SLEEP WELL, WORK WELL: THREE STUDIES

by

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Abstract

My dissertation explores the relationship between sleep and work, with attention to how sleep impacts work-related outcomes. Study 1 extended the current work stress and sleep literature by examining the reciprocal relationship between sleep and work stress within the job demands-control-social support model of work stress. The reciprocal relationship was tested using five-wave longitudinal data. This cross-lagged model was partially supported, as sleep impacted perceptions of work stress across the five wave study, whereas work stress affecting sleep was marginally significant across the five wave study.

Study 2 examined the influence of sleep on both positive (i.e., transformational leadership) and negative (i.e., abusive supervision) leadership behaviors. I hypothesized that sleep influences leadership indirectly through its effects on self-control. To examine the indirect relationship between sleep and leadership behaviors, a daily diary study methodology was used, where leaders described their daily sleep and self-control and followers rated their leaders’ leadership behaviors. A multilevel structural equation model was used to test these mediational models. There was support for sleep affecting abusive supervision through self-control across the 15 day daily study, however this relationship was not supported for transformational leadership.

Study 3 examined the impact of a common sleep disorder (obstructive sleep apnea; OSA) on work withdrawal behaviors. To examine this relationship, a sample of individuals attending an overnight sleep laboratory, with possible OSA were recruited. A within-subjects, pre-test, post-test design was used, where individuals completed a survey before and then two times after they received clinical treatment for their sleep disorder. Latent growth curve modeling was used to test this relationship. Findings show that daytime sleepiness caused by OSA effects withdrawal from work (partial absenteeism and absenteeism). Daytime sleepiness also lead to
withdrawal at work (work neglect) through cognitive depletion. In addition, receiving treatment for sleep apnea decreased daytime sleepiness across time, and this improvement in daytime sleepiness resulted in decreased withdrawal from and at work over time; the indirect effects of the improvements in daytime sleepiness on withdrawal at work was mediated by improvements in cognitive depletion.

The dissertation closes with a general discussion of the contributions of these three studies.
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Statement of Originality

I hereby certify that all of the work described within this thesis is the original work of the author. Any published (or unpublished) ideas and/or techniques from the work of others are fully acknowledged in accordance with the standard referencing practices.

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Chapter 1

Sleep and Work: An Introduction

Sleep is a fundamental requirement for healthy human functioning (Siegel, 2005). The human body seeks sleep with a drive at least as great as the drive for food or sex and humans sleep one-third of our lives away (Siegel, 2005). Powerful physiological mechanisms regulate sleep, so that although people can thwart sleep and stay awake for a while, the control over sleep-wake patterns is limited and prolonged periods of waking activity lead to heavy drowsiness and will eventually lead to sleep (Barnes, 2012; Breslau, Roth, Rosenthal & Andreski, 1997; Porkka-Heiskanen et al., 1997).

Siegel (2005) defines sleep as “a state of immobility with greatly reduced responsiveness, which can be distinguished from coma or anesthesia by its rapid reversibility” (p. 1264). Rather than a cessation of brain activity, sleep is regarded as a reorganization of neural activity that has many restorative processes necessary for brain functioning (Hobson, 2005). Sleep consists of four cycles that are generally categorized as REM (rapid eye movement) or non-REM sleep (NREM; McCarley, 2007). After going through the three NREM stages, the first REM stage occurs, usually about 70 minutes after falling asleep. The full sleep cycle repeat about every 90 minutes (Barnes, 2012; McCarley, 2007). Theories of REM sleep suggest it is important in periodic brain activation during sleep, in localized recuperative processes and regulation. In contrast, theories of NREM sleep suggest that NREM sleep is important for energy conservation and nervous system recuperation (Siegel, 2005).

Although much is known about sleep and sleep processes, the exact purpose of sleep is still unclear (Saper, Scammell, & Lu, 2005; Siegel, 2005). Research supports theories that suggest that sleep saves energy, keeps species from being active at inopportune times, reverses
waking-induced changes in brain functioning, and has a restorative effect on the brain (Saper et al., 2005; Siegel, 2005). Previous research also suggests that an adequate amount of sleep is essential for optimal daytime functioning (Pilcher & Huffcutt, 1996). The recommended amount of sleep for adults is eight hours a night (Cote, 2003).

Sleep has a broad array of effects on human functioning. Yet sleep research in the organizational literature remains sparse despite the interdependence of sleep and work. Employed individuals not only have work-related responsibilities, but simultaneously must engage in activities outside of work, of which sleep is one (Barnes, Wagner, & Ghumman, 2012). Studies indicate that on average people spend more time sleeping than working, making sleep a dominant activity in the lives of most working adults (Barnes & Wagner, 2009; Biddle & Hamermesh, 1990). Because of this, sleep and work often conflict with one another and generally the more people work, the less they sleep (Hurst, 2008). Sleep and work are profoundly interrelated and more research is needed to further understand this relationship.

Therefore, the purpose of my dissertation is to contribute to the growing body of literature on sleep and work; particularly by extending the literature on how sleep affects different work-related outcomes across the three empirical studies. My goal is to illustrate the importance of sleep within a work setting by demonstrating the wide-ranging effects that sleep has on work. In the remaining part of this introductory chapter, I describe the importance of sleep and why organizational researchers should care about sleep, define important sleep constructs and provide examples of previous research that has investigated the relationship between sleep and work. Finally, I provide a theoretical model for understanding the relationship between sleep and work and describe the three studies of my dissertation.
Importance of Sleep

Organizational behavior (OB) researchers should be concerned about sleep because research from across the world suggests that adults are sleeping less; with sleep decreasing at a rate of about 5 minutes per decade in the last three decades (Kronholm et al., 2008). The majority of Canadian adults sleep an average of 6.9 hours per night, while 30% get less than 6 hours (Adams, 2012). This pattern of insufficient sleep is also evident elsewhere in the world, including the United States, Korea, Finland, Sweden, and England (Groeger, Zijlstra, & Dijk, 2004; Luckhaupt, Tak, & Calvert, 2010; Park et al., 2010; Rowshan Ravan, Bengtsson, Lissner, Lapidus, & Bjorkelund, 2010; Salminen et al., 2010; Westerlund et al., 2008). Thus, across many countries, many employees go to work each day after an insufficient amount of sleep.

Organizational researchers should also be concerned about insufficient sleep because of the close relationship between sleep, well-being and health. Sleep affects the regulation of well-being. For example, when sleep is restricted from ten hours to four hours across only 12 consecutive days, optimism-sociability (emotional well-being) declined progressively and bodily discomfort (physical well-being) increased (Haack & Mullington, 2005). Well-being impacts every aspect of life, including work functioning (Haack & Mullington, 2005). Individuals high in well-being are evaluated more positively by supervisors, have increased performance and productivity, and make better managers. In contrast, they are also less likely to show counterproductive workplace behavior and job burnout (Lyubomirsky, King & Diener, 2005). Sleep is also essential in the recovery from overly-demanding work, thereby promoting employee health and well-being (Saper et al., 2005; Siegel, 2005; Sonnentag, 2001). Sleep also affects physical health, with consequent economic costs through employee absence, illness (e.g., hypertension and heart disease) and on-the-job productivity loses (e.g. Goetzel et al., 2004;
Mallon, Broman & Hetta, 2002; Olson, King, Hensley, & Saunders, 1995). Thus because of the potential impact of sleep on well-being and health, it is crucial that organizational psychology researchers examine sleep.

**Sleep Constructs**

Sleep loss or lack of sleep can be understood through a number of different constructs. One construct is sleep deprivation, which has been described as a state of diminished capacity induced by a shortage of sleep. This can occur acutely (e.g., after staying awake for prolonged periods of time such as 37 hours continuously; Caldwell, Caldwell, Brown, & Smith, 2004) or chronically (e.g., when restricting sleep to six hours per night for two weeks; Van Dongen, Maislin, Mullington, & Dinges, 2003). There is an enormous literature outside of the organizational behavior area demonstrating the many detrimental effects of sleep deprivation (for reviews, see Harrison & Horne, 2000; Lim & Dinges, 2010; Pilcher & Huffcutt, 1996). For example, missing a single night of sleep results in decreases in innovative thinking (Harrison & Horne, 1999), and executive functioning (Nilsson et al., 2005). Elmenhorst et al. (2009) found that four consecutive nights of five hours of sleep per night leads to cognitive task performance equivalent to a blood alcohol content of 0.6%. Thus even small amounts of sleep deprivation can result in important negative outcomes (Barnes, 2012).

There are two other important constructs relating to sleep loss, namely sleep quantity and sleep quality. Sleep quantity refers to the amount of time spent in the sleeping state, whereas sleep quality refers to difficulty of falling asleep, staying asleep and the number of awakenings experienced in the night (Harvey, Stinson, Whitaker, Moskovitz, & Virk, 2008; Scott & Judge, 2006). Individuals could sleep many hours in a given night (sufficient sleep quantity), while having many periods of being awake (poor sleep quality) and therefore not find sleep refreshing,
or they could sleep very few hours (insufficient sleep quantity) but sleep soundly (high sleep quality; Barnes, 2012). Therefore, sleep quantity and quality are conceptually and empirically distinct. Nonetheless, sleep quality and quantity may have similar outcomes and their effects are potentially parallel and additive (Barnes, Schaubroeck, Huth, & Ghumman, 2011; Barnes & van Dyne, 2009; Hursh et al., 2004).

There is one final construct that is an important outcome of sleep loss or sleep deprivation, namely daytime sleepiness (Mullins, Cortina, Drake, & Dalal, 2014), which is the most common and disabling immediate consequences of sleep problems (e.g., Pack et al., 2010; Swanson et al., 2011). Close to half of patients seen by physicians in sleep centers and at least 11% of the general population experience daytime sleepiness (Carskadon et al., 1986; Drake, 2011; Mullins et al., 2014). Sleepiness is a physiological need state, or the desire for sleep (Dement & Carskadon, 1982). Sleepiness is associated with increased sleep pressure that results in decrements in psychological functioning (Drake, 2011; Roehrs, Carskadon, Dement, & Roth, 2011). Sleepiness results from reductions in quantity or quality of sleep, sleep disorders, circadian rhythms, drugs that act upon the central nervous system (CNS), or the presence of a CNS disorder (Roehrs et al., 2011).

**Sleep and Work**

There is a large body of sleep physiology research that highlights the effects of sleep on human functioning (for reviews, see Harrison & Horne, 2000; Lim & Dingis, 2010). However, until recently organizational behavior research has generally ignored the effects of sleep on work. What little research that does exist on sleep and work demonstrates that sleep affects work and is affected by work (e.g., Akerstedt, Fredlund, Gillberg, & Jansen, 2002; Barnes et al., 2012). For example, sleep deprivation leads to poor task performance (Kessler et al., 2011;
Pilcher & Huffcutt, 1996) and the prevalence and severity of work injuries (Barnes & Wagner, 2009; Kling, McLeod, & Koehoorn, 2010). As well, low sleep quantity and quality are associated with job dissatisfaction (Scott & Judge, 2006), less organizational citizenship behavior (Barnes, Ghumann, & Scott, 2013) and increased levels of social loafing (Hoeksema-van Orden, Gaillard, & Buunk, 1998). Insufficient sleep is also a risk factor for burnout (Soderstrom, Jeding, Ekstedt, Perski, & Åkerstedt, 2012). Sleepiness has been associated with work withdrawal behaviors, such as arriving late at work, falling asleep at work, and leaving early from work (Swanson et al., 2011). Finally, one study (Horne, 1988) found that multiple dimensions of creativity including flexibility and originality were significantly impaired in participants experiencing sleep deprivation compared with those who were not.

At the same time, sleep is also influenced by work-related activities. Previous research has demonstrated that high job demands and low job control predict sleep disturbances (e.g. De Lange et al., 2009; Kalimo, Tenkanen, Härnä, Poppius, & Heinsalmi, 2000; Sonnentag & Zijlstra, 2006). As well, physical working conditions, psychosocial working conditions and work-family conflict predict increased sleep complaints (e.g. Lallukka, Rahkonen, Lahelma, & Arber, 2010). Finally, both organizational injustice and workplace bullying have been found to increase sleep disturbances (e.g. Greenberg, 2006; Niedhammer, David, Degioanni, Drummond, & Philip, 2009). Thus, research in the area of work and sleep suggests that sleep plays an important role in work-related outcomes and that work also has the potential to impact sleep. To make sense of the relationship between work and sleep, most researchers have turned either to daytime sleepiness (discussed above; Mullins et al., 2014) or to self-regulation theories as explanatory mechanisms, and I now turn my attention to self-regulation.
Most major personal and social problems involve some failure at self-regulation (Baumeister & Heatherton, 1996). Theories of self-regulation describe how awareness and attention maintain and enhance psychological and behavioral functioning, often in the presence of adverse or distracting stimuli (Lord, Diefendorff, Schmidt & Hall, 2010). Human beings have an extraordinary capacity to override their immediate response and change how they act (Baumeister, 2002). This capacity to alter one’s responses, thoughts, emotions and action is referred to as self-regulation or self-control (Baumeister, 2002). Self-control enables individuals to conform to standards, ideals, values, morals and social expectations in the pursuit of long-term goals (Baumeister, Vohs, & Tice, 2007).

All theories of self-regulation suggest that individuals can control their responses to environmental stimuli (Baumeister et al., 2007). Baumeister and colleagues (1994) were the first to suggest that self-control depended on a limited energy resource (Baumeister Heatherton & Tice, 1994). They (e.g. Baumeister et al., 1994; 1998; Muraven & Baumeister, 2000) describe this energy theory of self-control as the “strength model” of self-control, which operates on the basis of a limited resource that becomes depleted through use. Specifically, acts of self-control draw from a common resource that controls thoughts, emotions and behaviors (Baumeister, Bratslavsky, Muraven, & Tice, 1998). The depletion of self-regulatory resources involves a temporary reduction in one’s capacity to engage in volitional action (Baumeister, Muraven, & Tice, 2000; Christian & Ellis, 2011). This energy model of self-control is likened to that of a muscle: As the regulatory muscle gets depleted through use, it requires rest for recovery (Baumeister et al., 2007). The analogy between self-control and a muscle was supported by early
findings from multiple research literatures that suggested that self-control performance deteriorates after initial exertions, just as a muscle gets tired (Baumeister et al., 2007).

To test this hypothesis, Baumeister and colleagues (e.g. Baumeister et al., 1998; Muraven, Tice, & Baumeister, 1998) conducted a series of experiments to examine self-control across two consecutive tasks, where the first act of self-control consumed some quantity of the resource, leaving a diminished capacity to engage in self-control on subsequent tasks. The findings from these studies repeatedly support the strength model of self-control. The validity of this model is suggested further by studies focusing on self-regulation of thoughts, emotions, impulses and task performance. For example, Muraven et al. (1998) randomly assigned people to regulate their emotions (or not), while watching sad, distressing video clips. Afterward, participants who have regulated their emotions gave up on a seemingly unrelated measure of physical stamina (squeezing a handgrip) faster than others who had not engaged in emotional regulation (Muraven et al., 1998). Importantly, resources seems fairly limited because even brief and seemingly minor exertions in lab studies were sufficient to result in its depletion. The term “ego depletion” has been used to refer to the state of diminished resources following exertion of self-control (Baumeister, 2002).

On a physiological level, engaging in concerted self-control requires effortful exertion of the pre-frontal areas of the brain (Baumeister et al., 1998). At any moment, there is only a fixed amount of this capacity. Loss of ego strength or a decreased capacity to engage in concerted self-control is associated with the metabolization of glucose that is available to the brain to energize prefrontal cortex operations (Gailliot et al., 2007; Kaplan & Berman, 2010). Expending available glucose through the persistent exertion of self-control is followed by a period of cognitive
fatigue, or reduced ability to utilize self-control, until it builds up again (Muraven & Baumeister, 2000).

It is important to understand how these limited self-regulatory resources are replenished. Baumeister et al. (2000) speculated that sleep is essential for replenishing depleted executive resources. Evidence about patterns of self-control failure reviewed by Baumeister et al. (1994) indicated that well-rested people enjoy better self-regulatory capacity. For example, few self-control failures occur early in the morning soon after enjoying a good night’s sleep (Baumeister, 2002). As well, people’s self-control gradually grows weaker throughout the day, as their drive to sleep increases (Baumeister, 2002). Physiologically, brain imaging studies of sleep-deprived participants show that the greatest decline in cerebral metabolic rate is in the pre-frontal cortex (Schnyer, Zeithamova, & Williams, 2009; Wimmer, Hoffmann, Bonato, & Moffitt, 1992). Given that the pre-frontal cortex plays a key role in executive functioning (Nilsson et al., 2005), lack of sleep produces a diminished ability to self-regulate (Barnes, 2012).

In sum, evidence converging across psychology, neuroscience, and management suggests that sleep plays an important role in self-regulatory behavior (e.g. Barnes, 2012; Harrison & Horne, 2000; Lim & Dinges, 2010). Although organizational researchers are just beginning to examine and understand the role of sleep in employee states and behaviors, this recent research indicates the important impact of sleep on work (Barnes, 2012). Therefore the goal of my dissertation was to contribute to the growing body of literature on sleep and work by examining how sleep impacts different work-related outcomes including work stress (Study 1), leadership (Study 2) and withdrawal behaviors (Study 3). Each study asked different questions about the relationship between sleep and work, and relied on unique methodologies to examine the sleep-
work relationship. My goal was to understand the importance of sleep in the context of work. Below I outline my three studies.

