and developing efficient psychological strategies to improve sleep patterns in these workers. A sleep self-regulation model was developed to guide the research. Measures included the Pittsburgh Sleep Quality Index (PSQI) and the Copenhagen Psychosocial Questionnaire. In the first study, analysis of the baseline data from 91 daytime employees indicated that giving sleep a high priority was associated with higher levels of pre-sleep arousal which in turn was linked with greater sleep difficulty (shown by higher PSQI scores). Work-goal motivations (personal commitments to achieving goals at work) were associated with a faster time to sleep and improvement in pre-sleep arousal yet poorer sleep quality and greater sleep difficulty. Results from mixed model analyses of daily reports of sleep behaviour collected over the remaining 10 days suggested that (1) higher cognitive demands at work were associated with later time of lights out (beginning to try and go to sleep) that night; (2) higher emotional demands at work predicted both an earlier time of lights out that night and an earlier time of waking the next morning; and (3) positive emotions arising from work-related events and finding work to be meaningful were associated with better sleep quality that night. These results supported the need to utilise self-regulation techniques to protect sleep from being influenced by external demands and internal reactions to these demands.

The aim of the next three studies (two intervention development studies and a larger randomised controlled trial) was to develop a sleep self-regulation intervention that could be delivered efficiently to the wider non-clinical population. The final randomised controlled trial assessed the efficacy of four mental imagery techniques: (1) imagery focused on arousal reduction techniques; (2) imagery incorporating implementation intentions (a strategy designed to link specified behaviour with the anticipated context) for sleep-related behaviour; (3) a combination of imagery using arousal reduction and implementation intention strategies; or (4) a condition where participants were asked to imagine their typical post work activities. A total of 104 participants completed an online, daily diary of sleep behaviours and, at baseline and Day 21, an online questionnaire. Improvement in several sleep-related indicators occurred across all groups. Moreover, relative to groups not using the implementation intentions imagery, groups using this imagery exhibited a greater reduction in negative sleep habits, greater sleep-related self-efficacy, and greater improvements in the sleep-related actions targeted in the imagery exercise. Mixed model analyses also suggested greater improvements in daily perceptions of sleep quality and time to sleep from using the implementation intentions imagery. These studies represent one of the first examples of the application of implementation intentions to sleep-related behaviour. The importance of time cues for instigating behavioural change, including behaviours that are strongly habitual (e.g. time of lights out), are also highlighted. In summary, results point to the utility of an empirically based intervention delivered online at low cost and high convenience to a population of busy employees.

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LIST OF ABBREVIATIONS

ANOVA - Analysis of Variance

AR - Arousal Reduction Imagery

CBT - Cognitive Behavioural Therapy

CD - Compact Disk

CSM - Commonsense Model of Self regulation of Health and Illness

DSM-IV - Diagnostic and Statistical Model - IV

HAPA - Health Action Process Approach

II - Implementation Intentions Imagery

PSQI - Pittsburgh Sleep Quality Index

RCT - Randomised Controlled Trial

SRCT - Sleep-Relevant Cognitions Test

CHAPTER 1 OVERVIEW OF THESIS

At the women's triathlon during the 2008 Olympics in Beijing, a commentator stated that "The difference between a good race and a bad race can simply be a good night's sleep" (One Network News, 18th September 2008). Like athletic performance, productivity in the modern workplace can also decline when individuals are sleep deprived, though much remains to be learnt on how to improve sleep in this population. Guided by a sleep self-regulation model, this thesis has a dual focus on identifying work-related factors contributing to sleep loss in a population of employees and developing efficient psychological strategies to improve sleep patterns and related behaviour in these workers. Self-regulation has been defined as involving behavioural control and planning, and is conscious, deliberative and goal directed (Hagger, 2010). Based on this definition, the sleep self-regulation model suggests that one's ability to consciously plan for the goal of getting enough quality sleep may benefit from tighter behavioural control. At the same time, individuals attempt to control their cognitions, emotions and behaviours that result from work-related demands. The first study investigated specifically how emotions and demands relating to the workplace may have differential influences on sleep. A new assessment technique was also developed to investigate in more detail which of the intended sleep-related behaviours was most likely to interfere with sleep. The prevalence of untreated sleep deprivation in the general population was the basis for a self-regulation intervention that could be delivered efficiently to non-clinical populations in the workplace and other settings. To ensure the intervention was transportable to the modern workplace, mental imagery techniques were incorporated which allowed for efficient tailoring of messages.

Structure of Thesis

Chapters are organised around the descriptive study and the main randomised control trial (RCT) and include summaries of two intervention development studies designed to test key components of the RCT. The thesis begins with introductory chapters reviewing theory and research on sleep deprivation and its development and why daytime employees are an at-risk population. Next is a theoretical overview of self-regulation processes involved in the context of work and sleep. In this chapter the sleep self-regulation model is also described. The next set of chapters summarise the online, descriptive study investigating the relationships of various work-related demands and emotions with sleep quality and behaviour in daytime employees. Following on is how findings from the descriptive study were used to inform the development and assessment of the imagery-based sleep intervention studies. The methodology for the three intervention studies is then presented followed by a chapter summarising the results from the first two of these studies. Results of the main RCT of imagery techniques for promoting sleep initiation is then presented before a discussion of the key findings. The thesis finishes with an overview of possible directions for future research, and a general conclusion.

CHAPTER 2 SLEEP DEPRIVATION AND ITS DEVELOPMENT

A critical function for human survival, sleep is essential for physical and mental well-being. Much research has concentrated on clinical diagnoses of insomnia (e.g. Daley, Morin, LeBlanc, Gregoire, & Savard, 2009; Morin, Bootzin, et al., 2006; Vincent & Lewycky, 2009) yet the wider population who experience sleep difficulty but continue to function in society has been largely neglected. In this chapter, the distinction between clinical diagnoses of insomnia and sleep deprivation is highlighted. One reason for the lack of focus on sleep deprivation in the wider population is that the consequences on health are poorly understood. Current understanding of the direct and indirect health consequences of sleep deprivation is summarised to emphasise the importance of continuing to find ways to improve sleep. Key sleep-related indicators that enable researchers and clinicians to examine sleep patterns will also be discussed. Finally, individual differences in risk factors for sleep deprivation are addressed.

Insomnia versus Sleep Deprivation

Sleep deprivation can occur either acutely (over a 24-hour period) or chronically (over a period of weeks, months or even years) through a cumulative loss of sleep (Rosekind, Flower, Gregory, & Jung, 2005). This deprivation can induce a state of reduced capacity (Barnes & Hollenbeck, 2009) in daily functioning (Harrison & Horne, 2000b). One form of chronic sleep deprivation is insomnia, a condition that is highlighted as one of the most prevalent psychological disorders (Jansson-Frojmark & Linton, 2008). Insomnia involves a cluster of symptoms that include subjective sleep complaints, negative daytime functioning, and severe distress in other vital areas of functioning such as mental health (e.g. likely to cause affective and anxiety disorders) (Morin, LeBlanc, Daley, Gregoire, & Merette, 2006). Sleep complaints of individuals with this condition include difficulty falling asleep at bedtime (i.e. problems with time to sleep), awakening during the night and having difficulty going back to sleep (i.e. problems with sleep maintenance), and awakening too early in the morning (i.e. terminal insomnia) (Morin, 1993). One recent study found that 74% of people with sleeping difficulty reported problems for at least one year, with 46% reporting distress for the full 3-year period of the study (Morin, et al., 2009).

Various criteria for the diagnosis of insomnia have been set, which has led to confusion as to its prevalence (Edinger, et al., 2004). For example, one review (Lichstein, Durrence, Taylor, Bush, & Riedel, 2003) established that the most appropriate criteria for its diagnosis is a time to sleep of ≥ 31 minutes for ≥ 3 nights per week for ≥ 6 months. The Diagnostic and Statistical Manual version IV (DSM-IV) provides a more detailed and slightly different description of the criteria (Edinger, et al., 2004). Specifically, formal diagnoses of insomnia now tend to rely on perceptions of sleep quality and duration along with daytime functioning rather than objective physiological measures (Buysse, 2005). Given the variation in diagnostic criteria, it is now recommended that to capture all domains or components of insomnia, multiple measurement systems should be used (Morin, 2003). First, the individual must have difficulty initiating sleep, difficulty maintaining sleep, waking too early or having sleep that is chronically non-restorative. Second, the sleep difficulty should occur despite adequate opportunity and circumstances for sleep. Third, there should be some form of daytime impairment related to the night-time sleep difficulty.

It is in the second component of the DSM-IV that the distinction between individuals with sleep deprivation and people with clinical insomnia becomes apparent. Individuals who are sleep deprived but do not have insomnia may have difficulty sleeping because they do not allow themselves the appropriate opportunities and circumstances for sleep rather than experiencing hyper-arousal. One study also found subtle, biological differences between individuals with insomnia and people who are merely sleep deprived or otherwise normal (Altena, Van Der Werf, Strijers, & Van Someren, 2008). For example, individuals with clinical insomnia were faster than normal controls on a simple vigilance task, yet they were relatively slower on a more complex vigilance task. Studies estimate that 10 to 40% of the general adult population are chronically sleep deprived and for many due to lifestyle choices (for a review see E. Kronholm, et al., 2008; Linton & Bryngelsson, 2000). Yet, in contrast to the significant amount of research on insomnia (e.g. Morphy et al., 2007; Ohayon, 2002), there is a relative lack of understanding on sleep deprivation in this general population (Jansson-Frojmark & Linton, 2008). Further, sleep deprivation is largely under-treated in New Zealand and other countries (Drake, Roehrs, & Roth, 2003; The MaGPIe Research Group, 2005).

The Health Consequences of Sleep Deprivation

Reduction in alertness from sleep deprivation can have major effects on learning and cognition, health behaviours, job performance, and personal life including stress, well-being and relationships with significant others (Papp, et al., 2004). Sleep deprivation can also affect one’s ability to work effectively (for a review see Harrison & Horne, 2000b). As such, individuals who are sleep deprived appear to have an overall poor quality of life (Drake, Roehrs, & Roth, 2003) and are also thought to be at a greater risk of developing a chronic disease (Hagger, 2010)To further understand the links between sleep deprivation and chronic disease, more direct links between sleep deprivation and health behaviours can be investigated.

Many health behaviours require high motivation or considerable self control and so their use may deteriorate with sleep deprivation (Engle-Friedman, et al., 2003; Pilcher & Odle-Dusseau, 2005); one health behaviour significantly affected being diet (Imaki, Hatanaka, Ogawa, Yoshida & Tanada, 2000). A short sleep duration is also linked to an increased body mass index as a result of decreased levels of leptin and ghrelin hormones regulating appetite (Taheri, Lin, Austin, Young, & Mignot, 2004). Smoking nicotine can also directly interfere with sleep according to research on sleep hygiene (e.g. Mastin, Bryson, & Corwyn, 2006). Evidence that health behaviours are linked (Ussher, Sampuran, Doshi, West, & Drummond, 2004) supports the associations found between lifestyle behaviours and sleep patterns. The relationship between sleep and health behaviour is suggested to be reciprocal as other evidence suggests that level of exercise and poor diet can affect sleep patterns (for a review see Atkinson & Davenne, 2007).

Much of the research has focused on the reciprocal relationship of sleep and health behaviour at a cross-sectional level (Donaldson, Sussman, Dent, Severson, & Stoddard, 1999; Trockel, Barnes, & Egget, 2000) rather than over time, thereby limiting understanding of the flow-on effects of improving sleep on other behaviours. A related study investigated sleep patterns as a moderator of work demand alongside alcohol use and physical activity and found sleep patterns influenced psychological outcomes (e.g. depression) but not physical symptoms (e.g. headaches, intestinal upset) (Dolan, Adler, Thomas, & Castro, 2005). The study also found no correlation between hours of sleep and the health behaviours of alcohol intake and exercise. However, the data was collected from a population of United States soldiers who may have followed strict health behaviour regimens because of their need to meet certain fitness requirements. The extent to which changes in sleep patterns can influence the health behaviours of a wider population who do not face such requirements requires further investigation. Further understanding of these links may also shed light on the longer-term associations between sleep deprivation and chronic disease.

Chronic Disease

Sleep deprivation has been identified as a precursor for a number of chronic diseases and is even thought to affect all-cause mortality (D. J. Taylor, Lichstein, & Durrence, 2003). For example, sleep deprivation is proposed to be a precursor for depression and anxiety disorders (Morphy, Dunn, Lewis, Boardman, & Croft, 2007; Ohayon & Roth, 2003); cardiovascular disease (Kawachi, et al., 1995; Newman, et al., 2000); and colorectal cancer (Schernhammer, et al., 2003). The majority of studies highlight a link between disruptive patterns of sleep and mortality although some also demonstrate that this risk diminishes considerably when controlling for co-morbid risk factors (Kripke, Marler, & Calle, 2005).

Sleep problems also often occur alongside more general physical and mental health problems. For example, total sleep time has been found to be related to depressed mood in a non-clinical population (Kawada, Katsumata, Suzuki, & Shimizu, 2007). Sleep deprivation occurring alongside chronic disease has been linked with increased levels of role disability and functional impairment (Stein, Belik, Jacobi, & Sareen, 2008) and poor sleep quality has also been related to poor adherence to anti-viral medication in HIV affected women (K. D. Phillips, et al., 2005). Yet the full extent of the deleterious effects of sleep deprivation on chronic disease is still relatively unclear. For example, evidence is limited as to whether sleep disruptions cause disease, compromises resistance to disease or is associated with other instigators of disease (Sarsour, Morin, Foley, Kalsekar, & Walsh, 2010). Nevertheless, investigating direct associations between sleep deprivation and health behaviours can provide information on the more indirect relationships with chronic disease.

Indicators of Sleep Quality

To further understand sleep and how it can be affected by work-related factors in the current population, it is necessary to identify the factors of sleep that can be used as indicants of sleep deprivation. These include the dependent variables of stages of sleep, sleep quality, the time to sleep, sleep maintenance, hours of sleep, time of lights out, time of waking and pre-sleep arousal.

Sleep Stages

The most common objective tool for measuring sleep is electroencephalography (EEG), where electrodes are placed on the scalp to measure the electrical waves of the brain (Horne, 1988). These waves are measured in terms of amplitude (the voltage between the peak and trough of a wave) and frequency (the number of complete waves or cycles occurring in one second). As sleep deepens, amplitude tends to increase and frequency falls. Through analysing EEG, sleep is traditionally divided into a series of stages. Stage zero represents a waking state, in which wakefulness alpha (relaxed) and beta (alert) activity occur. In stage one, sleep theta activity is recorded by the EEG and eye rolling occurs as the eyelids slowly open and shut a few times. This is known as a transition stage from drowsiness to true sleep. Stage two is defined by the presence of K complexes and Sleep Spindles with the bulk of human sleep (roughly 45%) made up of this stage. Cognitive processing of information is also most likely to occur in stage two. In stage three, delta waves start to appear. Known collectively with stage four as “slow wave sleep”, the person is moving into a deep sleep and blood pressure drops at this point. The progression of sleep to stage four is subtle and defined as such when over 50 percent of the waves are delta waves. This is the deepest stage of sleep. Finally, in REM sleep, theta and beta activity occurs. This final stage of sleep is delineated as that where dreaming occurs (Yu, 2007). When a person does not experience the deeper stages of sleep for sufficient duration, it can affect perceptions of the quality of sleep, (Torsvall & Akerstedt, 1988). As measurement using EEG is difficult with the community sample recruited for the studies conducted in this thesis, only perceptions of the quality of sleep could be measured.

Sleep Quality

Evidence suggests that perceptions of sleep quality are stronger predictors of fatigue and general well-being than are objective measurement of the hours of sleep (Pilcher, Ginter, & Sadowsky, 1997; Rook & Zijlstra, 2006). Sleep quality has also been linked to hours of sleep, sleep continuity and the deeper sleep of stages three and four (Akerstedt, Kecklund, & Gillberg, 2007). Ease of falling asleep has also been shown to have an effect on these perceptions. For example, rumination in the pre-sleep period following a stressful event has been found to reduce sleep quality in individuals who have a dispositional tendency to ruminate (Guastella & Moulds, 2007; Thomsen, Mehlsen, Christensen, & Zachariae, 2003). There is general agreement that the duration of sleep, length of time to get to sleep, time of lights out and getting up, quality of sleep and maintenance of sleep throughout the night all influence how sleep is experienced (Akerstedt, 2006). However, the degree to which any one of these factors is important for overall quality of sleep or how they interact to influence self-perceptions of sleep needs more investigation.

Time to Sleep

The onset of sleep can be described as a progressive loss of consciousness, reduction of stimulus reception, decreasing behavioural response and a lack of memory (Tang & Harvey, 2004). Diagnoses of insomnia and other forms of sleep difficulty usually involve a time to sleep of greater than 30 minutes (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989; Lichstein, et al., 2003). Increasing motivation for sleep has been found to reduce the length of time it takes to fall asleep (Harrison, Bright, & Horne, 1995) and could be targeted to prevent sleep onset difficulties from occurring. It is also argued that reducing cognitive activity rather than trying to suppress it is likely to lead to a shorter time to sleep (Harvey, 2003). However, not all individuals who experience difficulties sleeping have problems getting to sleep. It is important therefore to control for people who may be experiencing other issues with sleeping such as difficulty with sleep maintenance. Research has also found that individuals who described their sleep quality as poor had a significantly longer time to sleep (Pace-Schott, Kaji, Stickgold, & Hobson, 1994). Given the relative importance placed on this variable for sleeping well, it is important that time to sleep is also assessed as a primary outcome.

Sleep Maintenance

Most people are able to sleep through the night (unless disturbed by an external stimulus) and are able to suppress other aspects of functioning (e.g. desire to drink, eat or void). There is a sub-area of sleep disorders (categorised as sleep-maintenance insomnia) where people do experience broken sleep by awakening completely in between many of the sleep cycles (Bonnet, 1985; Morin & Espie, 2003). For individuals whose arousal levels are too high, waking during the night can be common (Waters, Adams, Binks, & Varnado, 1993). This waking may have direct negative influences on one’s health. For example, micro-arousals during sleep have been associated with morning cortisol, heart rate, systolic and diastolic blood pressure, and total cholesterol and its indicators (high and low density lipoprotein) (Ekstedt, Akerstedt, & Soderstrom, 2004). Should night-time waking occur, research suggests that it can lead to daytime sleepiness and impairments in functioning (e.g. on mood and performance) the following day (e.g. Bonnet, 1985). Although it is important to define the types of difficulties people may have with sleeping, arousal levels can affect all stages and so participants with sleep maintenance issues as a cause of their sleep deprivation were included.

Hours of Sleep

The amount of sleep needed can fluctuate according to a number of individual factors (Moore & Minhoto, 1997). Nevertheless, evidence shows that when nocturnal sleep is reduced by 1.3 to 1.5 hours for one night for any individual, daytime alertness can be reduced by as much as 32% (Bonnet & Arand, 1995). Sleep deprivation beyond these levels is common in the general population and, in particular, individuals who are employed (Hakkanen & Summala, 2000; Hublin, Kaprio, Partinen, & Koskenvuo, 2001). For example, it is estimated that over the past century the hours of sleep in

Americans has decreased by around 20 percent (NCSDR, 1994). People can be grouped into three categories according to the length of their sleep duration: “short sleepers” (6 hours or less); “mid-range sleepers” (7-8 hours); and “long sleepers” (9 hours or more) (Erkki Kronholm, Harma, Hublin, Aro, & Partonen, 2006). Generally, sleep durations of less than six hours per night are associated with suboptimal health (Kojima, et al., 2000). Other research suggests a slightly higher threshold with less than 6.5 hours per night seen as harmful (Chatzitheochari & Arber, 2009). The average adult tends to fall into the mid-range category of 7-8 hours a night (Morin & Espie, 2003). At the other end of the spectrum, sleeping for too long (10 hours per night or more) may also be damaging for one’s health (Harrison & Horne, 1996). When testing the small number of people in the population who claim to routinely sleep less than 6 hours, there was a tendency for sub-clinical hypomania symptoms to appear (Monk, Buysse, Welsh, Kennedy, & Rose, 2001). In addition, these “short sleepers” were found to wake up at the same time as standard sleepers and instead lose their sleep by going to bed at a consistently later time. One study by Monk et al (2001) found that increased sleepiness from insufficient sleep is more a result of behavioural and/or health factors from short sleep rather than hours of sleep per se. Further evidence suggests that sleep debt tends to affect sleepiness the next day when measured subjectively but not objectively (Sallinen, et al., 2004). Although self-reports of sleep hours seem to be an important contributor to how sleep quality is perceived, other factors like the time of going to sleep may also be important.

Time of Lights Out

Of all the factors relating to sleep quality, the time that one turns off the lights and attempts to go to sleep is probably the most amenable to change from a behavioural perspective. Through the use of modern technologies such as electricity, people can now choose to stay up much later than was the case in earlier times. Employees also are able to bring work home more easily and therefore may decide to work late into the night rather than going to bed at an appropriate time. Entertainment provided by computers and television is now available for 24 hours a day in many areas of the world and may be seen as a more desirable activity than going to bed and to sleep (Asaoka, Fukuda, Tsutsui, & Yamazaki, 2007; Basner et al., 2007). Given that the ability to sleep in is usually more restricted from social demands such as presenting at work, going to bed at a certain time (usually prior to midnight) is seen as being an important step to getting sufficient sleep (Yaniv, 2003).

Time of Waking

In general, the majority of people tend to have regular waking schedules, particularly individuals who wake without the use of alarm clocks (Matsuura, Hayashi, & Hori, 2002). This is largely the result of external factors such as the restrictions with work or family that ensure people are up and about at a certain time. Yet, a significant proportion of the general population wake up prior to a time where they would feel rested and have trouble getting back to sleep again (Morin, 1993). One cause of early morning waking that has received less investigation is when anxiety about an event or deadline the following day leads to early awakening. For example, when individuals have to get up early to catch a plane or attend an early morning meeting they may wake up earlier than anticipated for fear of over-sleeping. Evidence suggests that the cortisol wakening response is greater on work days than on weekend days implying that greater anticipatory anxiety is experienced for an individual's working life than their personal one (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004). Moreover, the increase in cortisol is linked to anxiety about a future situation rather than events that have already occurred. The effect of anticipated events and cross-over effects from the previous day's demands and events on time of waking remains relatively unknown.

Pre-Sleep Arousal

The appraisal process following sleep deprivation can include analysis of how work-related influences are affecting one's ability to get to sleep which, in turn, can affect one's general state of arousal (pre-sleep arousal). A person is said to experience high pre-sleep arousal when they display cognitive symptoms (e.g. intrusive thoughts) and somatic symptoms (e.g. tense muscles) that create difficulty in shutting the mind and body down for sleep (Nicassio, Mendlowitz, Fussell, & Petras, 1985). As well as being a sleep-related indicator in its own right, pre-sleep arousal is an important contributor to perceptions of sleep quality (Akerstedt, Kecklund, & Axelsson, 2007; Morin, Rodrigue, & Ivers, 2003). Pre-sleep arousal was also included as a dependent variable because it could prove to be a useful indicator of motivation level in the subsequent intervention studies and provide a means to test regulation of the cognitive and emotional representations of work stress. Finally, pre-sleep arousal is important because it can negatively affect a person even if their actual sleep is not impaired (i.e. can be distressing).

Demographic Differences in Sleep Quality

Individual characteristics of sleep patterns are well researched (Hublin, Kaprio, Partinen, &

Koskenvuo, 2001) and should be taken into account when studying sleep. Individual differences may affect sleep directly or through the lifestyles and work practices (Kaleta, Makowiec-Dabrowska, & Jegier, 2006). The primary characteristics that were investigated across studies conducted for this thesis included age, gender, occupational type, and marital status. Many of these characteristics have been used as a means of categorising people in terms of degree of risk for sleep problems.

Age

One of the primary characteristics predicting quality and duration of sleep is a person's age (Morin & Espie, 2003). Age can also affect the extent to which sleep is exchanged for other waking activities (Basner et al., 2007). Many sleep studies indicate that sleep difficulties are higher in older adults (e.g. Akerstedt, Fredlund, Gillberg, & Jansson, 2002), although at least one study has found no difference between older and younger adults in terms of hours of sleep (Pilcher, Schoeling, & Prosansky, 2000). On the other hand, there is strong argument for research focusing on the young adult population (e.g. Coren, 1994; Suen, Hon, & Tam, 2008) as sleep deprivation is high in young adults in the 20-34 year-olds age bracket (Bernert, Merrill, Braithwaite, Van Orden, & Joiner, 2007; Doi, Minowa, & Tango, 2003). The discrepancy between preferred and actual sleep time has been found to be highest in adolescents (Oginska & Pokorski, 2006). The young adult population may be sleep deprived as a result of the enjoyment of freedom in their work and university study without being constrained by the role responsibilities associated with marriage and parenthood (Arnett, 2000; Suen et al., 2008). The ability to self-regulate one's behaviour, which is critical for sleeping well, is also thought to develop slowly and may not be fully developed in adolescents or young adults (Peverly, Brobst, Graham, & Shaw, 2003). Therefore, the younger age-group may be a good population to target with interventions designed to improve self-regulation skills such as ignoring social cues in order to go to sleep. In one study, sleep delays, thought to be the most significant contributor to these sleep problems, were more strongly related to social than academic causes (Suen, Hon, & Tam, 2008). In summary of this research, employees from a wide age range should be targeted due to the relative risk factors associated with each age group.

Gender

The majority of studies report that the prevalence of sleep difficulties is higher in females than in males (e.g. Akerstedt, Fredlund, et al., 2002; Leger, Guilleminault, Dreyfus, Delahaye, & Paillard, 2000). Females also show a greater need for sleep than males and exhibit higher levels of daytime sleepiness when sleep deprived (Oginska & Pokorski, 2006). Hours of sleep may show a different pattern, though, as a study from Finland reported that men slept for less time than women, particularly amongst working-age men (Kronholm et al., 2008). It is important not to take these gender differences regarding perception of sleep at face value however. For example, it is suggested that the male relationship with sleep is far more complex than originally thought (Meadows, Arber, Venn, & Hislop, 2008) and may depend on the nature of the male's role (e.g. worker, father, and husband). The recent trend towards more flexible but irregular hours (Costa, et al., 2004) may also have differential effects on sleep patterns for women in comparison to men. Specifically, due to a greater tendency of women to take on childcare roles in the family (Simon, 1995), women may be more likely than men to take up the flexible hours but less likely to experience recuperation (needed for sleep) from the arrangement.

Occupation

Much sleep-related research has been conducted on occupations associated with shift-work (Nakata, et al., 2004; Rosekind, et al., 2005). Although these employees represent an at-risk population, they are not alone in their experience of sleep difficulty. In a sample of 12,779 French people, the highest rates of sleep difficulty were seen amongst white collar workers (20.8%) (Leger, et al., 2000). Socioeconomic status linked to occupation type may also contribute to the association found between occupation and insomnia(Gellis, et al., 2005). Nevertheless, the relationship between employment status and poor sleep quality has been found to no longer be significant when various work characteristics are controlled (Sekine, Chandola, Martikainen, Marmot, & Kagamimori, 2006). Confusion remains as to exactly which occupational indicators are associated with sleep difficulty (i.e. education, income, employment length or actual occupational type (Metlaine, Leger, & Choudat, 2005). Moreover, there is argument that prevalence of sleep deprivation within the working population as opposed to the general population is not well understood. Investigation of this population provides further insight into how employees regulate behaviours when control over choices like when to go to sleep is possible.

Marital Status

People who are single are reported to have the lowest rates of sleep difficulty with widows in contrast reporting the highest (Leger, et al., 2000). The most common sleep complaint in the latter group was difficulty initiating sleep. However, in this study, when age and sex were controlled, no significant difference amongst individuals of different marital status emerged. Being married is also thought to act as a risk factor for experiencing long or short sleep durations (Erkki Kronholm, et al., 2006). A variety of factors may be responsible for this relationship. Disturbance by one's partner may be a primary cause of poor sleep in this group as sleep disordered breathing or snoring by the bed partner may affect a person's sleep patterns(Worthman & Brown, 2007). Moreover, work stress can carry over and not only affect the employee's sleep but the patterns of the person who shares the room with them (Jones & Fletcher, 1996). In turn, the partner can go on to disrupt sleep patterns through frequent night-time awakenings. Yet contrary evidence suggests that sharing a bed space is actually associated with more stable sleep patterns and fewer night-time arousals (Sharief, Silva, Goodwin, & Quan, 2008). Moreover, there is growing argument that the quality of a person's relationship may be more important to one's sleep patterns than marital status per se (Scharfe & Eldredge, 2001; Troxel, Robles, Hall, & Buysse, 2007). Nevertheless, marital status can provide some indication as to the type of sleeping arrangement a person is likely to face so should be included as a possible covariate.

How Predisposing Factors Interact with the Environment

Evidence is accumulating of the situational determinants of sleep difficulty, yet there is still no consensus as to which factors influence sleep the most and how situational influences interact with existing characteristics (Drake et al., 2003; Fortunato & Harsh, 2006). One suggestion is that problematic beliefs relating to sleep combine with a variety of situational social, work, and health-related behaviours to increase arousal and distress, which then interfere with sleep (Harvey, 2002). For example, evidence suggests that a relatively large proportion of individuals who have chronic sleep deprivation use alcohol to help them sleep with many also arguing that it is effective (Ancoli-Israel & Roth, 1999; Daley, et al., 2009). Contrary to these lay arguments that alcohol is a sleep aid, research indicates that alcohol is listed as one of the factors that interferes with sleep (e.g. Mastin, et al., 2006). In addition to alcohol, many other environmental, social, and cultural factors can contribute to these psycho-physiological arousal processes influencing sleep (Neubauer, 2006). The workplace arguably represents a common source of precipitating factors for sleep deprivation (Bastien, Vallieres, & Morin, 2004). Yet there is a lack of prospective longitudinal designs on sleep deprivation in the employee population to investigate these influences as most of the literature has come from exclusively clinical samples (Jansson-Frojmark & Linton, 2008). Guided by a sleep self-regulation model, the present research is designed to explore the role of work-related events and experiences as contributing factors influencing sleep deprivation and then develop and evaluate an intervention strategy for improving the self-regulation of sleep.

Measurement of Sleep Self-Regulation

Sleep behaviour is complex and prone to bias when measured by self-report (Gehrman, Matt, Turingan, Dinh, & Ancoli-Israel, 2002). To reduce the effects of self-report biases and adequately capture the complexity of sleep behaviour, measurement tools have typically incorporated a variety of sleep-related indicators. The most established of these measurement tools is the Pittsburgh Sleep Quality Index (PSQI; Buysse, 1989). The PSQI covers seven dimensions of sleep including its quality, duration, length of onset, efficiency, disturbances during the night, medication use and effects on daytime functioning. While using tools like the PSQI provide a good benchmark as to a person's sleep patterns, it is also important to take into account the contextual nature of sleep behaviour and how it can change on a daily basis. The present studies were designed to include two additional measurement strategies aimed at providing data that would complement reports obtained through more traditional, cross-sectional measures of self-reported experiences. The first of these measurement strategies was a new narrative based instrument designed to assess sleep decisions following a hypothetical scenario. The second measurement strategy was a daily diary approach to assess sleep behaviours over time.

Sleep-Relevant Cognitions Test* (*SRCT)

To provide more understanding of the decision-making process involved in sleep behaviours, a narrative-based SRCT was developed and administered. The measure was first tested for construct validity by a group of psychologists from within the university before being closely examined for predictive validity in the online descriptive pilot study (31 participants). The tool was similar to a narrative, "story completion task" developed by Norris and Devine (1992) to assess decisions to partake in safe sexual activity. These types of instruments have primarily been used as an assessment tool for use with younger children to determine developmental stages for a variety of cognitive constructs. For example, studies using this type of instrument have investigated meta-representational reasoning (Lucariello & Mindolovich, 1995); adolescent risk taking (Moore, Gullone & Kostanski, 1997); and perceptions of family relationships (Laible, Carlo, Torquati, & Ontai, 2004). In addition, story completion tasks have been used in a young adult population to explore men's and women's understandings of "unfaithful" heterosexual relationships (Kitzinger & Powell, 1995). This type of test may be particularly useful when the researcher suspects that there are barriers to using direct self-report. Moreover, story completion tasks can mimic actual behaviour (e.g. Moore et al, 1997). A narrative can evoke emotions, attention, imagery and cognitive processing through a focus on story events and, if done well enough, can transport the person into the world that the narrative has created

(Green, 2006). This narrative approach thus has the potential to aid further understanding of sleep self-regulation particularly because it may trigger memories and assist recall of behaviour that often occurs at a sub-conscious level.

Longitudinal Measurement of Sleep Patterns

It is often recommended that people suffering from sleep problems keep a sleep diary in order to identify the source and nature of their poor sleep-related habits (Institute of Medicine of the National Academies, 2006). This principle holds true for sleep researchers as well. Greater accuracy can be gained when measuring sleep on a daily basis rather than using self-reported averages of sleep behaviour over a particular (e.g. two-week) time period (e.g. Ashworth, Burke, & McCracken, 2008). One reason is that sleep patterns can be highly variable over time, especially for individuals who are sleep deprived (Vallieres, Hansivers, Bastien, Beaulieu-Bonneau, & Morin, 2005). Therefore, multiple assessments over time are needed to make sense of the patterns. There has been strong argument in the literature for more researchers to use multilevel statistical procedures to assess the daily process in order to better understand health behaviours (Affleck, Zautra, Tennen, & Armeli, 1999; Hamilton, et al., 2008). Multi-day measurement has also been called for to understand the intricacies between daily demands and indicators of poor health (DeLongis, Folkman, & Lazarus, 1988). Nevertheless, there appears to be a lack of understanding on how beliefs and sleep-patterns co-vary on a daily basis. Understanding these relationships may provide insight into how self-regulation of emotions and cognitions can affect the self-regulation of sleep-related behaviour.

Summary

Sleep deprivation remains a significant health problem in society. In order to alleviate sleep deprivation, however, it is important to understand the social, psychological and behavioural processes influencing sleep quality and behaviour. To date, much research has focused on treating insomnia and yet a large proportion of the population experiences sleep difficulties and may benefit from interventions aimed at promoting healthy sleep habits. Understanding of the interaction between healthy sleep habits and other health behaviours may also provide information on the more indirect links previously found between sleep deprivation and chronic disease. The causes of sleep deprivation in individuals who are sleep deprived but fall into the non-clinical group also need further elucidation before they are targeted for intervention. Demographic characteristics of these individuals and how these characteristics interact with the environment should be considered along with a careful approach to the measurement of what it means to be sleep deprived. The next chapter will provide insight into the environment of the workplace from which sleep deprivation may originate.

CHAPTER 3 THE WORKPLACE AS A TARGET FOR INTERVENTION

In Japanese there is a word, "Karoshi", which means "death by overwork". This word reflects a culture that has driven its workers into a lifestyle that leaves people regularly lacking sleep and dying young (Doi, et al., 2003). Yet Japan is not alone in its need to improve the health of its workers. Recent research (e.g. Basner, et al., 2007) suggests that the workplace is one of the primary sources of poor sleep in many Western countries. One reason for the link is the modern workplace is now more service-orientated, white-collar, and technologically driven, often with low job security and greater overlap between the work and home life (Jones, Burke, & Westman, 2006; Jones, Kinman, & Payne, 2006). As such, mental demands are higher which can increase difficulty in initiating the shut-down process required for a good sleep.

There is an increasing number of studies attempting to examine or promote sleep in shift workers (Bambra, Whitehead, Sowden, Akers, & Petticrew, 2008; Costa, 2003; Van Reeth, 1998) and long-haul drivers (e.g. Hakkanen & Summala, 2000). However, more insight is needed regarding regular day workers, how they make decisions around behaviours leading to sleep, and how their work affects these decisions. To highlight why this population is at risk for sleep deprivation and poor health, this chapter will discuss the economic burden of sleep deprivation and the need to improve the health of employees. It will then focus on identifying the gaps in understanding exactly how sleep deprivation can originate from the workplace. Possible contributors to sleep deprivation discussed include quantitative, cognitive and emotional demands, work goals, work-role conflict, meaning of work and work-related emotions.

The Hidden Costs of Sleep Deprivation in the Workplace

Over the past few decades, there has been an increased focus on the workplace as a target for improvement of the health of its workers. For example, in the USA, 93% of companies are offering health promotion and management programmes (Kickbusch & Payne, 2003). The hidden costs of being sleep deprived for the individual and the workplace are considerable. Canadian research indicates that for every dollar spent on maintaining and improving employee health, there is a four to eight dollar return on investment (Makrides, 2004). Despite the recognised need for work-based health interventions and their demonstrated effectiveness in the USA, a recent review found a relative lack of evidence-based health promotion interventions for the workplace in New Zealand (Novak, 2006). One reason may be that 71% of New Zealand businesses are small (Department of Labour, 2003) and so simply cannot afford the high-cost models used in the USA. Understanding how to improve the health of all workers, including employees in small businesses, may encourage the translation of research into practice. Internationally, there have been calls for health promotion to occur more regularly in the workplace and to attend more carefully to the contributions of task characteristics, work conditions and social aspects to health behaviours as well as general well-being (for a review see Semmer, 2006). With people now taking work home more often (Jones, Kinman, et al., 2006), strategies to improve employee health could also concentrate on the home environment.

A major aim of this thesis was to investigate how the workplace may affect sleep patterns. The importance of investigating the relationship in this direction has become more apparent in recent times with the nature of work changing from largely physical work to primarily mental work (Erkki Kronholm, et al., 2006). As such, the workplace has been reviewed as a potential source of sleep deprivation both directly and indirectly. Direct effects of work on sleep quality have been found to include factors such as shift-work, a work week longer than 48 hours and exposure to vibrations (Ribet & Derriennic, 1999). One direct occupational factor that was related to sleep deprivation was a sense of having to hurry to complete work tasks. Work demands are also likely to affect sleep indirectly through increases in anxiety (Kelly, 2002), or stress (Hall et al., 2000; Healy et al., 1981; Linton, 2004; Utsugi et al., 2005).

Work demands are likely to be a primary source of factors impeding quality sleep, with work-related stress potentially playing a mediation role in the relationship between work experiences and sleep behaviour. For example, for a long time now research has suggested that daytime stress can be associated with increased bedtime arousal and result in more sleep disturbances (Morin & Azrin, 1987). Defining the concept of stress may help to understand how it relates to sleep behaviour. One definition of stress is that it encompasses emotional, cognitive, behavioural and psychological symptoms (Stranks, 2005). Emotional symptoms of stress may include tiredness, anxiety and lack of motivation whereas cognitive symptoms may include an increased likelihood of error and resulting accidents. Yet there are also alternative definitions of stress which present conceptual issues with its measurement. For example, work-related stress is also delineated as an individual, psycho-physiological and subjective state, characterised by a combination of high arousal and displeasure (Warr, 2007). Individual approaches to understanding workplace stress have traditionally concentrated on personality, cognitions (cognitive appraisals) and (coping) behaviours of individual workers (Bohle, 1993).

Proponents of the work adjustment theory (Rounds, Dawis, & Laofquist, 1987) argue that although stable cognitive, behavioural and emotional dispositions underlie perceived stress, situational influences have an impact upon these stable dispositions in both positive and negative ways. Stress can also be viewed very differently according to the culture of the organisation. For example, stress may be ignored, tolerated, deflected, or even celebrated (Fineman, 2003).

Although research on stress in the workplace has increased considerably over recent decades, it is noted that emotional reactions to stressful events and the cognitive appraisals of these reactions are often neglected (Spielberger & Reheiser, 2005). One reason is the majority of research investigating the effect of stress on sleep has been cross-sectional (for a review see Akerstedt, 2006). One study that did measure and analyse daily stress levels over an extended time period found evidence to suggest stressors can have a daily effect on mood and minor health complaints (Repetti, 1993). That is, the authors found that increases in job stressors were associated with a same-day reduction in physical and psychological well-being. Recent research has also demonstrated the utility of designing longitudinal examinations of the workplace with multiple assessment points in order to capture how its changing nature can affect employees (e.g. Grunberg, Moore, Greenberg, & Sikora, 2008).

Work-related problems are one of the most frequently reported by individuals according to a survey of 112 married couples suggesting that work is a significant source of stress in modern life (Schwartz & Stone, 2007). A previous study also found that being bothered at work was associated with poorer sleep quality whereas stressful experiences at home showed no such association (Burgard & Ailshire, 2009). Stressors originating from the workplace may show stronger associations with sleep because the person has less control over their work and so is less able to regulate their behaviour in response to them (Akerstedt, 2006; Akerstedt, Kecklund, & Gillberg, 2007; Haynes, Adams, & Franzen, 1981; Morin, Rodrigue, & Ivers, 2003). Although stress can be difficult to deal with at any time, managing stress in the workplace is often more complex due to the constraints present in the work environment that can restrict the range of acceptable coping responses (Zeidner, 2005). For example, emotional coping (such as by expressing one’s feelings to others in order to gain social support) is often frowned upon by colleagues and management but is nonetheless needed. It has been suggested that it is not just the direct demands which a person needs to cope with in a stressful encounter but also the emotions evoked by these demands. Sources of stress in the workplace known to precipitate insomnia include conflicts with a supervisor, interpersonal relationship difficulties, workload and financial strain (Bastien, et al., 2004).

There is also evidence that work-related stress and work demand can affect health behaviours such as alcohol consumption, diet and exercise (Cohen & Williamson, 1988; Jones, Kinman, et al., 2006). Currently there are calls for studies to investigate the more specific effects of stress on sleep (e.g.

Akerstedt, Kecklund, & Gillberg, 2007; Briner, 1999) rather than attempting to investigate this broad concept on its own as has been done traditionally (Harma, 2006). Through developing the Copenhagen Psychosocial Questionnaire, Kristensen, Hannerze, Hogh and Borg (2005) have provided a tool that can now measure specific stressors in the workplace so as to improve understanding on what factors in the work environment place the greatest demand on individuals. Factors in the workplace investigated in the current study using this tool included quantitative, cognitive and emotional demands, meaning of work and work-role conflict. The more specific emotional states experienced in the workplace environment and the events that cause them will also be elucidated. In support of this additional focus, it has been argued that specific feeling states are more predictive of behaviour than more general, non-specific affective states (e.g. Briner, 1999).

Work Goals

As internal and external resources are limited, to manage work-related demand and to reduce the distractions from work-related events, employees set themselves work goals to achieve (J. D. Abraham & Hansson, 1995) with difficult and specific goals expected to be more motivating (Deci & Ryan, 2000). Nevertheless, difficult goals may surpass the individual's resources and, in turn, create stress (Drach-Zahavy & Erez, 2002). Incentives can also be important motivators that may influence the setting of work goals and can have implications for policy and work management (Carver, Meyer, & Antoni, 2000). The mixed evidence on the effects of work goals suggest more research is needed to assess whether cognitions relating to these goals influence other health behaviours (e.g. sleep) in the field setting as well as experimentally. Self-efficacy may also vary depending on the person's ability to both create and meet a goal. For example, some individuals may have high self-efficacy in their ability to set ambitious goals whereas others may believe they are able to recover well from set-backs (Schwarzer, 1999). Belief in one's ability may also translate to sleep self-efficacy in which a person believes they are able to get a good night's sleep. In turn this high sleep self-effiacy could be associated with perceptions of higher sleep quality. Both the setting of goals and recovery from set-backs are important components of achieving a goal but they can also be classified as different phases on the path to this achievement.

Due to the limited nature of personal resources, processes of goal setting occur to ensure resources are appropriately distributed. Much goal-related research within the workplace setting has focused on the properties of goals and feedback that is easily manipulated and measured (e.g. specificity and level) (R. Wood, 2005). There have been numerous calls for other details such as the temporal range of goals, their connectedness, and the hierarchical arrangement of multiple goals (Amir & Ariely, 2008; Austin & Vancouver, 1996). Evidence suggests that people tend to attach greater value to their social goals than to their health goals but reward themselves more when they make progress towards their health goals (Karoly & Ruehlman, 1995). It is also proposed that when biological needs (also known as visceral needs) are forecasted in the future they are less motivating (Loewenstein, 2001). Given the visceral nature of sleep, the proposed tendency to delay needs may explain why people often choose to work towards external goals rather than get enough sleep until they are over-tired.

Work-Goal Motivations

Although assessment of the full process of recovery from set-backs is beyond the scope of the present research, some information on how individuals conceptualise their goals in the first place will be provided through measuring work-goal motivations in the first study. These motivations are defined as personal commitments to the work goal that is set (Pomaki, Maes, & ter Doest, 2004). Evidence suggests that people are more likely to make progress in their goals when they have strong social and self-regulatory skills and when the goals are intrinsic as opposed to extrinsic (Downie, Koestner, Horberg, & Haga, 2006; Koestner, Lekes, Powers, & Chicoine, 2002). In addition, well-being appears to increase generally with progress towards goals but increases the most when the goals are consistent with inherent psychological needs (Koo & Fishbach, 2008). When commitment is certain, one's focus on progress in terms of what is left to do can initiate action, otherwise it is better to concentrate on what is already done. According to research on indicators of successful development by Wiese and Freund (2000), employees with a work-orientated goal structure had higher levels of general as well as work-related well-being. These authors argue that the results suggest that it is adaptive to set priorities.

The value that one places on these priorities in relation to other areas of their life is also important. For example, too high a priority placed on work and an unwillingness to let go of this priority can interfere with sleep (Burgard & Ailshire, 2009). Unfortunately, many people often adopt goals for external reasons such as to please others or satisfy their own beliefs about what they should do (Sheldon & Kasser, 1998). In relation to work goals, a person may feel pressured into executing the behaviours necessary to meet the goal sometimes at the sacrifice of their own health (e.g. sleep needs). One reason for valuing social goals is that the process of how to go about achieving them is more clearly defined. Priority of sleep-related needs in contrast is thought to be associated with a need to take time out from the workplace and so is categorised as more private and possibly less defined (Anderson & Horne, 2008). To understand the hierarchical structure of personal goals, it is important to measure work goal-related cognitions as well as the priority of the work and sleep goal separately. How these priorities are understood by individuals, the value that one places on specific work goals, and how they may interfere with sleep was investigated.

Work-Related Events

To capture the true source of a problem and investigate the dynamics of often transient emotions, it is suggested there should be an emphasis on analysing the work-related event itself (Zohar, 2003). Events are argued to be the primary cause of affective reactions (Weiss & Cropanzano, 1996) and present a stronger link to emotions than job satisfaction in the workplace (Briner, 1999). Attention is diverted away from features of the environment and focused instead on events as proximal causes of the affective reactions. The structure of affective reactions is considered particularly important as different reactions (e.g. anger, joy, frustration) can result in different behavioural implications. Work-related events within the workplace are also a useful indicator to understanding the changes in emotions over time (Fisher & Noble, 2004). How individuals perceive the events around them and the stress events cause plays a large role in how much demand is placed upon the individual.

In reacting to events, people can form two types of appraisals (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). In primary appraisal, an evaluation of what is at stake in the encounter takes place. This is followed by a secondary appraisal where the person determines if anything can be done to overcome or prevent harm or improve the likelihood of benefits occurring from the event. Work-related events that cause people to feel strain usually have high personal consequences or involve demands over which they have little control. For example, Lazarus (1991a) argues that the primary appraisal of an event involves an assessment of goal relevance and goal congruence. In reaction to events, self regulation processes also enable an individual to guide their goal-directed activities over time and across changing circumstances (Karoly, 1993).

Work events may also have more direct effects on sleep patterns to the extent that they require adaptation to a changing circumstance. Although one study found that work events did not override personal events in predicting sleep deprivation, working conditions still remained a significant predictor of sleep debt (Kageyama, Nishikido, Kobayashi, & Kawagoe, 2001). Other research suggests that it is the response to life events rather than the frequency of these life events that interferes with sleep later on (Morin, Rodrigue, & Ivers, 2003). Negative events are particularly likely to generate somatic symptoms (Burman, 1996). Self-regulatory processes are also activated by certain events which, in turn, may contribute to somatic symptoms (R. Wood, 2005). For example, a single event often creates a range of emotional transactions with the environment, all logically organised around a single underlying theme (Frijda, Ortony, Sonnemans, & Clore, 1992). This theme may also be guided by personally relevant goals. It is thought that following an event a person can remain in a state of “continuous emotional engagement” (p. 387) which means a heightened level of arousal and attention. Based on this evidence, it is important to assess if work-related events that conflict with personal work goals can go on to affect sleep through potential increases in arousal level.

Quantitative Demand

Quantitative demand encompasses work-related demands that involve having to do a lot of work in a short space of time. Evidence suggests that it is this effort component of work demand which is often created by time pressure, that is the most closely linked to disturbed sleep (i.e. it is not simply "having a lot to do") (Akerstedt, Knutsson, et al., 2002). One reason for these effects is that the perception of time is one of the primary resources used in decision making (MacGregor, 1993). Increased time pressure may also result in decisions being made that the person regrets. In some countries the greater period of holiday time has seen more and more pressure placed on the individual through having less time available to do the same amount of work (Rosekind, et al., 2005) so a focus on this type of demand is becoming more important. High time pressure is also found to affect situational well-being later in the evening rather than at the point of doing the work. Further, over-commitment, another component of quantitative demand, can lead to increases in cortisol (Steptoe, Siegrist, Kirschbaum, & Marmot, 2004) which, in turn, may contribute to sleep disturbance. Further research by Winwood and Lushington (2006) suggest that a high work pace in nursing is likely to exacerbate the psychological rather than the physical strain in this occupation. In turn, this psychological strain affects sleep quality and impairs recovery from overall work strain between shifts.

Cognitive Demand

Cognitive judgments can include comparisons with other people, situations and times as well as judgments against personal reference points (Warr, 2006) (e.g. remembering a lot of things). The concrete-perceptual experience of the individual and how that experience is interpreted may be critical for motivation and the source of fear itself especially with regards to one's health (Leventhal, Brissette, & Leventhal, 2003). There is also support from the stress literature that high cognitive arousal brought on by high job strain (high work demand and low control) can interfere with the quality of sleep (Jones & Fletcher, 1996).

Another aspect of cognitive demand is the duration of work. In the past, work was confined to daylight hours. With the availability of light and machines that do not require sleep, it is now possible to work around the clock (Rosekind, et al., 2005). The more widely studied effect that this change has had on sleep has concerned the sleep patterns and effects on shift workers. One observation made with shift-work is that people who work a night shift never fully adapt to the altered sleep pattern formally known as their circadian cycle (Akerstedt, Fredlund, et al., 2002). Yet modern round-the-clock operations are now common in almost every work setting. Due to increased technology and the desire for consumer goods, many non-shift-workers are working longer hours which may in turn impact on sleep. As a positive but weak relation has been found between long work hours and ill health (Harma, 2003) the number of work hours has since been extensively researched with regard to work stress, health and sleep (for a review see Harma, 2006). In general, the review found that long work hours were related to shortened sleep but not clinical insomnia. Moreover, although long work hours have been strongly associated with short-sleep length, a review found that many of the secondary links to health outcomes are mixed (van der Hulst, 2003). A suggestion from this review was that the work-hours may have been too long to even allow for some critical behaviours that negatively affect health (e.g. excessive drinking) therefore nullifying potential effects.

Work-related effects on sleep can also extend to factors outside the actual workplace. For example, commuting to and from work can significantly extend the workday and in turn reduce the time set aside for sleep (Rosekind, et al., 2005). One study evaluating flexible working hours, health and well-being in Europe found that only 27% of employees and only 5% of people who are self-employed work regular hours (Costa, et al., 2004). The majority of other employees reported higher workloads. However, one study found that cognitive workload appears to be a poor predictor of sleep deprivation (e.g. De Bruin, Beersma, & Daan, 2002). Work ability may mediate this relationship between cognitive demand and health behaviours such as sleep (Kaleta, et al., 2006). Given the lack of literature on how cognitive demand influences sleep, and despite a lay person's tendency to blame deadline type tasks which make up this type of demand for sleep difficulty, it is important to investigate the effect of this measure further.

Emotional Demand

This type of demand involves the degree to which individuals are emotionally affected by their work. The connection between emotional demand and sleep may occur at a relatively subconscious level, yet it may be more powerful than other demands. For example, people may argue that certain types of work were much more draining due to the personal importance of the work, even though the work was not necessarily difficult or high in workload. The term "emotional demand" is often confused with the term "emotional labour", where the employee is required to hide or display certain emotions in front of their customers (Lewig & Dollard, 2003). Research regarding emotional demand as an indicator of health has also concentrated largely on this emotional expression and how we manage it (e.g. Ashkanasy, Zerbe, & Hartel, 2002; Mann, 1999). However, emotional demand also concentrates on how personally involved a person is with their work and, as a result, the personal consequences of the work such as sleeping (Kristensen, et al., 2005).Whether this latter experience of emotional demand in high levels can go on to affect sleep remains uncertain.

Role Conflict

Role conflict occurs when there is a discrepancy between the expectations of an individual and organisation in terms of the appropriate behaviours for a job (Zeidner, 2005). In early industrialised societies managers tended to rule by imposed control and employees had very little say as to their work patterns (Baldry, et al., 2007). Now, employees in modern businesses have a lot more flexibility in how they work and, as a result, have a significant role in decisions regarding their activities. Flexibility in making work-related decisions can have numerous influences on our lives. It is possible that uncertainty arising from role conflict associated with work flexibility can affect sleep through an increase in negative emotions and a higher state of physiological arousal. For example, uncertainty has been shown to have detrimental effects on emotional states as can cause worry and a high degree of negative affect (Freeston, Rheaume, Letarte, Dugas, & Ladouceur, 1994). Later research argues that it is more the intolerance of uncertainty that generates negative emotions rather than the uncertainty itself (Dugas, Freeston, & Ladouceur, 1997).

One study found a direct relationship between role conflict and difficulty initiating sleep as well as non-restorative sleep, however, the study was cross-sectional so was unable to determine the direction of causality (Knudsen, Ducharme, & Roman, 2007). Other research suggests that conflict with supervisors leads to psychological outcomes that affect the workplace whereas conflict with co-workers affects personally relevant psychological outcomes (e.g. sleeping well) (Frone, 2000). Unfair treatment of employees by superiors or co-workers has also been found by one longitudinal study to be associated with sleep problems in both men and women (Elovainio, et al., 2009). To investigate the impact of role conflict on sleep further it will be included as one of the work-related measures in the first study.

Meaning of Work

The search for meaning suggests a sense of purpose, a set of values, a sense of efficacy and a feeling of self-worth (Baumeister & Vohs, 2002; Baumeister & Wilson, 1996). These components describe the key functions of self-regulation that are also necessary to organise and conduct behaviour required for a good night's sleep. Evidence suggests that due to a higher level of education in today's workforce (Kompier & Taris, 2005), meaning of work is becoming more important to workers and is now valued more than pay or job security (for a review see Cartwright & Holmes, 2006). This has led to suggestions that organisations need to pay greater attention to the meaning of work by their employees in order to improve performance and retain workers. Work has a considerable impact on how one constructs meaning in their lives and on individual well-being (Gill, 1999). Individuals develop concepts of meaning through their experiences with work and the contexts they work in but also go on to use these work meanings to develop and change organisations and social structures (MOW-International Research Team, 1987). How one finds meaning in their work can also help explain how people differ in their responses to certain roles and how they cope with stress (Simon, 1995).

Different life domains can affect how the meaning of work is construed. For example, research argues that meaning is socially constructed (Twenge, Catanese, & Baumeister, 2003). Individuals who are socially excluded are thus more likely to attempt to escape from self-awareness and avoid meaningful thought. Experience may also influence meaning of work as research suggests people tend to develop more meaning in their careers as they progress through them (Harpaz, Honig, & Coetsier, 2002). This may be a result of tasks moving from menial through to complex as an employee develops in their career. Cross-cultural differences have also been found between the ability to find meaning in one's work (Harpaz et al., 2002). Specifically, employees from countries where work was considered central in life found more meaning through the monetary and economic rewards gained from the work than employees from countries where work was more peripheral. Lastly, gender differences in how individuals conceptualise work and cope with conflicts between work roles and family roles have been identified (Simon, 1995). For example, males attach greater emphasis on the work role as they see themselves as provider for the family. Although females also think of their work role they are more likely to experience conflict with their additional care-giving role.

In addition to the value placed on this concept by the workplace, finding meaning in work may also be beneficial for one's sleep patterns. In support of this argument, finding meaning in general has previously been associated with positive well-being (Ryff & Singer, 1998). It may also lead to better recovery as has previously been associated with less work-related burnout (Borritz, et al., 2005). These relationships between finding meaning and well-being may be explained by the more immediate relationship with self-regulation processes involved in sleep-related behaviour, a focus of the current research. In support, the ability to find meaning in life experiences, including work tasks appears to be beneficial in guiding self-regulation and developing a stable sense of self (Molden & Dweck, 2006). Individuals who are unable to do so may be less able to delay gratification, a crucial self-regulation task (Twenge, Catanese, & Baumeister, 2002). This ability may thus mean an individual is less distracted by external influences that keep them up late at night instead of sleeping.

Work-Related Emotion

Emotional self-regulation in response to work-related events can also go on to affect sleep. Emotions contain a subjective component, what we feel, and a displayed component, what we show (Fineman, 2003), and are argued to be tied to a specific event (Frijda, Ortony, Sonnemans, & Clore, 1992; Weiss

& Cropanzano, 1996). Evidence also suggests that people react with stronger emotions to more important events (Diener, Colvin, Pavot, & Allman, 1991; Schimmack & Diener, 1997; Sonnemans & Frijda, 1995). Many describe emotions as social phenomena that are created through language and expressed in the presence of audiences (Antonacopoulou & Gabriel, 2001). The experience of positive emotion occurs when work has a high motivating potential while negative affect results from role conflict at work (Fisher, 2000; Saavedra & Kwun, 2000). Unlike the wider literature on moods (which are defined as affective states that lack a salient target of causation) (Weiss & Cropanzano, 1996), the areas of emotional intensity and types of emotion experienced remain neglected. Emotions can be distinguished by their intensity, duration and specificity (Frijda, et al., 1992). However, the first two of these dimensions are argued to be poor discriminators as they can vary across mood and emotion. The real distinguishing feature is the event or object that presents itself. This study focused on work emotion as opposed to mood in order to have a more accurate understanding of the behaviours that resulted. What needs further investigation is whether differences in types of work-related demand (e.g. quantitative, cognitive, and emotional) or work-role conflict as well as meaning of work also influence the types of emotion generated.

How the self-regulation of these work-related emotions affects sleep also needs to be examined to provide insight into another way sleep can be affected by the workplace. History has seen a long tradition of investigating how our emotions affect health and behaviours, and how work can contribute to these effects. For example, Wegge, van Dick, Fisher, West and Dawson (2006) found that both negative and positive emotions at work were significantly correlated with health complaints when controlling for the impact of job satisfaction. Moreover, delineating the links between emotional representations and disease can provide understanding of the structure and function of emotional systems (Leventhal & Patrick-Miller, 2000). Although emotions have long been of interest with regards to well-being (e.g. Warr, Cook, & Wall, 1979), the processes involved in emotional self-regulation have only been recently examined. Emotions are seen as practical and critical for self-regulation of behaviour and adaptation to the social and physical environment yet, in organisational culture and through the eyes of employers, emotions are often viewed as irrational and in need of control (Fineman, 2000). Baumeister and Heatherton (1996) argue that rather than being practical and adaptive, emotions can be problematic in self-regulation as they can cause focus to from the goal and onto the immediate stimuli. When people are stressed or experience high emotion, self-regulation patterns often break down, possibly due to self-regulatory capacity being depleted. Emotion resulting from a distressing memory can also cause one to focus on the immediate stimuli as a way of distracting from the distressing thoughts.

Negative emotions in particular are likely to be damaging to self-regulation (e.g. Cacioppo & Gardner, 1999) and although negative work-related emotions are more likely to interfere with sleep, the relationship is complex (Fortunato & Harsh, 2006). The work-related emotions investigated in the first study included: liking for someone or something, contentedness, pride, happiness, feeling pleased, feeling optimistic, enthusiasm, embarrassment, depression, frustration, anger, disappointment, disgust and unhappiness. Further, motivation for pursuing the work goal was assessed as a separate construct. Rather than assuming the dimensional split with these emotions, factor analytic techniques were used to determine whether there were distinctive clusters of these work-related emotions or whether they were best construed as general positive emotions versus negative emotions.

Work Recovery

The ability to switch off mentally from work has also been associated with the degree to which one is able to relax (Sonnentag & Bayer, 2005). Moreover, a failure to unwind following work can result in high levels of cognitive arousal that go on to affect sleep (Meijman, Mulder, & Van Dormolen, 1992). Work recovery may also affect perceptions of sleep quality and, in turn, influence functioning the following day. For example, failure to unwind after work led to more sleep complaints and feeling less refreshed in the morning (Sluiter, van der Beek, & Frings-Dresen, 1999). Work recovery was also found to mediate the relationship between job stressors and psychological well-being (Sonnentag & Fritz, 2007). It is important to determine if work recovery could be improved through successful sleep self-regulation processes and if this improvement would go on to influence sleep quality.

Summary

The evidence discussed provides strong support for the need to improve the sleep of employees not just for their own health but for the wider economic benefits it provides. Yet to adequately understand the influence of work on sleep, there is a need to move away from vague operational definitions of constructs such as stress. More authors are now concentrating on identifying specific problematic aspects of the work environment on health. The interest in this research lies in how individuals regulate their thoughts, emotions and behaviours around work demand in ways that can affect sleep. Specific work-related influences that may affect sleep self-regulation include work-related demand (quantitative, cognitive and emotional), work-related events and the emotions that arise from them, work-role conflict, and the degree one finds meaning in work. Recovery from these work-related influences is also important. The self-regulatory processes involved in managing these influences in order to sleep well is discussed in detail in the next chapter.

CHAPTER 4 THEORETICAL OVERVIEW OF SELF-REGULATION AND SLEEP

Given the complexity of sleep and sleep-related behaviour, there is still much to be learnt to understand why some healthy people without clinical sleep disorders nevertheless have so much difficulty with sleeping well. The focus of this chapter is on theory and research regarding how people conceptualise or mentally represent sleep deprivation and workplace demands, how behaviour is regulated in response to these representations (the focus of the first study), and how sleep self-regulation can fail. From this understanding, strategies will be developed to address the self-regulatory failures that can interfere with sleep (the focus of the second study). The aim of this chapter is to delineate a theoretical framework for the regulation of sleep-related behaviour. This framework integrates a range of self-regulation principles from theoretical perspectives. For example, the sleep self-regulation model used for the framework draws upon the Commonsense Model of the Self-Regulation of Health Behaviour (CSM; Leventhal, et al., 2003) and the Health Action Process Approach (HAPA) model (Schwarzer, 1999). Situational factors such as activities and events arising are sources other than the workplace that can also influence sleep. However, the model is concentrated on mapping only critical constructs involved with the relationship between work and sleep.

Sleep Self-Regulation

Central to self-regulation models are the principles that both cognitions and emotions guide behaviour (Leventhal, Leventhal, & Cameron, 2001; Molden & Dweck, 2006; Shell & Husman, 2008), and that individuals are active decision makers who organise and plan their behaviour in order to reach their long-term goals (Cantor, et al., 1991). The first study examined how the self-regulation of work-related influences affected sleep. Building on this knowledge, the second study implemented strategies to prevent the consequences of sleep-related appraisals from continuing to develop into insomnia. To investigate how these processes work together in explaining sleep-related behaviour, the CSM and the HAPA provide useful frameworks.

The CSM (Leventhal et al., 2003; Leventhal, Leventhal, & Cameron, 2001) was originally designed to identify how self-regulation processes operate when dealing with illness and other health threats. As a result, the model has been largely limited to use in evaluating the health threat experiences within various illness populations (for a review see Hagger & Orbell, 2003). Nevertheless, the model is relevant to understanding health behaviours in healthy populations and it has been applied to such behaviours including physical activity, sun protection, and sleep related motivations and behaviour

(Cahn, et al., 2005; Cameron & Chan, 2008; Henderson, Hagger, & Orbell, 2007). One benefit of the model is that it has the potential for taking into account many factors that may affect self-regulation. For example, its dual focus on both cognitive and emotional representations means it is able to capture the types of cognitive and affective processes influencing sleep that may originate from the workplace. The model involves three phases: the cognitive and emotional representations of the threat or challenge; coping behaviour elicited in response to the threat or challenge; and appraisal of the effectiveness of these actions. The cognitive representations are schema including beliefs about the dangers of the threat (e.g. threatening aspects of a work demand) or the type of challenge presented (e.g. week versus 12-month work goals) and how committed the person is to the goal. Emotional representations encapsulate the emotive experiences linked to the situation. For example, a person may become anxious regarding the threats of the work demand or they may feel optimistic at working towards the challenge of the work goal. Appraisals of these actions further shape representations of the threat and coping strategies thereby guiding future self-regulatory behaviour.

The HAPA is a complementary model of self-regulation identifying both a motivational phase and an action phase of responses to a health threat (Schwarzer, 1992, 1999; Schwarzer & Fuchs, 1995). In the motivational phase (often labelled the decision-making stage), the individual forms the intention to either take a precautionary measure (e.g. increase exercise levels) or change risk behaviour (e.g. cut back on cigarette smoking). Two key beliefs identified in the HAPA include expectations of self-efficacy and response-efficacy, both of which may contribute to motivation. Low efficacy is widely researched and argued to be one of the main reasons why a person may fail to self-regulate their behaviour (Luszczynska & Schwarzer, 2003; Schwarzer, 2008; Thelwell, Lane, & Weston, 2007). Self-efficacy in particular is proposed to be a crucial component of effective self-regulation and so may contribute in a number of ways to overall sleep quality (Bandura, 1997). Self-efficacy is the belief that a behaviour is or is not within one's control (Conner & Norman, 1996). Response-efficacy, on the other hand, is the belief that a given behaviour will or will not lead to a given outcome. Self-efficacy and response-efficacy are also important constructs for understanding behavioural intentions and thus provide insight into possible intermediate processes of sleep self-regulation.

The action phase of the HAPA is defined as being where planning, implementation and maintenance of an intended behaviour occurs. Depending on how hard a person tries and how long he or she persists with the behaviour, determines whether they successfully achieve what they intended to or not. In short, the motivational phase involves instigation of the action whereas the action phase involves efforts to control and maintain the action. The HAPA is of particular use for conceptualising sleep-related behaviour as it focuses on situational influences important in the action phase and places emphasis on the dynamics of these actions with regards to how they can change (Schwarzer, 1999).

Another key principle in self-regulation models is the tenet that personal goals are organised in a hierarchical structure, with higher-order more abstract goals influencing lower-order more concrete goals (Sheier & Carver, 2003). Progress towards a lower goal can contribute to the attainment of a higher goal. Although individuals may not be focusing specifically on longer-term aims as they engage in efforts to attain short-term goals, they may nevertheless be sensitive to the larger meanings, effects and implications of what they are doing (Vallacher & Wegner, 1987). Maes and Gebhardt (2000) in their delineation of the Health Behaviour Goal Model argued that working towards lower order goals can be influenced by higher-order goals; whether or not the person intends for them to do so. Hierarchical goal research also showed that life goals interfered with exercise goals for non-exercisers but that exercise goals dominated over life goals for people who exercised regularly (Karoly et al., 2005). This research implies that understanding personal goals is important when trying to change a health behaviour.

The Sleep Self-Regulation Model (see Figure 4.1) was designed for the current study to incorporate the regulation of behaviour in response to work goals and the regulation of behaviour around sleep deprivation (conceptualised as a health threat). Relevant principles of self-regulation of lifestyle health behaviours, including principles of action control and appraisal processes covered by the CSM and the HAPA, are incorporated into the model. It is important to understand that both models contribute to the self-regulation process in different ways and it has been argued that these types of models should not be compared but instead used to complement each other (Hagger, 2009; Leventhal, Weinman, Leventhal, & Phillips, 2008). The integrated sleep self-regulation model identifies how work goals (week and 12-month), which can be appraised as either threats or challenges, may trigger the self-regulation processes that go on to influence sleep. For example, these goals may either create work-related demand and higher levels of perceived stress (from a threat perspective) or they may assist the individual in finding meaning in their work (from a challenge perspective). Work-role conflict arising from appraisals that one’s role is unclear or contrary to expectations of others is another potential cause of the work demand. Work demand and work-priority along with meaning of work and work-role conflict, can also affect emotional regulation either positively or negatively depending on how the influences are perceived. Over time, one’s general state of mental health may also be affected through higher levels of anxiety, depression and fatigue.

The model also incorporates sleep-relevant motivations and their relationships with work-related demands. These sleep-relevant motivations constitute the motivation phase identified by the HAPA and include motivation for sleep, sleep self-efficacy, sleep response-efficacy, how sleep is prioritised in relation to work and how the sleep process is visualised. The role of implementation intentions (II), which are designed to link the context with the desired sleep-related action, is also specified in the model. II are motivations in the form of behavioural rules specifying that if one is in a particular situation, then one will engage in a particular behaviour. The sleep-relevant motivations then guide the sleep-relevant actions, which can be referred to as sleep hygiene behaviours. Both the sleep-relevant motivations and the sleep actions may be influenced by current situations such as when a work-related event occurs that conflicts with either a week or a 12-month work goal. The actions leading up to sleep, along with regulation of the work-related emotions, may influence how effectively a person is able to recover from work and may contribute to pre-sleep arousal. Pre-sleep arousal may influence the sleep experience (sleep quality) and, in turn, its appraisals. Indicators of sleep quality include the time of turning off the lights, time taken to get to sleep, hours of sleep, time of waking and amount of sleep disturbance. Using the model, the first study concentrates on work-related influences of sleep quality. The three intervention studies are then highlighted in the model through the use of imagery which includes a tension releasing backpack exercise designed to increase sleep-related motivation and reduce pre-sleep arousal. Imagery incorporating II was also included to improve positive sleep-related actions whilst cancelling out negative sleep-related actions.

The sleep self-regulation model is argued to be supported if certain critical relationships are confirmed: First, if any of the negative work-related influences (work-related goals, work demand, work priority/work goal motivation, work-related events, work goal conflict, negative work-related emotions) are associated with poorer sleep quality or its related indicators (PSQI scores, sleep quality, time to sleep, hours of sleep, sleep maintenance, time of waking) those portions of the model are supported. Second, if the mental imagery targeting sleep-relevant motivations or II for positive sleep-related actions has an effect on sleep quality compared to groups who do not receive either of these instructions, those aspects of the model are supported. By allowing confirmation of the model in this way it enables understanding of these concepts to progress and future refinements to be made given the core structure of the model holds true.

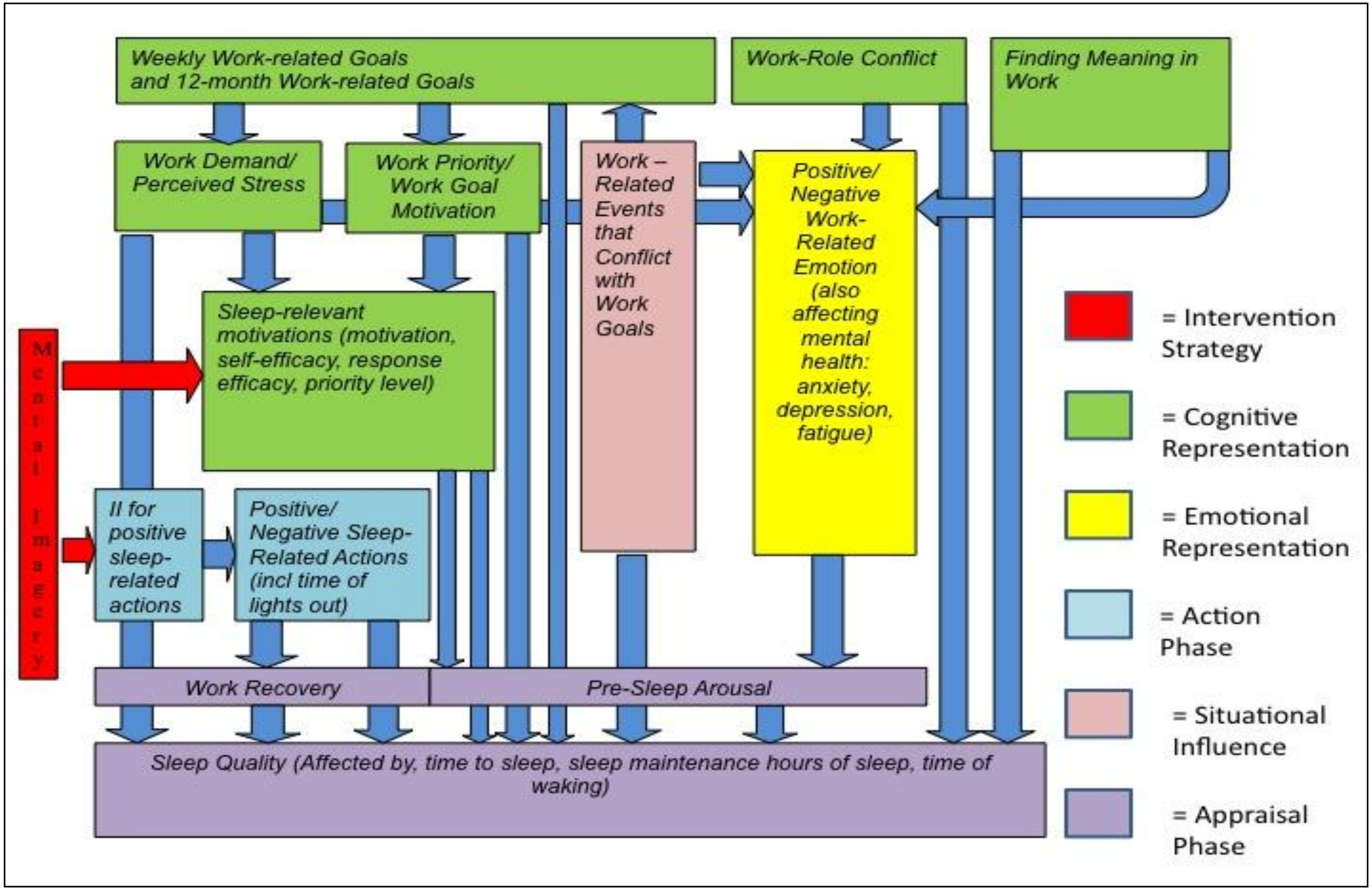

Figure 4.1 **Sleep Self-Regulation Model (II = Implementation Intentions)**

Focus of Study 1: Evaluation of Self-Regulatory Processes of Sleep in Response to Work

The sleep self-regulation model delineates how sleep deprivation may initially be triggered by a relatively difficult time at work. Using this model, an examination will follow of how work-related perceptions are shaped, how work-related emotions are formed, how these representations affect actions leading to sleep, the impact of situational influences, and the appraisal of sleep-relevant actions.