**Summary of Studies**

**Study 1**

The first study of my dissertation examined the relationship between sleep and work stress. Previous research suggests that stressful work conditions lead to sleep problems (e.g. Akerstedt, 2006; Akerstedt et al., 2002; Kalimo et al., 2000) but less is known about the potential influence of sleep on work stress. Although studies have demonstrated that sleep predicts numerous other work-related activities (see, Scott & Judge, 2006; Sonnentag & Zijlstra, 2006; Barnes et al., 2013), more research is needed to further examine the relationship between work stress and sleep. As a result, my first study examined the lagged reciprocal relationships between work stress and sleep. I hypothesized that work stress (high job demands, low job control, and low social support) are prospectively and negatively related to sleep (quality and quantity) and conversely, that sleep is also prospectively and negatively related to work stress. I tested these hypotheses using a five-wave archival longitudinal survey of over 17,000 Canadians. The results of this study are important both in terms of theory and practice because of the potential that reciprocal effects have to create a vicious cycle of poor sleep and increased work stress.

**Study 2**

My second study examined the influence of sleep on both positive (i.e., transformational leadership) and negative (i.e., abusive supervision) leadership behaviors. Drawing from self-regulation theory, I proposed a mediated model, in which sleep quantity and quality predict next-day leadership behaviors, through self-regulation. To examine this relationship, I recruited a sample of leaders and at least one of their followers from three large hospital settings across
Canada to participate in a 15 day, dyadic daily diary study. Leaders described their daily sleep and self-control each morning, while followers described their leader’s behavior in the afternoon. I hypothesized that leaders’ daily fluctuations in sleep impacts daily leadership behaviors and that this effect will be mediated through daily fluctuations in self-control. Results of this study are important because although leadership is a highly researched topic, less is known about the antecedents of leadership and specifically, the non-work related antecedents of leadership behaviors.

Study 3

Work withdrawal behaviors (e.g., partial absenteeism, turnover intention, absenteeism, work neglect and cyberloafing) are relatively common and costly outcomes within organizations. Work withdrawal is influenced by both work (e.g. attitudes) and non-work (e.g. family-to-work conflict) factors. In this third study, I investigate one non-work antecedent of withdrawal behaviors, namely sleep and specifically having a sleep disorder. To date, even though the number of sleep disorders are increasing and sleep disorder affect numerous working adults (Hossain & Shapiro, 2002), little research has focused specifically on the relationship between clinical sleep disorders and work experiences. Accordingly, my goal in this study is to examine the impact of obstructive sleep apnea (OSA) on work withdrawal, and how changes in sleep following treatment for sleep apnea influences these withdrawal behaviors. I hypothesized that sleepiness caused by OSA would impact withdrawal from work (i.e., partial absenteeism, turnover intention and absenteeism) directly and that sleepiness indirectly affects withdrawal at work (i.e., work neglect and cyberloafing) through ego depletion. I also posited that improvements in sleep (after receiving treatment for a sleep disorder) would decrease both forms of work withdrawal. To examine these hypotheses, a sample of individuals with potential OSA
were recruited from a sleep laboratory at a large hospital. A within-subjects, pretest, posttest design was used. This study is important as it expands organizational researchers understanding of sleep and specifically how sleep disorders influence work withdrawal behaviors.

**Conclusion**

Overall, the objective of this dissertation is to expand our understanding of how sleep and work are related. This was achieved by examining the relationship between sleep and work across different organizational groups (e.g. general population, individuals with sleep apnea, leaders) and different organizational outcomes (i.e. work stress, leadership behaviors and work withdrawal). Through my proposed studies I further the understanding of the sleep and work relationship and contribute to the advancement of literature on sleep and work.
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Chapter 2

The Reciprocal Effects of Work Stress and Sleep: A Five-Wave Longitudinal Study

Abstract

Prior research has demonstrated that work stress negatively impacts sleep, but the role of sleep as an antecedent of work stress has received little attention despite emerging research on sleep as a predictor of diverse work outcomes. In this study, I hypothesize lagged, reciprocal and negative relationships between work stress (high job demands, low job control, and low social support) and sleep (quantity and quality). Hypotheses were tested using a subsample of employed individuals across the last five cycles (2002-2010) of the National Population Health Survey of over 17,000 randomly-selected Canadians. Cross-lagged analyses showed that sleep predicted subsequent work stress across a two-year time lag over the five cycles. In contrast, the effects of work stress on subsequent sleep approached significance over the same time periods. These differential findings point to the importance of considering the nature of the predictor when positing specific time lags. Conceptual, methodological and practical implications are discussed.
2.1 Introduction

Work stress is a prevalent feature of work, experienced at one time or another by perhaps anyone who is employed. Stressful work conditions have long been known to elicit a variety of negative work (e.g., work withdrawal; Cavanaugh, Boswell, Roehling, & Boudreau, 2000; Stamper & Johlke, 2003) and non-work (e.g., physical health; Ganster & Schaubroeck, 1991; Macik-Frey, Quick, & Nelson, 2007) outcomes.

There is now a large body of literature devoted to an examination of the relationship between work stress and sleep, and the results of this research suggests that work stress is related to impaired sleep (see Sonnentag, Tzschach, & Pinck, in press, for review). Most of the studies that have examined work stress and sleep have either used cross-sectional designs, or have only examined the unidirectional hypothesis that work stress impacts sleep, ignoring the possibility that sleep may also influence work stress (see De Lange et al., 2009; Magnusson Hanson et al., 2011 for exceptions). As well, Berset, Elfering, Luthy, Luthi and Semmer (2011) have noted that much of the research has been empirically-driven and has neglected conceptual explanations for this relationship. In the current study I conceptually develop and empirically test hypotheses accounting for the reciprocal relationships between work stress and sleep across five time points.

Work stress is a broad concept that covers the conditions in a person’s work environment, the cognitive, affective, and physiological reactions to these conditions, as well as the interplay between conditions and reactions. To avoid the ambiguity inherent in the work stress concept, work stress can be understood to be comprised of three stages: work stressors (objective conditions in the job environment), work stress (people’s subjective experience of workplace conditions), and strain (cognitive, affective, and physiological reactions to the subjective experiences; Kahn & Byosiere, 1992; Pratt & Barling, 1988).
Work stressors can also be distinguished with respect to the frequency and duration of the stressors, i.e., chronic and more acute (Pratt & Barling, 1988). Chronic stressors refer to more or less enduring conditions that are present over longer periods of time (e.g., months or even years), while acute stressors refer to more short-term events that are present on specific days or weeks (Sonnentag et al., in press). This distinction between the types of stressors is reflected in the designs of empirical studies: most cross-sectional and longitudinal panel designs address chronic stressors, whereas most day-level and week-level studies focus on acute stressors (Sonnentag et al., in press).

Karasek’s (1979) demand-control (DC) process remains one of the most widely-studied work stress models, and posits that work stress is the combination of high job demands and low decision latitude (discretion) available to workers facing those demands. Social support was subsequently added to the model, resulting in the demand-control-support (DCS) model (Karasek & Theorell, 1990; Johnson & Hall, 1988), which predicts that low support will add to the psychological and physical strain (often referred to as “job strain”) experienced from high demands and low control. Importantly, sleep problems would typify strain symptoms (e.g., Nixon, Mazzola, Bauer, Krueger, & Spector, 2011). In the current study, work stress is conceptualized within the demand-control-support model (Karasek & Theorell, 1990) as a latent construct encompassing individuals’ perceptions of high job demands, low job control, and low social support.

This study extends previous research both conceptually and methodologically. First, departing from the unidirectional focus that has dominated prior research, I examine the reciprocal effects between work stress and sleep. Second, I provide a theoretical rationale for the

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1 In his demand-control model, Karasek (1979) refers to work stress as work strain.
different reciprocal relationships between work stress and sleep. Third, I test the hypotheses using data from a nationally representative sample of employed Canadian adults.

**From Work Stress to Sleep**

By its very nature, work stress results in a state of over-arousal. Work stress leads to psychological and physiological arousal, both of which are incompatible with the relaxed state of sleep (Akerstedt, 2006). Similarly, work stress also results in cognitive arousal in the form of rumination, which interferes with sleep (Brosschot, Gerin, & Thayer, 2006; Sonnentag, Kuttler, & Fritz 2010). Precisely because of this over-arousal, work stress increases individuals’ need for recovery, a period during which they can replenish their resources (Sluiter, 1999). The effort required to cope high job demands that offer little personal latitude or social support draw on individuals’ resources (Hockey, 1996) and are psychologically depleting, increasing the need for replenishment (Sonnentag & Zijlstra, 2006).

There are several theoretical explanations for why work stress may impact sleep. First, the effort-recovery model (Meijman & Mulder, 1998) suggests that expending energy at work leads to specific load reactions which include physiological, behavioral, and subjective responses that are reversible when an individual is no longer confronted with the work stress (Sonnentag, 2001). Second, the conservation of resources theory (COR; Hobfoll, 1998) assumes that people strive to obtain, retain, and protect their resources. According to this theory, stress occurs when individuals’ resources are threatened or lost, or when no resources are gained after resource investment (Sonnentag, 2001). Applied to the context of work, the conservation of resources theory implies that work stress threatens or even harms an individual's resources, such as well-being, health, and functioning in other life domains (Hobfoll, 1998). Both these theories suggest that well-being would be improved from time spent outside the job or away from the work stress.
Therefore, situations such as non-work time during the evenings and weekends, vacations and sleep offer opportunities for recovery processes and the restoration of threatened or lost resources (Sonnentag, 2001).

However, there are conditions under which the effects of work stress may be prolonged or sustained even after individuals have had opportunities for resource replenishment (Berset et al., 2011). Research demonstrates that work stress (e.g. high workload) is associated with increased negative affect during work, and that negative affect spills over from the work to the home domain (Ilies et al., 2007), resulting in prolonged activation and inability to recover even when away from work (Sonnentag et al., 2010). This prolonged activation, which involves thinking and ruminating about work-related issues (Brosschot et al., 2006; Sonnentag et al., 2010), makes recovery from work difficult, with research showing that there is a negative relationship between workload and psychological detachment from work during non-work time (e.g., Sonnentag & Fritz, 2007; Taris, Geurts, Schaufeli, Blonk, & Lagerveld, 2008). This relationship is especially strong when the work stress is sustained or chronic, as there would be very little opportunity for recovery from the daily stressors and rumination, as a result of which individuals experiences these as chronic stress (Berset et al., 2011; Brosschot, 2010).

Importantly, representations of stressful past and future events (rumination and worry) often produce similar physiological responses as representations during these stressful events themselves. This makes rumination a major potential cause of prolonged or chronic physiological stress activity (Brosschot, 2010).

Prior studies have supported the notion that work stress interferes with sleep. Karasek (1979) provided early support for the idea that work stress affected sleep, noting that employees characterized by high “job strain” or high work stress suffered from sleep disorders more often
than those who were not characterized as such. More recent research substantiates this relationship: High job demands and low job control lead to disturbed sleep (Akerstedt et al., 2002a, 2002b), insomnia, sleep deprivation, daytime fatigue (Kalimo, Tenkanen, Härmä, Poppius, & Heinsalmi, 2000), and sleep complaints (Lallukka, Rahkonen, Lahelma, & Arber, 2010).

There are also a number of studies that have examined the longitudinal effects of stress, i.e., the effects of chronic stress. Van Laethem, Beckers, Kompier, van Dijksterhuis, and Geurts (2013) reviewed 16 longitudinal studies on workplace factors and sleep quality and reported strong evidence for job demands being negatively related to sleep quality over time. For instance, in one of the high-quality studies, De Lange et al. (2009) found that high levels of job demands predicted sleep complaints one year later, when controlling for earlier sleep complaints. As well, a more recent review including 24 studies resulted in similar findings, reporting a significant association between high job demands combined with low job control and future sleep disturbances (Linton et al., 2015).

Support for the role of rumination in linking work stress and sleep problems comes from research on the impact of pre-sleep cognitive activity (e.g., rumination) on subsequent sleep quality (see Harvey, Tang, & Browning, 2005, for review), with studies showing that experimentally-induced stress can increase arousal and delay sleep onset (Gross & Borkovec, 1982; Harvey & Payne, 2002; Van Egeren, Haynes, Franzen, & Hamilton, 1983). This effect was again demonstrated in a study using objective sleep measures. Akerstedt, Kecklund, & Axelsson (2007) found significantly lower objective sleep efficiency during the nights with higher stress and worrying ratings (i.e., rumination) at bedtime. A separate study using objective measures (Brosschot, Van Dijk, & Thayer, 2007) found that stressors and worrying were related to higher
heart rate when awake, and that these effects of stressors and worry extended into the sleeping period. This is important as individuals experiencing high work stress may experience delayed psychological and physiological recovery following work which impacts sleep (Cropley & Millward Purvis, 2003; Rau, Georgiades, Fredrikson, Lemne, & de Faire, 2001; Steptoe, Cropley, & Joekes, 1999). Thus, both previous research and theory support the proposition that work stress leads to sleep problems therefore:

*Hypothesis 1: There is a negative time-lagged relationship between chronic work stress and sleep.*

**From Sleep to Work Stress**

The paucity of research on how sleep affects work stressors stands in sharp contrast to the numerous studies that have examined the influence of work stress on sleep. Despite this, there are several theoretical and conceptual reasons why I predict that sleep will influence subsequent work stress. First, both effort-recovery (Meijman & Mulder, 1998) and COR theory (Hobfoll, 1998) suggest that sleep problems affect work stress through “resource spirals”. The central assumption of effort-recovery theory is that the strain associated with work stressors becomes greater if there is continued exposure to the work stressors with incomplete recovery (De Lange et al., 2009; Geurts & Sonnentag, 2006). Similarly, COR theory (Hobfoll, 1989, 1998, 2001) predicts that once resource depletion occurs, individuals may struggle to re-stock their resource reservoirs (Hobfoll, 1989, 2001), such that resource loss begets further resource loss (e.g., Christie & Barling, 2009; Wells, Hobfoll, & Lavin, 1999).

Faced with a lack of resources, individuals are likely to view their work as more stressful. The reason for this is that sleep problems have the potential to change an individuals’ perceptions of work-related phenomenon (Barber & Budnick, 2015). In their study Barber and Budnick (2015) demonstrated that sleepiness enhanced individuals’ cognitive bias. Specifically
they found that sleepiness increased negative interpretive bias when social threats were clearly present. Zapf, Dormann, and Frese (1996) labeled this effect as the “true strain–stressor process”, where stressors may sometimes be affected by strain, in that strain effects our perceptions of the stressor (De Lange, Taris, Kompier, Houtman, & Bongers, 2005). This phenomenon has also been referred to as “stressor creation hypothesis” (Spector, Zapf, Chen, & Frese, 2000).

Conceptually, sleep may impact stress for a number of separate reason. First, sleep deprivation exerts its negative effects by undermining self-regulatory resources, thereby decreasing people’s ability to cope with environmental demands (e.g., Zohar, Tzischinsky, Epstein, & Lavie, 2005). Poor sleep quality and quantity can impact subsequent cognitive and affective states (Barnes, 2012; Mullins et al., 2014). Impaired cognitive and affect states not only undermine task-accomplishment processes, but also leaves fewer cognitive resources available to deal with job stressors, and therefore contributes to the experience of work as more stressful.

Second, sleep deficits increase negative affect and decrease positive affect (Scott & Judge, 2006; Sonnentag, Binnewies, & Mojza, 2008). High negative affect, in turn, will make individuals more likely to perceive stressors in the work environment, and as a consequence the overall level of job stressors will be perceived to be higher.

Some empirical findings provide direct support for sleep impacting perceptions of work stress. Specifically, sleep-deprived individuals are more reactive to negative or aversive events than those who are not (Anderson & Platten, 2011; Franzen, Buysse, Dahl, Thompson, & Siegle, 2009), and poor sleepers perceive workplace events as more distressing than better sleepers, even when the amount of daily stressors is the same (Morin, Rodrigue, & Ivers, 2003). Finally, Barber and Budnick (2015) demonstrated that increased sleepiness predicted greater negative
interpretive biases in response to threatening and potentially threatening workplace cues across three studies. Therefore:

Hypothesis 2: There will be a negative time-lagged relationship between sleep and work stress.

Evidence of a reciprocal relationship between work stress and sleep.

Two studies have gone further, and have explicitly examined the reciprocal relationship between work stress and sleep (i.e., De Lange et al., 2009; Magnusson Hanson et al., 2011); the results of the two studies, however, were not consistent. De Lange et al. (2009) found support for the job strain hypothesis (DC model: Karasek, 1979): High-strain work environments (high job demands, low job control) were associated with subsequently higher levels of sleep-related complaints (sleep quality, fatigue). However, sleep problems did not affect work stress across the four year, four-wave study. Magnusson Hanson et al. (2011) extended De Lange et al.’s (2009) study by including social support in their conceptualization of the job strain hypothesis (i.e., the DCS model). They examined the reciprocal relationship between each job stressor (i.e. job demands, job control and social support) and sleep disturbances separately over a 2 year period, and again mixed results made interpretation of the findings difficult. First, the relationship between job demands and sleep disturbances was marginally significant, but sleep disturbance was not associated with subsequent job demands. Second, no significant relationships emerged between job control and sleep disturbances. Last, a reverse causal relationship (sleep affecting work stress) emerged between social support and sleep disturbances, but the strain hypothesis was not supported for these variables.