Cognitive Representations of Work-Related Demand

Work-related demand can arise from constraints created by work situations and other factors on appraisals of one's ability to achieve work goals. Goal systems theory proposes that personal goal representations are structurally and functionally similar to other mental representations such as those of health conditions (e.g. cancer risk) or sleep deprivation (Kruglanski et al. 2002). Therefore, mental representations of personal work goals should follow the same pattern as the those of sleep-priority and be able to be compared alongside sleep motivations. Motivations to achieve demanding work goals (classified as work-goal motivations) may often directly motivate efforts to get quality sleep (e.g. to be more alert for the morning presentation) or engage in other healthy behaviours (e.g. to achieve flow-on effects to diet and exercise of feeling energetic and refreshed). However, in addition to work-priority, work-goal motivations may also have negative consequences for sleep to the extent that they detract attention away from sleep-related goals and actions. In contrast to the effects of work-related motivations, placing sleep at a high priority may motivate the individual to take the steps necessary to achieve this aim resulting in a higher sleep quality. Nevertheless, the prioritisation of sleep may also contribute to affect intensity which, in turn, may lead to detrimental effects on one's sleep (Schimmack & Diener, 1997).

Cognitive representations of week and 12-month work goals also influence how one copes with demand. For example, when working towards a week goal that is clear and easily achieved, work generated by it may place less demand on the person. Similarly, many 12-month work goals, may lessen demand on a person because time pressure is relatively low. Cognitive processes investigated in Study 1 include how quantitative, cognitive and emotional demands, work-priority, sleep-priority, work-goal motivations and work-role conflict may negatively affect a person's sleep while meaning of work may be more of a protective factor. According to the sleep self-regulation model, work goals that conflict with work-related events are likely to generate more negative work-related emotion which, in turn, creates higher levels of pre-sleep arousal. Direct effects on the indicators of sleep (time of lights out, time to sleep, hours of sleep, sleep quality and time of waking) from increased negative emotion are also anticipated.

In addition to direct effects on sleep, work demand and work-role conflict are argued to lead to greater levels of pre-sleep arousal whereas meaning of work acts as a protective factor. Another indirect pathway to poor sleep is through work recovery, or the extent to which one is able to detach mentally from work-related thoughts once leaving the workplace. Evidence supports that cognitive representations of work goals and demands can influence post-work recovery (Geurts & Sonnentag, 2006) which, in turn, can affect sleep (Zijlstra & Sonnentag, 2006). Some work-related stress models, such as Karasek's job control demand model (Karasek & Theorell, 1990), identify how work stress arises when the level of work-related demand exceeds the person's ability to control it. In other words, employees who work in high demand and low control situations are more at risk of stress-related illnesses. Yet, it is also important to understand the types of work demand that may affect our sleep and the specific types of emotion that may result. It is possible that differences in representations of these influences can have differential effects on our sleep.

Emotional Representations of Work-Related Demand

Emotional representations arising in response to various work threats or challenges may include both the conceptual awareness of the emotion generated (e.g. labelling "I'm happy") and concrete-experiential processes (feelings and action potentials). They can also trigger actions in ways that are partially independent of cognitive representations (Cameron & Jago, 2008). As highlighted, cognitive representations are argued to influence the emotional state which, in turn, can influence levels of pre-sleep arousal and indicators of sleep. Exactly what specific emotional states are represented while coping with work demand and which emotions are most likely to affect sleep need further investigation. It is suggested that people use positive emotional words to describe their home life yet negative emotional words to describe their work life (Montgomery, Panagopoulou, Peeters, & Schaufeli, 2005). On the other hand, experimental research has found that people who experienced induced positive mood were more likely to talk about their job or school whereas people with induced depressed mood were more likely to want to be alone, nap or relax quietly (Cunningham, 1988). According to this research, depressed affect may cause people to want to sleep more. Yet, despite the evidence for an association between depressed mood and poor sleep quality, depressed affect may not necessarily lead to sleep deprivation (Riemann, Berger, & Voderholzer, 2001; Vazquez & Blanco, 2006; Waters, et al., 1993).

Although much research has focused on the general positive/negative dimension of emotions (e.g. Gotlib & Meyer, 1986), specific emotions may have differential effects on behaviour. For example, representations of fear and anger have been found to have opposite effects on risk perception (i.e. perceptions of threats) even though they can both be considered negative emotions (Lerner & Keltner, 2001). Differences in threat perceptions can then have alternative effects on how sleep-related decisions are made. Anxiety can influence decision making (Cameron, 2003) in ways that inhibit behaviours needed to manage the health problem of sleep deprivation such as the decisions to consume comfort foods or drink in an attempt to dispel the negative feeling. Alternatively, anxiety can enhance the quality of decisions in certain conditions leading to more proactive behaviours in managing one's health (Teigen, 1994). In the case of anxiety about sleeping, for example, a person may go to bed earlier or partake in relaxation exercises. The strong dimensional split between positive and negative affect may also mask other categorisations. For example, an activation dimension to emotions is thought to often be obscured by the strong positive/negative categorisation (Tellegen, Watson, & Clark, 1999). Given the potential influences of different emotions on decision-making and arousal, further investigation of the role of specific work-related emotions in work-related processes influencing sleep may yield important insights.

Research also suggests that negative moods and emotions from work influence home life where positive moods do not (K. J. Williams & Alliger, 1994). Therefore, it is likely that negative emotions experienced during a working day are more likely than positive emotions to spill over into home life and go on to affect sleep. Emotions may differ in how they affect health depending on their intensity, frequency and duration (Mayne, 1999). At relatively low levels, negative emotions may cause more accurate symptom perceptions and encourage social support, care seeking and preventive health behaviours (Cameron, 2003; Mayne, 1999). Links between types of emotional experiences and personal goals may also determine their impact on sleep. For example, it may be that impaired progress in achieving work goals are a potent source of negative emotion that, in turn, disrupt sleep. It is suggested that positive emotions will result when the rate of discrepancy between a goal and current behaviour is reduced rapidly and negative emotions will result when this process is slow (Carver, Lawrence, & Sheier, 1996). Therefore, if a work task is not achieved or progress in achieving the task is slower than anticipated, the emotions that are generated from it are likely to be negative. Likewise, the higher the motivation towards a goal, the greater the emotional intensity experienced by that person (Austin & Vancouver, 1996; Brockner & Higgins, 2001). If a person is highly motivated by a work goal they may experience emotions of sufficient strength to raise arousal levels to a point whereby sleep is impaired.

Actions Taken In Response to Work-Related Representations

Sleep-related behaviour may be motivated by efforts to indirectly cope with the tensions associated with work. Situational influences such as conflicts between work-related events and work goals may either directly affect sleep quality or interfere with pre-sleep cognitions and actions. Cognitive strategies for overcoming these influences and achieving a work goal may include: sacrificing more sleep; training or education that interferes with sleep; setting sub-goals; meeting with a work group or setting aside thinking time; problem solving or prioritising the work over other activities including sleep. Emotion regulation efforts may also affect sleep behaviour. For example, efforts to manage emotions elicited by a work goal can include engaging in relaxation strategies (to reduce distress); cancelling exercise (to allow time to work on the task); engaging in unhealthy behaviours (e.g. smoking, drinking alcohol, eating comfort or convenience foods); scheduling a holiday or using an escape strategy like reading a book (to deny/ avoid the threat).

Alternatively, behaviours may be executed to directly alleviate feelings of existing sleep deprivation. Behaviours to directly manage sleep deprivation can include cognitive strategies such as: prioritising sleep over other activities (e.g. finishing the task); decreasing exercise levels (so one can get more sleep), improving sleep hygiene; engaging in relaxation strategies; and taking sleep-inducing medication. Direct strategies for managing emotional states induced by sleep deprivation may include: turning to comfort or convenience foods, smoking more; increasing alcohol intake to feel better by engaging in these areas; denial or avoidance of the problem; or ingesting coffee or other stimulants to ward off the mood effects of sleep deprivation. There is also evidence that work-related demands can affect the final action of actually sleeping (Burgard & Ailshire, 2009; de Lange et al., 2009). What the current research hopes to achieve is an understanding of how cognitive and emotional representations of work stresses can affect the behaviours leading up to sleep (e.g. time of going to bed). For example, it has recently been argued that people are more likely to turn to passive actions following work like watching television in response to high demands (Sonnentag & Zijlstra, 2006). These actions are thought to be less restorative and more likely to impede sleep (Rook & Zijlstra, 2006; Zijlstra & Cropley, 2006)

The Appraisal Process

Appraisal of feedback is a feature of both cognitive and emotional regulation processes. When appraising the actions taken to address cognitive representations of a work goal, whether the action taken solved the problem is initially questioned. If the result from this analysis is that the action did not work another strategy may be adopted in which case the self-regulation process repeats. Actions may also be examined further by trying to determine if other areas of life (e.g. health) are affected by the actions. For example, if a person stayed up late to finish a work task, a conclusion may be reached that the action solved the problem. However, the negative effects on health may mean that the person would be unlikely to repeat that action again. Analysis of the actions taken to address the emotional representation of the work goal may be focused on the degree of effort the person engaged in; how the control of emotions affected cognitive appraisal of the task and whether emotions changed as a result of actions taken. There is limited research on the feedback loop that guides the evaluation of sleep-related behaviour. One study that did investigate this loop found that the motivational context can influence how we automatically evaluate the behaviour (Ferguson & Bargh, 2004). That is, when in active pursuit of a goal, goal-relevant objects are related more positively in response to feedback than goal-irrelevant objects. To further investigate this type of appraisal, work-priority and sleep-priority were compared before examining the relationship of these measures to sleep patterns.

Aim of Study 1: Evaluation of Self-Regulatory Processes of Sleep in Response to Work

The primary purpose of Study 1 was to systematically assess the role of sleep self-regulation in sleep initiation and gain a good understanding of how work-related factors can influence the process. As identified by the proposed sleep self-regulation model, cognitive and emotional representations of the work situation may affect sleep-related actions. External influences such as work-related events that are in conflict with the drive to achieve the work goals and the influence this conflict has on sleep self-regulation will also be investigated. As sleep-related processes can be difficult to assess due to being relatively private, two alternative methods were used. First, was a story completion task in which participants were asked to identify behaviours likely to occur prior to bed in a given scenario. This technique is likely to have benefits over direct quantitative measures as it allows participants to come up with behaviours they would be likely to do themselves providing a potentially greater variety of responses. However, one limitation could be that the story itself may lead to a certain pattern of responding that participants would not have followed otherwise. Second, work and sleep-related measures were also administered on a daily basis to assess the frequency of certain pressures and responses over time. Given that work-related demand as well as sleep can fluctuate considerably over the period of a week, research of a longitudinal nature with frequent measurement was also needed. It was anticipated that findings from the first study would guide the three sleep self-regulation interventions targeting daytime employees.

Focus of Study 2: Prevention of Sleep Self-Regulation Failure

The majority of the population want to sleep well and have intentions to get sufficient sleep. However, research has demonstrated that intentions can fail to translate into action (Brandstatter, Lengfelder, & Gollwitzer, 2001; Gollwitzer & Sheeran, 2006). It is now recognised that psychological and behavioural processes can play a significant role in whether these intentions get translated into the actions necessary to get sufficient sleep (Buysse, Ancoli-lsrael, Edinger, Lichstein, & Morin, 2006). The first study examined whether perceptions of work demand could affect indicators of quality sleep. The second study focused more on preventing psycho-behavioural consequences of sleep deprivation from continuing by addressing failures in the self-regulation process. The sleep self-regulation model was used to structure the explanations provided in this chapter for why intentions to take the necessary steps to sleep well may fail to be actioned. Although other theories are discussed in relation to specific areas of the research, the proposed model guided the overall structure of the second study. Two psychological processes identified as potential causes of sleep self-regulation failure include the motivational level for sleep and the influence of levels of pre-sleep arousal. The decision to act may also change as a result of distractions in the immediate environment, the influence of pre-existing beliefs and habitual behaviours. Strategies used in the intervention to address some of these sleep self-regulatory failures are discussed in more depth in Chapter 9.

Failure of Sleep-Self-Regulation

A meta-analysis by Webb and Sheeran (2006) of 47 studies found that the relationship between intention and behaviour is more limited than previously thought. Two problems that affect striving for health goals include failures to initiate action and failure to protect an ongoing goal pursuit from unwanted influences (Gollwitzer & Sheeran, 2006; Sheeran, Webb & Gollwitzer, 2005). People can fail to initiate goal striving for at least three reasons: (1) The person could forget to act, (2) Opportunities to initiate goal striving are missed (3) The person may have difficulty overcoming an initial reluctance to act (Schwarzer, 2008). These failures are also argued to apply to sleep self-regulation. Researchers have long proposed that attitudes and intentions predict behaviour only under certain conditions (Miller, Levin, Kozak, & Cook, 1987). Specifically, the intention and behaviour must closely correlate on four elements: the action performed; the target for which the action is directed; the context that the action is performed in and the time when the action is performed. Factors that can deter a person from ongoing goal pursuit include adverse contextual influences (e.g. when the participant believes they have little control over the behaviour or when there is potential for social reaction) and unwanted habitual responses (Gollwitzer & Sheeran, 2006). The sleep improvement intervention developed and assessed in the present research acknowledges four of these potential disruptions in sleep self-regulation: lack of clarity in intention; interference from pre-existing beliefs; influence of pre-sleep arousal levels; and behaviours that occur prior to sleep that distract from it due to either immediate temptations in the enironment or pre-existing habits that undermine sleep-related decisions.

Focus 1: Clarity in Intention

As a result of extensive experience, people can hold complex schemas concerning sleep and its related behaviour which, in turn, shapes future behaviour. One study found that the way people with coronary heart disease described sleep fell into three descriptive categories (Johansson, et al., 2007). These were: lifestyle as reflected in their sleep behaviour; handling the practices around tiredness and sleep; feelings of negative and positive efficacy. Yet, much research is concentrated in sleep laboratories providing results that have little relevance to how real-world decisions and demands influence sleep-related behaviour (Meadows, 2005). One argument for why sleep self-regulation fails in the real world is that people often set too many goals that interfere with sleep or set goals that conflict with each other and increase arousal (Baumeister & Heatherton, 1996). Moreover, goals that create intrapersonal conflict can reduce sleep hygiene efforts in the longer term (Sheldon & Elliot, 2000). To date, research investigating goal conflict has largely concentrated on the conscious processing that occurs in order to reach one’s goals (Maes & Gebhardt, 2000). However, non-conscious goals are also likely to influence behaviour and may be an additional influence that causes people to fail in their consciously set goals. Biological processes are an example of an unconscious motivating force that do not necessarily result from a process of decision making (Bagozzi & Edwards, 1998). Hull’s (1943) drive theory describes incentive motivation as a pull-force where people naturally move towards the goal, whereas drivers that result from biological processes are seen as more of a push-force and more effort is required (Lens, 2001).

Nevertheless, due to its biological necessity, people do not tend to forgo sleep entirely, or at the very least, not for a continued period. It is the behaviours leading up to sleep that may instead be sacrificed (Basner, et al., 2007; Chatzitheochari & Arber, 2009). Failure in doing the intended action may be a result of a change in priority of that behaviour. When faced with temptation, a conflict can arise between the desired object or activity and other goals. Further, to resolve the motivational conflict and the resulting anticipatory guilt or cognitive dissonance, people often activate compensatory beliefs (Rabiau, Knauper, & Miquelon, 2006). For example, certain sleep behaviours (e.g. staying up late to finish a work task during the week) can be compensated for or “neutralised” by engaging in another healthy behaviour (e.g. planning to sleep in later when it came to the weekend). In this case, although the same health goal (sleep) is referenced, the goal creates two different behaviours at either end of its execution which can be used to compensate each other. When susceptible to temptations in the environment the above factors can work to prevent that person from getting adequate sleep. For example, when there is a lack of clear signals coming from the body, a person is more inclined to use external cues in the environment to regulate their behaviour such as social influences (Herman, Roth, & Polivy, 2003). Thus, the cycle of sleep deprivation is started when the person does not have strong internal signals like tiredness that indicate the need for sleep.

Another reason why self-regulation fails is people often do not accurately assess why they want to reach their goals (Sheldon & Kasser, 1998). If motivating goals are not set in place, the direction to be followed becomes unclear when sleep deprived and thus fatigued. One of the problems regarding making decisions about sleep is that sleep deprivation itself can affect the cognitive processes involved with deciding on the appropriate course of action. For example, sleep deprivation leads to increased visual and auditory distraction, thus a lack of focused attention (for a review see Harrison & Horne, 2000b) where the sleep-deprived person may show an increased vulnerability to distractions such as television, preventing the appropriate routine from occurring prior to going to bed. Individuals who are sleep deprived may over-rely on previous strategies so these behaviour patterns may continue despite their negative consequences to their health.

Motivational levels for sleep can be seen as a primary distinguishing factor between clinical insomnia and general sleep deprivation. In insomnia, patients appear to be highly motivated for sleep, to the point where they actually become obsessive about it (Jansson-Frojmark & Linton, 2008; Morin et al., 2003). In contrast, being sleep deprived for behavioural reasons may cause a lack of motivation for sleep through it being a lower priority than other responsibilities in life. In support, evidence suggests that, in many situations people fail to do the intended action not because of poor memory but because they make an overt decision to continue doing the current activity instead (Marsh, Hicks, & Landau, 1998). The priority one gives to sleep can change depending on how much it is lacking and how critical it is that the person functions well the next day. For example, when sleep deprived and individual may place the priority of getting sleep above any other health goal or work goal. However, when sleep the previous night has been adequate and there are no pressing engagements the next day, sleep may be sacrificed to pursue other activities. In this latter situation, the person may be more inclined to continue the passive behaviour of watching television rather than commencing activities needed to prepare for sleep. Again, finding balance in one's focus is necessary by concentrating on the correct level of the goal hierarchy for sleep. Specifically, attention should be drawn to mid-level processes such as establishing one's routine rather than specific behaviours or the ultimate goal of getting a good sleep.

Focus 2: Interference of Pre-Existing Beliefs

Although one may form the intention to sleep well, pre-existing beliefs about sleep deprivation may serve to override this intention or distract from it through the level of anxiety generated. Cognitive therapy designed to alter dysfunctional beliefs about sleep is a common treatment for insomnia (Morin, Bootzin et al., 2006; Morin, Vallieres, & Ivers, 2007) for good reason as dysfunctional sleep beliefs are thought to be one of the main contributors to new cases of insomnia (Jansson-Frojmark & Linton, 2008). For example, some people worry excessively if their sleep requirements are not met while others fear the impact that sleep deprivation can have on their daytime functioning (Morin, Vallieres, & Ivers, 2007). Although existing dysfunctional beliefs concerning consequences of sleep deprivation were not manipulated in the present intervention studies, it was important to record and consider the influence of these beliefs and to control for them when analysing the data.

Two other types of beliefs that can be damaging to the behaviours needed for sleep may contribute to the effects from the intervention studies despite not being directly manipulated. These beliefs concern the ability to carry out the behaviours needed to get a good sleep (sleep self-efficacy) and the perception of how effective these behaviours actually are for achieving quality sleep (sleep response self-efficacy). Enactment of the intended sleep-related actions is unlikely if a person is low in either sleep self-efficacy or sleep response-efficacy.

Focus 3: Pre-Sleep Arousal Levels and its Contribution to Sleep Deprivation

Existing expectations can generate high levels of arousal which affects the quality of one's sleep (Morin & Espie, 2003) and the efficiency of sleep-related behaviour (e.g. length of time in bed) (Akerstedt, Kecklund, & Axelsson, 2007). Research shows clearly that different types of arousal (e.g. cognitive and somatic) can have varying effects on sleep perception in general (Tang & Harvey, 2004). Yet many interventions that try to reduce arousal to improve sleep are focused on distraction without understanding the nature of the arousal (Harvey & Payne, 2002; Morin & Azrin, 1987). According to the sleep self-regulation model, emotions and cognitions from the workplace are two important sources of arousal. In support of the proposed model, one study found that emotion, attention and stress measures accounted for 41% of the variance in sleep parameters (Waters, Adams, Binks & Varnado, 1993). Emotions and cognitions resulting from high arousal levels can also generate behaviours that further increase arsousal. For example a person may turn to exercise or increase their intake of substances (e.g. coffee) that affect sleep prior to bed.

Through a series of three studies, Schimmack and Diener (1997) provide some support for the hypothesis that higher emotional intensity increases physiological arousal. The emotion intensity that contributes to this arousal state can be described in terms of multiple dimensions, including overall felt intensity, peak felt intensity, average felt intensity, felt duration, onset latency, peak latency and peak duration (Frijda, et al., 1992). The intensity of emotions has also been associated with the absence of routine or situations of high stimulation and novelty (Zapf, Vogt, Seifert, Mertini, & Isic, 1999). Despite the contribution of emotional regulation on levels of physiological arousal prior to sleep, the majority of people tend to blame their sleep disturbance on cognitive arousal (Johansson, et al., 2007). Much research on sleep deprivation also includes this focus on levels of cognitive arousal (Akerstedt, Kecklund, & Axelsson, 2007; Belanger, Morin, Gendron, & Blais, 2005; De Valck, Cluydts, & Pirrera, 2004). Nevertheless, emotional arousal is stipulated to be closely intertwined with cognitive arousal states (Brosschot, Van Dijk, & Thayer, 2007; Espie, Brooks, & Lindsay, 1989) therefore measures addressing both contributors is necessary.

Effect of Pre-Existing Mental Health Conditions on Arousal Levels and Sleep

Depression is strongly linked to sleep complaints and is seen to be a primary cause of early morning waking due to increased levels of arousal (for a review see Riemann, et al., 2001). Related to depression, alexthymia is also strongly linked to sleep complaints in a normal population, even when controlling for depression (De Gennaro, Martina, Curcio, & Ferrara, 2004). Depression, or subclinical depression, has also been closely linked to cognitive intrusions, another contributor of sleep deprivation as intrusions can affect the time it takes to get to sleep (Hall, et al., 2000). High levels of perceived stress and anxiety have been identified as a major pre-cursor to the experience of sleep-deprivation (Drake, et al., 2003; Hall, et al., 2004; Morin, et al., 2003; Waters, et al., 1993). Finally, fatigue is a common outcome of sleep deprivation (Akerstedt, et al., 2004). Although it is logical to assume that fatigue levels are likely to affect perceptions of the following night’s sleep, encapsulating fatigue effects in the intervention studies will help assess whether approaches taken to improve sleep self-regulation may also reduce fatigue levels.

Focus 4: Failure of Sleep-Related Behaviour to Promote Sleep

It has been argued that one of the most important reasons for not executing a planned behaviour is the conscious changing of plans (e.g. Marsh, et al., 1998). Reasons for changing plans include: distractions and temptations that cause a conflict in attention; unanticipated obstacles and barriers to enacting the behaviour; internal states that make the behaviour less likely (e.g. depressed mood, being fearful of the behaviour); or the creation of new goals developed in the situational context that conflict with the original goal (Gollwitzer & Sheeran, 2006). Temptations that may distract from personal goals are usually triggered by situational cues that give the allure of immediate gratification at the cost of a significant longer-term outcome (Fishbach, Friedman, & Kruglanski, 2003). Rewards along with evaluation, surveillance, coercion and time pressure are examples of situational pressures to succumb to temptations (Lens, 2001).

The strength model of self-regulation emphasises that the ability to resist temptation is a finite resource limited in its capacity (Hagger, Wood, Stiff, & Chatzisarantis, 2009). This model views self-regulation as a type of energy or strength that is limited in its capacity. Once depleted (through using one's self-regulation capacity on a previous activity) self-regulatory failure is likely to occur. Although this resource can be used up through doing tasks during the day, it is proposed that sleep is one of the ways this resource can be replenished. Therefore, if one is sleep deprived, the ability to regulate behaviours to get the required sleep the following night may be compromised and the vicious cycle may continue. Self-regulation can also use up affective resources which can have additional consequences such as a distorted time perception and a greater tendency to live in the present (Vohs & Schmeichel, 2003). This distortion presents another reason why people may lose track of time and not follow the appropriate routine that enables them to sleep soundly.

The establishment of positive habits surrounding sleep is one way self-regulation resources may be used efficiently. Although people have extensive experience with sleeping and the behaviours surrounding sleep, it is unclear if these experiences are stable enough to form habits that encourage sleeping well. When goal-directed behaviour is consistent and occurs in a similar situation with positive reinforcement, the behaviour becomes habitual and occurs automatically with less conscious attention (Bargh & Chartrand, 1999; Ouellette & Wood, 1998). Recent research further suggests that habits do not form from repeated behaviour alone but require lack of intention, uncontrollability, lack of awareness and efficiency (Ajzen, 2002; Verplanken & Orbell, 2003). As sleep itself requires a descent into an unconscious state, the behaviours may also be more likely to occur outside of awareness. Nevertheless, sleep can also be identified as an appetitive drive with people more likely to address the drive at certain times of the day (W. Wood & Quinn, 2005). Therefore, in the right circumstances, there is potential for creating a stable situation to encourage the development of positive sleep-related habits.

The importance of habits in leading healthy and productive lives has been emphasised by researchers from early on and continues to this day (for a review see Aarts & Dijksterhuis, 2000). Habits have been defined as being a form of hierarchical mental representation where activation of one goal lead to other goals lower in the hierarchy being initiated. Forming an intention often requires a person to override previous negative habits which may draw on their self-control resources and thus make control over other behaviours less likely (for a review see Hagger, et al., 2009). It takes about a month for habit strength to completely develop; if the behaviour is performed daily, it is half developed after roughly a week (e.g. Tobias, 2009). It also takes a similar time period for an established habit to decay. The complexity of sleep-related behaviour means that while new habits should be created, simultaneous deletion of negative habits may also be required. At the same time, strategies are required that enable the individual to overcome the immediate situational influences which can interfere with sleeping well.

Aim of Study 2: Development of the Sleep Self-Regulation Intervention, "Using Imagery to Promote Quality Sleep"

The main randomised controlled trial (RCT) and two preliminary studies conducted to develop the sleep self-regulation intervention had three primary aims. The first (tested in the first intervention development study) was to increase motivation for sleep by visualising sleeping well and its benefits so it was not sacrificed for other demands. Contributions of the motivational influences of sleep self-efficacy and sleep response-efficacy to sleep improvement were also investigated. The second aim (tested in the second intervention development study and the main RCT as a separate process) was to reduce pre-sleep arousal levels using a guided imagery exercise. The third (tested in the two development studies and the main RCT) was to instil sleep initiation behaviours that ensured preparedness in sleeping well. A measure was included in the main RCT at follow-up that assessed whether the sleep actions targeted were actually executed. All intervention studies used mental imagery to deliver the psychological components. Imagery techniques have proven to be previously successful in installing new health habits (Cameron & Chan, 2008). The use of imagery was identified as a viable means to deliver cost and time efficient individually tailored techniques in a group based intervention. More detail in why these strategies were used is provided in Chapter 9. To test the effectiveness of the psychological manipulations, comparison is made to a neutral imagery control group as well as a group who are asked to practice a combination of the two strategies.

Outcomes from using these strategies are likely to be three tiered. Specifically, initial outcomes of using one or more of these strategies is that levels of pre-sleep arousal reduce, psychological work-recovery may improve, sleep-related beliefs may change (i.e. levels of sleep motivation, sleep self-efficacy, sleep response-efficacy may increase and dysfunctional sleep beliefs may decrease); and sleep-related behaviour may change (i.e. negative sleep habit frequency and strength may decrease and the level of positive sleep-related planning and positive sleep action may increase). As a result of these motivational and behavioural changes, actual changes in sleep patterns may occur. For example, time of lights out may become earlier, time to sleep may be shortened, hours of sleep may increase, and time of waking may become later. In turn, total scores on the overall measure of sleep difficulty (PSQI) may be reduced. It is also argued that improving sleep could lead to improvements in other health behaviours (e.g. diet, exercise levels, smoking status and alcohol intake) as well as general fatigure levels. Although it is impossible to account for all the alternative influences on sleep, some key co-variates were included that may affect the hypothesised relationships (e.g. perceived stress and depression).

Summary of the Self-Regulation of Sleep Behaviour

Investigating the self-regulation of sleep-related behaviour in the dual contexts of work and home should provide new understanding of self-regulation and the sleep initiation process as well as make future sleep-related treatments more adaptable to a wider population. Yet research across multiple environments is not without difficulty and calls for innovative ways to measure outcomes without the invasion of private lives. To understand how an employee self-regulates this broader range of behaviours that can relate to sleep, an online descriptive study was first projected followed by three intervention studies designed to improve night-time sleep in daytime employees.

CHAPTER 5 OVERVIEW OF STUDY ONE: A DESCRIPTIVE STUDY TO EVALUATE THE SELF-REGULATORY PROCESSES OF SLEEP IN RESPONSE TO WORK

Identified gaps in the literature suggest that further understanding is needed before embarking on an intervention to improve the night-time sleep of day time employees. The limited research that has been conducted on sleep self-regulation has largely been cross-sectional (e.g. Akerstedt, 2006; Akerstedt, Kecklund, & Gillberg, 2007; Sekine, et al., 2006) and so temporal relationships between key contributors of sleep initiation are still relatively unclear. Two longitudinal studies did find that job demands can have significant cumulative and negative effects on perceptions of sleep quality (de Lange, et al., 2009; Gadinger, et al., 2009). Nevertheless, the origins of these demands and their characteristics, as well as their influences on specific aspects of sleep regulation, still require further investigation. There have also been strong arguments in the literature for more researchers to use methodological procedures that allow for the assessment of daily process complexities in health-related experiences (Affleck, et al., 1999; Hamilton, et al., 2008). Multi-day measurement can be beneficial in understanding the intricacies between daily stress and indicators of poor health (DeLongis, et al., 1988).

The first study was a longitudinal descriptive study, the primary focus being to assess how personal work goals, the emotions they generate, and work-related demand are associated with self-reported quality of sleep and other sleep-related indicators. A secondary focus of the study was to explore how decisions are made in the hours leading up to sleep and the development of a tool to assess this decision-making process. A pilot study was also conducted to test out the procedures and measures utilised in the main study. Two further subscales of sleep-priority and work-priority were added following this pilot study. Participants completed measures at baseline and then on a daily basis for 10 working days (no surveys were completed on weekends). On the final day of measurement, the assessment of sleep quality was more detailed so as to provide a direct comparison to baseline results. Aims are summarised below, followed by a list of the key hypotheses.

Aims of Study One

The primary aim of the first study was to test some of the key relationships delineated by the sleep self-regulation model. Specific aims generated by testing these relationships are outlined below.

1) To examine whether greater conflict between work goals and work-related events is associated with indicators of sleep quality
2) To examine how work and sleep-priority relate to sleep quality
3) To investigate how work-related indicators (quantitative, cognitive, and emotional demands, meaning of work, work-role conflict, positive/negative work-related emotions) are associated with sleep quality
4) To investigate the level of association between work-related indicators (quantitative, cognitive, and emotional demand, work-role conflict and meaning of work) and work-related emotion
5) To investigate the relationship between sleep-relevant motivations with sleep quality indicators
6) To examine whether daily indicators of sleep are associated with overall sleep difficulty
7) To develop a narrative tool that assesses intentions for sleep initiation behaviour

Hypotheses of Study One

Based on the literature covered in the preceding chapters and the proposed model, there are five hypotheses.

Hypothesis 1: Greater conflict between work-related events and work goals is associated with poorer sleep quality

Hypothesis 2: High priority for a work goal is associated with poorer sleep quality, whereas high priority for sleep is positively associated with sleep quality

Hypothesis 3: High perceived demand (quantitative, cognitive and emotional, and work-role conflict) and negative work-related emotion is associated with poorer quality sleep whereas finding meaning in one's work and positive work-related emotion is associated with a better quality of sleep

Hypothesis 4: High perceived demand quantitative, cognitive and emotional, and work-role conflict) is associated with higher negative work-related emotion and lower work-related positive emotion, whereas finding meaning in one's work is associated with a higher positive work-related emotion

Hypothesis 5: Responses on the narrative tool reflecting intentions for behaviours that are not conducive to good sleep (i.e. a late intended time of lights out) are associated with poorer sleep quality

CHAPTER 6 METHODOLOGY STUDY ONE

This chapter describes the study design, participants, recruitment methods, measures used and procedures followed. The statistical analyses used and ethical guidelines adhered to are also described.

Study Design

An online, longitudinal, descriptive study was conducted over a period of 11 days including a baseline assessment day. Participants completed measures at baseline and then on a daily basis for 10 working days (no surveys were completed on weekends). Baseline measures included clinical and demographic characteristics, depression, anxiety, work goals, work-goal motivations, work and sleep-priority, pre-sleep arousal and a measure of sleep difficulty. Daily measures included: assessments of work-related demand (quantitative, cognitive and emotional); work goals, events and emotions (for the following 9 work days); and sleep quality, time of lights out, time to sleep, and time of waking (on all 10 workdays). In baseline data analyses only, the independent variables included: work-goal motivations; work-priority; sleep-priority and pre-sleep arousal; The dependent measures were time of lights out; time to sleep; hours of sleep; sleep quality; time of waking; PSQI scores and pre-sleep arousal. Age and marital status were entered as covariates for the analyses concerning hours of sleep and time of waking respectively. In the analyses of the daily data, the independent variables were the between-subjects, baseline variables of individual code, work-goal motivation and priority and sleep-priority. Within-subject, daily independent variables were quantitative,cognitive and emotional demands, positive and negative work-related emotions; the dependent variables were the within-subjects daily variables of sleep quality. A pilot study of 31 participants was conducted first that tested procedures and measures utilised in the main study.

Participants

Participants were initially identified from three companies approached through personal contacts working within them. These included a law firm, a corporate travel agency and a university which gave a total sample pool of 5407. Letters were first sent to the contact person in Human Resources who obtained management approval. The purpose of these letters was to advertise the study and request permission to advertise to participants. Once permission from management was obtained, notices were then circulated around the organisation by either human resources staff or the designated contact person on the staff circular. Distribution of the notices occurred through email and postings in prominent locations around the targeted workplace setting. Additional participants were recruited through direct contact with local sporting organisations.

Selection Criteria: To take part in the study, participants needed a good understanding of English to comprehend and respond to the online questionnaires. Participants also needed to be in full time employment and in a predominately sedentary role for high exercise levels as part of one's work could also alter sleep patterns. Daily email access was also necessary in order to complete the online surveys.

Exclusion Criteria: First, if interested employees already had a diagnosed biological or psychological disorder that interfered with their sleep they were excluded. Employees who worked shift-work were excluded since this type of work was thought to produce alterations in the sleep-related measures that would interfere with the analysis of the data. Employees who had participated in any sleep-related study within the past two months were also excluded as they may have responded differently to the questions if they had come across similar ones before.

Ninety-four employees were recruited for the study. Two respondents were excluded for having pre-existing medical conditions that interfered with their sleep (pregnancy and depression) and a third due to missing data. Of the 91 remaining employees who completed the baseline questionnaire, 84 completed some of the daily data and had full data for the sleep-related measures at baseline. In total, 81% of the sample completed more than 50% of the daily surveys. A total of 69 participants (74%) completed the final assessment. Common reasons why people dropped out (reported in response to the invitation to take part in the on-site practice session) included reports of being too busy ($n = 8$), being called away from work for a period of time ($n = 2$), being away from work due to medical reasons ($n = 2$) or repeated forgetting to complete the questionnaires ($n = 3$). No participants identified themselves as having insomnia or experiencing a sleep-related disorder in the past two weeks. There were twice as many females as males with the majority of participants in the 26-30 age-group followed by the 21-25 and the 35-40 age brackets. The majority were either in a de facto relationship or married and a quarter of the sample were single. The types of jobs varied although all were sedentary. Most people indicated that their combined annual income was in the $100,000+ bracket; this could reflect the high number of participants who were in a de facto relationship or married and thus likely to be in a dual-career relationship. The sample was representative in that their characteristics were similar to a previous study which measured sleep deprivation in an employee setting (Gander, 2005). Demographic characteristics of the current sample population are summarised in Table 6.1.

Table 6.1 ***Summary of the Demographic Characteristics of the Sample***

Demographic	*n*	*%*	*Demographic*	*n*	*%*
Age			*Occupation*		
21-25 years	15	16.5%	Researchers	22	23.9%
26-30 years	38	41.8%	Office Workers	18	19.9%
31-35 years	9	9.9%	Professional (e.g. Doctor, Lawyer, Accountant)	13	14.6%
36-40 years	13	14.3%	Manager	11	11.9%
41-45 years	6	6.6%	Sales	6	6.6%
46-50 years	2	2.2%	Consultants	6	6.7%
51-55 years	1	1.1%	Technical	5	5.3%
56-60 years	3	3.3%	Teachers	4	4.0%
61-65 years	1	1.1%	*Location*		
Gender			Auckland	88	94.7%
Male	30	33.0%	Outside Auckland (inside New Zealand)	3	3.9%
Female	60	65.9%	*Combined Annual Income*		
Ethnicity			0-$20,000	4	4.7%
New Zealand European	58	63.7%	$21,000-$30,000	3	3.5%
European	16	17.6%	$31,000-$40,000	6	7.0%
Asian	5	5.5%	$41,000-$50,000	8	9.3%
South East Asian	7	7.7%	$51,000-$60,000	15	17.4%
New Zealand Maori	2	2.2%	$61,000-$70,000	7	8.1%
Pacific Island	1	1.1%	$71,000-$80,000	6	7.0%
Other (Australian)	1	1.1%	$81,000-$90,000	4	4.7%
Marital Status			$91,000-$100,000	6	7.0%
De facto	34	37.4%	over $100,000	27	31.4%
Single	26	28.6%			
Married	29	31.9%			
Separated/Divorced	1	1.1%			
Children					
Yes	18	19.8%			

(n = 91)

Procedure

Online Descriptive Pilot Study

A pilot study was first conducted to ensure that all procedures and measures provided adequate acceptability, feasibility, and reliability for the main online descriptive study. A secondary focus was to develop two new measures; the Work/Sleep-Priority Scale; to assess internal consistency and acceptability; (results from testing this new scale are described in the measures section); and the Sleep-Relevant Cognitions Test (SRCT), designed to assess intentions for behaviours leading up to sleep following a hypothesised scenario of a typical day at work. Additionally, this second measure was to test whether the wording in the narrative was sufficiently broad enough to apply to a wide range of employees and whether responses had face validity and displayed sufficient dispersion.

Thirty-one employees from a wide variety of occupations took part in the pilot study. Participants were recruited through direct contact with local sporting organisations as well as through staff and post-graduate students based at the university. The demographics of the pilot study participants were similar to individuals included in the main study. Specifically, there were more females (n = 23) than males (n = 8). Most participants were married (n = 10) or in a de facto relationship (n = 12), 8 respondents described themselves as single and 1 person was divorced. The most common occupation was student (n = 7) although a relatively large number also worked in research (n = 6). The remaining occupations varied widely from professional careers such as accountancy, law, psychology and consulting to sales and technical positions. Income levels also varied widely with the most common category the $100,000+ bracket ($n$ = 8).

Interested employees were asked to complete an online screening survey (these assessments were the same as for the main study). If meeting the criteria, respondents were sent daily emails for 10 working days; the emails included measures of their daily work demand and sleep patterns. The SRCT was administered by email on Day 5. On Day 10 of the daily data, sleep was measured in more detail by including the PSQI in the email. This index uses multiple indicators to provide a total score of sleep difficulty. The only alteration to the main study relevant to the pilot study concerned the inclusion of the two subscales of work-priority and sleep-priority. These scales were included subsequent to the pilot study as preliminary analysis on the work goals alone failed to convey the potential conflict between work goals and the need for sleep. Although the SRCT provided some insight into how conflicting decisions between work priorities and sleep were made, further analysis on the actual priorities of the work and sleep goals was needed.

Main Study

Respondents to the study notices at consenting workplaces were sent an email with a electronic link to an online consent form, information sheet and baseline survey on a Monday (giving respondents two days to complete the consent and baseline survey and be screened before the first daily email was sent). This email included the participant's individual code which was used to track their data throughout the study. Participants were asked to ensure that this code was included in their responses made regarding the study. Immediately following completion of the consent form, participants were asked to complete the baseline measures which included screening for depression and anxiety; work-goal motivations; priority ratings of work and sleep; pre-sleep arousal levels; perceived stress levels; fatigue; sleep quality and demographics. Participants were also screened for the presence of any medical or psychological disorders. Following completion of these online questionnaires, participants who met the criteria were reminded that the first daily email assessment would be sent at 3pm that Wednesday. A reminder was provided regarding the continuation of daily assessments for the next 9 days following the initial daily assessment and that completion of the subsequent questionnaires occurred at a set time (3pm) each working day. Participants who had not meet the criteria were thanked for their time and told that results from the group data would be sent via email on completion of the study.

For 10 working days following completion of the baseline measures, participants were asked to fill out a questionnaire, sent by email towards the end of each work day (3pm), assessing emotional and cognitive aspects of work demands and sleep quality. Upon receipt, a confirmation email with a fun quote was sent to the participant to encourage future responding. In these daily questionnaires, participants were asked to record a work-related event in which a strong emotion was experienced. Participants then completed a modified version of the Job Emotions Scale (Fisher, 2000) to assess work-related emotions resulting from the event. In addition, participants completed a brief measure of sleep quality. Lastly, subscales of quantitative demand, cognitive demand, emotional demand, meaning of work, and work-role conflict from the Copenhagen Psychosocial Questionnaire (Kristensen, et al., 2005) were used to measure daily demand.

On Day 5, participants were asked to complete the SRCT in addition to the work demands questionnaire. Sleep quality was assessed one final time by email on Day 10 of the study using the full PSQI. On completion of the study, participants received a small incentive ($10 petrol voucher) as well as individual results. Based on research, the daily follow-up period of two weeks was argued to be an adequate timeframe for detecting change in sleep patterns (Lacks & Morin, 1992; Totterdell, Reynolds, Parkinson, & Briner, 1994) and work-related demand (Grandey, Tam, & Brauburger, 2002; Jones & Fletcher, 1996).

Measures

Established measures were utilised alongside instruments developed for the purpose of this study (See Appendix B for the full measures). Measures were administered at different points during the study period; from once only administration through to daily assessments over a period of 10 days. To provide a logical flow, measures are described in order of the time points administered commencing with assessments at baseline (see Table 6.2 for an overview).

Baseline Assessments

Participants responded to the baseline questionnaire based on their experiences over the previous 2 weeks. The 2-week baseline period was chosen to match the 2-week daily follow-up period. The baseline questionnaire included possible covariates including the mood indicators of depression, anxiety, perceived stress as these moods may interfere with sleep. Fatigue was also measured in the baseline questionnaire to provide an additional indicator of the relationship of sleep loss to the following day’s functioning. Specific details of measurements included in the baseline questionnaire are outlined below.

Table 6.2 ***Overview of Work-Related and Sleep-Related Measures Used and Their Assessment Points in Study 1***

Measures	*Baseline Mon/Tues*	*Day 1 Wed*	*Day 2 Thurs*	*Day 3 Fri*	*Day 4 Mon*	*Day 5 Tues*	*Day 6 Wed*	*Day 7 Thurs*	*Day 8 Fri*	*Day 9 Mon*	*Day 10 Tues*
Demographics	*										
Depression	*										
Anxiety	*										
Workplace Goal	*	*	*	*	*	*	*	*	*	*	*
Work-goal Motivations	*										
Pre-sleep Arousal	*										
Perceived Stress	*										
Fatigue	*										
Sleep Difficulty (PSQI)	*										*
Sleep Quality SF		*	*	*	*	*	*	*	*	*	
Work/Sleep-Priority[a]	*										
Workplace Event[a]		*	*	*	*	*	*	*	*	*	
Time of Event		*	*	*	*	*	*	*	*	*	
Event Goal Relation[a]		*	*	*	*	*	*	*	*	*	
Emotion Type		*	*	*	*	*	*	*	*	*	
Emotion Intensity		*	*	*	*	*	*	*	*	*	
Quantitative Demand		*	*	*	*	*	*	*	*	*	
Cognitive Demand		*	*	*	*	*	*	*	*	*	
Emotional Demand		*	*	*	*	*	*	*	*	*	
Meaning of Work		*	*	*	*	*	*	*	*	*	
Role Conflict		*	*	*	*	*	*	*	*	*	
SRCT[a]						*					

* = Time-point at which measures were administered; [a] = measure developed for the purposes of the research

Demographic Measures

Information about demographic characteristics of the sample included assessment of age (by category), gender, ethnicity, occupational type, employment length, marital status, presence of children and their age(s). For occupation, participants entered this into a text box and these were then coded according to current census descriptions of job type (Statistics New Zealand, 2006). See Appendix B for full details of these measures.

Depression

The Centre for Epidemiological Studies in Depression Short Form (CES-D) was used to measure levels of depression at baseline. Research shows that depression can affect sleep quality (e.g. Drake, et al., 2003; K. D. Phillips, et al., 2005) so the CES-D was included as a possible covariate. The 11-item short-version of the CES-D (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993) was chosen to measure depression because of its successful use in a broad range of healthy and ill populations, including studies investigating sleep (De Gennaro, et al., 2004; Freeman, Sammel, Lin, & Nelson, 2006; Kawada, et al., 2007; Nakata, et al., 2004; K. D. Phillips, et al., 2005). Participants reported how many times they have had each of the 11 experiences (e.g. “I felt that people disliked me”). Responses are made on a 4-point scale ranging from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), with the ratings summed to generate a total score. Scores ranged from 0 to 44, with higher scores indicating more symptoms of depression and with a criterion of 8.8 regarded as a good indicator of depressive disorder. Reliability for the current sample was acceptable (α = .82). See Appendix B for full details of the measure.

Anxiety

The Short-Form State Trait Anxiety Index (STAI) (Marteau & Bekker, 1992) was used to measure anxiety at baseline. Anxiety was assessed because of its potential utility as a covariate given the likely influences of state anxiety on sleep quality (Drake, et al., 2003). Participants responded to the 6-item scale with ratings ranging from 1 (*not at all*) to 4 (*extremely*) regarding how they had felt for the previous 2 weeks (e.g. “I am worried”). This brief form of the STAI has previously shown acceptable internal consistency for the 6 items (α = .82) which was similar to the level for the original 20-item STAI (α = .91). The scale also showed acceptable internal consistency for the current sample (α= .84). See Appendix B for full details of the measure.

Work-goal Motivations

The Mid-Level Work Goal Processes Scale (Pomaki, et al., 2004) was also used at baseline to provide a more detailed assessment of how participants felt about a selected work goal (described in detail under the daily assessment section). This scale encompassed the directive, regulatory, and emotional arousal processes related to a self-set, mid-level work goal. Participants responded on a 5-point scale ranging from 1 (*completely disagree*) to 5 (*completely agree*) to indicate how they felt about the 20 items relating to their work goal. Scores were summed to provide a total indicator of work-goal motivation. An example item is "Pursuing this goal has negative effects on my well-being". Internal consistency for this scale was in the acceptable range (α = .84). See Appendix B for full details of the measure.

Priority Rating of Work and Sleep

A purpose-built set of measures was used to assess the prioritisation of work and sleep at baseline. Each scale consisted of 10 items, with responses rated 1 (*strongly disagree*) to 5 (*strongly agree*). The work-priority items focused on the importance of the weekly goal specified by the participant, and the sleep-priority items focused on the importance of daily sleep quality as a goal. Items were selected from a larger pool of items on the basis of evaluations of content validity provided by 54 staff and graduate students with training in self-regulation and health. The final step to ensure the scales would be used in the analyses was to check their psychometrics with the full sample. Internal consistencies were acceptable; α = .84 and α = .79 for the work and sleep-priority scales respectively (see Table 6.3).

Table 6.3 ***Summary of Factor Loadings for Work and Sleep-Priority Scales***

Items	*Factor One (Work-Priority)*	*Factor Two (Sleep-Priority)*
Work: Reaching this goal is one of my top priorities	.86	
Of all the work goals I have, this goal is the most important	.78	
Work: This goal means a lot to me	.76	
Work: I would sacrifice other things I want to do in order to reach this goal	.64	
Work: This goal is a valuable goal for me	.62	
Work: I place this goal as one of my most important goals in my life this week	.62	
Work: This goal is the main goal I think about	.60	
Work: It doesn't matter if I don't work towards this goal	.58	
Work: It concerns me if I cannot work towards this goal	.51	
Work: I would rather use my time to do other things than spend the time working towards this goal	.42	
It concerns me if I miss out on my sleep		.82
I would sacrifice other things I want to do in order to get enough sleep at night		.68

Items	*Factor One (Work-Priority)*	*Factor Two (Sleep-Priority)*
Getting a good night's sleep is one of my top priorities		.67
Having adequate sleep is a valuable goal for me		.66
It doesn't matter if I don't get enough sleep		.62
I just cannot cope if I don't get sufficient quality sleep		.61
If I don't get enough sleep I have trouble functioning the next day		.59
I place sleep as one of my most important goals		.55
Of all the health related goals I have getting enough sleep is the most important		.43
I would rather use my time to do other things than spend the time sleeping		.43

Intrusive thoughts

Pre-sleep arousal was measured at baseline by the Glasgow Content of Thoughts Inventory (Harvey & Espie, 2004). This measure was used to provide an additional indicator of sleep quality. Participants were asked to respond to the 25 items on a 4-point scale ranging from 0 (*never*) to 3 (*always*) to indicate how often the listed thoughts had kept them awake over the past 2 weeks. An example of an item on this scale is "Things that happened during the day". The scale has demonstrated good test-re-test reliability (ICC = .88), internal consistency (α = .87) and sensitivity (Harvey & Espie, 2004; Morin, Stone, Trinkle, Mercer, & Remsberg, 1993; Nicassio, Mendlowitz, Fussell, & Petras, 1985). Internal consistency of the scale for the current study was excellent (α =.91). See Appendix B for full details of the measure.

Perceived Stress

The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was used to measure perceived stress and to provide a general assessment of this in contrast to the more specific accounts of emotional and cognitive demand reported by participants. An example of an item is "In the last two weeks, how often have you been upset because of something that happened unexpectedly?" Participants were asked to indicate how often they felt or thought a certain way over the past 2 weeks on a 5-point scale ranging from 0 (*never*) to 4 (*very often*). Internal consistency of the scale with the current sample was acceptable (α = .81). See Appendix B for full details of the measure.

Fatigue

A modified version of the fatigue subscale from the Profile of Mood States (McNair, Lorr & Droppleman, 1992) was used to measure fatigue with the purpose of providing a secondary measure of sleep deprivation as well as acting as a potential covariate. The subscale has demonstrated good internal consistency in both a general sample (α= .94) and a New Zealand sample (α=.90) (Barker-

Collo, 2003; Curran, Andrykowski, & Studts, 1995; McNair, Lorr, & Droppleman, 1992; Shacham, 1983). In the current sample, internal consistency was acceptable (α= .86). Participants were asked to respond on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*) to indicate the extent to which they had been feeling fatigued over the past 2 weeks. The scale included items such as "I feel exhausted". See Appendix B for full details of the measure.

Sleep Quality

A detailed description of sleep quality was collected at screening and at final follow-up through administration of the Pittsburgh Sleep Quality Index (PSQI) (Buysse, et al., 1989). In addition, daily descriptions of sleep were recorded based on modifications of this index. The PSQI has been extensively used both in epidemiological research (e.g. K. D. Phillips, et al., 2005) and in clinical practice (Ashworth, et al., 2008) and assesses sleep quality during the previous 3 weeks. It has established reliability with an overall coefficient of $\alpha = 0.83$ (Buysse, et al., 1989). The scale consists of 19 self-rated questions and five questions rated by the bed partner or roommate. The 5 additional questions did not contribute to the final score but provided an additional indicator of sleep quality. Factors assessed by the scale include sleep quality, hours of sleep, sleep latency, and the frequency and severity of specific sleep-related problems. To calculate the final PSQI score the 19 self-rated items are combined to form seven component scores which each has a range of 0 (*no difficulty*) to 3 (*severe difficulty*). The component scores are then added to provide a global score ranging from 0 (*no difficulty*) to 21 (*severe difficulties in all areas*). The entire index takes 5-10 minutes to complete and around 5 minutes to score. Due to the distinctiveness of each of the seven dimensions internal consistency is not relevant. See Appendix B for full details of the measure.

The first area was subjective sleep quality. Participants are asked to respond regarding the quality of their night-time sleep on a 10-point scale (adapted from the original 4-point scale) ranging from 1 (*very restless*) to 10 (*very sound*). The second area was sleep latency, where participants reported how long it took them to get to sleep. Raw score recordings were made and then divided into four categories ranging from 0 (*≤ 15 minutes*), 1 (*16-30 minutes*), 2 (*31-59 minutes*) and 3 (*> 60 minutes*). Hours of sleep was the third area, with participants asked to record the total hours of sleep they had the previous night. Raw scores were then assigned a code according to the following criteria: 0 (*>7 hours*), 1 (*6-7 hours*), 2 (*5-6 hours*), 3 (*<5 hours*). Fourth was sleep efficiency calculated by dividing the total hours slept by the number of hours spent in bed and then re-calculated to give a percentage score. This percentage was then categorised according to the following criteria: 0 (*>85%*), 1 (*75-84%*), 2 (*65-74%*), 3 (*< 65%*). Sleep disturbances was fifth and participants were asked to respond on a 4-point scale ranging from 1 (*not during the past 2 weeks*) to 4 (*three or more times per week*). This area contained 10 items that assessed factors that may have disturbed the sleep during the night. Although contained in a scale format items related to multiple areas that could cause a disturbance so internal consistency was low. An example of an item is "During the past 2 weeks, how often have you had trouble sleeping because you… have to get up to use the bathroom?"

The last two areas related to functioning. Use of sleeping medication was the sixth area where participants were asked to indicate on a 4-point scale ranging from 1 (*not during the past three weeks*) to 4 (*three or more times per week*) how often they had taken sleeping medication. Daytime dysfunction was the seventh area. Participants were asked to respond to two questions. The first asked whether they had trouble staying awake for certain daytime activities (e.g. driving, eating meals, or engaging in social activity). Participants were asked to respond on a 4-point scale ranging from 1 (*not during the past three weeks*) to 4 (*three or more times per week*). The second question asked how much of a problem it was to keep up enough enthusiasm to get things done. Responses to this question were made on a 4-point scale ranging from 1 (*no problem at all*) to 4 (*a very big problem*).

Daily Assessments

These brief questionnaires were sent via email at 3pm each day for a period of 2 weeks (10 working days). This length of daily measurement has been identified as being sufficient for measuring emotions in the workplace (Fisher & Noble, 2004). A 2-week period has also been used previously to study the changing nature of sleep patterns (Gellis, et al., 2005). Participants were asked to send a reply email in which they answered the questions. Measures that were included in these daily assessments are outlined below. The full daily assessments can be found in Appendix C.

Daily Sleep Quality

Evidence indicates that daily sleep diaries show significant and high correlations with retrospective sleep questionnaires (e.g. Libman, Fichten, Bailes, & Amsel, 2000) thus supporting the idea that a measure such as the PSQI (Buysse, et al., 1989) is a viable measure on its own. However, the current interest was in measuring the daily impact of emotional and cognitive arousal on daily sleep quality as well as determining the overall impact of these factors. Therefore, modifications were made to the PSQI so that these items could be used to determine daily sleep quality as well (see Appendix C). To develop this measure, key items were taken from the PSQI and modified to suit a daily analysis of sleep. The items included Time of Lights Out, Total Hours of Sleep, Time to Sleep, Time of Waking, and Self-Reported Sleep Quality. Participants were asked to think back to their previous night's sleep in order to answer these questions. In addition, participants were asked to report if there were any factors outside the workplace that disturbed their sleep the night previous. To calculate the total hours of sleep on a daily basis, the 24 hour clock was used with the exception that all time past 12am was recorded as a continuation (e.g. 1am = 13). As a manipulation check, the daily sleep quality measures were also compared to PSQI scores.

Work Goals

Participants were asked to state each work day a 1-week work goal and a 12-month work goal (see Appendix C). The reason for the daily recording of these goals was that it provided an opportunity for participants to alter the goal should they have achieved the previous set one or changed their mind. Examples of work goal categories used in a previous study (Pomaki et al. 2004) and on which the current study categories were based, included the following: "increase knowledge and expertise", "finish two new projects", and "improve my job performance". Goals in the current study were coded for type and clarity. Coding for the 12-month work goals was compared against two other raters experienced in content analysis in order to check for inter-rater reliability. Rater A was a layperson who had received no previous training of content analysis. Rater B was an international postgraduate student on exchange who had had previous experience with this type of assessment. Symmetry was acceptable with a Kappa agreement of .99 with Rater A and .98 with Rater B at baseline. Using content analysis, 12-month work goals at baseline fell into 10 categories. These categories were new role, work/life balance, self-achievement, departmental goals, make progress, complete current task, improve efficiency, financial goals, increase workload, improve communication and unclassified/missing. Ratings for the week work goals were again compared against two other raters experienced in content analysis in order to check for inter-rater reliability. Results from these comparisons are presented in the statistical analyses section of this chapter. Using content analysis, weekly work goals fell into 12 categories including an undefined category. These categories reflected goals that came under the themes of time pressure, work-life balance, self-achievement, departmental goals, make progress, complete task, improve efficiency, financial, get through an event, increase workload, improve communication and unclassified/missing.

Work-Related Events

Participants were asked to record details of the work-related event that generated the emotion (see Appendix C). Details of the event included time of day it occurred and an open answer description of the event. Participants were then asked to rate on a 2-item scale from 1 (*not at all*) to 5 (*a lot*) how much they thought the work-related event promoted and conflicted with their 12-month work goal and their week work goal. These events were also later rated according to their event type. Raw scores were used separately for each item for both the 12-month goal and the week goal. Work-related events were coded into 16 categories (see Table 6.4).

Table 6.4 ***Work-Related Event Categories***

Category	***Example***
"Logistical/Technical"	"business systems not working"
"Communication"	"colleague asked for update of results"
"Personal Event"	"driving to work"
"High Workload/Deadline"	"extremely busy period"
"Mistake/Failure"	"got really annoyed when didn't do something correctly"
"Training/Knowledge"	"training a new person to process our policies"
"Personal Event"	"reading a disturbing article in the paper at lunch"
"Not Described/Vague"	"n/a"
"Difficult Task/Decision Needed"	"when trying to decide what antibodies to order"
"Achievement"	"had my ideas for some wording accepted"
"Someone Else's Issue"	"found out co-worker is leaving in a few weeks"
"Monotonous/Straightforward Task"	"mundane monotonous task"
"Physical Event"	"team building"
"Planning"	"preparation of a meeting"
"Not at Work"	"did not go to work"
"Work Meeting/Public Event"	"leadership meeting"

Work-Related Positive and Negative Emotions

Each day, participants completed a modified version of the Job Emotions Scale (Fisher, 2000) to rate the extent to which they experienced each of 16 emotional states in relation to a self-specified work-related event (see Table 6.5). Eight items related to positive emotional experiences (happy, enthusiastic, pleased, proud, optimistic, liking for someone or something, enjoying something, and content) and 8 items to negative emotional experiences (depressed, frustrated, angry, disgusted, unhappy, disappointed, embarrassed, and worried). The original Job Emotions Scale was modified by replacing the 5-point scale with a scale ranging from 0 (*not at all*) to 10 (*extremely*) in order to increase the sensitivity in detecting minor, daily fluctuations (Beal & Dawson, 2007; Lozano, Garcia-Cueto, & Muniz, 2008). Daily ratings were averaged to generate positive emotion and negative emotion scores; for the positive emotion subscale, alphas ranged from .87 to .94 over the 9 days; for negative emotion scores, alphas ranged from .80 to .89 over the 9 days.

Table 6.5 ***Summary of Factor Loadings for Work-Related Emotions***

	Factor One (Positive Affect)	*Factor Two (Negative Affect)*
Happy	.89	
Pleased	.88	
Enjoying Something	.84	
Enthusiastic	.84	
Optimistic	.79	
Content	.75	
Liking for Someone or Something	.67	
Proud	.62	
Frustrated		.84
Angry		.83
Unhappy		.79
Disappointed		.73
Worried		.63
Depressed		.60
Embarrassed		.80
Disgusted		.53

Cognitive and Emotional Demands at Work

Daily levels of demand were recorded using five subscales from the Copenhagen Psychosocial Questionnaire (Kristensen, et al., 2005) (see Appendix C). This questionnaire has been used successfully in research with working populations (Aust, Rugulies, Skakon, Scherzer, & Jensen, 2007; Borritz, et al., 2005; Winslow & Borg, 2008). To make the subscales applicable to daily measurement, some of the original items were deleted. Specifically, the item "do you have a responsible job" was deleted from the cognitive demand subscale as the item was unlikely to change from one day to the next. An item from the meaning of work subscale ("is your work useful to the recipients?") was also deleted as was not thought to apply to all job-types. Participants were asked to respond on a 5-point scale ranging from 1 (*never/hardly ever*) to 5 (*constantly*) for 16 of the items and to a 6-point scale ranging from 1 (*to a very small extent*) to 6 (*to a very large extent*) for 14 of the items. The two remaining items concerning the decision to work overtime and whether overtime hours were worked required a 1 (*Yes*) 2 (*No*) response.

The first subscale used was quantitative demand (α = .79 to .88 over the 9 days), which had 8 items (e.g. "how often do you not have time to complete all your tasks). This subscale focused on the demands placed on a person by having a lot of work to do in a relatively short period of time. The second assessed cognitive demand (α = .87 to .91 over the 9 days) with 8 of the original 9 items included. This subscale focused on difficult tasks people had to do at work (e.g. "does your work require you to make difficult decisions?"). A third subscale of emotional demand (α = .76 to .88 over the 9 days) included 4 items assessing various types of emotive tasks in the workplace (e.g. "is your work emotionally demanding?"). Meaning of work (α = .79 to .88 over the 9 days) was another dimension examined with 4 of the original 5 items used. This subscale asked participants to report how much their work meant to them (e.g. "do you feel that the work you do is important?"). Lastly, work-role conflict (α = .79 to .85 over the 9 days) was assessed with a 4-item scale that measured how much clarity one had in their role (e.g. "are contradictory demands placed on you at work?"). Scores were generated through a sum of the items from each subscale to provide a subscale score (quantitative demand, cognitive demand, emotional demand, meaning of work and work-role conflict).

Single Assessment

Sleep-Relevant Motivations

The SRCT was developed for the study in order to assess how people make decisions about sleep-related behaviour without the need for direct observation. This test utilised a narrative scenario to assess sleep-relevant motivations and tendencies (see Appendix D). The test was based on a previous study that used a similar technique to assess cognitions relating to risky sexual practices (Norris & Devine, 1992). The test is similar to scenario techniques for assessing health behaviour motivation used in other research (Cameron, Sherman, Marteau, & Brown, 2009; Heatherton & Nichols, 1994). Participants were asked to read a hypothetical scenario about the end of a typical (white collar) employee's day at work. The scenario included behavioural options that participants may have chosen to do upon returning home (e.g. finishing paperwork, preparing for a presentation, watching a favourite television show) and the next morning (e.g. exercising with a friend in the morning, leaving earlier for work due to road works).

Participants were then instructed to fill in the missing gaps in the story from 7:30pm onwards. Decisions recorded included which behaviours participants chose to do leading up to sleep as well as their intended bedtime. The first type of coding done was on the behaviour type (see Table 6.6). Thirty-two types of behaviour were initially identified with each behaviour assigned a unique code. The intended time to sleep measure was then noted and coded into two groups. When "go to bed" was followed by blank timeslots this was categorised as "going to sleep". However, if "go to bed" followed by a timeslot completed with "sleep", that later timeslot was the time recorded. If the person indicated that they would continue working until the task was done, they were put into the category "work through the night". The first group were identified as late (score = 1) with time of going to sleep occurring after 12am. This group included participants who stated they would work on the hypothetical task until it was finished. The second group were classified as standard (score = 0) and included bedtimes ranging from 9pm to 12am. Data relating to this coded time to sleep were then compared against the PSQI indicators and the work-related measures.

The measure was also checked for face validity in the online descriptive pilot study where the 31 participants were asked to comment on whether the story applied and made sense; all participants reported that the story was credible and relevant.

Table 6.6 ***Categories of Behaviour Identified in the SRCT***

Code	*Behaviour*	*Code*	*Behaviour*	*Code*	*Behaviour*
1	Cancel Exercise	12	Consume Alcohol	23	Personal Computer Work
2	Watch Television	13	Consume Hot/Cold Drink	24	Make Future Personal Plans
3	Record Television	14	Prepare Meal	25	Listen/Play Music
4	Prepare for Deadline	15	Quiet Resting	26	Sleep
5	Other Paperwork	16	Exercise	27	Driving
6	Arrange Exercise	17	Shower/Bath	28	Talk to Friends/Family
7	Prioritise/Plan Work	18	Play with Dog	29	Wake up/Lying Awake
8	Domestic Tasks	19	Set Alarm	30	Use the Bathroom
9	Financial Planning	20	Get Ready for Bed	31	Do a Puzzle, Board Game
10	Prepare for Next Day	21	Read	32	Take Medicine
11	Pack Lunch	22	Go to Bed		

Statistical Analyses

The statistical software SPSS version 15.0 was utilised for analysis of the baseline, daily data and follow-up data collected for the first study. For all statistical tests mentioned in this study a 95% confidence interval was utilised. To ensure sufficient power to test the hypotheses, power analyses using the program G*power (Faul, Erdfelder, Lang, & Buchner, 2007) were first conducted to determine the appropriate sample size. A priori analyses indicated that a sample size of 92 provided enough power to detect medium sized associations (Cohen's d effect size 0.50). Preliminary analyses were also conducted to test whether the data met the assumptions required for parametric analyses. The data were initially examined for irregularities, missing values and outliers using graphic and statistical tools. Principal component analyses were also conducted to ensure that the new measure of work and sleep priority reflected the anticipated dimensional structure. This data along with alpha levels of all the measures employed are presented in the measures section of this chapter. Distributions of the data were also assessed as to whether it met the assumptions underlying the statistical tests employed (e.g. correlation analyses, linear regression and analysis of variance). For the analyses of variance, the data reflected appropriate skew for a normal distribution as well as homogeneity of variance to continue with parametric analyses. The cases also represented a random sample from the population and were independent of each other. The data used for the correlation and regression analyses met these same assumptions as well as the additional assumptions that the residual errors were uncorrelated, the data was related to each other in a linear fashion and there were no problems of multicollinearity. Although the sleep-related indicators were ranked to assess their associations with the overall PSQI, thus could also fit non-parametric analyses (Salkind, 2011), a decision was made to stay with parametric analyses. The reason for this decision was based on the fact that non-parametic analyses generate less power thus would have required a larger sample size than the one obtained (and possible) to draw the same conclusions with the same degree of confidence.

Missing Data Analysis

When a response to a daily item needed for an independent measure was missing (e.g. missing hours of sleep at final follow-up) an average was calculated from the remaining 9 day period. Although in many cases this method is not the preferred strategy (Enders, 2006; Shaefer & Graham, 2002), it was used in this study because the multiple daily assessments provided data from which to derive good estimates of the missing values while reducing loss of observations in analyses. Missing values for dependent measures were not replaced because the mixed model approach can accommodate missing daily observations. For all measures, missing values for all scales were replaced with a mean rating from the other items for each individual. If more than 70% (n = 18) of the data for generating scores was missing for any one person, data from that individual was not used.

Descriptive Statistics

Baseline means, standard deviations, variance and range are first described for the sleep-related measures. Longitudinal properties of the key sleep-related and work-related measures are then outlined.

Content Analysis

For the content analysis, inter-rater reliability was assessed by having three independent raters code the data. All raters were trained in the coding procedure and were provided with coding instructions. Scores were matched across the three raters and discrepancies between coding scores were discussed and resolved between them. A Cohen's Kappa analysis was then conducted to determine the agreement of each rater with the coding by the author and with each other. The content analysis approach taken followed that recommended by Krippendorff (2004) for the classification of words into content categories.

Work-Related Events

Cohen's Kappa analysis revealed a range of agreement of .99 to 1.0 for the three raters. To assess associations of work-related events with the sleep-related measures, the most frequently reported categories of events (aside from "not described") for Day 1 were selected and recoded into dummy measures. This new measure indicated whether participants had experienced an event in the "communication" category or not 1 (*yes*) or 0 (*no*). The degree work events conflicted with work goals was then entered into one-way ANOVAs with the dependent measures of PSQI scores, sleep quality, time of lights out, time to sleep, hours of sleep and time of waking.

Work Goals

Participants were also asked to state a 12-month work goal at baseline along with a week work goal. Cohen's Kappa analysis revealed a range of agreement of .95 to .96 for the three raters for the 12-month goals and .93 to .94 for the week goals. At the start of each of the 2 weeks participants were reminded to state their new week work goal. If any changes occurred during the week to either the 12-month or week work goal they were also asked to notify of the change in the email. Goals reported across the 9 days were then compared with baseline goals. For the 12-month work goals there was significant agreement with baseline on all days except Day 2. For the week work goals agreement there was significant agreement with baseline for all days except for Days 4, 7 and 8 (see Table 6.7). Nevertheless, agreement for week goals was unacceptably low for all days except Day 1. Based on this limitation, and as the baseline data provided the broadest range of categories despite agreement with other days being relatively high, it was decided to only use the baseline data in the final analyses.

Table 6.7 ***Inter-rater Agreement with Type of Goal Reported Over Time***

Day	*Kappa 12-month Work Goal*	*Kappa Week Work Goal*
Day1	**.95*** **	**.75*** **
Day 2	-.00	**.65*** **
Day 3	**.94*** **	**.13** **
Day 4	**.95*** **	.02
Day 5	**.94*** **	**.18** **
Day 6	**.94*** **	**.15** **
Day 7	**.92*** **	.07
Day 8	**.96*** **	.08
Day 9	**.95*** **	**.17*** **

* $p < .05$, ** $p < .01$, *** $p < .001$

Sleep-Relevant Cognitions Test

Analyses were made of the data at both the quantitative level (what time the person said they would go to sleep) and through content analysis of the discourse which each person wrote about the behaviours they would do leading up to sleep. Cohen's Kappa analysis revealed a range of agreement of .72 to.77 for the three raters for the time to sleep. Agreement for the behaviours stated ranged from a kappa of .96 to.99.

Demographic Analyses

To assess the potential need to include covariates in the main analyses, the demographic measures of age, income level, employment length and caring for children were correlated with the key mental health, sleep-related and work-related measures used at baseline. The categorical measures of gender, ethnicity, occupation type and marital status were also entered into one-way ANOVAs to assess whether they should be included as covariates. Multivariate ANOVAs were not used due to the distinctiveness of each of the sleep-related measures. Any demographic measures that showed significant relationships with sleep-related measures were entered as covariates in the main analyses. Correlations between the demographic and mental health measures administered on a daily basis were assessed to identify potential predictors for use in the regression and mixed model analyses. Finally, additional correlation analyses were conducted to confirm that the daily sleep-related indicators of sleep quality, time of lights out, time to sleep, hours of sleep and time of waking were associated with PSQI scores. To examine their associations with PSQI scores, the daily sleep indicators from Days 1-8 (Day 9 was used to calculate the final PSQI score) were also ranked and converted into z scores. The purpose of this conversion was to assess which sleep-related measure showed the strongest association with final PSQI scores. Chi square analyses were then conducted to assess which of the ranked sleep measures (sleep quality, time of lights out, time to sleep, hours of sleep and time of waking) showed the strongest association with PSQI scores. This technique was recommended by Edwards (1984) as a viable means to assess the strength of associations between measures of interest.

Regression Analyses

To test the proposed hypothesis that priority for work or sleep could affect sleep differently, work-goal motivations, work-priority, sleep-priority and pre-sleep arousal were initially investigated as independent predictors of the baseline sleep-related measures. In further regression analyses, pre-sleep arousal was also entered as a dependent measure with the remaining measures continuing as potential independent predictors.

Mixed Model Analyses

Mixed models are a generalised set of linear models that can include both fixed and random effects.

The mixed model allows random effects to be properly specified and computed. These mixed model analyses were conducted with the SAS statistical programme using PROC MIXED (see Hsiao, 2003, for details) to assess predictors of self-reported sleep quality as well as other indicators of quality sleep (e.g. sleep-relevant motivations, pre-sleep cognitive arousal). The technique provides greater accuracy than repeated measures and ANOVAs as it can include data of participants with missing values on dependent measures. This inclusion means that missing data or outliers have less impact on the overall results.

To build the model, methods that build different covariance matrices were compared in order to decide on the best one to use. Commands used for the analyses in SAS are described in Appendix L. The model of time-specific associations assumed a first-order autoregressive process: AR (1). The AR (1) process assumes that observations close in time are more correlated than observations further apart in time (Bliese & Ployhart, 2002). This method was chosen as it is also likely that one night's sleep may be affected by the previous night's sleep. On comparison with the alternative unstructured (UN) method, the autoregressive process was a better fit.

Type III (HType = 3) specifies the type of hypothesis test that was chosen (R. C. Little, Milliken, Stroup, & Wolfinger, 1996). Type III hypotheses are constructed by working with a more general form of estimable function where each effect is compared to zero. This type of comparison allows for greater detection rates important for examining potentially small differences in sleep estimates that can occur when multiple levels in the model are used (e.g. 10 daily data assessments were conducted). In the first set of analyses, dependent measures initially investigated were self-reported sleep quality, time of lights out, time to sleep, total hours of sleep and time of waking for each of the 10 days of data collection. The independent measures, assessed on 9 of these 10 days were work-goal motivations, work-priority, sleep-priority, quantitative demand, cognitive demand, emotional demand, work-role conflict, and negative work-related emotion. In a second set of analyses meaning of work and positive work-related emotion were replaced as the independent predictors of the sleep-related measures. Mixed model analyses were also conducted with work-related events that conflicted or supported the work goal as the independent measure with the dependent sleep-related measures. In a final set of mixed model analyses, SRCT scores on Day 5 were entered as an independent predictor of the sleep and work-related measures from Days 6 to 10.

Ethical Considerations

Ethics approval was sought from the University of Auckland Ethics Committee for all studies relating to this thesis (i.e. the descriptive study described above as well as the three intervention studies). All participation was voluntary and responses and information collected were kept completely confidential. Participants also had the right to remove their data up to a designated period upon which the data was required for analysis. Code names were assigned during the studies so that no identifying information appeared on the questionnaires or other materials. Participants in all studies relating to this thesis, and management from the businesses employees were recruited from, all provided written informed consent prior to taking part in the study. Participants were also debriefed at the end of the studies and provided with contact details should they have had any questions or any distress as a result of taking part in the research.

CHAPTER 7 RESULTS OF STUDY ONE

This chapter provides an overview of the results from the quantitative and content analyses of the data collected from the first study commencing with preliminary analyses of the baseline data. Descriptive statistics are then provided for the daily sleep quality indicators (i.e. sleep quality, time of lights out, time to sleep, hours of sleep and time of waking) and work-related key measures (e.g. work-related demand, meaning of work, work-role conflict, work-related emotions and work goal event and goal interaction). Results from further exploratory investigations of these data are then discussed. This includes one-way ANOVAs and correlation analyses used to identify potential covariates from the demographic data and correlation analyses to detect associations between the key sleep-related measures, and work-related measures. Results from analyses testing the five hypotheses are then presented followed by a general summary.

Preliminary Analyses of the Baseline Data

Descriptive analyses of the baseline data indicated that people attempted to go to sleep around the same time and get up around the same time as each other (see Table 7.1). Time to sleep varied considerably and there were several outliers. Overall sleep quality was reported to be slightly above average and the total hours of sleep was, on average, in the recommended time frame for health (6 hours of sleep or more) according to insomnia diagnostic guidelines (Kojima, et al., 2000). Most of the mental health measures showed relatively low average scores; depression scores were particularly low. For the work-related measures, cognitive demand showed the greatest variation as well as the highest mean score. Variance in baseline levels of goal cognition and work-priority were high on the relevant subscales although mean levels were moderate. The rate of attrition was higher for the work-priority scale relative to the other measures. The high attrition was attributed to questions not appearing relevant to all participants.

Table 7.1 ***Summary of Descriptive Statistics for Key Measures at Baseline***

Measure	*N*	*M*	*SD*	*Variance*	*Range*
PSQI	84	5.74	3.38	11.40	1-15
Sleep Quality	84	5.98	2.15	4.63	1-9
Time of Lights Out	84	22.48	0.66	0.44	1-3
Time to Sleep	84	22.25	20.39	415.68	0-120
Hours of Sleep	84	7.03	0.98	0.96	0-5
Time of Waking	84	6.62	0.83	0.68	1-5
Pre-sleep Arousal	85	20.44	11.68	136.51	1-46
Sleep-Priority	73	33.18	6.22	38.73	1-27
Work Goal Motivations	74	77.47	9.15	83.68	1-45
Work-Priority	68	36.24	6.06	36.75	1-30
Depression	91	6.40	4.52	20.42	1-19
Anxiety	91	11.79	3.37	11.32	1-15
Perceived Stress	84	24.46	6.85	46.90	1-32
Fatigue	85	12.96	5.61	31.49	1-25

Preliminary Analyses of the Longitudinal Data

The descriptive statistics for the daily sleep and work-related measures are presented in Table 7.2. Of the sleep-related measures “time to sleep” showed the greatest variation whereas “time of waking” showed the least variation over time. Mean hours of sleep fell into the 6-8 hour bracket. Participants attempted to go to sleep around the same time and get up around the same time each night. However, time to sleep varied considerably each night, due in part to several outliers. Overall sleep quality was reported to be slightly above average and the total hours of sleep was, on average, in the recommended time frame for health (above 6 hours sleep) according to insomnia diagnostic guidelines (Kojima, et al., 2000).

Table 7.2 ***Summary of the Descriptive Statistics for Key Measures Over Time***

Measure	*Observations (N)*	*M*	*SD*	*Variance*	*Range*
Sleep Quality	600	6.48	2.18	4.76	1-9
Time of Lights Out	604	11.07	1.03	1.06	1-16
Time to Sleep	604	23.31	25.06	627.88	0-240
Hours of Sleep	602	7.14	2.46	6.05	0-58
Time of Waking	603	6.55	0.82	0.67	1-8
Quantitative Demand	594	14.32	6.17	38.02	1-28
Cognitive Demand	599	17.37	7.27	52.88	1-33
Emotional Demand	599	9.34	4.89	23.94	1-28
Meaning of Work	599	15.50	4.70	22.04	1-25
Work- role Conflict	599	6.65	3.57	12.71	1-20
Positive Work-Related Emotion	596	4.88	2.04	4.16	1-10
Negative Work-Related Emotion	596	2.16	1.74	3.02	1-9
Event Help Week Goal	540	1.42	1.92	3.69	1-5
Event Conflict Week Goal	540	1.81	2.00	3.98	1-5
Event Help 12-month Goal	541	1.53	1.89	3.57	1-5
Event Conflict 12-month Goal	541	1.24	1.74	3.03	1-5

Relationships Between Key Measures

Correlation analyses were first conducted amongst the key baseline measures (PSQI scores, pre-sleep arousal, work-priority, sleep-priority, goal cognition, depression, anxiety, stress, and fatigue) and measures administered on Day 1 of the daily data collection (quantitative demand, cognitive demand, emotional demand, meaning of work, work-role conflict, positive work-related emotion and negative work-related emotion) (see Table 7.3). The purpose of these analyses was to evaluate the zero-order relationships of the key baseline measures with PSQI scores and levels of pre-sleep arousal. Results suggested that the mental health measures of depression, anxiety, perceived stress and fatigue were all significantly and positively associated with PSQI scores and levels of pre-sleep arousal. Role conflict was also significantly and positively correlated with these two measures. The only other work-related measure to be significantly correlated was negative work-related emotion which was, as expected, positively correlated with levels of pre-sleep arousal. Role conflict and negative work-related emotion were also significantly and positively correlated with the four mental health measures. In contrast, positive work-related emotion was only significantly negatively correlated with levels of anxiety and perceived stress. As a result of these associations, depression anxiety, perceived stress and fatigue were all included in the initial multiple regression analyses.

Correlation coefficients were next computed for the 10 Sleep-related and Work-related Scales measured over time. To evaluate the measures, individual items were summed and then total responses compared. Results suggest that time of lights out was significantly and positively correlated with quantitative demand and cognitive demand but none of the other work-related measures. The total hours of sleep were significantly and positively correlated with all key measures with the exception of role conflict. Time to sleep was significantly and positively correlated with emotional and cognitive demand. A higher meaning of work was associated with a later time of waking. Sleep quality was not correlated with any of the work-related measures. The correlation coefficients also suggest there was no problem of heteroscedasticity between the sleep-related measures or work-related measures over time. Table 7.4 presents a summary of these results.

Table 7.3 ***Correlations of Key Work-Related Measures at Baseline and Day 1 with Sleep Difficulty (PSQI)***

	Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
1	*PSQI*	-															
2	*Pre-sleep Arousal*	**.49****	-														
3	*Work-Priority*	.10	.07	-													
4	*Sleep-Priority*	.02	**.36****	.07	-												
5	*Work Goal Motivations*	.13	-.17	.22	-.15	-											
6	*Depression*	**.39****	**.49****	.06	**.27***	**-.38****	-										
7	*Anxiety*	**.33****	**.32****	.06	.09	**-.27***	**.54****	-									
8	*Perceived Stress*	**.29****	**.52****	.06	**.28***	**-.35****	**.66****	**.59****	-								
9	*Fatigue*	**.52****	**.34****	-.07	.20	-.13	**.47****	**.36****	**.41****	-							
10	*Quantitative Demand^{a}*	-.07	-.13	.13	-.17	.07	-.16	-.01	-.11	-.04	-						
11	*Cognitive Demand^{a}*	.00	.10	.11	-.11	.10	-.09	-.11	.00	-.09	**.36****	-					
12	*Emotional Demand^{a}*	-.06	.19	.05	.02	-.07	.15	.10	.12	.06	**.35****	**.47****	-				
13	*Meaning of Work^{a}*	-.05	-.04	.07	.00	.17	-.15	-.12	-.05	-.06	.20	**.32****	**.35****	-			
14	*Role Conflict^{a}*	**.25***	**.34****	.08	.05	-.00	**.28***	**.28***	**.27***	**.28***	**.28***	**.30****	**.58****	.07	-		
15	*Positive Work Emotion^{a}*	-.12	-.14	.06	-.17	.24	-.22	**-.31****	**-.27***	-.19	-.08	**.24***	-.07	**.24***	-.19	-	
16	*Negative Work Emotion^{a}*	.14	**.32****	-.09	.24	**-.34****	**.29***	**.39****	**.36****	**.27***	**.25***	-.04	.19	**-.23***	**.39****	**-.42****	-

* *$p < .05$*, ** *$p < .01$. Note:* ^{a} *= measure taken from the first day of daily assessment*

Table 7.4 ***Correlations of Key Work and Sleep Measures Over Time***

	Measure	*1*	*2*	*3*	*4*	*5*	*7*	*8*	*9*	*10*	*11*
1.	*Time of Lights Out*	-									
2.	*Hours of Sleep*	**-.27****	-								
3.	*Time to Sleep*	-.06	**-.28****	-							
4.	*Time of Waking*	**.26****	**.24****	.10	-						
5.	*Sleep Quality*	**.10***	**.35****	**-.21****	-.08	-					
6.	*Quantitative Demand*	**.13***	**-.12***	-.02	-.10	.09	-				
7.	*Cognitive Demand*	**.13***	**-.19****	**.12****	.09	.07	**.42****	-			
8.	*Emotional Demand*	-.04	**-.19****	**.19***	.05	-.10	**.27****	**.56****	-		
9.	*Role Conflict*	.10	-.10	-.02	-.02	.08	**.27****	**.43****	**.39****	-	
10.	*Meaning of Work*	.02	**-.15**	-.06	**.16****	-.00	**.28****	**.52****	**.39****	**.16****	-

* *p* < .05, ** *p* < .01

Identification of Relationships between Demographic and Key Sleep Measures

To determine whether demographic characteristics were associated with any of the key measures, correlation analyses were first conducted to assess associations of age, income and employment length with the sleep-related and work-related scales. Older age was associated with less hours of sleep (r = -.27, $p < .05$); and an earlier time of waking (r = -.25, $p < .05$). Employment length was the only measure to be associated with perceptions of sleep quality (r = .23, $p < .05$); the longer the employment length, the better the sleep quality. No significant relationships were found between the key sleep-related measures and income. There were significant, positive associations between cognitive demand and the demographic measures of income (r = .24, $p < .05$) and employment length (r = .23, $p < .05$).

To test whether the categorical demographic measures (gender, ethnicity, occupation type and marital status) were associated with the key sleep-related measures, one-way ANOVAs were conducted. The analyses revealed gender differences in time of lights out; $F(1,79) = 5.27$, $\eta^2 = .06$, $p < .05$. Specifically, women (M = 22.55, SD = 0.78) tended to report later times of lights out than men (M = 22.75, SD = 0.65). Marital status was also associated with the total hours of sleep ($F(1,80) = 6.18$, $\eta^2 = .13$, $p < .01$) and time of waking ($F(1,78) = 3.84$, $\eta^2 = .09$, $p < .05$). Specifically, results suggested that participants who were married (M =6.91, SD = 1.04) reported fewer hours of sleep than participants who were in de facto relationships (M = 7.27, SD = 0.98) (-.77, $p < .01$). In contrast, participants who were married (M = 6.69, SD = 0.84) had a later time of waking than participants who were single (M = 6.29, SD = 0.64) (.59, $p < .05$). Participants in de facto relationships (M = 7.27 , SD = 0.98) also reported more hours of sleep than participants who were single (M = 6.70, SD = 1.11) (.69, $p < .05$).

One-way ANOVAs were conducted using the same independent measures of gender, ethnicity, occupation type and marital status with the dependent work-related measures of demand (quantitative, cognitive and emotional), work-related emotions, meaning of work and work-role conflict. Marital status was significantly associated with cognitive demand; $F(73) = 3.89$, $\eta^2 = .10$, $p < .05$. Specifically, being married (M = 17.58, SD = 7.43) was associated with significantly less cognitive demand than being of single status (M = 22.11, SD = 6.20). In short, age, income, employment length, gender and marital status were included in the relevant regression analyses. No other relationships between demographic and key sleep and work-related measures were significant.

Sleep-Related Indicators of Overall Sleep Quality

Results from analyses using the converted "z" scores suggested that sleep quality demonstrated the closest correlation to PSQI scores at final follow-up (see Table 7.5). This was followed in order by the measures of hours of sleep and time to sleep equally, time of lights out and time of waking. Chi square analyses revealed that the ranked correlations were significantly different ($\chi^2 = 3.99$, $p < .05$) with sleep quality showing the strongest association with PSQI scores ($p < .01$).

Table 7.5 ***Correlations between Key Sleep-Related Measures and Final PSQI Scores***

	PSQI at Final Follow-up	*PSQI Ranked Converted z Scores*
Time of Lights Out	-.10	3
Hours of Sleep	**-.30***	**2**
Time to Sleep	**.30****	**5**
Time of Waking	-.01	4
Sleep Quality	**-.47****	**1**

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

Work-Related Events Conflicting with Work Goals as Predictors of Sleep Quality

Content analyses were used to code work-related events by their type in order to determine their influence on sleep patterns (see Figure 7.1). Aside from the "not described" category, "communication" events were reported most frequently. "Someone else's issue" was also reported as an emotional event a number of times followed by "a meeting or public event" and "achievement related events". Days 1 and 2 had the highest frequency of reported events.

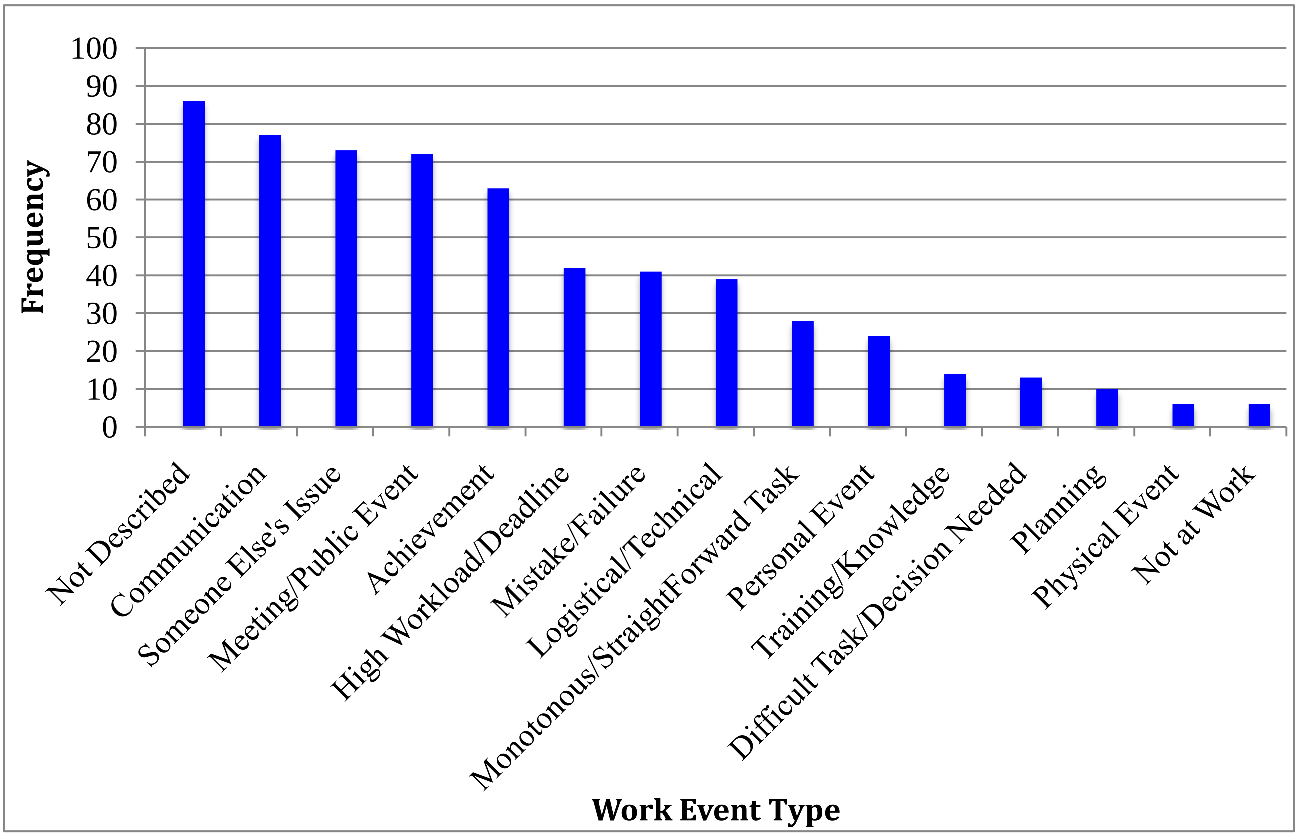

Figure 7.1 **Bar Graph of Total Frequency of Work-Related Events**

Goal type for both the 12-month goals and week goals were also coded. Self-achievement goals featured the most often at baseline for the 12-month work goal question (see Figure 7.2). Other work goals reported often for the 12-month work goal included “completing the current task or project”, “finding a better work/life balance”, “changing to a new role”, and “financial goals”.

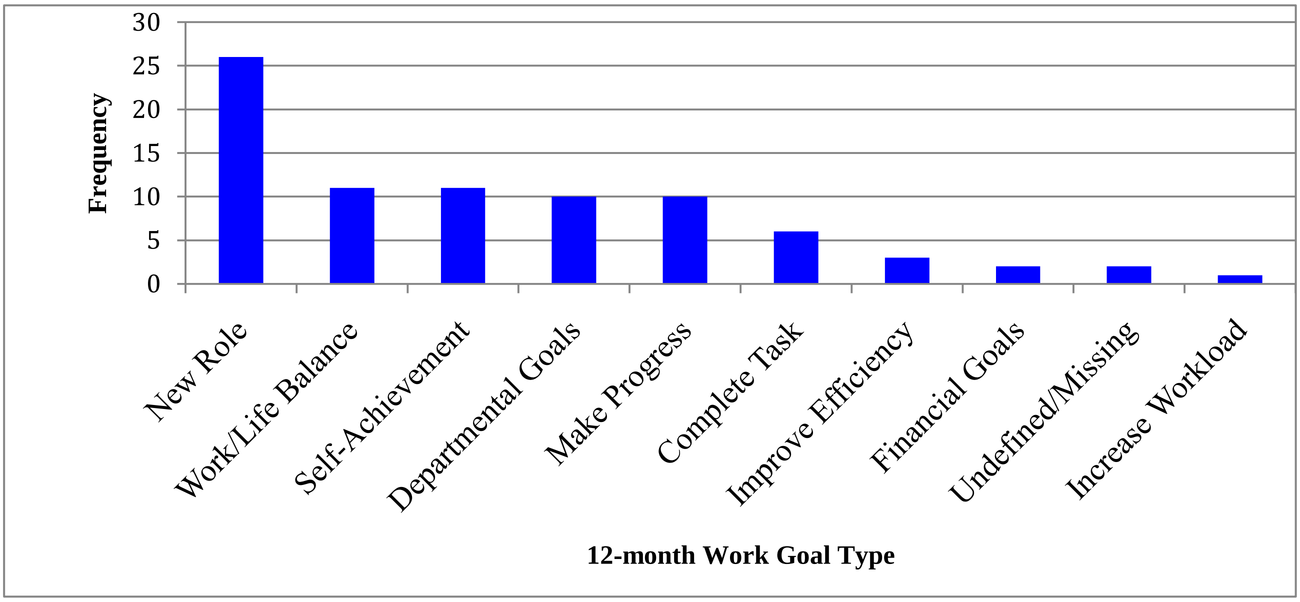

Figure 7.2 **Bar Graph of Baseline Frequencies at Baseline for 12-month Work Goals**

Next, the week work goals were coded using content analysis. Within these, "making progress" was reported most often followed by "completing a task" (see Figure 7.3). These goals were more reflective of progressing in one's everyday work rather than having any idealistic targets for the week. Two additional goals ("get through an event" and "improve communication") that were not found for the 12-month goals were also identified.

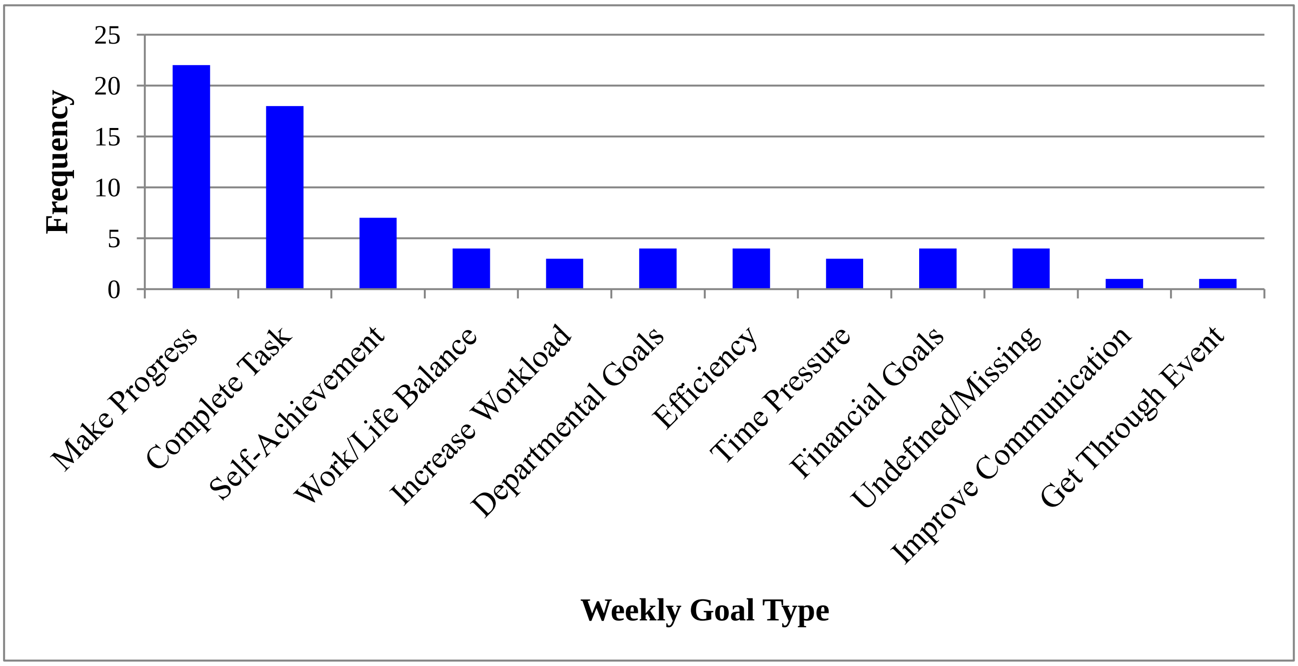

Figure 7.3 **Bar Graph of Total Frequencies at Baseline for Week Work Goals**

Work-Related Event Conflict and Associations with Sleep at the Daily Level

Mixed model analyses were used to test Hypothesis 1 that conflict between work-related events and work goals is associated with poorer sleep quality, later time of lights out, later time to sleep, shorter hours of sleep and an earlier time of waking. Two sets of analyses were conducted. In one set, conflict of work-related events with weekly goals was used as the independent measure; in the second set, conflict of work-related events with yearly goals was used as the independent measure. Results from these analyses only partially supported the hypothesis. Work-related events that conflicted with 12-month work goals were associated with an earlier time of waking (t = -2.44, p < .05) whereas no associations were found with sleep regarding event conflict with week goals (see Appendix M for full results). Work-related events that promoted work goals were not associated with any sleep-related measures.

Priority of Work and Sleep

The baseline data were used to test the second hypothesis that a high priority for a work goal would be negatively associated with the sleep-related measures whereas high priority for sleep would be positively associated with the sleep-related measures. Work-goal motivations were included as an additional and more detailed measure of the importance placed on work-related tasks. An initial one sample t-test also indicated that work-priority (M = 36.17, SD = 6.15) was rated significantly higher than sleep-priority (M = 33.14, SD = 6.39; t (65) = 2.82, p < .01.

Based on the correlation matrices, age and marital status were entered as covariates in the final analyses. Final regression analyses showed that after controlling for marital status, work-goal motivations were significantly associated with a poorer sleep quality, a later time of waking and higher PSQI scores (see Table 7.6). However, work-goal motivations were also associated with a faster time to sleep. Higher sleep-priority was also related to more hours of sleep. No significant associations were found between work-priority and any of the sleep-related variables or pre-sleep arousal. Pre-sleep arousal was also entered into the regression analyses and was significantly associated with fewer hours of sleep and higher PSQI scores. Pre-sleep arousal was then examined as a dependent measure in an analysis using work-goal motivation, work-priority and sleep-priority as the independent measures. Results showed that work-goal motivation was significantly negatively associated with pre-sleep arousal whereas sleep-priority was significantly positively associated.

Table 7.6 ***Summary of Regression Analyses Testing Associations between Work and Sleep Related Measures at Baseline***

Measure	*B*	*SE B*	*B*	*t*	*Model F*	R^2
Time of Lights Out					1.69	.08
Work-goal Motivations	.00	.01	.01	0.04		
Work-Priority	-.03	.02	-.21	-1.93		
Sleep-Priority	-.03	.02	-.17	-1.52		
Pre-sleep Arousal	.00	.01	.00	0.03		
Time to Sleep					1.98	.09
Work-goal Motivations	.81	.39	.23	**-2.07***		
Work-Priority	.40	.58	.07	0.69		
Sleep-Priority	.77	.57	-.15	-1.37		
Pre-sleep Arousal	.37	.28	.15	1.31		
Hours of Sleep						
Step 1					**6.86****	.07
Age	-.12	.05	-.23	**-2.35***		
Step 2					**6.96****	.30
Work-goal Motivations	-.01	.01	-.07	-0.67		
Work-Priority	.03	.02	.15	1.63		
Sleep-Priority	.04	.02	.22	**2.20***		
Pre-sleep Arousal	-.04	.01	-.49	**-4.86****		
Sleep Quality					3.02	.13
Work-goal Motivations	-.07	.03	-.26	**-2.42***		
Work-Priority	-.06	.04	-.15	-1.40		
Sleep-Priority	-.05	.04	-.12	-1.09		
Pre-sleep Arousal	-.02	.02	-.12	-1.12		
Time of Waking						
Step 1					7.62	.08
Marital Status	-.33	.11	-.33	**-3.19****		
Step 2					2.91	.15
Work-goal Motivations	.02	.01	.24	**2.25***		
Work-Priority	-.02	.02	-.16	-1.56		
Sleep-Priority	.00	.02	.00	0.01		
Pre-sleep Arousal	-.00	.01	-.01	-0.07		
PSQI					**7.30****	.27
Work-goal Motivations	.09	.04	.23	**2.26***		
Work-Priority	.01	.06	.02	0.20		
Sleep-Priority	-.08	.06	-.14	1.35		
Pre-sleep Arousal	.15	.03	.54	**5.21****		
Pre-sleep Arousal					**4.60****	.15
Work-goal Motivations	-.31	.15	-.22	**-2.03***		
Work-Priority	.17	.23	.08	0.75		
Sleep-Priority	.61	.22	.29	**2.82****		

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

Perceived Work-Related Demand and Perceptions of Sleep Quality

To test the hypothesis that the types of work-related demand and negative work-related emotions would differentially affect sleep quality, mixed model analyses were conducted with the subscales of work-goal motivations, work-priority, sleep-priority, quantitative, cognitive, and emotional demands, work-role conflict and negative work-related emotions included as predictors in the models of the sleep quality measures (see Table 7.7). The only work-related measure to be associated with sleep quality was work-goal motivation. Results suggested that the higher the work-goal motivations, the higher the sleep quality. Significant relationships were found between cognitive demand and emotional demand (but not quantitative demand) and time of lights out that night. As predicted, higher cognitive demand was associated with later time of lights out. However, contrary to expectation, high emotional demand was associated with an earlier time of lights out. Significant associations were also found between high emotional demand and fewer hours of sleep that night as well as an earlier time of waking the next day. Contrary to expectation, negative work-related emotions were not associated with sleep quality or any of the other sleep-related measures (time of lights out, time to sleep, hours of sleep and time of waking). Thus, analyses revealed only partial support for Hypothesis 2 that high perceived demand and negative work-related emotion would be associated with a poorer quality of sleep.

Associations between Work-Related Demand and Work-Related Emotion

Mixed model analyses were used to examine whether any of the independent measures (work-goal motivations, work-priority and sleep-priority, quantitative, cognitive and emotional demands and work-role conflict) were associated with positive and negative work-related emotions experienced during the day (see Table 7.8). Contrary to predictions, a higher level of cognitive demand was significantly associated with higher positive work-related emotion. In support of predictions, higher levels of emotional demand and work-role conflict were associated with higher levels of negative work-related emotion. In short, despite some findings being contrary to expectation, the fact some relationships were found means that the first boundary condition for the sleep self-regulation model has been met.

Table 7.7 ***Mixed Model Analyses to Assess Associations between Independent Work-Related Measures and Dependent Sleep-Related Measures***

Sleep Outcomes	*Work-goal Motivations*		*Work-Priority*		*Sleep-Priority*		*Quantitative Demand*		*Cognitive Demand*		*Emotional Demand*		*Work-role Conflict*	
	Est. (SE) [CI]	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*
Sleep Quality[a]	**-.090(.034) [021, .159]**	**2.62****	.024(.038) [.053, .100]	0.62	-.002(.022) [-.047, .042]	-0.11	.062(.032) [.002, .126]	1.90	-.040(.029) [-.097, .017]	-1.39	-.026 (.043) [-.111, .059]	-0.61	.037(.048) [-.059, .132]	0.75
Time of Lights Out[b]	.003(.012) [-.027, .022]	-0.23	-.025(.021) [-.067, .017]	-1.18	-.032(.019) [-.070, .006]	-1.71	.009(.018) [-.026, .044]	0.52	**.038(.016) [.006, .069]**	**2.38***	**-.051 (.024) [-.098, -.004]**	**-2.17***	.035(.026) [-.017, .087]	1.33
Time to Sleep[b]	-.192(.250) [-.693, .309]	-0.77	.173(.435) [-.702, 1.048]	0.40	-.325(.385) [-1.099, .449]	-0.84	.167(.322) [-.467, .802]	0.52	-.273(.289) [-.844, .298]	-0.94	.417 (.421) [-.412, 1.246]	0.99	-.352(.457) [-1.252, .548]	-0.77
Hours of Sleep[b]	-.004(.028) [-.060, .052]	-0.14	.058(.047) [-.036, .152]	1.22	-.037(.042) [-.120, .047]	-0.87	-.032(.045) [-.122, .057]	-0.71	.008(.040) [-.070, .087]	0.21	**-.120 (.061) [-.240, .000]**	**-1.97***	.043(.070) [-.096, .182]	0.61
Time of Waking[c]	.013(.010) [-.008, .034]	1.26	.005(.018) [-.032, .042]	0.26	-.014(.016) [-.046, .019]	-0.83	-.015(.011) [-.036, .005]	-1.46	.010(.010) [-.009, .029]	1.01	**-.039 (.014) [-.066, -.012]**	**-2.88****	.003(.014) [-.025, .031]	0.22

Sleep Outcomes	*Negative Work-Related Emotion*	
	Est. (SE) [CI]	*t*
Sleep Quality [a]	.086(.106) [-.295, .123]	-0.81
Time of Lights Out [b]	-.065(.058) [-.180, .050]	-1.12
Time to Sleep [b]	-.716(1.012) [-2.709, 1.277]	-0.71
Hours of Sleep [b]	.217(.156) [-.091, .525]	1.39
Time of Waking[c]	-.002(.032) [-.065, .061]	-0.05

*Note. Analyses include observations from 42 employees over 10 days * with 527 to 530 observations missing: [a] Observations = 260; [b] Observations = 263; [c] Observations =262. * p < .05, ** p < .01, *** p < .001; Independent measures are entered into the model together.*

Table 7.8 ***Mixed Model Analyses of Relationships between Key Work-Related Measures and Work-Related Emotion***

Work-Related Emotions	*Work-goal Motivations*		*Work-Priority*		*Sleep-Priority*		*Quantitative Demand*		*Cognitive Demand*		*Emotional Demand*		*Work-Role Conflict*	
	Est. (SE) [CI]	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*	*Est. (SE) [CI]*	*t*
Positive Work-Related Emotion	.044(.027) [-.010,.099]	1.64	-.030(.048) [-.126,.065]	-0.64	-.008(.042) [-.092,.077]	-0.18	-.038(.010) [-.081, -.004]	-1.78	**.060(.021) [.018, .102]**	**2.81***	-.026(.029) [-.084, -.031]	-0.91	-.056(.030) [-.115, -.004]	-1.85
Negative Work-Related Emotion	-.016(.016) [-.048,.016]	-0.98	.029(.029) [-.028,.085]	1.02	-.014(.025) [.064,.036]	-.056	**.069(.018) [.035, .104]**	**3.94***	-.021(.017) [-.055, .012]	-1.24	**.090(.024) [.044, .137]**	**3.83***	**.062(.025) [.012, .112]**	**2.45****

*Note. Analyses include observations from 91 employees over 10 days with 303 observations missing: Observations = 588. * p < .05, ** p < .01, *** p < .001*

Associations between Meaning of Work, Positive Work-Related Emotion and Sleep Quality

A significant relationship was found between meaning of work and sleep quality as well as positive work-related emotion and sleep quality. Contrary to expectation, the higher the meaning of work, the lower the perceptions of sleep quality. In line with expectations, higher levels of positive work-related emotion were associated with better sleep quality the following night. In a second set of mixed model analyses, the independent measure of meaning of work was also entered with the dependent measures of positive and negative work-related emotion. As expected, higher meaning of work was significantly associated with a higher intensity of positive work-related emotions and a lower intensity of negative work-related emotion. These results reveal only partial support for the hypothesis that finding meaning in one's work and positive work-related emotion would be associated with a better quality of sleep. Table 7.9 and Table 7.10 present a summary of these results.

Table 7.9 ***Mixed Model Analyses to Assess Associations between Meaning of Work and Positive Work-Related Emotion with Sleep-Related Outcomes***

Sleep Outcomes	*Meaning of Work*		*Positive Work-Related Emotion*	
	Est. (SE) [CI]	*t*	*Est. (SE) [CI]*	*t*
Sleep Quality[a]	**-.005(.005) [-.104, -005]**	**-2.17***	**-.192(.057) [.080 .304]**	**3.38****
Time of Lights Out[b]	.006(.013) [-.019, .032]	0.05	0.45(.029) [.013, .103]	1.54
Time to Sleep[b]	.097(.276) [-.445.638]	0.35	.168(.632) [-1.073, 1.409]	0.27
Hours of Sleep[c]	.-054(.030) [-.113, .005]	-1.80	.087(.067) [-.044, .219]	1.31
Time of Waking[c]	-.006(.008) [-.023, .010]	-0.77	.023(.020) [-.015, .061]	1.18

Note. Analyses include observations from 79 employees over 10 days with 320 to 324 observations missing: [a] *Observations = 466;* [b] *Observations = 470;* [c] *Observations =469. * $p < .05$, ** $p < .01$, *** $p < .001$; Independent measures are entered into the model together.*

Table 7.10 ***Mixed Model Analyses to Assess Associations between Meaning of Work and Work-Related Emotion***

Work-Related Emotion	*Meaning of Work*	
	Est. (SE) [CI]	*t*
Positive Work-Related Emotion	**.115(.017) [.081, .149]**	**6.67*****
Negative Work-Related Emotion	**-.043(.017) [-.076, -.010]**	**-2.57****

*Note. Analyses include observations from 79 employees over 10 days with 199 observations missing: Observations = 591; * $p < .05$, ** $p < .01$, *** $p < .001$*

Intentions for Sleep-Related Behaviour and Perceptions of Sleep Quality

Prior to testing the hypothesis that intentions reported in the SRCT would be associated with actual sleep-related behaviour, the SRCT behaviours listed by participants were coded as to the type of activity and the intended time of lights out. Findings suggested that preparing for the deadline was the activity chosen the most frequently (by 16% of respondents) although completing other paperwork was also highly reported (by 14% of respondents; however, for some participants it was unclear whether this paperwork meant the deadline or other paperwork). Phoning a friend to cancel the morning exercise session was the third most frequently reported activity (12%). Watching television was the most common activity selected during the 10pm timeslot (20%) and remained the third most common activity in the 10.30pm timeslot (13%) behind sleep (22%) and going to bed (17%). It was noted that at 11pm watching television (3%) is overtaken by working on the deadline task (6%). Figure 7.4 of timeslots selected as the intended time of sleep reveals that most respondents selected a time between 10pm and 12pm. There were also a relatively high number of participants who indicated that they would continue working through the night until the task was complete.

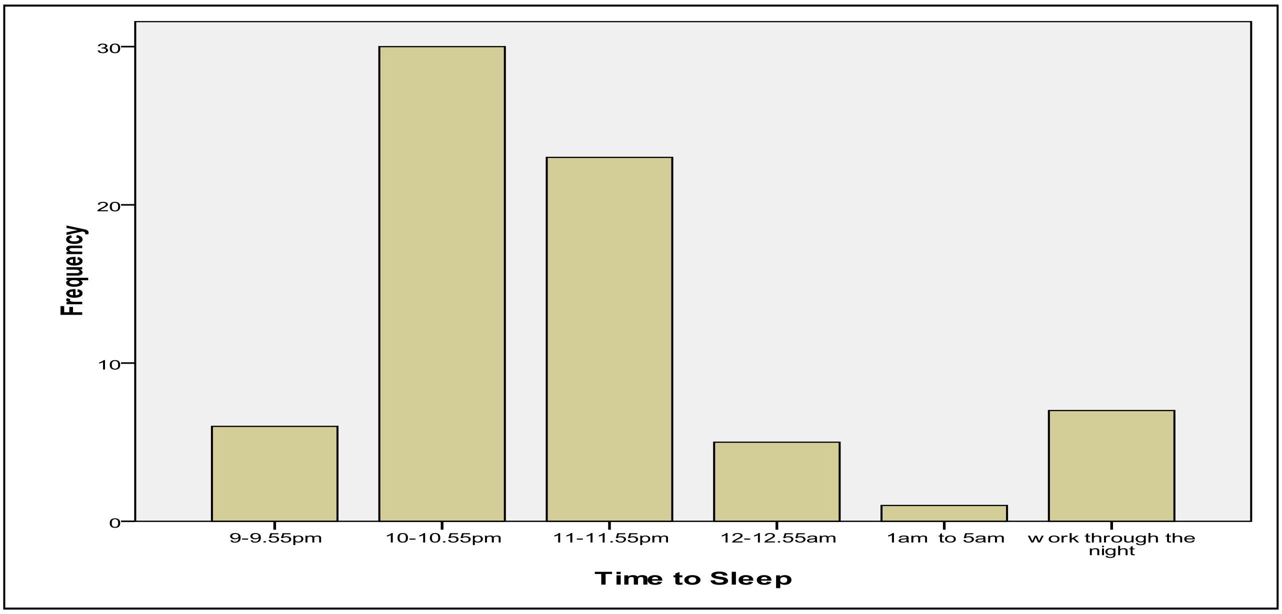

Figure 7.4 **Bar Graph Showing Frequencies of Intended Time to Sleep**

Regression analyses assessed Hypothesis 5 that intended sleep behaviour reported on the SRCT would predict sleep quality for the night following completion of the SRCT. Later intended bedtime was associated with greater sleep disturbance the following night; (F (1,73) = 11.68, β = 5.25, $SE\ \beta$ = 1.54, *Beta* = .37, t = 3.42, $p < .001$) but not with the self-reported actual time to sleep or overall PSQI scores. Specifically, the data suggested that the later the intended time to sleep, the more sleep disturbances were reported. Entered regression analyses were also conducted with the independent work-related measures of quantitative demand, cognitive demand, emotional demand, work-role conflict and negative work-related emotions on Day 1 against the dependent measure of SRCT intended bedtime scores on Day 5. Meaning of work and positive work-related emotions on Day 1 were also regressed onto SRCT intended bedtime on Day 5. Emotional demand was the only measure to show a significant association with intended bedtime (t = 2.19, p < .05) and the overall model was non-significant; (F (1,66) t = 1.24, p = .31). Specifically, the data suggested that the greater the emotional demand on Day 1 the earlier the intended bedtime on Day 5; however, the predictor variables as a set did not significantly predict intended bedtime.

Mixed model analyses were conducted using SRCT scores on Day 5 as an independent measure of the work-related measures of quantitative, cognitive and emotional work-related demand, work-role conflict and meaning of work from Days 6 to 10 of the daily data. Results revealed that later bedtime intentions on the SRCT (Day 5) were associated with higher cognitive and emotional demand (but not quantitative demand), higher work-role conflict and higher meaning of work on Days 6 to 10. Mixed model analyses were also conducted with the dependent sleep-related measures of sleep quality, time of lights out, time to sleep, hours of sleep and time up for Days 6 to 10 but no significant associations were found. Table 7.11 summarises the results.

Table 7.11 ***Summary of Mixed Model Analyses of the Contribution of SRCT Scores of Bedtime Intentions as Predictors of Work-Related Measures***

	SRCT Scores	
Work-Related Measures	*Est. (SE)* *[CI]*	*t*
Quantitative Demand[a]	.306(.307) [.307, .919]	1.00
Cognitive Demand [*b*]	**1.03(.357) .318, 1.741]**	**2.89****
Emotional Demand[*b*]	**.535(.235) [.067, 1.004]**	**2.28***
Work-role Conflict[*b*]	**.470(.141) [.188, .752]**	**3.32****
Meaning of Work[*b*]	**.591(.207) [.180, 1.003]**	**2.86****

*Note. Analyses include observations from 71 employees from Days 6 to 10 with 84 to 85 observations missing: [a] Observations = 231; [b] Observations = 232; * p < .05, ** p < .01, *** p < .001.*

Results Summary

In short, results showed partial support for the predictions made using the sleep self-regulation model. The first hypothesis that greater conflict between work-related events and work goals would be associated with poorer sleep quality was true only for the 12-month goals and only in relation to time of waking. As expected, the sleep-related daily indicators of sleep quality, time to sleep and hours of sleep were associated with PSQI scores although the measures of time of lights out and time of waking were not.

As predicted, cognitive demand was associated with a later time of lights out and emotional demand was associated with an earlier time of waking and less total hours of sleep. Work-goal motivations were also associated with higher pre-sleep arousal in baseline regression analyses. In line with expectations, higher meaning of work was associated with higher positive work-related emotion and lower negative work-related emotion. Also as expected, emotional demand and work-role conflict were associated with higher levels of negative work-related emotion. However, contrary to expectation, high emotional demand was associated with an earlier time of lights out and work-goal motivations were associated with higher sleep quality whereas meaning of work was associated with lower sleep quality. Work-goal motivations also showed an association with low PSQI scores in baseline regression analyses. Contrary to prediction, cognitive demand was associated with higher levels of positive work-related emotion. As expected, sleep-priority was associated with longer hours of sleep in baseline regression analyses but was also associated with higher pre-sleep arousal. In turn, pre-sleep arousal, as expected, was associated with higher PSQI scores.

The results also showed the potential in using the SRCT to determine intentions for a delayed behaviour prior to that behaviour occurring. Hypothesis 5 was partially supported: a sleep-related intention predicted sleep disturbances, although it did not predict actual time of lights out or overall PSQI scores. High emotional demand on Day 1 was also significantly associated with later intended bedtime using the SRCT on Day 5. The next chapter will discuss these results in more detail and is structured around the predictions made using the sleep self-regulation model.

CHAPTER 8 DISCUSSION STUDY ONE

In the first study, personal work goals, the emotions and cognitions generated and work-related demand and their associations with self-reported quality of sleep and other sleep-related indicators were described on a daily basis over a 10- day period. In general, the findings indicated that there were important connections between these work-related demand measures and self-report measures pertaining to quality sleep, with some factors in the workplace more likely to have an impact on sleep than others. In demonstrating these relationships the first section of the sleep self-regulation model was supported and provided a solid basis for the intervention studies to follow. This chapter will discuss findings from the preliminary analyses before examining results from each of the hypotheses. The chapter will conclude with a general overview of the overall contribution of the study to the field of sleep self-regulation.

Sleep-Related Indicators

Self-reported quality of sleep is a complex perception. To capture sleep quality properly, multiple measures of sleep quality were administered including hours of sleep, time to sleep, time of lights out and time of waking. The average hours of sleep fell just on the 7 hours recommended as sufficient for adult sleep (Horne, 1988; Kojima, et al., 2000) suggesting that for many participants, their sleep length was inadequate. Average time to sleep was under the 30 minutes set as a benchmark for poor sleep in the Pittsburgh Sleep Quality Index (PSQI) (Buysse, et al., 1989). Average time of lights out was prior to midnight and scores appeared to be fairly stable around this mean. Past research argues that an irregular time of lights out is a major contributor to sleep difficulty (Cheek, Shaver, & Lentz, 2004). The lack of fluctuation in the time of lights out over the 10 days of data collection therefore suggests that this population may be less likely to be chronically sleep deprived. This was supported by the relatively low average of the full PSQI scores. Nevertheless, associations later found between work-related measures and sleep-related measures highlighted factors to address in individuals who do have greater sleep difficulty. There also appeared to be little variation in the time of waking. It is possible that time of waking may be more socially restricted than time of lights out due to the need to be at work at a certain time and so was similar between individuals. In support, previous evidence suggests that work has a large influence on a person’s waking activities and their patterns around waking (Basner, et al., 2007). Waking early may still be a threat nevertheless as it is likely to present immediate dangers to health through factors like fatigue while driving as well as functional impairments in the workplace (Harvey, Eidelman, & Talbot, 2008; Home, 2008).

The association found between daily reports of sleep quality and PSQI scores adds to the growing body of research that supports the use of a daily sleep diary as an accurate form of sleep quality measurement (e.g. Rook & Zijlstra, 2006; Sonnentag, 2001; Tennen & Affleck, 2002). A previous study also showed that online daily sleep diaries show significant and high correlations with retrospective sleep questionnaires (e.g. Libman, et al., 2000). However, results from one study suggested that associations with sleep quality differed for subjectively versus actigraph assessed data (Tworoger, Davis, Vitiello, Lentz, & McTiernan, 2005). Nevertheless, the authors suggested that more reliable estimates may be obtained when recordings are made on multiple nights. In the current study, measurements were taken daily over a period of 11 days so great accuracy may be maintained at the daily level. Moreover, as the PSQI total score takes into account a number of factors it could also be seen as more accurate than the subjective self-report recordings done in the actigraph study.

Analyses were also conducted to assess the strength of the association of each sleep-related indicator with the overall PSQI scores. Sleep quality, time to sleep and hours of sleep showed a significant correlation with the PSQI score at final follow-up assessment. Further chi square analyses using converted sleep correlations into ranked z scores suggested that sleep quality showed the strongest association with PSQI scores. This finding helps to answer the current call to understand what sleep-related components are most accountable for perceptions of sleep difficulty (Akerstedt, 2006). One other study found that individuals who described their sleep quality as poor also had a significantly longer sleep onset (Pace-Schott, et al., 1994). However, this study only took into account perceptions at one time point rather than an average of several days of measurement. The findings from the current study add support to the viability of self-reported indicators administered on multiple days of measurement to accurately measure sleep.

Further preliminary analyses found a significant relationship between fewer hours of sleep, an earlier wake time and older age. These findings contribute to a large body of research on the associations of age with sleep patterns. Much of the evidence concerning which age group is most at risk of sleep deprivation is still mixed. For example, some studies suggest that young adults are particularly at risk of sleep deprivation due to their lifestyle (Coren, 1994; Johnson, 2006). On the other hand, another body of literature suggests problems are more prevalent in the elderly (Cohen-Mansfield & Jensen, 2005; Morphy, et al., 2007; Ohayon, 2002). The current study included a wide age range (21 to 65), and results suggested that older participants were more at risk of poor sleep.

Marriage was associated with a later time of waking compared to participants who were not in a relationship. (Troxel, et al., 2007). Salivary cortisol levels are thought to be one influence of the time of waking and appear to vary more in terms of anticipation of the work day (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004). It is possible that married individuals may exhibit lower levels of salivary cortisol due to a greater stability in their relationships in comparison to individuals who are single so are less likely to wake early. Changes in heart-rate variability that occur with anticipatory stress are thought to be another contribution to poor sleep maintenance and an earlier time of waking (Hall, et al., 2004). If marital difficulty is on-going, anticipating the problems that occur on waking may therefore be another reason for the association.

Yet, married individuals also had fewer hours of sleep than participants in a de facto relationship. It may be that participants who are married may face different demands to individuals who are in a de facto relationship or single. The types of demands experienced in turn could lead to fewer hours of sleep. Although children (more likely in participants who are married) could be one example of an additional demand, it is unlikely to explain the current results since the number of participants with children was relatively few. Low variance in time of waking suggests that the current results may be questioned. Moreover, existing evidence suggests that married individuals are likely to report a better quality of sleep than individuals not in a relationship (Leger, et al., 2000). Nevertheless, the current findings highlight how relationship stability and its on-going associations with sleep could be an interesting avenue of research to pursue.

Analyses of the remaining demographics revealed that females reported a later bed time than males but there were no associations with sleep quality. This result is surprising as most of the research on sleep quality has found gender to be a significant predictor (e.g. Erkki Kronholm, et al., 2006; Leger, et al., 2000; Morphy, et al., 2007; Ohayon, 2002). It is possible that the low percentage of males in the study (33%) meant there was not enough specificity to detect significant gender differences in sleep quality but allowed for the association with bed time to be detected.

Measures relating to mental health (depression, anxiety, perceived stress and fatigue) were also administered at baseline. Depression scores were low and so were unlikely to contribute to the final results. As expected, although depression was significantly correlated to PSQI scores at baseline, the measure did not emerge as a significant predictor in the multiple regression analyses. In contrast, levels of perceived stress, anxiety and fatigue were moderate. In a population of busy day-time employees who had volunteered to take part in a study concerning sleep this was expected. Correlation analyses also showed that stress, and anxiety were significantly correlated to PSQI scores at baseline although multiple regression analyses suggested that none of these measures actually predicted PSQI scores. The lack of associations between general demand measures such as perceived stress, anxiety and fatigue with PSQI scores show support for the main focus of the study to be on specific work-related predictors such as work-goal motivations and emotions.

Work-Related Events, Work Goals and Sleep Quality

Research suggests that self-regulatory processes that guide sleep behaviour can be understood better through analysis of the events that activate them (Frijda, et al., 1992; Weiss & Cropanzano, 1996; R. Wood, 2005). For example, measures of personal goals, emotions and events have all been found to be closely associated and critical for self-regulation processes (Cantor, et al., 1991; Diener, et al., 1991; Schimmack & Diener, 1997; Sonnemans & Frijda, 1995). Yet, initial analyses only partially supported the predictions as only events that conflicted with 12-month work goals showed an association with sleep. Further, the only sleep-related measure to be negatively affected was time of waking. It is suggested that when an event is relevant to achieving important goals (of which 12-month goals could be considered) an emotional reaction is generated (Austin & Vancouver, 1996). The emotions generated from these types of conflicts could then go on to affect sleep. It is also questioned why work events that conflict with work goals were associated with a sleep-related indicator but events that promoted the work goals were not. Energising effects of events that enhance one’s goals were previously found to persist longer than detrimental effects of events that disrupted one’s goals (Zohar, 2003). It is possible then that the negative emotions generated by the events that conflicted had a more powerful effect on sleep than the actual event, because the events were considered work-related.

Priority of Work and Sleep

A one sample t-test indicated that work-priority and sleep-priority were significantly different from one another. Moreover, scores suggested that work goals were valued more than the set goal of getting quality sleep. There are several possible reasons for why work goals were more valued than sleep. According to self-determination theory (Deci & Ryan, 2000), people are more motivated by their goals when they have the opportunity to define them alone as opposed to when they are externally set. In the current study, the goal of getting adequate sleep was externally set whereas the work goals were self-determined, hence participants may have been less motivated to achieve the sleep goal. Research also suggests that biological needs are less motivating when they are in the future so alternative activities that are closer in time are chosen (Loewenstein, 2001). Therefore, participants may have been more highly motivated by work since daily questionnaires were answered in the workplace setting when sleep was still forecast for some time in the future. Having a balance of work and life priorities is conductive to general well-being (Salmela-Aro & Wiese, 2006). The higher value placed on work goals than could suggest an imbalance leading to poorer well-being. To rectify this imbalance it is possible that the importance of sleeping well is highlighted.

Nevertheless, regression analyses suggested that, contrary to predictions, a high priority for sleep was associated with higher levels of pre-sleep arousal. High motivation for sleep has been associated with a faster time to sleep in a normal population (Harrison, et al., 1995), which can seem conflicting to this finding. However, more recent evidence suggests that high motivation can cause someone to draw on their self-regulatory resources more which, in turn, causes a loss of control and higher levels of pre-sleep arousal (Muraven & Slessareva, 2003). It is also possible that the relationship between sleep-priority and sleep patterns is not linear. On the one hand, individuals that have reached the level of sleep deprivation where they are diagnosed with insomnia may be too highly motivated (Belanger, et al., 2005; Drake, et al., 2003). Alternatively, members of a normal population may have motivation levels low enough to be problematic for their sleep. There is also evidence that sleep deprivation reduces motivation levels generally (Engle-Friedman, et al., 2003). To investigate whether work versus sleep-priority predicted change in sleep patterns, priority of sleep and priority of work were also entered into mixed model analyses along with work-goal motivations and the work-demand related measures. Analyses revealed that at a daily level only work-goal motivations were associated with sleep quality the following night. Many people intend to sleep well but for a myriad of reasons do not end up getting the sleep required (Pilcher & Odle-Dusseau, 2005). This argument helps to explain why no direct association was found between sleep-priority and daily sleep patterns.

In contrast to predictions, higher work-goal motivations were associated with a higher sleep quality. Work-goal motivations represent a more detailed account of the importance placed on work (Pomaki, et al., 2004). Evidence suggests that employees have an intrinsic need to feel competent in the workplace and placing importance on work goals can lead to better psychological adjustment (Baard, Deci, & Ryan, 2004). Being better psychologically adjusted in the workplace may explain the higher sleep quality reported at night in participants with strong work-goal motivations. At baseline, analyses also revealed that work-goal motivations were associated with lower levels of pre-sleep arousal whereas work-priority showed no association. It is possible that cognitions relating to the work goal need to be more complex than a simple level of priority in order to be associated with sleep. Yet, the complexity seems to be less relevant to sleep-priority as results also revealed simply rating sleep at a higher priority can be enough to increase levels of pre-sleep arousal. The association between clear work-goal motivations (as evidenced by a higher score) and lower pre-sleep arousal (as well as sleep quality on a daily basis) also suggests that work-related cognition is not always detrimental to sleep. Evidence in support of this conclusion suggests that having clear objectives is less likely to lead to rumination, a major influence on arousal levels (Dugas, et al., 1997).

To further investigate the role that pre-sleep arousal played with sleep and see the impact of these work and sleep priorities and work-goal motivations, pre-sleep arousal was also entered into regression analyses as a dependent measure. In support of existing evidence (e.g. Morin, et al., 2003; White, 1994), pre-sleep arousal was associated with fewer hours of sleep and higher PSQI scores. Currently, the majority of work done to promote sleep has been focused on trying to tell people about its benefits and thus increase its priority. The finding that high sleep-priority was associated with higher pre-sleep arousal at baseline calls for a better understanding of sleep priority before trying to motivate people to prioritise sleep. It was also predicted that priority and goal cognition would be associated with negative emotion but no significant associations were found. As the measures of work-priority, sleep-priority and work-goal motivation were highly cognitive and related to the workplace it is likely that the measures were too distinct from emotion to show an association.

Perceived Work-Related Demand and Sleep Quality

There has been recent interest in how elements of the work environment and the demands that it places on individuals can go on to have possible health consequences (e.g. Kristensen, et al., 2005). Evidence suggests that psychological demand is associated with night-time sleep quality and can contribute up to 14% of the variance when it comes to explaining it (Winwood & Lushington, 2006). Yet much of the literature has focused on coping with the consequences of a poor night's sleep rather than how specific demands can predict sleep problems (Karasek & Theorell, 1990; Kompier & Cooper, 1999). In the current study, it was predicted that a high level of perceived demand would be associated with estimates of poor quality sleep but that the relationship would vary according to the type of demand (quantitative, cognitive or emotional). Moreover, of the psychological strains experienced, cognitive demand was expected to be the most likely measure to be associated with poor sleep quality. A high work pace which is the central factor in cognitive demand (Akerstedt, Fredlund, et al., 2002; Winwood & Lushington, 2006) was thought to be particularly important in the high pressure roles investigated. Prolonged activation of arousal arising from chronic cognitive demands shows established links to poor sleep (Brosschot, Pieper, & Thayer, 2005).

Yet, neither quantitative demand nor cognitive demand was significantly related to night-time sleep quality. In the literature, findings are mixed. For example, a previous study found that cognitive workload was a poor predictor of sleep deprivation in general but was a good predictor of perceptions of sleep quality specifically (e.g. De Bruin, et al., 2002). Rumination, defined as being more cognitive than constructs like worry, has also been associated with poorer sleep (Thomsen, Mehlsen, Christensen, & Zachariae, 2003). Another study investigating burnout (which may be a result of high cognitive demand) found no significant differences in sleep quality between burnt out employees versus employees who had reduced working hours, workload, or work pace (Soderstrom, Ekstedt, Akerstedt, Nilsson, & Axelsson, 2004).

As it was possible that cognitive demand was associated with sleep quality through arousal levels, the association between cognitive demand and time to sleep was also investigated. Research suggests that when trying to suppress cognitive activity there is a longer sleep-onset latency and estimations of sleep quality do tend to be poorer (A. G. Harvey, 2003). According to ironic control theory (Wegner, 1994) this intentional thought control is unsuccessful because it requires joint action of both monitoring and operating processes. Because the monitoring process is less effortful it tends to sensitise attention to the very thoughts selected for avoidance. Although the relationship between cognitive demand and time to sleep alone was non-significant it is still possible that the amount of effort that one puts into trying to suppress this activity is the key factor in time to sleep rather than the level of cognitive demand per se.

Cognitive demand was, however, significantly associated with a later time of lights out. A conclusion was reached that cognitive demand may be more likely to interfere with self-regulation for sleep related behaviour than with individual perception. Evidence suggests that when cognitive resources are depleted self-regulation of behaviour is negatively affected, particularly through a lack of self-control (Vohs, Ciarocco, & Baumeister, 2005). The lack of self-control in turn increases susceptibility to immediate external influences like a favourite television show or current work demands that cause the person to go to bed later. The lack of association between quantitative demand and time of lights out may suggest that it is the time pressure aspect of cognitive demand (a key differentiating factor between the two measures) that was responsible for the relationship with only cognitive demand.

Analyses revealed that emotional demand was not associated with sleep quality but was negatively associated with behavioural indicators of sleep such as time of lights out and time of waking. Individuals who are unable to regulate emotional demands in their environment may be less accurate at interpreting behavioural cues in the environment (Gross & John, 2003). Therefore, employees who perceive higher emotional demand may also be unable to regulate sleep behaviours like going to bed at an appropriate time instead of watching television.

However, the time of waking could be viewed as being largely outside of one's control thus less amenable to the efficacy with which a person can regulate cognitive demand. Concern about future events (e.g. a work deadline) could also be responsible for an increased perception of cognitive demand and the resulting influence on time of waking. Research has investigated the role of anticipatory anxiety on time of waking (Hall, et al., 2004) with significant causal mechanisms found between this type of anxiety and physiological processes like heart-rate variability. Emotions generated from the emotional demand may include anxiety, which could explain the relationship with time of waking. Cognitive demand, on the other hand, may not generate sufficient levels of emotion to show the same association with time of waking.

Analyses also revealed that the higher the levels of emotional demand, the lower the total hours of sleep the following night. Emotional demand was also associated with fewer hours sleep in a sample of shift-workers, with the authors of the study concluding that job satisfaction was a possible mediator between the levels of emotional demand and hours of sleep (Takahashi, et al., 2006). Related research shows that a tendency to put high effort into work (suggesting that the person is highly emotionally involved) is a primary contributor to short sleep hours (Monk, et al., 2001). However, the question remains as to why emotional demand would not also show associations with the other sleep-related measures.

No significant associations were found between work-role conflict and sleep-related measures. Therefore, although relationship issues were the main work-related event reported it appeared that this level of conflict did not go on to affect sleep. Research has found a direct relationship between role conflict and difficulty initiating sleep as well as non-restorative sleep, although the study was cross-sectional so was unable to determine the direction of causality (Knudsen, et al., 2007). It is possible that the items measured by work-role conflict were too dissimilar to the relationship difficulty issues reported by the participants to show the same associations with sleep. For example, research suggests that conflict with supervisors leads to psychological outcomes that affect the workplace whereas conflict with co-workers affects personally relevant psychological outcomes (Frone, 2000).

However, unfair treatment of employees by superiors may override this distinction as was found by one longitudinal study to be associated with sleep problems in both men and women (Elovainio, et al., 2009). Role conflict may also arise when a person has uncertainty about the work role they are there to do or there is a lack of clarity on work objectives (Zeidner, 2005). Working from home (where roles are less defined) appears to be associated with greater levels of work pressure and work-life conflict (Russell, O'Connell, & McGinnity, 2009). Developing further ways to measure role conflict in order to see the true effect of the construct on sleep is supported by the fact that the current sample had relatively low mean levels of role conflict.

Meaning of Work and Sleep Quality

Contrary to expectation, a negative relationship was found between meaning of work and perceptions of sleep quality. In general, finding meaning is argued by philosophers to be central to one’s well-being and key for leading a fulfilling life (Ryff & Singer, 1998). Possibly as a result of these positive effects, meaning of work is argued to be more important to today’s workforce than pay or job security (Cartwright & Holmes, 2006). In a similar vein, meaning of work is argued to be more developed in employees further on in their career and is thought to improve retention of employees (Cooper-Thomas & Anderson, 2005). The demographics of the current sample showed employees were largely developed in their career and scores on the meaning of work subscale were high. The finding that meaning of work was associated with poorer sleep quality appears conflicting to the above research in that sleep quality could also be considered an indicator of well-being (Jenkins & Palmer, 2004).

Nevertheless, some evidence does suggest that meaning of work can be associated with poorer sleep. A previous study found that a higher importance of work (similar to meaning of work), was actually associated with greater sleep debt (Kivisto, Harma, Sallinen, & Kalimo, 2008). Another series of studies found that people who lack meaningful thought are likely to be socially excluded, are unable to delay gratification and have distorted time perception (Twenge, et al., 2002). The distortion in time perception was thought to result from an inability to link the current situation to future goals, due to the lack of meaning which brings with it a sense of structure. A previous study investigating social exclusion and meaninglessness (Twenge, et al., 2002) found results that supported this hypothesis. Specifically, the authors found that individuals with the above traits were more likely to choose the short-term pleasures of magazines, candy and video games over the long-term benefits of good health and doing well on an upcoming test. Strong associations have also been found between high meaning of work and low burnout 3 years later suggesting possible links with mental well-being (Borritz, et al., 2005). These results suggest that meaning of work is important for self-regulatory processes so may assist in the self-regulation of sleep-related behaviour. In support of these findings, the current study revealed that, meaning of work was associated with lower levels of pre-sleep arousal. However, extension of the findings to sleep quality may be more complex, as a relationship was actually found with poorer sleep quality not higher.

Work-Related Emotion and Sleep

It is well established that the affect system has parallel as well as integrative processing areas that are structured primarily into positivity and negativity (for a review see Cacioppo, Gardner, & Berntson, 1999; Ryff & Singer, 1998). In separating the two dimensions, negative work-related emotions were thought to show stronger associations with poor sleep quality than positive work-related emotions. Yet findings suggested that only positive work-related emotions were associated with perceptions of higher sleep quality. A previous study also showed a link between positive emotion and PSQI scores but found no such association with negative affect (Bower, Bylsma, Morris, & Rottenberg, 2010). This small correlation study is part of a recent increase in emphasis on positive psychology to improve health in the literature (Kivisto, et al., 2008; Tugade, Fredrickson, & Barrett, 2004). Positive emotions may also interact with mediating measures in order to exert an influence on sleep. For example, positive mood states have been associated with increased self-efficacy towards self-set goals in academic examinations (Thelwell, et al., 2007). In turn, a high self-efficacy may contribute to high ratings of sleep quality since the trait is more in line with success. Perceived task performance and skill set has also previously been shown to interact with emotion. For example, a lack of skill can produce negative emotions such as worry, embarrassment, frustration and disappointment (Fisher & Noble, 2004). However, these predictions are yet to be tested and many other mediating measures that have not been investigated here may also have contributed to the positive emotion and sleep quality association.

The lack of association between negative work-related emotions and sleep quality is surprising as negative emotions were suggested to narrow one's thoughts and increase arousal levels in preparation for action (Tugade, et al., 2004) which in turn can hinder the sleep initiation process. Negative affect can also build up over time to a certain level of allostatic load (Cacioppo & Gardner, 1999) which may further contribute to poor sleep. Previous evidence also suggests that only negative emotions are associated with successful behaviour change (Heatherton & Nichols, 1994). Therefore, it was thought that negative emotions would be particularly damaging and would show the stronger relation to sleep patterns. Emotions associated with our basic needs (visceral emotions) are thought to be delayed when needs are forecasted in the future (Loewenstein, 2001; Slovic, Finucane, Peters, & MacGregor, 2004). When basic needs are immediate motivation is increased. Therefore, it may be that any negative emotions generated by the threat of not meeting sleep needs were not present at the time of measurement (i.e. at the end of the working day, prior to bedtime).

The ability to report the emotions felt may be another explanation for the lack of association between negative emotions and sleep quality. Evidence suggests that being able to differentiate between one's emotions (emotional granularity) leads to better self-regulation, resilience and coping skills (Tugade, et al., 2004). A person with this skill may be less affected by their daily work demands and so go on to sleep a lot easier. Emotion is also thought to be one of the major forces in connecting the mind with the body (Ryff & Singer, 1998). So an increased understanding of emotions may lead to better co-ordination of these mind-body processes. People who display a repressive coping style in trying to regulate their emotions may lack this understanding. For example, receiving negative feedback led to less intensity in the expression of emotion in repressors (Mendolia, 2002). Floor effects from the tendency to repress negative emotions could explain why negative emotion was not a significant predictor of any of the sleep-related variables. Repression of emotions could be an important factor to consider when examining the effect of emotional self-regulation on sleep quality.

Analyses to test for further sub-groups of negative work-related emotions failed to reveal further categories that were meaningful, such as distinguishing high and low arousal emotions. Previous evidence supports the splitting of emotions beyond positive and negative affectivity (Warr, 2007). For example, energy levels as well as affect states can be regulated (Thayer, 2001) and this type of affect regulation could go on to influence sleep. It is possible that the current items used in the job affect scale (Fisher & Ashkanasy, 2000) were too dissimilar to the emotions previously used when investigating the arousal dimension (Warr, 2007). Nevertheless, the measurement of individual work-related emotions that are tied to a specific event allows for greater flexibility in the analysis of how these emotions are regulated than a general positive and negative affect scale would have.

Perceived Work-Related Demands and Emotion

Work-related demands are most likely to affect sleep through their effect on our emotions (e.g. Hall, et al., 2000; Kelly, 2002). In the initial tests of the hypothesis that work demand and negative emotion would be significantly associated, the predictions were partially supported. Quantitative demand, emotional demand and work-role conflict were all associated with higher negative work-related emotion. Work demands such as demands generated in response to personally relevant work-related events are often neglected by research (Spielberger & Reheiser, 2005). Individuals often interpret emotions as needing to be excluded from the workplace so follow the myth that they do not exist in one's normal workday (Kiefer & Briner, 2006). Therefore, it is possible that people compensate for the effect of high demand on emotion by ignoring it (Jones & Fletcher, 1996).

Research on cognitive dissonance supports this assumption (Festinger, Carlsmith, & Bem, 2007). For example, it may be that people who experience a high demand compensate for the high load by trying to maintain a façade that everything is going well, and therefore experience an increased level of positive emotions. Contrary to expectation, higher scores of cognitive demand were associated with higher average levels of positive work-related emotion. Previously, cognitive demand measures, such as rumination, have been associated with the more negative emotions such as anxiety or anger (McLaughlin, Borkovec, & Sibrava, 2007; Thomsen, et al., 2003). It is possible that the type of compensatory façade suggested for emotional demand explains why cognitive demand was associated with high positive emotions but not negative emotions. Nevertheless, the degree to which these conflicting thoughts are even present in workers requires further investigation.

As predicted, greater work-role conflict was associated with a higher level of negative work-related emotion but no relationship was found with positive work-related emotion. Uncertainty, a central feature of work-role conflict, is stipulated to be a key component of the emotion of anxiety, which may explain the strong relationship found with negative work-related emotion (Dugas, et al., 1997; Freeston, et al., 1994). Moreover, self-concept clarity, which could be argued is similar to role clarity, is indicated as the main contributor to depression, which involves sadness, another negative emotion (Butzer & Kuiper, 2006). A lack of self-clarity was also thought to lead to more upward social comparisons which create a cycle that is likely to generate further negative emotions. A possible reason for the increase in social comparisons is that the person could be less certain about the event that occurred (Weary, Marsh, & McCormick, 1994). Therefore, discussion with others is more likely as a means of making sense of the event.

As expected, meaning of work was associated with a high average daily level of positive emotion and a low daily average of negative emotion. Meaningful thought in general is likened to a basis for self-awareness which in turn can generate emotions (Twenge, et al., 2003). Grawitch, Granda & Barber (2008) also found an association between the feeling of having performed well and positive affect. Finally, response appraisals that involve self-monitoring, such as meaning of work, have been associated with end of day affect (Grawitch, et al., 2008). Yet, the association between meaning of work and emotion being linked to self-awareness is purely speculative and therefore would need to be tested by empirical research before accepting this conclusion.

Intention for Sleep-Related Behaviour

The Sleep-Relevant Cognitions Test (SRCT) was developed to provide insight into how intentions for sleep-related behaviour compete with other behaviour after leaving the workplace It proved to be a useful tool in understanding the sleep self-regulation process. Results from using this tool showed that health was not considered important when work priorities were high. For example, cancelling planned exercise was a common activity chosen when an upcoming work-related deadline task was predicted. The SRCT also revealed that the later the intended time of lights out on Day 5, the greater the sleep disturbaces at follow-up assessment. Other studies found that when intending to use the time surrounding sleep for other activities sleep quality can be affected (e.g. Basner, et al., 2007; Chatzitheochari & Arber, 2009). Recent attempts to understand where sleep sits in terms of priority amongst the other responsibilities in our lives (e.g. Meadows, 2005) also reveal that sleep is often passed over for other activities.