Several factors preclude robust conclusions being drawn from either study. First, while no support emerged for reciprocal relationships in De Lange et al.’s (2009) study, the measurements of sleep quality were only obtained at Wave 1 and 4, thereby constituting a two-
wave study across four years. This makes it impossible to control for the prior levels of sleep when studying the relationship between demands and control at time 3 and sleep quality and fatigue at time 4, possibly resulting in an under- or over-estimation of the true effect sizes (De Lange et al., 2009; Dormann & Griffin, 2015).

Likewise, several factors preclude robust conclusions being drawn from the Magnusson Hanson et al. (2011) study. First, this study does not account for the relationship between the three job stress factors and by treating job demands, decision authority, and support separately, and therefore does not provide an adequate test of the DCS model. Second, the Magnusson Hanson et al. (2011) study only comprises two-waves, precluding the possibility of within-sample replication over time.

As a result, there have been recent calls for research examining the reciprocal relationship between work stress and sleep problems (Sonnentag et al., in press). The current study, which examines the reciprocal relationship between work stress (job demands, job latitude, social support) and sleep (quality and quantity) in a large nationally representative sample across five waves of data separated by two year time lags, responds to this call.

2.2 Method

Study Design

The National Public Health Survey (NPHS) is a longitudinal multi-wave survey of 17,276 Canadians from each of the ten Canadian provinces (Statistics Canada, 2012). The NHPS collects data on the health and health-related behaviors of Canadians along with socio-economic and demographic information. Using a weighted sample, participants’ mean ages and demographic characteristics are representative of the Canadian population in 1994, the initial year of the survey. Participants involved in the first cycle of data collection were subsequently
interviewed every two years; and the survey is ongoing with the most recent Cycle 9 results (2010-2011) released in September 2012.

The NPHS uses a multi-stage selection process to identify regional clusters based on socio-economic and geographic data and selected with a probability proportional to size. Next, dwellings within these clusters were selected and random samples of dwellings drawn with one member of each household randomly selected to be surveyed. Surveys were administered both in person and via telephone by trained Statistics Canada staff using computer-assisted interviewing (CAI). CAI allowed survey questions to be adapted to previous answers and previous cycles (e.g. name, age, sex), and to identify automatically invalid entries and maintain logical flow.

As a probability sample, the NPHS uses sampling weights in each cycle for estimation of all descriptive statistics and analyses. These weights reflect the number of persons in the population that each randomly selected individual is intended to “represent”. Calculating the associated weight for each member of the selected sample allows for meaningful analysis and estimates to be drawn from the survey sample. These weights are calculated to represent the true probability of selecting a given panel member at the time the longitudinal sample was selected in Cycle 1, but not selecting that unit in other samples.

**Sample Characteristics**

The data analyzed in the current study encompasses the last five consecutive cycles (Cycles 5 to 9) of the NPHS, representing data collected for the periods 2002, 2004, 2006, 2008 and 2010, respectively. Data from the first four cycles were excluded due to changes in survey questions across time periods. In keeping with the focus on work stress, I limited the sample to those participants who were employed in all five periods sampled. This subset included 2,871 individuals, 55% of whom were male, with a mean age of 41 years (SD = 10.4), and an average
income of $50,000 to $59,999 in the first year (i.e., 2002).

**Measures**

**Work stress.** An overall latent measure of work stress was used. The seven item index was derived from Karasek and Theorell’s (1990) scale that measures individuals’ global perception of stressful experiences at work, specifically their self-perceptions about psychological demands, job control, and job-related support. Sample items include “Your job is very hectic” (job demands), “Your job allows you freedom to decide how you do your job” (job control), and “The people you work with are helpful in getting the job done” (social support). Respondents’ answers were coded on a five-point scale ranging from 1 = strongly disagree to 5 = strongly agree. Items are summed for each of the DSC-model and used to create a latent variable measure of work stress with higher values indicate greater job stress.

A latent measure of work stress was computed for several reasons. (a) Composite measures provide a broader and more holistic representation of exposure to work stress. (b) The approach in which demands, control and support provide an overall measure of work stress is followed almost exclusively in similar research (e.g., Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Huynh, Xanthopoulou, & Winefield, 2014), and (c) has also been used in prior studies linking work stress and health outcomes using the NPHS data (e.g. Christie & Barling, 2009. (d) Our goal in this research is to test the relationship between overall work stress and sleep, and (e) using a composite work stressor measure minimizes the number statistical tests that needed to be computed.

**Sleep.** The sleep measure reflected sleep quality and sleep quantity. Sleep quality was assessed with two-items, namely “how often do you have trouble going to sleep or staying awake” and “how often do you find sleep refreshing”, with both items rated on a five-point scale
(1 = none of the time to 5 = all of the time). Sleep quantity was assessed with a single item, “How long do you usually spend sleeping each night?” that was rated on a 12 point response scale, ranging from less than 2 hours to 12 hours or more. Again, a latent variable was created using the sleep quality and quantity items. Previous research suggests that the effects of sleep quality and quantity are related and potentially additive (Barnes, 2012), and an approach that combines the sleep quality and quantity is used frequently (e.g., The Sleep Questionnaire, Johns, Gay, Goodyear, & Masterton, 1971; VHS Sleep Scale, Snyder-Halpern & Verran, 1987; The Basic Nordic Sleep Questionnaire, Partinen & Gislason, 1995; and The Sleep Evaluation Questionnaire, Parrot & Hindmarch, 1978). Last, using a latent variable measure of sleep again lessens the number of statistical tests required.

The questions from this study are in Appendix A.

2.3 Data Analysis

To examine the hypothesized reciprocal relationship between work stress and sleep, confirmatory factor analysis and structural equation modeling analyses were conducted in Mplus 6 (Muthén & Muthén, 2010). Following Meier and Spector (2013), I first conducted a confirmatory factor analyses to ensure the latent variables reflected the different constructs. In the second step, I tested whether there is measurement invariance across time for the latent variables (e.g., Finkel, 1995). I compared the fit of the measurement model from step 1 with an identical second model where the factor loadings were constrained to be equal across time. If the constrained model does not have worse fit than the unconstrained model, then the constraints are empirically justified and ensure that the latent constructs have the same meaning across time (i.e., metric invariance; Schmitt & Kuljanin, 2008). In the third step, the fit of the structural cross-lagged model for the work stress and sleep variables was tested. In cross-lagged models, a
latent variable at Time 2 is predicted by the same variable at Time 1 and the other latent variable at Time 1. The cross-lagged paths indicated the effect of one variable on the other, while controlling for the stability of the variables over time (Finkel, 1995).

I used robust full-information maximum-likelihood estimation (MLR) to deal with missing values and non-normality of the measures, and to fit models directly to the raw data (Muthén & Muthén, 2010). Model fit was assessed by the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root-mean-square error of approximation (RMSEA), based on the recommendations of Hu and Bentler (1999) and MacCallum and Austin (2000). Good fit is indicated by values greater than or equal to .95 for CFI and TLI and less than or equal to .06 for RMSEA (Hu & Bentler, 1999). To compare nested models, differences in fit were calculated according to Satorra and Bentler (2010; see also Bryant & Satorra, 2012) and the test recommended by MacCallum, Browne, and Cai (2006).

### 2.4 Results

Table 1 shows the means and standard deviations of the measures used. I used three indicators for each latent construct for the structural equation models, with the work stress construct containing item parcels that were composed of the three components of the DCS model. This procedure results in more reliable latent variables than do just individual items by reducing random error, thereby increasing the reliability of the structural coefficients of the model (Little, Cunningham, Shahar, & Widaman, 2002). Sleep was also operationalized as a latent construct, with the sleep quantity and two sleep quality items reflecting the three indicators of sleep.

The first step was to conduct a confirmatory factor analyses to examine whether the two latent variables reflected the different constructs of work stress and sleep. I tested two models, a
single factor and a two-factor model. In all analyses, all factor loadings were freely estimated and the uniqueness of individual indicators were correlated over time to account for consistency in indicator-specific variance (Cole & Maxwell, 2003). For each measurement occasion in the two-factor model, the work stress parcels were placed in one factor and the sleep parcels were in a separate factor; all 10 factors were correlated with each other. In the one-factor model, all parcels were placed into a single factor for each measurement occasion, so that there were a total of five factors that were correlated with each other. The results showed that only the measurement model with two factors had a good fit (see Table 2).

In the second step, I tested whether measurement invariance across time existed for the latent variables (e.g., Finkel, 1995) to establish the equivalence of the factor loadings across time (Kelloway, 2015). To do so, I compared the fit of the two-factor model with freely estimated factor loadings \( \chi^2 (300) = 444.37, p < .05; \text{CFI} = .99; \text{TFI} = .98; \text{and RMSEA} = .013 (.010, .015) \); with a second model that was identical to the first except that factor loadings of each indicator were constrained to be equal across time \( \chi^2 (316) = 471.64, p < .05; \text{CFI} = .99; \text{TFI} = .98; \text{and RMSEA} = .013 (.011, .015) \). If the constrained model does not fit worse than the unconstrained model, the constraints are empirically justified and ensure that the latent constructs have the same meaning across time (i.e., metric invariance; Schmitt & Kuljanin, 2008). The fit of the two models did not differ significantly (see Table 2); consequently, the more parsimonious constrained model was favored and the longitudinal constraints on factor loadings were retained in the subsequent analyses.

The fit of the structural cross-lagged model for each pair of work stress and sleep measures was tested in the third step. I computed the analyses of the cross-lagged models in three nested model steps (Kelloway, 2015). I began by estimating the stability effects (i.e., the
autoregressive effects) as the simplest model (each variable is predicted by the same variable at the preceding wave). I then accounted for variance due to measurement occasion by cross-sectionally correlating the disturbances of the corresponding factors (Cole & Maxwell, 2003), after which the cross-lagged effects that are of interest were added (see Figure 1).

All structural coefficients were freely estimated in this cross-lagged model, resulting in good model fit with these free structural coefficients \(\chi^2 (328) = 481.76, p < .05; \ CFI = .99; \ TFI = .98; \ \text{and} \ \text{RMSEA} = .013 (.010, .015)\). In a second cross-lagged model, the structural parameters (stability coefficients and cross-lagged coefficients) were constrained to be equal across all time intervals \(\chi^2 (340) = 501.46, p < .05; \ CFI = .99; \ TFI = .98; \ \text{and} \ \text{RMSEA} = .013 (.010, .015)\). The fit of the model with the free structural coefficients and the constrained model did not differ (see Table 3). Consequently, the more parsimonious model was favored, and the longitudinal constraints on structural coefficients were retained.

Table 4 shows the standardized cross-lagged effects for the final models with the longitudinal constraints on structural coefficients and the cross-sectional correlations at Time 1; the stability coefficients (autoregressors) are shown in Table 5. Hypothesis 1 received partial support, as work stress was a marginally significant predictor of sleep across all four time periods (T1-T2: \(\gamma = -0.034, p = 0.053\); T2-T3: \(\gamma = -0.032, p = 0.055\); T3-T4: \(\gamma = -0.038, p = 0.052\); T4-T5: \(\gamma = -0.039, p = 0.055\)). In contrast, Hypothesis 2 was fully supported: the results indicated that sleep predicted subsequent increased levels of work stress across all time periods (T1-T2: \(\gamma = -0.045, p < 0.05\); T2-T3: \(\gamma = -0.039, p < 0.05\); T3-T4: \(\gamma = -0.039, p < 0.05\); T1-T2: \(\gamma = -0.041, p < 0.05\)).
2.5 Discussion

The unidirectional effects of work stress and sleep are well-documented; whether poor sleep predicts work stress has only received empirical attention more recently. The possibility that these relationships are best characterized as reciprocal has received even less conceptual and empirical attention. Using a large, nationally representative, longitudinal sample of employed Canadians over a ten-year period, I showed that contrary to previous research, the lagged effect of subjective perceptions of work stress on sleep was marginally significant across this five-wave, cross-lagged study. However, the reverse hypothesis that sleep affects work stress was significant across all four lags that were tested. Thus, the results of the current study provide limited support for the reciprocal effects of work stress and sleep, and conceptual and methodological features of the current study help to explain these findings.

Work Stress → Sleep

Contrary to the large body of empirical studies showing that high levels of work stress predict the development of sleep problems over time (see Sonnentag et al., in press), the relationship between work stress and sleep only approached significance across the five waves in the current study. I suggest that two factors might account for these different findings, namely the timing of the measurement lags and the different job stressors.

First, echoing an earlier and more general observation that deciding when to conduct measurements in longitudinal research is of critical conceptual importance (Mitchell & James, 2001), Dorman and Griffin’s (2015) observation that the time lag will affect the magnitude of any coefficients and Sonnentag et al.’s. (In press) more specific reiteration that any effects of job stressors and sleep problems are potentially time-dependent, I suggest that the timing of the current studies measurement may have impacted the results. The reason for this is that the two
previous studies that examined the reciprocal relationship between work stress and sleep had different timing of the measurements and different results. In the first study (De Lange et al., 2009), work stress predicted sleep complaints using a time lag of one year. In contrast, similar effects did not emerge in a separate study using a two year time lag (Magnusson Hanson et al., 2011).

In the current investigation, the data in the archival database also used two-year lags. I propose that the difference in these findings regarding work stress lies in people’s ability to adapt to stress over different periods of time. When individuals’ experience work stress, especially chronic stress, they try to access coping resources and defensive processes to diminish the negative effects of stress (Somerfield & McCrae, 2000). Across the two year period of the current study, the effect of stress and sleep are potentially reduced because individuals have greater time, and hence more opportunity, to adapt to the work stressors. When the time period is shorter, there would be less opportunity for adaptation and coping, and hence any effects of work stress on sleep may have be stronger. This is consistent with Dorman and Griffin’s (2015) recent observations, and their call for more “shortitudinal” studies, i.e., longitudinal studies over shorter time periods. Evidence from daily studies examining work stress and sleep, might support this notion. For example, a daily study using objective measures of sleep showed significant effects on sleep quality after workdays during which employees experienced social exclusion (Pereira, Meier & Elfering, 2013). Thus, the results of the current study suggest that the relationship between stress and sleep is potentially time dependent.

Second, like other researchers (e.g., Christie & Barling, 2009; Demerouti et al., 2001; Huynh, et al., 2014), I conceptualized work stress as a latent variable composed of job demands, job control and social support (Karasek & Theorell, 1990). However, it is possible that
conceptualizing work stress as a global construct might mask any effects of individual work stress on sleep. While the effects of different methods cannot be excluded, prior findings suggest that job demands, job latitude and social support do not exert uniform effects on sleep across different time periods. For example, in cross-sectional research, the largest effect sizes on sleep are associated with social stressors (Sonnentag et al., in press). In contrast, the results from longitudinal studies show that job demands have the strongest effects on sleep (Linton et al., 2015; Van Laethem et al., 2013). Taken together, I believe it is premature to exclude the possibility that work stress affects subsequent sleep longitudinally, and that effects might emerge if the time periods across which this effect is studied is calibrated more specifically to the nature of the relationship under investigation, and work stressors are conceptualized and operationalized separately.

Sleep → Work Stress

Consistent with theoretical suggestions that resource loss spirals downwards over time (Hobfoll, 2001)—and empirical support for this notion (e.g., Christie & Barling, 2009), the hypothesis that sleep predicts work stress two years later was supported. This finding supports the strong empirical evidence that sleep affects subsequent cognitive and affective states (Mullins, Cortina, Drake, & Dalal, 2014) and that this in turn makes it more likely that individuals will perceive stressors in their work environments (Barber & Budnick, 2015). This finding also answers recent calls for the investigation of the impact of sleep on work stress (Sonnentag et al., in press), and is consistent with one previous study examining the reciprocal effects of work stress and sleep that showed that sleep predicted work stress over a two year time period (Magnusson Hansen et al., 2011).
Study Strengths and Limitations

The present study has several strengths that enable robust conclusion about work stress and sleep problems to be drawn from the findings. First, several theoretical explanations as to why I might expect differential lagged reciprocal relationships between work stress and sleep (i.e., resource spirals; Hobfoll, 2001) are offered. Second, this study is based on a large, representative sample of the Canadian workforce, thereby enhancing external validity of the findings. Third, the data on both work stress and sleep problems were drawn from five waves of data each separated by two years, enabling greater confidence in the consistent findings regarding the nature of the relationships across the waves tested.

As with all research, however, some limitations remain. First, as is the case with all archival research, our access to items assessing sleep was restricted by to those available in the NPHS. Thus, I was limited to two items assessing sleep quality, and one item assessing sleep quality. Second, in line with much of the previous research on the DCS model I used a composite measure of work stress, where a latent construct was created from three types of work stressors (i.e. job demands, job control and social support). Nonetheless, the three different experiences of work stress, namely job demands, job control and social support might potentially affect sleep differently, and it remains for future research to assess whether the findings that emerged in this study are replicated when separate aspects of work stress, and sleep problems, are assessed. In order to identify the specificities of job stressors, future research needs to examine the diverse set of stressors within the same studies, using identical study designs and time lags.

Third, because of the archival nature of the data, I could not select the time lags between measurements a priori, and as previously discussed, time lags should be theoretically grounded, rather than a matter of convenience as the time lag potentially affects the magnitude of
coefficients (Dorman & Griffin, 2015; Mitchell & James, 2001). In the current study however, a two year time lags may be appropriate for the study of chronic stress (Pratt & Barling, 1988; Gottlieb, 2013). That said, considering the nature of time lags needs to be accounted for in future research, and Dorman and Griffin’s (2015) recommendation that “shortitudinal” lags been used in panel studies needs to be considered. While the present study has captured significant longitudinal relationships across ten years, further investigation of the short-term more immediate reciprocal effects of work stress on sleep should be investigated.

Finally, the NPHS relies solely on self-report data. Earlier research on both work stress and sleep has pointed to the limitations of using self-reports as the sole data source in studies of work conditions and stress outcomes (Barnes, 2012; Hurrell, Nelson & Simmons, 1998). Future studies might try to capture objective indicators of both sleep and work stress, through measurement such as actigraphs to measure sleep (van de Water et al., 2011) and cortisol levels to measure stress (Russell, Koren, Rieder, & Van Uum, 2012).

**Implications and Future Directions**

The fact that sleep significantly predicted subsequent work stress, and that this finding was replicated across four time lags, has important implications for research. First this study starts to answer previous research questions about the importance of sleep to work stress. The findings from the current investigation suggest over a longer time period (i.e., two years), sleep has important effects on individuals’ perceptions of work stress. However this is an initial attempt to examine reciprocal relationships and further studies are needed. As was previously discussed, the timing of any lags between sleep and work stress might be critical, and future research should examine reciprocal relationships using shorter time lags to understand sleeps influence on acute stressors.
The result that the effects of work stress on sleep only approached significance across all four time lags, raises some interesting questions, as this relationship has been previously established in the organizational literature. As previously stated, more research using different timing of measurements and separate measures of work stressors and sleep are necessary to further enhance our understanding of this relationship. In addition, my study provided marginal support for the reciprocal relationship between work stress and sleep, an important finding that demonstrates the potential detrimental spiraling effects of resource loss. Future research therefore should investigate potential moderators (e.g. conscientiousness) of this relationship, or more specifically ways in which individuals could break this spiral (e.g. coping or preventative behaviors).

The results of this study on the reciprocal relationships between work stress and sleep underscore the need for more complex models and theories that recognize the dynamic interplay between employees and their work environments. Such theories need to conceptualize behaviors (e.g., work stress and sleep) as potentially both inputs and outputs, as was the case in the current study, with both sleep and work being predictors and outcomes at different stages of the model. The potential contribution of such models and theories will be enhanced in the extent to which they incorporate time lags on the basis of theory (e.g., Baumeister, 2002; Hobfoll, 1998), and focus on processes rather than static snapshots.

This reciprocal relationship between work stress and sleep is also of importance to policy makers and organizational leaders: Specifically, these groups need to start to acknowledge that sleep, which has been viewed as external to the work environment and within the personal realm only, can affect work in general, and perceptions of work stress more specifically. The challenges in doing so should not be underestimated: Organizational leaders and policy makers
have historically been reluctant to cross the line and be seen as engaging or interfering in employees’ personal lives. However, the current findings suggest that sleep is one aspect of individuals’ personal lives that has a significant effect on their work and well-being. Thus, organizational leaders need to consider any appropriate ways in which they can influence employees’ sleep without intruding unnecessarily into their employees' private lives. For example, some organizations have turned to having nap rooms within their organizations that can be accessed by employees (e.g. Huffington, 2013; Smith, Kilby, Jorgensen, & Douglas, 2007). Another important factor to consider is having policies that prohibit emailing/contacting employees during sleep related times (Barling, 2014), i.e., acknowledging that their employees’ sleep is important.

**Conclusion**

This study points to the possibility of a longitudinal reciprocal relationship between work stress and sleep. While robust evidence emerged for a lagged effect of sleep on work stress, the effects of work stress on sleep approached significance across all time lags studied. The findings highlight the importance of conceptual factors (i.e., the nature of chronic work stress) underlying different time lags operating between work stress and sleep, and sleep and work stress, as well as the importance of theoretically-grounding the choice of time lags used. I offer ways in which future research might contribute further to an understanding of the reciprocal relationship between work stress and sleep.
2.6 References


Table 2-1: Descriptive Statistics and Correlations

<table>
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<th>Variables</th>
<th>N</th>
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<th>SD</th>
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<tbody>
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<td>11. WS-t1</td>
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Note. SQN_ sleep quantity; SQL_ sleep quality; WS_ work stress; t1–t5_ Time 1 to Time 5; ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).
Table 2-2: Measurement Models Fit: Construct Dimensionality and Measurement Invariance

<table>
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<tr>
<th>Model</th>
<th>SB-χ²</th>
<th>df</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA (90% CI)</th>
</tr>
</thead>
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<td>One-factor model</td>
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<td>335</td>
<td>.96</td>
<td>.94</td>
<td>.025 [.025, .027]</td>
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<td></td>
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<td>Free loadings</td>
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<td>.99</td>
<td>.98</td>
<td>.013 [.010, .015]</td>
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<tr>
<td>Longitudinal</td>
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<td>316</td>
<td>.99</td>
<td>.98</td>
<td>.013 [.011, .015]</td>
</tr>
</tbody>
</table>

Note. SB-χ² = Satorra-Bentler scaled chi-square; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval. *p = .05.
### Table 2-3: Fit of Cross-lagged Models

<table>
<thead>
<tr>
<th>Model</th>
<th>SB-$\chi^2$</th>
<th>$df$</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA (90% CI)</th>
</tr>
</thead>
<tbody>
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<td>Cross-lagged models</td>
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<td></td>
<td></td>
</tr>
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<td>.99</td>
<td>.98</td>
<td>.013 [.010, .015]</td>
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<td>.99</td>
<td>.98</td>
<td>.013 [.010, .015]</td>
</tr>
</tbody>
</table>

$SB-\chi^2$ = Satorra-Bentler scaled chi-square; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval.

*p = .05.*
Table 2-4: Overview of the Cross-Lagged Effects, Separated by Time Lag

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Work Stress → Sleep</td>
<td>-0.034†</td>
<td>-0.032†</td>
<td>-0.038†</td>
<td>-0.039†</td>
</tr>
<tr>
<td>Sleep → Work Stress</td>
<td>-0.045*</td>
<td>-0.039*</td>
<td>-0.039*</td>
<td>-0.041*</td>
</tr>
</tbody>
</table>

*Note. Although the coefficients were constrained to be equal across time, the constraints were imposed on unstandardized coefficients (as is typically recommended), which led to slight variation in the resulting standardized coefficients. Time lag is indicated in years. *p = .05; †= p = .10.
Table 2-5: Stability Effects at Each Time Lag

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>0.59*</td>
<td>0.50*</td>
<td>0.55*</td>
<td>0.62*</td>
</tr>
<tr>
<td>Sleep</td>
<td>0.64*</td>
<td>0.62*</td>
<td>0.66*</td>
<td>0.64*</td>
</tr>
</tbody>
</table>

Note. Although the coefficients were constrained to be equal across time, the constraints were imposed on unstandardized coefficients (as is typically recommended), which led to slight variation in the resulting standardized coefficients. Time lag is indicated in years. *p = .05.
Figure 2-1: Structural models to test the reciprocal effect of work stressors and sleep.
Chapter 3
Sleep, Self-Control and Leadership Behaviors:
A Daily Mediational Study

Abstract

I examined leaders’ daily sleep as an antecedent of daily leadership behaviors, i.e., transformational leadership and abusive supervision. Drawing from self-regulation theory, I proposed a mediated model, in which sleep quantity and quality predict next-day leadership behaviors, through self-regulation. I hypothesized that poor nightly sleep quality and quantity lead to ego-depletion, which in turn leads to increased abusive supervision and decreased transformational leadership. I tested this model using a daily diary study over fifteen days with data from 42 supervisors and at least one of their subordinates. Results from a mediational analysis using multilevel structural equation modeling support the role of the indirect effects of sleep quality and sleep quantity through leader self-control on abusive supervision, but not on transformational leadership.
3.1 Introduction

Humans need sleep and most adults need around eight hours of sleep each night (Cote, 2003; Siegel, 2005). However, popular news reports would leave you believing that many high profile leaders are among the “sleepless elite” who do not need that much sleep. For example, one article from the Business Insider (Cutrone & Nisen, 2012) titled *19 Successful People Who Barely Sleep* describes how several high profile CEO’s sleep very little. This type of popular commentary about sleep, and specifically the almost deification of the supposedly little sleep that truly successful leaders need, perpetuates the belief in the business world that sleep is an unnecessary luxury that motivated people (i.e. “real leaders”) can do without (Kirn, 2004). Even among those who acknowledge the importance of sleep for employees, Barnes, Ghumman, and Scott (2013) note that a common assumption is that small amounts of lost sleep are not important. Because this runs counter to what is known from the very large literature on sleep and its consequences (see Barnes, 2012; Harrison & Horne, 2000; Lim & Dinges, 2010), and to augment what is known about non-work predictors of leadership behaviors, I will examine whether and how sleep predicts leadership behaviors on a daily basis.

Leadership is one of the most intensively researched topics in organizational behavior, however most of the research in this area has focused on the outcomes of leadership (Barling, 2014). This leaves many questions unanswered about what factors influence either positive (e.g., transformational leadership; Bass & Riggio, 2006) or negative (e.g., abusive supervision; Tepper, 2007) leadership behaviors. Some research has investigated individual, relational and contextual antecedents to transformational leadership (e.g., Bommer, Rubin, & Baldwin, 2004; Rubin, Munz, & Bommer, 2005), and abusive supervision (e.g., Hoobler & Brass, 2006; Tepper, Moss, & Duffy, 2011). However, much less research (see Barnes, Lucianetti, Bhave, & Christian, 2015;
Byrne et al., 2014; Tepper, Duffy, Henle, & Lambert, 2006 for exceptions) has been conducted on leader’s own well-being as a predictor of leadership behavior. In one exception to this, Byrne et al. (2014) found that leader’s own psychological well-being, conceptualized as depressive symptoms, anxiety, and workplace alcohol consumption, separately predicted lower transformational leadership, and higher abusive supervision.

In this study, I extend this to include sleep in the conceptualization of psychological well-being. Sleep has powerful effects on well-being through its influence on executive functioning in the prefrontal cortex (see Barnes, 2012, for review). For example, Nilsson et al. (2005) found that missing one night of sleep decreased executive functioning in the area in the brain responsible for regulation of cognitions, emotions and behavior (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Schnyer, Zeithamova, & Williams, 2009; Wimmer, Hoffmann, Bonato, & Moffitt, 1992). Both low sleep quantity and poor sleep quality result in lower activation in the prefrontal cortex of the brain (Altena, Van Der Werf, Strijers, & Van Someren, 2008; Thomas et al., 2000). Harrison and Horne (1999) demonstrated that missing a single night of sleep decreased innovative thinking, and Elmenhorst et al. (2009) found that four consecutive nights of five hours of sleep per night leads to decrements in a cognitive task equivalent to a blood alcohol content of 0.6%. Haack and Mullington (2005) showed that emotional well-being (optimism-sociability) progressively declined 15% over 12 consecutive days of sleep restriction. Finally, one study examining leadership (Barnes et al., 2015) demonstrated that daily sleep quality affected daily abusive supervisory behaviors through ego depletion, which in turn affected work unit engagement.

As Barnes et al (2015) demonstrated, diminished well-being caused by sleep deprivation was associated with negative leadership behaviors, i.e., abusive supervision. As stated by Barling
(August 10, 2014), even “relatively small amounts of sleep loss are enough to deplete the
cognitive and emotional resources needed for high quality leadership, leaving leaders vulnerable
to making the kind of mistakes that can hurt their leadership.” Specifically, a lack of sleep leaves
leaders psychologically drained, or ego-depleted, rendering them unable to regulate their
behaviors and emotions at work (Barling, 2014), or the compassion that is the basis of high
quality leadership (Barling, 2014).

Therefore, my goal in the current study is to examine the impact of sleep on both positive
and negative leadership behaviors; specifically how nightly fluctuations in sleep affect leadership
behaviors the following day. I hypothesize that sleep will influence leadership behaviors
indirectly, namely through self-regulation.

**Theoretical Development**

**Sleep and Self-Regulation**

I have previously discussed both sleep quality and quantity, and I investigated the effects
of both in the current study. These are distinct constructs, as individuals could sleep many hours
in a given night, but have restless sleep with frequent awakenings. Alternatively, they could
sleep only a few hours, but soundly. Sleep research indicates that both sleep quantity and sleep
quality are important, with similar outcomes of too little sleep and poor quality sleep (Barnes,
Schaubroeck, Huth, & Ghumman, 2011; Barnes & van Dyne, 2009; Hursh et al., 2004). The
effects of sleep quality and quantity are suggested to be similar and additive (Barnes, 2012;
Barnes et al., 2011).

Previously I have also suggested that sleep exacts its influence on organizational
outcomes through its importance to self-regulation or more specifically, Baumeister and
colleagues model of self-control (Muraven & Baumeister, 2000). Baumeister and colleagues
(1994) were the first to suggest that self-control depended on a single finite pool of resources that control emotions, attitudes, thoughts, and behaviors (Baumeister Heatherton & Tice, 1994); and that ego depletion occurs when this single stock of self-control resources is depleted (Baumeister, 2002). Ego depletion theory describes how the ability to exert self-control changes across time, due to resource availability. According to Baumeister, Muraven, and Tice (2000), sleep is one essential way in which depleted resources become replenished. Evidence about patterns of self-control failure reviewed by Baumeister et al. (1994) indicated that well-rested people enjoy better self-control. Physiologically, brain imaging studies of sleep-deprived participants show that the greatest decline in cerebral metabolic rate occurs in the pre-frontal cortex (Schnyer et al., 2009; Wimmer, et al., 1992). Given that the pre-frontal cortex plays a key role in executive functioning (Nilsson et al., 2005), high quality sleep positively affects the ability to self-regulate (Christian & Ellis, 2011).

Therefore:

*Hypothesis 1a: Sleep quality is positively related to self-control.*

*Hypothesis 1b: Sleep quantity is positively related to self-control.*

**Self-Regulation and Leadership Behaviors**

Self-regulated behavior is important in organizations and is especially important to leadership. Effective leadership is inherently complex and demanding and an important component of leadership is the management of social relationships (Parry, 2011). Leadership has previously been described as a social process of influencing the thoughts, feelings, and actions of others (Yukl, 2012). To do so effectively, leaders need to show higher levels of self-control. In terms of positive leadership behavior, transformational leadership requires that leaders be inspirational and motivational as well as be thoughtful to the employees’ individual needs, all of
which require that leaders regulate their emotions and behaviors. Negative leadership behaviors suggest a lack of self-control (Goleman, 1998). When employees behave negatively or perform poorly, leaders may want to react with anger, even though it would be more beneficial to be less reactive. Suppression of anger in situations such as this, again, require higher levels of self-control.

While the link between self-regulation and leadership behaviors has not received much research interest, there is some support for the importance of self-regulation to the expression of positive leadership behaviors. First, emotional intelligence has been previously linked to transformational leadership (e.g. Barling, Slater & Kelloway, 2000; Leban & Zulauf, 2004) and one component of emotional intelligence is the ability to regulate ones’ own emotions. Second, Richards and Hackett (2012) showed that leaders’ awareness and regulation of emotions enabled them to achieve situation-appropriate responses at work. Third, leaders’ depleted resources (i.e., depressive symptoms, anxiety, and workplace alcohol consumption) predicted lower levels of transformational leadership (Byrne et al., 2014).

Importantly, ego depletion may not only hinder the enactment of positive leadership, but may also influence negative leadership behaviors. Self-regulation is essential for reducing negative leadership behaviors because optimal levels of self-control enhances impulse control (Barnes et al., 2014). Individuals rarely plan to behave unethically or abusively; instead, leaders with low impulse control due to ego depletion find it difficult to resist temptations to engage in negative behaviors (Goleman, 1998). Recent research supports this notion. In both laboratory and field studies, ego depletion predicts lying (Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009), cheating (Christian & Ellis, 2011), deception (Welsh, Ellis, Christian & Mai, 2014), and other unethical behavior (Barnes et al., 2011; Gino, Schweitzer, Mead, & Ariely, 2011).
of leadership, recent research demonstrates that reduced self-control or a lack of personal resources is related to abusive supervision (Barnes et al., 2015; Byrne et al., 2014). Therefore:

**Hypothesis 2:** Self-control is positively related to high quality leadership behaviors (transformational leadership).

**Hypothesis 3:** Self-control is negatively related to low quality leadership behaviors (abusive supervision).

**Sleep and Leadership**

Sleep is potentially important to leadership, as it replenishes self-control resources (Barnes, 2012; Baumeister et al., 2000). If, as previously hypothesized, self-control predicts high quality leadership, it would follow that leaders would constantly be regulating themselves to ensure they are engaging in high quality leadership behaviors. However, self-regulation depletes resources and because sleep replenishes self-control, sleep is important to leadership behaviors.