Further mixed model analyses showed that SRCT scores for an intended later time to sleep on Day 5 were associated with higher perceptions of demand (cognitive, emotional and work-role conflict) as well as a higher level of meaning on Days 6 to 10. Through highlighting how intention to stay up late can affect coping with demand, these results support previous findings that a certain amount of recovery activity, such as sleep, is needed to prevent poor performance and fatigue the next day (Rook & Zijlstra, 2006; Sonnentag & Zijlstra, 2006). The association between later SRCT and intended time to sleep scores and high meaning of work may be a result of placing more value on getting the work done due to the personal commitment of staying up late. Evidence links sleep deprivation with coping poorly with the demands of work the next day (for a review see Harrison & Horne, 2000b). For example, sleep deprivation has been associated with impaired language skills, lack of innovation, inappropriate attention to peripheral concerns, over-reliance on previous strategies and reduced motivation to perform in one's job. In using the SRCT, key activities were identified that were chosen in place of sleep and its preparation (e.g. working on the deadline task and watching television) when work demands were high. Helping to understand these influences means more effective education and self-regulation campaigns targeting sleep hygiene can be conducted. In the proposed intervention studies, validity checks for its use in a sleep deprived population will be done. Results from this further testing will be discussed in the relevant chapters.

Attrition

Retention rates for the main study were reasonably high despite the multiple days of measurement, with 74% of participants completing the majority of the surveys. The high retention rate may be due to two factors: first, the online nature of the study encouraged convenience in response; second, tracking participants through the study was made easy by organising them into small groups of 10-15 people for each wave of data collection. There is strong evidence for using online surveys to obtain positive response rates (Kraut, et al., 2003; Logie & Maylor, 2009; Reimers & Stewart, 2007; Strom, Pettersson, & Andersson, 2004; Vincent & Lewycky, 2009). However, in many of these studies, participants were asked to click on a link that took them to an external site to do the survey. In the current study, administering the surveys via email meant that no surveys were blocked by firewalls and so required less effort in response. A health-related study also found that clinicians prefer email as a form of communication with their patients due to the high response rate (Tsuru, 2004). People are also more likely to check emails as a form of time out from their work (e-breaking) even though the type of email checked is often work-related rather than personal (J. G. Phillips & Reddie, 2007). The grouping of participants into small groups allowed for easy monitoring of the data collection and ensured that reminders to complete missed surveys were timely. Monitoring of a small group also ensured that the automatic delivery of the daily surveys went smoothly and no surveys were missed. This method for tracking the data was first tested in a small pilot study conducted prior to the online descriptive study.

Limitations of the Current Study

Caution in applying some of the results is advised since the work-demands were recorded at the same time as the reports of the previous sleep so may have influenced the accuracy of the self-reported data. For example, the high level of association between all the key work-related measures tested and positive emotion may be due to a problem of heteroscedasticity. However, preliminary analyses did not support this conclusion. It is also possible that the emotions reported are more intense than what the participants actually felt at the time. The reasoning for measuring this way was that asking employees to complete two surveys per day was not feasible during a busy work day, particularly given the longitudinal nature of the study. Nevertheless, accuracy may be lost by the delayed measurement and by the self-report of emotions. Repetitive measurement of emotions may also have led to a bias from practice effects. However, as for a previous study investigating the associations between emotions and sleep (Yu, 2007), the current results show enough variance to make this possibility unlikely.

The accuracy in recording the sleep-related estimates may also be questioned, given that the person should be progressing into unconsciousness at the time so recall may be impaired. Evidence suggests that self-reported emotional duration following an event can be extreme (Ayton, Pott, & Elwakili, 2007). It is unclear though whether this tendency to report a greater intensity of emotions applies to reporting of events that have already occurred. According to the durability bias, estimates of the duration of the emotions experienced may be impaired, particularly the longer duration emotions (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 2002). Although frequency and intensity of emotion were measured in this study, as opposed to duration, it is possible that a similar bias is operating that affects all three dimensions of emotion. Some researchers have recommended a method known as the "fuzzy response set" whereby the person provides estimates within an upper and a lower boundary (Gehrman, et al., 2002). Results showed that the method had more accuracy than the traditional point estimate as used in the current study. However, the method mainly applies when estimates cover a relatively long period (e.g. 1 month), and is less applicable when collecting daily data as was done for the current study. Further, if measures are controlled statistically, accurate relationships can be identified even if the time point of measurement is the same (e.g. Scott & Judge, 2006).

As the regression analyses were conducted with baseline data it is also important to highlight their correlational and descriptive nature and problems that could arise with the inference of causality on this basis. It is also acknowledged that there is the risk of making a Type I error due to the large number of regression analyses. However, these risks need to be balanced against the risk of making a Type II error. That the findings held together in a coherent pattern and were supported by the findings from the mixed modelling analyses suggest that the significant findings did not arise simply due to Type 1 errors. Nevertheless, the possibility of Type 1 error remains and therefore highlights the need for further research to confirm these patterns of results.

General Conclusions

Despite these limitations, this descriptive study provided insight into how self-regulation of external influences such as work can interfere with the sleep self-regulation process. In doing so, the first boundary condition for the sleep self-regulation model (that negative or positive work-related influences were associated with a sleep-related indicator) was supported. For example, certain work-related demands (e.g. cognitive and emotional demand) were significantly associated with the behavioural indicators of time of lights out and time of waking. On the other hand, meaning of work was associated with lower levels of pre-sleep arousal and positive work-related emotions were associated with perceptions of better sleep quality. Work-goal motivations were also associated with better sleep quality, suggesting that complex cognitions relating to work goal motivation can be beneficial to sleep patterns. Rather than grappling with vague concepts such as stress, employers can now use this detailed information to take more appropriate steps to ensure that their employees get a good night's sleep to be productive the next day. Moreover, the new instrument, the SRCT, provided information on the decisions made by employees following work that may affect their ability to sleep regardless of work-related demand. Through an increased understanding of this complex area, future interventions are now equipped to provide tailored assistance to improve night-time sleep quality in daytime employees. These results also support the need to utilise self-regulation techniques to protect health behaviours (e.g. going to bed at an appropriate time) from being influenced by external demands. Allowing for individual differences in daily demands and sleep patterns also provided insight into the dynamics of these interactions. The next set of studies in this thesis aims to take advantage of this knowledge to design and provide a group-based intervention to improve sleep in employees through using mental imagery.

CHAPTER 9 BACKGROUND TO THE INTERVENTION STRATEGIES

"Charles Dickens once suggested that one would sleep better if the bed faced north, thus taking advantage of the pull from the North Pole" (Bootzin, 1977, p 180). Today the solutions for improving sleep have ballooned into a multi-million dollar industry and include tools ranging from magnetic underlay to mattresses to relaxation techniques. Taking medication, however, continues to be the primary form of intervention for many sufferers. This chapter describes the rationale for an intervention that uses imagery aimed at improving self-regulation of sleep-related behaviour and emotions. The developed sleep self-regulation model was used as a basis for developing the intervention, with guidance from the Health Action Process Approach (Schwarzer, 1992) and the Commonsense Model of Self-regulation of Health and Illness (Leventhal, et al., 2003). The first descriptive study also contributed to the understanding of emotions and behaviours likely to be experienced by the population of sleep-deprived daytime employees. This understanding helped to identify the specific factors to target in the development of the intervention.

There is a lack of recent intervention studies that target sleep deprivation in the general daily working population worldwide in order to promote health and productivity, with little done over the past 15 years. In New Zealand, sleep deprivation is also largely under-treated. One study found that individuals diagnosed with a mental disorder in general practice tend to get only medication or a brief discussion with the general practitioner with no referrals or other treatments provided (The MaGPIe Research Group, 2005). World-wide, short-acting hypnotic drugs are one of the most commonly prescribed forms of treatment for sleep deprivation (Bliwise, 1991; Casola, Goldsmith, & Daiter, 2006). However, this form of treatment is not adequate to treat chronic sleep deprivation in many cases as adverse effects can result from taking the medication which, over time, can be damaging to a person's health (Buysse, 2005). Evidence also suggests education strategies coupled with medication treatments further lack effectiveness since the improved knowledge of sleep hygiene does not improve practices surrounding sleep or actual sleep quality (Gallasch & Gradisar, 2007).

On the other hand, meta-analytic reviews found that psychological treatments can produce considerable improvement in sleep patterns without the adverse effects that can occur from using medications (Morin, Culbert, & Schwartz, 1994; Murtagh & Greenwood, 1995). Psychological treatments are also preferred by patients over pharmacological treatments (Morin, Gaulier, Barry, & Kowatch, 1992). Psychological treatments have developed over the years from an initial focus on arousal reduction alone to a combination of this with more behavioural based treatments (Manber, 2005).

Psychological interventions are often restricted to clinical populations (Jansson-Frojmark & Linton, 2008). Sufferers of sleep deprivation who are undiagnosed or in the early stages of insomnia often turn to self-help treatments, their doctor prescribes medication, or the symptoms are simply endured. One reason for the lack of treatment focus for the wider population is that current clinical treatments are often time-consuming and expensive to implement even though they may prove to be more cost-effective than medication in the long-term (Morin, Bootzin, et al., 2006). Many individuals who are sleep deprived are also not willing to attend the clinical practice in order to receive the regular sessions required for the treatments (e.g. Morin, LeBlanc, et al., 2006; Verbeek, Schreuder, & Declerck, 1999). One explanation for the lack of attendance is that many people are motivated to avoid the label of mental illness that comes from being associated with psychological health services and therefore may not seek treatment for sleep deprivation (Corrigan, 2004; Sheeran, Webb & Gollwitzer, 2007). Research also suggests that people with sleep problems do not seek treatment as the problem is not viewed as serious enough to warrant it (S. Edwards, Tinning, Brown, Boardman, & Weinman, 2007). In the translation of the many sleep deprivation treatments into wider practice, the literature has further been hindered by the lack of standardised definitions, assessments and reporting standards of sleep deprivation (Buysse, et al., 2006). This has created strong arguments for the development of self-guided treatments in the general population (e.g. Buysse, et al., 2006; Morin, Beaulieu-Bonneau, LeBlanc, & Savard, 2005).

Evidence suggests that even minimal intervention strategies addressing health behaviours (of which sleep could be classified) can produce clinically significant changes at the population level (Orleans, Gruman, Ulmer, Emont, & Hollendonner, 1999). Nevertheless, evidence for using self-guided psychological sleep deprivation treatment is mixed (Morin, et al., 2005; van Straten, Cuijpers, Smit, Spermon, & Verbeck, 2009). One reason may be that the type of treatments used varies considerably and many are not effectively tailored to the individual (Rothman & Salovey, 2007). Although current self-help strategies are easy to learn and use, many individuals may not implement them because work-related demands and goals take precedence and interfere with these intentions to improve one’s sleep. In order to be applied in a workplace setting and be acceptable to a wider and non-clinical population, there is a need for self-guided psychological interventions that are short in duration yet maintain their effectiveness over time. Recently, there have been attempts made to develop psychological treatments that require less time to administer. For example, one study found that a brief intervention using sleep retraining was effective in treating chronic primary insomnia (Harris, Lack, Wright, Gradisar, & Brooks, 2007). Remote treatment for sleep deprivation has also provided a means of making psychological treatment more convenient, cost-effective, and available to the wider community. For example, a brief behavioural intervention delivered by correspondence to 47 Japanese workers (17 men, 30, women) who were sleep deprived led to increases in sleep time of 27 minutes, reductions in time to sleep by 17.5 minutes and improvements in sleep efficiency by 6.9 points (Adachi, Sato, Kunitsuka, Hayama, & Doi, 2008). However, since this study did not have a control condition, the extent to which improvements would have been made naturally was not confirmed. Moreover, 23 of the participants were shift-workers so the ability to make sleep-related changes may have been hindered by irregular work hours.

Traditional self-help methods may also fail because of the misinterpretation of treatment administration from the lack of direct contact with the therapist. Modern technology may assist with providing closer monitoring of treatment to prevent incorrect application. The recent use of the internet to provide psychological treatment for sleep deprivation online was found to be moderately successful (Strom, et al., 2004). The programme was also more cost-effective than the traditional means of seeing a therapist to learn about the self-guided treatment. Nevertheless, a more recent randomised controlled trial (RCT) that investigated the effectiveness of online treatment for sleep deprivation, highlighted that future research should first identify who is likely to benefit most from this type of treatment (Vincent & Lewycky, 2009). For example, participants recruited from the community were significantly less likely than physician-referred participants to drop out of the study.

Another study showed that designing an enhanced method of transmitting health risk information through the use of computer-generated imagery was successful (Kreuter & Strecher, 1996). Health risk information was tailored to each participant, and the programme led to a greater improvement in health behaviours in comparison to a control programme. Although this intervention focused on seven health behaviours (cholesterol screening, dietary fat consumption, physical activity, smoking, seat belt use, mammography and pap smears) and not sleep, the study has implications for sleep interventions as elements of preparation were required to attend to or avoid the behaviour. To sleep well one also needs to attend to the appropriate sleep-related behaviours. The use of mental imagery may be more transportable than computer-based imagery and thus more appropriate for the relatively private environments in which sleep normally occurs. Moreover, using a computer to watch an imagery intervention involves screen use which, similar to television use may counteract attempts to prepare the individual for sleep (Basner & Dinges, 2009).

Implications of Study 1 Findings for Intervention Development

Results from Study 1 (the online descriptive study) provide further insight into treatment options and the population to be targeted for the sleep self-regulation intervention. One of the main findings to emerge was that the focus on work-related priorities and the demands resulting from work can affect sleep in different ways. In addition, responses on the Sleep-Relevant Cognitions Test (SRCT) showed that many people indicated that an important work task would be completed above all other options, including getting a good night's sleep. Research indicates that increasing motivational and volitional intentions for a behaviour can, in turn, make that target behaviour a higher priority and thus more likely to occur (e.g. Sheeran & Silverman, 2003). Therefore it is suggested that, in order to shift the focus from the work task to more sleep appropriate behaviours, focus is concentrated on motivational and volitional intentions for positive sleep related behaviours (e.g. going to bed at an appropriate time).

Another finding from the online descriptive study was that interfering thoughts were one of the most commonly reported obstacles to getting a good night's sleep. One way to prevent these thoughts from occurring is to ensure that the process of arousal reduction occurs both through appropriate behaviours and relaxation strategies. Strategies to address these concerns are discussed in detail including an overview of why imagery was used to deliver them.

The development of the intervention involved three studies, two preliminary intervention studies and one full RCT each of which assessed slightly different techniques. The sleep self-regulation model was used to guide the intervention development and study methodologies (see Figure 4.1). The first intervention development study assessed mental imagery techniques that targeted three factors; sleep motivation and pre-sleep arousal (in a singular group), and sleep-related behaviour. A third group practiced a combination of the assigned techniques. Finally, all three intervention groups were compared to a control group who imagined their normal night's routine. Following the completion of an online screening survey and an initial training session where pre and post measures were completed, each group was asked to practice the techniques for a 20 day period. Groups were then followed up on Day 21 by an online survey to assess the effectiveness of the techniques. In the second intervention development study, the motivational component was removed with all other procedures remaining the same. The purpose of this was to test whether the motivational component interfered with the arousal reduction (AR). In the third and full RCT, the AR strategy was integrated into the behavioural storyline to ensure the message was recalled more effectively and an additional imagery practice session was included.

Intervention Strategy 1: Increase Motivation for Sleep

The first intervention strategy planned to shift away from a representation of sleep deprivation as a threat and instead focus on sleep as a goal to be approached. Evidence suggests that reframing an event or goal from a stressor or threat to a challenge or positive goal state leads to better coping strategies (e.g. Drach-Zahavy & Erez, 2002). Similarly, gain-framed messages have been found to be more effective than loss-framed messages in promoting prevention or health promotion behaviours (Rothman & Salovey, 2007). Feedback from the online descriptive study suggested that many employees appear to have perspectives of work and sleep that are contrary to construal of sleep as a positive goal state. In support, other research shows that many employees often seem to enjoy stating that they are busy, stressed and lacking sleep as it suggests that they are a hard worker (Garhammer, 2002). This is in contrast to the reaction one would expect if sleep deprivation was associated with a label of a serious health threat. Motivation towards improving sleep for the correct reasons could be achieved by portraying how sleep can improve functionality the next day creating a better worker. The associations found in the first study between work-goal motivations (suggesting the person saw work as a challenge) and sleep quality supports this strategy. The strength of the intention and the degree of outcome self-efficacy and the degree of response self-efficacy in combination is also proposed to be a strong predictor of motivation (Schwarzer, 1999).

Rather than a focus on health goals, motivational constructs in health psychology often refer to health threats and how people's actions are motivated to avoid them. This focus is based on the understanding that awareness of the health threat alone can be enough to change a behaviour (C. Abraham, Sheeran, & Johnston, 1998). However, there is mixed evidence in the field of sleep-related problems as some argue that the greater the fear associated with sleep deprivation (i.e. when it is perceived as a threat), the more severe the sleep problem is (Morin, et al., 1993; Ree & Harvey, 2004). More recent research has highlighted the importance of keeping the focus on approach-orientated goals as this provides a stronger motivational focus than avoidance-orientated goals (e.g. Chan, 2008). Applied to sleep deprivation, an approach focus may prove to be even more crucial as avoidance-orientated goals may have the adverse effect of increasing emotional arousal which, in turn, may interfere with sleep rather than promote it. Research on emotional regulation (e.g. Skaalvik, 1997) suggests that avoidance goals lead to greater emotional arousal than approach goals. Increases in worry or anxiety that result from a focus on the threat could also obstruct self-regulation for sleep-related behaviour, another target in the three intervention studies.

Intervention Strategy 2: Decrease Arousal Levels Prior to Bed

Evidence suggests that an emotional regulation intervention can provide benefits not only regarding emotional experiences, but to self-regulation of behaviour in general (Cameron, Booth, Schlatter, Ziginskas, & Harman, 2007). The reductions in arousal resulting from successful emotional regulation may be particularly important for regulating sleep-related behaviour. For example, pre-sleep arousal and a poor ability to regulate one’s emotions has been found to be a significant contributor to the development of insomnia (Jansson-Frojmark & Linton, 2008). Findings from the first study also showed that pre-sleep arousal was significantly associated with greater sleep difficulty (PSQI scores). Self-regulation theory and research suggests that, in terms of promoting adaptive behaviours and well-being, it is more effective in the longer term to process and deal with distressing emotions and cognitions in order to reduce arousal than to distract from them (Cameron, 2004; Cameron, et al., 2007). Further, writing interventions based on emotional disclosure and processing to reduce arousal were effective in improving sleep (Harvey & Farrell, 2003; Landhuis, 2008).

The lack of ability to recover from work-related stress may be one reason for the high level of arousal experienced prior to sleep. Evidence suggests that a failure to unwind after work leads to more sleep complaints and makes people feel un-refreshed in the morning (Sluiter, et al., 1999). Recovery is suggested to rely on four types of abilities: to psychologically detach from work, to relax, the level of mastery of tasks and the level of perceived control over behaviour (Sonnentag & Fritz, 2007). Moderate relations have also been found with arousal levels, job stressors and psychological well-being. Evidence indicates that being physically away from the workplace may aid recovery but is not sufficient to completely detach psychologically (Hartig, Kylin, & Johansson, 2007). Studies have shown that negative inner states can affect the quality of athletic performance (e.g. Anshel & Anderson, 2002; Hanegby & Tenenbaum, 2001) so arousal levels could also go on to affect sleep-related behaviour. However, as the first study suggested that a positive inner state is more likely to affect quality of sleep, it may be better to focus on improving a positive emotional state than trying to reduce a negative one. To address arousal levels, an imagery-based exercise was designed whereby the person imagined putting concerns into a backpack and then removing the backpack. Reasons for using an imagery-based intervention will be described later in this chapter.

Intervention Strategy 3: Addressing the Intention-Action Link in Positive Sleep-Related Behaviour: The Use of Implementation Intentions

There have been recent calls for the development of more innovative ways to address sleep-related behaviour (Jansson-Frojmark & Linton, 2008). Cognitive behavioural therapy (CBT) treatments for insomnia have also highlighted the benefit of addressing behaviour to improve sleep (Edinger & Means, 2005; A. G. Harvey & Tang, 2003). Application of the SRCT in the first study suggested a number of behaviours that were likely to be problematic for sleep during the time period leading to their intended sleep (e.g. working late on the work-task or watching television immediately prior to going to bed). The third intervention strategy focused on increasing the implementation of behaviours conductive to sleep during the evening and night. The SRCT was included as a measure to assess whether these behaviour choice processes improve in response to the intervention.

A popular technique used to address sleep-related behaviour is known as stimulus control, and was initially developed by Bootzin (1972). Stimulus control is focused on controlling the environmental factors and daily living routines connected to the experience of sleep. For example, a primary aim of this type of treatment is to re-associate the bed or bedroom with sleep and to re-establish a consistent sleep-wake schedule (Morin et al., 2006). Examples include ensuring that the bedroom or where sleep occurs is at the correct temperature and remains noise free. However, it is noted that stimulus control appears to work better for sufferers who are not on medication for insomnia (Riedel, et al., 1998). Therefore, this strategy may be most applicable to the wider non-clinical population who are sleep deprived, the same population that the current intervention is targeting. Stimulus control is also focused more on the behaviours that one should not do which could be seen as being avoidance focused. The aim for the current intervention would be to keep the messages delivered in an approach focused way such as a message encouraging actions to get ready for bed rather than avoiding activity that distracts from going to bed. One further problem with the stimulus control method is that although people may intend to engage in sleep initiation behaviours, daily life can get in the way and the intended actions do not result.

Research has recently been concerned with improving the processes by which intentions are translated into action (for a review see Gollwitzer & Sheeran, 2006; Orbell, 2007; Sheeran, Webb, & Gollwitzer, 2006). According to this research, performance of behaviour includes a motivational phase where the person decides to act and an action phase where the person plans how they are going to make the decision a reality. A key aspect of the action phase is the formation of an implementation intention (II) or plan to perform the behaviour at a particular time and in a specified place. The idea is that through using an "if then" plan, the mental representation of the specified cue becomes highly activated and thus more easily accessible to the person (Gollwitzer, 1999). In turn, this easy access means the person is more likely to detect the cue when going to do the targeted behaviour.

Formation of this "if then" plan has been shown to facilitate both getting started with goal striving as well as preventing goal striving from straying off course (Achtziger, Gollwitzer, & Sheeran, 2008). When people tie down their goal with a specific behavioural plan it can greatly enhance the progress made towards that goal. Recent meta-analyses of II formation showed that II can lead to medium to large effects on goal attainment compared to just having goal intentions (Gollwitzer & Sheeran, 2006; Koestner, et al., 2002). The success of the strategy is attributed to establishing a link between the desired behaviours and certain situations which in turn lead to a more automatic response when in the imagined context (Gollwitzer, 1999). The association is formed through a more concrete cognitive representation of intention as well as more efficient emotional regulation. A recent study by Sheeran, Aubrey and Kellett (2007) showed that II can help buffer against anticipated negative emotions (which in terms of the sleep self-regulation model could be construed as emotional representation). Good opportunities for starting goal-directed behaviour are often overlooked when one is preoccupied with an emotional experience or caught up in rumination (Brandstatter, Lengfelder, & Gollwitzer, 2001). Research recently supports that forming II can help goal striving by preventing anxious inner states from taking an effect (Achtziger, et al., 2008). With II, a single mental act can be enough to make the process more automatic which in turn requires less cognitive loading and thus is less prone to interference from high negative emotion or rumination.

In a similar population to the one anticipated for the current interventions, Sheeran and Silverman (2003) attempted to develop an II intervention for employees to increase attendance at a workplace health and safety programme. These researchers found that the II intervention group showed the greatest attendance at the programme compared to a motivation intervention group, a combined motivational with AR/II group and a control group. The technique has also been applied to other relatively healthy populations such as helping people to establish a healthier diet (Verplanken & Orbell, 2003). However, the results of this study showed that although the strategy was able to establish the new habit it was unable to completely break the negative influence of previously established unhealthy habits. It is argued on the basis of studies such as this that interventions to date that address behaviours not conductive to habit formation are thought to be more successful than behaviours that are more habitual (W. Wood & Neal, 2007). Research by Brickell, Chatzisarantis and Pretty (2006) also demonstrated that spontaneous II interacted with past behaviour and predicted exercise behaviour, although only for participants who did not exercise frequently in the past. Actions that have become habitual do not require II as actions that are habitual do not require much intention. Therefore, an intention formation focus is of particular use for actions that occur in contexts that are not conductive to habit formation and occur infrequently. Moreover, habits are differentiated from formed II as performance of II requires conscious monitoring of the environment in order to recognise the cues for action (Kliegel, McDaniel, & Einstein, 2000).

Although established habits can be seen as problematic in many health promotion campaigns, recent arguments suggest they can also be a powerful agent for change (Ajzen, 2002; Holland, Aarts, & Langendam, 2006). Other research supports the argument that II can be powerful enough to override habitual behavioural tendencies if used correctly (Orbell & Verplanken, 2010; Verplanken & Orbell, 2003). Specifically, habits are thought to disappear when intentions are strong and well formed, the person has realistic expectations and has formed II plans that are specific (Ajzen, 2002). Unfortunately, much research using II has tended to concentrate on the when and where which is now thought to be more suitable for when only one course of action is possible and unlikely in the case of habitual behaviour (Sheeran et al., 2005). Instead, the use of planning or II are thought to be most useful when the activated goal can be achieved through multiple actions (Aarts & Dijksterhuis, 2000). To test this argument, the current intervention aims to use II to increase behaviours that aid in the sleep initiation process.

The II may have more effect on behaviour change when the person themselves makes the choice for when, where and how to execute behaviour due to the implicit requirement of choice (Brickell, et al., 2006). When people form their own plans to achieve their goals, there is active volitional control of information processing (Brickell, et al., 2006) which, in turn, produces a memory advantage (Kuhl &

Kazen, 1994). When New Year resolutions in university students were explored, results suggested that a personally motivating goal combined with II served to increase progress towards the set goals (Koestner et al., 2002). A later intervention designed to increase motivation for study habits alongside behavioural intentions also found that encouraging personal relevance in motivating messages increased the chances of success of the programme (Kim & Keller, 2008). Therefore, to encourage personal relevance to the positive sleep-related behaviours targeted, it was left up to the participants as to the positive sleep behaviour chosen. Further, daytime (non shift-work) employees were targeted as may have more flexibility in choices made about sleep-related behaviour than shift-workers.

Greater success has been achieved using II when trying to improve behaviours that, although habitual, require daily repetition (Orbell & Verplanken, 2003). Evidence suggests II can also become automatic after a certain amount of repetition (e.g. Ajzen, 2002; Brandstatter, Lengfelder, & Gollwitzer, 2001). Nevertheless, although sleep and its related behaviours occur on a nightly basis, research indicates that high frequency alone is not enough to create a habit (Ajzen, 2002). It is therefore important to assess which negative sleep-related behaviours are firmly established to gauge which behaviours are likely to be amenable to intervention.

Following the appropriate behavioural process also allows one to recover sufficiently from work. Although sleep is viewed as a critical process in work recovery, it occurs alongside other processes that also contribute to recovery (Zijlstra & Cropley, 2006). Results from a study investigating work recovery found that low effort and social activities were not beneficial to work-related recovery whereas sleep and physical activity were significant predictors of better work recovery (Rook & Zijlstra, 2006). In contrast, another study found that low-effort activities were predictive of recovery from work-related fatigue (Sonnentag, 2001). Other evidence also suggests that only the first area of high-duty tasks and specifically job-related ones negatively affected well-being and psychological work recovery (Sonnentag & Bayer, 2005). These findings suggest that sleep interventions should encourage individuals to avoid high duty work tasks close to bedtime to keep arousal levels low.

Imagery as a Delivery Tool

It has long been argued that visual imagery is more effective in reducing arousal levels than other techniques such as progressive muscle relaxation (e.g. Woolfolk & McNulty, 1983). Yet, research on the use of imagery techniques for the treatment of sleep deprivation remains limited, even though some promising studies have been done over the past 30 years. Related trials using imagery techniques have been successfully used to treat chronic nightmares (Krakow, Kellner, Pathak, & Lambert, 1995) and nocturnal panic attacks (Tsao & Craske, 2003) which, in turn, lead to significant increases in self-reported sleep quality. Research in the 1980s concentrated on the use of mental imagery as a distraction technique for treating sleep deprivation (e.g. visualising counting sheep) (Morin & Azrin, 1987). A more recent study also found that imagery distraction was more effective than standard distraction in eliminating unwanted pre-sleep thoughts and, in turn, accelerating the time to sleep (Harvey & Payne, 2002). However, this study was based on removing unwanted thoughts in order to improve sleep; reducing the emotive content associated with such thoughts or emotive-laden cognitions may be much more difficult.

According to the sleep self-regulation model, images could be centred around three themes in order to improve sleep and its related behaviour. First, images should help to improve self-efficacy and response-efficacy (such as envisioning how one is sleeping soundly and applying the suggested techniques) and, as a result, increase motivation for sleep. Second, mental simulation is proposed to improve emotional regulation through enhancing emotional states (e.g. calmness, relaxation) that facilitate sleep-related actions and decreasing states (e.g. anxiety) that may interfere with action. Third, mental images can be used for cues to action in the course of one’s daily activities (e.g. practicing a sleep-promoting bed-time routine). Situational cues that are associated with sleeping well include how comfortable the bed is, how hot or cold the room is as well as ventilation, noise or how quiet the bedroom is. In combination with managing these factors it is recommended that a pre-sleep routine is started about 60-90 minutes before bed and work activities are cleared well in advance of starting this routine (Sonnentag, 2001; Sonnentag & Bayer, 2005). This time period is crucial for allowing the body enough time to shut down in preparation for sleep.

Some evidence shows that sleep deprived individuals do engage in specific poor sleep hygiene practices (Jefferson, et al., 2005). In contrast, another study by Cheek, Shaver and Lentz (2004) found no relation in sleep hygiene practices between insomniac patients and good sleepers. It may then depend on the type of activity chosen as to whether it interferes with sleep. For example, evidence indicates that shorter than average sleepers spend more time socialising and engaging in leisure activities such as watching television (Basner, et al., 2007). Sleeping less to get work accomplished or scrolling through the internet are other popular activities chosen in place of sleep (Chatzitheochari &

Arber, 2009). In short, the actual contribution of certain sleep-related behaviours to quality of sleep remains relatively unclear.

Mental imagery may be an effective means of delivering volitional (using II) and motivational intentions designed to change a health behaviour (Cameron & Chan, 2008). Success in improvement of health behaviours was attributed to a volitional focus in two areas serving as a cue to action (e.g. to practice the techniques), and increasing self-efficacy and response-efficacy (e.g. a model practicing the targeted behaviour). The strategies for the current study were based in particular on research that used process imagery (similar to II) and motivational imagery to increase exercise levels in a sample of non-exercisers (Chan, 2008). In this study, results suggested that participants in the process imagery groups had significantly greater levels of planning for exercise at follow-up than other groups but participants in the motivation imagery groups had higher increases in actual exercise levels. The success of this intervention suggested that similar techniques may be able to be applied to sleep self-regulation.

Evidence suggests that interventions using forms of imagery rather than direct face-to-face communication, can be more effective in improving sleep by reaching larger numbers at less expense (Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998). Mental imagery can be even more flexible as can be performed in one's own home without the reliance of media devices to play the imagery (Harvey, 2000a). Yet, it has long been recognised that individuals may differ in their ability to form mental images (Marks, 1973). It is suggested that the closer the healthy image is tied to images of experiences as viewed by a possible self, the more likely it is to evoke emotional engagement (Holmes, Coughtrey, & Connor, 2008). Moreover, situations that mirror contexts reflective of the person's everyday life are more likely to assist with behaviour change than situations that are not. Finally, imagery that follows a storyline also enhances attitude and behaviour change (Green & Brock, 2002). Stories can also seem less threatening than a straight message and thus enable the individual to process emotions enough for their meaning to be understood but not to the point where they overwhelm the individual (Oatley, 1999).

Further, if vivid images are created but are not tied into the story the images may actually reduce the persuasive effect of a message rather than enhance it (Smith & Shaffer, 2000).One study that investigated a variety of emotions using imagery found that enabling subjects to generate their own personal imagery scripts produced the strongest emotions, along with the most vivid imagery and greater skin conductance (Velasco & Bond, 1998). Daily practice of the imagery was also required as one-off visualisation practice is suggested to be lessened by up to 50% three weeks later (Ouellette, Hessling, Gibbons, Reis-Bergan, & Gerrard, 2005). Further evidence suggests that, to be effective, the visualisation must be reinforced through further mental practice every one to two weeks at least (Driskell, Copper, & Moran, 1994).

Using Imagery to Increase Motivation for Sleep

Motivational imagery allows people to more clearly imagine a future situation that is not currently be happening and thus can make it seem more possible (S. E. Taylor & Pham, 1996). By incorporating one's own environment into the imagery, the mental image can fit constraints of reality which, in turn, makes the future even more likely. Images created in one's mind can integrate perception, motivation, subjective meaning and abstract thought (Sheikh, 2002). Imagining a goal can also allow individuals to explore its relation to their motives (Schultheiss & Brunstein, 1999). People can then base their decision on whether to pursue the goal by its ability to meet their emotional needs. Goals themselves are defined as mental representations of wanted future states that direct individual thoughts and behaviour and fill their lives with meaning and purpose (Emmons, 1996). Thus, instructions to vividly imagine oneself engaging in sleep behaviours and achieving associated goals can enhance sleep motivations that, in turn, enhance sleep behaviour and quality sleep experiences.

Mental images can have significant emotion-altering effects and mental images that symbolise the release of tension have been found to reduce arousal levels over the short-term and longer-term (Borkovec, Ray, & Stober, 1998). Moreover, research suggests that arousal levels can be reduced more effectively through visualisation than through verbalisation alone (Borkovec, et al., 1998; Vrana, Cuthbert, & Lang, 1986). The resulting relaxation that comes from processing an emotion through mental imagery is a also necessary prerequisite for concentration which, in turn, helps to further visualise the image properly (Sheikh, 2002). Therefore, AR using imagery can be used in combination with the motivational and behavioural imagery strategies to promote their efficacy. Audio-visual techniques to help reduce anxiety and improve sleep were effective in a study of Chinese adults with cardiac disease (S. Tsai, 2004). The style of guided imagery used in this study incorporated the therapist's voice as a stimulus for participants to self-create images (Baider, Uziely, & Kaplan De-Nour, 1994). Participants were instructed to focus on a mental image until it became a reality.
It is also important that care is taken with the style of imagery used as imagery aimed at directly

processing emotions may increase arousal in the short-term. For example, panic disorder patients and people with health anxieties often have images of physical and mental catastrophes (e.g. heart attack, losing control) that may have contributed to the anxiety attacks (Ottaviani & Beck, 1987; Pratt, Cooper, & Hackmann, 2004; Wells & Hackmann, 1993). It is recommended then that the interventions use imagery focused on putting the emotions aside to reduce arousal rather than trying to activate and process them. In the current intervention studies, some participants were instructed to create mental images designed to reduce pre-sleep arousal through a backpack exercise which allowed the emotions to be put aside.

Use of Imagery in Addressing the Intention to Behaviour Gap Prior to Sleep

The use of mental imagery is increasingly being recognised as an important behavioural change technique (Armitage & Reidy, 2008; Cameron & Chan, 2008). Unlike real action, imagined action can be repeated with each repetition potentially leading to an improvement in components or changes to endings (S. E. Taylor & Pham, 1996). Increased mental simulation for the action also means that scenarios in which the action is likely to occur are made more accessible (Eyck, Labansat, Gresky, Dansereau, & Lord, 2006). Action identification theory also supports the use of mental imagery as states that thinking about the finer points of actions at a detailed level makes changes as to the understanding of these actions at a higher level (Vallacher & Wegner, 1987). Therefore, concentrating on the more immediate sleep behaviours may contribute to the higher level goal of getting quality sleep. Mental practice can have an enhanced effect on performance although the degree of improvement can depend on the type of behaviour the imagery is intended for (Driskell, et al., 1994; Ouellette, et al., 2005). In support, related work using mental imagery has shown more success with emotional and behavioural self-regulation such as improving the performance in athletes with subtle behaviour changes (Kunzendorf, 1991).

In short, the three intervention studies drew upon the sleep self-regulation model by using strategies designed to increase sleep motivation, reduce pre-sleep arousal and improve the self-regulation of sleep-related behaviour. The use of imagery to deliver these three types of strategies proved to be highly useful although care was needed as to how the mental imagery exercises were enacted. The next chapter will outline the key aims and hypotheses of these intervention studies.

CHAPTER 10 KEY HYPOTHESES OF THE THREE INTERVENTIONS USING IMAGERY TO PROMOTE QUALITY SLEEP

This chapter covers the aims and hypotheses of the main randomised controlled trial (RCT) as well as providing an overview of the design. The aims and hypotheses of the two development studies which informed the main RCT will be covered in Chapter 12.

Study Aims

1) To determine whether Arousal Reduction Imagery (AR), Implementation Intentions for Positive Sleep-Related Behaviour (II) or a combination of the two techniques, provide the most effective strategy for improving sleep quality, sleep-beliefs and sleep-related behaviour at final follow-up assessment and sleep quality on a daily basis relative to a control group
2) To examine whether the main RCT can reduce levels of pre-sleep arousal
3) To test whether improving sleep mediates the effect of the interventions on additional health behaviours (e.g. diet, alcohol intake, smoking status and exercise)
4) To further validate the SRCT by demonstrating that individuals who are more sleep deprived can be distinguished by their scores on this measure and that the main RCT significantly alters scores by ensuring a significantly earlier intended time of lights out
5) To determine whether the addition of a second imagery session within half an hour before bed using written imagery instructions will increase the effectiveness of the main RCT relative to the intervention development studies

Study Hypotheses

To test the sleep self-regulation model in the primary intervention "using imagery to promote quality sleep", which compared the individual and combined effects of a AR Imagery strategy and an II for positive sleep-related behaviour using imagery strategy. The primary RCT had five main hypotheses.

Hypothesis 1: AR and II have independent and combined effects in improving sleep patterns, such that the combined AR/II group will demonstrate the greater improvement in sleep indicators at the day 21 follow-up assessment and on a daily basis

Hypothesis 2: Pre-sleep arousal is decreased most in the groups with the AR component

Hypothesis 3: AR and II have independent and combined effects in improving sleep patterns, such that the combined AR/II intervention group for sleep behaviour will demonstrate the greatest increase in sleep self-efficacy, sleep response-efficacy and sleep-related planning

Hypothesis 4: Improvement in sleep patterns mediates the effects of the intervention on other health behaviours (smoking status, alcohol intake, diet and exercise levels) at the day 21 follow-up assessment

Hypothesis 5: On the SRCT, the groups using the II instructions (relative to the AR and control groups) are more likely to report behaviours relating to bedtime routine and exercise, less likely to report behaviours relating to work tasks and screen use (i.e. television and computer) and will indicate an earlier intended time of lights out

Study Design:

The design for the main RCT utilised a 2 (*AR versus no AR*) X 2 (*II for positive sleep behaviour versus no II*) X 3 (*Baseline to Post-Intervention*) design (see Figure 10.1; the design of the first two development studies is reported in more detail in Chapter 12). In all intervention studies, respondents from consenting institutions were sent information and consent forms and screened to determine whether they were eligible to take part in the study. Participants who met criteria were then randomised into one of four groups. After an initial training session, groups were asked to practice the assigned imagery exercises for 20 days (excluding weekends). Surveys were also completed immediately prior to and immediately following the initial training session with questions designed to check whether the manipulation worked. On Day 21, a final online survey was completed. The study was designed and reported according to CONSORT guidelines (Moher & Schulz, 2001; see Appendix P).

<table>
<tr><td></td><td></td><td colspan="2">AR</td></tr>
<tr><td></td><td></td><td>No</td><td>Yes</td></tr>
<tr><td rowspan="2">II</td><td>No</td><td>CONTROL:
Neutral Imagery only. This group imagined their normal night’s routine</td><td>AR:
This group imagined loading their concerns into a backpack, imagined its weight then imagined the release of the weight upon its release</td></tr>
<tr><td>Yes</td><td>II:
This group imagined doing a series of positive sleep-related behaviours and for each behaviour, the context in which it occurred</td><td>Combined AR/II:
This group first imagined doing the same backpack exercise that was done in the AR group then imagined doing the sleep-related behaviours as per the II group</td></tr>
</table>

Figure 10.1 **Diagram of Intervention Design: “Using Imagery to Promote Quality Sleep”**

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

CHAPTER 11 METHODOLOGY OF THE THREE INTERVENTIONS USING IMAGERY TO PROMOTE QUALITY SLEEP

This chapter will discuss in detail the methods used for the two intervention development studies and the main randomised controlled trial (RCT). The three studies highlight a progression of ideas which are summarised in each study section. Participant characteristics for the main RCT are first discussed. Information on each of the measures used for all three interventions is provided next followed by the final procedure with details on how it was developed. The types of analyses employed for the three intervention studies are also outlined. Further aims and hypotheses are presented in the following chapter for the two development studies along with details of the sample characteristics that are specific to these studies.

Participant Selection

Ten large corporate organisations and one small firm employing mainly white collar workers were recruited with participants from all divisions of the organisations involved. Final numbers in the study were 104. Power analyses revealed that a sample size of 104 was sufficient to detect moderate group effect (η^2= .23) in final PSQI scores. A summary of the final numbers recruited at each stage is presented in Figure 11.1.

The workplaces were identified through personal contacts from within the organisation, direct approach and through advertisements in an online recruiting agency (www.getparticipants.com). Businesses that were directly approached were identified first by employing over 100 staff and second for showing an interest in the health and well-being of their employees. Once a suitable workforce was identified, a meeting was arranged with the Health and Safety Manager, the Human Resources Manager or the General Manager. The purpose of this meeting was to advertise the study and request permission to advertise for participants (see Appendix E for management recruitment documents). Notices (see Appendix E) were then targeted at employees who are likely to have high pressure roles, have daytime sleepiness or report being sleep deprived. These notices were distributed on the staff circular and by email as well as displayed in prominent locations around the workplace by the key liaison person, nominated by management as the contact person for the study. The liaison varied in his or her organisational role depending on the structure of the organisation participating (e.g. Human Resources Manager, owners, or personnel in senior management). Interested employees also had the opportunity to contact the principal investigator directly for more information about the study.

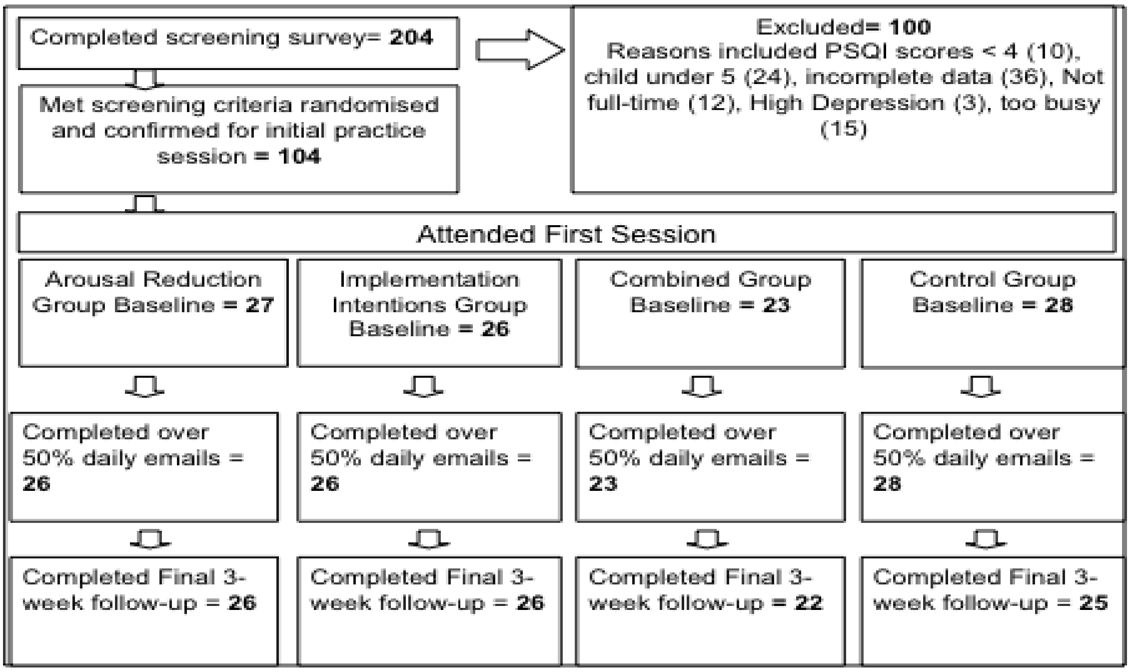

Figure 11.1 **Diagram Showing Numbers Through Each Stage of the Main Intervention Study**

Inclusion Criteria: To take part in the study, participants needed be 16-years of age or older and have a good understanding of English to be able to comprehend and respond to the online questionnaires. They needed to be in full time employment and work regular daytime hours. As the focus was on how decisions were made about one's sleep, participants were excluded if they did shift-work either through the organisation or through a secondary job because any shift-work could alter responses to the sleep-related measures (e.g. by not going to bed at the usual time). Participants also needed to work a sedentary job for the most part of their work because high physical activity can alter sleep patterns. Daily access to email was another criteria in order to complete the email surveys. Finally, to take part in the study beyond the initial screening survey, participants needed to obtain a score of four or greater on the Pittsburgh Sleep Quality Index (PSQI) which is indicative of having at least moderate difficulties in two or more areas (e.g. subjective sleep quality and daytime dysfunction) (Buysse, et al., 1989).

Participants were excluded if they had been formally diagnosed as having an identifiable biological cause of current sleep deprivation including sleep apnoea, narcolepsy, restless leg syndrome or periodic limb movement disorder, pregnancy, or a diagnosed psychological disorder. The reason for this exclusion criterion was to isolate as much as possible the factors within the workplace causing disruptions to sleep patterns as opposed to existing conditions. Individuals who had participated in any sleep-related study within the past 2 months were also excluded as they may have responded differently to the measures if they had recently completed similar measures. Finally, participants were excluded if they cared for a child under the age of five as this may have also led to a lack of control over one’s sleep.

Participant Characteristics

The demographic characteristics of the participants in the main intervention study are presented in Table 11.1. Average age was 37 years (*SD* 10.56) with the youngest participant recruited 21 years-old and the oldest 62 years-old. There were nearly twice as many female as male participants and the majority of participants were New Zealand European, although there was representation from a wide range of ethnicities. A high percentage reported as married and the rest single or in de facto relationships. The majority of participants did not have children. For participants who did have children, none were excluded for having children under the age of five. Most people were experienced at their jobs although they tended to be in lower to mid-level management positions. Many participants were on high incomes of $100,000 or more per annum.

Table 11.1 ***Summary of Participant Characteristics***

	N	%		*N*	%
Mean Age 37.36 (*SD* 10.56, *Range* = 21-62)	104		*Total Income Available*		
Gender			0-$40,000	3	2.9%
Male	38	36.5%	$41,000-$50,000	11	10.6%
Female	66	63.5%	$51,000-$60,000	10	9.6%
Ethnicity			$61,000-$70,000	8	7.7%
New Zealand European	76	73.1%	$71,000-$80,000	8	7.7%
New Zealand Maori	5	4.8%	$81,000-$90,000	7	6.7%
Pacific Island	3	2.9%	$91,000-$100,000	7	6.7%
Asian	5	4.8%	$100,000 +	47	45.2%
South East Asian	2	1.9%	*Position*		
Other (e.g. European, Australian)	13	12.5%	Graduate entry level position	10	9.6%
Marital Status			Experienced	47	45.2%
Married	42	40.4%	Supervisor of small team	16	15.4%
De facto	28	26.9%	Supervisor of large team	3	2.9%
Single	28	26.9%	Lower level management	17	16.3%
Separated/Divorced/Widowed	6	5.8%	Senior level management	7	6.8%
Children					
None	68	65.4%			
One Child	10	9.6%			
Two Children	17	16.3%			
Three or more Children	9	8.6%			

Measures

All measures used, including the measures administered in the first two development studies are described along with a summary of the internal consistency for these measures, as calculated using the sample in the main RCT (provided in Table 11.2). Findings suggested that the measures at all three time-points showed adequate internal consistency. The primary measure of interest, PSQI scores, is not included here as the distinctiveness of each subscale meant that calculating internal consistency of the instrument was not appropriate.

Table 11.2 ***Summary of Alphas for Key Measures in the Intervention Studies***

Measure (n = 104)	*Baseline*	*Post-Practice*	*Post-Intervention*
Quality of Imagery Recorded Instructions		.83	
Quality of Imagery Written Instructions			.78
Depression	.78		
Fatigue	.85		.80
Anxiety	.80	.77	.89
Sleep-Related Planning	.82	.92	.92
Sleep Imagery Action			.72
Vividness of all Images		.83	.88
Vividness of Arousal Reduction Imagery		.94	.95
Vividness of Implementation Intentions Imagery		.95	.95
Negative Sleep Habit Frequency	.67		.68
Negative Sleep Habit Strength	.87		.89
Dysfunctional Sleep Beliefs	.79		.81
Pre-sleep Arousal	.87		.87
Perceived Stress	.85		.86
Work Recovery	.87		.90
Exercise	.74		.62
Diet	.80		.84

Manipulation Checks

Quality of Imagery Instructions

The quality of the pre-recorded instructions was measured to ensure that the imagery instructions were communicated clearly (see Appendix H). Participants were asked to indicate how strongly they agree or disagree with statements on a 10 item scale with possible responses ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale was developed for use in a previous study that also used pre-recorded instructions for an imagery exercise (Chan, 2008). Following the first two development studies and the creation of an additional written form of the imagery instructions, a measure of the quality of the written instructions was tested in the main RCT. The format and responses required using this measure mirrored the quality of recordings measure although wording was changed from “recording” to “written instructions”. The quality of the recorded instructions was measured immediately following the initial imagery practice whereas the quality of the written imagery instructions was assessed at the end of the intervention.

Imagery Practice

Indicators of the amount of imagery practice undertaken were collected from two sources in the main RCT (see Appendix H for full details on these items). First, daily records of practice were summed by recoding any ratings of imagery vividness as 1 (*practiced the imagery*) or 0 (*did not practice the imagery*). If the participant failed to complete a survey on a particular day their practice was recorded as zero. The second indicator of the degree of practice was three items in the final questionnaire that asked how often the participant practiced the imagery using the recording, using the written instructions and using no imagery aids. Preliminary correlation analyses suggested that these two sources of imagery practice were closely related (see Table 13.4). Imagery practice is not reported for the two development studies.

AR and II Imagery Vividness

To assess how well the participants could form the images that were requested of them, the Vividness of Visual Imagery Questionnaire (VVIQ) (Marks, 1973) was used in the first intervention development study (see Appendix H). This scale was found to be a useful measure for when imagery forming ability is measured through self-completion, common when doing group measurement for interventions (Campos, 1998; Wallace, 1995). The vividness of the imagery was also measured at baseline and daily using the technique employed by Harvey and Payne (2002). Participants were asked to respond on a 5-point scale ranging from 1 (*no image at all*) to 5 (*perfectly clear and vivid*) how vivid the AR or II image was that they visualised. Due to the length in administering this measure, however, it was later dropped for the second intervention development study and the main RCT.

Vividness of the specific AR and II imagery was also measured (see Appendix H). For each of the 10 instructed images, participants were asked to indicate how vividly they experienced them, with responses ranging from 1 (*no image at all*) to 5 (*perfectly clear and vivid*). Based on a principal components analysis, at the immediate the post-practice assessment the AR and II dimensions fit accounted for 80.55% of variance in imagery (27.47% and 53.08% for each dimension respectively). At the 3-week follow-up the AR and II dimensions accounted for 82.27% of the variance of the imagery (21.66% and 60.61% for each dimension respectively). Following the first intervention development study, the AR image of the emotions after releasing the backpack did not appear to contribute anything to the final scale so this item was removed from further analyses. Each subscale was summed to provide a score and internal consistency levels were checked.

Anxiety

The Short-Form State Trait Anxiety Index (Marteau & Bekker, 1992) was used in the first two development studies to measure anxiety prior to the intervention and at the final follow-up assessment on Day 21 to confirm whether the manipulation of the AR imagery was effective in reducing arousal levels. See Chapter 6 for details of the measure. In the main RCT, this measure was also administered immediately following the initial practice session in order to examine the effect of the intervention on the ability to relax and reduce levels of arousal.

Sleep-Related Planning

To assess the role of II in the first intervention development study, sleep-related planning was assessed at baseline, post-practice and the follow-up assessment using an open response format (see Appendix G). Participants read eight IF-THEN scenarios (worded to match the post-work context) which they were asked to complete with the actions they would take in response to the scenario (e.g. "*When* I get home from work *then* I will…"). Responses were then coded as either 1 (*promoting sleep*) or 0 (*interfering from sleep*). Measurement of planning was changed to a quantitative scale in the second intervention development study and main RCT (see Appendix G). The reasoning behind this change was to provide a more definitive and objective account in the change in level of planning for sleep. In the main RCT, the measure was also administered immediately post-practice to determine if there were any immediate effects on planning ability as a result of the initial imagery session. To assess how detailed the person's behavioural plan was for getting a good night's sleep, the person was asked "how detailed is your plan for sleep?" Responses ranged from 1 (*not at all*) to 7 (*very much*). To further assess the level of detail, additional questions asked about the location, time and method of going to sleep that the participants had planned (e.g. "how detailed is your plan… to prepare for bed?"). This methodology was guided from two previous studies which had also used this technique to understand II for exercise (Brickell, et al., 2006) and attendance at breast screening (Luszczynska & Schwarzer, 2003). Responses were then summed to give a total planning score.

Sleep Imagery Action

Results from the first intervention development study also indicated that an outcome measure was lacking regarding whether participants actually did the specific sleep-related actions that the II imagery covered. To assess these behaviours, a measure was developed by following guidelines provided by Brickell and Chatzisarantis (2007) and was tested in the second intervention development study (see Appendix J). The new measure asked participants to respond to six items on a scale from 1 (*not at all*) to 7 (*every night*) to indicate how often they did the sleep-related actions listed. These actions were based on the imagery exercises that the participants were asked to practice (e.g. "each evening how often did you...change into comfortable clothes upon arriving home"). Item responses were then summed to generate scores. Results from the second intervention development study showed that the tool was able to reliably discriminate between the intervention groups (Chapter 1).

Pre-sleep Arousal Measures

Pre-sleep Arousal

In the first intervention development study, pre-sleep arousal was measured at baseline and at a 1-week follow-up by the Glasgow Content of Thoughts Inventory (GCTI; K. J. Harvey & Espie, 2004) which was also used for the first study in this thesis (see Chapter 6 for details). Although internal consistency of the scale for the first intervention development study was also excellent (α =.89), the measure was changed from the GCTI to the Pre-sleep Arousal Scale (Nicassio, Mendlowitz, Fussell, & Petras, 1985) for the second intervention development study and the main RCT as the original measure appeared to focus more on intrusive thoughts than levels of arousal(see Appendix G). The measure is divided into two subscales. The first is the 8-item somatic subscale (e.g. "how often in the last week before bed have you had a tight, tense feeling in your muscles?"). The second is the 8-item cognitive subscale (e.g. "how often in the last week before bed do you review or ponder events of the day?"). Participants were asked to respond on the scales from 1 (*not at all*) to 5 (*extremely*) with total responses summed. Reliabilities for these scales have proved to be adequate (0.79 and 0.88 for the somatic and cognitive subscales respectively in a non-clinical population of college students).

Perceived Stress

The Perceived Stress Scale (Cohen, et al., 1983) was administered at baseline, immediately post-practice, at 7 days, 14 days and, final follow-up in the main RCT; it was used just at baseline and final follow-up in the two intervention development studies. The 10-item scale was used at baseline, immediately post-practice, and the final follow-up (see Chapter 6 for measure details). The shorter, 4-item version (Cohen, 1986) was used on days 7 and 14 in order to reduce fatigue and completion time while onsite in the workplace (see Appendix F).

Depression

The Centre for Epidemiological Studies in Depression Short Form (Kohout, et al., 1993) was used to measure levels of depression in all three RCT at baseline (see Chapter 6 for measure details).

Work-Related Demand/Recovery

In the first intervention development study, work demand was assessed using the same subscales from the Copenhagen Psychosocial Questionnaire (Kristensen, et al., 2005) as were used in the first study of this thesis (see Chapter 6). In the second intervention development study, however, the Copenhagen Psychosocial Questionnaire was replaced with the "Recovery from Work" scale (Van Veldhoven & Meijman, 1994; see Appendix F). The reason for this change was that the first intervention development study failed to demonstrate any significant effects of the intervention on perceptions of the work-related demands. Further, experiences reported by participants led to considerations that level of arousal after work was likely to have a more direct impact on sleep. In the main RCT, participants were asked to respond to a 5-point scale ranging from 0 (*not at all*) to 6 (*everyday*) to indicate whether they agreed or disagreed with the 11 statements (e.g. "I find it hard to relax at the end of a working day"). This response format varied from the initial yes/no type response participants were asked to make in the second intervention development study. The change to the 5-point scale was made to provide greater specificity in work recovery as it was felt that intervention effects would be more subtle since work recovery was not directly targeted by the intervention imagery. Internal consistency of the scale was adequate in a study of 66, 775 workers in the United States ($\alpha = 0.88$) (Van Veldhoven & Broersen, 2003). The scale is also shown to be a moderate predictor of health problems and sleep difficulties (Sluiter, et al., 1999). The scale was administered at baseline and follow-up assessment.

Sleep-related Outcome Measures

Sleep Motivational Intentions

To assess motivation for sleep at baseline, immediately post the initial practice session and at the 3-week follow-up, participants were asked to indicate how motivated they were for sleep on a 10 point scale ranging from 1 (*not at all motivated*) to 10 (*very motivated*). Due to lower power, the post-practice assessment was dropped in the two development studies but was retained for the main RCT. Motivation has previously been measured in this way across a wide range of studies (for a review see Schwarzer, 2008). Appendix G describes this measure.

Sleep Quality

In all three intervention studies, a detailed description of sleep quality was collected at screening and at final follow-up through administration of the PSQI (Buysse, et al., 1989). This measure, which was also administered in the first study of this thesis, is described in Chapter 6. Internal consistency of the subscale of sleep disturbances remained acceptable at follow-up (α = 57) considering the variability in what the scale was measuring. The PSQI was also used as a screening tool, with participants who obtained a score of 4 or below excluded from the main intervention study. The criterion differed from an inclusion criterion of a score of 5 or above used in previous studies (e.g. Atlantis, Chow, Kirby, & Fiatarone Singh, 2006; Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002) to allow for a wider range of participants to be included. As with the first descriptive study of this thesis, daily measures of sleep quality were also administered. Responses were evaluated against clinical guidelines to determine whether changes in sleep patterns following the intervention studies were beneficial or detrimental to the person. For example, a move to having total hours of sleep in the 7-8 hour bracket (Bonnet & Arand, 1995; E. Kronholm, et al., 2008) at follow-up assessments was set as the benchmark indicator for sleep deprivation improvement.

Second, if the time of lights out changed to a time prior to midnight it was classed as an improvement since most workers would need to be awake by 8am in order to start the standard work day and would need to be asleep prior to midnight to obtain between 7 and 8 hours sleep. Although participants in the first intervention study responded using an open text box, participants in the second intervention development study and main RCT were provided with instructions to respond in a certain format. For example, for time of lights out, participants were asked to respond in a modification of the 24 hour format (e.g. 11pm=11.00, 12am=12.00, 1am=13.00, 2am=14.00 etc.). For time to sleep, participants were asked to use numerals only and respond in minutes (e.g. 1 hour = 60). Obtaining a time to sleep of under 30 minutes as recommended by PSQI guidelines (Buysse, et al., 1989) was set as the benchmark of improvement for this measure. Time of waking was of less relevance since it tends to be more reliant on external factors such as the time needed to present oneself at work. Instead, the focus here was on reducing the during-the-night-awakenings. A self-reported sleep quality score that changed from below average to above average was also considered to be a clinically meaningful change.

Fatigue

A modified version of the fatigue subscale from the Profile of Mood States (McNair, Lorr & Droppleman, 1992) was used to measure fatigue at baseline and final follow-up as a secondary outcome measure. The subscale has good internal consistency in both a general sample (α= .94) and a New Zealand sample (α=.90) (Barker-Collo, 2003). Participants were asked to respond on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*) to indicate the extent to which they had been feeling over the past 3 weeks. The scale included items such as "I feel exhausted" Appendix B presents the full measure.

Sleep-Relevant Cognitions

The Sleep-Relevant Cognition Task (SRCT), described in Chapter 6, was used to assess cognitions indicative of a willingness to stay up late as well as sleep-related behaviour. In addition to showing good predictive validity in the online descriptive study, psychometric properties of the tool are reflected by the convergent and discriminant validity with relevant measures in the intervention studies. For example, correlation analyses conducted showed associations between the SRCT time to sleep measure and frequency of negative sleep habits, diet and time of lights out (see Appendix D). Sleep-related behaviours assessed by the measure included: getting ready for bed, indication of a bedtime routine, screen use (television and computer use), engaging in work task (including the "urgent" task needed for the 11am deadline the next day and the "non-urgent" work task of general paperwork), and intention for exercise (cancelling the exercise; intending to engage in exercise that night or intention to arrange to do it another time).The SRCT was also administered at baseline and follow-up during the two preliminary development studies to explore the potential for the measure to detect intervention-induced changes in sleep intentions. However, due to the limited space in this thesis and low sample sizes, the full results from application of the SRCT and graphs relating to preliminary analyses in the development studies will not be presented.

Sleep-Related Belief Measures

Sleep Efficacy

Participants were asked to indicate how confident they were that they would get a good night's sleep that night from 1 (*not at all confident*) to 10 (*very confident*). Lastly, participants were asked to indicate how confident they were they could take the necessary steps to get good sleep that night from 1 (*not at all confident*) to 10 (*very confident*). Each item was analysed separately (see Appendix G). Self-efficacy and response-efficacy has been previously measured in this way across a wide range of studies with modifications made to the scales based on the behaviours under examination (for a review see Schwarzer, 2008). In the main RCT, sleep efficacy was administered at baseline, immediately post practice and at final follow-up assessment. However, due to insufficient power, the post-practice assessment was dropped in the two development studies.

Dysfunctional Sleep Beliefs

To gain an understanding of how one values and conceptualises sleep, as well as how these beliefs may change as a result of the intervention study, the brief 16-item version of the Dysfunctional Beliefs about Sleep Scale (Morin, et al., 2007) was administered at baseline and final follow-up assessment in the main intervention (see Appendix G). The scale is designed to measure the faulty beliefs and appraisals, unrealistic expectations, and perceptual and attention biases that are argued to maintain insomnia. An example of an item is "I am worried that I may lose control over my abilities to sleep". Participants were asked to indicate how much they agree or disagree with the 16 statements on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Developed from the original 28 item version (Morin, et al., 1993), the scale has shown adequate internal consistency in clinical (α = .77) and non-clinical (α = .79) populations.

Sleep-Related Behaviour Measures

Negative Sleep Habits

The frequency of negative sleep habits was measured using the Sleep Hygiene Index (Mastin, et al., 2006) (see Appendix F). Unlike other Sleep Hygiene measurement scales (e.g. Sleep Hygiene Awareness and Practice Scale, Lacks & Rotert, 1986; Sleep Hygiene Self-Test, Blake & Gomez, 1998), the Sleep Hygiene Index has been strongly related to sleep quality and perceptions of daytime sleepiness. Participants were asked to rate on a scale from 1 (*never*) to 5 (*all the time*) how frequently they engaged in 13 behaviours (e.g. I take naps lasting two or more hours). In the second intervention development study, an "other" option was also included so that participants could enter free responses describing a 14th behaviour. However, this was later removed for the main RCT because of a low response rate to this "other" item. Scores were summed to provide a total negative sleep habit frequency score.

Negative Sleep Habit Strength

A 12-item self-report measure of habit strength (the Self-Report Habit Index, SRHI) (Verplanken & Orbell, 2003) (see Appendix F) was used to assess whether the interventions were able to reduce the strength of the most frequent negative habitual behaviour identified in the sleep hygiene index (Mastin, et al., 2006). The measure has been successfully used for assessing daily habitual behaviours (Orbell & Verplanken, 2010) so is likely to be useful in examining the negative sleep habit recorded. Questions related to the most frequent habit reported in the Sleep Hygiene Index (e.g. this behaviour is something that...I do automatically"). Participants were asked to rate the strength of the behaviour by indicating agreement with the 12 statements from 1 (*strongly disagree*) to 5 (*strongly agree*). Scores were then summed to provide a total negative sleep habit strength score.

Health Behaviour Measures

Exercise Levels

The International Physical Activity Questionnaire (IPAQ) (Craig et al. 2003) was adapted to provide a basic measure of the levels of physical activity each participant had engaged in over the past week (see Appendix F). Participants were asked to respond to 7 items that each assessed aspects of physical or sedentary activity (vigorous, moderate or walking). An example of an item is "during the last 7 days, on how many days did you do vigorous physical activities?" For each type of activity, responses ranged from 0 (*0 days*) to 7 (*7 days*). Because the measure was of secondary interest and the questionnaire was already very lengthy, the items addressed only activities that were done for 30 minutes or more during the week in order to allow for faster completion times. The reasoning behind the time limit of 30 minutes is that physical activity guidelines suggest that improvements in fitness and health only start to be seen after this time period (Ministry of Health, 2008; Sullivan, Oakden, Young, Butcher, & Lawson, 2003). More information on the original instrument is available at www.ipaq.ki.se. This measure is well established and shows good reliability and validity across a wide range of populations. In addition, it was found to be of particular use when assessing changes in physical activity over time making it the preferred tool following interventions (Brown, Bauman, Trost, & Mummery, 2004).

Diet

In the first intervention development study, rather than including a detailed measure of dietary intake which often involves a lengthy questionnaire and questionable results, a one-item measure of intake of junk food was utilised. The use of a 1-item measure to record how often a person has consumed what they believe to be unhealthy food has been successfully used previously in a population of college students (Birkimer, Druen, Holland, & Zingman, 1996). Participants were asked to respond on a scale ranging from 1 (*not in the last three weeks*) through to 5 (*three or more times per day*) how often they consumed what they believed to be junk food. Five additional items were added following the first intervention development study to provide a more thorough assessment of the participant's intake of healthy food (see Appendix F for the final scale). The reasoning behind the additional items was the junk food item alone showed poor validity in the first intervention development study. The additional items were taken from a previous study that investigated diet in college students (Hudd, et al., 2000) and assessed the extent to which a person ate a diet that was low in fat and sugar and high in fruits, vegetables, fibre and protein. The same response scale was used, with response options ranging from 1 (*not in the last three weeks*) through to 5 (*three or more times per day*) for these additional items as was used for the initial item assessing junk food intake (junk food was reverse scored).

Ingestion of Substances that Interfere with Sleep

Alcohol intake and smoking status were measured at baseline and final follow-up assessment to determine the frequency and amount of consumption over an average week (see Appendix F for details on these items). Alcohol intake was classified according to current international guidelines for alcohol intake (Bondy, et al., 1999). According to these guidelines, intake should be under 14 drinks per week on average for men and nine standard drinks per week for women to avoid problems in general. In the two development studies, participants were asked to respond on a one-item scale that asks how many standard alcoholic drinks (e.g. one small glass of wine or one can of beer) they drank per week on average over the last three weeks. In the main RCT, responses for this item were changed from a descriptive response in a textbox to a 6-point scale ranging from 0 (*none*) to 6 (*16 or more drinks*) to make for easier cleaning of the data. In addition, consumption of alcohol was included with the daily questions assessing whether the person has consumed any substances that may interfere with sleep. Whether participants smoked nicotine or not was also recorded at baseline along with the frequency of the behaviour. Ingestion of stimulants in general was further measured by asking participants on a daily basis whether they had ingested any substances that may interfere with sleep (e.g. caffeine, energy drinks).

Procedure

Following the recruitment of businesses, notices were sent to staff within the organisation. Individuals who responded to the notices completed a brief screening survey to assess their eligibility for the study and provide written consent. The screening measure also contained baseline information needed for randomisation. To ensure that the randomisation was not influenced by bias from the principal investigator, a person blind to the purpose of the intervention study conducted the randomisation procedure. This random assignment took place following collection of screening measures and was done through an online randomisation site (www.therandomizer.org). To ensure that the data were also analysed by a person blind to condition allocation, the person assigned to do the randomisation received the collected data following the initial practice session, made a note of who was in what group (which was kept confidential) then shuffled the participants data together and handed them back to the principal investigator with a dummy code. Once analysis was complete, the codes for the group allocations were revealed. All participants were blinded as to which group they were assigned to and were only informed about their group allocation at the end of the intervention period via debrief letter.

Imagery Training Session

Following randomisation, participants who met the criteria were informed of the date, time and location of the practice session to take place (depending on their assigned group) as well as further information about the study. Individuals who did not meet the criteria were also contacted and thanked for their time. Participants went through the study in waves. Each wave started in the same week and participants in each wave tended to be from the same organisation. On arrival, all four groups were asked to complete a series of post-randomisation measurements pertaining to motivation, level of detail in planning for sleep and beliefs surrounding sleep. Consent forms were signed and collected before the intervention commenced and after having a second opportunity to read the participant information sheet. Each individual was also assigned a codename used to track the data while protecting his or her identity. The SRCT was also administered at this time point. Following completion of the questionnaire, participants were asked to practice an imagery exercise specific to their intervention condition. To ensure that the intervention was conducted as planned, a treatment manual was developed (see Appendix K).

Participants in the AR group were asked to visualise a tension reducing exercise (the exact text used in this exercise is included in Appendix K). Participants were asked to imagine wearing a backpack with all of their worries inside of it, then removing the backpack and putting it down, and finally the experience of relief. In the original version used in the first intervention development study, participants then visualised how good they would feel the next day after sleeping well. The purpose of this imagery was to increase motivation levels to help improve sleep. However, results from the first intervention development study suggested that any focus on sleep in the visualisation exercise only served to counteract the arousal reducing effect of the backpack exercise. Therefore no motivating sleep imagery exercises were mentioned in the second intervention development study or the main RCT.

Participants in the II intervention group used instructions to form a specific behavioural plan designed to meet a set goal of obtaining quality night-time sleep (the exact text used in this exercise is included in Appendix K). In addition, the plan incorporated behaviours for promoting sleep from the sleep hygiene practice scale (Mastin, et al., 2006). To form the behavioural plan, participants were asked to visualise changing into comfortable clothes, taking time to relax prior to going to bed and visualising the details regarding what time they planned to go to sleep, where they planned to go to sleep and the bedtime sleep routine they would follow to help them to get to sleep. At bedtime, this group were asked to run through in their head a checklist of these behaviours and then do any behaviour that they had not yet completed.

Participants in the combined AR/II group were encouraged to perform the same backpack exercise as was experienced by the AR group except the backpack was replaced with a work bag being released upon arriving home. Participants in the combined AR/II group then went on to form a specific behavioural plan for sleeping well. The behavioural plan involved the same cues to action right through to imagining the specific details of the bedtime routine as experienced by the II group. The exact text used in this exercise is included in Appendix K. Participants in the control group were asked to practice neutral imagery. Specifically, participants in this group were asked to visualise their normal after-work routine. The narrative was worded so that participants could create a variety of images in response to the recording (see Appendix K).

The imagery exercises were designed so that the lengths of the visualisation exercises for the control and the three intervention groups were equivalent. Participants were also asked to imagine a still pond at the start of the exercise (which was present in all four imagery exercises) as a way of ensuring that all participants started the exercise off from a neutral standpoint. However, following the first intervention development study this instruction was removed as participant responses suggested that this image may have been distracting. Details on whether any deviations from the original instructions occurred throughout the intervention were recorded in the final follow up survey. The instructions and visualisation scripts were assessed for Flesch reading ease to ensure that they were understood easily.

In the Flesch scoring system, higher numbers represent material that is easier to read whereas lower numbers represent material that is more difficult with the possible scores ranging from 0 (*no comprehension*) to 100 (*total comprehension*) (Flesch, 1948). The Flesch reading ease for the four passages in the current study varied between 72.8 and 83.9 indicating a high likelihood that the narratives would be understood. Immediately following the initial practice session, and at the final follow-up assessment, vividness of the imagery experienced was assessed. In the second intervention development study and, in the main RCT, motivation levels for sleep, sleep self-efficacy, sleep response-efficacy, and detail in planning for sleep were also reassessed immediately post-practice and at the final follow-up assessment. In the main intervention study, anxiety was also added post-practice as an extra manipulation check for whether the Arousal Reduction Imagery exercise was working.

Consolidation of Imagery

Participants in all four groups were instructed in person regarding the imagery immediately following baseline assessments. Participants were then asked to carry out the designated tasks for 20 days by replaying the recording and using the written instructions to allow adequate learning of the new behaviour. In the first intervention development study, the period was only 15 days but feedback from participants suggested that the intervention length needed extension. The final daily data collection and intervention length was based on procedures done by Taylor and Pham (1996) as well as Tsai (2004). Following the second intervention development study, participants were also asked to practice the imagery a second time. During the intervention period, participants were asked to practice the imagery twice per day for 5 minutes. As well as completing the recording at the end of the day's work, the groups received a set of laminated written instructions to follow. The written instructions were exactly the same as those in the recorded version. Participants were asked to put these instructions next to their bed in an obvious place and practice the imagery using the instructions within half an hour of going to bed. The rationale for doing this was to act as either a final AR exercise or a checklist that the sleep promoting behaviours were done depending on intervention type. The control also received these instructions and again followed the same exercise as they had used with the recording. The groups continued to practice the CD recording toward the end of the day's work (around 3pm).

In order to ensure these practice sessions occurred, participants were asked to note the time they completed the exercise in an email that was sent at 8am each morning along with a short record of their previous night's sleep (see Appendix I). Participants were also asked to rate their images on a daily basis over the 21 working days. This diary method to record intentions has been used successfully in a previous study measuring II (Orbell & Sheeran, 2000). At follow-up assessment, all four groups underwent online testing to re-assess all baseline measures and examine the effectiveness of the intervention. Additional questions relating to personal beliefs regarding the effectiveness of the intervention were also included (see Appendix J). Debrief letters and the individual reward ($10 petrol voucher), were sent to the participants shortly after completion.

Statistical Analyses

The statistical software SPSS version 15.0 was utilised for analysis of the baseline, post-practice and final follow-up data for all three intervention studies. For all statistical tests mentioned in this intervention research, a 95% confidence interval was utilised and regarding power, a one-tailed test was used with the program G*power (Faul, et al., 2007) to detect a moderate effect size of 0.50 (Cohen's d). It is noted that the type of repeated measures Analyses of Variance (ANOVA) conducted on the pre-post intervention data could also be considered as mixed model analyses. However, the ANOVA label was retained in reporting the results to ensure these analyses were distinguished from the mixed model analyses of the daily data. The data were first examined for whether it met the requirements of parametric analyses. Results from descriptive statistics, correlations and graphic data indicated that it met the assumptions required for ANOVA. Specifically, there were appropriate skew for a normal distribution and homogeneirty of variance, the cases represented a random sample from the population and were independent of each other. For the repeated measures ANOVA the correlations among pairs of levels of the repeated variables were constant. Chi square analyses and one-way ANOVAs were used to determine whether there were any major differences between the randomly assigned groups on the categorical and continuous measures respectively. Correlation analyses were used to assess relationships between the measures at baseline and final follow-up assessments. The same missing data methods that were used in the first study (see Chapter 6) were applied for all data analysed for the intervention studies. Repeated measures ANOVAs were used to assess group differences in changes from pretest to post-test in measures of sleep quality, sleep-related behaviour and beliefs and other health behaviours (i.e. diet, exercise, alcohol intake and smoking status). Significant AR and II X Time interactions were then followed by simple effects analyses. Between-subjects ANOVAs were also used to assess group differences on AR and II imagery vividness at post-practice and follow-up assessment.

Mixed model analyses were conducted with the SAS statistical program using the mixed model analysis of data PROC MIXED (see Hsiao, 2003, for details). The dependent measures were self-reported sleep quality, time of lights out, time to sleep, total hours of sleep and time of waking. The fixed effects were the intervention types (AR versus II imagery). As in the first study of this thesis, the model of time-specific effects assumed a first-order autoregressive process: AR (1). It was again found that, on comparison with the alternative, unstructured method, the autoregressive process provided a better fit. Type III (HType = 3) was the type of hypothesis test used for the fixed effects. Like the first study, the multiple levels required for the model (e.g. 21 daily data assessments were conducted) meant the Type III test was the most appropriate for the type of design used. Commands used for the analyses in SAS are described in Appendix D.

For the free response data, content analysis was the primary methodology used. For the first intervention development study, responses to the planning measure using the IF-THEN scenarios were coded and then assessed for the degree to which these codes changed. No change scored “0”, a negative change scored “-1” and a positive changed scored “1”. Intended time of lights out on the SRCT was also coded in the manner as the first descriptive study (see Chapter 6). The actual time of lights out was used as the dependent measure in analyses. If no time was stated and the work task was the last entry the time was coded as 24. Repeated measures ANOVAs were used to assess group differences in changes in these SRCT scores from baseline to follow-up assessments.

Chi square analysis was then used to assess group differences in changes in the frequency and duration of certain behaviours identified as likely to interfere with sleep. Two trained raters were employed to code the data to check for inter-rater reliability. Analyses revealed that Cohen’s Kappa values (reflecting levels of agreement) ranged from .98 to 1.00 for comparison of the baseline data with rater A and .94 to 1.00 for comparison of the baseline data with rater B. For the follow-up data, Cohen’s Kappa values ranged from .97 to 1.00 with rater A and from .98 to 1.00 with rater B.

CHAPTER 12 DEVELOPMENT OF A SLEEP SELF-REGULATION INTERVENTION: OVERVIEW OF TWO RANDOMISED CONTROLLED TRIALS

This chapter will discuss in detail the findings from the two intervention development studies conducted to develop the main randomised controlled trial (RCT) "using imagery to promote quality sleep". The first intervention development study compared the individual and combined effects of sleep motivation and arousal reduction imagery (AR) and sleep behaviour implementation intentions (II) using imagery techniques. The second intervention development study compared the individual and combined effects of the AR imagery and the II imagery. The section first covers the aims and hypotheses relevant to these two studies. Participant characteristics and method of recruitment are briefly summarised, followed by a presentation of the main findings and a discussion of what these findings mean for the main intervention. Further detail on key measures used and procedures followed in the main RCT, including revisions from these initial two development studies is presented in the methodology chapter of the main intervention (see Chapter 11).

Intervention Development Study One

The purpose of the first intervention development study was to assess whether the AR and II strategies were able to improve sleep behaviour as well as examine the validity of the methods proposed for the main RCT.

Aims

1) To determine whether Sleep Imagery Motivation and AR imagery versus II imagery or combined effects from the AR and II images provide the most effective strategy for improving sleep, sleep beliefs and sleep-related behaviour
2) To examine whether the intervention can be effective in reducing levels of pre-sleep arousal
3) To assess the effects on other health behaviours from improving sleep-related behaviour
4) To further validate the Sleep-Relevant Cognitions Test (SRCT)

Hypotheses

In testing the intervention "using imagery to promote quality sleep", the initial two intervention development studies had three main hypotheses.

Hypothesis 1: AR and II have independent and combined effects in improving sleep patterns, such that the combined AR/II group demonstrates the greatest improvement on a daily basis in sleep indicators and at the day 21 follow-up assessment

Hypothesis 2: Pre-sleep arousal shows the greatest decrease over time in the AR groups

Hypothesis 3: AR and II have independent and combined effects in improving sleep beliefs and behaviour, such that the combined AR/II intervention group will demonstrate the greatest increase in sleep self-efficacy, sleep response-efficacy and sleep-related planning

Hypothesis 4: Improvement in sleep patterns mediate the effects of the intervention on other health behaviours (smoking status, alcohol intake, exercise levels and diet) at the day 21 follow-up assessment

Recruitment

Details of the inclusion and exclusion criteria were the same as the main intervention but the participants did not need to work full-time since university study reflects a comparable workload. It was decided to conduct the first intervention development study with undergraduate psychology and health science students because these populations are more easily accessible than workplace employees for use in the preliminary stages of intervention development. The student population is also likely to be at comparable or higher risk for sleep deprivation relative to workplace employees (L. Tsai & Li, 2004). The study was advertised to the students via an electronic notice put on CECIL, a program used for posting course-related information online. A link on this notice took the participants directly to the online screening survey, which included an information sheet and consent form. Eligible participants were then contacted within 2 weeks to organise times for the initial practice session.

Promotion of the study yielded a large response from interested students and the majority of respondents met the criteria for being sleep deprived (58%). The number of respondents attending the imagery practice session was considerably lower (n = 40). There were fairly even numbers in the groups at baseline (two groups of 10 and two groups of 9) and only one participant's data was missing at final follow-up. The proportions of the sample who engaged in the daily practice ranged from a low of 54.05% on Day 13 to a high of 83.78% on Day 12; M = 71.89%. The three intervention groups and

control group were equivalent in terms of rates of practicing the imagery exercises over the course of the intervention development study. Overall, results from the first intervention development study indicated relatively high adherence to the study exercises and assessments, although there was a noticeable reduction in participation rates in the final few days. Comments from participants made in the final survey indicated that course examinations were on at final follow-up assessment.
With a largely undergraduate population, the sample in the first intervention development study was generally young with 50% of participants less than 20 years of age (M = 23.29, SD = 7.79, *Range* = 18-50). Also characteristic of this age group, the majority were not in an established relationship (74%) and few (10%) had children. The majority of participants were female (76%) and a large number were of New Zealand European ethnicity (42%). However, a relatively large percentage was also classed as Asian (32%). Also representative of an undergraduate population, total income levels were low with the majority of participants falling into the $0 to $20,000 per annum category (79%).

Descriptive Analyses for Levels of Key Sleep-Related Dependent Measures at Baseline

At baseline, Pittsburgh Sleep Quality Index (PSQI) scores were above the cut-off score of 5, which is indicative of at least moderate sleep difficulty (Buysse, et al., 1989). The time taken to fall asleep (time to sleep) was above 30 minutes, which is also set by the PSQI index as a marker for sleep difficulty. Mean pre-sleep arousal levels were above halfway on the subscale as were dysfunctional sleep beliefs. Hours of sleep were also below the 8 hours recommended to provide sufficient sleep in an average adult (Chatzitheochari & Arber, 2009). Low scores reported on the subscale indicated poor sleep quality. Mean time of waking was later than the normal employee (Basner, et al., 2007) which was expected of a student population not restricted by normal work hours.

Motivation levels for sleep and sleep self-efficacy showed above average scores on the subscale at baseline, whereas sleep response-efficacy was only just above average on the subscale. Unexpectedly, sleep-related planning levels were moderate which suggests that participants had given some thought as to how they were going to sleep well already. Negative sleep habit frequency levels and the strength of the worst sleep habit were sitting close to the highest scores possible on the measure. Scores on the measures of fatigue and perceived stress suggested reasonably high levels. Descriptive analyses for the other health behaviours showed that alcohol intake was low at baseline and diet was adequate. However, scores also indicated low mean exercise levels. Means and standard deviations are presented in Table 12.1. In short, analyses revealed that the sleep-related indicators at baseline were indicative of a sleep-deprived but otherwise relatively healthy population.

Analysis of Group Differences on Key Measures at Baseline

To check that randomisation was successful in creating equivalent groups, chi square analyses were conducted for gender, ethnicity, and marital status between the groups. Analyses revealed no significant differences at baseline which indicated that the randomisation process was a success. Next, results from one-way ANOVAs suggested that there were no significant differences between the imagery manipulations for the continuous demographic measures of age, income and occupational position. Participants in the AR imagery groups reported lower levels of emotional demand at baseline (M = 11.56, SD = 3.20) compared to participants in the non-AR groups (M = 14.53, SD = 4.39; $F(3, 33) = 5.48$, $p < .05$). Therefore emotional demand was controlled in in the first intervention development study in analyses relating to the AR manipulations.

Table 12.1 ***Descriptive Statistics of Key Measures Used in the First Intervention Development Study***

		P1 Baseline				P1 Post-Practice				P1 Follow-up			
Measure	*a*	*N*	*Range*	*Mean*	*SD*	*N*	*Range*	*Mean*	*SD*	*N*	*Range*	*Mean*	*SD*
Sleep Motivation	n/a	37	1-7	7.16	1.94	#	#	#	#	37	1-9	6.76	2.43
Sleep Self-Efficacy	n/a	37	1-7	6.43	1.95	#	#	#	#	37	1-9	6.19	2.26
Sleep Response-Efficacy	n/a	37	1-5	4.86	1.55	#	#	#	#	37	1-7	6.05	2.15
Sleep-Related Planning	n/a	37	0-4	2.24	1.04	#	#	#	#	37	0-4	2.92	1.09
Anxiety	.88	38	1-14	16.05	4.06	#	#	#	#	36	1-16	14.42	4.22
Depression	.75	38	1-20	12.29	5.19	#	#	#	#	37	1-21	11.59	5.53
Perceived Stress	.87	36	1-30	29.33	8.31	#	#	#	#	36	1-35	26.17	8.89
Fatigue	.85	37	1-16	19.32	4.18	#	#	#	#	36	1-23	14.69	6.60
Quantitative Demand	.84	38	1-22	25.37	4.88	#	#	#	#	37	1-23	22.46	4.89
Cognitive Demand	.89	38	1-21	23.95	5.10	#	#	#	#	37	1-23	22.76	5.34
Emotional Demand	.82	37	1-19	13.08	4.09	#	#	#	#	36	1-15	10.50	4.02
Meaning of Work	.84	37	1-15	15.27	3.78	#	#	#	#	35	1-18	16.80	3.86
Role Conflict	.79	37	1-11	8.19	3.11	#	#	#	#	35	1-13	8.89	3.47
Dysfunctional Sleep Beliefs	.68	38	1-25	56.74	4.79	#	#	#	#	36	1-31	54.44	6.98
Pre-sleep Arousal	.89	37	1-35	32.59	11.08	#	#	#	#	35	1-52	51.37	13.63
Negative Sleep Habit Frequency	.72	32	1-34	37.44	7.22	#	#	#	#	32	1-31	35.47	8.06
Negative Sleep Habit Strength	.90	28	1-32	45.36	9.37	#	#	#	#	28	1-35	49.86	8.85
PSQI	n/a	38	1-7	7.05	1.97	#	#	#	#	37	1-11	9.30	2.67
Time of Lights Out	n/a	38	1-11	8.82	4.09	#	#	#	#	36	1-11	9.24	4.11
Time to Sleep	n/a	38	0-175	51.58	45.08	#	#	#	#	37	0-90	32.89	26.11
Hours of Sleep	n/a	38	0-6	7.05	1.50	#	#	#	#	37	0-4	7.12	1.08
Time of Waking	n/a	38	1-8	8.39	1.82	#	#	#	#	35	1-8	7.93	1.72
Sleep Quality	n/a	38	1-7	4.08	1.40	#	#	#	#	37	1-7	6.05	1.51
Imagery Ability	.90	36	1-52	57.83	11.33	#	#	#	#	#	#	#	#
AR Imagery Vividness	.88	#	#	#	#	38	1-24	16.45	6.20	35	1-21	17.03	6.16
II Imagery Vividness	.89	#	#	#	#	38	1-14	18.05	3.63	34	1-15	17.71	4.25
Diet	.79	38	1-14	15.87	3.55	#	#	#	#	34	1-14	15.41	3.65
Smoking Status	n/a	38	0-5	0.71	1.51	#	#	#	#	37	0-5	1.78	1.62
Alcohol Intake	n/a	38	1-15	3.00	3.82	#	#	#	#	36	1-12	2.58	3.25
Exercise Levels	n/a	38	1-15	9.26	3.74	#	#	#	#	35	1-20	8.00	4.73
Quality of Recording	.66	#	#	#	#	38	1-16	45.16	3.96	#	#	#	#
Sleep-Related Action	#	#	#	#	#	#	#	#	#	#	#	#	#

** $p < .05$, ** $p < .01$, *** $p < .001$; # = measure not administered at this time point, n/a = not applicable. P1 = Development Study One Note: Reported alphas are from baseline measures*

Analysis of Relationships between Key Measures at Baseline

Correlation analyses were also conducted between the key measures at baseline to ensure that the measures targeted for the intervention were associated with the primary outcome measure of PSQI. Full results from these analyses are presented in Appendix N. Analyses revealed that there were no significant associations between any of the independent measures and PSQI. Notable associations found from these analyses are instead discussed. Higher fatigue and lower levels of work-goal motivations were associated with greater perceived stress (r = .50, p < .01 and r = -.55, p < .01 respectively). Other measures also associated with perceived stress were diet, pre-sleep arousal, and sleep response-efficacy at the .05 level. A higher frequency of negative sleep habits were strongly associated with higher work-related demand (quantitative, cognitive and emotional) (r = .55, p < .01), pre-sleep arousal (r = .49, p < .01) and less motivation to get a good night's sleep (r = -.43, p < .01). Negative sleep habit frequency was also negatively associated with sleep response-efficacy (r = -.34, p < .05). and sleep-related planning (r = -.33, p < .05). Work-related demand was associated with higher pre-sleep arousal (r = .49 p < .05). Whereas work-goal motivations were associated with less fatigue (r = -.34, p < .05). As expected, self-efficacy for sleep was strongly associated with sleep response-efficacy (r = .69, p < .01) and with high sleep motivation (r = .47 p < .01). Sleep motivation, sleep self-efficacy and sleep response-efficacy were also positively associated with sleep-related planning at the .01 level. To allow for greater sensitivity in the detection of main and interaction effects of the AR and II manipulations on sleep patterns, additional sleep-related indicators (e.g. sleep, quality, time of lights out, time to sleep, hours of sleep and time of waking) were used as primary outcome variables as well as PSQI scores.

Manipulation Checks

Between-subjects ANOVAs revealed an AR X II interaction in II imagery vividness immediately after the initial practice session (post-practice). Simple effects analyses also revealed that the AR X II interaction was due to the AR groups who reported a lower II imagery vividness rating at post-practice than non-AR groups; p < .05. An AR main effect in AR imagery vividness was also found immediately after the end of the intervention (follow-up). Simple effects analyses revealed that AR groups perceived the AR images more vividly at follow-up assessment than the non-AR groups; p < .05. As AR groups showed significantly lower II imagery vividness ratings at post-practice and significantly greater AR vividness ratings at follow-up it suggests that the AR imagery was easier to imagine than the II imagery. A repeated measure ANOVA showed that sleep-related planning had significant time effects and increased overall from baseline (M = 2.24, SD = 1.04) to follow-up (M =

2.92, *SD* = 1.09). The lack of an II imagery interaction for sleep-related planning suggested that the manipulation was having little effect in II groups. Table 12.2 presents a summary of these results.

Table 12.2 ***Summary of Between-Subjects ANOVAs to Assess Group Differences in AR and II Imagery Vividness***

Measure	*AR* *M* (*SD*)	*II* *M* (*SD*)	*Combined AR/II* *M* (*SD*)	*Control* *M* (*SD*)	*AR*	*II*	*ARXII*
AR Imagery Vividness							
Post-Practice	15.22(8.98)	16.00(4.47)	17.50(4.11)	17.78(7.14)	*ns*	*ns*	*ns*
Follow-Up	19.56(4.50)	15.00(8.96)	19.00(4.38)	14.78(4.74)	$F(1,30) = 4.41$* partial $\eta^2 = .13$	*ns*	*ns*
II Imagery Vividness							
Post-Practice	17.67(3.16)	15.44(4.30)	19.75(2.71)	19.50(2.56)	*ns*	*ns*	$F(1,30) = 7.35$** partial $\eta^2 = .20$
Follow-Up	16.11(4.26)	19.11(4.29)	18.00(4.34)	17.63(4.31)	*ns*	*ns*	*ns*

** p < .05, **p < .01, *** p < .001, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Table 12.3 ***Repeated Measures ANOVA to Assess Change in Sleep-Related Planning***

Measure	*AR* *M* (*SD*)	*II* *M* (*SD*)	*Combined AR/II* *M* (*SD*)	*Control* *M* (*SD*)	*Time*
Sleep-Related Planning					
Baseline	2.78(1.30)	1.89(0.78)	2.33(1.23)	2.00(0.71)	$F(1,32) = 10.97$**
Follow-Up	3.11(1.36)	3.00(1.00)	2.78(1.09)	2.78(1.09)	partial $\eta^2 = .26$

** p < .05, **p < .01, *** p < .001, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Intervention Group Differences in Changes in Outcome Measures over Time

In the first intervention development study, a series of 2 (*AR and Motivation versus no AR and Motivation*) X 2 (*II versus no II*) X 2 (*Baseline to Post-Intervention*) repeated measures ANOVAs were conducted to determine if either manipulation influenced the key outcome measure of PSQI and other sleep-related indicators (sleep quality, time of lights out, time to sleep, hours of sleep and time of waking). There was a significant increase in overall PSQI scores suggesting greater difficulty in sleeping from baseline (M = 7.03, SD = 2.00) to follow-up (M = 9.30, SD = 2.67), although no significant AR or II X Time interactions occurred (see Table 12.4). However, for the individual sleep indicators, the direction was the opposite with a significant time effect suggesting an overall increase in perceptions of sleep quality from baseline (M = 4.08, SD = 1.40) to follow-up (M = 6.05, SD = 1.51). No Group X Time interactions occurred for sleep quality. There was a significant AR X Time interaction for time of lights out. Simple effects analyses revealed that the AR groups had an increase in time of lights out from baseline to follow-up compared to non-AR groups; $p < .05$. Time of lights out also showed a significant AR X II X Time interaction. Further simple effects analyses revealed that the significant effect was due to the AR groups which showed a higher increases in time of lights out over time relative to non-AR groups; $p < .05$. A significant AR X Time interaction was also found for time of waking. Simple effects analyses suggested that AR groups reported an earlier time of waking, from baseline to follow-up compared to non-AR groups; $p < .05$. No AR or II interactions were found for time to sleep or hours of sleep.

To test the second hypothesis that pre-sleep arousal levels would show the greatest decrease in the AR groups, repeated measures ANOVAs were conducted for pre-sleep arousal, perceived stress and fatigue. Contrary to prediction, all groups had significant increases in levels of pre-sleep arousal from baseline (M = 32.60, SD = 11.40) to follow-up (M = 51.37, SD = 13.63). However, there was a significant decrease overall in perceived stress from baseline (M = 29.47, SD = 8.24) to follow-up (M = 25.97, SD = 9.12). There was also a significant decrease overall in fatigue from baseline (M = 19.26, SD = 4.25) to follow-up (M = 14.43, SD = 6.50). No AR or II X Time interactions occurred for pre-sleep arousal, perceived stress or fatigue. Table 12.5 presents a summary of these results.

Table 12.4 ***Summary of Results from Repeated Measures ANOVAs to Assess Changes in Key Sleep-Related Indicators***

Measure	*AR* *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*Time*	*TimeXAR*	*TimeXII*	*Time X AR X II*
PSQI								
Baseline	6.50(1.72)	6.22(1.72)	7.22(2.11)	8.22(2.11)	$F(1,33) = 19.11$***	*ns*	*ns*	*ns*
Follow-Up	9.00(2.06)	7.22(1.79)	10.22(2.77)	10.78(2.82)	partial $\eta^2 = .37$			
Time to Sleep								
Baseline	42.00(34.58)	32.22(14.81)	57.22(57.07)	80.00(54.14)	*ns*	*ns*	*ns*	*ns*
Follow-Up	31.00(21.06)	19.22(17.48)	27.44(26.27)	54.11(28.61)				
Hours of Sleep								
Baseline	7.45(1.59)	6.98(1.09)	7.17(2.11)	6.44(1.13)	*ns*	*ns*	*ns*	*ns*
Follow-Up	7.25(1.21)	7.06(0.68)	6.89(1.34)	7.28(1.12)				
Time of Lights Out								
Baseline	7.16(4.92)	10.83(0.92)	8.18(4.62)	9.12(4.39)	*ns*	$F(1,32)$ 4.03*	*ns*	$F(1,32) = 4.80$*
Follow-Up	11.29(0.87)	10.89(0.97)	7.96(5.02)	6.77(5.50)		partial $\eta^2 = .11$		partial $\eta^2 = .13$
Time of Waking								
Baseline	8.36(1.90)	7.04(1.65)	9.59(1.54)	8.47(1.67)	*ns*	$F(1,31) = 4.67$*	*ns*	*ns*
Follow-Up	7.56(1.30)	6.86(1.37)	8.69(2.20)	8.85(1.35)		partial $\eta^2 = .13$		
Sleep Quality								
Baseline	3.90(1.37)	4.33(1.22)	4.67(1.80)	3.56(1.13)	$F(1,33) = 36.63$***	*ns*	*ns*	*ns*
Follow-Up	5.90(1.10)	7.22(1.56)	5.67(1.23)	5.44(1.67)	partial $\eta^2 = .53$			

 *$p < .05$, ** $p < .01$, *** $p < .001$, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Table 12.5 ***Summary of Changes in Pre-Sleep Arousal***

Measure	*AR*	*II*	*Combined AR/II*	*Control*	*Time*
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	
Pre-sleep Arousal					
Baseline	28.40(11.81)	31.22(10.52)	30.43(11.13)	40.33(9.81)	$F(1,31) = 184.24$***
Follow-Up	48.40(12.63)	46.33(15.91)	52.14(11.82)	59.11(12.02)	partial $\eta^2 = .86$
Perceived Stress					
Baseline	27.56(9.02)	28.29(7.89)	31.89(9.03)	29.89(7.66)	$F(30) = 12.74$**
Follow-Up	23.33(8.70)	21.57(8.75)	31.33(9.15)	26.67(8.26)	partial $\eta^2 = .30$
Fatigue					
Baseline	19.25(3.73)	17.67(4.27)	21.11(5.06)	19.00(3.74)	$F(1,31) = 28.70$***,
Follow-Up	13.25(6.14)	11.67(5.85)	17.56(5.34)	15.11(7.88)	partial $\eta^2 = .48$

** $p < .05$, **$p < .01$, *** $p < .001$, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Repeated measures ANOVAs were also conducted to test the hypothesis that combined effects from the AR and II imagery manipulations would result in the greatest improvement in sleep-related beliefs (sleep motivation, sleep self-efficacy, sleep response-efficacy, dysfunctional sleep beliefs), and sleep-related behaviour (negative sleep-related habit frequency, negative sleep habit strength) (see Table 12.6). No AR or II interactions were found for levels of sleep motivation. A trend towards a significant II X Time interaction was found for levels of sleep self-efficacy. Simple effects analyses revealed that non-II groups showed a slight decrease in sleep self-efficacy from baseline to follow-up relative to the II groups; $p = .07$. A significant time effect in sleep response-efficacy was found, which suggested an overall increase from baseline ($M = 4.86$, $SD = 1.55$) to follow-up ($M = 6.05$, $SD = 2.15$). Negative sleep habit frequency showed a significant decrease overall from baseline ($M = 37.55$, $SD = 6.45$) to follow-up ($M = 35.47$, $SD = 8.06$). However, the strength of the worst self-identified negative sleep habit showed a significant increase overall from baseline ($M = 45.36$, $SD = 9.37$) to follow-up ($M = 49.86$, $SD = 8.85$). Level of dysfunctional sleep beliefs showed a significant decrease overall from baseline ($M = 56.69$, $SD = 4.90$) to follow-up ($M = 54.44$, $SD = 6.98$). No AR or II interactions were found for sleep response-efficacy, negative sleep habit frequency, strength of the worst identified negative sleep habit or dysfunctional sleep beliefs.

Repeated measures ANOVAs were also used to test the hypothesis that the independent and combined effects of the AR and II imagery manipulations would also result in improvements in other health behaviours (exercise, diet, alcohol intake and smoking status). Analyses revealed a significant AR X Time interaction in alcohol intake (see Table 12.6). Simple effects analyses suggested that AR groups had a significant decrease in alcohol intake from baseline to follow-up relative to non-AR groups; $p < .05$. No significant AR or II Group X Time interactions were found for the health behaviour indicators of exercise, smoking status and diet.

Table 12.6 ***Summary of Changes in Sleep-Related Beliefs and Behaviour over Time***

Measure	*AR* *M* *SD*	*II* *M* *SD*	*Combined AR/II* *M* *SD*	*Control* *M* *SD*	*Time*	*TimeXAR*	*TimeXII*	*Time X AR X II*
Sleep Motivation								
Baseline	7.44(2.13)	6.67(1.80)	7.89(1.45)	6.56(2.35)	*ns*	*ns*	*ns*	*ns*
Follow-Up	7.33(2.00)	6.67(2.35)	5.78(2.54)	7.11(2.98)				
Sleep Self-Efficacy								
Baseline	6.78(2.39)	6.56(1.67)	6.56(1.81)	5.67(2.06)	*ns*	*ns*	F(1,32) = 3.09,	*ns*
Follow-Up	7.00(1.80)	6.00(2.87)	5.22(1.64)	6.33(2.55)			partial η^2 = .09, p = .09	
Sleep Response-Efficacy								
Baseline	5.67(2.00)	4.89(1.17)	4.44(0.88)	4.44(1.88)	F(1,32) = 8.08**	*ns*	*ns*	*ns*
Follow-Up	6.33(1.50)	7.00(2.60)	4.89(1.45)	6.00(2.65)	partial η^2 = .20			
Dysfunctional Sleep Beliefs								
Baseline	57.00(2.91)	54.25(6.04)	57.33(4.27)	57.89(6.11)	F(1,32) = 4.36*	*ns*	*ns*	*ns*
Follow-Up	54.30(5.95)	53.38(5.95)	54.67(6.75)	55.33(9.75)	partial η^2 = .12			
Negative Sleep Habit Frequency								
Baseline	34.60(4.50)	34.43(4.16)	38.43(8.81)	42.75(8.33)	F(1,28) = 5.76*	*ns*	*ns*	*ns*
Follow-Up	31.70(4.86)	31.14(5.93)	38.57(8.10)	41.25(9.16)	partial η^2 = .17			
Negative Sleep Habit Strength								
Baseline	44.25(5.74)	38.11(5.80)	49.87(9.75)	50.14(9.48)	F(1,24) = 9.07*	*ns*	*ns*	*ns*
Follow-Up	46.50(3.11)	42.89(7.64)	53.38(8.86)	56.71(5.16)	partial η^2 = .27			
Exercise								
Baseline	10.06(3.75)	8.60(3.69)	8.56(4.15)	9.88(4.42)	*ns*	*ns*	*ns*	*ns*
Follow-Up	7.89(6.11)	6.50(3.21)	10.75(4.40)	7.25(4.56)				
Diet								
Baseline	15.90(4.41)	16.63(3.85)	13.71(2.63)	17.00(2.34)	*ns*	*ns*	*ns*	*ns*
Follow-Up	15.50(3.24)	16.25(4.03)	13.71(2.87)	15.89(4.40)				
Alcohol Intake								
Baseline	4.56(6.00)	2.39(2.12)	3.33(3.31)	1.94(3.21)	*ns*	F(1,32) = 4.12*	*ns*	*ns*
Follow-Up	2.72(4.16)	2.89(3.86)	2.44(2.56)	2.28(2.68)		partial η^2 = .11		
Smoking Status								
Baseline	0.90(1.66)	0.33(1.00)	0.67(1.41)	1.00(2.00)	*ns*	*ns*	*ns*	*ns*
Follow-Up	1.80(1.62)	1.44(1.33)	1.89(1.69)	2.00(2.00)				

* p < .05, **p < .01, *** p < .001, ns = *Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

To determine whether there were any differences in sleep patterns between intervention groups on a daily basis, mixed model analyses were conducted. The dependent measures were sleep quality, time of lights out, time to sleep, hours of sleep, and time of waking. Table 12.7 presents a summary of these results. A significant II X Time interaction was found for sleep quality. Simple effects analyses showed that II groups reported a significantly higher quality each night than non-II groups; $p < .05$. A significant AR X II X Time interaction was also found for sleep quality. Simple effects analyses suggested the significant effect was due to the II groups reporting higher increases in sleep quality over time relative to non-II groups; $p < .05$. A significant AR X II X Time interaction for time of lights out was found. Simple effects analyses showed that the effect was due to II groups which showed more change to an earlier time of lights out over time relative to non-II groups; $p < .01$. A significant II X Time interaction was found for time to sleep with the II groups showing a significantly faster time to sleep than non-II groups; $p < .05$. A significant II X Time interaction for time of waking suggested II groups had a significantly earlier time of waking relative to non-II groups; $p < .01$. Finally, a significant AR X II X Time interaction for time of waking was found. Simple effects analyses revealed that the effect was associated with AR groups which showed more change to an earlier time of waking over time relative to non-AR groups; $p < .05$.

Table 12.7 ***Daily Group Differences on Dependent Sleep-Related Variables in the First Intervention Development Study***

Sleep Outcome	*Motivational/AR* Est. (*SE*) [*CI*]	*t*	*II* Est. (*SE*)[*CI*]	*t*	*Motivational/AR*II* Est. (*SE*)[*CI*]	*t*
Sleep Quality [a]	.373(.351) [-.322, 1.067]	1.06	**.838(.352) [.143, 1.53]**	**2.38***	**-1.06(.521) [-2.09, -.030]**	**-2.03***
Time of Lights Out [b]	**12.000(.989) [.027, 3.97]**	**2.02***	**2.226(.980) [.277, 4.18]**	**2.27***	**-3.80(1.453) [-6.69, -.907]**	**-2.61****
Time to Sleep [c]	-68.121(35.850) [-140.19, 3.947]	-1.90	**-75.324(35.991) [-147.58, -3.072]**	**-2.09***	60.237(52.849) [-45.847, 166.32]	1.14
Hours of Sleep [d]	-4.369(3.992) [-12.244, 3.505]	-1.09	-3.765(4.001) [-11.655, 4.126]	-0.94	3.442(5.938) [-8.270, 15.153]	0.58
Time of Waking [d]	-.675(.611) [-1.899, .549]	-1.10	**-1.620(.599) [-2.819, -.420**	**-2.70****	**2.453(.887) [.678, 4.228]**	**2.76****

Note. Analyses include observations from 40 university undergraduate students over 15 days with 158-169 observations missing; [a] Observations = 403; [b] Observations = 412; [c] Observations = 407; [d] Observations = 414;**p < .05, ** p < .01; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Overall, the participants in the first intervention development study appeared to deteriorate regarding PSQI scores (and no significant AR/II interactions were found which suggested that combined effects of the imagery manipulations led to better sleep, its related beliefs or sleep behaviour). An AR X II X Time interaction was found which suggested that the II groups had less deterioration in sleep self-efficacy than non-II groups. Improvements in perceptions of sleep quality and faster reported times to sleep in II-groups compared to non-II groups was found however at the daily level. In short, these results are negligible and call for further refinements to the intervention to be made.

Discussion

The first intervention development study pilot-tested the efficacy of using individual and combined effects of a motivational and AR imagery as well as an II imagery strategy. The motivational and AR imagery included an AR exercise (backpack imagery) and a focus on the end-stage goal of sleeping. The II imagery talked the person through a process of behaviours that prepare the individual for bed from finishing work through to drifting off to sleep (but not sleep itself). The individual and combined effects of these imagery techniques were compared to a control strategy involving the imagination of one's normal night routine. Some significant improvements in sleep self-regulation were found in the II groups at a daily level. For example, improvements in perceptions in time to sleep and sleep quality on a daily basis were found in the II groups.

Nevertheless, limitations of the study were identified. One of the key problems was that this sample of students faced course examinations at the time of the follow-up assessments, thereby creating a significant confound. Although this potential problem was considered at the start of the study, it was predicted that the students would experience consistent levels of stress and workload throughout the 3-week intervention period rather than just at the follow-up assessment. This reasoning was based on the high likelihood of having additional assignments throughout the intervention period. In contrast, it seemed that most of the students did not experience high stress levels until immediately before the exam period, which is when the intervention finished. In contrast to the hypothesis that pre-sleep arousal would decrease most in the groups with the AR component, all groups in the first intervention development study showed an increase in levels of pre-sleep arousal. An overall increase in PSQI scores also suggested that all groups experienced greater sleep difficulty at follow-up than at baseline. These problems suggested that modification of the intervention strategies was needed before commencing the full development study. Therefore, a second intervention development study was conducted. Modifications made to the intervention will be discussed in the next section.

Intervention Development Study Two

The second intervention development study used the same hypotheses and design as the first with a few exceptions. The primary change was the removal of the motivational imagery from the AR imagery strategy. The purpose of this change was to ensure that the imagery motivation component did not interfere with the imagery designed to reduce arousal. The neutral imagery of the pond that occurred at the start of imagery for all four groups in the first intervention development study was also removed as reports from participants showed it may have been distracting. Tighter controls were also made with the sample selected in the intervention development study to ensure that the population were in full-time employment rather than studying full-time. The purpose of this change was to match the population with the sample anticipated for the main intervention. A number of measures were also modified (e.g. work demand, pre-sleep arousal, sleep-related planning), while others were removed (e.g. individual sensory measure of imagery ability). These changes ensured that the new questionnaires administered were easier and faster to complete, reducing the burden on participants and alleviating any potential fatigue effects. Finally, the order of the imagery was re-arranged in the combined AR/II imagery group so the AR imagery fit better with the storyline and occurred at the start of the exercise rather than at the end.

Recruitment

University staff were targeted in the second intervention development study as well as employees from other workplaces (e.g. law firms and medical practices) who were recruited through word of mouth. A similar number of participants were randomised into the four groups and completed the initial imagery practice (N = 39). Although total numbers were reduced slightly for the daily data of the second study, all except one participant completed the final follow-up survey. Rates of participation were higher in the second half of the intervention (Day 10 onwards) relative to the first half. Overall, practice rates for using the imagery instructions ranged from a low of 17.95% on Day 8 to a high of 53.85% on Day 5.

In the second intervention development study, the range of occupations was diverse with these participants all being in full-time employment. The mean age was also older (M = 38.91, SD = 14.64, *Range* = 18-65) than the first intervention development study with a greater proportion reported to be in an established relationship (60%) and more participants reporting that they had children (33%). Unlike the first intervention development study, income levels were high with a third earning over $100,000 (29%) and relatively few earning under $20,000 (18%). The most common occupation reported was researcher (67%). The greater proportion of participants were again female (81%) and the majority identified as New Zealand European (66%).

Descriptive Analyses for Levels of Key Measures at Baseline

In the second intervention development study, sleep-related indicators (PSQI scores, time to sleep, hours of sleep, time of waking, dysfunctional sleep beliefs and pre-sleep arousal levels) remained indicative of poor sleep patterns and showed similar levels to the first intervention development study. Sleep motivation and sleep self-efficacy showed a high mean at baseline whereas mean sleep response-efficacy was reported at low levels by all four groups. Like the first intervention development study, sleep-related planning levels were moderate suggesting that participants had again given some thought as to how they were going to sleep well already. Mean negative sleep habit frequency levels and the mean strength of the worst sleep habit were again close to the highest scores possible on the scale. Fatigue levels were lower than in the first intervention development study but perceived stress levels remained high on the scale. Descriptive analyses for the other health behaviours showed a low alcohol intake with high scores on the diet subscale also indicating a healthy food intake. However, again, exercise levels were low at baseline. A summary of the means and standard deviations from the second intervention development study is presented in Table 12.8. In short, analyses revealed that the sleep-related indicators at baseline were (like the first intervention development study) indicative of a sleep-deprived but otherwise relatively healthy population.

Table 12.8 ***Descriptive Statistics of Key Measures Used in the Second Intervention Development Study***

		P2 Baseline				*P2 Post-Practice*				*P2 Follow-up*			
Measure	*a*	*N*	*Range*	*Mean*	*SD*	*N*	*Range*	*Mean*	*SD*	*N*	*Range*	*Mean*	*SD*
Sleep Motivation	.75	39	1-9	7.36	2.39	#	#	#	#	37	1-7	7.76	1.74
Sleep Self-Efficacy	n/a	39	1-8	5.28	2.04	#	#	#	#	38	1-8	6.00	2.23
Sleep Response-Efficacy	n/a	39	1-6	4.82	1.72	#	#	#	#	38	1-9	5.76	2.43
Sleep-Related Planning	.82	39	0-21	13.03	5.90	#	#	#	#	38	0-22	15.03	5.51
Anxiety	.85	37	1-15	14.49	4.05	#	#	#	#	#	#	#	#
Depression	.81	37	1-20	9.16	5.49	#	#	#	#	#	#	#	#
Perceived Stress	.92	35	1-34	26.86	8.82	#	#	#	#	38	1-33	22.92	9.48
Fatigue	.83	38	1-18	10.47	4.61	#	#	#	#	37	1-15	12.81	4.24
Work Recovery	.56	36	1-12	8.72	2.97	#	#	#	#	38	1-11	4.61	3.28
Dysfunctional Sleep Beliefs	.75	39	1-24	35.69	5.89	#	#	#	#	38	1-28	35.42	6.43
Pre-sleep Arousal	.90	36	1-40	33.75	11.04	#	#	#	#	37	1-46	34.19	12.78
Negative Sleep Habit Frequency	.42	32	1-25	32.34	5.24	#	#	#	#	38	1-19	32.95	5.26
Negative Sleep Habit Strength	.74	31	1-27	46.00	5.92	#	#	#	#	36	1-42	45.25	8.02
PSQI	n/a	39	1-9	7.62	2.41	#	#	#	#	38	1-10	6.84	2.43
Time of Lights Out	n/a	39	1-5	11.00	1.30	#	#	#	#	38	1-4	10.74	0.90
Time to Sleep	n/a	39	0-178	43.38	35.91	#	#	#	#	38	0-118	30.39	28.08
Hours of Sleep	n/a	39	0-6	6.73	1.26	#	#	#	#	38	0-5	6.72	1.13
Time of Waking	n/a	39	1-6	7.95	1.00	#	#	#	#	38	1-4	6.86	0.98
Sleep Quality	n/a	39	0-2	1.49	0.56	#	#	#	#	38	0-3	1.45	0.72
Diet	.76	38	1-15	16.76	3.75	#	#	#	#	38	1-17	17.76	4.00
Smoking Status	n/a	39	1-5	0.36	1.27	#	#	#	#	38	1-5	0.39	1.24
Alcohol Intake	n/a	38	1-30	6.71	6.89	#	#	#	#	37	1-21	5.62	5.76
Exercise Levels	n/a	39	1-12	7.62	3.52	#	#	#	#	38	1-17	8.66	4.04
Quality of Recording	.69	38	#	#	#	35	1-30	41.37	5.69	#	#	#	#
AR Imagery Vividness	.97	#	#	#	#	39	1-8	4.72	2.89	35	1-8	4.83	2.63
II Imagery Vividness	.95	#	#	#	#	36	1-28	20.53	9.62	34	1-26	19.88	8.31
Sleep-Related Action	.68	39	#	#	#	#	#	#	#	38	0-27	30.11	6.61

** p < .05, ** p < .01, *** p < .001, # = measure not administered at this time point, n/a = not applicable. P2 = Development Study Two; Note: Reported alphas are from baseline measures*

Analysis of Group Differences on Key Measures at Baseline

To check that randomisation was successful, chi square analyses were conducted for gender, ethnicity and marital status between the groups. Gender differences between the II and non-II groups were found ($\chi^2 = 4.43$, $p < .05$) with a higher percentage of females in the II group ($N = 12$; 67%) than the non-II group ($N = 6$; 33%). No significant differences emerged between the AR and non-AR imagery groups. Therefore, gender was controlled in further analyses in the second intervention development study involving the II manipulations. There were no significant differences between groups on any of the key work and sleep-related measures.

Analysis of Relationships between Key Measures at Baseline

Correlation analyses were again conducted between the key measures at baseline to ensure that the measures targeted for the intervention were associated with the primary outcome measure of PSQI. Indicators of arousal levels including anxiety ($r = .50$, $p < .01$), perceived stress ($r = .48$, $p < .01$), work recovery ($r = .41$, $p < .05$), depression ($r = .50$, $p < .05$) were all significantly associated with PSQI scores. Therefore, associations will primarily be discussed in relation to these measures. Correlation analyses revealed that sleep-related planning was negatively associated with levels of pre-sleep arousal ($r = -.28$, $p < .05$) and negative sleep habit frequency ($r = .49$, $p < .01$). Although not associated with PSQI scores, sleep motivation was positively associated with dysfunctional sleep beliefs ($r = .62$, $p < .01$). Sleep self-efficacy was negatively associated with general perceived stress levels ($r = -.37$, $p < .01$). Sleep-related planning was positively associated with sleep self-efficacy ($r = .47$, $p < .01$) and sleep response-efficacy ($r = .38$, $p < .05$). Sleep response-efficacy was negatively associated with anxiety ($r = .-.40$, $p < .05$) perceived stress levels ($r = -.51$, $p < .01$), fatigue ($r = -.34$, $p < .05$) and levels of pre-sleep arousal ($r = -.48$, $p < .01$).

The independent measure of anxiety was positively associated with the covariate measure of depression ($r = .70$, $p < .01$), the other independent measure of stress ($r = .85$, $p < .01$), as well as the dependent measures of PSQI scores ($r = .50$ $p < .01$), pre-sleep arousal ($r = .64$, $p < .01$), dysfunctional sleep beliefs ($r = .35$, $p < .05$) and fatigue levels ($r = .64$, $p < .01$). Anxiety ($r = .75$, $p < .01$), depression ($r = .70$, $p < .01$), perceived stress ($r = .75$, $p < .01$), and fatigue ($r = .76$, $p < .01$), were significantly positively associated with the dependent measure of work recovery. A significant positive association was also found between depression and levels of pre-sleep arousal ($r = .40$, $p < .05$), pre-sleep arousal and perceived stress ($r = .54$, $p < .01$) as well as pre-sleep arousal and fatigue ($r = .45$, $p < .01$).

Some of the dependent measures were also related to each other. For example, dysfunctional sleep beliefs were negatively associated with total exercise levels (r = -.37, p < .05). In addition, fatigue was negatively associated with total exercise levels (r = -.36 p < .05). Level of pre-sleep arousal was also associated with higher negative sleep habit frequency (r = .49, p < .01). In short, these results suggest that, like the first intervention development study, few associations were found with PSQI scores with relationships found relating primarily to the mental health measures. Therefore, additional sleep-related indicators (e.g. sleep, quality, time of lights out, time to sleep, hours of sleep and time of waking) were included as outcome variables. Appendix N presents a full summary of the baseline and follow-up correlation analyses.

Manipulation Checks

To examine whether the intervention strategies were responsible for key changes found in sleep patterns, between-subjects analyses were conducted using the immediate post-practice data and final follow-up data for AR and II imagery vividness, while repeated measures ANOVAs were conducted for sleep-related planning. In partial support of predictions, between-subjects ANOVAs revealed significant AR and II main effects at post-practice and follow-up assessment, AR main effects at post-practice and follow-up assessment for AR imagery vividness and an AR X II interaction at post-practice and follow-up assessment in II imagery vividness (but not AR imagery vividness; see Table 12.9). Simple effects analyses suggested that the significant effect was due to the II groups which showed a significantly higher level of II imagery vividness at follow-up (p < .01) relative to non-II groups which showed a significantly lower level of imagery vividness at follow-up (p < .01). These results indicate that intervention groups were able to be distinguished on II imagery vividness but not AR imagery vividness. Sleep-related planning showed significant time effects from baseline (M = 13.03, SD = 5.90) to follow-up (M = 15.03, SD = 5.51) (see Table 12.10). No significant AR or II main effects were found for sleep-related action as targeted by the II imagery at follow-up.

Table 12.9 ***Manipulation Check: Between-Subjects ANOVAs for AR and II Imagery Vividness***

Measure	*AR* *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*AR*	*II*	*AR X II*
AR Imagery Vividness							
Post-Practice	6.90(1.60)	2.70(2.21)	6.78(2.54)	2.00(0.00)	*F*(3,27) = 65.18*** partial η^2 = .71	*ns*	*ns*
Follow-Up	6.30(2.06)	3.20(2.53)	6.44(1.81)	2.67(1.63)	*F*(3,32) = 34.25*** partial η^2 = .56	*ns*	*ns*
II Imagery Vividness							
Post-Practice	7.38(0.74)	25.50(7.89)	23.89(5.56)	26.83(2.93)	*F*(3,27) = 31.13*** partial η^2 = ..54	*F*(3,27) = 16.16*** partial η^2 = .37	*F*(3,27) = 22.33*** partial η^2 = .45
Follow-Up	7.00(0.00)	27.00(3.38)	21.67(2.74)	19.83(3.06)	*F*(3,27) = 90.34*** partial η^2 = 77	*F*(3,27) = 130.53*** partial η^2 = .83	*F*(3,27) = 15.40** partial η^2 = .36

** p < .05, ** p < .01, *** p < .001,* ns *= Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Table 12.10 ***Manipulation Check: Repeated Measures ANOVA to Assess Change in Sleep-Related Planning Over Time***

Measure	*AR* *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*Time*	*Time X AR*	*Time X II*	*Time X AR X II*
Sleep-Related Planning								
Baseline	14.10(6.30)	11.50(5.42)	12.44(5.90)	12.89(5.75)	*F*(1,34) = 5.74*	*ns*	*ns*	*ns*
Follow-Up	14.40(5.02)	15.50(6.04)	15.00(5.77)	15.22(6.10)	partial η^2 = .14			

** p < .05, ** p < .01, *** p < .001, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Testing Differences between Intervention Groups over Time

To test differences between the two types of imagery manipulation in the second intervention development study, 2 (*AR versus no AR*) X 2 (*II versus no II*) X 2 *(Baseline to Post-Intervention*) repeated measures ANOVAs were also conducted to determine if either manipulation influenced the key outcome measures of PSQI and its indicators. Results indicated that there was significant reduction in PSQI scores for all groups from baseline to follow-up although no main or interaction effects were found (see Table 12.11). Sleep quality showed a significant AR X Time interaction. Simple effects analyses suggested that the non-AR groups showed a significant decrease in sleep quality from baseline to follow-up relative to the AR groups; $p < .05$. There was no II X Time interaction for perceptions of sleep quality. Time to sleep also showed a significant reduction overall from baseline ($M = 43.38$, $SD = 35.91$) to follow-up ($M = 30.39$, $SD = 28.08$). No AR X Time or II X Time interactions occurred for time to sleep. An AR X Time interaction and a II X Time interaction was found in time of lights out as well as an AR X II X Time interaction. Simple effects analyses indicated that the effect was due to the non-AR groups which showed a significantly earlier time of lights out than AR groups; $p < .05$. Simple effects analyses also suggested a trend towards a significantly earlier time of lights out from baseline to follow-up in II groups relative to non-II groups; $p = .07$. A trend towards a significant AR X Time interaction was also noted for time of waking. Further simple effects analyses suggested that it was the non-AR groups which showed a trend towards an earlier time of waking compared to AR groups; $p = .08$.

To test the second hypothesis that pre-sleep arousal levels would show the greatest decrease in the AR groups, repeated measures ANOVAs were conducted. Dependent measures included pre-sleep arousal, work recovery, perceived stress and fatigue. Table 12.12 presents a summary of these results. Analyses showed a trend towards a significant AR X II X Time interaction in pre-sleep arousal. Simple effects analyses revealed that effects from the II groups and non-II groups may have cancelled each other out with the II groups showing a significant decrease in pre-sleep arousal levels; $p < .05$, and the non-II groups showing a significant increase; $p < .05$. There was also a significant time effect for perceived stress from baseline ($M = 26.86$, $SD = 8.82$) to follow-up ($M = 22.92$, $SD = 9.48$). Work recovery also showed a decrease overall from baseline ($M = 8.72$, $SD = 2.97$) to follow-up ($M = 4.68$, $SD = 3.29$). However, there were also significant time effects for fatigue which showed an overall increase from baseline ($M = 10.47$, $SD = 4.61$) to follow-up ($M = 12.81$, $SD = 4.24$). No AR or II X Time interaction occurred for perceived stress, work recovery or fatigue.

Table 12.11 ***Summary of Results of Repeated Measures ANOVAs to Assess Changes in Sleep Quality Indicators Over Time***

	AR *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*Time*	*Time X AR*	*Time X II*	*Time X AR X II*
PSQI								
Baseline	7.80(2.82)	6.80(2.20)	8.00(2.45)	7.78(2.44)	$F(1,34) = 5.04$*, partial $\eta^2 = .13$	*ns*	*ns*	*ns*
Follow-Up	7.00(2.40)	6.10(1.66)	6.89(2.52)	7.44(3.21)				
Time to Sleep								
Baseline	44.50(31.75)	30.70(26.68)	45.56(53.94)	55.56(29.73)	$F(1,34) = 12.18$*** partial $\eta^2 = .26$	*ns*	*ns*	*ns*
Follow-Up	27.00(23.88)	19.60(19.47)	31.89(34.91)	44.67(31.16)				
Hours of Sleep								
Baseline	6.90(1.78)	7.18(1.11)	6.26(1.14)	6.61(0.82)	*ns*	*ns*	*ns*	*ns*
Follow-Up	6.75(1.38)	6.93(1.19)	6.72(0.97)	6.44(1.07)				
Time of Lights Out								
Baseline	10.75(0.94)	11.68(1.91)	10.22(0.67)	11.09(0.78)	*ns*	$F(1,34) = 6.11$* partial $\eta^2 = .15$	$F(1,34) = 4.64$* partial $\eta^2 = .12$	$F(1,34) = 3.33$, partial $\eta^2 = .09$, $p = .07$
Follow-Up	10.92(0.92)	10.64(1.24)	10.30(0.29)	11.09(0.73)				
Time of Waking								
Baseline	6.94(1.47)	7.73(1.87)	6.23(0.54)	7.34(0.95)	*ns*	$F(1,34) = 3.25$, $p = .09$ partial $\eta^2 = .15$	*ns*	*ns*
Follow-Up	7.18(0.94)	7.02(1.10)	6.33(0.58)	7.09(0.85)				
Sleep Quality								
Baseline	1.20(0.42)	1.70(0.48)	1.44(0.73)	1.67(0.50)	*ns*	$F(1,34) = 6.25$*, partial $\eta^2 = .16$,	*ns*	*ns*
Follow-Up	1.40(0.52)	1.50(0.85)	1.78(0.83)	1.11(0.60)				

** $p < .05$, ** $p < .01$, *** $p < .001$, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Table 12.12 ***Summary of Results of Repeated Measures ANOVAs to Assess Change in Pre-Sleep Arousal over Time***

	AR *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*Time*	*Time X AR*	*Time X II*	*Time X AR X II*
Perceived Stress								
Baseline	27.78(9.88)	24.00(8.57)	24.75(9.07)	30.22(8.39)	$F(1,30) = 6.07$**	*ns*	*ns*	*ns*
Follow-Up	22.44(8.90)	17.00(6.28)	25.88(10.09)	26.78(9.78)	partial $\eta^2 = .17$			
Fatigue								
Baseline	10.78(5.29)	9.70(5.50)	10.33(3.46)	11.88(4.76)	$F(1,32) = 9.58$**	*ns*	*ns*	*ns*
Follow-Up	13.00(2.69)	11.40(5.21)	12.22(4.63)	14.75(4.06)	partial $\eta^2 = .23$			
Pre-sleep Arousal								
Baseline	34.00(11.16)	31.44(8.40)	34.33(15.05)	38.33(9.85)	*ns*	*ns*	*ns*	$F(1,30) = 3.69$,
Follow-Up	33.00(12.55)	25.22(4.52)	34.33(15.66)	44.33(10.42)				p = .06, partial $\eta^2 = .11$
Work Recovery								
Baseline	8.33(3.46)	8.00(3.28)	8.78(3.15)	9.75(2.12)	$F(1,31) = 67.81$***	*ns*	*ns*	*ns*
Follow-Up	4.67(3.39)	3.33(3.20)	5.22(3.53)	6.25(2.38)	partial $\eta^2 = .69$			

** $p < .05$, ** $p < .01$, *** $p < .001$, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Repeated measures ANOVAs were also conducted to test the hypothesis that the combined effects of the AR and II imagery would lead to the greatest improvement in sleep-related beliefs (sleep motivation, sleep self-efficacy, sleep response-efficacy and dysfunctional sleep beliefs), and sleep-related behaviour (negative sleep-related habit frequency and negative sleep habit strength). Table 12.13 presents a summary of these results. Results indicated that there were significant time effects for sleep motivation with all groups showing an improvement overall from baseline (M = 7.36, SD = 2.39) to follow-up (M = 7.76, SD = 1.74). There were significant time effects in sleep self-efficacy from baseline (M = 5.28, SD = 2.04) to follow-up (M = 6.00, SD = 2.23). Sleep response-efficacy also showed significant time effects from baseline (M = 4.82, SD = 1.72) to follow-up (M = 5.76, SD = 2.43). A significant II X Time interaction was also found in sleep response-efficacy. Simple effects analyses revealed that the II groups had a significant increase in sleep response-efficacy from baseline to follow-up relative to non-II groups; $p < .05$.

No significant time effects were found in negative sleep habit frequency although a significant AR X Time interaction was found. Simple effects analyses suggested that participants in the AR groups increased in negative sleep habit frequency from baseline to follow-up ($p < .05$) relative to non-AR groups. A trend towards a significant II X Time interaction in negative sleep habit frequency was also found. Simple effects analyses suggested that II groups had a significant decrease in negative sleep habit frequency from baseline to follow-up ($p < .05$) relative to non-II groups. No significant interaction effects were found in negative sleep habit strength. A trend towards a significant II X Time interaction was found in dysfunctional sleep beliefs. Yet despite the trend, further simple effects analyses revealed there was no significant change in dysfunctional sleep beliefs in II groups ($p = .22$) relative to non-II groups.

Repeated measures ANOVAs were also conducted to assess whether other health behaviours (exercise, diet, alcohol intake and smoking status) changed significantly over time (see Table 12.13). Analyses revealed a significant time effect for exercise suggesting an overall improvement in exercise levels from baseline (M = 7.62, SD = 3.52) to follow-up (M = 8.66, SD = 4.04). Significant time effects were also found in diet suggesting an overall improvement in diet from baseline (M = 16.76, SD = 3.75) to follow-up (M = 17.76, SD = 4.00). No AR or II X Time interactions were found in exercise levels or diet and no main effects were found in alcohol intake or smoking status.

Table 12.13 ***Change Over Time in Sleep-Related Beliefs and Behaviour and Other Health Behaviours***

	AR *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*	*Time*	*Time X AR*	*Time X II*	*Time X AR X II*
Sleep Motivation								
Baseline	7.60(1.65)	6.80(3.62)	7.56(2.01)	7.44(2.19)	$F(1,34) = 214.63$***	*ns*	*ns*	*ns*
Follow-Up	7.60(2.12)	7.70(2.16)	7.89(1.05)	7.88(1.55)	partial $\eta^2 = .86$			
Sleep Self-Efficacy								
Baseline	5.60(1.71)	5.50(2.72)	5.00(2.24)	4.89(1.62)	$F(1,34) = 4.04$*	*ns*	*ns*	*ns*
Follow-Up	6.10(1.73)	6.40(1.72)	6.67(2.18)	4.78(2.05)	partial $\eta^2 =.11$			
Sleep Response-Efficacy								
Baseline	4.90(1.91)	4.70(1.95)	4.89(1.45)	4.67(1.80)	$F(1,34) = 5.96$*	*ns*	$F(34) = 3.89$*	*ns*
Follow-Up	5.60(2.17)	6.70(2.21)	6.33(2.60)	4.33(2.45)	partial $\eta^2 = .15$,		partial $\eta^2 = .10$	
Sleep-Related Planning								
Baseline	14.10(6.30)	11.50(5.42)	12.44(5.90)	12.89(5.75)	$F(1,34) = 5.74$*	*ns*	*ns*	*ns*
Follow-Up	14.40(5.02)	15.50(6.04)	15.00(5.77)	15.22(6.10)	partial $\eta^2 = .14$			
Negative Sleep Habit Frequency								
Baseline	30.67(4.42)	35.50(7.05)	30.86(4.38)	34.00(2.00)	ns	$F(1,25) = 12.57$**	$F(1,25) = 3.17$, $p = .08$,	*ns*
Follow-Up	33.22(4.87)	30.38(5.37)	32.00(3.56)	32.60(4.56)		partial $\eta^2 = .34$	partial $\eta^2 = .11$	
Negative Sleep Habit Strength								
Baseline	46.25(4.50)	44.89(8.16)	47.83(5.46)	46.57(4.89)	*ns*	*ns*	*ns*	*ns*
Follow-Up	47.75(6.23)	43.44(6.15)	45.17(6.71)	48.00(5.63)				
Dysfunctional Sleep Beliefs								
Baseline	37.50(3.98)	34.00(7.62)	36.00(5.85)	35.11(6.27)	*ns*	*ns*	$F(1,34) = 3.13$, $p = .08$,	*ns*
Follow-Up	36.90(5.99)	32.80(5.77)	34.56(6.78)	37.56(7.06)			partial $\eta^2 = .08$	
Exercise								
Baseline	7.30(3.56)	9.20(3.99)	7.78(3.27)	6.56(2.96)	$F(1,34) = 4.50$*	*ns*	*ns*	*ns*
Follow-Up	7.90(3.73)	9.50(5.62)	8.22(3.93)	9.00(2.60)	partial $\eta^2 = .12$			
Diet								
Baseline	18.20(4.08)	16.78(2.59)	15.00(3.71)	16.44(4.16)	$F(1,33) = 4.11$*	*ns*	*ns*	*ns*
Follow-Up	19.00(3.33)	19.00(3.81)	16.33(3.50)	16.33(5.07)	partial $\eta^2 = .11$			
Alcohol Intake								
Baseline	5.20(6.36)	6.20(5.53)	10.11(8.18)	6.25(7.59)	*ns*	*ns*	*ns*	*ns*
Follow-Up	4.60(5.76)	4.00(4.90)	9.89(6.39)	4.13(4.36)				
Smoking Status								
Baseline	0.50(1.58)	0.00(0.00)	1.00(2.00)	0.00(0.00)	*ns*	*ns*	*ns*	*ns*
Follow-Up	0.70(1.64)	0.00(0.00)	0.89(1.83)	0.00(0.00)				

**p < .05, **p <. 01, *** p < .001, ns = Non-Significant; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

Assessment of Key Measures at the Daily Level

To determine whether there were any differences in sleep patterns between intervention groups on a daily basis, mixed model analyses were also conducted for the second intervention development study. Results showed a significant II X Time interaction in time of lights out with groups using the II imagery reporting an earlier time of lights out each night than groups who did not use the imagery (see Table 12.14). A significant AR X II X Time interaction was also found. Simple effects analyses suggested that II groups reported significantly greater decreases for time of lights out each night than non-II groups; $p < .05$. A significant AR X Time interaction was found with AR groups reporting a longer time to sleep each night than non-AR groups; $p < .05$. A significant II X Time interaction was also found for time to sleep with II groups reporting a faster time to sleep each night than non-II groups; $p < .01$. An AR X II X Time interaction was also found. Simple effects analyses suggested that the AR groups; $p < .05$, and the II groups; $p < .01$, both reported a faster time to sleep relative to control but the II groups had the greatest reduction over time. Finally, there was a significant AR X Time interaction suggesting that AR groups had an earlier time of waking each morning relative to non-AR groups; $p < .01$.

Table 12.14 ***Daily Group Differences on Dependent Sleep-Related Measures in the Second Intervention Development Study***

Sleep Outcome	*AR* Est. (*SE*) [*CI*]	*t*	*II* Est. (*SE*)[*CI*]	*t*	*AR * II* Est. (*SE*)[*CI*]	*t*
Sleep Quality [a]	-.428(.294) [-1.008, .152]	-1.46	.206(.305) [-.367, .808]	0.67	.176(.390) [-.594, .946]	0.45
Time of Lights Out [b]	-.569(.334) [-1.227, .090]	-1.70	**-1.457(.345) [-2.138, -.775]**	**-4.22*** **	**1.459(.442) [.586, 2.332]**	**3.30** **
Time to Sleep [c]	**-16.051(6.215) [-28.322, -3.780]**	**-2.58***	**-16.836(6.423) [-29.517, -4.155]**	**-2.62** **	**30.440(8.252) [14.145, 46.736]**	**3.69** **
Hours of Sleep [a]	-.624(.357) [-1.328, .079]	-1.75	-.112(.370) [-.841, .618]	-0.30	.124(.472) [-.806, 1.054]	0.26
Time of Waking [a]	**-.863(.278) [-1.414, -.312]**	**-3.11** **	-.365(.289) [.939, .210]	-1.26	.049(.373) [-.691, .790]	0.13

Analyses include observations from 40 University staff and postgraduate students over 20 days with 214-219 observations missing; [a] Observations = 516; [b] Observations = 521; [c] Observations = 513; **p < .05, ** p < .01, *** p < .001; AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery*

In short, participants in the second intervention development study showed an overall improvement in PSQI scores. Significant II X Time interactions for negative sleep habit frequency, sleep response-efficacy, dysfunctional sleep beliefs and time of lights out as well as significant AR X II X Time interactions for pre-sleep arousal. Further analyses suggested that II groups showed a greater improvement in these variables than non-II groups. Contrary to predictions, the combined effects of the AR and II imagery did not appear to lead to any further benefits than the II intervention component alone except for the time taken to get to sleep (time to sleep). Nevertheless, overall, there were a greater number of AR and II interactions which suggested improvement in sleep patterns in these groups compared to the first intervention development study.

Discussion

In the second intervention development study and contrary to prediction, the combined effects of the AR and II imagery did not lead to the greatest improvements in overall sleep quality or sleep-related measures at final follow-up assessment. Yet, compared to the first intervention development study, results from the repeated measures ANOVAs showed that there was a significant reduction in arousal levels even though it was the II groups rather than the AR groups that experienced the greatest reductions in levels of pre-sleep arousal. Sleep motivation levels also showed an overall increase despite not being specifically targeted by the imagery in the second intervention development study. Significant improvements were also found for intake of a healthy diet and exercise levels across all groups except the control suggesting that improvements may have been related to the intervention components. In contrast to the first intervention development study, PSQI scores showed an overall decrease across all four groups in the second intervention development study. Time of lights out was also decreased in the II groups at follow-up as well as in daily analyses. Sleep-related behaviours and beliefs about sleep behaviours also showed improvements for the II groups. For example, negative sleep habit frequency was reduced in the II groups and a trend towards a decrease in dysfunctional sleep beliefs was also found.

Despite some areas of promise from both preliminary intervention development studies, a few remaining issues of concern needed to be addressed prior to rolling out the main intervention. General feedback from the combined AR/II imagery group suggested that the order of the imagery (as changed following the first intervention development study) was now appropriate, yet changes to specific imagery manipulations could have been improved. Specifically, tighter control of the AR imagery manipulation was needed. This need was addressed by the inclusion of a second anxiety assessment immediately following the initial practice session. It was anticipated that changes in this anxiety measure in the AR groups would indicate if arousal had been reduced as a result of the AR imagery or not. Feedback from participants suggested that inclusion of an additional imagery practice prior to going to bed would greatly enhance the effectiveness of the AR imagery in reducing pre-sleep arousal levels. Many of the participants in the AR groups felt that the gap between practicing the imagery at the end of the work day and going to bed was too great. As a result, arousal levels prior to bed increased over the post-work period. Inclusion of a second imagery session prior to bed would further ensure the imagery was practiced. This would also allow for a catch-up session in all groups should participants happen to miss the first at the end of the workday. It was anticipated that with these changes and with a larger sample size to provide sufficient power for accurate results, the effectiveness of the intervention in improving sleep patterns would be enhanced in the main intervention. Notwithstanding the refinements still to be made, the significant improvements in sleep patterns in groups using the II imagery in the second intervention development study means the secondary boundary condition of the sleep self-regulation model has been at least partially supported. That is, mental imagery targeting II for positive sleep-related actions (but not sleep-relevant motivations) had an effect on sleep quality compared to groups who did not receive either of these instructions.

CHAPTER 13 RESULTS OF THE MAIN RANDOMISED CONTROLLED TRIAL: USING IMAGERY TO PROMOTE QUALITY SLEEP

The purpose of the main randomised controlled trial (RCT) was to evaluate individual and combined effects of arousal reduction imagery (AR) and sleep behaviour implementation intentions (II) using imagery techniques to improve the quality of night-time sleep in daytime employees. Two intervention development studies were conducted prior to the main RCT which tested methodologies used in the main study. This chapter presents the results from the main RCT including: correlation, ANOVA and mixed model analyses of intervention effects on the dependent measures of Pittsburgh Sleep Quality Index (PSQI) scores, negative sleep habits and their strength, work recovery, dysfunctional sleep beliefs, sleep motivation, efficacy and positive sleep planning and action. Further validation of the Sleep-Relevant Cognitions Test (SRCT) is also discussed. The chapter ends with a short summary of the findings.

Attrition Rates During the Intervention Period

Responses from the daily email surveys indicated that 84% of participants completed the imagery practice using the audio-recorded instructions on 5 or more days (range 0-20) with 70.1% using the recording for over 50% of the intervention period. Participants used the written instructions with slightly more frequency, with 86% completing the recording on 5 or more days using the written instructions and 76.4% using the instructions for 10 or more days of the intervention period. Days 1 and 4 were the only 2 days to show significant differences with other days of the intervention period and only with regards to the practice of the imagery recording. Specifically, more participants practiced the imagery recording on Day 1 (78%) than on Days 4 (46%, $\chi^2 = .34$, $p < .05$), 10 (44%, $\chi^2 = .31$, $p < .05$), 12 (46%, $\chi^2 = .27$, $p < .05$), 14 (44%, $\chi^2 = .27$, $p < .05$, 17 (41%, $\chi^2 = .31$, $p < .05$), and 19 (43%, $\chi^2 = .29$, $p < .05$). In addition to being significantly lower than Day 1, practice rates on Day 4 were lower than practice rates on Day 7 (63%, $\chi^2 = .26$, $p < .05$).

Description of the Key Measures at Baseline, Post Intervention and 3-Week Follow-up

All of the key measures of interest were examined for their respective averages at baseline, immediately post-practice and post-intervention 21 days later. These statistics are presented in Table 13.1. All measures were normally distributed. The primary outcome measure, the PSQI showed a mean of over 5 at baseline which is indicative of sleep difficulty. It was expected that participants would engage in little or no planning surrounding their sleep environment. However, sleep-related planning was higher than expected at baseline suggesting that participants generally put some thought into what actions they would take to ensure a good night's sleep. Sleep motivation and sleep self-efficacy were also rated highly at baseline whereas sleep response-efficacy was at relatively low levels.

Finally, the secondary measures of health behaviours (smoking status, alcohol intake, exercise levels, and diet) provided indications of general health habits at baseline. Exercise levels were low at baseline with most people stating walking as their only physical activity and very few stating that they engaged in vigorous activity regularly. Smoking status scores were low at baseline with the majority of participants indicating that they were non-smokers. On average, alcohol intake was also below the recommended guidelines for average intake per week. Mean levels of healthy food intake were also higher at baseline than was found in previous worksite health behaviour interventions using similar dietary measures (e.g Cook, Simmons, Swinburn, & Stewart, 2001; Payne, Jones, & Harris, 2005). In short, analyses revealed that the baseline data were indicative of a sleep-deprived but otherwise relatively healthy population.

Table 13.1 ***Range, Means (M), Standard Deviations (SD) and Variances (V) of Key Measures at Baseline, Post-Practice and 3-Week Follow-Up***

Measure					*Baseline*					*Post-Practice*					*Post-Intervention*
	N	***Range***	***M***	***SD***	***V***	***N***	***Range***	***M***	***SD***	***V***	***N***	***Range***	***M***	***SD***	***V***
PSQI	104	1-11	7.92	2.89	8.32			#			98	1-14	6.10	2.97	8.81
Sleep Quality	104	1-2	1.18	0.52	0.27			#			98	1-3	1.64	0.65	0.42
Time of Lights Out	103	1-10	10.91	1.21	1.46			#			98	1-6	10.67	0.83	0.69
Time to Sleep	104	0-119	31.59	25.56	653.11			#			98	0-119	22.23	20.83	433.73
Intended Time to Sleep (SRCT)	102	0-15	11.85	2.95	8.68			#			94	0-15	11.02	1.58	2.51
Hours of Sleep	104	0-5	6.39	1.01	1.01			#			98	0-5	6.78	0.95	0.90
Time of Waking	104	1-5	6.51	0.84	0.70			#			98	1-4	6.58	0.82	0.68
Sleep Motivation	104	1-9	7.00	2.27	5.17	104	9	7.87	1.99	3.94	95	1-5	7.94	1.38	1.89
Sleep Self-Efficacy	104	1-9	6.07	2.30	5.29	104	9	6.69	2.14	4.58	99	1-8	6.64	1.92	3.68
Sleep Response-Efficacy	104	1-9	4.76	1.98	3.93	104	9	5.72	2.02	4.07	99	1-9	5.98	2.36	5.57
Sleep-Related Planning	104	1-20	11.62	5.29	27.95	104	24	14.81	6.34	40.20	97	1-24	14.28	6.79	46.10
Sleep-Related Action			#					#			99	1-36	28.69	7.27	52.89
AR Imagery Vividness			#			104	1-12	6.28	4.02	16.13	98	1-8	3.93	2.45	5.99
II Imagery Vividness			#			104	1-28	22.69	9.26	0.42	98	1-28	19.22	8.51	72.34
Quality of Recording			#			104	1-29	45.64	5.93	35.20			#		
Quality of Written Instructions			#					#			96	1-23	39.57	4.92	24.25
Anxiety	104	1-16	35.27	3.20	10.22	104	1-9	14.06	1.78	3.16	98	1-17	12.14	3.62	13.13
Depression	104	1-21	12.72	4.72	22.27			#			99		#		
Perceived Stress	104	1-29	9.44	5.86	34.35			#			99	1-29	15.25	6.20	38.48
Fatigue	104	1-19	14.11	4.58	20.97			#			99	1-19	13.22	4.97	24.71
Work Recovery	104	1-52	35.48	12.95	167.73			#			98	1-62	31.47	13.12	172.11
Dysfunctional Sleep Beliefs	104	1-32	35.27	6.04	36.51			#			98	1-29	33.64	6.38	40.67
Freq of Negative Sleep Habits	104	0-32	31.88	6.54	42.83			#			96	0-36	31.23	6.25	39.06
Negative Sleep Habit Strength	104	1-52	41.80	11.73	137.54			#			91	1-40	42.57	8.18	66.96
Pre-sleep Arousal	104	1-45	35.12	10.03	100.69			#			98	1-36	28.67	9.13	83.40
Exercise Levels Total	104	0-13	4.72	3.14	9.85			#			97	0-18	9.04	4.12	16.98
Diet	103	1-17	15.90	3.92	15.32			#			93	1-17	16.52	4.10	16.84
Smoking Status	104	0-5	0.82	1.75	3.04			#			96	0-5	0.79	1.68	2.82
Alcohol Intake	104	0-6	2.03	1.86	3.47			#			97	0-5	2.87	1.53	2.33

= not assessed at this time point

Prior to analysis, groups were also compared according to their age, income, gender, ethnicity, marital status, position within the organisation and presence of children. The purpose of these analyses was to ensure that the randomisation process successfully resulted in equivalent groups. The only group difference to emerge between the AR and non-AR groups was for gender ($\chi^2 = 6.53$, $p <.05$) with a greater percentage of females than males being in the AR group compared to the non-AR groups (see Table 13.2). In contrast, a significantly greater percentage of females were in the non-II groups compared to the II groups ($\chi^2 = 4.32$, $p <.05$). There were no other significant differences. Next, group differences on key measures at baseline were assessed using one-way ANOVAs. Results indicated that there were significant differences in sleep response-efficacy ($F(1,103) = 4.47$, $p < .05$) between the AR ($M = 5.38$, $SD = 1.84$) and non-AR groups ($M = 4.50$, $SD = 2.03$) at baseline. No significant differences in the key measures emerged between the II and non-II groups. Therefore, gender and sleep response-efficacy were included as covariates in the analyses relating to AR manipulations.