While there is little research on the direct influence of sleep on leadership behaviors (see Barnes et al., 2015, for exception), there is some support for this idea from the effects of sleep on organizational outcomes that might be considered important to leadership. First, a lack of sleep leads to workplace absences (Salo et al., 2010), poor concentration at work (Wagner, Barnes, Lim, & Ferris, 2012), difficulty with organization (Dean et al., 2010), poor motivation (Baranski et al., 2007), impatience (Swanson et al., 2011), workplace deviance (Christian & Ellis, 2011), lack of innovation and creativity (Wagner, Gais, Haider, Verleger, & Born, 2004), lack of trust (Anderson & Dickinson, 2010), prejudice (Ghumman & Barnes, 2013), interpersonally inappropriate (Kahn-Greene, Lipizzi, Conrad, Kamimori, & Killgore, 2006) and unethical behavior (Barnes et al., 2011). Second, lack of sleep also results in lower interpersonal functioning, including reduced empathy toward others and worse quality of interpersonal relationships, stress management skills (reduced impulse control and difficulty with delay of
gratification), and coping (Killgore et al., 2008). Third, sleep deprivation reduces one’s own willingness to behave in ways that facilitate effective social interaction (Kahn-Greene et al., 2006). Fourth, sleep deprivation increases the propensity to make risky choices (Hockey, Maule, Clough, & Bdzola, 2000; Killgore, Balkin, & Wesensten, 2006; Killgore, Kamimori, & Balkin, 2011). Finally, sleep deprivation increases expectations of gain in risky decisions and makes people less sensitive to loss (Venkatraman, Chuah, Huettel, & Chee, 2007).

Therefore, integrating Hypotheses 1, 2 and 3, I predict that sleep quality and sleep quantity will be positively related to high quality leadership behaviors (i.e., transformational leadership) and negatively related to low quality leadership behaviors (i.e., abusive supervision) and that self-control will mediate these relationships. Poor sleep quality and quantity will hinder the restoration of self-control resources and result in more low-quality leadership behaviors and fewer high quality leadership behaviors (see Figure 1).

**Hypothesis 4a:** Sleep quality is positively related to high quality leadership behaviors (transformational leadership) through self-control.

**Hypothesis 4b:** Sleep quantity is positively related to high quality leadership behaviors (transformational leadership) through self-control.

**Hypothesis 5a:** Sleep quality is negatively related to low quality leadership behaviors (abusive supervision) through self-control.

**Hypothesis 5b:** Sleep quantity is negatively related to low quality leadership behaviors (abusive supervision) through self-control.

I controlled for three variables, namely, gender, tenure as a leader and liking of leader. I control for gender because there are gender differences in both sleep and leadership (e.g., Burgard, Alshire & Hughes, 2010; Eagly, Johannesen-Schmidt, & Van Engen, 2003). I controlled for tenure of the leader because tenure has previously been found to be an important determinant of leadership performance (Bettin & Kennedy, 1991). I controlled for liking of
leader because it has previously been shown to influence ratings of leadership behaviors (e.g., Brown & Keeping, 2005). I was also planning to control for positive affect because it has been previously been found to be related to leadership behavior (e.g., Barling, Christie, & Hoption, 2010; Newcombe & Ashkanasy, 2002). However positive affect was highly correlated with liking of leader (see Table 1) and therefore only liking of leader was controlled for.

3.2 Method

Overview

I used a daily diary study methodology to examine my hypotheses. The study participants completed an initial survey that included demographic and trait level variables at the beginning of the study, i.e., prior to daily completion of surveys. Thereafter, they completed the daily surveys over 15 consecutive working days. For this study, I linked the daily data collected regarding sleep and self-control from the leaders each morning, with data collected from the followers that same afternoon assessing leadership behaviors. This type of time-based designs allows for investigating experiences as they unfold (Iida, Shrout, Laurenceau, & Bolger, 2012).

Participants and Recruitment

Participants were recruited from three health regions across Canada. The sample included administrative leaders and at least one of their followers who worked a minimum of 30 hours a week. Leaders were recruited by email with the assistance of each health region’s Human Resources and/or Research departments. The email inviting leaders to participate explained that they needed to recruit at least one of their followers to participate in the study with them. Once the leaders and at least one of their followers agreed to participate in the study, the process of daily survey completion began. When leaders recruited more than one follower, the mean score of the followers’ responses were taken. I recruited 62 leaders to participate in the study. However
due to the inability to recruit followers or non-response after completion of initial survey, the final sample included 42 leaders with at least one of their followers. The average age of the leaders was 50.1 years ($SD = 6.7$; 69% female). Leaders had been in leadership roles for an average of 13.9 years ($SD = 9.6$) and on average, had 56.4 ($SD = 147.3$, Range 1-800) people reporting to them. These leaders worked an average of 49.3 hours a week ($SD = 8.9$). The followers’ average age was 46.3 ($SD = 10.1$), with 83% being female. The average tenure that followers had worked with their leader was 5.7 ($SD = 5.0$) years and 55% had between a little to a moderate amount of contact with their leader throughout the daily surveys.

**Procedure**

Before the daily portion of the study started, all leaders and followers completed a survey to collect demographic and trait-level data. Only after both the leader and follower had completed the initial survey were they sent the daily questionnaires. Participants completed a diary survey each work day for 15 days and leaders on average completed 12.5 ($SD = 3.5$) days and there was matched data for an average of 10.0 ($SD = 3.4$).

Each morning, leaders received their daily survey email at 10.00 am. Followers received their daily survey towards the end of the workday (i.e., 3.00 pm) so that leaders had the opportunity to interact with their followers. As previously recommended for daily diary studies (Reis & Gable, 2000), both leaders and followers were asked to complete their daily surveys at the same time each day, and each daily survey took an average of 5 minutes to complete. Upon the completion of the 15 day daily study, participants each received a $20$ Tim Hortons $gift$ card. This study received approval from the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board.

**Measures**
Leaders: Initial survey.

**Demographics.** Demographic questions included gender, age, years of education, income, job tenure, type of work, weekly hours work, years of leadership experience, number of subordinates.

**Trait positive affect.** I assessed trait positive affect with the 10 positive items from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Each item was rated on a 5-point scale ranging from 1 = very slightly or not at all to 5 = extremely.

Leaders: Daily survey.

**Daily leader sleep quantity.** Leader sleep quantity was measured using the Pittsburgh Sleep Diary (Monk et al., 1994). Participants were asked the “time at which they went to bed”, “how long it took them to fall asleep”, “what time they woke in the morning”, and “how long they were awake after initially falling asleep”. Time awake after initially falling asleep is referred to in the sleep physiology literature as “wakefulness after sleep onset” (WASO). Participants were provided with an example to help them understand the meaning of the WASO item (“For example, if you were asleep until 1am, woke at 1am and fell back asleep at 1:20am for the rest of the night, your answer would be 20 minutes”). These times were used to calculate the number of minutes spent asleep as the measure of sleep quantity. Previous research indicates that this measure of sleep quantity correlates very highly with objective measures of sleep quantity (Barnes et al., 2011).

**Daily leader sleep quality.** To measure sleep quality four items from the Karolinska Sleep Questionnaire were used (Akerstedt, Knutsson, Westerholm, Theorell, Alfredsson, & Kecklund, 2002). Questions are answered on a 4- point rating scale ranging from “none” to “a lot”. High scores indicate worse sleep quality.
**Daily leader ego depletion.** To measure daily ego depletion, a five item scale used by Lanaj, Johnson, & Barnes (2014) to assess ego depletion in the diary study format was used. These 5 items were taken from Christian and Ellis (2011). Items will be measured on a 5 point Likert scale, in which 1= *very slightly or not at all* and 5= *very much*. A sample item is “My mental energy is running low.”

**Subordinates: Initial survey.**

**Demographics.** Demographic questions included gender, age, years of education, income, job tenure, type of work, weekly hours work, and tenure under leader.

**Liking of leader.** Liking of the leader was measured using a four-item liking scale previously used by Brown and Keeping (2005) to assess the degree to which subordinates liked their supervisor. One item (“How much do you like your supervisor”) was revised (“I like my supervisor”). Responses were indicated on a 5-point Likert scale with 1 representing “Strongly Disagree” and 5 representing “Strongly Agree”.

**Subordinate: Daily survey.**

**Daily abusive supervision.** Abusive supervision was measured using a shortened 4-item version of Tepper’s (2000) 15-item abusive supervision scale (e.g., “Today my leader expressed anger at me when he/she is mad for another reason.”). Internal consistency for the full scale has been found to be high (e.g., $\alpha = .94$; Tepper, Henle, Lambert, Giacalone, & Duffy, 2008), as a result of which using a shortened version is appropriate, and have been used in other studies (e.g., Shoss, Eisenberger, Restubog, & Zagenczyk, 2013). Participants were asked to indicate agreement as to whether their leaders engage in these behaviors at work, using a 5-point Likert scale ranging from 1= *strongly disagree* to 5= *strongly agree.*
Daily transformational leadership behavior. Transformational leadership was measured by adapting four items ($\alpha = .87$) from the 21 item scale developed by Podsakoff, MacKenzie, Moorman, and Fetter (1990), a procedure that has been used in previous research (Johnson, Venus, Lanaj, Mao, & Chang, 2012). Each item measured a core aspect of transformational leadership: articulating a vision, emphasizing group goals, intellectual stimulation, and displaying enthusiasm. An example item is “My leader communicated a desirable goal or vision to a work group member today.” Participants were asked to indicate agreement as to whether their leaders engage in these behaviors at work, using a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

The study questionnaire appears in Appendix B.

3.3 Data Analysis

Due to the nested nature of the data (days nested within individuals) and my focus on testing a mediation model at the within-person level, I followed the recommendations of Preacher, Zyphur, and Zhang (2010) and used a multilevel structural equation modeling (MSEM) framework (MPlus Version 6; Muthén & Muthén, 2008) to analyze the data. The MSEM procedure partitions the variances of daily observations into two components, between-person and within-person variances. This ability to estimate Level 1 effects while taking account of Level 2 effects makes this procedure superior to running two separate within- and between-persons SEMs. Multilevel SEM also allows for testing of cross-level moderation, which cannot be examined in separate within- and between-persons SEMs. Further, MSEM allows for simultaneous estimation of the parameters in the mediation model, offering more robust estimates of standard errors of parameters than piecemeal approaches such as a series of
hierarchical linear models (for detailed mathematical explanations and simulation evidence, see Preacher et al., 2010).

In order to test mediation in the model, I tested separated models of daily leader sleep quantity and quality as the predictor variables, daily leader ego depletion was the mediator, and daily transformational leadership and abusive supervision as the two separate outcome variables. Mediation was tested and reported through a test of the statistical significance of the indirect effect and its associated confidence intervals (MacKinnon, 2008). The data consisted of two levels. The lowest level (Level 1) comprised daily abusive supervision and transformational leadership, leader sleep and ego depletion, all of which were nested within leaders (Level 2). The control variables (gender, liking of leader, tenure as a leader) were level 2 variables.

Thus, before testing my hypotheses, I determined whether or not it was appropriate to aggregate the outcome variables to the between-level, i.e., within-person aggregation by calculating interclass correlations (ICCs). For leader daily abusive supervision, the ICC was 0.50 and for transformation leadership the ICC was 0.55, suggesting that aggregation within person was appropriate.

Sample Size

I recruited 62 leaders and at least one of their followers for this daily diary study. Diary studies represent a two-stage cluster sampling, with individuals in the first step, and daily responses in the second step leading to daily responses being clustered within persons (Ohly, Sonnentag, Niessen, & Zapf, 2010). When planning a diary study, researchers need to consider whether maximizing sample size or the number of days is more appropriate (Scherbaum & Ferreter, 2009); and this depends of whether within-subject or between-subject change is more central to the hypotheses (Ohly et al., 2010). For this study I was interested in tracking changes
within individuals over time, and therefore I maximized the number of days (Fuller et al., 2003). My final sample of 42 dyads with an average of 10 days of complete data provided approximately 420 observations.

3.4 Results

Table 1 reports the descriptive statistics and the correlations at the within-person level. Tables 2-5 report the results of the hypothesis testing and the multilevel SEM analysis. I control for gender, tenure of leader and liking of leader in all analyses.

My first hypotheses examined the relationship of sleep and self-control. Specifically, I hypothesized that daily leader sleep quality (H1a) and sleep quantity (H1b) would be positively related to leader self-control. Both hypothesis 1a and 1b (respectively) were supported, as both daily sleep quality (γ = 1.09, \( p < .001 \); see Table 2: Model 1) and daily sleep quantity (γ = -0.23, \( p < .001 \); see Table 3: Model 1) were both associated with self-control.

Hypotheses 2 posited that daily leader self-control is positively related to daily transformational leadership, but was not supported (γ = -.03, \( ns \); Tables 4 and 5: Model 2). In contrast, Hypothesis 3 specified that daily leaders’ self-control is negatively related to daily abusive supervision, and this hypotheses was empirically supported (γ = -.02, \( p < .05 \); Tables 2 and 3: Model 2).

Hypotheses 4 proposed that self-control would mediate the relationship between daily sleep quality (H4a) and daily sleep quantity (H4b) and daily transformational leadership behaviors. However, neither of these mediational hypotheses were not supported (\( ab = -.03, ns \); 95% CI [-.057, .11]; see Table 2: Indirect effects) and (\( ab = .01, ns \); 95% CI [-.01, .02]; see Table 3: Indirect effects).
In contrast both Hypothesis 5a and Hypothesis 5b were supported. The indirect effect of daily sleep quality (5a) and sleep quantity (5b) on daily abusive supervision via daily leader self-control were significant ($ab = -.02, p < .05; 95\% \, CI \, [-.037, -.005];$ see Table 4: Indirect effects) and ($ab = .01, p < .05; 95\% \, CI \, [.001, .008];$ see Table 5: Indirect effects), respectively. These results indicate that self-control mediated the relationship between daily leader sleep quality and quantity and daily abusive supervision.

3.5 Discussion

I used a daily diary study methodology to examine the daily relationship between leader sleep and subsequent leadership behaviors, namely, transformational leadership and abusive supervision. The results supported a mediational model in which daily sleep quality and quantity affected daily self-control, which in turn affected daily abusive supervision. Similar indirect effects were not supported for daily sleep affecting daily transformational leadership behaviors. A number of theoretical, methodological and practical implications warrant discussion.

Theoretical Implications

To begin, by using a daily study methodology, I examined daily leadership behaviors, or the within-person variation in leadership behaviors, which challenges the more prevailing trait-like (i.e., between-person) approach which dominates research on leadership behaviors (see, Barnes et al., 2014; Johnson et al., 2012, for exceptions). My research adds to the leadership literature by demonstrating the potential utility of using a more state-level or within-person, dynamic perspective in understanding leadership behaviors. My study goes further, by examining how sleep predicts leadership behavior and specifically abusive supervision. In this way, my study contributes to the very small body of research on antecedents of leadership behaviors. Like others (e.g., Barnes et al. 2014; Byrne et al., 2014) this study suggests the
importance of non-work predictors of the quality of leadership behaviors, and how leaders’ own well-being may impact their leadership behaviors. More specifically, the findings of this study isolate one reason why leaders might exhibit daily variation in their negative leadership behaviors (i.e., sleep). In terms of abusive supervision, the current findings offer some insight into why leaders behave abusively, a question that has been intrigued researchers for almost two decades (Tepper, 2000).

This study again demonstrates the importance of sleep within organizational behavior. Like Barnes et al. (2014), I used a self-control/ego depletion framework to explain why sleep would affect leadership behaviors. To my knowledge, this is only the second study to do so. Moreover, this study examined two different aspects of sleep, namely sleep quality and quantity. This responds to calls to focus on how different sleep variables affect behaviors (Barnes et al., 2011). Unlike Barnes et al. (2014), I found that both sleep quality and quantity predicted abusive supervision. One possible reason for this discrepancy is that sleep quality was measured using different scales in each of our studies. To measure sleep quality, Barnes et al. (2014) used reverse-coded wakefulness after sleep onset, which captures interruptions to sleep, to operationalize sleep quality. In contrast, I used items from the Karolinska Sleep questionnaire (Akerstedt et al., 2002) to assess sleep quality. The findings in the current study of sleep quality and quantity as significant indirect predictors of abusive supervision adds to the range of sleep variables that affect work related behaviors, but further research replicating the results of this study are still warranted.

**Strengths and Limitations**

I have already alluded to the major conceptual strengths of the current study, which include conceptualizing leadership as a dynamic rather than trait-like variable, and isolating the
mediating role of self-control on the indirect effects of sleep on abusive supervision. What follows is a consideration of methodological strengths of the current study.

One major methodological strength of the current study is the implementation of a daily diary study, which uses a within-participant design that partials out any between-participant differences in order to test the within-person hypotheses. Such within-person designs offer a means of analyzing daily fluctuations in variables of interest (Ohly et al., 2010). In addition, I collected data from separate sources (subordinates and supervisors) to avoid inflated correlations that can afflict single source data (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Although there are many benefits to this study there are also limitations. While I controlled for a number of between-level variables including liking of the leader, gender and tenure as a leader, and used a design that parses out any potential between-supervisor confounds, I did not include within-level controls, such as daily levels of leader or follower stress. Inferences from future research will be more robust when such within-level controls are included.