Table 13.2 ***Percentages of Males and Females in Each Group***

	Male	*Female*
AR	5 (18%)	22(82%)
II	16(62%)	10(38%)
Combined AR/II	7(30%)	16(70%)
Control	10(36%)	18(64%)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

Correlations Between Key Measures at Baseline

A primary purpose of correlation analyses conducted with the baseline data was to evaluate the extent to which the measures targeted by the intervention were associated with the primary outcome measure of sleep difficulty (the PSQI). as well as to identify any problems of collinearity. Only the central relationships of interest will be discussed. Fatigue, depression, work recovery, dysfunctional sleep beliefs, negative sleep habit frequency, and levels of pre-sleep arousal were all significantly associated with PSQI. Associations were also found between smoking status and time of lights out and between diet and the individual measure of sleep quality but not PSQI scores. Although sleep-related planning was not associated with PSQI, there was a negative association of sleep-related planning with negative sleep habit frequency which was significantly associated with PSQI scores. Diet was negatively related to anxiety, perceived stress and fatigue at the .01 level. No problems of collinearity were identified. In short, significant associations between many of the outcome measures (e.g. dysfunctional sleep beliefs, negative sleep habit frequency and pre-sleep arousal levels) and PSQI scores suggests that these measures are also reflective of sleep difficulty. Table 13.3 presents a summary of these results.

Table 13.3 ***Correlations Between Key Measures and PSQI at Baseline***

	Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1	*PSQI*	-													
2	*Sleep Motivation*	.12	-												
3	*Sleep Self-Efficacy*	-.05	**.53****	-											
4	*Sleep Response-Efficacy*	-.18	**.33****	**.69****	-										
5	*Sleep-Related Planning*	-.07	**.30****	**.26****	.02	-									
6	*Anxiety*	.13	.08	.00	-.12	-.02	-								
7	*Depression*	.17	-.10	-.11	-.17	**-.36****	**.47****	-							
8	*Perceived Stress*	.06	-.03	-.03	-.05	**-.23***	**.51****	**.68****	-						
9	*Fatigue*	**.27****	.02	.08	-.05	-.13	**.32****	**.45****	**.47****	-					
10	*Work Recovery*	**.24***	.01	.01	-.07	-.01	**.30****	**.44****	**.45****	**.46****	-				
11	*Dysfunctional Sleep Beliefs*	**.23***	**.32****	.13	-.07	.13	**.26****	**.19***	**.25***	**.24***	**.37****	-			
12	*Negative Sleep Habit Frequency*	**.21***	.01	.16	.19	-.15	-.00	.16	**.21***	.09	.08	-.01	-		
13	*Negative Sleep Habit Strength*	.19	.02	.03	.04	-.07	-.01	.12	.06	**.32****	.12	.07	.14	-	
14	*Pre-sleep Arousal*	**.30****	.12	-.02	-.19	-.05	**.42****	**.32****	**.30****	.19	**.26****	**. 29****	.17	-.04	-

* *p < .05*, ** *p < .01*

	Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	*PSQI*	-									
2	*Exercise*	-.02	-								
3	*Smoking*	.03	-.02	-							
4	*Alcohol*	.11	.17	**.19***	-						
5	*Diet*	-.04	**.36****	**-.25****	.12	-					
6	*Sleep Quality*	**-.57****	-.03	-.17	-.14	**.20***	-				
7	*Time of Lights Out*	-.03	.08	**.24***	.09	-.06	-.11	-			
8	*Time to Sleep*	**.62****	.06	.12	.15	-.03	**-.34****	.01	-		
9	*Hours of Sleep*	**-.66****	-.02	-.08	-.04	-.05	**.22***	-.11	**-.24***	-	
10	*Time of Waking*	.05	-.12	.03	-.02	-.18	.01	**.20***	.07	.14	-

* *p < .05*, ** *p < .01*

Correlations for Key Measures at Final Follow-up

A primary purpose of the correlation analyses of the follow-up data was to evaluate the extent to which the measures targeted by the intervention remained associated with the primary outcome measures of PSQI and the other sleep-related indicators as well as to identify any problems of collinearity. In addition, relationships between PSQI scores, its indicators and additional health behaviours were examined to determine whether there was a need to run further analyses to test for mediation. Only the central relationships of interest will be discussed.

Sleep self-efficacy, sleep response-efficacy, anxiety, perceived stress, fatigue, work recovery, negative sleep beliefs, and levels of pre-sleep arousal were all associated with PSQI scores. However, unlike at baseline, negative sleep habit frequency and strength were not associated with PSQI scores and neither was sleep-related planning. Sleep-related planning was associated with lower pre-sleep arousal which was, in turn, associated with PSQI scores. A new measure of sleep-related action was introduced at final follow-up to determine whether participants performed the sleep initiation actions outlined in the imagery. This measure was associated with greater sleep motivation, more detailed sleep-related planning, low negative sleep habit frequency, low negative sleep habit strength and a healthy diet ($r = .34$, $p < .01$). Table 13.4 presents a summary of these results.

As expected, the indicators of sleep quality, time to sleep and hours of sleep were all significantly associated with the primary outcome measure of PSQI (see Table 13.5). The remaining measures that did not show a significant association with PSQI again included the health behaviour measures of exercise, smoking status, alcohol intake and diet. These findings suggest that although sleep-related indicators remained indicative of PSQI scores, there were unlikely to be improvements to other health behaviours as a result of improving sleep and its related behaviour. Nevertheless, it is possible that the AR or II imagery manipulations could still have direct effects on other health behaviours despite being designed to improve sleep-related behaviour.

Table 13.4 ***Correlations between Key Independent Measures and PSQI Scores at Final Follow-up***

	Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1	*PSQI*	-													
2	*Sleep Motivation*	-.07	-												
3	*Sleep Self-Efficacy*	**-.48****	**.29****	-											
4	*Sleep Response-Efficacy*	**-.62****	.15	**.73****	-										
5	*Sleep-Related Planning*	-.16	.13	**.36****	**.33****	-									
6	*Anxiety*	**.48****	-.16	**-.32****	**-.44****	-.15	-								
7	*Perceived Stress*	**.32****	**-.23***	**-.39****	**-.42****	-.15	**.71****	-							
8	*Fatigue*	**.32****	-.19	**-.36****	**-.39****	-.05	**.42****	**.39****	-						
9	*Work Recovery*	**.35****	-.06	**-.21***	**-.20***	.03	**.29****	**.31****	**.40****	-					
10	*Dysfunctional Sleep Beliefs*	**.39****	-.00	**-.20***	**-.30****	.04	**.29****	**.37****	**.25***	**.66****	-				
11	*Negative Sleep Habit Frequency*	.13	-.20	-.10	-.12	**-.34****	**.23***	.20	.06	.15	.19	-			
12	*Negative Sleep Habit Strength*	.13	-.02	-.15	-.20	-.19	**.22***	**.29****	.07	.20	**.21***	**.35****	-		
13	*Pre-sleep Arousal*	**.47****	**-.22***	**-.30****	**-.35****	-.16	**.55****	**.48****	**.37****	**.43****	**.37****	**.23***	**.26***	-	
14	*Sleep-Related Action*	.09	**.30****	.12	.11	**.41****	-.09	-.16	-.12	.09	.04	-.08	**-.38****	**-.25***	-

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

Table 13.5 ***Correlations between Health Behaviours, Sleep-Related Indicators and PSQI Scores at Final Follow-up***

	Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	*PSQI*	-									
2	*Exercise*	.14	-								
3	*Smoking*	.00	-.03	-							
4	*Alcohol*	.06	-.04	.05	-						
5	*Diet*	.07	**.23***	**-.33****	.00	-					
6	*Sleep Quality*	**-.78****	-.14	-.02	-.08	-.02	-				
7	*Time of Lights Out*	-.01	.05	.16	.16	-.04	-.06	-			
8	*Time to Sleep*	**.54****	.09	.09	.13	.01	**-.40****	.08	-		
9	*Hours of Sleep*	**-.60****	**-.21***	.04	.02	-.16	**.38****	**-.29****	-.11	-	
10	*Time of Waking*	-.02	-.15	.18	.10	**-.24***	.04	**.24***	**.28****	**.38****	-

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

Manipulation Checks

As a manipulation check, between-subjects ANOVAs were conducted to assess whether the AR groups (versus non-AR groups) reported higher vividness of AR imagery, and the II groups (versus the non-II groups) reported higher vividness of II imagery at the post-practice and follow-up assessments. Results at the post-practice assessment revealed an AR main effect $F(3,104) = 115.32$, $p < .001$, partial $\eta^2 = .54$ on AR imagery vividness with AR images perceived more vividly by the AR groups than non-AR groups. No II main effects were found for AR images. For II imagery vividness, between subjects ANOVAs revealed an AR main effect $F(3,104) = 36.90$, $p < .001$, partial $\eta^2 = .27$, a significant II main effect $F(3,104) = 103.08$, $p < .001$, partial $\eta^2 = .51$, and a significant AR X II interaction $F(3,104) = 57.32$, $p < .001$, partial $\eta^2 = .36$. Further simple effects analyses revealed that the AR groups perceived the II imagery as less vivid than non-AR groups $p < .01$, whereas the II groups perceived the II imagery more vividly than the non-II groups; $p < .01$. Independent group means and standard deviations are presented in Table 13.6.

Results at the follow-up assessment revealed an AR main effect $F(3,94) = 144.62$, $p < .001$, partial $\eta^2 = .59$ on AR imagery vividness with AR images perceived more vividly by the AR groups than non-AR groups. For II imagery vividness, between subjects ANOVAs revealed a significant AR main effect, $F(3,94) = 9.74$, $p < .001$, partial $\eta^2 = .09$, with groups using the AR imagery reporting a significantly lower II vividness rating than non-AR groups. A significant II main effect was also found, $F(3,94) = 50.90$, $p < .001$, partial $\eta^2 = .35$, with groups using the II instructions reporting a significantly higher II vividness rating than non-II groups. Finally, a significant AR X II interaction $F(3,94) = 7.81$, $p < .01$, partial $\eta^2 = .08$ was found. Further simple effects analyses suggested that the significant effect was due to the II imagery with the AR groups reporting a lower vividness rating at follow-up assessment than the non-AR groups; $p < .05$. This interaction suggests that participants using the AR imagery instructions reduced their mental simulations of II behaviours as they focused on AR imagery. Independent group means and standard deviations are presented in Table 13.6.

Table 13.6 ***Independent Group Means (M) and Standard Deviations (SD) of Imagery Vividness Ratings and Manipulation Checks***

Measure	*AR* *M* (*SD*)	*II* *M* (*SD*)	*Combined AR/II* *M* (*SD*)	*Control* *M* (*SD*)
AR Imagery Vividness				
Post-Practice	9.46(3.24)	3.69(2.51)	9.10(3.52)	3.00(0.00)
Follow-Up	5.50(2.08)	2.31(0.93)	6.29(2.33)	2.00(0.00)
II Imagery Vividness				
Post-Practice	10.19(6.42)	27.58(4.43)	28.86(4.22)	24.68(6.51)
Follow-Up	10.81(6.81)	24.38(6.58)	23.95(6.90)	18.64(5.82)
Anxiety				
Baseline	12.44(3.03)	12.58(3.37)	12.39(3.03)	13.39(3.39)
Post-Practice	14.04(1.81)	14.04(1.89)	13.52(1.34)	14.54(1.92)
Follow-Up	11.92(3.26)	11.65(2.48)	11.95(4.52)	13.04(4.17)
Sleep-Related Planning				
Baseline	10.24(4.59)	12.76(6.13)	11.91(5.15)	12.12(5.28)
Post-Practice	11.64(5.42)	16.52(5.04)	17.82(7.21)	14.72(6.18)
Follow-Up	11.76(6.09)	16.96(6.28)	15.59(7.91)	12.96(5.97)
Sleep-Related Action				
Follow-Up	24.27(7.29)	30.81(6.37)	31.82(6.38)	28.32(6.90)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

Results from mixed model analyses also suggested a significant II X Time interaction for the daily ratings of the vividness of the CD recording during the daily practice (see Table 13.7). Analyses revealed that the II groups tended to rate the vividness of the CD recording higher than other groups. In addition, an AR X Time interaction was found for the written instructions during the daily practice with results suggesting that the AR group reported lower ratings of written imagery vividness than other groups.

Table 13.7 ***Mixed Model Analyses to Assess Daily Differences on Imagery Vividness***

Daily Imagery Vividness	*AR* Est. (*SE*) [CI]	*t*	*II* Est. (*SE*) [CI]		*AR* * *II* Est. (*SE*) [CI]	*t*
CD vividness [a]	-.094(.169) [-.427,.239]	-0.56	**.750(.185) [.385,1.114]**	**4.05*** **	-.107(.257) [-.612,.397]	-0.42
Written vividness [b]	**-.418(.164) [-.741,-.094]**	**-2.54***	.154(181) [-.201,.510]	0.85	.223(.250) [-.269,.714]	0.89

Analyses include observations from 93 employees over 20 days with 10-17 observations missing. [a] = Observations 1388; [b] = Observations 1382; *$p < .05$, ** $p < .01$, ***$p < .001$. (*AR* = Arousal Reduction Imagery*; II = Implementation Intentions imagery*)

Repeated measures ANOVAs were conducted on anxiety ratings from immediately prior to the initial imagery practice and immediately post-practice to assess whether the AR imagery manipulation was successful in reducing arousal. A significant time effect was found $F(1,93) = 17.54$, partial $\eta^2 = .27$, $p < .05$ that suggested an overall increase in anxiety levels from baseline ($M = 12.72$, $SD = 3.20$) to post-practice ($M = 14.06$, $SD = 1.78$; $p < .001$) but then a significant decrease at follow-up ($M = 12.14$, $SD = 3.62$; $p < .001$). Nevertheless, as only the post-practice assessment measured anxiety levels immediately following the imagery manipulation, only this assessment can be attributed to possible increases in arousal levels. Moreover, there were no AR X Time or II X Time effects for anxiety.

As a test of whether the II imagery manipulation was effective in making detailed plans for sleeping well, 2 (*AR Imagery versus no AR Imagery*) X 2 (*II Imagery versus no II Imagery*) X 3 (*Baseline versus Post-Practice versus Post-Intervention Follow-Up*) repeated measures ANOVAs were conducted on the quantitative measure of sleep-related planning (see Figure 13.1). Analyses revealed significant time effects $F(1,92) = 24.63$, partial $\eta^2 = .35$, $p < .001$ suggesting an overall increase in planning from baseline ($M = 11.62$, $SD = 5.29$) to post-practice ($M = 14.81$, $SD = 6.34$) but showed a slight decrease at follow-up ($M = 14.28$, $SD = 6.79$). Moreover, a significant II X Time interaction effect was shown $F(1,92) = 4.46$, partial $\eta^2 = .09$, $p < .05$. Simple effects analyses revealed that the main increase in sleep-related planning was between baseline and post-practice as II groups showed a greater increase relative to non-II groups ($p < .01$). However, II groups also maintained sleep-related planning between post-practice and follow-up relative to non-II groups which showed a significant decrease ($p < 01$). Table 13.6 presents a summary of the independent group means and standard deviations.

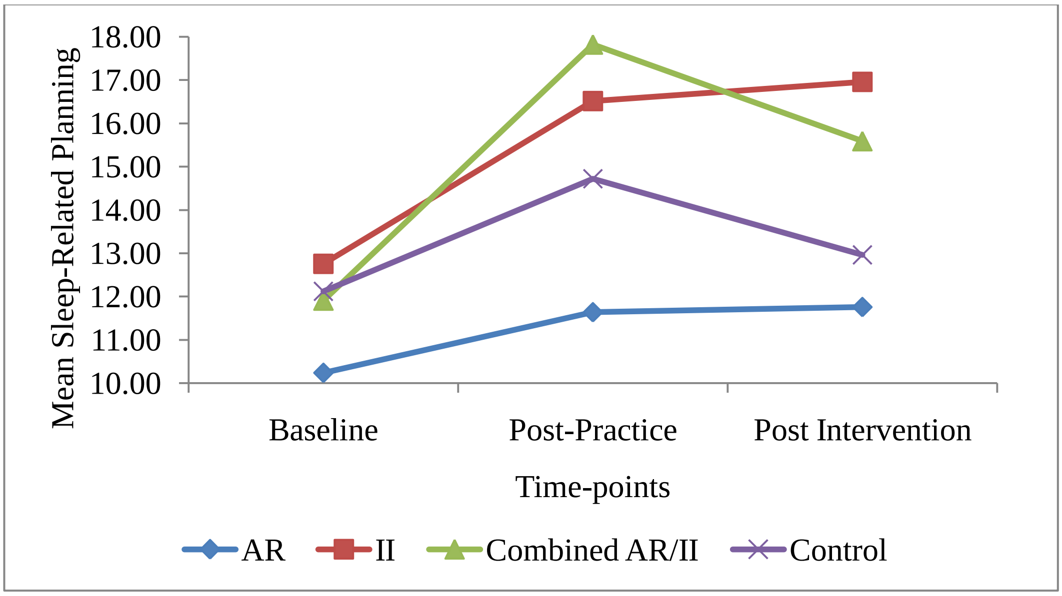

Figure 13.1 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Sleep-Related Planning From Baseline to Post-Intervention**

Finally, to test that the II imagery manipulation was effective in instilling the anticipated actions, between subjects ANOVAs were conducted to determine whether the intervention groups differed on sleep-related action at the follow-up assessment. These sleep-related actions were specifically referred to in the II instructions but not the AR imagery instructions. As expected, there was a significant main effect for II groups $F(1,95) = 13.58$, partial $\eta^2 = .13$, $p < .001$, such that the II groups reported more sleep-related actions than did the AR group and control group. In contrast, there were no significant main or interaction effects of AR imagery on sleep imagery action. Table 13.6 presents a summary of independent group means and standard deviations for sleep-related action.

Intervention Effects on Sleep Patterns

To test the independent and combined effects of the AR and II imagery manipulation on sleep patterns as assessed by the PSQI at the Day 21 follow-up assessment, 2 (*AR versus no AR*) X 2 (*II versus no II*) X 2 *(Baseline to Post-Intervention Follow-up*) repeated measures ANOVAs were conducted. These analyses were used to test the first hypothesis that the independent and combined effects of the AR and II imagery would lead to the greatest improvement in sleep patterns at follow up assessment. PSQI scores showed a decrease over time, suggesting reductions in sleep difficulty across the AR and II imagery groups from baseline (M =7.92, SD = 2.89) to follow-up (M = 6.10, SD = 2.97), $F(1,94) = 30.73$, partial $\eta^2 = .25$ $p < .001$). No significant AR or II X Time interactions for PSQI scores were found however. The individual indicator of sleep quality significantly increased overall from baseline (M = 1.18, SD = 0.52) to follow-up (M = 1.64, SD = 0.65), $F(1,94) = 46.42$, partial $\eta^2 = .33$ $p < .001$, although again there were no AR or II X Time interactions. Hours of sleep also showed significant time effects with an overall increase from baseline (M = 6.39, SD = 1.01) to follow-up assessment in the AR and II imagery groups (M = 6.78, SD = 0.95), $F(1,94) = 14.84$, partial $\eta^2 = .14$, $p < .001$. Time to sleep also showed significant time effects and decreased overall, $F(1,94) = 13.71$, partial $\eta^2 = .08$ $p < .001$, from baseline (M = 31.59, SD = 25.56) to follow-up assessment (M = 22.23, SD = 20.83). Fatigue was also measured as a potential sleep-related outcome (as it showed strong correlations with PSQI scores) but did not show an AR X Time or II X Time interaction. Table 13.8 presents a summary of independent group means and standard deviations of the sleep-related measures.

Table 13.8 ***Independent Group Means (M) and Standard Deviations (SD) of Sleep-Related Measures***

Measure	*AR* *M (SD)*	*II* *M (SD)*	*Combined AR/II* *M (SD)*	*Control* *M (SD)*
PSQI				
Baseline	8.19(3.45)	7.69(2.45)	8.18(2.70)	7.71(2.65)
Follow-Up	6.42(3.29)	6.15(2.89)	5.91(3.53)	5.88(2.17)
Time to Sleep				
Baseline	38.46(27.16)	30.31(23.20)	30.64(28.04)	25.97(23.47)
Follow-Up	27.50(19.96)	22.04(24.19)	21.25(24.05)	17.64(13.33)
Intended Time of Lights Out (SRCT)				
Baseline	12.19(3.70)	12.37(3.59)	11.56(2.89)	11.11(0.89)
Follow-Up	10.71(0.66)	11.03(0.98)	11.30(2.97)	11.07(0.68)
Time of Lights Out				
Baseline	10.83(0.73)	11.39(1.52)	10.78(1.12)	10.64(1.28)
Follow-Up	10.83(0.79)	10.54(1.04)	10.55(0.74)	10.75(0.71)
Hours of Sleep				
Baseline	6.42(1.21)	6.27(0.92)	6.34(0.85)	6.58(0.91)
Follow-Up	6.87(0.84)	6.62(0.95)	6.84(1.07)	6.79(0.97)
Time of Waking				
Baseline	6.70(0.68)	6.56(0.62)	6.38(1.15)	6.40(0.88)
Follow-Up	6.57(0.86)	6.62(0.74)	6.59(0.88)	6.53(0.88)
Sleep Quality				
Baseline	1.08(0.69)	1.15(0.37)	1.18(0.50)	1.29(0.46)
Follow-Up	1.42(0.64)	1.69(0.47)	1.68(0.84)	1.79(0.59)
Fatigue				
Baseline	14.31(4.20)	13.08(4.77)	15.50(4.73)	13.48(4.40)
Follow-Up	14.04(4.61)	11.73(4.50)	13.77(5.86)	13.44(4.92)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

Significant time effects were noted for time of lights out from baseline (M = 10.91, SD = 1.21) to follow-up (M = 10.67, SD = 0.83), $F(1,94) = 4.72$, partial $\eta^2 = .05$, $p < .05$. The analyses also showed II X Time interaction effects, $F(1,94) = 6.84$, partial $\eta^2 = p < .01$; see Figure 13.2. Simple effects analyses revealed that the II groups reported an earlier time of lights out at follow-up compared to baseline ($p < .01$) relative to non-II groups.

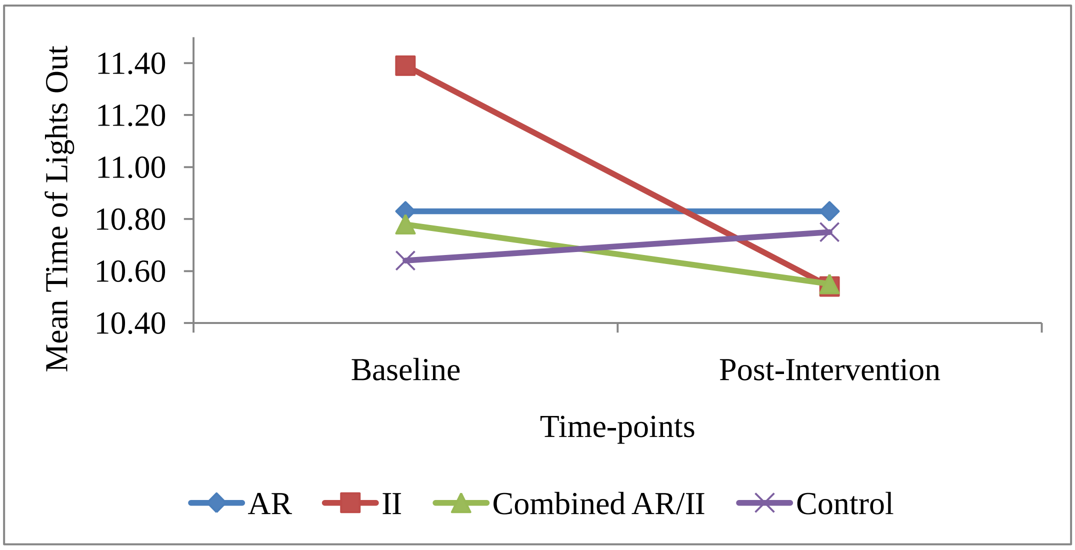

Figure 13.2 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Time of Lights Out From Baseline to Post-Intervention**

Hypothesis 2 stated that pre-sleep arousal would show the greatest decrease in the groups with the AR component. Further 2 (*AR Imagery versus no AR Imagery*) X 2 (*II Imagery versus no II Imagery*) X 2 *(Baseline to Post-Intervention Follow-Up*) repeated measures ANOVAs were conducted to test this hypothesis. Given strong relationships found with pre-sleep arousal, the measures of perceived stress and work recovery were also examined using 2 x 2 repeated measures ANOVAs. Significant time effects $F(1,94) = 36.13$, partial $\eta^2 = .28$, $p < .001$ suggested that pre-sleep arousal decreased overall from baseline ($M = 35.12$, $SD = 10.03$) to follow-up ($M = 28.67$, $SD = 9.13$). Significant time effects were also found for work recovery $F(1,94) = 12.60$, partial $\eta^2 = .12$ $p < .001$ suggesting an overall decrease from baseline ($M = 35.48$, $SD = 12.95$) to follow-up ($M = 31.47$, $SD = 13.12$). However, no significant AR X Time or II X Time interactions were found for work-recovery or levels of pre-sleep arousal and no time effects, AR X Time interaction or II X Time interaction were shown for levels of perceived stress. Table 13.9 presents the independent group means and standard deviations.

Table 13.9 ***Summary of Independent Group Means (M) and Standard Deviations (SD) of Key Pre-Sleep Arousal Measures***

Measure	*AR* *M* (*SD*)	*II* *M* (*SD*)	*Combined AR/II* *M* (*SD*)	*Control* *M* (*SD*)
Perceived Stress				
Baseline	16.42(4.47)	16.54(5.94)	15.41(5.84)	17.36(6.56)
Follow-Up	15.73(5.47)	14.23(4.70)	14.45(6.84)	16.52(7.64)
Work Recovery				
Baseline	34.15(13.12)	35.69(11.91)	36.32(14.73)	36.04 (11.40)
Follow-Up	29.92(13.13)	33.15(13.53)	31.09(12.37)	31.67(13.92)
Pre-sleep Arousal				
Baseline	36.04(8.91)	32.96(8.24)	35.18(11.40)	34.00(11.19)
Follow-Up	30.15(10.35)	26.96(7.78)	27.23(8.20)	30.25(9.89)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

Hypothesis 3 stated that the combined AR/II intervention group for sleep behaviour would show the greatest improvement in positive sleep-related beliefs (e.g. sleep self-efficacy and sleep response-efficacy), planning and actions over time as well as the greatest reduction in negative sleep-related habits and dysfunctional sleep beliefs, whereas the AR group would show the greatest improvement in sleep motivation. To test this hypothesis, repeated measures ANOVAs were conducted to assess intervention group differences from baseline to follow-up. Dependent measures included sleep motivation, sleep self-efficacy, sleep response-efficacy, sleep-related planning, negative sleep habit frequency, negative sleep habit strength, and dysfunctional sleep beliefs (see Table 13.10).

Table 13.10 ***Summary of Independent Group Means (M) and Standard Deviations (SD) of Sleep-Related Beliefs and Habits***

Measure	*AR*	*II*	*Combined AR/II*	*Control*
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Sleep Motivation				
Baseline	7.17(1.59)	7.00(2.65)	7.38(2.06)	6.56(2.65)
Post-Practice	8.13(1.49)	8.31(1.52)	8.14(1.88)	7.24(2.31)
Follow-Up	7.83(1.61)	7.92(1.26)	8.43(1.36)	7.64(1.22)
Sleep Self-Efficacy				
Baseline	6.42(2.25)	5.42(2.40)	6.68(2.03)	5.80(2.24)
Post-Practice	6.88(2.20)	6.27(2.01)	7.82(1.99)	6.16(1.77)
Follow-Up	5.92(2.21)	7.08(1.60)	7.27(1.58)	6.36(1.98)
Sleep Response-Efficacy				
Baseline	5.38(1.84)	4.50(2.03)	5.00(2.14)	4.12(1.74)
Post-Practice	5.92(1.88)	5.35(2.08)	6.86(1.73)	5.16(1.82)
Follow-Up	5.50(2.50)	6.19(2.19)	6.64(2.44)	5.68(2.29)
Negative Sleep Habit Frequency				
Baseline	31.85(6.48)	31.69(6.98)	33.67(4.61)	31.70(7.59)
Follow-Up	32.27(5.73)	29.96(7.51)	30.05(5.13)	32.57(6.08)
Negative Sleep Habit Strength				
Baseline	43.68(7.67)	43.48(8.61)	45.55(9.38)	39.14(12.96)
Follow-Up	42.48(6.82)	42.48(8.62)	41.05(9.52)	44.24(8.07)
Dysfunctional Sleep Beliefs				
Baseline	34.15(5.88)	35.42(4.37)	36.36(7.38)	35.46(6.44)
Follow-Up	33.81(6.31)	34.38(5.22)	34.36(7.14)	32.00(6.94)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

Analyses revealed that the AR and II groups increased in sleep motivation from baseline (M = 7.00, SD = 2.27) to follow-up (M = 7.94, SD = 1.38) $F(1,91) = 14.16$, partial $\eta^2 = .14$, $p < .001$, although there were no significant AR or II X Time interactions.

Time effects were also found for sleep self-efficacy $F(1,95) = 4.90$, $p < .05$, partial $\eta^2 = .05$ with an overall increase in sleep self-efficacy found from baseline (M = 6.07, SD = 2.30) to post-practice (M = 6.69, SD = 2.14) that persisted to follow-up (M = 6.64, SD = 1.92). A significant AR X Time interaction $F(1,95) = 4.16$, partial $\eta^2 = .04$, $p < .05$, and II X Time interaction, $F(1,95) = 4.41$, partial $\eta^2 = .04$, $p < .05$ on sleep self-efficacy were also found (see Figure 13.3). Simple effects analyses revealed the II groups showed a significant increase in sleep self-efficacy from baseline to post-practice assessment ($p < .001$) and another significant increase at follow-up assessment ($p < .05$) relative to non-II groups. Simple effects also revealed that the AR X Time interaction was between post-practice and follow-up assessment where the AR groups showed no real change in sleep self-efficacy (p =.12) relative to non-AR groups who showed a significant increase ($p < .05$).

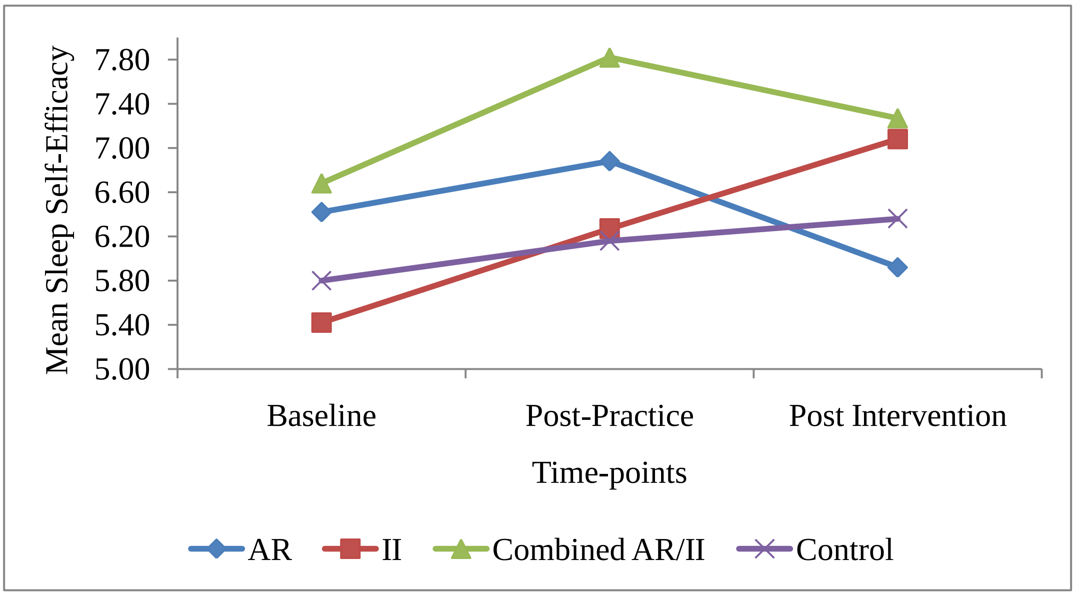

Figure 13.3 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Sleep Self-Efficacy From Baseline to Post-Intervention**

Sleep response-efficacy (see Figure 13.4) showed significant time effects $F(1,94) = 27.22$, partial $\eta^2 = .37$, $p < .001$ suggesting an overall increase from baseline ($M = 4.76$, $SD = 1.98$) to follow-up ($M = 5.98$, $SD = 2.36$). A significant AR X Time interaction $F(1,94) = 3.00$, partial $\eta^2 = .06$, $p < .05$ and a significant AR X II X Time interaction $F(1,94) = 3.23$, partial $\eta^2 = .06$, $p < .05$ were found on sleep response-efficacy. Simple effects analyses revealed that the interaction was between post-practice and follow-up as the AR groups showed a significant decrease in sleep response-efficacy ($p < .05$) relative to non-AR groups. In contrast, simple effects analyses revealed that the II groups showed a significant increase in sleep response-efficacy from baseline to post-practice ($p < .01$) and another increase at follow-up ($p < .05$) relative to non-II groups.

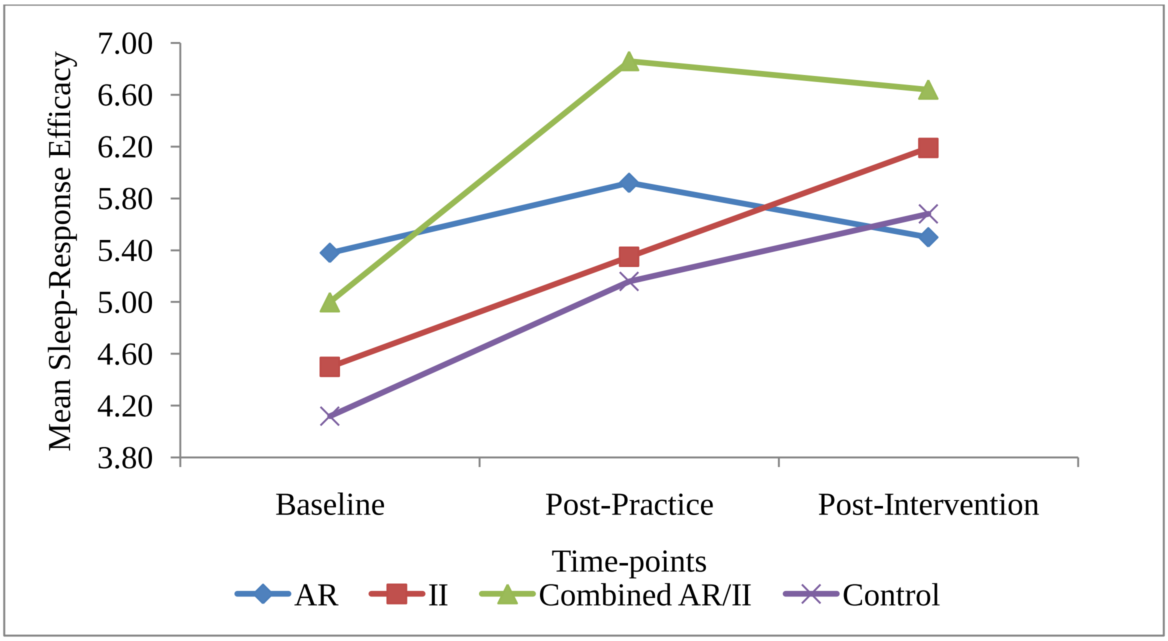

Figure 13.4 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Sleep Response-Efficacy From Baseline to Post-Intervention**

Negative sleep habit frequency also showed a significant II X Time interaction, $F(1,92) = 4.89$, partial $\eta^2 = .05$, $p < .05$. Simple effects analyses revealed that negative sleep habit frequency was significantly reduced in the II groups relative to the non-II groups ($p < .01$; see Figure 13.5).

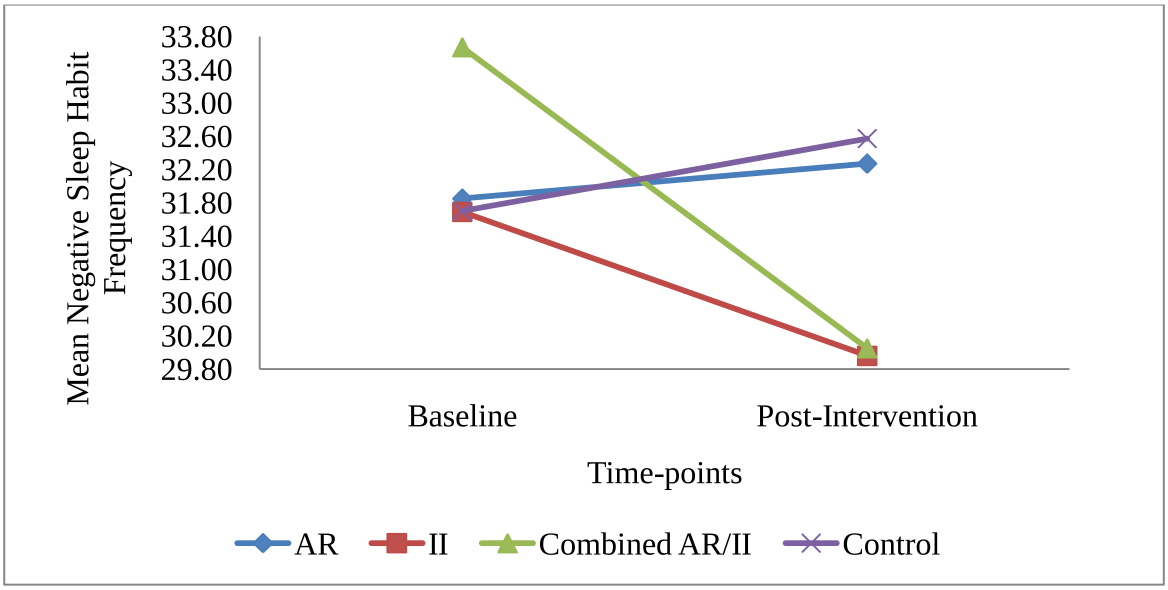

Figure 13.5 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Negative Sleep Habit Frequency From Baseline to Post-Intervention**

Frequency analyses of the self-identified worst sleep-related behaviour revealed that planning, thinking or worrying before bed was the most common behaviour reported at baseline and at follow-up (see Figure 13.6).

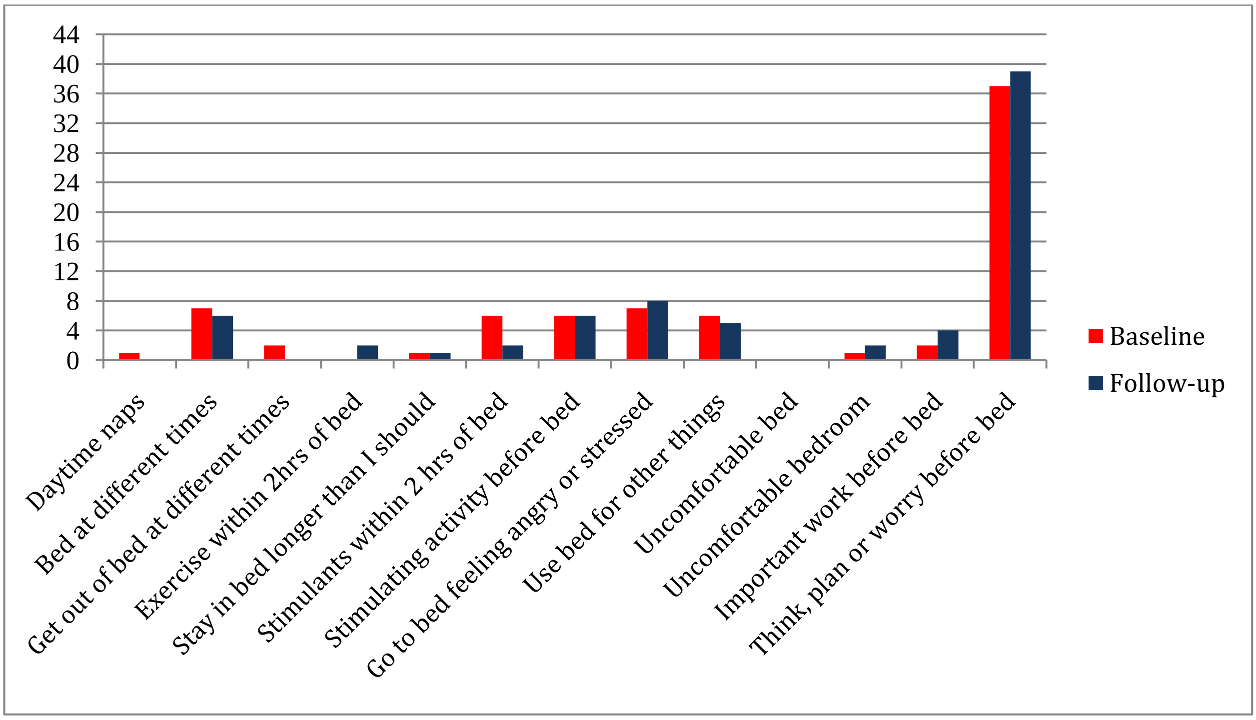

Figure 13.6 **Frequency of the Worst Sleep-Related Habit Reported by Participants (N = 104)**

Repeated measures ANOVA revealed significant AR X Time effects, $F(1,87) = 4.80$, partial $\eta^2 = .05$, $p < .05$, on the strength of the self-reported worst sleep habit (see Figure 13.7). Yet simple effects revealed that there was only a trend towards significance with AR groups showing a slightly greater decrease from baseline to follow-up in negative sleep habit strength relative to non-AR groups ($p = .06$). There was also a significant II X Time interaction; $F(1,87) = 4.42$, partial $\eta^2 = .05$, $p < .05$. Further simple effects analyses revealed no significant differences between II and non-II groups ($p = .12$). Nevertheless, although results from simple effects analyses were non-significant, combined effects were found, with the combined AR/II group showing the greatest decrease from baseline to follow-up ($p = .07$).

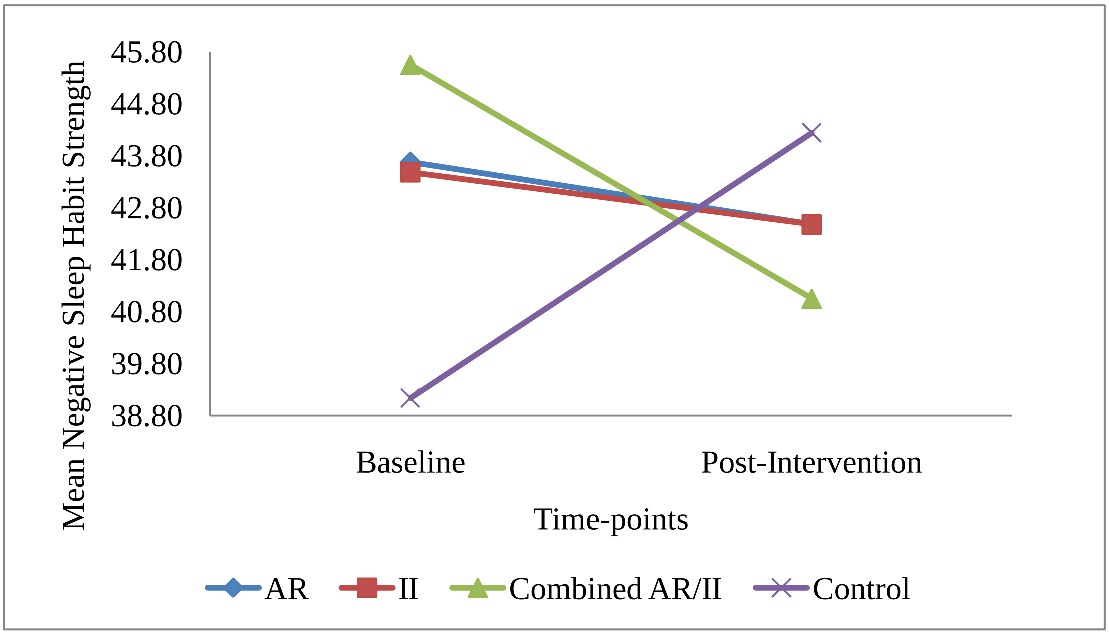

Figure 13.7 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Negative Sleep Habit Strength From Baseline to Post-Intervention**

Dysfunctional sleep beliefs also showed significant time effects $F(1,94) = 14.16$, partial $\eta^2 = .13$, $p < .001$ from baseline ($M = 35.27$, $SD = 6.04$) to follow-up ($M = 33.64$, $SD = 6.38$). In addition, there was a significant AR X II X Time interaction, $F(1,94) = 5.02$, partial $\eta^2 = .05$, $p < .05$. Contrary to expectation, simple effects analyses suggested that participants in the control group were the only group to experience a significant decrease in dysfunctional sleep beliefs from baseline to follow-up assessment ($p < .01$). Figure 13.8 provides an illustration of these results.

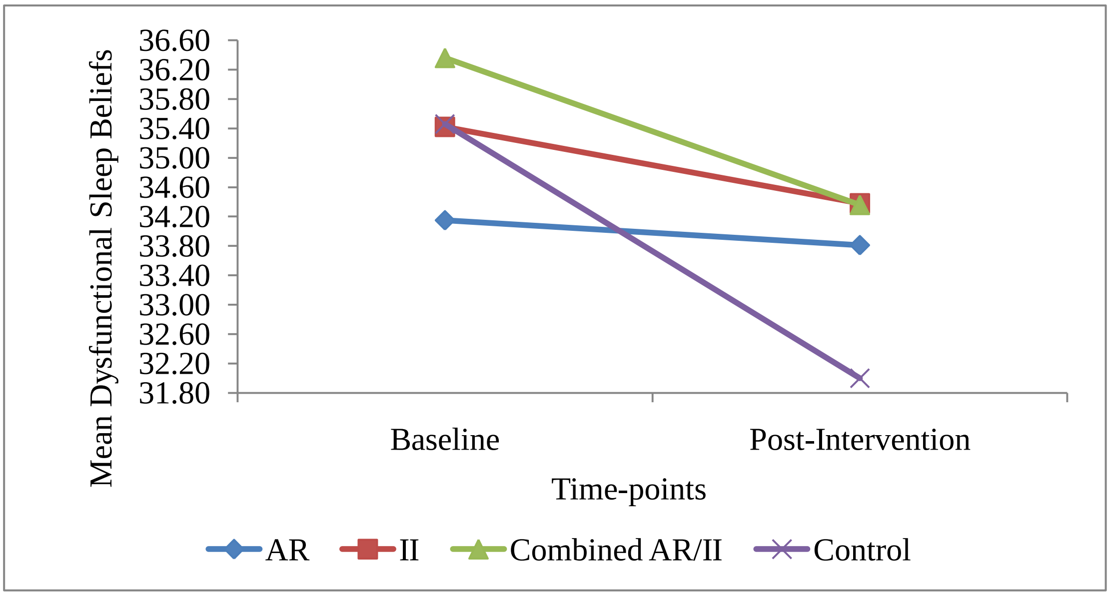

Figure 13.8 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Dysfunctional Sleep Beliefs From Baseline to Post-Intervention**

Hypothesis 4 stated that improvement in sleep patterns would mediate the effects of the intervention on other health behaviours at follow-up (see Table 13.11). Significant time effects were found for exercise levels, $F(1,93) = 120.82$, partial $\eta^2 = .57$, $p < .001$, suggesting an overall increase from baseline ($M = 4.72$, $SD = 3.14$) to follow-up ($M = 9.04$, $SD = 4.12$; $p < .01$). Moreover, a II X Time interaction was found, $F(1,93) = 3.92$, partial $\eta^2 = .04$, $p < .05$, that suggested that the II groups had a significantly higher increase in exercise levels from baseline to follow-up (p <.001) than non- II groups (see Figure 13.9).

Table 13.11 ***Summary of Independent Group Means*** **(*M*)** ***and Standard Deviations*** **(*SD*)** ***of Additional Health Behaviours***

Measure	*AR* *M* (*SD*)	*II* *M* (*SD*)	*Combined AR/II* *M* (*SD*)	*Control* *M* (*SD*)
Exercise				
Baseline	4.50(3.33)	4.50(2.23)	5.32(3.36)	4.87(3.55)
Follow-Up	8.50(4.12)	9.92(3.25)	9.91(4.26)	7.83(4.68)
Smoking Status				
Baseline	0.88(1.86)	1.12(1.99)	0.59(1.50)	0.83(1.85)
Follow-Up	0.88(1.88)	0.88(1.80)	0.59(1.22)	0.78(1.78)
Alcohol Intake				
Baseline	1.92(1.77)	2.35(1.70)	2.14(2.25)	1.96(1.89)
Follow-Up	3.08(1.52)	3.35(1.41)	2.36(1.56)	2.57(1.50)
Diet				
Baseline	15.20(4.24)	15.20(3.80)	16.30(4.51)	16.86(2.92)
Follow-Up	15.76(4.06)	16.48(4.18)	16.90(4.29)	17.41(3.75)

Note: AR = Arousal Reduction Imagery; II = Implementation Intentions Imagery

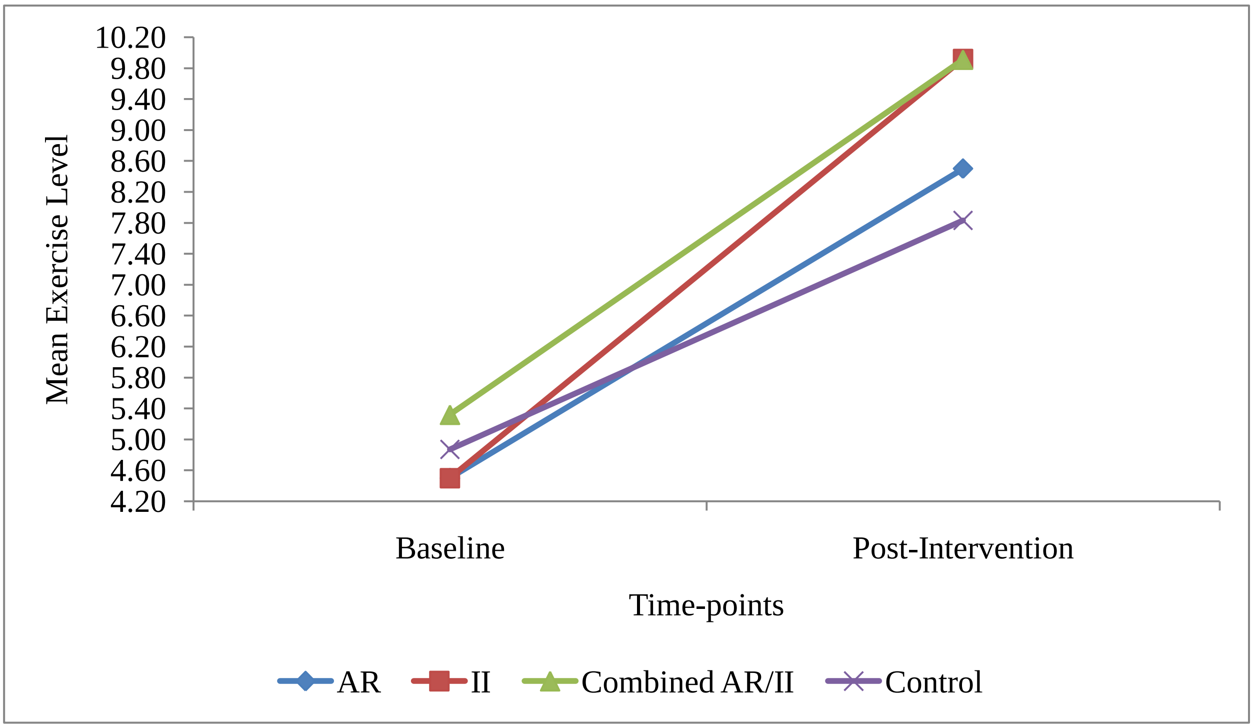

Figure 13.9 **AR (Arousal Reduction Imagery Imagery) and II (Implementation Intentions Imagery) Group Differences in Exercise Level From Baseline to Post-Intervention**

An unexpected result was that significant time effects for alcohol intake were found $F(1,93) = 23.13$, partial $\eta^2 = .20$, $p < .001$, suggesting an overall increase from baseline ($M = 2.03$, $SD = 1.86$) to follow-up ($M = 2.87$, $SD = 1.53$; $p < .01$). A significant AR X II X Time interaction, $F(1,93) = 4.49$, partial $\eta^2 = .05$, $p < .05$, was found. Simple effects analyses revealed that the combined effects of the AR and II imagery was a protective factor against an increase in alcohol intake since the change over time in the combined AR/II group was non-significant ($p = .62$; see Figure 13.10). Diet also showed significant time effects, $F(1,88) = 5.48$, partial $\eta^2 = .06$, $p < .01$, with an overall improvement in diet from baseline ($M = 15.90$, $SD = 3.92$) to follow-up ($M = 16.52$, $SD = 4.10$) although no AR X Time or II X Time interactions were found. Smoking status remained relatively unchanged over time overall and there were no significant AR X Time or II X Time interactions.

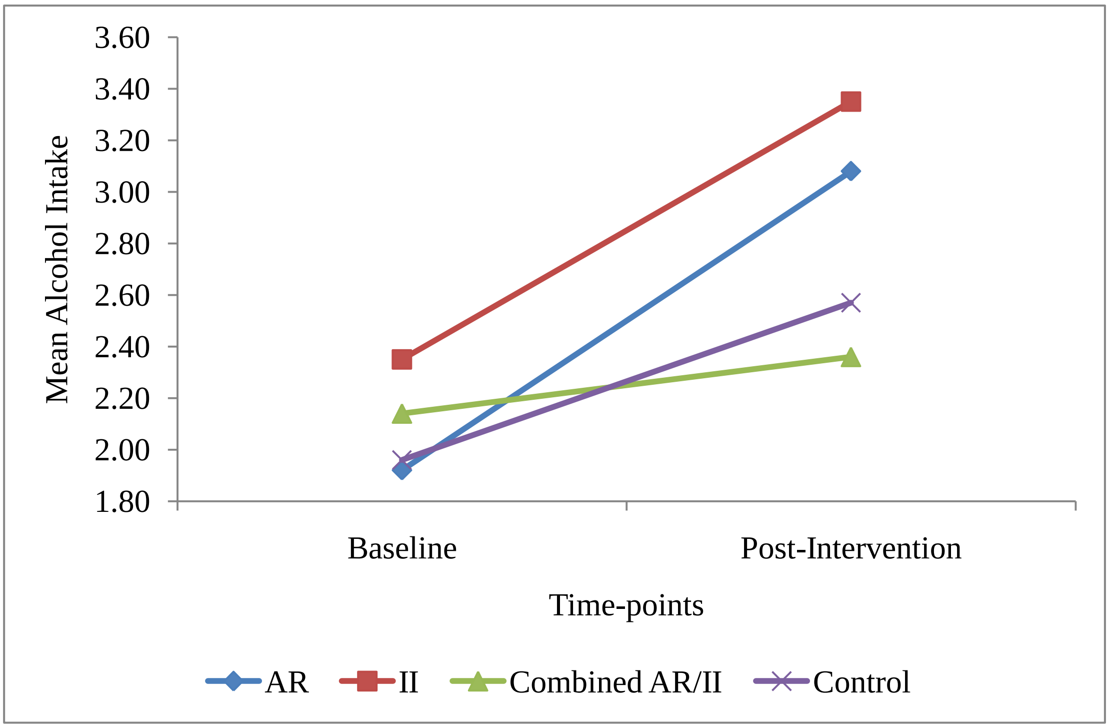

Figure 13.10 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Alcohol Intake From Baseline to Post-Intervention**

The next step was to determine whether the improvement in health behaviours was mediated by the improvements in sleep quality. Correlation analyses suggested that the only associations found at follow-up between the sleep-related measures and health behaviours were between hours of sleep and exercise, and between time of waking and diet. However, further one-way ANOVAs to test these associations and controlling for baseline levels failed to show mediation. Mediation also did not occur when intervention type (AR versus II) was controlled.

Results from Content Analysis of the SRCT

Hypothesis 5 stated that groups would be able to be distinguished based on their intended time of lights out scores on the SRCT. To test this hypothesis, 2 (*AR Imagery versus non-AR Imagery*) X 2 (*II Imagery versus non-II Imagery*) X 2 (*Baseline to Post-Intervention Follow-Up*) repeated measures ANOVAs were conducted with the intended time of lights out (see Figure 13.11). Analyses revealed a significant time effect suggesting an overall decrease in intended time of lights out $F(1,90) = 7.85$, partial $\eta^2 = .08$, $p < .01$, from baseline ($M = 11.85$, $SD = 2.95$) to follow-up ($M = 11.02$, $SD = 1.58$). There was also a significant AR X II X Time interaction, $F(90) = 5.14$, partial $\eta^2 = .05$, $p < .05$. Simple effects analyses revealed that AR groups ($p < .05$) and the II groups ($p < .05$) both had significant decreases in intended time of lights out from baseline to follow-up assessment using the SRCT.

However, there appeared to be no combined effects of the AR and II images with the combined AR/II imagery group showing no greater reductions in intended time of lights out than groups using each imagery component alone or the control group. Individual group means and standard deviations are presented in Table 13.8.

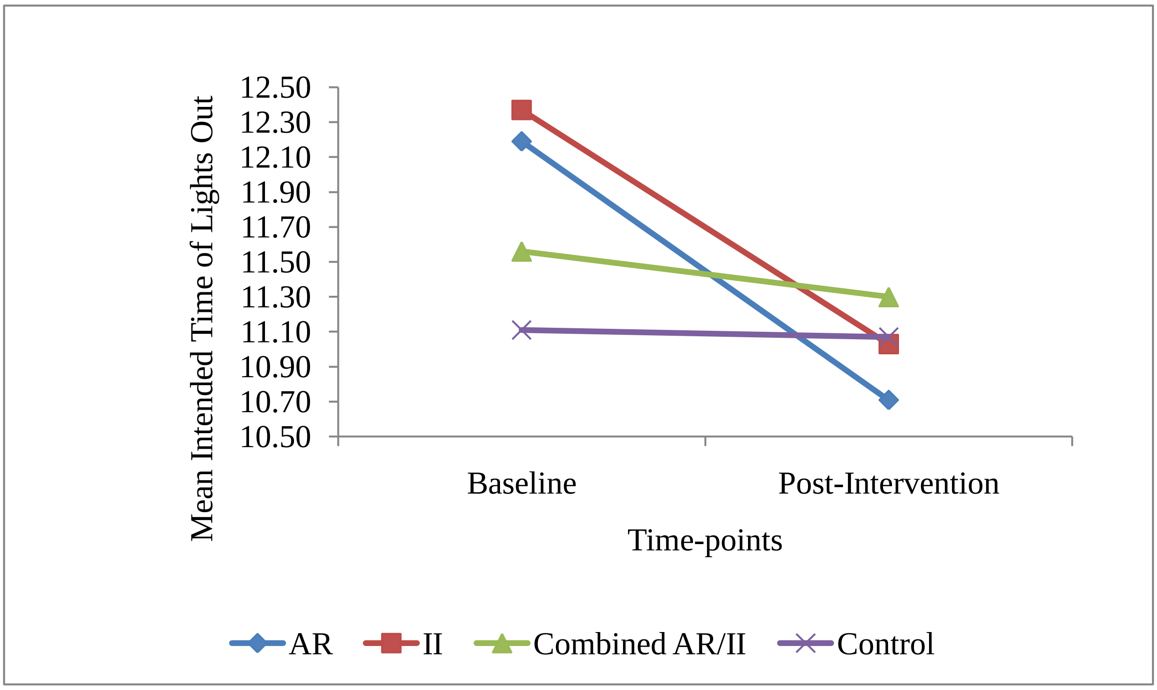

Figure 13.11 **AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Intended Time of Lights Out From Baseline to Post-Intervention**

Another target of the II imagery was establishing a bedtime routine and, at a minimum, making attempts to get ready for bed rather than just going straight to bed. Results from chi square analyses of the SRCT suggested that using II imagery was likely to affect intentions for getting ready for bed (χ^2 = 13.88, $p < .05$; Spearman correlation = 2.00, p < .05; see Figure 13.12). Participants who used II imagery showed a higher frequency of following a bedtime routine (17%) than participants using the AR instructions (7%), both types of instructions (6%) or control (5%). Peaks in getting ready for bed occurred at both 9.30pm and 10.30pm with a slight drop-off at the in-between time-slot of 10pm.

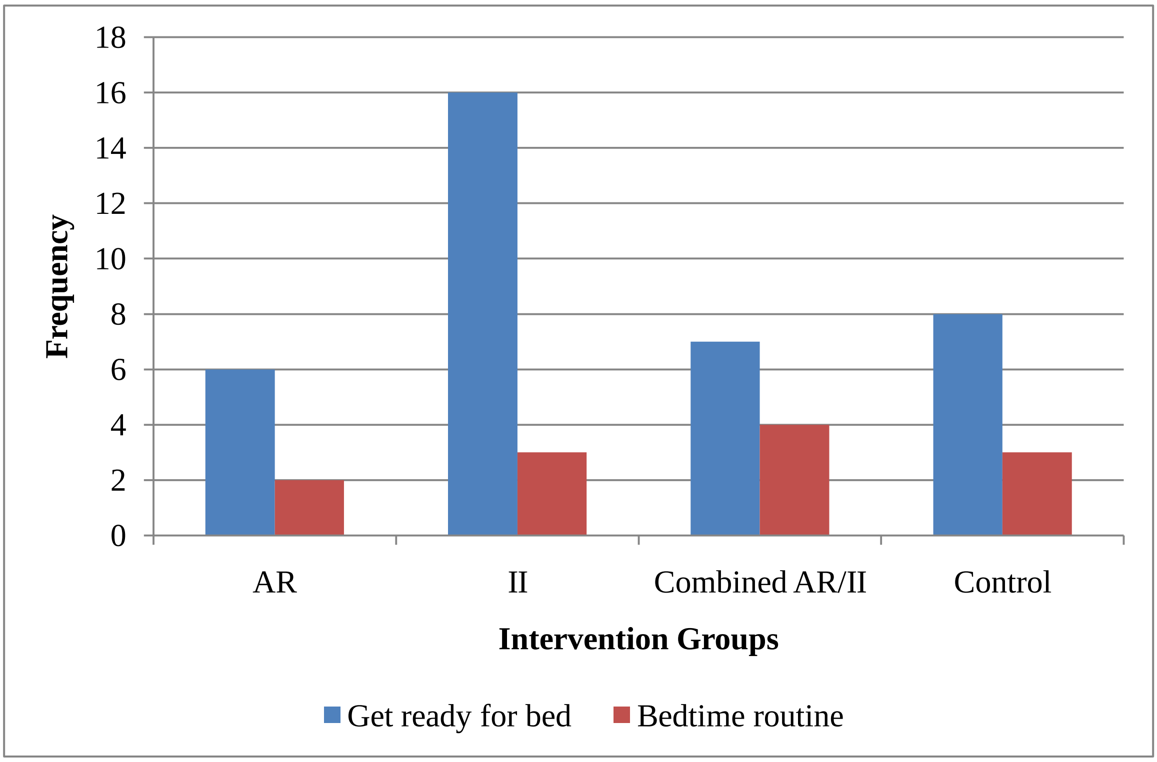

Figure 13.12 **Bar Graph Showing AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Getting Ready for Bed Intention at Follow-up**

Screen use (television and computer) as a common reported behaviour on the SRCT was also examined. A high percentage of participants said they would watch television at some point during the night (43.5%) although the majority said viewing would only continue for half an hour. Overall, 15.8% of participants also said they would use the computer (main tasks were checking emails and online general searches) with most individuals continuing the behaviour for an hour. Times when participants were most likely to use the television and computer were also recorded. The most frequent time of use for the television was between 8.30pm and 10pm with a sharp drop-off after this time period. Computer use on the other hand peaked at 7.30pm and again at 9.30pm with levels in both types of use remaining low from 11pm onwards. Chi square analyses revealed no significant AR or II group differences for screen (χ^2 = 21.62, p = .60) or computer use (χ^2 = 9.27, p = .41) (see Figure 13.13).

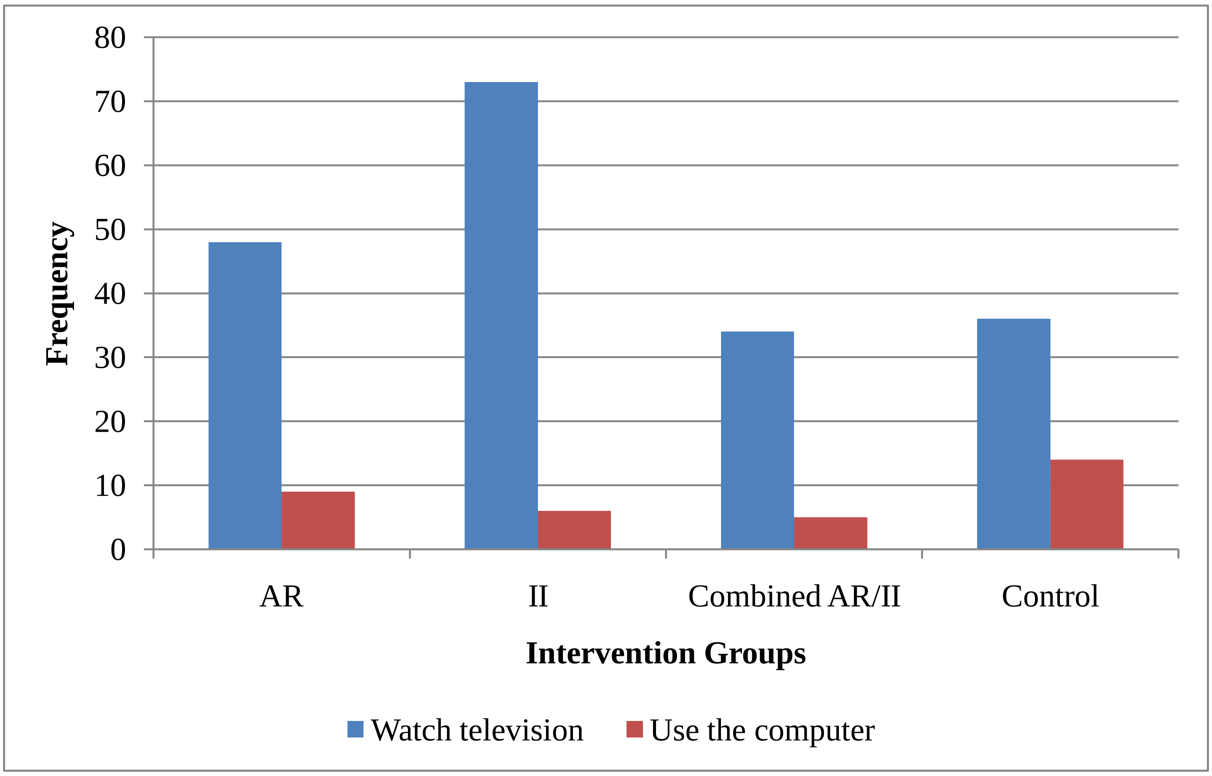

Figure 13.13 **Bar Graph Showing AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Screen Use Intention at Follow-up Assessment**

Work-related tasks as reported in the SRCT were also examined for group differences, duration and time period. Figure 13.14 provides a graphical summary of these results. Although the II groups showed the highest frequency of both the urgent (task due at 11am the next day) (29%) and non-urgent work-related tasks (34%), chi square analyses revealed that group differences were non-significant for the urgent ($\chi^2 = 20.37$, $p = .50$) and non-urgent tasks ($\chi^2 = 11.96$, $p = .68$). Examination of the average duration of doing the work tasks suggested intention for spending half an hour on the task was reported most often for both the urgent and the non-urgent work tasks. Participants were more likely to work for 3.5 hours or more on the non-urgent work task where work only continued up to a 3-hour period on the urgent work tasks. Frequency of participants working that long on the work-tasks were relatively low however. The most common intended time period participants chose to work on the urgent work task was 8.30pm where the non-urgent work task was slightly earlier at 8pm. Both the urgent work task and non-urgent work task showed a sharp decrease at 9pm and 9.30pm respectively. A relatively steady decrease in frequency was then reported until midnight when very few participants stated work would continue on either type of task.

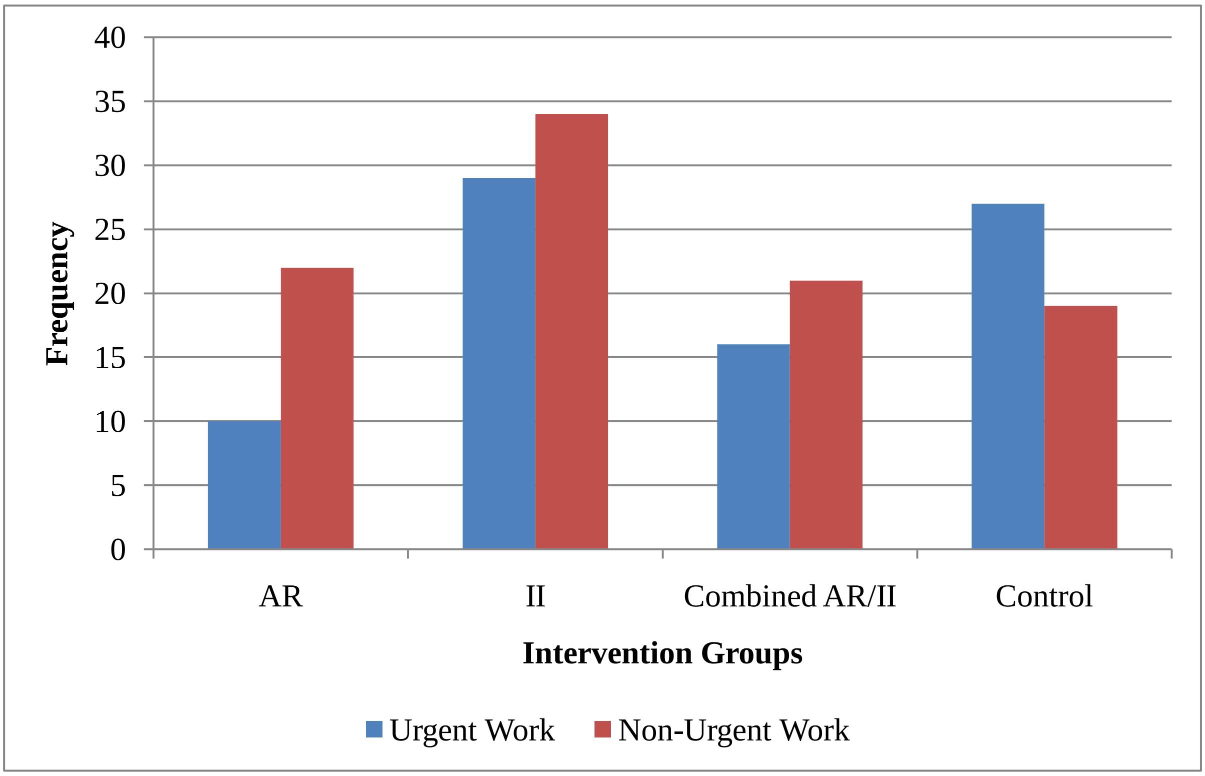

Figure 13.14 **Bar Graph Showing AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Work Task Intention at Follow-up Assessment**

The final behaviour identified in the SRCT to be examined in detail was exercise levels with a focus on intention to cancel exercise, intention to postpone exercise or intention to actually do exercise that night. A relatively high percentage of participants (12.9%) said exercise plans with a friend in the morning would be cancelled due to having too much work to do. Fewer participants said steps would be taken to arrange the exercise to ensure they still managed to do it (2.8%) or would partake in exercise that night (5.6%). The II only group showed the highest reported frequencies of cancelling the exercise (7%; see Figure 13.15). However this group also showed the highest reported frequencies of actually doing the exercise the night before (5%). Chi square analyses revealed that the group differences were not significant ($\chi^2 = 9.64$, $p = .38$). Of the participants who said they would actually do the physical activity, three people said the exercise would take place at 8pm with one person stating it would continue until 9pm. One other participant showed intention for engagement in exercise for half an hour at 9pm with an additional participant stating gentle exercise would be done between 11pm and 11.30pm. Finally, three further participants showed intention to engage in exercise for half an hour at 4.30am (one person) and 5.30am (two participants) upon waking. In short, the analyses of the SRCT show group differences on behaviours directly targeted by the sleep-related imagery (e.g. bedtime routine) but not the other behaviours that can also occur around bedtime.

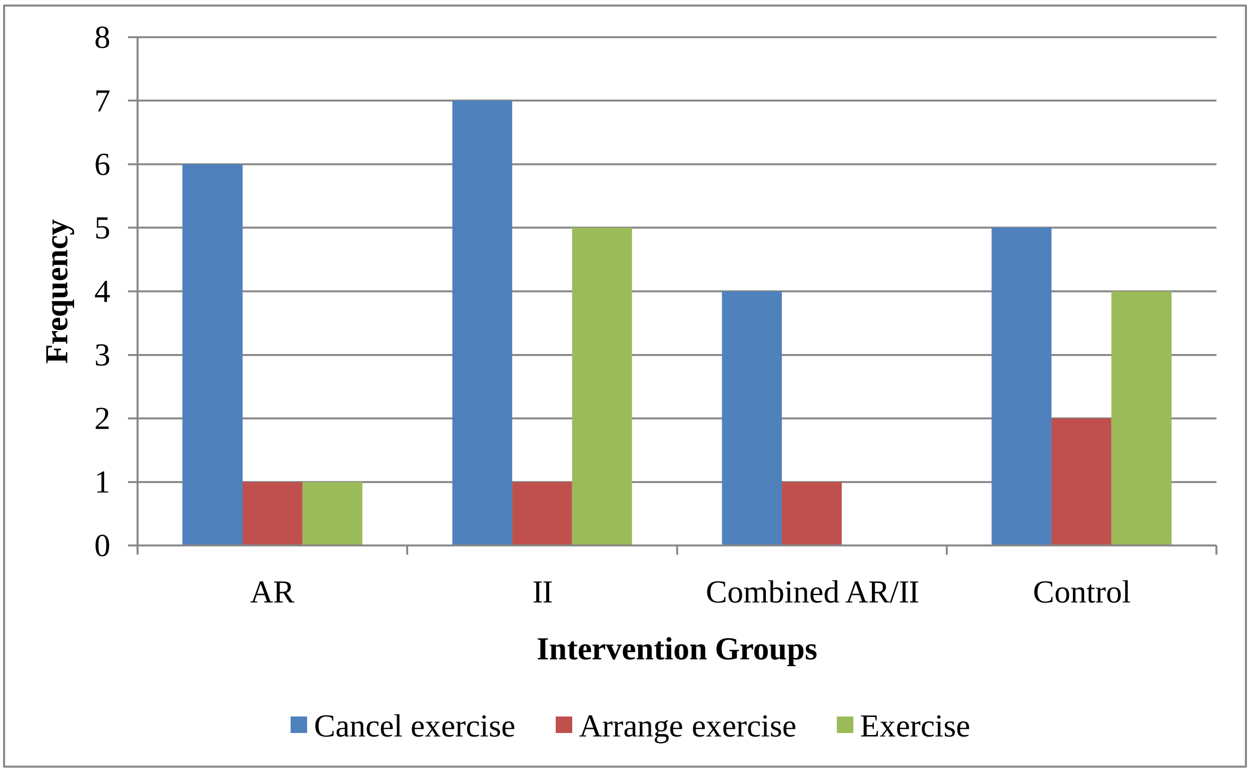

Figure 13.15 **Bar Graph Showing AR (Arousal Reduction Imagery) and II (Implementation Intentions Imagery) Group Differences in Exercise Intention at Follow-up Assessment**

AR and II Group Effects for Daily Sleep-Related Measures

To further test the first hypothesis that the independent and combined effects of the AR and II imagery manipulations would show a greater improvement in sleep patterns on a daily basis relative to control, a series of mixed model analyses were conducted to assess AR and II group effects for daily reports of sleep patterns. Results from these analyses are summarised in Table 13.12.

Table 13.12 ***Summary of Mixed Model Analyses to Assess Daily Group Differences on Sleep-Related Measures***

Sleep Outcome	*AR Est. (SE)* *[CI]*	*t*	*II Est. (SE)* *[CI]*	*t*	*AR * II Est. (SE)* *[CI]*	*t*
Sleep Quality [a]	.177 (.191) [-0.199, 0.552]	0.93	**.434(.207) [-.026, .842]**	**2.09***	-.267(.288) [-.833, .299]	-0.93
Time of Lights Out [b]	-.053(.098) [-246, .140]	-0.54	.138(.106) [-.070, .346]	1.31	-.154(.147) [-.444, .136]	-1.05
Time to Sleep [c]	2.459(2.772) [-2.991, 7.909]	0.89	**-7.381(2.988) [-13.257, -1.505]**	**-2.47***	**10.592(4.161) [2.410, 18.774]**	**2.55***
Hours of Sleep [a]	-.253(.360) [-.960, .455]	-0.70	-.411(.379) [-1.155, .333]	-1.09	.063(.532) [-.982, 1.109]	0.12
Time of Waking [d]	.043(.111) [-.176, .262]	0.38	-.085(.123) [-.327, .156]	-0.70	-.215(.169) [-.548, .118]	-1.27
Waking During Night [e]	-.010(.042) [-.092, .072]	-0.23	**-.104(.045) [-.192, -.016]**	**-2.32***	.063(.062) [-.059, .186]	1.01
Exercise Before Bed [f]	-.003(.018) [-.039, .033]	-0.17	-.007(.019) [-.044, .031]	-0.34	-.023(.027) [-.076, .031]	-0.84
Stimulants Before Bed [g]	**.088(.028) [.033, .143]**	**3.13****	.035(.030) [-.023, .094]	1.19	**-.172(.042) [-.254,-.090]**	**-4.14*****

Analyses include observations from 93 employees over 20 days with 10-42 observations missing: [a] Observations = 1379; [b] Observations = 1386; [c] Observations = 1380; [d] Observations = 1377; [e] Observations = 1389; [f] = Observations = 1357; [g] Observations = 1387; **p < .05, ** p < .01, ***p < .001*. (*AR = Arousal Reduction Imagery, II = Implementation Intentions Imagery*).

Significant II X Time interactions were found with higher reports of sleep quality, time to sleep and waking during the night relative to the AR and control groups. When viewed graphically (see Figure 13.16) the daily trend for sleep quality between the II group and the control group shows consistently better reports of sleep quality in the II group. Further, some of the peaks in the sleep quality in the II group correspond with depressions in sleep quality in the control group. Baseline levels of sleep quality are not reported here as the measure was different to the one used on a daily basis.

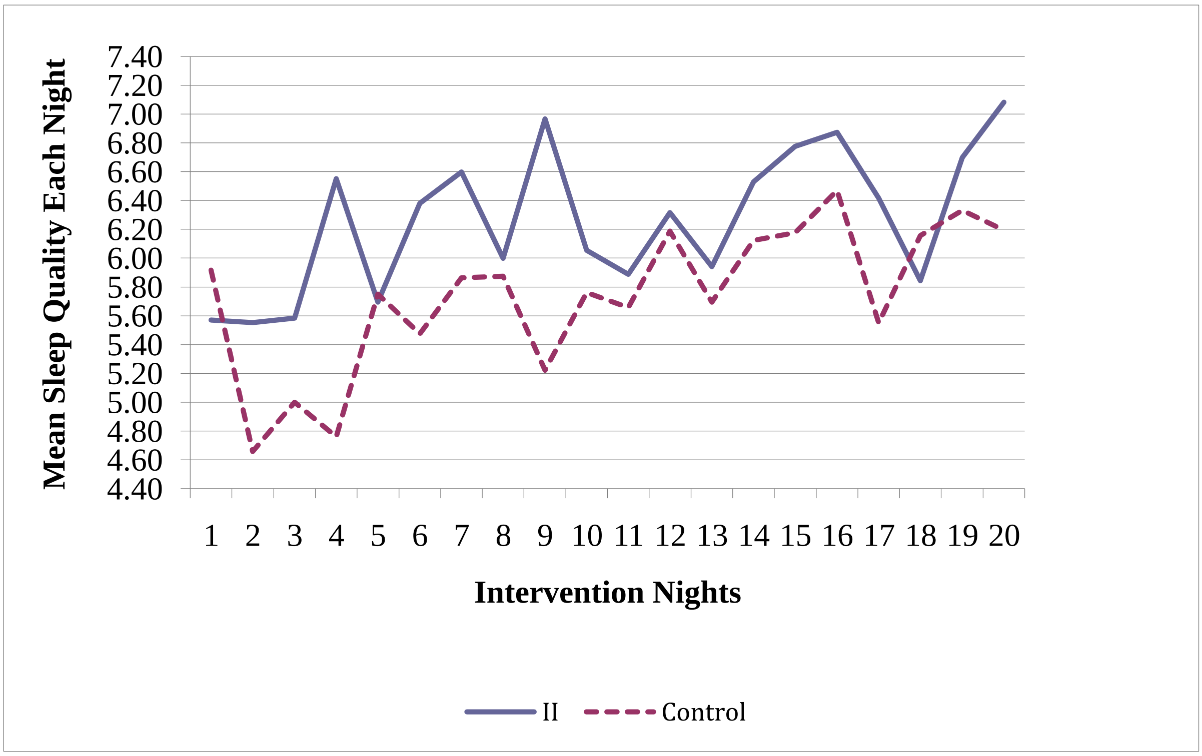

Figure 13.16 **Line Graph Showing Mean Sleep Quality Each Night (II = Implementation Intentions Imagery)**

There was also a significant AR X II X Time interaction for time to sleep. Simple effects analyses revealed that the interaction was associated with the II groups with these groups reporting a faster time to sleep than non-II groups; $p < .0001$. The individual group differences when graphed (see Figure 13.17) were most apparent in the initial few days of the intervention and the final few days although peaks in time to sleep in the control group on Days 9, 11, and 14 also showed a high contrast with the II group. Compared to the II group, the combined AR/II group more closely matched that of the control except at the start and end of the intervention as well as on Day 5 and on Days 10-11.

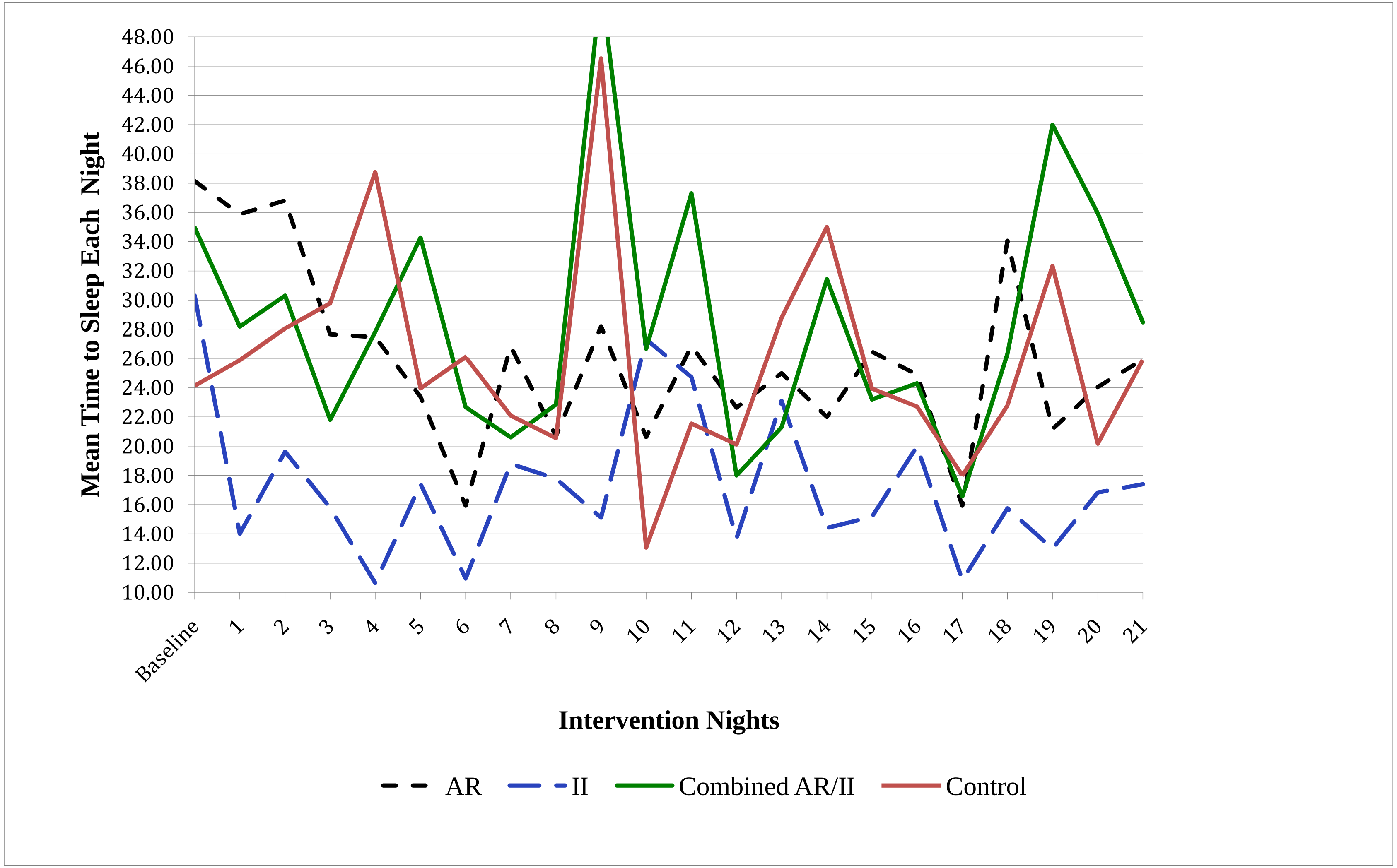

Figure 13.17 **Line Graph Showing Mean Time to Sleep Each Night (AR = Arousal Reduction Imagery, II = Implementation Intentions Imagery)**

Frequency of waking during the night also showed a contrast in the daily trend between the II group and the control (see Figure 13.18). The differences were most pronounced on Day 4 and between Days 13 and 15. Both the control and the II group showed a reduction in the frequency of night-time waking by Day 19 with the trend heading downwards for both groups; although the reduction was more dramatic for the II group. Frequency of waking during the night was not recorded at baseline.

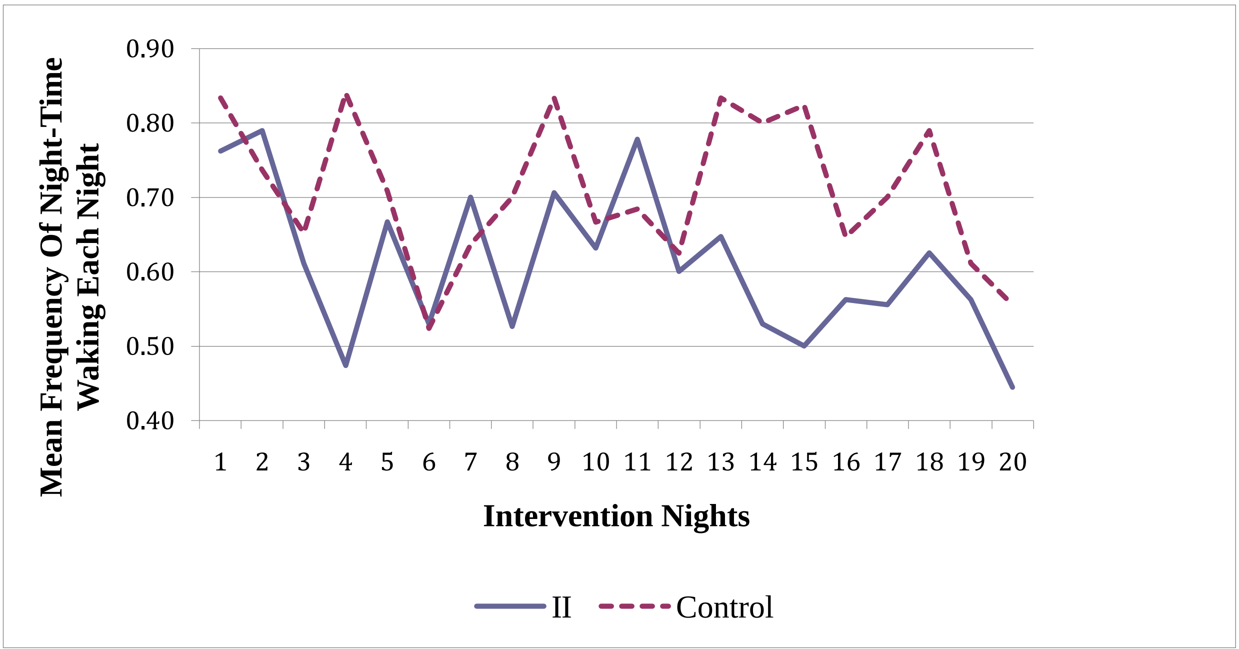

Figure 13.18 **Line Graph Showing Mean Frequency of Waking Each Night (II = Implementation Intentions Imagery)**

There was also a significant AR X II interaction effect for the use of stimulants within 2 hours of going to bed (see Figure 13.19). Simple effects analyses suggested combined effects in that the interaction for stimulant use was associated with the AR imagery ($p < .01$) and the II imagery ($p < .05$) and with groups using AR and II manipulations reporting a higher intake of stimulants before bed relative to the control group. The daily trend for the AR groups suggested the greatest differences compared to control were on Days 4, 7, 11, 14, 18 and 21, whereas the difference between II groups and the control seemed the most pronounced on Days 4 and 14. No other significant AR or II group effects for daily measures were observed. In short, analyses of the daily data show significant support for the use of II imagery as this type of imagery helped with improving sleep quality, reducing the time taken to get to sleep and reducing the frequency of waking during the night.

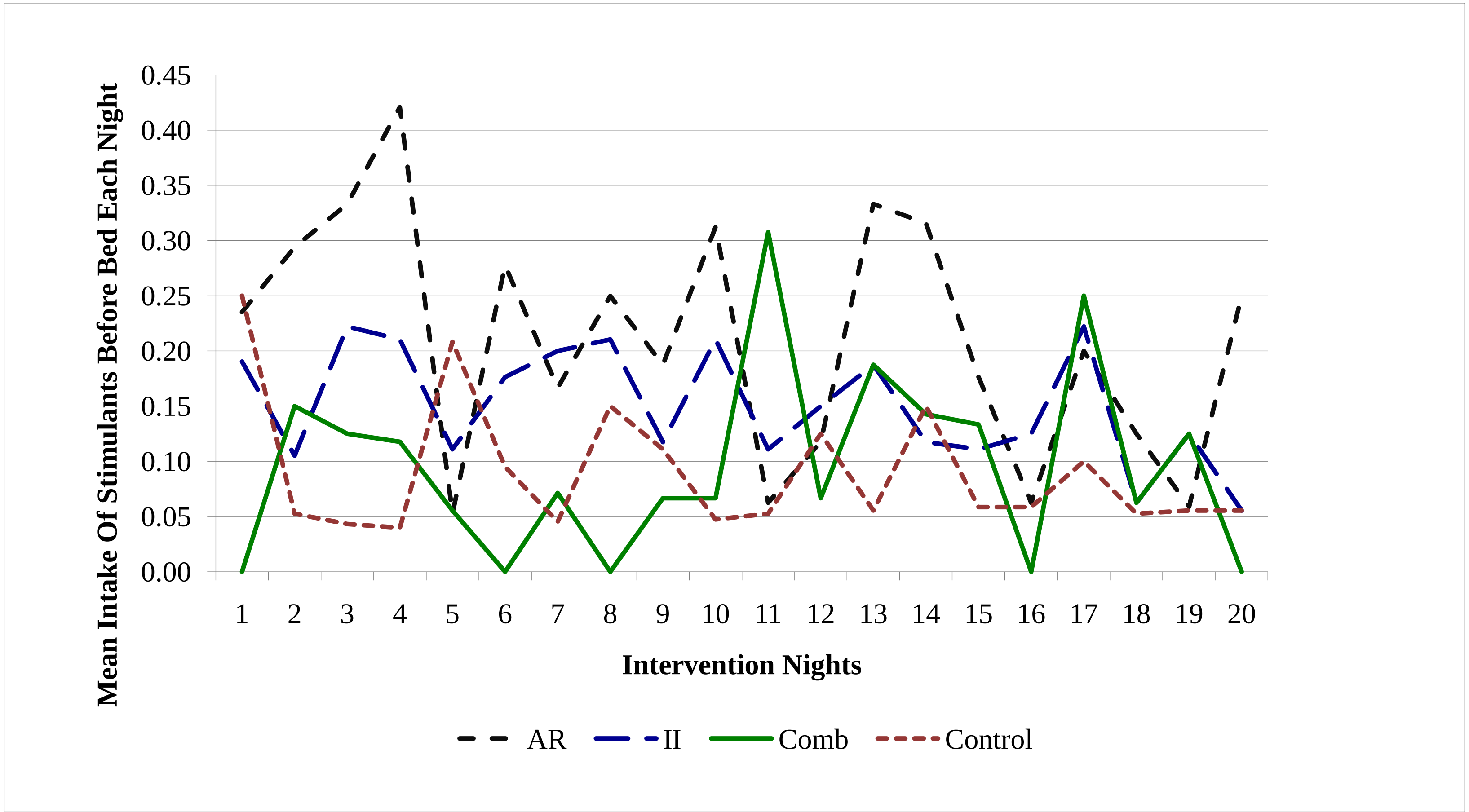

Figure 13.19 **Daily Stimulant Use (AR = Arousal Reduction Imagery, II = Implementation Intentions Imagery)**

Summary of Results

In short, findings from the three intervention studies are mixed. In the main intervention study, the II groups showed significantly greater improvements in the targeted behavioural indicators (e.g. sleep self-efficacy, sleep response-efficacy, time of lights out, sleep-related planning and sleep imagery action) as well as group differences with greater reductions in negative sleep habit frequency and negative sleep habit strength. Analyses of the daily data were further supportive of the II imagery manipulation. For example, the II groups had a significantly higher sleep quality, a faster time to sleep and less during the night waking than other groups. However, the AR groups failed to show greater improvements in levels of sleep motivation or pre-sleep arousal levels as anticipated. The only combined effects from the AR and II imagery were an increase in stimulant use each night yet a milder increase in alcohol intake relative to the other groups. The control group in contrast showed the only significant decrease in dysfunctional sleep beliefs. Analyses of the secondary outcome measures of the health behaviours revealed greater improvements in the II groups over other groups for exercise. However, no associations were found with overall PSQI scores so improvements were likely a result of improvements in sleep quality as predicted. A more detailed discussion will follow to explain why these results may have occurred, comparisons made to similar studies, and whether the conditions for the sleep self-regulation model were met.

CHAPTER 14 DISCUSSION STUDY TWO

Following two intervention development studies, the main randomised controlled trial (RCT) assessed the independent and combined effects of two imagery strategies; imagery focused on arousal reduction imagery (AR); and imagery focused on implementation intentions (II) designed to improve sleep-related behaviour by linking the context with the appropriate actions. Results from the main intervention study showed the potential in using implementation intentions to improve sleep-related behaviour in daytime employees with some improvements in perceptions of sleep quality each night also found. However, imagery techniques designed to reduce pre-sleep arousal levels still require further refinement. Nevertheless, the significant effects of the II imagery provide partial support for the second boundary condition of the sleep-self-regulation model. This chapter will discuss the results from the two intervention development studies and the main RCT in more detail with a focus on the RCT. These discussions will be guided by the framework of the developed sleep self-regulation model.

Group Differences in Sleep and its Related Behaviour as a Result of the Imagery Based Intervention.

Recently, there have been calls for further behavioural RCT, with individual components thought to be best understood when compared both separately and together against a control (Michie & Abraham, 2004). The first intervention development study combined motivational imagery with the AR imagery and compared this combination to II imagery and a control group. The second intervention development study and the main RCT compared two types of strategies (AR imagery and the behavioural strategy of II imagery) delivered via audio and written instructions) against a control group (with the control group using a neutral imagery exercise delivered in the same way). To examine whether a focus on AR and motivational imagery, mental imagery of II for sleep initiation behaviours, or the combined effects from both of these strategies were more effective in improving sleep, each component is discussed separately then together.

Combined Effects from the Motivation, AR and II Imagery

Based on past evidence (e.g. Morawetz, 1989; Verbeek, et al., 1999), the primary hypothesis was that combined effects from the AR and II imagery would achieve more success in preparing the body for sleep than either technique alone. Yet no interaction effects were found that suggested the combined AR/II intervention group reported greater improvement in sleep quality or sleep-related behaviour than the other three groups. Other studies have reported mixed results regarding the improvements made by combining arousal reduction and behavioural based strategies. For example, Pallesen and colleagues

(2003) conducted an intervention study designed to treat sleep deprivation in older adults (60 years and over) but found no support for the combination of relaxation and stimulus control over one of the treatments alone. However, the relaxation component used by Pallesen and colleagues also had sleep hygiene education which is the basis of stimulus control therapy. In addition, the relaxation treatment focused on the physical aspects of relaxation. In contrast, cognitive/emotional AR strategies were used in the current study in order to avoid the intrusive thoughts associated with high pre-sleep arousal (K. J. Harvey & Espie, 2004). Moreover, the relaxation strategy used in the current study (AR) was assessed in isolation and was found to lack effectiveness in reducing levels of pre-sleep arousal.

Another study found combining AR techniques with behavioural strategies resulted in sleep quality showing greater improvements than using either technique separately (Jacobs, et al., 1993). A meta-analysis also suggested that multi-component psychological interventions may produce results that are comparable to single-therapy component treatment (Morin, et al., 1994). It is possible that contradiction of the current findings with this research was a result of cognitive demand being too high in the combined AR/II group with all the images the participants had to process. In turn, this increased cognitive load may have interfered with the imagery designed to encourage sleep-related behaviour that initiates good sleep. In the first descriptive study, higher cognitive demand showed associations with problematic sleep-related behaviour (e.g. a later time of lights out). Yet the combined AR/II group did not appear to be specifically worse off for sleep-related behaviours. The second and more likely possibility is that the AR images contributed to the lack of combined effects. Results suggested that the inclusion of AR imagery with the II imagery did not show any greater improvement in sleep self-regulation than was found with the II imagery alone. Therefore, in addition to finding a better way to manage the increased cognitive load from the combined AR and II images, it is important to understand why the AR imagery may have been ineffective.

The Components: Motivational Imagery, Arousal Reduction Imagery and the Effects on Pre-Sleep Arousal

Motivation to improve quality of sleep was initially targeted in the AR groups to ensure participants were motivated enough to take the steps needed to reduce arousal prior to sleep. However, the increase in arousal levels in the AR groups in the first intervention development study suggested that the motivational technique used was counterproductive. The decrease in pre-sleep arousal levels in the AR groups when the motivation strategy was removed (i.e. in the second intervention development study), further suggested that sleep motivation may have been a cause of high pre-sleep arousal levels. Results of the two intervention development studies and the main RCT indicated that poor sleep quality was not due to a lack of motivation (levels were already high at baseline) and so this type of manipulation was not necessary. Related research shows that high motivation to get quality sleep is a primary contributor to the hyper-arousal seen in people with chronic insomnia (Altena, Van Der Werf, Strijers, & Van Someren, 2008). Although the current sample were thought to be sleep-deprived through choices made rather than constituting a clinical sample, high sleep motivation nevertheless seemed to be detrimental to sleep quality. Thought intrusions arising from trying to suppress undesired negative thoughts associated with sleeping can cause increases in arousal levels (Beevers, Wenzlaff, Hayes, & Scott, 1999). Therefore, asking participants to imagine sleeping well could have triggered negative thoughts that in turn lead to the high arousal levels. The second intervention development study achieved somewhat more positive results from testing AR on its own against the use of II (i.e. pre-sleep arousal levels showed a general decrease even if the decrease was not more pronounced in the AR groups). Therefore, the main RCT continued to use only arousal-reduction focused imagery as the comparison. It was also important to determine the effects of the AR and II manipulations first without the complexity of introducing the third measure of motivation.

In support of the developed sleep self-regulation model, pre-sleep arousal levels were associated with higher overall PSQI scores at baseline and final follow-up indicating greater sleep difficulty. This finding lends support to the argument that pre-sleep arousal levels is a primary contributor to sleep difficulty (Morin, et al., 2003). Anxiety levels have been identified as one of the primary contributors of overall arousal levels (Akerstedt, Kecklund, & Axelsson, 2007). The present study provided additional empirical evidence for this link since anxiety levels were significantly and positively correlated with pre-sleep arousal levels at baseline and at follow-up assessment of the main RCT. Significant time effects showed that anxiety levels were higher immediately following the initial imagery practice session which suggested that there was a short-term increase in arousal levels as a result of the imagery manipulations. However, the significant decrease overall to below baseline levels at the three week follow-up assessment suggested that imagery manipulation may have worked to eventually reduce anxiety levels generally. Early experimental research also pointed towards an initial increase in arousal from emotion-based imagery but a decrease over time (Acosta & Vila, 1990; Lang, Levin, Miller, & Kozak, 1983).

Anxiety levels were assessed post-practice as a way of indicating whether arousal levels were different in the AR groups as a result of the imagery manipulation based on these findings as it was anticipated that these groups would then show a reduction in arousal levels with practice. The absence of significant AR X Time effects for anxiety at immediately post-practice or at follow-up assessment suggested that contrary to expectations, the AR imagery was not more effective at reducing arousal levels than the II manipulation or the control. Evidence for the use of relaxation strategies designed to reduce arousal alone is mixed (Buysse, et al., 2006; Floyd, Falahee, & Fhobir, 2000; Katz, 1979; Pallesen, et al., 2003). Nevertheless, the existing literature (Brosschot, et al., 2005; Morin, et al., 2003; Tang & Harvey, 2004; Teigen, 1994) and the associations found in the main RCT between PSQI scores and pre-sleep arousal levels, suggest a need to address the levels of pre-sleep arousal in future interventions aimed at improving sleep quality.

The Components: Implementation Intentions Imagery and the effect on Sleep-Related Behaviour

Relative to the groups not using II imagery, the II groups had greater reductions in the frequency of negative sleep habits (e.g. thinking and planning and worrying in bed) and greater improvements in the sleep-related actions (e.g. following a bedtime routine prior to going to bed) targeted in the II imagery exercise. Repeated measures ANOVAs also showed that the II group were the only intervention group to show a significantly earlier bedtime compared to control. The use of II has previously been successful in a range of health interventions (e.g. Holland et al., 2006; Orbell, 2007; Sheeran, Aubrey & Kellet, 2007; Sheeran & Silverman, 2003) although, to date, the three intervention studies were the first studies to extensively test the use of II with sleep-related behaviour. One explanation for why using the II strategy was successful in improving the sleep self-regulation process may be that this intervention was more likely to affect the level of detail in one's planning for pre-sleep behaviours. Implementation intentions are thought to work by activating the mental representation of the situation by increasing the level of the detail in the planning of the situation so cues to action when in that situation become more accessible (Gollwitzer, Fujita, & Oettingen, 2004). In turn, when a person encounters the 'real life' situation they are more easily able to attend to what they should be doing despite possible temptations to engage in behaviours which could compromise the quality of their sleep. For example, a person could engage in an appropriate bedtime routine to help relax instead of going straight to bed and then spending time thinking, planning and worrying about the task worked on prior to going to bed.

Detail in the level of planning for sleep was measured as a way of assessing whether the II imagery manipulation was working. Mean level of sleep-related planning was low at baseline showing around a third of the total possible score. The level of detail in planning for sleep-related behaviours was higher at 3-week follow-up assessment in II groups than non-II groups which suggested the imagery manipulation was working. Moreover, sleep-related planning at post-practice was significantly associated with sleep actions at follow-up assessment and was also significantly higher in II groups than non-II groups. This finding showed that the improvement in planning in the II only group also led to a greater likelihood that sleep appropriate behaviours would occur. Evidence suggests that practising mental imagery of the desired action can facilitate implementation of that actual behaviour (Driskell, et al., 1994).

Moreover, research using imagery to deliver process planning (similar to II) has shown the strategy to be particularly useful for implementing plans, especially when targeting a health behaviour which requires a number of intermediate steps to be taken to achieve it (Armitage & Reidy, 2008; Chan, 2008; Milne, Orbell, & Sheeran, 2002). In some of these studies the motivational or combined strategies were found to be superior (Milne, et al., 2002) where in other studies (Armitage & Reidy, 2008)outcome simulations (similar to the motivational strategy used) had no effects on changing behaviour. In the current set of intervention studies the II group were more likely than the motivational group, the combined group, or the control group to carry out positive sleep-related actions. It was suggested that implementation intentions or process type imagery may be more successful when it incorporates time cues. In the current research there was a strong emphasis in the II groups on visualising the appropriate time to go to bed and on organising ‘real’ sleep-related behaviours accordingly. Based on the success of using these time cues, future research should continue to incorporate time cues when supporting behaviour change.

The success of II imagery for improving sleep-related behaviours was also shown by the results from mixed model analysis of the daily data, which revealed that participants using II imagery showed greater improvements in sleep quality, greater decreases in time to sleep and greater decreases in the frequency of waking during the night compared to other groups. It is interesting that group differences in subjective perceptions of improvement such as sleep quality were only found with the daily data and not in the repeated measures ANOVAs from baseline to follow-up assessment. It is likely that the changes in sleep-related behaviour are more stable than perceptions of sleep quality which explains why group differences were found without taking into account the daily variance. In support, evidence suggests that sleep-related measures such as sleep quality and quantity show greater variance in predicting daytime sleepiness than habitual behaviours (e.g. caffeine and alcohol consumption) (Pilcher & Ott, 1998).

The fact that the II group had significantly greater reductions in the strength and frequency of negative sleep habits than the other groups was somewhat unexpected considering that the imagery was not directly targeting these behaviours and changing habitual behaviour using II is argued to be more difficult (W. Wood & Neal, 2007). Some evidence does show the utility in using II to improve negative sleep-related behavioural habits as suggests the II strategy is effective to break habitual behaviour if used correctly (e.g. Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 2000). Irregular and negative sleep habits (detrimental to good sleep) may have been replaced by new and regular habits conductive to better sleep quality. In support, it has been suggested that disturbances of behavioural circadian rhythms are similar to biological rhythms in that when out of sync, result in poorer sleep quality (e.g. Monk, et al., 2001; Monk, Frank, Potts, & Kupfer, 2002; Monk, Reynolds, Buysse, DeGrazia, & Kupfer, 2003).

Other evidence also supports the argument that habits form in stable contexts and when the behaviour occurs on a daily or short-term basis (Ouellette & Wood, 1998). Although sleep-related behaviour occurs regularly, it may be that for individuals who do not sleep well the context is unstable (differing times or environments) and so prevents habit formation and results in high pre-sleep arousal levels. Therefore, rather than making active attempts to reduce pre-sleep levels, high arousal may naturally reside once a strong plan is in place and behaviours become habitual. The most frequent negative sleep habit reported at both baseline and final follow-up was that the person thought, planned or worried when they were in bed, a habit that is also closely tied to arousal levels. As this self-reported habit is near the time where a person may have difficulty sleeping the person may be more likely to report it because of the close association. Research has also shown worry to be one of the most common self-identified causes of sleep deprivation (Kelly, 2002; Watts, Coyle, & East, 1994). Therefore, the importance of investigating the remaining lower frequency negative sleep habits should not be ignored.

Effects of Improving Sleep-Related Behaviour on Other Health Behaviours

Other health behaviours (thought to be linked to poor sleep quality) measured to identify indirect benefits of the intervention included smoking status, alcohol intake, diet and exercise levels. Initial investigation of these behaviours showed smoking status scores were already low at baseline with the majority of participants being non-smokers. Alcohol levels were also already well below the alcohol advisory guidelines for short-term levels of safe drinking at baseline and at follow-up (Bondy, et al., 1999). Although diet also appeared to be adequate at baseline (Swinburn, Caterson, Seidell, & James, 2004), exercise levels were relatively low compared to previous research (Hagstromer, Oja, & Sjostrom, 2006; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Therefore, aside from a lack of exercise, the population across all three intervention studies seemed to be relatively healthy.

No significant associations were found between these health behaviours and PSQI scores at follow-up assessment which was expected given that the sample appeared to be relatively healthy. Moreover, existing evidence on the link between sleep quality and health behaviour is also mixed (Atkinson & Davenne, 2007; Burgard & Ailshire, 2009; Werch, et al., 2007). Significant II X Time and AR X II X Time interactions were found in exercise level and alcohol consumption respectively however. First, at follow-up assessment, exercise levels and sleep self-efficacy had significantly increased in the II groups relative to non-II groups. Sleep-quality also showed significant II X Time effects in the mixed model analyses of the daily data. Although the intervention studies targeted sleep self-efficacy specifically, self-efficacy in general has been associated with the regulation of multiple health behaviours (for a review see Schwarzer & Fuchs, 1996). Therefore, measurement of health behaviours, sleep patterns and appropriate domain specific measures of self-efficacy on a daily basis may demonstrate the indirect effects of improving sleep on behaviours like exercise. Moreover, when sampling relatively healthy populations such as the current non-clinical population of sleep deprived employees, daily data analyses may provide enough specificity to detect associations between health behaviour and sleep patterns not otherwise found. Therefore, using daily data to analyse the relationship beween sleep and other health-related behaviours may also help to resolve the current confusion in the existent literature on sleep and health behaviour.

Second, an unexpected AR X II X Time interaction was found that suggested that the increase in alcohol intake over the intervention period was smallest in the combined AR/II group relative to other groups. One explanation is that using the AR and II strategies together required more effort which in turn made the person more conscious of all their health-related behaviours. Evidence suggests that alcohol intake is reduced when an effort is made to maintain other health behaviours although these health behaviours (e.g. exercise and diet) were not affected by the general exertion of effort (Birkimer, et al., 1996).

Unlike exercise levels, daily intake of alcohol was measured to some extent by asking participants to report whether they consumed stimulants within 2 hours of going to bed. However, the findings here were contrary to expectation as suggested that on a daily basis, participants who experienced the combined effects of the AR and II imagery manipulations were taking more stimulants within 2 hours of going to bed. It is suggested that alcohol can also be classified as a stimulant and many individuals see it in the stimulant category (H. J. Little, 2000). Nevertheless, it is possible that the difference in findings are again due to the measurement of alcohol only at baseline and follow-up assessment compared to stimulant use which was measured on a daily basis. Therefore, further investigation into the combined effects of the AR and II imagery on alcohol and stimulant consumption with both constructs assessed daily is needed.

General Improvements Found in Sleep-Related Indicators

Pittsburgh Sleep Quality Index (PSQI) scores indicating greater sleep difficulty were high at baseline in the two intervention development studies as well as the main RCT thus supporting the need for an intervention study. Following modifications to the AR and II strategies from the first intervention development study, the second intervention development study and the main RCT demonstrated lower PSQI scores at follow-up assessment (at the end of the 21 day intervention period) than at baseline in all groups, including the control. Previous studies have shown the PSQI to be a valid and reliable indicator of sleep difficulty (Atlantis, et al., 2006; Backhaus, et al., 2002). The current study shows that PSQI scores can also reflect change as a result of a sleep self-regulation intervention even with the neutral imagery strategy used for the control group.

In the main RCT, like PSQI scores, perceptions of sleep quality also showed overall significant improvement during the course of the intervention. However, there were no Group X Time effects to suggest a greater improvement at follow-up assessment in any one group over control. Sleep quality is argued to be one of the areas most sensitive to changes in perception of improvement (Vincent, Penner, & Lewycky, 2006). Therefore, some of the improvements in sleep quality such as perceptions in the control group may be attributed to the placebo effect of having participated in the intervention. Mixed model analyses which accounted for daily and individual differences and so allowed for greater specificity in detecting change, showed that the II groups experienced the greatest improvements in sleep quality.

Overall time to sleep appeared to be long enough to indicate sleep difficulty at baseline with mean scores in the AR and II groups close to the 30 minute cut-off for sleep difficulty that is recommended by the authors of the PSQI (Buysse, et al., 1989). A significant time effect was found with time to sleep decreasing from baseline to follow-up assessment to well below this recommended bench-mark for all groups. This suggests that most people experienced less difficulty falling asleep as a result of the intervention, including participants in the control group. Mixed model analyses of the daily data also suggested that time to sleep showed the most improvement in the II groups. The group differences found at the daily level again supports the use of daily data to truly capture intervention effects on sleep patterns.

Time of lights out was also found to be significantly earlier at follow-up in the II groups compared to non-II groups. As time of lights out is a behavioural indicator and targeted specifically in the II imagery, it may explain why it was the only primary sleep indicator to show group differences in the repeated measures ANOVAs. Nevertheless, this result does suggest that the mental imagery targeting an earlier time of lights out in the II groups was effective as suggested that participants followed through on the action of going to bed that was visualised.

Total hours of sleep at baseline was below the 7 hours recommended as being adequate to meet needs for most of the population (Hasler, et al., 2004; Pilcher, et al., 1997). The total hours of sleep increased significantly over time in all four groups although no one group showed significantly greater changes than another. Moreover, the average hours of sleep remained under 7 at follow-up assessment which suggested that hours of sleep could still be increased further. Nevertheless, it is possible that the hours reached by participants were personally adequate, even though they were below the recommended 7 level. It may also be that sleep length was extended by being less broken so was more likely to meet personal needs (Akerstedt, Hume, Minors, & Waterhouse, 1994).

Of the sleep-related measures, time of waking was the only measure to not show a significant change in the repeated measures ANOVAs. It is possible that time of waking may be more socially controlled due to the need to be at work at a certain time so may be less amenable to intervention. Time of waking is also thought to be more affected by anticipatory stress (Brosschot, et al., 2005) which results from concern about future events. As the current intervention was focused on reducing arousal generated from existing stress (caused by the previous day's events), it may not have addressed the type of stressor needed to affect time of waking.

Effect of Arousal Reduction and Implementation Intentions Imagery on Intention for Sleep-Related Behaviour

In the first study of this thesis, the sleep-relevant cognitions test (SRCT) proved to be a valid sleep-related outcome measure. The purpose of the three intervention studies was to assess whether the measure could also reflect effects of active manipulation of sleep self-regulation. In line with predictions, the combined AR/II group showed significantly greater improvements in intended time of lights out relative to other groups (as indicated by the results of analysis of the SRCT). Participants in the combined AR/II group may have focused on the time imagery (intended time of lights out) as it was the most easiest image to picture given they had to form mental images relating to both AR and II manipulations and probably experienced the highest cognitive load from doing so. It is believed that when there are multiple messages, and particularly if the messages are different, attention will be limited to the simplest form of the imagery (Smith & Shaffer, 2000) which in this case was time.

Other behavioural intentions such as following a routine prior to bed, screen use (computer and television viewing) prior to bed, finishing a work-related task, and postponing or cancelling planned exercise were also reported using the SRCT, yet getting ready for bed was the only behaviour to show a significant difference. Results indicated that this behaviour, targeted most directly by the II images showed a greater increase in the II groups than the other groups. This result shows how mental imagery of a particular action or action series can later affect intention for that action. Future examination of sleep-related behaviours identified in the SRCT and their manipulation should provide further opportunity for effective sleep-self-regulation.

Relationship of Mental Health Measures to Sleep-Related Indicators

Depression levels were also measured at screening with a moderate rating being reported by most participants (around a third of the total possible score) in the main RCT. It is also noted that three people were excluded from this main RCT by having high depression scores at screening (over 24). The reason for the exclusion of these outliers is that results changed significantly when the participants were removed from the analyses. As supported by past research (e.g. De Gennaro, et al., 2004; Hall, et al., 2000), depression scores also showed strong positive correlations with PSQI scores indicating greater sleep difficulty in participants who were depressed.

Perceived stress levels were lower at final follow-up overall than they were at baseline. A positive association was also found between perceived stress levels and PSQI scores at final follow-up. Therefore, it could be argued that AR and II imagery manipulations reduced perceived stress levels through less sleep difficulty (as measured by the PSQI). Nevertheless, the lack of intervention group differences over control for these measures means further empirical research is needed to test this theory.

Fatigue levels were another measure relating to sleep that was assessed but as a secondary outcome. Results revealed that although fatigue levels seemed lower at the follow-up assessment than at baseline, the change was not significant. Fatigue is a complex construct (Clarkson, Hirt, Jia, & Alexander, 2010; Lichstein, Means, Noe, & Aguillard, 1997) and so measurement devices used may not have been adequate to detect change as a result of the intervention studies. Moreover, perceptions of fatigue were not directly targeted in the intervention so any outcomes relating to fatigue were considered to be of secondary interest.

Change in the Control Group as a Result of Imagery Manipulations

The purpose of including a control group was to assess the effect of the active manipulation of the AR and II techniques while allowing for practice effects from using the imagery and improvements in sleep from completing daily records of sleep-related behaviour. This control group was expected to show some improvement from using the imagery and completing the recordings but not as much as the groups using the active manipulations. As expected, across the four groups (i.e. AR, II, combined and control) improvements were found for many of the sleep-related outcome measures. What was unexpected was the improvements seen in outcomes (e.g. sleep-related planning) that could be classified in the action phase of self-regulation according to the developed sleep self-regulation model. The strategy of using II was designed to specifically target this action phase and is suggested to be more effective than concentrating on just the final goal alone (Sheeran et al. 2005; Sheeran & Silverman, 2003). It is therefore unclear why the control group showed improvements in this action phase of sleep self-regulation when they only knew of the final goal of trying to improve their sleep. It is possible that although the control group did not receive instructions on how to form plans for sleep-related behaviours, such plans may have formed spontaneously as a result of practicing the mental imagery. In support, mental simulations are thought to generate planning for the imagined actions (S. E. Taylor & Pham, 1996).

The impact of behavioural self-awareness on sleep self-regulation may also be acknowledged through keeping daily recordings (of which all four groups were asked to do). A number of participants (including those in the control group) reported that the intervention helped to raise awareness of their sleep related behaviour largely because of the daily recordings. Sleep diaries are often used alongside other treatments as a tool for measurement, as the act of recording allow the individual to recognise how specific behaviours may create or exacerbate arousal known to interfere with sleep (Harris, et al., 2007; Strom, et al., 2004). For example, a person may be less responsive to behavioural cues for going to bed through their lack of behavioural self-awareness. Also, by engaging in behaviours like communicating online with someone located in a country where it is not time to go to sleep, external cues may further discourage positive sleep-related behaviour. By asking each participant to keep a daily record of sleeping patterns and behavioural detrimental to sleep quality, greater self-awareness may be achieved. In turn, the awareness may have led to the modification of these maladaptive behaviours which could ultimately result in an increase in sleep quality. As argued by the developed sleep self-regulation model, appropriate appraisal of sleep quality may then guide future perceptions of threat or challenge as well as future sleep-related behaviours.

Asking participants to keep daily records may also have acted as a self-regulation reminder and so may have further contributed to improvements in sleep self-regulation. A recent study showed reminders can be effective in improving self-regulation (Sitzmann & Ely, 2010). Self-regulation prompts may also affect learning on future self-regulatory activity so can explain why attrition rates were lower than expected for the control group (Sitzmann & Ely, 2010). Even if participants in the control group were not taught specifically which strategies to follow, a reminder to make an effort to sleep well could have had unexpected effects on sleep self-regulation.

Attrition

Overall, attrition rates were relatively low for the three intervention studies with more participants practicing the imagery using the written instructions than the recording. As in the first study of this thesis, the low attrition rate may be attributed to the use of emailed surveys making for easy completion as well as acting as a strong reminder to keep practicing the imagery. The use of internet and email has previously been used to deliver health interventions (Franklin, Rosenbaum, Carey, & Roizen, 2006; Kaipainen, Mattila, Kinnunen, & Korhonen, 2010) and may be a cost-effective way to improve the health of employees. Promoting motivational intentions and II through the use of email messages also proved to be successful in improving undergraduate student motivation to study, study habits and academic achievement (Kim & Keller, 2008). In the current study, the daily results revealed that frequency of practice was significantly higher on Day 1 than the other days and significantly lower on Day 4. The higher frequency of practice on the first day was attributed to participants being introduced to the study the day before causing high levels of motivation and willingness to try the exercises at least once. The significantly lower levels of practice on Day 4 may have been due to a break in the routine that day being a Monday for most participants (having started the study the previous Wednesday) and experiencing a two day gap in imagery practice from the weekend.

The intervention period of 21 days (including the initial imagery practice session) was chosen on the premise that it takes around this length of time to break old habits and simultaneously create behavioural change (Holland, et al., 2006; Michie & Abraham, 2004). This length of time has been found to be adequate in detecting variation in both sleep-patterns and emotions in the workplace (Scott & Judge, 2006). To test whether the intervention length was adequate, vividness of imagery was recorded. It expected that if participants had lost interest (i.e. the intervention period was too long) or if the intervention was too short, then the imagery exercises would not be perceived as vividly. Results suggested that the written imagery instructions (read within half an hour of going to bed), which were included for all groups following the second intervention development study, were rated as more vivid in the AR groups indicating that this form of delivery was appropriate for this type of exercise. It is also possible that the recorded instructions (listened to at the end of a working day) were at a time that was less practical and therefore neglected. For example, many participants may have been rushing to get home for various reasons. Also, numerous participants may finish work at different times so lack a good routine around actually playing the recording. On the other hand, the written instructions were tied in with the bedtime routine (appropriate for the II groups), and were close in time for when the AR imagery was anticipated (i.e. right before bed). The written instructions also provided a visual cue to remember to use it by being beside the bed whereas the CD could have been hidden from view through being in the computer or device used to play the recording.

However, the recorded instructions were perceived more vividly in the II groups than the non-II groups. When messages are presented through audio, distraction is more likely to be a problem since the person receiving that message has less control over the flow of information (Frey & Eagly, 1993). Yet in the II groups, images to be practiced were more concrete than the AR exercise as captured previously experienced routines and so may have helped protect the person from any distraction resulting in more efficient processing. Based on past research (Bandura, 1986), messages used in the intervention studies were designed to be broad enough to allow each participant to make the image personally relevant. This was particularly the case for the II instructions. These results point to the importance of ensuring an intervention strategy is practical and personally relevant as this type of intervention is more likely to be remembered.

Limitations of the Intervention Studies

The two intervention development studies conducted prior to the main RCT in addition to the main RCT have contributed to the understanding of the sleep initiation process by highlighting how successful II strategies can be in improving sleep self-regulatory behaviour. Concerns about the findings should be explored to help explain some of the unexpected results. Limitations of the current studies concerned the inclusion of participants who may have had undiagnosed insomnia and potential biases inherent in the use of self-reported data.

Insomnia is largely undiagnosed in the general population (Drake, et al., 2003; Morin, LeBlanc, et al., 2006) so some participants may have failed to indicate they suffered the condition at the start of the study. These participants may, in turn, have been less likely to respond to intervention manipulations (e.g. AR imagery) than individuals who were sleep deprived through lifestyle choices. For example, research suggests that individuals with insomnia also show differences in arousal levels and vigilance compared with individuals who may be just sleep deprived (Altena, et al., 2008). Manipulations to reduce arousal levels was relatively ineffective (i.e. AR imagery did not seem to show any significant benefits over II imagery) so participants with undiagnosed insomnia may have compromised the final results. Findings from an earlier study using AR and behavioural strategies similar to the strategies used in the current research (stimulus control) also showed that effects of treatment were reduced in individuals with clinical insomnia (Morawetz, 1989). A record was made of participants who had indicated having been diagnosed with insomnia by their doctor. However, as there was no difference in baseline levels of PSQI scores between these individuals and the rest of the participants, their data was included in the final analyses. Nevertheless, more care should be taken to screen out insomnia in future self-regulation interventions designed to reduce sleep deprivation in the general population. One way to distinguish these groups more effectively in the future could be to include a measure of sleep effort (e.g. Broomfield & Espie, 2005) as this is suggested to be the primary factor that distinguishes these two groups (Broomfield & Espie, 2005; Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006; Watts, et al., 1994).

The second limitation concerns the collection of the data through self-reported questionnaires which may have led to inherent biases in the results. For example, as the sleep quality data was self-report it could be argued that the sleep improvements were under-reported (Vincent, et al., 2006). Yet, perceptions of sleep quality have demonstrated a greater influence on daytime functioning than more objective measures (Buysse, et al., 2006). Also, point estimates of sleeping and the type of measure used in the current study, are particularly susceptible to self-report biases from the memory distortions created by time lags (Gehrman, et al., 2002). As sleep-deprivation is known to negatively affect memory processes the distortions may have been compounded in this type of population (Harrison & Horne, 2000a). However, within individual improvements (and particularly in the II intervention groups) in sleep quality, time to sleep and frequency of night-time awakenings were found in the mixed model analyses. These analyses were less affected by memory distortions as were reported soon after the previous night's sleep. Therefore, it is likely that improvements in sleep self-regulation were at least in part due to the active manipulations of the intervention studies.

Summary

The three intervention studies suggest that although influences on sleep are complex, improvements in sleep self-regulation can be achieved with II and can also lead to improvements in perceptions of sleep quality at a day-to-day level. For example, in the main intervention II groups showed significant improvements over other groups in sleep-related planning, sleep self-efficacy and the targeted sleep-related actions as well as a lower frequency of negative sleep habits overall. Significant improvements in perceptions of sleep quality, faster times of falling asleep and less during the night waking at the daily level were also found compared to other groups. Through these effects the second boundary condition of the sleep self-regulation model was partially supported in that the II imagery exerted effects but the AR imagery strategy did not. Nevertheless, use of the AR imagery manipulation without the motivational imagery and the inclusion of an extra imagery practice may have added to the success of the main RCT compared to the two intervention development studies. Further improvements could be made through the introduction of alternative emotive and cognitive regulation strategies. The following chapter discusses new directions for research from these combined studies and highlights the overall contribution of the thesis to the understanding of sleep self-regulation.

CHAPTER 15 GENERAL DISCUSSION

Sleep is a complex behaviour and the potential causes of not sleeping well are multiple. Through the development and testing of the sleep self-regulation model, insight has been provided on some of the key cognitive, emotional and behavioural factors theorised to be associated with sleep deprivation. The two intervention development studies and the main randomised controlled trial (RCT) that were guided by this model demonstrated the utility of implementation intentions imagery for installing appropriate sleep self-regulatory behaviour. Some important contributions to understanding the sleep initiation process have been made. Importantly, the conditions required for the support of the sleep self-regulation model have been met. However, the current research has also raised some important questions and future refinement of the sleep self-regulation model is recommended. This chapter will discuss these key directions for future research.

Implications and Future Research from Study 1: Online Descriptive Study to Evaluate the Self-Regulatory Processes of Sleep in Response to Work

To understand how self-regulation of sleep-related behaviour in response to work-related influences can affect sleep quality, a longitudinal online study was conducted with full-time daytime employees. The complex nature of the first study, a necessity when investigating sleep, provided a detailed account of self-regulatory processes using multiple methodologies. For example, the statistical approach of mixed model allowed individual and group daily variances to be controlled providing a deeper understanding of how work-related demand, cognitions and emotions can differentially affect sleep patterns. Additionally, through the development of the Sleep-Relevant Cognitions Test (SRCT), an approach has been forged that uses narrative to measure behavioural intention in personal environments. In this way, text based on a written scenario has been used as a predictor of intention without being an experimental manipulation. Contributions from this first study will be discussed next along with questions raised as a result of the research.

Measurement of the Interaction of Sleep Patterns and Work-Related Influences at the Daily Level

The workplace can be a complex and demanding environment with multiple influences affecting individuals and their sleep patterns in a variety of ways. For example, work-related cognitive and emotional demands seemed to directly impact time of lights out but in opposite directions. Greater cognitive demand led to a later time of lights out whereas greater emotional demand was associated with an earlier time. A methodological strength of this first study concerned its online delivery of daily surveys which allowed multiple recordings of work and sleep-related data over an 11 day period to be assessed. A previous study investigating the relevance of events to life tasks in female college students had demonstrated higher accuracy in reporting using daily experiences than at the pre-post assessments (Cantor, et al., 1991). The current research extended this approach by showing that daily experiences in the workplace, can affect sleep-related behaviour outside of it. The mixed model approach used in the current research examined which work-related variables emerged as the key predictors of self-reported sleep quality as well as other indicators of quality sleep (e.g. willingness to stay up late, pre-sleep arousal, etc). Mixed model analysis is argued to be superior to repeated measures ANOVAs as accounts for individual and group daily variation in the data while reducing potiential bias from missing data and outliers (Gueorguieva & Krystal, 2004). Future sleep-related research should continue to monitor changes in patterns at a daily level to ensure that accuracy in self-report is maintained.

In developing the Copenhagen Psychosocial Questionnaire (Kristensen, et al., 2005), Kristensen and colleagues have identified a number of work-related influences that may also affect sleep patterns. For example, the study of the influence of others on our sleep is gaining interest with exciting new approaches to studying the dynamics involved with sleep and its related behaviour (Dunham, 2007; Meadows, 2005; Worthman & Brown, 2007). Social influences from the workplace considered important by the Copenhagen Psychosocial Questionnaire include quality of leadership, social support, feedback at work, social relations and a sense of community (Kristensen, et al., 2005). Although no relationships were found between the social measure of role conflict and sleep patterns, associations with sleep patterns may have been more indirect (e.g. through its association with work-related emotions).

Results from the current online descriptive study also suggests that self-regulation of emotions resulting from work-related demands may be a particularly important area for future research to address. Contrary to expectations, positive work-related emotions seemed to lead to higher perceptions of sleep quality whereas negative work-related emotions did nothing to decrease perceptions of sleep quality or affect any of the other sleep-related indicators. This finding contrasts with research that indicated negative emotions are likely to have a greater impact on sleep quality than positive emotions (Montgomery, et al., 2005; K. J. Williams & Alliger, 1994). However, as intensity of reported emotions are thought to vary following sleep as opposed to prior to sleep (Yu, 2007), the true influence of these work-related emotions may be distorted. Through daily measurement, the current research was able to more accurately analyse how work-related emotions went on to influence the following night's sleep. Future studies should also examine the impact of future-focused cognitions on sleep and emotion self-regulation. Evidence suggests that there are differences in how people experience concern about future events (worry) versus past events (rumination) (McLaughlin, et al., 2007). Anticipatory anxiety resulting from concern about future events is shown to have physiological effects that can affect the time of waking (Brosschot, et al., 2005; Hall, et al., 2004). Yet, how this type of anxiety affects other sleep-relevant behaviours is still poorly understood. Future research could also concentrate on the anticipated consequences from work-related events that are relevant to personal goals, as results suggested conflict between these measures was associated with an earlier wake time the following morning. The nature and impact of goal conflict (e.g. conflicts between work goals and sleep goals) has often been investigated separately rather than in consideration of the self-regulation process in its entirety (for a review see Brief & Weiss, 2002). The development of the Sleep-Relevant Cognitions Test (SRCT) provided further understanding of decisions made in more personal environments. Nevertheless, a continued focus on both personal and professional environments and the effects anticipated consequences can have on alternative environments is recommended.

The primary contribution of the associations found between various work-related factors and sleep self-regulation in the first study has been that the search for more effective treatments for sleep deprivation can move beyond the clinical setting and into community-based intervention. Key work-related factors to target include reducing levels of perceived demand on the one hand and increasing the sense of meaning an employee gets from their work and positive emotions that result from the workplace on the other. Identifying appropriate work-goal motivations may also be key to helping achieve better sleep. In further application of the sleep self-regulation model, three intervention studies were conducted in order to directly target the sleep self-regulation process.

Questions generated from Study 2: an Intervention: "Using Imagery to Promote Quality Sleep"

The three intervention studies were designed to test whether addressing the motivation and action phases described in the sleep self-regulation model would prevent failure of sleep self-regulatory behaviours. All three studies provided insight into how a person may benefit from cognitive and emotional self-regulation strategies. For example, the first intervention development study showed how motivation based imagery interfered with the arousal reduction (AR) imagery process. Following improvements in pre-sleep arousal levels from the removal of the motivational imagery in the second intervention development study compared to the first intervention development study, an additional imagery practice at the point of going to bed was also added in the main RCT. A larger sample size in the main RCT also provided greater power to detect Group X Time differences. Results from this main RCT suggested that while the implementation intention (II) imagery was able to improve sleep-related behaviour, including behaviours that were not specifically targeted, the AR imagery was not able to reduce levels of pre-sleep arousal. The addition of the extra written form of imagery practice did appear to suit the AR groups better however as participants in these groups rated the written form of imagery instructions as more vivid. Along with addressing the question of how to improve pre-sleep arousal levels, the following section will discuss other key directions for future research based on the findings from these three studies.

Further Understanding the Use of Imagery

Using imagery to promote motivational and II for health behaviours is a relatively new technique although it has been used in other contexts (e.g. Chan, 2008; Pham & Taylor, 1999). Matching the cues used in the mental imagery to the physical environment is supported by the argument that II interventions tend to work through increasing one's attention to situational cues (Gollwitzer, 1999) rather than affecting participants' motivation to perform the behaviour (Sheeran & Orbell, 1999; Milne, Orbell & Sheeran, 2002; Orbell, Hodgkins & Sheeran, 1997). To test the application of II through using imagery, comparison was made to a control group that experienced sleep imagery (was asked to imagine their normal routine) but without the II imagery instructions. Although the results of the three intervention studies show the benefit of using II imagery, future comparison should still be made to other behavioural strategies that do not use imagery. To date, there is scarce research that incorporates environmental prompts in combination with II imagery strategies and virtually no studies that test the utility of doing so to promote adequate sleep. As the II only group appeared to be the most successful in improving sleep behaviour, there is a need for further research into this technique through comparison of the imagery versus actual cues.

The intervention studies also concentrated on reducing the arousal levels generated by previous demands and/or events through using imagery. Support for the benefits of reducing arousal levels for health comes from work to improve emotional regulation through writing (Pennebaker & Chung, 2007) as well as the development of treatments for phobias and panic disorders (e.g. Lang, et al., 1983). Further evidence suggests emotions are processed more effectively using images than using text or thoughts alone (A. G. Harvey & Payne, 2002). Other early studies used a distraction-based form of mental imagery (counting sheep) to improve sleep quality (e.g. Morin & Azrin, 1987). However, the distraction technique can be seen as more of a band-aid approach that did not seem to be that effective in the longer-term. Results from the current RCT used a slightly deeper level of emotional self-regulation as involved mentally putting the emotions aside for the present rather than being simply distracted with another image. However, no AR X Time interactions were found that suggested this strategy was any better than the II strategies at reducing pre-sleep arousal levels. It is possible that the intervention period of 3 weeks for the three studies was not of sufficient length to show significant AR X Time effects in arousal levels. For example, other research using a emotional regulation strategies in cancer survivors was effective in reducing distress at a 1-year follow-up (Cameron, et al., 2007). A second possibility is that the AR images which were designed to reduce arousal levels instead acted as a cue to focus on regulating one's emotion rather than reducing arousal. Future imagery interventions should be careful to not include any references to material that could increase arousal levels. It might also be of benefit to test which images work best experimentally to reduce arousal before commencing future intervention studies such as the ones conducted.

Future Attempts at Improving Motivational Levels for Sleep

As it was thought that the inclusion of the motivational focus increased arousal with higher anxiety about sleep, the motivational component was removed from the second intervention development study and was also not used for the main intervention. Yet, motivation for sleep could have been manipulated to the appropriate level rather than being removed following the first intervention development study. The Yerkes Dodson Law suggests that a mid-level of motivation is most closely tied with action (for an overview see Teigen, 1994). Therefore, if motivation levels are too high pre-sleep arousal levels may be poorly regulated leading to interference with going too sleep. On the other hand, when motivation levels are too low, sleep self-regulatory behaviours may be poorly maintained.

There is also the possibility that sleep motivation did not enhance the sleep self-regulation process because the motivator assigned in the mental imagery (i.e. sleeping well for the sake of feeling rested) did not have enough personal relevance to generate the appropriate behaviour. It has been argued that it is important to consider the personal goal structures of the individuals involved when designing interventions in order to prevent goal conflict (Maes & Gebhardt, 2000). Achieving personally orientated goals has been associated with high levels of motivation, greater task focus, formation of II and high levels of social support (Koestner, et al., 2002). To date, there has been little investigation on the interaction between health interventions and the personal lives of participants. One exception was a study that evaluated how a health intervention to reduce risky sexual behaviour could also change personal goals (Sanderson & Cantor, 1995). Findings from this study suggested that participants reduced risky sexual behaviours further when also encouraged in certain personal goal-relevant activities such as goals relating to intimacy versus identity when dating. Although there was a different behavioural focus here, these results provide support for the inclusion of personal goals to promote positive sleep-related behaviours.

Stability of the Environment Prior to Sleeping

Ensuring the context of the environment prior to sleep is stable when using the II strategy may support the formation of positive sleep-related habits (Heatherton & Nichols, 1994). For example, rather than participants starting the study at a set date it may be beneficial to plan to start the intervention at a time of their lives when little change is anticipated. In low volatile environments there is a tendency to pool resources towards a single task until its goal has been achieved so planning is relatively straightforward (Schmidt, Dolis, & Tolli, 2009). In more volatile environments, detailed planning (i.e. for contingencies etc) becomes paramount. Although II were designed to promote routine, if major change was occurring in a participant's life around the time of the intervention, effects may have been reduced as lifestyle regularity is lost. Future research should provide a greater window of opportunity to start the intervention or, at the very least, allow for screening of major changes occurring in a person's life. A delayed start may also help to reduce attrition rates or enable higher numbers for recruitment.

Targeting Sleep-Related Beliefs alongside ImpIementation Intentions for Sleep Initiation Behaviour

Cognitive Behavioural Therapy (CBT) is one of the most widely used treatments to date for sleep disorders (A. G. Harvey & Tang, 2003) and has shown success in altering dysfunctional beliefs about the consequences of sleep deprivation. The cognitive component of CBT is designed to challenge and change misconceptions about sleep, revise false attributions about the causes of insomnia and reappraise perceptions of its consequences on daytime functioning (Edinger & Means, 2005; A. G. Harvey, Tang, & Browning, 2005). Despite the success of CBT there are grounds for trying to improve the technique for insomnia and sleep deprivation in general, as effects to date are moderate compared to the application of the strategies to other psychological disorders (A. G. Harvey & Tang, 2003). As II imagery seemed to be successful in improving sleep-related behaviour but not in reducing dysfunctional sleep beliefs, it is suggested that II could be incorporated in future CBT to further improve the treatment of sleep deprivation.

Reducing Negative Sleep-Related Behaviour

Results suggested that the II imagery was successful in reducing negative sleep habits over non-II groups, even though these habits were not targeted specifically by the imagery. This finding shows the potential in further targeting the factors that cause poor sleep, considered health risk behaviours, rather than concentrate solely on the behaviours that promote sleep. Normally II are designed to target approach type behaviours rather than avoid negative ones (Sheeran, Webb, & Gollwitzer, 2005). However, evidence suggests that a person can also plan to avoid certain behaviours, by increasing what is known as behavioural willingness (Gibbons, Gerrard, Reimer, & Pomery, 2006). Individuals high in behavioural willingness are argued to have not thought much about the behaviour and its consequences so environmental factors are more likely to regulate behaviour. Using II imagery to reduce behavioural willingness may be further effective in reducing negative sleep habits.

Further Administration of the SRCT

Through the online application of the SRCT, a method was forged to understand the relatively private and highly contextual behaviours leading up to sleep. Findings from application of the SRCT in the first study suggested that intention for behaviours surrounding sleep was closely associated with actual time of going to bed as well as PSQI scores. Much sleep-related research has been conducted in experimental labs without acknowledging contextual influences considered important for understanding the behaviour (Meadows, 2005; Rozin, 2001). The potential of the internet and email for using narratives to reflect contextual influences in order to change behaviour has to date been under-utilised (James, 2007). In applying the SRCT in this way it was found that intention for one behaviour (i.e. going to bed) seemed often to be sacrificed by a strong intention for another behaviour (e.g. the deadline task).

Results from application of the SRCT across the three intervention studies also indicated that intentioned behaviours not conducive to sleep (e.g. going to bed at a late time) were associated with worse PSQI scores. Moreover, the tool was specific enough to identify II group differences in intention for two of the key behavioural images targeted by this type of imagery (intended time to sleep and following a bedtime routine). A previous study also looked at off-job activities yet found no association between any particular activity and psychological detachment from work (Sonnentag & Bayer, 2005). Nevertheless, it was argued that specificity may have been lacking in delineating what the activities were so the results may have been misleading. The current study was able to identify specific behaviours mentioned in the SRCT and then determine if group differences in these behaviours were present through chi square analyses. Psychometric properties of the tool are reflected by the convergent and discriminant validity with relevant measures. For example, correlation analyses in the main RCT showed associations between the SRCT time to sleep measure and frequency of negative sleep habits, diet and time of lights out. Further advances in the field of self-regulation could be made by continuing to investigate differences in specific sleep-related behaviour. By gaining this understanding, behavioural measurement and behavioural self-regulation intervention could be combined thus reducing the burden of completing questionnaires on any individual.

CHAPTER 16 CONCLUSION

The investigation into how work-related cognitions and emotions are processed and the relationship of this processing to intentions and actions for sleep-related behaviour was made possible through the development of the sleep self-regulation model. By enhancing understanding of self-regulation in general it allowed for the relationship of health and personal motivations with behaviour to be better understood. Further, the delivery of online, low-cost interventions based around self-regulation principles to a population of busy employees, broadened the scope of sleep deprivation treatments.

In the first study, key work-related factors (e.g. quantitative, cognitive and emotional demands and work-role conflict), as well as meaning of work, work-goal motivations and specific work-related emotions, were found to be important for certain sleep-related indicators. Although previous literature has concentrated on how vague concepts of stress are likely to influence sleep, this collected more detailed information on the nature of demands employees face. The new instrument, the Sleep-Relevant Cognitions Test (SRCT), also provided information on the decisions made by employees following work that may affect their ability to achieve optimum sleep regardless of work-related demand. Through an increased understanding of this complex area, future interventions are now equipped to provide tailored assistance to improve night-time sleep quality in daytime employees. Having this level of detail allows employers to be better equipped to ensure their employees get a good night's sleep and are healthy and productive the next day.

Results from the primary intervention study showed success in improving sleep quality through its behavioural components; the use of implementation intentions (II) delivered via imagery, but not in its relaxation technique, arousal reduction using guided imagery. Specifically, II groups had a reduced frequency of negative sleep habits relative to non-II groups. Sleep-related planning also became more detailed in II groups which led to actions more likely to initiate sleep rather than detract from it. Compared to participants not using II imagery, II groups reported faster times of falling asleep, higher self-reported sleep-quality and fewer night-time awakenings on a nightly basis in the mixed model analyses. In addition, the II group showed a significant increase in exercise levels over non-II groups at follow-up assessment, although no improvements of health behaviour (diet, exercise, smoking or alcohol intake) were directly associated with improvements in sleep patterns. Although there are future questions to address from this research, current findings have demonstrated how imagery-based II for sleep-related behaviour can be effective in treating sleep deprivation easily in the modern workplace.

Using the sleep self-regulation model, this research has made original contributions to theory assessment, intervention and practical evidence. For example, findings from the initial online descriptive study suggested that cognitive and emotional stressors arising from the workplace can result in a reduced self-regulatory capacity which can, in turn, interfere with the sleep initiation process. Next, by conducting three intervention studies, theory on II has, for the first time, been applied to sleep-related behaviour. Given the recent interest in temporal self-regulation theory (i.e. modelling how self-regulation changes over time), the research also highlights how important time cues are in instigating behavioural change, especially for changing behaviours that are strongly habitual (e.g. time of lights out). Throughout the course of the research some useful sleep measurement tools were also developed. For example, the SRCT provides a means to measure intentions for sleep-related behaviour in a way that gives the individual freedom to report the great variety of behaviours that are possible. In parallel with these measurements, the time periods which these behaviours occur in were able to be assessed providing a quantitative measure simultaneously. The use of robust randomised controlled designs in the intervention studies adds strength to the literature while showing that the design can also be conducted using daily measurement over a relatively long (3-week) period. In terms of the practical application, the results are of use to a wide audience as the intervention can be delivered to a population of busy employees outside of a laboratory setting. In short, the innovative way the design, measures and strategies of this research came together has ensured that this research can be extended beyond the research setting to have real-world applications.

Specific recommendations to employers include: (1) Cognitive and emotional demands can affect sleep differently. For example, cognitive demands are more likely to affect the behaviour of going to bed and turning out the lights at an appropriate time whereas emotional demands may also affect time of waking; (2) Encouraging employees to record their previous night's sleep quality in and of itself can be effective in encouraging better self-monitoring so that employees are more likely to take the steps necessary to get a good night's sleep; and (3) Concentrating on behaviours leading to sleep may be more important than trying to implement relaxation strategies.

Specific recommendations to researchers include: (1) Addressing the motivations behind work-related goals and demands could be a key factor in improving sleep; (2) Ensure time-relevant cues are included in future health behaviour intervention studies; and (3) The effectiveness of the II strategy used provides a good tool for translating research into practice as is likely to be useful in improving sleep in the masses.

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APPENDICES

Appendix A Study 1 Recruitment Material

Department of Psychology
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THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Work AND Sleep - What are the links?

A study is currently underway gathering information about the impact of work-related demands on sleep and we are inviting voluntary participation.

If you work full-time for this organisation and work regular daytime hours we would like to talk to you about your work goals, work experiences and your sleep quality.