One of the major limitations of using a daily diary study methodology is that any measures used are invariably shortened versions of original measures. This can be problematic as these shortened measures may be less reliable, and pose a threat to validity if they do not tap into the same construct measured by the full measures. Reliabilities were acceptable in the present study, but issues of validity remain to be assessed. A related limitation pertaining to the use of a daily diary study is the number of variables that can be assessed each day is more limited. The optimal length of a daily survey is between 5-7 minutes (Ohly et al., 2010). In the current study it may have been useful to examine a second mediational path to the positive leadership behaviors.
(i.e., transformational leadership), however another variable was not added because of the time limits of the survey, and this still needs to be considered in future research.

**Future Directions**

Understanding antecedents of leadership behavior, particularly non-work antecedents, has received relatively little attention within the leadership research, and as such I offer a number of future directions for this research. As I previously stated, the non-significant finding for transformational leadership poses some interesting research questions. A first question that arises is that while abusive supervision can be explained as a self-control failure (Kiewitz et al., 2012), the positive nature of transformational leadership means that failure to enact this form of leadership is likely not a failure of self-control. Instead, enacting transformational leadership requires more than just self-control. Given the psychological energy involved in enacting the four behaviors involved in transformational leadership, I would suggest that sleep may affect transformational leadership via cognitive functioning. Previous research demonstrates the effect that sleep has on cognitive functioning (Lim & Dinges, 2010) and there is a strong relationship between trait-level cognitive ability and leadership (Barling et al., 2010). Future research should examine whether cognitive functioning mediates any effects of sleep on transformational leadership.

Other possible outcomes of sleep and leadership that could be considered in future research are subordinate outcomes. For example, Barnes et al. (2014) found a significant indirect effect of daily sleep quality on daily work unit engagement through ego depletion and abusive supervision. Expanding the focus to include daily outcomes of leadership behaviors would add to our understanding of the pervasive effects of sleep.
Last, future research could also investigate other potential sleep variables that may influence leadership behaviors. One important sleep variable that was not examined in the current study or the Barnes et al. (2014) study is daytime sleepiness. A recent comprehensive framework of how the physiology of sleep impacts behaviors in, and experiences of, the workplace (Mullins, Cortina, Drake, & Dalal, 2014) suggests that daytime sleepiness is the casual mechanism through which sleep problems, including sleep quality and quantity, affect organizational outcomes. The Mullin et al. framework proposes that sleepiness exerts its effects on organizational outcomes in two ways: First, sleepiness indirectly affects work-related behavioral outcomes through its proximal effect on information processing and affect (i.e. psychological functioning). Second, daytime sleepiness directly influences work-related outcomes (Mullins et al., 2014). Extending this, daytime sleepiness might mediate any effects of sleep quantity and quality on different leadership behaviors, and this could be investigated in future research. While self-control did not mediate the relationship between sleep and transformational leadership, daytime sleepiness might negatively affect transformational leadership as sleepiness may cause leaders to pay less attention to employees. Likewise, daytime sleepiness might also mediate the effects of poor sleep quality and quantity on in laissez faire (or passive) leadership. Passive leadership remains relatively understudied, and its antecedents, especially non-work antecedents, even more so (Barling, 2014), and this could be an interesting direction for research on sleep and leadership.

**Practical Implications**

The results of this study suggest several implications for organizational practice. There are distinct practical advantages to focusing on the antecedents of daily leadership behavior rather than the traditional trait approaches to leadership behavior. The reason for this is that I do
not assume that leaders consistently act in a certain way, which is why I focused on daily leadership behaviors in this study. Findings showed that leaders are more abusive on days when they have less sleep and therefore less self-control. This might suggest that there could be effective methods to reducing abusive supervision that are neither selection nor termination based. Instead, interventions that target increased sleep in leaders could potentially lead to lower levels of abusive supervision.

A second implication of these findings is that leaders need to be made more aware of how their sleepiness and self-control are affected by the quantity and quality of their sleep. Through this awareness leaders could potentially schedule important and/or difficult interactions to those times when they do not feel sleepy. Through leadership training, organizations can increase awareness of the indirect effects of sleep on abusive supervision. Organizational leaders could possibly influence the quality of their leaders’ behaviors, for example, by not expecting leaders to be available to answer emails at all hours of the night. Last, organizations might positively affect the quality of leadership by making sleep resources (e.g., evidenced-based workshops) readily available to these groups.

Conclusion

Previous research has shown that sleep affects diverse organizational outcomes, but this study is only the second to show that sleep impacts leadership behaviors, specifically abusive supervision. What made this study unique, however, was the finding that daily changes in the quantity and quality of sleep exerted immediate, albeit indirect, effects on abusive supervision. The within-person, daily nature of these findings opens new avenues for research on sleep and leadership, as well possible opportunities for organizational interventions targeting the quality of leadership behaviors.
3.6 References


Byrne, A., Dionisi, A. M., Barling, J., Bergenwall, A., Robertson, J., Lys, R., ... & Dupré, K. The Depleted Leader: The influence of leaders’ diminished psychological resources on leadership behaviors. The Leadership Quarterly, 25, 344-357.

Canadian Sleep Society. (2003). Normal sleep and sleep hygiene. St Catharines, ON: Cote, K.


excessive sleepiness. *Journal of Occupational and Environmental Medicine, 52*, 144–149.


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<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<td>-</td>
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<td>.31**</td>
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<td>-.14**</td>
<td>-.09*</td>
<td>-.13**</td>
<td>(.78)</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-.08</td>
<td>-.14**</td>
<td>-.06</td>
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<td>6. Daily Ego Depletion</td>
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<td>.86</td>
<td>.03</td>
<td>.11*</td>
<td>-.12**</td>
<td>.61**</td>
<td>-.36**</td>
<td>(.93)</td>
<td>-</td>
<td>-</td>
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<td>7. Daily Abusive Supervision</td>
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<td>.44</td>
<td>.01</td>
<td>.08</td>
<td>-.46**</td>
<td>-.04</td>
<td>.15**</td>
<td>-.11*</td>
<td>(.98)</td>
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<td>8. Daily Transformational Leadership</td>
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<td>.24**</td>
<td>.56**</td>
<td>-.15**</td>
<td>-.043</td>
<td>-.14**</td>
<td>.34**</td>
<td>(.87)</td>
</tr>
</tbody>
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Table 3-1: Descriptives and Correlations N = 433

*Notes. *Cronbach’s alpha indicated on the diagonal using boldface.

*Correlation is significant at the 0.05 level (two-tailed).

**Correlation is significant at the 0.01 level (two-tailed).*
Table 3-2: Multilevel Path Analysis Sleep Quality and Transformational Leadership

<table>
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<th>Main Effects</th>
<th>Self-Control Model 1</th>
<th>Transformational Leadership Model 2</th>
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</thead>
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<tr>
<td>Gender</td>
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<tr>
<td>Leader Tenure</td>
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<td>.01</td>
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<tr>
<td>Liking</td>
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<td>.60***</td>
</tr>
<tr>
<td>Sleep Quality</td>
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<td>.01</td>
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<table>
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<tr>
<th>Indirect Effects</th>
<th>Estimate</th>
<th>LLCI</th>
<th>UCLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Quality – Transformation Leadership (via Ego Depletion)</td>
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<td>-0.568</td>
<td>0.107</td>
</tr>
</tbody>
</table>

N = 410. LLCI = lower level of the 95% confidence interval. UCLI = upper level of the 95% confidence interval. Unstandardized estimates are reported.

† p < .10, * p < .05, ** p < .01, ***p < .001 two-tailed.
Table 3-3: Multilevel Analysis Sleep Quantity and Transformational Leadership

<table>
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<th>Transformational Leadership (Model 2)</th>
</tr>
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<tr>
<td>Gender</td>
<td>-.12</td>
<td>-.32**</td>
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<td>.01</td>
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<tr>
<td>Liking</td>
<td>-.16</td>
<td>.60***</td>
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<tr>
<td>Sleep Quality</td>
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<tr>
<td>Self-Control</td>
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<tr>
<td><strong>Indirect Effects</strong></td>
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<td>Sleep Quality – Trans.</td>
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<td>Leadership (via Ego Depletion)</td>
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N = 410. LLCI = lower level of the 95% confidence interval. UCLI = upper level of the 95% confidence interval. Unstandardized estimates are reported.

* p < .05, ** p < .01, ***p < .001 two-tailed.
Table 3-4: Multilevel SEM of Sleep Quality and Abusive Supervision

<table>
<thead>
<tr>
<th></th>
<th>Main Effects</th>
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<th>Model 1</th>
<th>Abusive Supervision</th>
<th>Model 2</th>
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<tr>
<td>Gender</td>
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<tr>
<td>Leader Tenure</td>
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<td>Liking of Leader</td>
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<td>-.11***</td>
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<tr>
<td>Sleep Quality</td>
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<tr>
<td>Self-Control</td>
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*Indirect Effects*

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<th>LLCI</th>
<th>UCLI</th>
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<tbody>
<tr>
<td>Sleep Quality – Abusive</td>
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<td>-.037</td>
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N = 380. LLCI = lower level of the 95% confidence interval. UCLI = upper level of the 95% confidence interval. Unstandardized estimates are reported.

* p < .05, ** p < .01, ***p < .001 two-tailed.
Table 3- 5: Multilevel Path Analysis Sleep Quantity and Abusive Supervision

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<tr>
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</table>

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>Estimate</th>
<th>LLCI</th>
<th>UCLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Quality – Abusive Supervision (via Ego Depletion)</td>
<td>.01*</td>
<td>.001</td>
<td>.008</td>
</tr>
</tbody>
</table>

N = 406. LLCI = lower level of the 95% confidence interval. UCLI = upper level of the 95% confidence interval. Unstandardized estimates are reported.

* p < .05, ** p < .01, ***p < .001 two-tailed.
Figure 3-1: Proposed model of sleep, self-control and leadership.
Chapter 4
The Effects of Change in Sleep on
Withdrawal From and At Work

Abstract

Work withdrawal behaviors (e.g., partial absenteeism, turnover intention, absenteeism, work neglect and cyberloafing) are relatively common, incur costly outcomes within organizations, and have both work and non-work antecedents. In this study I investigated one non-work antecedent of withdrawal behaviors, namely sleep. To date, little research has focused on the relationship between clinical sleep disorders and work experiences, and I studied how changes in sleep following treatment for obstructive sleep apnea (OSA) influence withdrawal behaviors. A sample of individuals diagnosed with OSA were recruited from a sleep clinic at a large-sized hospital. A within-subjects, pretest-post-test design was used, in which participants completed questionnaires before receiving clinical treatment for their sleep disorder, and again twice thereafter. Findings show that daytime sleepiness caused by sleep apnea directly effects withdrawal from work (partial absenteeism and absenteeism) and indirectly affects withdrawal at work of (work neglect) through cognitive depletion. In addition, receiving treatment for sleep apnea positively affected daytime sleepiness across time, and improvement in daytime sleepiness resulted in less withdrawal from and at work. Moreover, the indirect effects of the improvements in daytime sleepiness on withdrawal at work was mediated by improvements in cognitive depletion.
4.1 Introduction

Attendance at work, and engagement once at work, are normative expectations. Yet neither can be taken-for-granted. Instead, employees withdraw from work, and at work, in a variety of different ways which can be costly for organizations (Hanisch & Hulin, 1991). Work withdrawal behaviors impact organizations in both financial and non-financial ways (Laczo & Hanisch, 2000). In the case of absenteeism, it is estimated that the direct cost of absenteeism averaged 2.4% of gross annual payroll in the USA. However the exact cost is not easy to quantify because it is difficult to differentiate between avoidable and unavoidable absence (Dabboussy & Uppal, 2012). Even so, there are considerable indirect costs of withdrawal behaviors, including employee morale, group cohesion and motivation when colleagues and co-workers consistently demonstrate withdrawal behaviors (Koslowsky, Sagie, Krausz, & Singer, 1997). As well, absenteeism has been linked to increases in workplace injuries (Goodman & Garber, 1988), all of which contributes negatively to overall organizational production and efficiency.

Given this, understanding what is meant by work withdrawal is an important issue. Work withdrawal is a multidimensional concept made up of several different behaviors. To bring conceptual clarity to this concept, previous researchers have distinguished between withdrawal from and withdrawal at work (LeBlanc, Barling, & Turner, 2014). Withdrawal from work is defined as “physical removal from a particular workplace either for part of a day, an entire day, or permanently” (Johns, 2001, p. 233). These withdrawal behaviors include partial absenteeism, tardiness, absenteeism, intentions to turnover and turnover. Partial absenteeism includes arriving late for work, leaving work early, and taking extended breaks during work (Barling, MacEwen, Kelloway, & Higginbottom, 1994).
In contrast, withdrawal at work is defined as being “physically at work but not productive” (LeBlanc et al., 2014, p. 401). These withdrawal behaviors include cognitive and emotional distraction and behavioral neglect. Distractions include any environmental events or stimuli that challenge our ability to maintain focus on goal-relevant information, and thus impair performance (Dolcos & McCarthy, 2006; Ellis & Ashbrook, 1988). Work neglect is more deliberate, and involves exerting less behavioral effort while at work (e.g., Schat & Kelloway, 2000).

As would be expected (because they are mostly visible and hence more amenable to research), most research on withdrawal behaviors have focused on withdrawal from work (i.e. lateness, absenteeism and turnover: Boswell, Ren, & Hinrichs, 2008). In predicting and explaining these withdrawal behaviors, focus has generally been on a variety of personal (e.g. gender; Steel & Rentsch, 1995), attitudinal (e.g. job commitment; Meyer, Stanley, Herscovitch, & Topolnytsky, 2002) and organizational antecedents (e.g. organizational support; Eisenberger, Fasolo, & Davis-LaMastro, 1990). Less is known about how non-work variables impact work withdrawal behaviors; notable exceptions to this include the study of how work-family conflict (Hammer, Bauer, & Grandey, 2003) or intimate partner aggression (LeBlanc et al., 2014) impact work withdrawal.

In the current study, I examined a different non-work activity that influences work withdrawal behaviors, namely sleep (e.g., Sivertsen, Björnsdóttir, Øverland, Bjorvatn, & Salo, 2013). Humans spend up to one-third of their lives sleeping, and sleep is a prerequisite for human functioning and a powerful determinant of affect, cognition and behavior (Barnes, 2012; Harrison & Horne, 2000; Lim & Dinges, 2010; Siegel, 2005). Despite its importance, (e.g. Barnes & Wagner, 2009; Barnes, Ghumman, & Scott, 2013) sleep has generally been ignored by...
organizational psychology researchers. However, this is now starting to change. Two possible reasons for this recent shift include the recognition of the restorative effects of sleep, and the understanding that even slight reductions in sleep can have tangible work-related effects (e.g. 40 minutes of lost sleep has been associated with increased work injuries; Barnes & Wagner, 2009). Nonetheless, recent research on sleep and work has focused more on cognitive (e.g., job satisfaction) and affective (e.g., positive and negative mood) outcomes of sleep (e.g., Barnes & Hollenbeck, 2009; Scott & Judge, 2006; Sonnentag & Zijlstra, 2006), with less research examining employee behaviors as an outcome of sleep loss (e.g., Barnes et al., 2013).

One salient feature of the research on the interdependence of sleep and work is that with few exceptions (e.g., Guglielmi, Jurado-Gámez, Gude, & Buela-Casal, 2014; Sivertsen et al., 2013; Sjøsten et al., 2009; Ulfberg, Carter, Talback, & Edling, 1996; Ulfberg, Carter, & Edling, 2000), this research has been based almost exclusively on non-clinical populations. In contrast, most research that has examined sleep disorders has been conducted outside of the organizational behavior field, limiting what might be learned about the interaction of sleep and work. This is a significant issue: The International Classification of Sleep Disorders distinguishes more than 80 different sleep disorders and problems, with falling asleep or daytime sleepiness affecting approximately 35 to 40% of the U.S. adult population (Hossain & Shapiro, 2002). Accordingly, the purpose of my study was to examine whether and how changes in sleep following treatment for one common sleep disorder, namely sleep apnea, affects change in work withdrawal behaviors.

**Theoretical development: Effects of Sleep Apnea on Work Withdrawal**

Sleep disordered breathing is one of the most common sleep disorders in the general adult population (Vgontzas & Kales, 1999), with obstructive sleep apnea (OSA) being the most
frequent category of sleep disordered breathing. An estimated 858,900 (3%) Canadian adults 18 years and older reported being diagnosed with sleep apnea, and over 1 in 4 (26%) adults reported symptoms and risk factors that are associated with a high risk of having or developing OSA (Public Health Agency of Canada, 2009). Clearly, OSA is a prevalent but underdiagnosed disorder that has harmful effects on sleep.

OSA is characterized by pauses in breathing or abnormalities in the quantity of ventilation during sleep (Wolk, Kara & Somers, 2003). On average, these pauses may occur 5 to 30 times or more per hour and last for 10 to 30 seconds before the brain corrects the problem (Public Health Agency of Canada, 2009). With each episode of apnea, blood oxygen levels are reduced (hypoxia), and sleep is disturbed as the sleeper wakes briefly to resume breathing. All this negatively affects sleep quality and results in chronic sleep deprivation over time (Public Health Agency of Canada, 2009). One of the most debilitating immediate consequences of OSA is daytime sleepiness (e.g., Pack et al., 2006), which is defined as “a craving or desire for sleep” (Dement & Carskadon, 1982, p. S57). Sleepiness reflects a universal physiological need state that is comparable to our physiological need states of hunger or thirst (Drake, 2011; Roehrs Randall, Harris, Maan, & Roth, 2011). Dinges (1995) suggests that sleepiness is one of the most important and common inhibitors of successful performance in our daily lives.