The study involves two short surveys that take about 15 minutes to complete. In addition, you will be required to complete brief daily diaries relating to sleep quality and workplace demands for a 2-week period.

Participants will be rewarded for taking part through provision of feedback on sleep patterns and guidance on how to promote quality sleep as well as a small token of appreciation.

If you would like to help us with this study please contact Marisa Loft at:

m.finn@auckland.ac.nz
and the survey link will be emailed to you

If you want further information about the study please also feel free to email or phone the principal researcher:

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APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

Department of Psychology
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WORK AND SLEEP
Organisational Recruitment Notice
A Study Investigating How Workplace Goals and Experiences Influence Sleep Patterns.

My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite your employees to volunteer to take part in a survey that aims to find out how work-related goals and activities are associated with sleep quality. A lack of sleep can have considerable effects on performance and employee health yet there is a lack of research that investigates ways to promote it in a daily working population. The current survey is designed to provide information for an intervention I will later be conducting that aims to promote sleep quality in employees through motivational and behavioural strategies that tie into their personal work goals. The specific aims of the project are to:

- Identify personal work-related goals which promote sleep or interfere with sleep
- Identify which work demands are likely to interfere with sleep patterns
- To determine the extent to which emotional arousal and cognitive demand independently influence sleep patterns

As participants in this study, employees who volunteer will be invited to complete a brief survey about their personal work-related goals, their degree of commitment to achieving these goals, and how their efforts to achieve these goals may influence their sleep patterns. Questions will also be asked relating to their current quality of sleep. The initial survey should take around 15 minutes to complete. In addition, for a two-week period they will be asked to complete the following brief measures:

- A short sleep diary each morning before work.
- A record of a workplace event which they felt strongly about and how it tied into their personal goals.
- Their emotions experienced and level of cognitive demand during the day (each afternoon via email).

A summary of the study's findings will be made available to you and your employees following completion of this study. Seminar presentations of the results of the study will also be provided if desired. In addition, a small token of appreciation will be given to all employees who complete the study. I will be making contact again in a week's time to find out if you are interested in participating.

For more information about the study, please contact Marisa Loft on 09 3737599 ext 86875 (mobile 0211764035) or email: m.finn@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

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New Zealand

Title: Work goals and their relation to sleep quality *(Participant Information Sheet)*

My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite you to take part in a survey that aims to find out how work-related goals and demands may be associated with sleep quality. The survey is designed to provide information for the development of a work-based programme for promoting sleep patterns in employees through motivational and behavioural strategies that take into account the demands of work goals and activities.As a participant in this study, you would be asked to complete a brief online survey about your personal work-related goals, how committed you are to them and whether you think they are likely to promote or interfere with your sleep. You will also be asked to provide information about your current quality of sleep. The survey should take around 15 minutes to complete. In addition, for the following two weeks you will be asked to complete a short sleep diary each morning and an assessment of your work demands each afternoon. You will also be asked to answer a follow-up questionnaire after this period of a similar length to the first questionnaire. It is possible that through the identification of these sleep-interfering goals some participants may become more concerned about disruptions to their sleep patterns. Should this occur please contact the principal researcher and you will be referred to a clinical psychologist with the appropriate experience.

All of your responses and information will be kept completely anonymous. You will be asked to select a codename to use during the study so that no identifying information will appear on the questionnaires or other materials. To participate in this study you must be over 16 years of age. Any data reported in summaries of the research findings, including research journals, will be presented as group averages and percentages so that it will not be possible to associate your identity with any of your responses. Your participation is entirely voluntary (your choice). If you do agree to take part, you are free to withdraw from the study at any time, without having to give a reason and may also withdraw information that you have provided at any time prior to 30 January 2008. In reward for your participation, you will have the option of having data on your individual sleep patterns sent to you and will be provided with a small gift as a token of our appreciation.The data will be stored in a locked filing cabinet in my office in the Department of Psychology, The University of Auckland for six years, after which time they will be destroyed by shredding. An electronic file of the study data will include your codename; it will not include your name or any other identifying information. This file will be password protected, myself and my supervisor (Dr Linda Cameron) will be the only people who have access to this file. Thank you very much for your time and help in making this study possible. If you have any queries or if you wish to know more about the study, please contact us:
Marisa Loft (PhD student), Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86875, Email: m.finn@auckland.ac.nz.
Associate Professor Linda Cameron, Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86869

You may also contact the Head of Department of Psychology: Associate Professor Fred Seymour, Department of Psychology, The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 88516. *(For any queries regarding ethical concerns please contact: The Chair, The University of Auckland Human Participants Ethics Committee,Private Bag 92019, Auckland. Telephone 373 7999 extn. 87830).* APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

CONSENT FORM
THIS CONSENT FORM WILL BE HELD FOR
A PERIOD OF SIX YEARS

Project title: Personal goals and their relation to quality of sleep
Researchers Names: Marisa Loft (PhD Student)
Associate Professor Linda D. Cameron

I have read and understood the Participant Information Sheet about this research project. I have had an opportunity to ask questions and have them answered.

- I agree to take part in the research
- I understand that my responses will be used for data analyses
- I understand that I am free to withdraw from the research at any time without giving a reason
- I understand that I have the right to withdraw my information/data up to 30 January 2008
- I understand that the research data will be stored securely in the University of Auckland Department of Psychology for six years, after which time it will be destroyed by shredding

Do you agree with the above statements?

☐ **Yes** ☐ **No** ☐ **I would like to discuss the study with the principal researcher first before agreeing to participate**

☐ **I would like a copy of my results sent to me.**

Full Name: ____

Date: ____

Email address: ____

Participant Code____

Signature (paper version only)_____________________________

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland,
New Zealand

Title: Work goals and their relation to sleep quality (*Participant Information Sheet – Manager)*
My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite your employees to volunteer to take part in a survey that aims to find out how work-related goals may be associated with sleep quality. The survey is designed to provide information for the development of a work-based program for promoting sleep patterns in employees through motivational and behavioural strategies that take into account the demands of work goals and activities.

As participants in this study, the employees who volunteer will be asked to complete a brief online survey about their personal work-related goals, how committed they are to them and whether they think they are likely to promote or interfere with their sleep. They will also be asked to provide information about their current quality of sleep. The survey should take around 15 minutes to complete. In addition, for the following two weeks they will be asked to complete a short sleep diary and a brief assessment of their work demands each afternoon. All responses and information will be kept completely anonymous. Participants will be asked to select a codename to use during the study so that no identifying information will appear on the questionnaires or other materials. Any information relating to the employees will be kept completely confidential. Any data reported in summaries of the research findings, including research journals will be presented as group averages and percentages so that it will not be possible to associate an identity with any of their responses. You will also have the option of receiving a copy of the study group findings. The participation of the employees is entirely voluntary (their choice). They do not have to take part in this study. Non-participation should not affect the employment status of any of the employees approached. If you do agree for your employees to take part, you are free to withdraw your organisation from the study at any time without having to give a reason. Should this occur, your employees will still be rewarded for their participation and will have the option of continuing with the study outside normal working hours should they wish to do so. Employees may also cease to participate in any or all aspects of this study at any time and may withdraw their information that that has been provided at any stage prior to 30 May 2008. The data will be stored in a locked filing cabinet in my office in the Department of Psychology, The University of Auckland for six years, after which time they will be destroyed by shredding. An electronic file of the study data will include the participant's codename; it will not include your employee's name, your organisation's name or any other identifying information. This file will be password protected, and my supervisor (Associate Professor Linda Cameron) and I will be the only people who have access to this file. Thank you very much for your time and help in making this study possible. If you have any queries or if you wish to know more about the study, please contact us:

Marisa Loft (PhD student), Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86875. Associate Professor Linda Cameron, Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86869

You may also contact the Head of Department of Psychology: Associate Professor Fred Seymour, Department of Psychology, The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 88516.*(For any queries regarding ethical concerns please contact: The Chair, The University of Auckland Human Participants Ethics Committee, Private Bag 92019, Auckland. Telephone 373 7999 extn. 87830).* APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

CONSENT FORM (Management)
THIS CONSENT FORM WILL BE HELD FOR
A PERIOD OF SIX YEARS

Project title: Personal goals and their relation to quality of sleep
Researchers Names: Marisa Loft (PhD Student)
Associate Professor Linda D. Cameron

I have read and understood the Participant Information Sheet about this research project. I have had an opportunity to ask questions and have them answered.

- I agree for my employees to take part in the research
- I understand that my employees' responses will be used for data analyses
- I understand that all information relating to my employees will be kept completely confidential by the principle researcher
- I agree that participation/non-participation in the study will not affect the employment status of the participants
- I understand that I am free to withdraw my organisation from the study at any time without giving a reason
- I understand that should I choose to withdraw my organisation from the study, my employees still have the option of continuing to participate outside normal working hours
- I understand that the research data will be stored securely in the University of Auckland Department of Psychology for six years, after which time it will be destroyed by shredding

Name:
(Please print clearly)

Signature:

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 20/07/2007 for a period of 3 years, from 20/07/2007 to 20/07/2010 reference 2007/243

Appendix B Baseline Questionnaire for Study 1

	Yes	No
Have you participated in any sleep-related study within the last two months?		
Do you care for any children under the age of 5 or have any reason outside your primary work that causes you to regularly lack sleep?		
Have you been recently diagnosed with clinical insomnia?		
Do you suffer from: Sleep Apnea?		
Narcolepsy?		
Restless Leg Syndrome?		
Periodic Limb Movement Disorder?		
Do you have any other diagnosed medical condition that currently interferes with the overall quality of your sleep?		

Depression (CES-D)
Please indicate how often you felt each of the following ways during the past week by placing a tick in the box that corresponds to how you felt for each item.

	Rarely/none of the time	**Occasionally**	**Moderately**	**Most/all of the time**
I did not feel like eating; my appetite was poor				
I felt depressed				
I felt everything I did was an effort				
My sleep was restless				
I was happy				
I felt lonely				
People were unfriendly				
I enjoyed life				
I felt sad				
I felt that people disliked me				
I could not get going				

Anxiety (STAI)
A number of statements which people have used to describe themselves are given below. Read each statement and, using the scale below, write the appropriate number in the space to the right of the statement to indicate **how you feel <u>right now.</u>**

	1(Not at all)	**2**	**3**	**4 (Extremely**
I am worried				
I feel calm				
I am relaxed				
I am tense				
I feel upset				
I feel content				

Work Goals

In this section you are asked to name your most important work goal for the coming 12 months. Examples of a "work goal" are as follows: getting a promotion, getting a raise, learning to say "no", avoiding excessive work demands, improving communication with my colleagues etc.

My work goal for the coming 12 months is:____________________________________

Now please indicate the degree to which you agree with the following statements regarding the goal listed above:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am capable of achieving this goal					
My partner will support me in case I have trouble attaining this goal					
My colleagues will support me in case I have trouble attaining this goal					
Pursuing this goal takes effort I would rather devote to other things					
Pursuing this goal conflicts with other goals I find important					
Pursuing this goal has negative effects on my well-being					
Pursuing this goal has negative effects on my social relationships					
I feel tense when I think about this goal					
I find it stressful to pursue this goal					
I feel good when I think about this goal					
I find it pleasant to work towards this goal					
Pursuing this goal promotes my self-confidence					
Pursuing this goal is a challenge for me					
It's hard to take this goal seriously					
Quite frankly, I don't care if I achieve this goal or not					
I am strongly committed to pursuing this goal					
It wouldn't take much to make me abandon this goal					
I think this is a good goal to shoot for					
I know how to achieve this goal					
I am capable of achieving this goal					

How much do you think that working towards/thinking about this goal **interferes** with your sleep at night? (please highlight)
Not at all………………Slightly……………………. Moderately………………… Extremely

How much do you think working towards/ thinking about this goal **helps** you to sleep well at night? (please highlight)
Not at all………………Slightly……………………. Moderately…………….…… Extremely

What is your current **short-term** workplace goal?____

Short-term (Weekly) Work Goal Priority
In relation to your short-term goal stated above, please tick the box that best corresponds to how you feel.

	Strongly Disagree	Disagree	Neither Agree/ Disagree	Agree	Strongly Agree
This goal is the main goal I think about.					
I would sacrifice other things I want to do in order to reach this goal.					
I place this goal as one of my most important goals in my life this week.					
I would rather use my time to do other things than spend the time working towards this goal.					
This goal means a lot to me.					
It doesn't matter if I don't work towards this goal.					
This goal is a valuable goal for me.					
Of all the work-related goals I have, this goal is the most important.					
It concerns me if I can't work towards this goal.					
Reaching this goal is one of my top priorities.					

How much do you think that working towards/thinking about this short-term goal **interferes** with your sleep at night? (please highlight)

Not at all……………………Slightly……………………. Moderately…………………… Extremely

How much do you think working towards/thinking about this short-term goal **helps** you to sleep well at night? (please highlight)

Not at all……………………Slightly……………………. Moderately…………………… Extremely

Sleep Priority Scale
Please place an * in the box that best corresponds to how you feel about each statement

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I just can't cope if I don't get sufficient quality sleep.					
I would sacrifice other things I want to do in order to get enough sleep at night.					
Of all the health related goals I have (e.g. diet, exercise) getting good sleep is the most important.					
I place sleep as one of my most important goals in my life this week.					
I would rather use my time to do other things than spend the time sleeping.					
If I don't get enough sleep I have trouble functioning the next day.					
It doesn't matter if I don't get enough sleep.					
Having adequate sleep is a valuable goal for me.					
It concerns me if I miss out on my sleep.					
Getting a good night's sleep is one of my top priorities.					

Content of Thoughts Inventory (Measure of Pre-Sleep Arousal)

Here are some thoughts that people have when they can't sleep. Please indicate by placing a tick in the appropriate box how often last night the following thoughts have kept you awake.

		Never	Sometimes	Often	Always
1.	Things in the future				
2.	Ways you can get to sleep				
3.	How tired/sleepy you feel				
4.	The effects of not sleeping well				
5.	Things that happened during the day				
6.	Pictures of things in your mind				
7.	How nervous/anxious you feel				
8.	Being awake all night				
9.	How mentally awake you feel				
10.	Noises you hear				
11.	Checking the time				
12.	How light/dark the room is				
13.	Trivial things				
14.	How frustrated/annoyed you feel				
15.	How you can't stop your mind from racing				
16.	Your work/responsibilities				
17.	How long you've been awake				
18.	How hot/cold you feel				
19.	Your health				
20.	Things you have to do tomorrow				
21.	Your personal life				
22.	How thinking too much is the problem				
23.	Things in your past				
24.	How bad you are at sleeping				
25.	Things to do to help you sleep				

Perceived Stress (Perceived Stress Scale, PSS)

The questions in this scale ask you about your feelings and thoughts during the last 2 weeks. In the last 2 weeks how often have you felt...

Statements	**Never**	**Almost Never**	**Sometimes**	**Fairly Often**	**Very Often**
... upset because of something that happened unexpectedly?					
...unable to control the important things in your life?					
...nervous and “stressed”?					
...you dealt successfully with irritating life hassles?					
...that you were effectively coping with important changes occurring in your life?					
...confident about your ability to handle your personal problems?					
...that things were going your way?					
...that you could not cope with all the things that you had to do?					
...you were able to control irritations in your life?					
...that you were on top of things?					
...angered because of things that happened that were outside of your control?					
...yourself thinking about things that you have to accomplish?					
...you were able to control the way you spend your time?					
...difficulties were piling up so high that you could not overcome them?					

Fatigue (Profile of Mood States, POMS)

Please rate the extent to which each of items describes how you have been feeling in the past 14 days.

	0 (Not at all)	1	2	3	4 (Extremely)
Exhausted					
Lively					
Very tired					
Very energetic					
Vigorous					
Lethargic					
Worn out					

Sleep Quality (Pittsburgh Sleep Quality Index, PSQI)

1. What time did turn off the lights and try to go to sleep last night?

TIME OF LIGHTS OUT___________________________

2. How many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed)

SLEEP DURATION PER NIGHT___________________

3. How long (in minutes) has it usually taken you to fall asleep last night?

NUMBER OF MINUTES__________________________

4. What time did you wake up this morning?

USUAL GETTING UP TIME_______________________

5. Sleep Quality

	Very restless	2	3	4	5	6	7	8	9	Very sound
How would you rate your sleep quality last night?										

6. Given your answers above, was your sleep last night sufficient to meet your needs today?

Not enough	Just right	Too much

Please state if there were any factors outside the workplace that disturbed your sleep last night

____

For each of the remaining questions, check the one best response with a *. Please answer ***all*** questions.

7. During the past 2 weeks, how often have you had trouble sleeping because you…	Not during the past 2 weeks	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				
Other reason(s) please describe_				

During the past 2 weeks, how often have you?

	Not during the past 2 weeks	Less than once a week	Once or twice a week	Three or more times a week
taken medicine (prescribed or "over the counter") to help you sleep				
had trouble staying awake while driving, eating meals, or engaging in social activity?				

During the past 2 weeks, 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

	No bed partner or do not share a room	Partner/flat mate in other room	Partner in the same room, but not same bed	Partner in the same bed
Do you have a bed partner or share a room?				

If you have a bed partner or share a room, ask him/her (or recall what people have said as best you can!!) how often in the past 2 weeks you have had….

	Not during the past 2 weeks	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/confusion during sleep				
Other restlessness while you sleep (please describe)				

Demographics

All information is kept anonymous and all identifying information is kept in the strictest confidence by the principle researcher.

What is your current age?

Under 20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66+

What is your ethnicity?

NZ European	Maori	Pacific Islander	Asian	South East Asian
Other (Please state________________________________)				

What is your average combined income?

0 - $20,000	$21,000-30,000	$31,000-40,000	$41,000-50,000	$51,000-60,000	$61,000-70,000	$71,000-80,000	$81,000-90,000	$91,000-100,000	$101,000 plus

What is your current marital status?

Married	Single	Separated/ Divorced	De facto/ have a partner	Widowed

Gender: Male/Female

Current Occupation ________________________

Current Position within the Organisation ________________________

Normal Working Hours ________________________

How long have you been employed by your current company?

0-6 months	6 months – 1 year	1 year	2 years	3 years	4 years	5-10 years	10 years+

Do you have children?

No	Yes – 1 child	Yes – 2 children	Yes – 3 children	Yes – 4+ children
If YES, please list the age(s) of your children:_____________________________				

------------------------------End of Survey---------------------------

Appendix C Daily Email Questionnaire for Study 1

Code:
Day:
Short-term work goal (weekly)________________________
Long-term work goal (12-month): _____________________

Daily Sleep Diary
What time did you turn off the lights and try to go to sleep last night? __________
How many hours of sleep did you get last night? __________
How long (in minutes) did it take you to fall asleep last night? __________MINUTES
What time did you get up this morning? __________

5. Sleep Quality

	Very restless	2	3	4	5	6	7	8	9	Very sound
How would you rate your sleep quality last night?										

6. Given your answers above, was your sleep last night sufficient to meet your needs today?

Not enough	Just right	Too much

Please state if there were any factors outside the workplace that disturbed your sleep last night____

WORK-RELATED EVENT
Please **BRIEFLY** describe the **workplace event** that you experienced today where you felt the strongest emotion
My event____

Time of day event occurred______________________________am/pm

How much did this event…	Not at all					Very much so
Help you to reach your **short-term** workplace goal?						
Help you to reach your **12-month** workplace goal?						
Conflict with your **short-term** workplace goal?						
Conflict with your **12-month** workplace goal?						

WORK-RELATED EMOTION

Using the scale below rate how intensely on average you felt each emotion today on the line provided

	No intensity									Extreme intensity
Liking for someone/something										
Embarrassed										
Content										
Depressed										
Frustrated										
Angry										
Proud										
Disappointed										
Happy										
Enthusiastic										
Pleased										
Disgusted										
Unhappy										
Optimistic										
Worried										
Enjoying something										

Did you do 30 minutes or more of moderate to vigorous activity yesterday? (e.g. exercise that made you ‘huff and puff’) YES NO

If YES – was the exercise done within 2 hours of when you tried to go to sleep last night? YES NO

Did you consume any stimulants yesterday? (e.g. coffee, tea, energy drinks) YES NO

If YES please describe type(s) ________________________________

If YES how many servings ________________________________

If YES was it within 2 hours of when you tried to go to sleep last night? YES NO

CopenHagen Psychosocial Questionnaire

Using the following scale please tick the box that best corresponds to how you feel about the following statements today:

	Never	Seldom	Sometimes	Often	Constantly
Did you have to work very fast?					
Was your workload unevenly distributed so it piled up?					
How often did you not have time to complete all your work tasks?					
Did you get behind with your work?					
How often could you take it easy and still do your work?					
Did you have enough time for your work tasks?					
Did you have too little to do at work?					
Did you have to keep your eyes on lots of things while you work?					
Did your work require that you remember a lot of things?					
Did your work demand that you are good at coming up with new ideas?					
Did your work require you to make quick decisions?					
Did your work require you to make difficult decisions?					
Did you have to make decisions of great importance to your work?					
How often did you have to deal with difficult problems in your work?					
Did your work put you in emotionally disturbing situations?					
Did your work require that you do not state your opinion?					
Did your work require a wide knowledge?					
Was your work emotionally demanding?					
Did you get emotionally involved in your work?					
Did your work require that you get personally involved?					
Did your work require that you hide your feelings?					
Was your work meaningful today?					
Did you feel that the work you did today was important?					
Do you feel motivated and involved in your work?					
Was your work useful to the recipients?					
Was your work part of a larger whole?					
Did you do things at work, which were accepted by some but not by others?					
Were contradictory demands placed on you at work?					
Did you have to do things, which ought to have been done in a different way?					

Do you plan to do overtime today? YES NO

Did you work overtime yesterday? YES NO

Appendix D SRCT

The following story is about two employees both at the end of a busy day at work. One is named Sam and the other is only referred to as "you". As you read this story, imagine you are the other employee. Every time you read the word "you" put yourself in this person's shoes. Imagine that you are experiencing what this person is experiencing.

Time	STORY *Please begin reading the story and then fill in the gaps in the spaces provided.*
4pm	You are getting to the end of your days work and are about to leave when a colleague (Sam) appears with a difficult question he needs help with. Although tired you agree to go through the problem and help Sam solve it.
5.20pm	The question is actually something that you find quite difficult to answer as well and before you realise, both of you have spent over an hour pouring over the problem. To make matters worse you feel that Sam does not appear to appreciate the extra effort you went to for him.
5.30pm	When you finally get back to your desk you realise that a number of emails/memos have come in. Although a lot of them are junk, two memos in particular seem to concern issues that are relevant to you personally. One is from a friend who is keen to exercise with you first thing in the morning and another is from your immediate boss reminding you about a deadline for a task that is due at 11am the following morning. Although you have already done a lot of work for the task you realise there is still a lot to do before 11am.
5.50pm	As you pack up your gear you spot some more paperwork that needs finishing so you throw that into your bag to take home.
6.00pm	During the drive home you notice that the road upgrade has progressed so that you now have to follow a detour to get to work in the morning. You make a mental note that you have to be up earlier to account for the longer time it will take for you to get to work.
6.15pm	Listening to the radio on the way home you also hear about an upcoming show that you would love to go to but then think that financially you probably will not be able to afford the tickets.
6.30pm	On arriving home you realise that your (partner/flatmate) is out for the night and you will have the house to yourself.
7.00pm	During dinner you see that your favourite series has a special double episode on tonight but it means that the programme will run quite late.
7.30pm	After having dinner you quickly realise that you have some time to yourself and notice that there are lots of things to do to fill this time. *In the following boxes write what you would do:*
7.30pm	
8.00pm	
8.30pm	
9.00pm	
9.30pm	
10.00pm	
10.30pm	
11.00pm	
11.30pm	
12.00am	
12.30am	
1.00am	
1.30am	
2.30am	
3.30am	
4.30am	
5.30am	
6.30am	Your radio alarm goes off and you get up to get ready for the next day's work

Appendix E Study 2 Recruitment Documents

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

Building 721,
200 Morrin Road,
Glen Innes
Ph: 3737599 ext 86875
Fax: 373-7043

Using Imagery to Promote Quality Sleep

My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite your employees to volunteer to take part in a study that aims to test the effectiveness of brief techniques in promoting sleep. A lack of sleep can have considerable effects on employees performance and health yet there is a lack of research that investigates ways to promote good sleep habits in a daily working population.

The specific aims of the project are to:

Test whether brief imagery techniques are useful for promoting sleep-related motivations and behavioural plans related to better sleep quality.

Test whether reducing pre-sleep arousal and creating more detailed plans for behaviours relating to good sleep then leads to better sleep quality.

The initial practice session will take place at either a quiet onsite location (if available) or in a quiet room on the University of Auckland's Tamaki Campus. Participants will also be invited to practice the techniques twice daily for three weeks using a CD recording and written instructions. To check how the intervention is going brief daily email assessments of sleep quality will need to be completed each workday morning. Lastly, they are asked to complete a short (10 minute) online follow-up survey.

A summary of the study's findings will be made available to you and your employees following completion of this study. Seminar presentations of the results of the study will also be provided if desired. In addition, a small token of appreciation ($10 petrol voucher) will be given to all employees who complete the study. I will be making contact again in one week to find out if you are interested in participating.

For more information about the study, please contact Marisa Loft on 09 3737599 ext 86875 (mobile 0211764035) or email: m.finn@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/08/2008 for a period of 3 years, from 20/08/2008 to 20/08/2011 reference 2008/28

Information Sheet (Management)
Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

Title: Using Imagery to Promote Quality Sleep

My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite your employees to volunteer to take part in an experimental study that aims to promote night-time sleep quality. As a participant in this study, your employees are asked to attend a ½ hour session where they learn a brief mental imagery technique and answer a brief questionnaire. In addition, they are asked to practice the imagery technique for five minutes once a work day at 3pm (towards the end of the day's work but prior to going home) and each night before bed for a period of 3 weeks as well as complete a brief report on their previous night's sleep quality shortly following this exercise. Lastly, there is one final follow-up questionnaire that assesses their final sleep quality and any improvement in their intentions for sleep that will be completed at the end of the 3 weeks. Participating in the study should take up the following amounts of time over the 3-week period (note that times are approximate). Screening survey: 10 minutes; Baseline survey, initial practice session and immediate post-practice survey: 1hr maximum (average=30 minutes); Daily email survey: 3 minutes each working day for three weeks (Mon-Fri); Final follow-up survey: 10 minutes.

In order to maintain confidentiality, the person who is appointed to send out the study announcement to employees is requested to inform potential participants that they are asked to respond directly to the link or the principal investigator. All responses and information will be kept completely confidential by the principal investigator. Participants will be asked to select a codename to use during the study so that no identifying information will appear on the questionnaires or other materials. Any data reported in summaries of the research findings, including research journals, will be presented as group averages and percentages so that it will not be possible to associate an identity with any responses. The participation of the employees is entirely voluntary (their choice). They do not have to take part in this study. Non-participation should not affect the employment status of any of the employees approached. If you do agree that I can access your employees, you are free to withdraw your organisation from the study at any time until the time that employees agree to participate, without having to give a reason. However, data already collected from employees may not be withdrawn. Employees may also cease to participate in any or all aspects of this study at any time. They may also withdraw information that they have provided at any time prior to 3 months after data collection starts after which the data will have been used for analysis. The data will be stored in a locked filing cabinet in my office in the Department of Psychology, The University of Auckland for 6 years, after which time they will be destroyed by shredding. An electronic file of the study data will include the participant's codename; it will not include your employee's name, your organisation's name or any other identifying information. This file will be password protected, and my supervisor (Associate Professor Linda Cameron) and I will be the only people who have access. Thank you very much for your time and help in making this study possible. If you have any queries or if you wish to know more about the study, please contact us: Marisa Loft (PhD student, principal investigator), Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86875; Associate Professor Linda Cameron, Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86869. You may also contact the Head of Department of Psychology: Associate Professor Fred Seymour, Department of Psychology, The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 88516. (For any queries regarding ethical concerns please contact: The Chair, The University of Auckland Human Participants Ethics Committee, Private Bag 92019, Auckland. Telephone 373 7999 extn. 87830) APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE 17/09/2008 for a period of 3 years, from 17/09/2008 to 17/09/2011 reference 2008/28

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

CONSENT FORM (Management)
THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

Project title: Using Imagery to Promote Quality Sleep
Researchers Names: Marisa Loft (PhD Student)
Associate Professor Linda D. Cameron

I have read and understood the Participant Information Sheet about this research project. I have had an opportunity to ask questions and have them answered.

- I agree for my employees to take part in the research
- I give permission for the principal researcher to access my employees for the purposes of the research
- I understand that my employees' responses will be used for data analyses
- I understand that I am free to withdraw my organisation from the research at any time until the time that employees agree to participate, without giving a reason
- I understand that data already collected from employees may not be withdrawn
- I understand that I will be asked to appoint a person to distribute notices regarding the study but that participants are asked to respond directly to the online screening survey and that all questions will be directed to the principal investigator
- I understand that my organisation will not be identified in any publications
- I understand that the research data will be stored securely in the University of Auckland, Department of Psychology for six years, after which time it will be destroyed by shredding

Name: (Please print clearly)

Signature:

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE 17/09/2008 for a period of 3 years, from 17/09/2008 to 17/09/2011 reference 2008/282

Participant Recruitment Documents STUDY 2

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Department of Psychology
The University of Auckland
Private Bag 92019
Auckland

Using Imagery to Promote Quality Sleep

Do you find you wake up feeling tired?

Do you get enough sleep for your needs?

Do you end up staying up late into the night because of things on your mind?

If you do, you may be interested in taking part in a study I am doing as part of my PhD in psychology that aims to improve night-time sleep quality in daytime employees.

If you decide to take part you will be invited to attend an initial practice session to learn a simple, sleep promoting technique, practice the technique for three weeks and complete an online follow-up survey. You will receive a small token of appreciation ($10 petrol voucher) as my way of thanking you for taking part.

If you would like to help me with this study please click here or copy/paste this link into your browser:
https://www.surveymonkey.com/s.aspx?sm=xcgBq6VTx3QKUBRrHJ5j6Q_3d_3d

This will take you to a study information sheet and a short screening survey that checks your eligibility to take part.

If you have any questions please contact me at:
Marisa Loft (PhD Student)
Psychology Department (Tamaki Campus)
The University of Auckland
Ph 09 3737599 ext 86875
Mobile 0211764035
Email: m.finn@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 20/08/2008 for a period of 3 years, from 20/08/2008 to 20/08/2011 reference 2008/282.
Department of Psychology, **The University of Auckland**
Private Bag 92019 Auckland, New Zealand

Participant Information Sheet

Title: *Using Imagery to Promote Quality Sleep*

My name is Marisa Loft and I am a PhD student in the Department of Psychology at the University of Auckland. I would like to invite you to take part in an experimental study that aims to improve sleep quality through the use of imagery. As a participant in this study, you will first be asked to complete a short screening questionnaire to assess your eligibility for the study. If meeting the criteria you are then asked to attend a practice session where you will learn a brief, mental imagery technique and answer a short questionnaire. In addition you are asked to practice the imagery technique for five minutes each afternoon and each night for a period of 3 weeks and complete a brief report on your previous night's sleep quality each morning by email. Lastly, there is one online final follow-up questionnaire at the end of the 3 weeks to complete that assesses your final sleep quality and any changes in your intentions towards sleep. Participating in the study should take up the following amounts of your time over the 3 week period (note that times are approximate).Screening survey: 10 minutes; Baseline survey, initial practice session and immediate post-session survey: 1 hr maximum Daily email survey: 3 minutes each working day for 3 weeks (Mon-Fri); Final follow-up survey:10 minutes

It is possible that through the identification of these sleep-interfering goals some participants may become more concerned about disruptions to their sleep patterns. Should this incident occur, or any other unexpected distress be detected, referral will be made to a clinical psychologist (Professor Glynn Owens) with the appropriate experience. All responses and information will be kept completely confidential. No identifying information will appear on the questionnaires or other materials. Any information relating to you will be kept completely confidential by the principal researcher. To participate in this study you must be over 16 years of age. Any data reported in summaries of the research findings, including research journals, will be presented as group averages and percentages so that it will not be possible to associate your identity with any of your responses. Your participation is entirely voluntary (your choice). If you do agree to take part, you are free to withdraw from the study at any time, without having to give a reason. You may also withdraw information that you have provided up to three months following data collection after which the data will have been used for analysis. The data will be stored in a locked filing cabinet in my office in the Department of Psychology, The University of Auckland for six years, after which time they will be destroyed by shredding. An electronic file of the study data will include your codename; it will not include your name or any other identifying information. This file will be password protected, myself and my supervisor (Associate Professor Linda Cameron) will be the only people who have access. Thank you very much for your time and help in making this study possible. If you have any queries or if you wish to know more about the study, please contact us:

-Marisa Loft (PhD student, principal investigator), Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86875, Email: m.finn@auckland.ac.nz.

-Associate Professor Linda Cameron, Department of Psychology (Tamaki Campus), The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 86869

-Associate Professor Fred Seymour, Head of Department of Psychology, The University of Auckland, Private Bag 92019, Auckland. Telephone 373 7599 extn. 88516

(For any queries regarding ethical concerns please contact: The Chair, The University of Auckland Human Participants Ethics Committee, Private Bag 92019, Auckland. Telephone 373 7999 extn. 87830)APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 17/09/2008 for a period of 3 years, from 17/09/2008 to 17/09/2011 reference 2008/282

Department of Psychology
The University of Auckland
Private Bag 92019 Auckland, New Zealand

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

Project title: Using Imagery to Promote Quality Sleep
Researchers Names: Marisa Loft (PhD Student)
Associate Professor Linda D. Cameron

I have read and understood the Participant Information Sheet about this research project. I have had an opportunity to ask questions and have them answered.

- I agree to take part in the research.
- I understand that my responses will be used for data analyses.
- I understand that I am free to withdraw from the research at any time without giving a reason
- I understand that I have the right to withdraw my information/data up to three months after data collection.
- I understand that should any unexpected distress occur from participating in this study, referral will be made to a clinical psychologist (Professor Glynn Owens) with the appropriate experience
- I understand that the research data will be stored securely in the University of Auckland, Department of Psychology for six years, after which time it will be destroyed by shredding.

Do you agree with the above statements?
☐ **Yes** ☐ **No**

☐ **I would like to discuss the study with the principal researcher first before agreeing to participate**

☐ **I would like a copy of my results sent to me.**

Full Name: ______________________________________

Signature: ______________________________________

Date: ______________________________________

Participant Code______________________________________

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIANTS ETHICS COMMITTEE on 17/09/2008 for a period of 3 years, from 17/09/2008 to 17/09/2011 reference 2008/282

Appendix F Screening Survey for Study 2: Additional Measures Used

	Yes	No
Have you participated in any sleep-related study within the last two months?		
Do you have any other diagnosed medical condition that currently interferes with the overall quality of your sleep?		
Do you care for any children under the age of 5 or have any reason outside your primary work that causes you to regularly lack sleep?		
Have you been recently diagnosed with clinical insomnia?		
Do you suffer from: Sleep Apnea?		
Narcolepsy?		
Restless Leg Syndrome?		
Periodic Limb Movement Disorder?		

In general would you say your main difficulty with sleeping is:

Trying to get to sleep	
Waking during the night	
Waking too early	
I do not have any difficulty sleeping	

Mental Health Measures

Perceived Stress (Perceived Stress Scale, PSS)

The questions in this scale ask you about your feelings and thoughts during the last 2 weeks. In each case, you will be asked to indicate how often you felt or thought a certain way using the scale below. In the last 2 weeks how often have you felt...

Statements	Never	Almost Never	Sometimes	Fairly Often	Very Often
... upset because of something that happened unexpectedly?					
...unable to control the important things in your life?					
...nervous and “stressed”?					
...confident about your ability to handle your personal problems?					
...that things were going your way?					
... you could not cope with all the things that you had to do?					
...you were able to control irritations in your life?					
...that you were on top of things?					
...angered because of things that happened outside of your control?					
...difficulties were piling up so high you could not overcome them?					

Recovery from Work

The following questions tap into your need to recover from your work. Please answer the questions as honestly as possible.

	Not at all						Every day
I find it hard to relax at the end of a working day							
At the end of a working day I am really feeling worn-out							
My job causes me to feel rather exhausted at the end of a work day							
Generally speaking, I am still feeling fresh after dinner							
Generally speaking, I am able to relax only on a second day off							
I have trouble concentrating in the hours off after my working day							
I find it hard to show interest in other people at home after work							
In general, it takes me over an hour to feel fully recovered after work							
When I get home, people should leave me alone for some time							
After a working day I am often too tired to start other activities							
At the end of the day I can’t perform my job well due to fatigue							

Depression (CES-D) (same as study 1)
Fatigue (Profile of Mood States, POMS) (same as study 1)

Health Behaviour Measures

IPAQ

During the last 7 days on how many days did you do the following activities for 30 minutes or more?	1 day	2 days	3 days	4 days	5 days	6 days	7 days
Vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?							
Moderate physical activities (these refer to activities that take moderate physical effort and make you breathe somewhat harder than normal)?							
Walking (e.g. walking to travel from place to place, and any other walking you might do solely for recreation, sport, exercise or leisure)?							

DIET

	Not in the last week	1-2 times over the last week	3-4 times over the last week	Every day
Consumed food/beverages that you consider to be unhealthy (e.g. junk food/convenience food/fast food)?(R)				
Ate a diet that was low in dietary fat?				
Ate 5 or more fruit and vegetables a day?				
Ate a diet that was high in fibre?				
Ate a diet that was high in protein?				
Ate a diet that was low in sugar?				

SMOKING STATUS

How often in the past week	I don't smoke	Not in the past week	1-2 times over the past week	3-4 times over the past week	Once a day	Three or more times a day
Have you smoked a cigarette?						

ALCOHOL INTAKE

How many standard drinks (e.g. one small glass of wine or one can of beer) have you drunk over the last week?	None	1-3 drinks	4-6 drinks	7-10 drinks	11-15 drinks	16 or more drinks
I have drunk						

Negative Sleep Habit Frequency

	Activity	Never	Not in the Last Week	Occasionally	Often	All the Time
1	I take daytime naps lasting one or more hours					
2	I go to bed at different times from day to day					
3	I get out of bed at different times from day to day					
4	I exercise to the point of sweating within 1 hr of going to bed					
5	I stay in bed longer than I should two or three times a week					
6	I use alcohol, tobacco, or caffeine within 2 hrs of going to bed or after going to bed					
7	I do something that may wake me up before bedtime (e.g. playing video games, using the internet)					
8	I go to bed feeling stressed, angry, upset or nervous					
9	I use my bed for things other than sleeping or sex (e.g. watch television, read, eat, or study)					
10	I sleep on an uncomfortable bed (e.g. poor mattress or pillow, too much or not enough blankets)					
11	I sleep in an uncomfortable bedroom (e.g. too bright, too stuffy, too hot, too cold, too noisy)					
12	I do important work before bedtime (e.g. pay bills, study)					
13	I think, plan, or worry when I am in bed.					
14	I do another behaviour not listed that interferes with my sleep					

Of these behaviours please state the number of the behaviour that you feel interferes with your sleep the most___________________________

Negative Sleep Habit Strength

This behaviour is something that...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
...I do automatically					
...I do without having to consciously remember					
...I do frequently					
...Makes me feel weird if I do not do it					
...I do without thinking					
...Would require effort not to do it					
...Belongs to my (daily, weekly, 3 week) routine					
...I start doing before I realise I'm doing it					
...I would find hard not to do					
...I have no need to think about doing					
...Is typically 'me'					
...I have been doing for a long time					

Demographics Study 2

All information is kept anonymous and all identifying information is kept in the strictest confidence by the principle researcher. Please highlight the appropriate option.

What is your current age? (In years) ________________________

Gender: Male/Female

What is your ethnicity?

NZ European	Maori	Pacific Islander	Asian	South East Asian
Other (Please state_______________________________)				

What is your average combined income

0 - $20,000	$21,000-30,000	$31,000-40,000	$41,000-50,000	$51,000-60,000	$61,000-70,000	$71,000-80,000	$81,000-90,000	$91,000-100,000	$101,000 plus

What is your current marital status?

Married	Single	Separated/ Divorced	Defacto/ Have a partner	Widowed

Current Occupation ___________________________

Current Position within Organisation ___________________________

Entry level (undergraduate)	Graduate	Experienced	Supervisor of small team	Supervisor of large team	Lower level management	Senior level management	CEO/Head of company

Normal Working Hours per day (e.g. 9-5) __________________________

Do you have children?

No	Yes – 1 child	Yes – 2 children	Yes – 3 children	Yes – 4+ children
	If YES, please list the age(s) of your children_____________________________			

-------------------------------End of Survey----------------------------

Appendix G Study 2 Baseline Questionnaire Additional Measures Used

Motivation, Sleep Self-Efficacy and Sleep Response Self-Efficacy

For the following three questions please tick the box that best corresponds to how you feel.

	Not at all									Very much
How **motivated** are you to ensure that you get a good sleep tonight?	1	2	3	4	5	6	7	8	9	10
How **confident** are you that you can **take the actions** necessary to get a good sleep tonight?	1	2	3	4	5	6	7	8	9	10
How **confident** are you that you will **actually** get a good sleep tonight?	1	2	3	4	5	6	7	8	9	10

Original Planning Measure Using IF-THEN scenario and open response (Used in Intervention Development Study One)

Please detail the steps you will take to ensure you get a good nights sleep

1. ***If*** I get home from work ***then*** I will ________________________________
2. ***If*** I have my favourite TV programme on late ***then*** I will ________________________________
3. ***If*** my room is too hot/cold ***then*** I will ________________________________
4. ***If*** there are distractions in my bedroom ***then*** I will ________________________________
5. ***If*** it is getting close to my normal bedtime ***then*** I will ________________________________
6. ***If*** my bed is uncomfortable ***then*** I will ________________________________
7. ***If*** I have lots of thoughts on my mind ***then*** I will ________________________________

Quantitative Planning Measure Used in Development Study Two and Main Intervention Study

People have various ideas for how they plan to get a good night's sleep. Please answer the following questions as honestly as possible by ticking the appropriate box

I have made a detailed plan for…	Not at all						Very much
...**how** I am going to **wind down** before going to sleep	1	2	3	4	5	6	7
...**how** I am going to **prepare for bed**	1	2	3	4	5	6	7
...**how** I am going to **prepare the place where** I will sleep	1	2	3	4	5	6	7
...the time **when** I go to sleep	1	2	3	4	5	6	7

Pre-Sleep Arousal

Please indicate how intensely you experienced the following symptoms last night on getting to sleep:

	Not at all	Slightly	Moderately	A lot	Extremely
Heart racing, pounding or beating irregularly					
A jittery, nervous feeling in your body					
Shortness of breath or laboured breathing					
A tight, tense feeling in your muscles					
Cold feeling in your hands, feet or body in general					
Have an upset stomach					
Perspiration in hands or other parts of your body					
Dry feeling in mouth or throat					
Worry about falling asleep					
Review or ponder events of the day					
Depressing or anxious thoughts					
Worry about problems other than sleep					
Being mentally alert/active					
Can't shut off your thoughts					
Thoughts keep running through your head					
Being distracted by sounds (e.g. ticking of clock)					

Dysfunctional Sleep Beliefs Scale: Please place a tick in the box below:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I need at least 8 hrs sleep to feel refreshed and function well during the day					
When I don't get enough sleep on a given night, I need to catch up on it the next day by napping or the next night by sleeping longer					
I am concerned that chronic sleep loss may have serious consequences on my physical health					
I am worried that I may lose control over my abilities to sleep					
After a poor night's sleep, I know it will interfere with my activities the next day					
When I feel irritable, depressed or anxious, it is mostly because I did not sleep well the night before					
When I sleep poorly one night, I know it will disturb my sleep schedule for the whole week.					
When I feel tired, have no energy, or do not function in the day, it is generally because I did not sleep well the night before					
I get overwhelmed by my thoughts at night and often feel I have no control over this racing mind					
I worry about getting enough quality sleep					

Appendix H Study 2: Immediate Post-Practice Questionnaire: Additional Measures Used

Imagery Forming Ability Questionnaire (Used only in Intervention Development Study One)

Visualise a relative or friend whom you frequently see. Consider carefully the picture that comes before your mind's eye.

		No image at all	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid
1	The exact contour of face, head, shoulders and body.					
2	Characteristic poses of head, attitudes of body etc.					
3	The precise carriage, length of step, etc. in walking.					
4	The different colours worn in some familiar clothes.					

Visualise the rising sun. Consider carefully the picture that comes before your mind's eye

		No image at all	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid
5	The sun is rising above the horizon into a hazy sky.					
6	The sky clears and surrounds the sun with blueness.					
7	Clouds. A storm blows up, with flashes of lightning.					
8	A rainbow appears.					

Think of the front of a shop which you often go to. Consider the picture that comes before your mind's eye

		No image at all	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid
9	The overall appearance of the shop from the opposite side of the road.					
10	A window display including colours, shape and details of individual items for sale.					
11	You are near the entrance. The colour, shape and details of the door.					
12	You enter the shop and go to the counter. The counter assistant serves you. Money changes hands.					

Finally, think of a country scene which involves trees, mountains and a lake. Consider the picture that comes before your mind's eye.

		No image at all	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid
13	The contours of the landscape.					
14	The colour and shape of the trees.					
15	The colour and shape of the lake.					
16	A strong wind blows on the tree and on the lake causing waves.					

SPECIFIC IMAGERY VIVIDNESS

Please rate the vividness of the imagery specified below that you just experienced. If you did not receive instructions for any particular image please tick the box rated “No image(s) at all”.

	No image(s) at all	Vague and dim	Somewhat vivid	Reasonably clear	Perfectly clear and vivid
Image of putting things into the bag					
Image of releasing the bag					
How you felt after you released the bag					
Getting home from work					
Relaxing at home					
Your night-time routine					
The time that you visualised going to bed					
The environment of your bedroom					
The details of the bed you are sleeping in					
The image of you falling asleep					
Please rate the **overall** vividness of the imagery you have just experienced					

Quality of Recordings

Please rate the extent to which you agree with each of the following statements

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The recording is clear					
The voice in the recording motivates me to sleep better					
The voice in the recording is relaxing					
The instructions are easy to follow					
The voice in the recording is not comfortable to hear					
The instructions guided me to generate images					
The recording is the appropriate length					
The voice in the recording does not convince me to improve my sleep patterns					
The recording has soothing instructions					
The voice in the recording is engaging					
The pauses are long enough for me to generate images					
The instructions were detailed enough to generate images					

If you had any problems with the recording please state them here______________________

Appendix I Study 2: Daily Email Questionnaires Study 2: Additional Measures

DAY INDIVIDUAL CODE________________________

For the imagery exercise, please rate the vividness of the imagery you experienced by putting in the time in the second column and a * in the appropriate box:

	Time of practice	**No image at all**	**Vague and dim**	**Moderately vivid**	**Clear and reasonably vivid**	**Perfectly clear and vivid**	**I did not do it**
Recording	am/pm						
Written Imagery	am/pm						

How was your sleep quality last night? (Please underline the relevant number)

1……….2……….3……….4……….5……….6……….7……….8……….9……….10

Very bad Fairly bad. Fairly good Very good

	Please delete the answer that is not applicable		
Was sleep sufficient to meet your needs today?	**YES**	**NO**	
Did you wake up during the night at all?	**YES**		If YES please state times here:
Did you exercise within 2 hrs of bedtime?	**YES**	**NO**	
Did you consume stimulants (e.g. coffee) within 2hrs of bedtime?	**YES**	**NO**	If YES please state type here:
Note: these should be rough estimates only.	**Please state**		
Time of lights out:	am/pm		
Time taken to get to sleep	minutes		
Hours of sleep	hours		
Time of waking	am		

Other comments

………………..The survey is complete thank you for your effort …………………………….

Appendix J Study 2: Final Follow-up Questionnaire: Additional Measures

Frequency of Practice

Over the past three weeks how often did you practice the imagery exercise?

	Not at all	Once or twice	At least 3 times per week	Only missed 1 or 2 days	I practiced the imagery every day
Using the recording?					
Using the written instructions before bed?					
Without any instructions?					

Quality of Written Instructions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The written instructions are clear					
The written instructions cleared my mind					
The written instructions were relaxing					
The instructions were easy to follow					
The instructions were hard to read					
The written instructions affected me emotionally					
The written instructions guided me to generate imagery					
The written instructions were the appropriate length					
The written instructions did not convince me to improve my sleep patterns					
The written instructions were easy to remember					
The instructions were detailed enough for me to generate imagery					
I had other problems with the written instructions which were: (Please state)					

How useful did you find the following tools?

	Not useful at all	Slightly useful	Moderately useful	Very useful
CD recording				
Written instructions				

VIVIDNESS OF IMAGERY

	No image(s) at all	Vague and dim	Moderately vivid	Clear and reasonably vivid	Perfectly clear and vivid
The images I experienced for the recording were:					
The images I experienced for the written instructions before bed were:					

SLEEP-RELATED IMAGERY ACTION

Each evening how often did you...	Not at all						Every night
Change into comfortable clothes upon arriving home?							
Sit down and relax quietly for at least half an hour before bed?							
Carry out a bedtime routine?							
Have a set bedtime each night?							
Ensure that the bedroom was comfortable?							
Make the bed as comfortable as possible?							

ADDITIONAL COMMENTS: Were there any changes you noticed over the 3 week period that resulted from taking part in this intervention? Please include any comments you have about the study here also.

Appendix K Treatment Manual Study 2

Introduction and Instructions Read:

"Thank you all for coming and agreeing to take part in this study. First I will explain the study then in a short moment I will be playing a tape with the instructions for your specific group. It is preferred that you keep the specific details of what you are doing to yourself to avoid compromising the study for others you know who are also taking part. This study attempts to use findings from recent research to promote night-time sleep in daytime employees. In this study you will participate in one of four study groups, each of which will receive a different set of visualisation techniques. You will be asked to practice these techniques for three weeks. Specific details of the group you are in will not be made available until you have finished the intervention. Soon I will be playing a tape with the instructions relating to your group. Once the tape has finished playing there will be a short questionnaire to complete then you will be free to go. Are there any questions before we begin? (pause). I will now turn off the lights – please try to follow the instructions as well as you can and get into a position where you feel the most relaxed".

Flesch reading ease: 63.1 Words: 209 Time: 1.05 minutes

IMAGERY INSTRUCTIONS

AR Only Group (A)

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. Imagine putting all your concerns, stresses and emotions into a bag ***(pause)****. Imagine picking up the bag feeling how heavy it is. Put the bag on your back and feel the weight on your shoulders. Imagine walking and feel the bag getting harder and harder to carry* ***(pause).*** *Now imagine stopping, unloading the bag from your shoulders and putting it down for now* ***(pause)****. Take a deep breath* ***(pause).*** *Feel the relief it is to get the bag off and how much lighter you are* ***(pause).*** *Slowly, walk away from the bag and feel how your body becomes lighter and lighter* ***(pause).*** *Spend some time experiencing these feelings of relief and feel the calmness around you as your breathing slows down* ***(pause).*** *Your mind is now clear your body is relaxed and you are ready to sleep* ***(pause)****. Take a moment then open your eyes."*

Flesch reading ease: 78.0 Words: 164 Time: 1.27 minutes

II Only Group (B) INITIAL SESSION ONLY

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. First imagine a time for bed that is early enough to meet your sleep needs, visualise what time this is ***(pause).*** *Make this your scheduled time for bed and have it set in your head. Refer to this time when you do the exercise from now on. Imagine it is NOW after work AND you are arriving home* ***(pause).*** *Imagine you are changing into some comfortable clothes* ***(pause).*** *It is NOW half an hour before your scheduled bedtime AND you are at home* ***(pause).*** *Imagine sitting down and relaxing quietly* ***(pause).*** *It is NOW just before your scheduled time for bed AND you are in the bathroom* ***(pause).*** *Imagine going through a set routine where you do activities such as brushing your teeth* ***(pause).*** *It is NOW time for bed AND you are in your bedroom* ***(pause).*** *Imagine making sure all distractions are removed, the bed is comfortable and the temperature soothing and finally changing into what you sleep in* ***(pause).****You are NOW lying in the dark AND ready for sleep* ***(pause).*** *Imagine your eyelids getting heavy and your breathing slowing down* ***(pause).*** *Once you have imagined this clearly open your eyes."*

Flesch reading ease: 75.1 Words: 213 Time: 2.26 minutes

II Only Group (B) DAILY SESSIONS

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. Imagine it is NOW after work AND you are arriving home. ***(Pause).*** *Imagine you are changing into some comfortable clothes* ***(pause).****It is NOW half an hour before your scheduled bedtime AND you are at home* ***(pause).*** *Imagine sitting down and relaxing quietly* ***(pause).****It is NOW just before your scheduled time for bed AND you are in the bathroom* ***(pause).*** *Imagine going through a set routine where you do activities such as brushing your teeth* ***(pause).*** *It is NOW time for bed AND you are in your bedroom* ***(pause).*** *Imagine making sure all distractions are removed, the bed is comfortable and the temperature soothing and finally changing into what you sleep in* ***(pause).*** *You are NOW lying in the dark AND ready for sleep* ***(pause).*** *Imagine your eyelids getting heavy and your breathing slowing down* ***(pause)****.Once you have imagined this clearly open your eyes."*

Flesch reading ease: 72.3 Words: 169 Time: 2.00 minutes

Combined II and AR Group (C) INITIAL SESSION ONLY

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. First imagine a time for bed that is early enough to meet your sleep needs, visualise what time this is ***(pause).*** *Make this your scheduled time for bed and have it set in your head* ***(pause).*** *Refer to this time when you do the exercise from now on. Imagine it is NOW after work AND you are arriving home.* ***(Pause).*** *Imagine that you are carrying a bag that has all your concerns, stresses and emotions loaded into it. Imagine how heavy it feels to walk carrying the bag. Now imagine unloading the bag from your shoulders and setting it down for now. Take a deep breath* ***(pause).*** *Feel how much lighter you are and the relief it is to get the bag off. Spend some time experiencing these feelings of relief and the calmness as your breathing slows down.* ***(Pause).*** *It is NOW half an hour before your scheduled bedtime AND you are at home* ***(pause).*** *Imagine sitting down and relaxing quietly* ***(pause).*** *It is NOW just before your scheduled time for bed AND you are in the bathroom* ***(pause).*** *Imagine going through a set routine where you do activities such as brushing your teeth* ***(pause).*** *It is NOW time for bed AND you are in your bedroom* ***(pause).*** *Imagine making sure all distractions are removed, the bed is comfortable and the temperature soothing and finally changing into what you sleep in* ***(pause).*** *You are NOW lying in the dark AND ready for sleep* ***(pause)*** *Imagine your eyelids getting heavy and your breathing slowing down* ***(pause).*** *Once you have imagined this clearly open your eyes."* **Flesch reading ease: 78 Words: 285 Time: 3.06 minutes**

Combined II and AR Group (C) DAILY SESSIONS

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. Imagine it is NOW after work AND you are arriving home. ***(Pause).*** *Imagine that you are carrying a bag that has all your concerns, stresses and emotions loaded into it. Imagine how heavy it feels to walk carrying the bag. Now imagine unloading the bag from your shoulders and setting it down for now. Take a deep breath* ***(pause).*** *Feel how much lighter you are and the relief it is to get the bag off. Spend some time experiencing these feelings of relief and the calmness as your breathing slows down.* ***(Pause).*** *It is NOW half an hour before your scheduled bedtime AND you are at home* ***(pause).*** *Imagine sitting down and relaxing quietly* ***(pause).*** *It is NOW just before your scheduled time for bed AND you are in the bathroom* ***(pause).*** *Imagine going through a set routine where you do activities such as brushing your teeth* ***(pause).*** *It is NOW time for bed AND you are in your bedroom* ***(pause).*** *Imagine making sure all distractions are removed, the bed is comfortable and the temperature soothing and finally changing into what you sleep in* ***(pause).*** *You are NOW lying in the dark AND ready for sleep* ***(pause)*** *Imagine your eyelids getting heavy and your breathing slowing down* ***(pause).*** *Once you have imagined this clearly open your eyes."*

Flesch reading ease: 75.8 Words: 240 Time: 2.39 minutes

CONTROL Group (D)

"Welcome to the "using imagery to promote quality sleep study". Please get into a comfortable position and close your eyes. Imagine you are finishing work then imagine what the trip was like since leaving work ***(pause).*** *Imagine where you went* ***(pause).*** *Now move ahead in time and picture how you spent your time since getting home* ***(pause).*** *Imagine yourself as you go through the activities you did after work. Walk through in detail what you did during this time of the day* ***(pause).*** *Imagine the night progressing and getting to a point where you were thinking about going to bed* ***(pause).*** *Think about the activities that you are doing at this time* ***(pause).*** *Imagine what you did before turning off the lights* ***(pause).*** *Picture the environment where you are sleeping and what your bed looks like* ***(pause).*** *Imagine how you feel as you lie in bed* ***(pause).*** *Picture some of the thoughts on your mind at this time* ***(pause).*** *Once you have imagined this clearly open your eyes."*

Flesch reading ease: 80.6 Words: 168 Time: 1.23 minutes

Passage Read Out At End of Initial Imagery Session

"Thank you for taking part today. As a reminder, please practice this imagery using the recording at 3pm each day and at night immediately before bed using the written instructions over the next three weeks. To assist you there are instructions on doing this and a CD. You will also be sent an email at 8am each work day for three weeks for you to record the time you completed the visualisation exercise. In addition, in this email you will be asked to complete a short measure assessing your previous night's sleep. At the three week completion date you will also be emailed a final short survey to complete. Once all the emails and the final survey have been received you will be sent your individual reward for taking part. Group results will follow once all the data is in. I hope you enjoyed the session. We really appreciate the time and effort you are putting in for this study. If you have any questions at any stage please do not hesitate to make contact."

Flesch reading ease: 63.8 Words: 175 Time: 1.02 minutes

-----End of Treatment Manual-----

Appendix L SAS code for mixed modelling

Commands used in Mixed Model Analyses: Online Descriptive Study

- **Proc mixed**;
- Class day;
- Model sleepqualityTN = day workpriority sleep priority workgoalcognitions quantdemand cognitivedemand emotiondemand roleconflict negworkemotions/s htype= (3) ddfm = kr CI;
- Repeated /subject = code type= AR(1);

Where: 'day' is the "day" measure (Day 1 to Day 8)

'sleepqualityTN' is the dependent measure of sleep quality for the following night

'workpriority sleep priority workgoalcognitions quantdemand cognitivedemand emotiondemand roleconflict negworkemotions' are the independent measures

'subject' is the subject identification number

'/s htype= (3) is the fixed effects method chosen

'type = AR(1)' is the random effects method chosen

(This method was repeated for the rest of the independent measures of time of lights out, time to sleep, total hours of sleep, and time of waking and, in a second round of analyses, the same dependent measures were entered with the independent measures of meaning of work and positive work-related emotions).

Commands used in Mixed Model Analyses of the Intervention Studies

- **Proc mixed**;
- Class day;
- Model sleepqualityTN = day arousal reduction implementation intentions arousal reduction*implementation intentions/s Htype= (3) ddfm = kr cL;
- Repeated /subject = code type= AR(1);

Where: ‘day’ is the “day” measure (Day 1 to Day 21)

‘sleepqualityTN’ is the dependent measure of sleep quality for the following night

‘arousal reduction’ includes the intervention groups that received the arousal reduction imagery

‘implementation intentions’ includes the intervention groups that received the implementation intentions imagery

‘subject’ is the subject identification number

‘/s htype= (3) is the fixed effects method chosen

‘type = AR(1)’ is the random effects method chosen

(This method was repeated for the rest of the dependent measures of time of lights out, time to sleep, total hours of sleep, time of waking, vividness of imagery, waking during the night and stimulant use before bed).

Appendix M **Summary of Mixed Modelling Analyses of the Relationships between Work-Related Events and Sleep-Related Measures**

Sleep Outcome	Events Conflicting with Week Goal		Events Conflicting with 12 month Goal	
	Est. *(SE)*[CI]	*t*	Est. *(SE)*[CI]	*t*
Sleep Quality [a]	.045(.045) [-.135, .044]	-1.00	.033(.049) [-.064, .130]	0.67
Time of Lights Out[b]	-.019(.024) [-.065, .028]	-0.79	.001(.026) [-.049, .052]	0.05
Time to Sleep[b]	.705(.464) [-.207, 1.616]	1.52	-.752(.496) [-1.728, .224]	-1.52
Hours of Sleep	-.025(.060) [-.144, .093]	-0.42	-.005(.067) [-.136, .227]	-0.07
Time of Waking[c]	.003(.013) [-.023, .029]	0.22	-.035(.014) [-.063, -.007]	**-2.44***

Note. Analyses include observations from 91 employees over 10 days with 465 to 468 observations missing: [a] Observations = 423; [b] Observations = 426; [c] Observations = 425; * $p < .05$

Appendix N Intervention Development Studies Correlation Tables

Correlations Amongst Key Measures at Baseline Development One

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. PSQI	-															
2. Dysfunctional Beliefs	-.07	-														
3. Perceived Stress	.03	.11	-													
4. Negative Sleep Habit Strength	.07	.01	.15	-												
5. Negative Sleep Habits	.17	.19	**.40***	.19	-											
6. Work-Related Demand	.06	-.25	.18	-.03	**.55****	-										
7. Diet	.13	.30	**-.36***	.04	-.28	-.08	-									
8. Alcohol	.12	.09	.05	.01	-.26	-.08	.32	-								
9. Fatigue	.01	.27	**.50****	.23	.27	.06	-.04	-.06	-							
10. Work Goal Motivations	.09	-.06	**-.55****	-.13	-.05	.13	.27	.22	**-.34***	-						
11. Exercise Levels	.08	.20	.11	-.01	.12	.07	.17	.14	.04	.01	-					
12. Pre-sleep Arousal	.15	.02	**.38***	.08	**.49****	**.36***	-.03	.04	.13	-.01	.16	-				
13. Sleep Motivation	-.08	.22	-.07	.09	**-.43****	-.30	.41	**.40***	.09	-.08	.00	-.23	-			
14. Sleep Self-Efficacy	.01	.04	-.11	.18	-.19	-.13	.20	**.33***	-.21	.02	.14	-.01	**.59****	-		
15. Sleep Response-Efficacy	.02	-.05	**-.37***	.05	**-.34***	-.12	.31	**.42****	**-.44****	.20	.11	-.15	**.47****	**.69****	-	
16. Sleep Planning	-.01	-.08	-.18	.09	**-.33***	-.28	.12	**.37***	-.20	.11	-.21	.14	**.33***	**.34***	**.38***	-

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

Correlations amongst Key Measures at Baseline Intervention Development Two

		1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	PSQI	-															
3	Sleep Motivation	-.07	-														
4	Sleep Self -Efficacy	-.23	**.47****	-													
5	Sleep Response -Efficacy	-.28	**.38***	**.73****	-												
6	Sleep-Related Planning	-.04	.27	**.43****	**.32***	-											
7	Anxiety	**.50****	.31	-.17	**-.40***	-.02	-										
8	Depression	**.50****	-.01	-.21	-.26	.12	**.70****	1									
9	Perceived Stress	**.48****	-.00	**-.37***	**-.51****	.01	**.85****	**.84****	-								
10	Fatigue	.21	.11	-.29	**-.34***	-.12	**.64****	**.64****	**.72****	-							
11	Work Recovery	**.41***	.32	-.17	-.29	-.02	**.75****	**.70****	**.75****	**.76****	-						
12	Dysfunctional Sleep Beliefs	.08	**.62****	.05	.11	.12	**.35***	.26	.25	**.41***	**.38***	-					
13	Pre-sleep Arousal	**.43****	-.10	-.32	**-.48****	**-.28**	**.64****	**.40***	**.54****	**.45****	**.40***	.10	-				
14	Negative Sleep Habits	-.18	.05	-.31	-.33	**-.42***	.20	.11	.29	.12	.16	.19	**.49****	-			
15	Negative Sleep Habit Strength	-.04	-.24	-.30	-.11	-.05	.00	.16	.03	.21	.09	-.20	.08	.01	-		
16	Diet	.18	.32	.18	.01	.28	-.01	-.20	-.27	-.26	-.10	.13	-.15	-.28	-.14	-	
17	Exercise	.15	-.17	.11	.09	.06	-.31	-.25	-.29	**-.36***	-.27	**-.37***	.09	.04	.12	.01	-

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

Correlations Amongst Key Measures at Final Follow-up Intervention Development Study One

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Diet	-																		
2	Smoking	-.01	-																	
3	Alcohol Intake	.20	.28	-																
4	Exercise Level	**.49****	.09	.26	-															
5	PSQI	-.27	.14	-.09	.03	-														
6	Sleep Motivation	.21	-.21	.17	.02	-.19	-													
7	Sleep-Related Planning	.18	-.04	.12	.13	-.24	**.62****	-												
8	Sleep Self-Efficacy	**.34***	-.17	.17	.23	-.28	**.73****	**.61****	-											
9	Sleep Response-Efficacy	.10	.08	.11	-.04	**-.57****	**.41***	.24	**.50****	-										
10	Sleep Quality	.06	-.02	.01	-.16	**-.75****	.14	.09	.13	**.60****	-									
11	Negative Sleep Habits	-.13	.22	.02	.02	**.55****	-.17	-.13	-.15	-.24	**-.42***	-								
12	Negaive Sleep Habit Strength	.13	.16	.15	.15	**.39***	.12	.11	.12	-.22	**-.44***	**.66****	-							
13	Quantitative Demand	-.12	.22	.06	-.03	.16	.05	.05	-.03	.07	-.14	**.62****	.08	-						
14	Cognitive Demand	.14	**.45****	.20	.27	-.02	-.16	-.22	-.16	.18	.26	.27	.07	.30	-					
15	Emotional Demand	.19	.14	.17	.11	-.04	.15	-.08	.13	**.33***	.22	.33	.22	.25	**.48****	-				
16	Anxiety	.16	-.08	-.12	.01	.15	-.14	.04	-.03	-.04	**-.33***	**.55****	**.40***	**.40***	.15	.23	-			
17	Depression	**-.38***	.15	.05	.08	**.57****	-.25	-.13	-.19	**-.34***	**-.58****	**.62****	**.45***	**.39***	.15	1.9	**.46****	-		
18	Perceived Stress	-.30	.16	.17	-.07	**.45****	-.33	-.20	**-.38***	**-.39***	**-.44****	**.73****	**.45***	**.52****	.23	.17	**.60****	**.79****	-	
19	Fatigue	-.24	-.04	-.10	.02	**.48****	-.08	-.04	-.23	**-.44****	**-.61****	**.46****	**.40***	.30	-.10	-.03	**.44****	**.72****	**.61****	-

** p < .05, **p < .01*

Correlations Amongst Key Measures at Final Follow-up Intervention Development Study Two

		1	3	4	5	6	7	8	9	10	11	12	13	14
1	PSQI	-												
3	Sleep Motivation	-.04	-											
4	Sleep Self Efficacy	**-.50****	**.38***	-										
5	Sleep Response Efficacy	**-.57****	.31	**.91****	-									
6	Sleep-Related Planning	.09	**.51****	.28	.16	-								
7	Fatigue	**.38***	-.05	**-.39***	**-.45****	-.27	-							
8	Work Recovery	**.47****	-.03	-.31	**-.34***	-.16	**.75****	-						
9	Dysfunctional Sleep Beliefs	**.45****	**.52****	-.20	-.24	.07	**.46****	**.57****	-					
10	Pre-sleep Arousal	**.49****	-.04	**-.35***	**-.41***	-.02	**.53****	**.51****	**.43****	-				
11	Negative Sleep Habits	**.40***	-.02	**-.38***	-.31	-.12	.31	.18	.31	**.50****	-			
12	Negative Sleep Habit Strength	.04	-.09	-.26	-.21	.09	-.06	.14	.10	.03	.06	-		
13	Diet	-.15	.28	**.41***	**.36***	.27	**-.38***	**-.35***	-.17	-.16	.02	-.23	-	
14	Exercise	.14	.07	.11	-.03	.30	**-.40***	-.24	-.09	-.08	-.33	-.01	.13	-
15	Sleep-Related Action	.06	**.36***	.22	.16	**.48****	-.26	-.10	.24	-.25	-.24	.23	.31	**.36***

** p < .05, **p < .01*

Appendix O Full Correlation Matrix of Main RCT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	PSQI	1																									
2	Sleep Motivation	-.07	1																								
3	Self-Efficacy	-.48**	.29**	1																							
4	Response-Efficacy	-.62**	.15	.73**	1																						
5	Sleep-Related Plan	-.16	.13	.36**	.33**	1																					
6	Anxiety	.48**	-.16	-.32**	-.44**	-.15	1																				
7	Perceived Stress	.32**	-.23*	-.39**	-.42**	-.15	.71**	1																			
8	Fatigue	.32**	-.19	-.36**	-.39**	-.05	.42**	.39**	1																		
9	Work Recovery	.35**	-.06	-.21*	-.20*	.03	.29**	.31**	.40**	1																	
10	Dys Beliefs	.39**	.00	-.20*	-.30**	.04	.29**	.37**	.25*	.66**	1																
11	Neg Sleep Habit	.13	-.20	-.10	-.12	-.34**	.23*	.20	.06	.15	.19	1															
12	Neg Habit Strength	.13	-.02	-.15	-.20	-.19	.22*	.29**	.07	.20	.21*	.35**	1														
13	Pre-sleep Arousal	.47**	-.22*	-.30**	-.35**	-.16	.55**	.48**	.37**	.43**	.37**	.23*	.26*	1													
14	Sleep-related Action	.09	.30**	.12	.11	.41**	-.09	-.16	-.12	.09	.04	-.38**	-.25*	-.08	1												
15	Exercise	.14	.03	.04	-.05	.02	-.17	-.16	.02	-.11	-.03	-.15	-.09	.04	.03	1											
16	Smoking	.00	-.05	.07	.12	.19	.04	.21*	-.07	.10	.03	.06	.03	.08	.09	-.03	1										
17	Alcohol	.06	-.07	-.02	.04	-.16	.02	.05	-.10	-.02	.00	.18	.13	-.17	-.15	-.04	.05	1									
18	Diet	.07	.13	.00	.01	-.04	-.17	-.24*	-.01	-.28**	-.15	-.26*	-.19	-.15	.34**	.23*	-.33**	.00	1								
19	Sleep Quality	-.78**	.15	.55**	.67**	.26*	-.47**	-.38**	-.43**	-.25*	-.37**	-.08	-.05	-.40**	.02	-.14	-.02	-.08	-.02	1.00							
20	Lights Out	-.01	-.38**	-.10	.00	-.20*	.14	.13	.10	-.10	-.10	.34**	.08	.08	-.14	.05	.16	.16	-.04	-.06	1						
21	Time to Sleep	.54**	-.05	-.23*	-.27**	-.11	.31**	.29**	.29**	.33**	.36**	.13	.12	.43**	.02	.09	.09	.13	.01	-.40**	.08	1					
22	Hours of Sleep	-.60**	.14	.29**	.36**	.04	-0.17	.01	-.04	-.02	.02	-.07	-.06	-.10	-.13	-.21*	.04	.02	-.16	.38**	-.29**	-.11	1				
23	Time of Waking	-.02	-.12	.09	.19	-.05	.13	.16	-.02	.09	.12	.22*	-.02	.14	-.11	-.15	.18	.10	-.24*	.04	.24*	.28**	.38**	1			
24	AR Vividness	-.10	.04	.12	.14	.13	-.11	-.08	.12	-.08	.02	-.11	-.13	-.07	-.07	.01	.02	-.09	-.01	.06	.03	-.01	.10	.06	1		
25	II Vividness	-.11	.20	.27**	.20*	.43**	-.04	-.10	-.08	-.02	-.04	-.17	-.08	-.13	.36**	.01	-.08	-.19	.05	.22*	-.18	-.14	-.01	.05	-.11	1	
26	SRCT Time to Sleep	.04	-.04	-.13	-.09	-.12	.05	.17	.03	.00	-.04	.21*	.00	.06	-.08	-.11	.07	-.01	-.26*	-.11	.25*	-.09	-.19	.19	-.17	.10	1

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

Appendix P CONSORT Checklist

Used for Main Randomised Controlled Trial: Using Imagery to Promote Quality Sleep

(From: www.consort-statement.org)

Checklist of items to include when reporting a randomised trial

PAPER SECTION AND TOPIC	Item	Description	Reported on page #
Title and Abstract	1	How participants were allocated to interventions: "randomly assigned".	132
Introduction	2	Scientific background and explanation of rationale	103-116
Methods: Participants	3	Eligibility criteria for participants and the settings and locations where the data were collected	119-120
Interventions	4	Precise details of the interventions intended for each group and how and when they were actually administered	133-135 and Appendix K
Objectives	5	Specific objectives and hypotheses	117-118
Outcomes	6	Clearly defined primary and secondary outcome measures and, when applicable, any methods used to enhance the quality of measurements (e.g. multiple observations, training of assessors).	135-137
Sample size	7	How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules.	119
Randomisation: Sequence generation	8	Method used to generate the random allocation sequence, including details of any restriction (e.g. blocking, stratification).	132
Randomisation: Allocation concealment	9	Method used to implement the random allocation sequence (e.g. numbered containers or central telephone), clarifying whether the sequence was concealed until interventions were assigned.	132
Randomisation: Implementation	10	Who generated the allocation sequence, who enrolled participants, and who assigned participants to their groups.	132
Blinding (masking)	11	Whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to group assignment. When relevant, how the success of blinding was evaluated.	132