OSA is also associated with serious health conditions including hypertension, heart disease, irregular heartbeat, heart failure, cerebrovascular disease, depression, and type 2 diabetes (Public Health Agency of Canada, 2009). OSA has also been linked to a number of work-related outcomes including stress and burnout (Guglielmi et al., 2014), workplace accidents (Ulfberg et al., 2000) and reduced productivity and performance (Mulgrew et al., 2007; Ulfberg et al., 1996). OSA has also been shown to affect work withdrawal behaviors such as
absenteeism (Sivertsen et al., 2008; 2013). However, studies have not examined the full array of withdrawal behaviors (which I have described and will investigate in this research), nor have they provided an explanation as to why OSA impacts work withdrawal behaviors.

To understand how OSA impacts work withdrawal behaviors, I turn to a recent comprehensive framework (see Figure 4-1) rooted in physiology that was developed to explain how sleep problems in general, and sleepiness more specifically, impact work outcomes (Mullins, Cortina, Drake, & Dalal, 2014). The main tenet of this framework is that sleep problems and sleep disorders cause sleepiness, and that sleepiness is the mechanism through which all sleep problems influence work-related outcomes. A secondary part of the framework proposes that sleepiness exerts it effects in one of two ways: First, sleepiness indirectly affects work-related behavioral outcomes through its proximal effect on information processing and affect (i.e. psychological functioning). Second, daytime sleepiness directly influences work-related outcomes (Mullins et al., 2014).

This model is especially useful for understanding how OSA, and in turn sleepiness, differentially influence withdrawal from vs. withdrawal at work. Specifically, I hypothesize that daytime sleepiness caused by OSA will have a direct effect on withdrawal from work. In contrast, I expect that sleepiness will indirectly influence withdrawal at work through psychological functioning.

**Withdrawal from Work**

Withdrawal from work involves physically removing oneself from work for at least some part of the day, through behaviors such as tardiness, arriving late, and leaving early, and full absenteeism (Barling et al., 1994; Johns, 2001). Intending to the leave the organization permanently would also reflect withdrawal from work. I propose that OSA impacts individuals’
withdrawal from work; specifically OSA increases daytime sleepiness and thereby lowers arousal, leads to chronic sleep deprivation and decreases overall physical health (Harrison & Horne, 2000), all of which would increase withdrawal from work.

In terms of the effect of OSA on partial or full absenteeism, excessive daytime sleepiness would make it difficult to wake up in the morning, resulting in arriving late to work or being absent from work. As well, the excessive sleepiness associated with OSA would also likely make it difficult to stay at work for the whole day: As the day progresses, individuals’ drive for sleep increases sleepiness (De Valck & Cluydts, 2003), causing excessive sleepiness towards the end of the day, as a result of which individuals might leave work early. As well, excessive daytime sleepiness due to OSA makes it difficult to stay awake leading individuals to take more breaks from work to ensure that they do not fall asleep while working.

There is some empirical support for the relationship between sleepiness and withdrawal from work. In one survey of 1000 adults in the USA (Swanson et al., 2011), 29% of respondents reported having fallen asleep or become significantly drowsy at work, 12% were late for work as a result of sleepiness, and 4% left work early as a result of sleepiness and sleep problems. This survey also showed that participants who were at-risk for sleep disorders, including OSA, were more likely to report missed work time due to sleepiness than those not at-risk for any sleep disorder. Research using a large national sample in Norway also demonstrated direct effects of OSA on withdrawal from work. Specifically, having symptoms of OSA was a significant risk factor for subsequent sick leave and permanent work disability (Sivertsen et al. 2008; 2013). Sjosten et al. (2009) also demonstrated that individuals with diagnosed OSA experienced an increase in sickness absence from work, and an increased risk for disability pension claims compared to controls. Therefore:
Hypothesis 1: Daytime sleepiness due to OSA will predict withdrawal from work, i.e., partial absenteeism (1a), turnover intentions (1b), absenteeism (1c).

Withdrawal at Work

Irrespective of how much or how well people sleep, or how sleepy they feel during the daytime, most individuals do not have the luxury of physically absenting themselves from work whenever they want. Regular attendance is a formal requirement with sanctions and punishment for non-compliance, because implicit norms further make missing work very difficult (Johns, 2010). Of all the functional difficulties associated with OSA, excessive daytime sleepiness has the greatest impact of the individuals’ daily lives, and specifically their working lives, given that work is the first place that many individuals go upon awakening (Guglielmi et al., 2014). As a result, many individuals attend work suffering from sleepiness, and it is in this state that withdrawal at work becomes likely. Thus, unlike withdrawal from work, withdrawal at work occurs when people attend work, but are not productive once there (LeBlanc et al., 2014) because of cognitive and emotional distraction and/or work neglect (LeBlanc et al., 2014).

There is research supporting this. For example, sleep deprivation has previously been related to poor task performance (Kessler et al., 2011; Pilcher & Huffcutt, 1996) as well as increased levels of social loafing (Hoeksema-van Orden, Gaillard, & Buunk, 1998). In addition, sleepiness has been associated with work withdrawal behaviors, such as arriving late at work, falling asleep at work, and leaving early from work (Swanson et al., 2011). Finally, one study from the organizational literature demonstrated that the shift to Daylight Saving Time (resulting in missing 40 minutes of sleep) resulted in a dramatic increase in cyberloafing (i.e., inattention) at work (Wagner, Barnes, Lim, & Ferris, 2012). In this study I conceptualize cyberloafing as a specific form of withdrawal at work. Thus:
Hypothesis 2: Daytime sleepiness due to OSA will predict withdrawal at work, i.e., work neglect (2a), cyberloafing (2b).

As is the case for withdrawal from work, OSA and the sleepiness it causes are potential antecedents of withdrawal at work. However, unlike the direct effects of sleepiness caused by OSA on withdrawal from work, daytime sleepiness would also indirectly affect withdrawal at work through its impact on psychological functioning. The effects of OSA and sleepiness on cognitive and affective functioning are well documented in medical research on sleep (e.g., Harrison & Horne 2000; Mullins et al., 2014), as are the mechanisms through which sleepiness will impact withdrawal at work behaviors. The sleepiness caused by sleep apnea lowers executive functioning in the pre-frontal cortex and as previously noted, executive functioning regulates cognitions and emotions in the pre-frontal cortex (Baumeister et al., 1998; Nilsson et al., 2005; Schnyer Zeithamova, & Williams, 2009; Wimmer, Hoffmann, Bonato, & Moffitt, 1992). On a physiological level, engaging in concerted self-control requires effortful exertion of the pre-frontal areas of the brain (Baumeister et al., 1998), which is impaired in individuals with OSA (Olaithe & Bucks, 2013). This is because having a sleep disorder effects the pre-frontal cortex, where prefrontal cortex-oriented tasks such as cognitive control are vulnerable to specific failures above and beyond those resulting from general low arousal and sleepiness (Harrison & Horne, 2000; Lim & Dinges, 2010). This effect has been documented in a recent meta-analysis showing that executive functioning is impaired in individuals with OSA (Olaithe & Bucks, 2013).

Impairments in psychological functioning caused by sleepiness will predict the withdrawal from work behaviors of inadequate attention and increased distraction, and work neglect. This is because inadequate attention, increased distraction and work neglect can all be understood as self-control failures. There is support for the indirect effect of sleepiness on work
withdrawal behaviors through cognitive functioning. First, Swanson et al. (2011) reported that individuals classified as at-risk for a sleep disorders, including OSA, were more likely to report impaired psychological functioning including difficulty with concentration and mood impairments. Second, emergency physicians were more susceptible to distractions at the end of their night shift than at any other time throughout their shift, when they were most sleep deprived (Machi et al., 2012). Third, a study examining the effects of reducing medical interns’ weekly work hours found that eliminating interns’ extended work shifts (24 hours or more) in an intensive care unit, significantly decreased distraction during night work hours (Lockley et al., 2004). Therefore:

_Hypothesis 3:_ Daytime sleepiness will predict withdrawal at work, i.e., work neglect (3a), cyberloafing (3b) through cognitive functioning.

**Treatment for Obstructive Sleep Apnea**

Obstructive sleep apnea (OSA) is a frequent and often underdiagnosed condition associated with upper airway collapse, oxygen desaturation, and sleep fragmentation. Untreated OSA is associated with increased healthcare utilization, sickness absence from work (Al-Ghanim, Comondore, Fleetham, Marra, & Ayas, 2008; Hillman, Murphy, & Pezzullo, 2006; Sjosten et al., 2009) and neurocognitive difficulties in memory, attention, and executive function (Bédard, Montplaisir, Malo, Richer, Rouleau, 1993; Olaithe & Bucks, 2013). Treatment for OSA, however, is now standard and generally accessible in developed societies.

The gold standard in treatment for OSA is continuous positive airway pressure (CPAP) (Canessa et al., 2011; Castronovo et al., 2009). CPAP therapy involves a machine that increases air pressure to the throat while sleeping so that the airway does not collapse while breathing during sleep. CPAP improves breathing while asleep, thereby decreasing nightly awakening and improving daytime sleepiness (Salepci et al., 2013). CPAP treatment has also been shown to be
successful in reducing executive function difficulties caused by OSA (Olaithe & Bucks, 2013):
Specifically, ratings of mood, cognitive performance, and vigilance, mental flexibility and
attention all improve following CPAP treatment (Engleman, Martin, Douglas, & Deary, 1994).

Treatment for sleep apnea provides me with a unique opportunity to assess the indirect
effects of OSA on work withdrawal. Despite its effectiveness, people undergoing CPAP
treatment will still be expected to show different levels of change in sleep and sleepiness. In this
study, I am predicting that the amount of change in daytime sleepiness following CPAP
treatment will directly influence withdrawal from work behaviors, and indirectly influence
withdrawal at work behaviors through cognitive depletion. Thus, my focus is not on an
evaluation of the OSA treatment per se, but rather on the amount of change induced by the
treatment in different participants. Doing so will enable change in sleepiness to be monitored
across time, and I will be able to determine whether the change in sleepiness predicts changes
cognitive depletion and work withdrawal. Thus, I hypothesize that:

Hypothesis 4: Change in sleepiness following treatment for OSA predicts change in
withdrawal from work, i.e., partial absenteeism (4a), turnover intentions (4b), absenteeism (4c).

Hypothesis 5: Change in sleepiness following treatment for OSA predicts change in
cognitive depletion which predicts change in withdrawal at work, i.e., work neglect (5a),
cyberloafing (5b).

4.2 Method

Design

To examine my five hypotheses, a sample of individuals who were referred to the Sleep
Disorders Laboratory with a possible diagnosis of OSA were recruited. All participants
completed an overnight sleep polysomnography at which stage the first set of questionnaires
were completed. The first post-intervention assessment took place one month following
treatment to allow sufficient time for differential change in sleep to occur, with the second post-
intervention taking place three months later. This study received approval from the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board.

Participants

Adults referred to the hospital’s Sleep Disorders Laboratory by their family physicians for an overnight polysomnography for suspected sleep disordered breathing, and who were employed for at least 30 hours a week, were invited to participate in this study. There were several criteria for inclusion in my study, and the information for these decisions were based on data derived from the initial assessments: (1) an Epworth Sleepiness score greater than 7, (2) the ability to apply the Level III monitoring equipment without supervision (after brief initial training) and (3) primary residence within 100 miles of the hospital’s sleep clinic (for returning the PM equipment). Exclusion criteria were (1) co-existing symptoms of another sleep disorder known to cause daytime sleepiness (e.g., periodic limb movement disorder), (2) other serious medical condition (e.g., known chronic obstructive pulmonary disease, congestive heart failure, or uncontrolled asthma), (3) or psychiatric disorder known to be associated with sleep disorders. All patients were informed that their participation was voluntary, and that participation required completing a survey at three time points. 142 participants recruited and 98 completed all assessments. The average age of the participants was 46.7 years, and 57% were men. The average tenure of employment was 11 years and the average weekly hours worked was 42.8.

Procedure

Individuals who were referred to the clinic and met the inclusion criteria were recruited for participation in the study during their initial overnight appointment at the Sleep Disorders
Laboratory. Their overnight appointment at the sleep clinic allowed for a full Polysomnography (PSG) study\(^1\).

The assessment at the pre-intervention gathered information about general medical history (e.g. viz. prior history of heart disease, cancer), health habits (viz. smoking, caffeine, and alcohol use), and all medications used. Demographic data (viz. age, gender, the industry in which they work, employment tenure) was also collected. A measure of trait affect was also obtained. Participants completed questionnaires assessing sleep (i.e. daytime sleepiness), and measures of cognitive depletion and work withdrawal behaviors at all three assessment periods.

One month following their overnight sleep study, patients received a follow-up appointment with the Sleep Disorders Education Centre, at which they usually received their diagnosis. Patients diagnosed with OSA were prescribed therapy, usually CPAP. Patients with mild sleep apnea were sometimes prescribed positional therapy. Participants who received CPAP therapy were also given education about the use of the CPAP unit, and had a follow-up clinic appointment with a sleep specialist within two to eight months after their overnight sleep study to monitor their progress and treatment compliance.

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\(^1\) PSG studies are multi-parametric tests used to diagnose sleep disorders. It is a comprehensive recording of the biophysical changes that occur during sleep (http://www.nhlbi.nih.gov/health/health-topics/topics/slpst/types.html). Recordings will be conducted using Sandman Elite SD32+ digital sleep recording system (Natus [Embla]; Ottawa, ON), and include 4 EEG channels (C4-A1, C3-A2, O2-A1, F3-A2), 2 EOG channels (ROC-A1, LOC-A2), submental EMG, intercostal (diaphragmatic surface) EMG, bilateral anterior tibialis EMG, ECG, respiratory piezo bands (chest and abdomen), finger pulse oximetry, a vibration snore sensor, nasal pressure airflow and oronasal thermocouple. PSG recordings will be conducted as either a diagnostic study or, in the event of severe OSA, a split-night study. For split-night studies, the initial diagnostic period will be followed by the introduction of treatment during the night.
Measures

**Psychological Well-being.** Psychological well-being was measured using the General Health Questionnaire (GHQ-12; Goldberg et al., 1997; Goldberg & Williams, 1988). The GHQ-12 contains 12 items that measure short-term change in mental health and in levels of psychological functioning. Sample items include “*Been feeling unhappy and depressed*” and “*Been losing confidence in yourself*”. For the current study three items were removed because of overlap with other scales (i.e., “*Been able to concentrate on what you’re doing*”—overlap with measure of cognitive depletion, “*Felt capable of making decisions about things*”—overlap with measure of cognitive depletion and “*Felt constantly under strain*”—overlap with measure of cognitive depletion). Responses are given on a 5-point scale (e.g., 1 = *much less usual*, 4 = *much more than usual*).

**Trait affect.** To measure trait affect, the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen 1988) was administered. This measure was used in my second study and full details appear in the Method section for Study 2.

**Daytime sleepiness.** Daytime sleepiness was measured using the 6-item daytime sleepiness subscale of the Karolinska Sleep Questionnaire\(^2\) (Akerstedt et al., 2002, 2008). Questions were answered on a 5-point rating scale ranging from *never* to *always*. A sample item is “*Unintentional dozing off (naps) during work?*” High scores indicate higher levels of daytime sleepiness.

**Cognitive Depletion.** Depletion was indicated by cognitive distraction, and was measured using a modified version of Fryer and Warr’s (1984) 12-item scale. Some items reworded to reflect the employment context (e.g., “*I’ve been feeling mentally alert and wide awake*” was

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\(^2\) The other two sub-scales of the Karolinska Sleep Questionnaire that assessed sleep quality and non-restorative sleep were not used.
changed to “I’ve been feeling mentally alert and wide awake at work.”). Four items were deleted from the original scale: two were nearly identical to an item in the Work Neglect scale described below, and two items were not relevant to a work context, resulting in an 8-item scale. Questions were answered on a 7 point rating scale ranging from strongly disagree to strongly agree.

Withdrawal from work.

Partial absenteeism. A modified version of Hepburn and Barling’s (1996) 5-item scale was used to assess partial absenteeism (e.g., “In the past month have you come in late?”) One item from Hepburn and Barling’s scale was deleted (“How often have you been distracted at work?”) because it is identical to an item used to measure cognitive depletion. Responses were measured on a 7-point scale, ranging from 1 (not at all) to 7 (all of the time).

Intention to quit. A modified 5-item version of the abbreviated form of the Marital Instability Index (Booth, Johnson, & Edwards, 1983) was used to measure participants’ turnover intentions (e.g., “In the past six months, have you thought about quitting your job?”). Responses were measured on a 5-point scale, ranging from 1 (not at all) to 5 (all of the time). These same items have been used to assess intentions to turnover elsewhere (e.g., LeBlanc et al., 2014).

Frequency of absenteeism. Frequency of absenteeism was measured using a single item that asked “How many times did you miss scheduled work in the past six months?” This single-item measure has been used in previous research (e.g. Waldman & Goldberg-Sharak, 1992).

Withdrawal at work.

Work neglect. Work neglect was measured with 7 items combined from two scales. Four items on the scale were originally from Barling, Rogers, and Kelloway’s (2001) Neglect Scale (e.g., “stayed out of sight to avoid work”), and three were from Kammeyer-Mueller and
Wanberg’s (2003) Work Withdrawal Scale (e.g., “fail to attend scheduled meetings”). Responses were measured on a 7-point scale, ranging from 1 (not at all) to 7 (all of the time).

**Cyberloafing.** Seven items were adapted from Lim’s (2002) 11-item Cyberloafing Scale to assess the frequency with which employees engage in a variety of cyberloafing behaviors. A sample item is “How many minutes per day do you browse sports related websites?” The scale was modified in several ways. First, separate items about sending and receiving personal emails were combined into a single item. Second, items asking about browsing adult-oriented websites and downloading non-work related information were removed due to the possible infrequency of these activities due to server restrictions of most work places. Third, the item asking about browsing non-work related information was deemed redundant and removed. Respondents were asked to indicate how many minutes per day they would estimate that they used the internet to perform each of the seven activities while at their place of work.

The questionnaires from this study are in Appendix C.

### 4.3 Data Analysis

The statistical analysis proceeded in several steps. I first calculated correlations between all measures administered at baseline (i.e., pre-treatment). This included demographic (age, gender,) and control (affect, psychological well-being) variables, as well as the predictor variable (daytime sleepiness) and mediator (cognitive depletion) and the dependent variables; withdrawal from work (i.e., absenteeism, turnover intention and partial absenteeism) and withdrawal at work (i.e., work neglect and cyberloafing),

I then used multilevel modeling (implemented through MPlus Version 6) with maximum likelihood estimation to determine if the predictor variables were related to the outcomes variables, and whether and how much work withdrawal and time-varying predictors changed
over time. An advantage of multilevel modeling is that it accommodates differences in the correlations of repeated assessments over time and allows for missing data in repeated measurements.

To do so, I first examined a series of unconditional growth models, i.e., models in which a single covariate (time) was the only predictor of the outcome variable. Outcome variables included work withdrawal, daytime sleepiness, and cognitive depletion. Both the initial level of the outcome variable (i.e., intercept) and the effects of the covariate (i.e., slope) were specified as random effects and thus were allowed to vary across individuals. These models provided estimates of the average intercept and slope of the variables’ change in trajectories over time, and an understanding of the average direction and quantity of change from pre-treatment to the one and three month follow-up periods across participants.

I then examined whether time invariant control variables, namely, age and well-being, predicted change in work withdrawal over time. I fit separate models with each time-invariant control by adding each one to the original unconditional growth model. I also examined whether receiving treatment or not was predictive of change in work withdrawal over time by adding treatment (value at baseline) and an interaction term (treatment × time) to the unconditional growth model. The interaction term tested whether treatment predicted change in the outcome variables over time.

After conducting separate univariate analyses of the control variables, I examined the time-varying predictor (daytime sleepiness) by adding it to the unconditional growth model. To do so, I fit a multilevel model that included both time and the time-varying variable as predictor variables and work withdrawal as the outcome variables. These models determined whether the time-varying predictors significantly predicted work withdrawal within individuals. For the
withdrawal at work outcome variables (i.e., work neglect, cyberloafing, turnover intention),
along with the direct effects model, I also examined the predicted indirect relationship between
the time-varying predictor (i.e. sleep) and outcome variables (withdrawal at work) through the
time-varying mediator (i.e. cognitive depletion) in a univariate model. These models allowed me
to test whether there was an indirect effect of sleep on withdrawal from work through cognitive
depletion. Finally, after testing the control variables and the time-varying predictor individually,
I fit a multivariate model for each of the outcome variable that included all significant predictors.

Sample size. There is no specific direction on what sample size is considered adequate to
reliably estimate growth models. However, sample sizes of at least 100 are recommended
(Curran, Obeidat, & Losardo, 2010). Therefore I recruited 142 participants for this study and 98
completed Time 3.

4.4 Results

Intercorrelations and internal consistency data for all baseline variables are displayed in
Table 1.

Two of the potential control variables (i.e., gender and positive affect) were excluded
from all further analyses. Gender was only correlated with one of the outcome variables
(absence). Positive affect was correlated with three of the outcome variables (absence and work
neglect). However, positive affect was highly correlated with psychological well-being (.47) as a
result of which only psychological well-being was included as a control variable.

Sample sizes and descriptive data for each variable across the three assessment periods
are presented in Table 2. Also shown in Table 2 are the parameter estimates for the time variable
for each of the measures that are time-varying. These parameter estimates can be understood as
the estimated average amount of change in a particular variable at each time point. Tables 3-7
present the results of tests predicting the dependent variables. The results of univariate models for each predictor appear on the left side of the table. The results of the multivariate models that included all significant predictors appear on the right side of the tables.

Hypothesis 1a was supported as daytime sleepiness predicted partial absenteeism ($\gamma = 0.034$, SE = 0.11, $p < .001$; see Table 3) in the univariate model. Daytime sleepiness remained a significant predictor in the multivariate model ($\gamma = 0.043$, SE = 0.14, $p < .01$), after controlling for age, psychological well-being and treatment group. Hypothesis 1b was not supported as daytime sleepiness did not predict turnover intention in the univariate model (Table 4: $\gamma = 0.026$, SE = 0.021, ns), as a result of which a multivariate model was not computed. Hypothesis 1c received marginal support (Table 5) as daytime sleepiness was a significant predictor of absenteeism in the univariate analysis ($\gamma = 0.397$, SE = 0.177, $p < .05$); however, this relationship became marginally significant in the multivariate model ($\gamma = 0.228$, SE = 0.170, $p = .09$).

The next set of hypotheses examined whether daytime sleepiness directly affected withdrawal at work (Hypotheses 2). Hypothesis 2a was supported as daytime sleepiness significantly predicted work neglect (Table 6: $\gamma = 0.054$, SE = 0.011, $p < .001$) in the univariate model and remained a significant predictor in the direct effects multivariate model (Table 6: $\gamma = 0.045$, SE = 0.011, $p < .001$). In contrast, Hypothesis 2b was not supported as daytime sleepiness did not predict cyberloafing in the univariate model ($\gamma = -0.001$, SE = 0.053, ns; see Table 7), as a result of which a multivariate model was not computed.

I then examined whether there was an indirect effect of daytime sleepiness on withdrawal at work through cognitive-depletion (Hypotheses 3). Hypothesis 3a was supported (Table 6): The indirect relationship between daytime sleepiness on work neglect through cognitive depletion was significant without controls (Indirect effect: $\gamma = 0.022$, SE = 0.009, $p < .001$). The indirect
model including control variables (i.e., age, psychological well-being and treatment) remained significant (Indirect effect: $\gamma = 0.021$, SE = 0.008, $p < .01$). Of note, the direct effect between sleepiness and work neglect was no longer significant in the indirect effects model, suggesting a fully mediated model through cognitive depletion. Hypothesis 3b was not supported, as sleepiness did not predict cyberloafing in a univariate model, and no analyses were undertaken on the indirect model (see Table 7).

Finally I examined the effects of change in the slope of sleepiness, which was significant ($\gamma = -0.147$, SE = 0.025, $p < .001$; see Table 2) on the outcome variables (Hypotheses 4-5). Results of changes in slope for all time-varying predictors and dependent variables are shown in Table 2. Hypothesis 4 examined the direct relationship between changes in sleepiness and withdrawal from work (i.e., partial absenteeism, turnover intention, absenteeism). First partial absenteeism had a significant change in slope over time ($\gamma = -0.014$, SE = 0.005, $p < .01$). When daytime sleepiness was added to the model of time predicting partial absenteeism (Hypothesis 4a), time became non-significant ($\gamma = -0.004$, SE = 0.005, ns), while daytime sleepiness was significant ($\gamma = 0.034$, SE = 0.011, $p < .01$). This suggests that daytime sleepiness is having its effect through time, and that there is no additional influence of time beyond the influence it has on daytime sleepiness (see Figure 2). Next, because turnover intention did not have a significant change in slope, Hypotheses 4b was not tested (see Figure 3). The last withdrawal from work variable examined, absenteeism, showed a significant change in slope over time ($\gamma = -0.197$, SE = 0.092, $p < .05$). When daytime sleepiness was added to the model (Hypothesis 4c), time became non-significant ($\gamma = -0.082$, SE = 0.108, ns), and daytime sleepiness was significant ($\gamma = 0.397$, SE = 0.177, $p < .05$; Figure 4).
The last set of analyses examined whether change in sleepiness indirectly affect change in withdrawal at work through changes in cognitive depletion (Hypotheses 5). As shown in Table 2, cognitive depletion had a significant change in slope ($\gamma = -0.265$, SE = 0.052, $p < .001$). To examine this indirect change model, daytime sleepiness and depletion were included in the model of time predicting work neglect (Hypothesis 5a). As shown at the bottom of Table 6, the change in daytime sleepiness predicted the change in cognitive depletion ($\gamma = 0.750$, SE = 0.097, $p < .001$). Change in cognitive depletion in turn predicted change in work neglect ($\gamma = 0.029$, SE = 0.010, $p < .01$). When cognitive depletion was added to the model, time became non-significant ($\gamma = -0.003$, SE = 0.006, ns) as did daytime sleepiness ($\gamma = 0.012$, SE = 0.018, ns). Therefore, the effects of changes in daytime sleepiness on change in work neglect is fully mediated through the change in cognitive depletion (see Figure 5). Last, I examined cyberloafing as an indicator of withdrawal at work (Hypothesis 5b). As shown in Table 2, the change in slope ($\gamma = 0.014$, SE = 0.017, ns) was not significant and as a result, Hypothesis 5b was not supported, and no further analyses on the slope of daytime sleepiness and cognitive depletion as predictors of change in cyberloafing were conducted (see Figure 6).

4.5 Discussion

The goal of my third study was to examine how changes in daytime sleepiness that resulted from treatment for a sleep disorder, affected change in work withdrawal behaviors. The findings point to the importance of daytime sleepiness on work withdrawal behaviors. Partial support emerged for the predictions regarding the direct relationship between sleepiness and withdrawal from work behaviors (Hypotheses 1). Specifically there was a significant relationship between daytime sleepiness and two of the withdrawal from work behaviors, namely partial absenteeism (Hypothesis 1a) and absenteeism (Hypothesis 1c). However, when the controls
(treatment, psychological well-being and age) were added to the model, daytime sleepiness was only a marginally significant predictor of absenteeism. Also there was no relationship between sleepiness and turnover intention (Hypothesis 1b).

Partial support also emerged for the direct effects of daytime sleepiness on withdrawal at work behaviors (Hypotheses 2). First sleepiness was a significant predictor of work neglect (Hypotheses 2a), but not cyberloafing (Hypothesis 2b). Continuing on with the withdrawal at work hypotheses, partial support also emerged for the indirect relationship between sleepiness and withdrawal at work, through cognitive-depletion (Hypotheses 3). There was a significant indirect relationship between sleepiness and work neglect through cognitive depletion (Hypothesis 3a), but not this indirect relationship was not supported for cyberloafing (Hypothesis 3b).

Perhaps more importantly, sleepiness significantly changed following treatment, and changes in sleepiness predicted significant change in the slope of partial absenteeism (Hypothesis 4a). However there was no significant change in the slope of turnover intention over time and therefore Hypothesis 4b was not examined. There was however support for the change in the slope of daytime sleepiness predicting the change in slope of absenteeism (Hypothesis 4c). Focusing on withdrawal at work, change in sleepiness significantly predicted change in cognitive depletion which in turn predicted change in the slope of work neglect (Hypothesis 5a). However there was no change in the slope of cyberloafing across time, and therefore tests for Hypothesis 5b were not conducted.

**Withdrawal from Work**

Consistent with previous research demonstrating that withdrawal from work is affected by non-work experiences, and specifically sleep-related variables (e.g. Swanson et al., 2011), in
the current study sleepiness predicted partial absenteeism, and had a marginal relationship with absenteeism. However, sleepiness was not associated with turnover intention. These findings are consistent with Mullins et al., (2014) theoretical framework explaining how the physiology of sleepiness impacts work-related outcomes; Mullins et al. (2014) proposed that sleepiness is the major mechanism through which sleep problems significantly influence workplace outcomes (Mullins et al., 2014). In the current study sleepiness predicted withdrawal from work behaviors and this direct relationship was maintained across time. Improvements in sleepiness following treatment for a sleep disorder, lead to improvements in withdrawal from work behaviors (i.e., partial absenteeism and absenteeism).

Withdrawal at Work

The results of the current study are consistent with the known effects of sleepiness on psychological functioning and the mechanisms through which sleepiness impacts behavior (Harrison & Horne 2000; Mullins et al., 2014). Namely, the sleepiness caused by OSA lowers executive functioning in the pre-frontal cortex, decreasing regulation of cognitions and emotions (Baumeister et al., 1998; Nilsson et al., 2005; Schnyer Zeithamova, & Williams, 2009; Wimmer, Hoffmann, Bonato, & Moffitt, 1992). Specifically theories of depletion suggest that the depletion caused by sleepiness results in detrimental effects on behavior (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000). The results of my research yielded a significant indirect effect of sleepiness on work neglect through cognitive depletion. Notably, the importance of cognitive depletion as the explanatory mechanisms through which sleepiness exerts its influence on work related outcomes was supported by the finding that the direct effect of sleepiness on work neglect were no longer significant when cognitive depletion was included in the model. These results also provide additional support for the framework proposed by
Mullins et al. (2014), and specifically their notion that sleepiness also affects work-related outcomes through cognitive and affective functioning. However, unlike previous research (e.g., Wagner et al., 2012), these findings did not extend to cyberloafing.

**Change across Time**

The results of the current study further advance sleep and work research by demonstrating that these relationship exist across time. The current study showed that treatment for OSA lead to decreased daytime sleepiness and cognitive depletion across three time periods. The results go further, showing that the positive outcomes of treatment for a sleep disorder extended beyond the sleep domain to affect work-related behaviors, namely, withdrawal from and at work. This type of longitudinal change design not only enhances the statistical power of hypotheses I tested, but also enabled me to understand how change in sleep from a treatment for a sleep disorder influenced change in work behavior across time.

**Strengths and Limitations**

There are a number of strengths and limitations of this research that warrant discussion. First by using a more nuanced approach to the examination of withdrawal behaviors, I was able to provide additional insight into the nature of work withdrawal and show the differences in *from* vs *at* are important. Second, these findings advance a conceptual indirect model of withdrawal at work, where sleepiness has its effects on withdrawal at work through cognitive depletion. These findings suggest that a more nuanced and comprehensive understanding of work withdrawal behavior should be used in future research in this area.

In terms of methodological strengths, the first strength of the current study is its longitudinal nature. A key advantage of longitudinal studies is their ability to demonstrate change over time, which enables causal inferences. What the use of a longitudinal design meant
for my research is that I could be more confident that sleepiness affected withdrawal behaviors because I was able to demonstrate the change in sleepiness affected the change in withdrawal behaviors. By using a sample of individuals that were receiving treatment for a sleep disorder I was able to examine a significant change in sleep that may not exist outside of such a treatment and demonstrate that this change in sleep improved work related behaviors. This goes beyond much of the previous cross-sectional research (e.g. Swanson et al 2011) pointing to the possible role of daytime sleepiness affecting work withdrawal.

A second methodological strength of my study is the control over extraneous variables (e.g., age and trait affect) inherent in within-subjects design. Within-subject designs mitigate against selection threats to internal validity, as well as compensatory rivalry and resentful demoralization threats to construct validity (Shadish, Cook, & Campbell, 2002). Moreover, within-person designs are efficient in their use of respondents, requiring fewer participants compared to a between subject design for similar levels of power (Shadish et al., 2002).

Like all research, conceptual and methodological strengths do not rule out all limitations. First, while the longitudinal nature of the design and the focus on change were significant strengths, longitudinal designs introduce the issue of participant attrition across the length of the study, a problem that is exacerbated the longer the study. In the current study there were 142 participants at Time 1, 101 At Time 2, and 98 at Time 3, therefore 44 participants were lost to attrition which can threaten any interpretations of the findings in at least two ways. First, internal validity is compromised if attrition is systematic, i.e., non-random. I examined whether there were differences between those who remained in the study as compared to those who did not on all the outcome variables, and the two groups only differed in terms of one outcome variable of interest, namely turnover intention, which was not a significant outcome in any of the models I
tested. Second, attrition can pose a threat to statistical conclusion validity if the remaining sample size means that analyses are under-powered. However, in my study with around 100 participants statistical power was not a problem (Curran et al., 2010).

Last, the use of a clinically sleep-disordered group attending a sleep clinic is a potential strength in an environment in which most research is conducted on the effects of sleepiness on work-related outcomes among community samples. Nonetheless, despite the ability to inform both clinical practitioners along with the research community, potential threats to the ability to generalize the current findings across different samples and settings remains to be demonstrated empirically.

**Directions for Future Research**

As indicated throughout the chapters of this dissertation, organizational researchers have only recently started examining the impact of sleep in the workplace, as a result of which there are many important and intriguing avenues for potential research. In this next section, I briefly describe some of the areas in which this research could be further expanded.

First, as this study examined a specific population of individuals with a clinical sleep disorder, an important next step would be to examine the hypothesized relationships in a sample of the general adult population. This is important because the nature and prevalence of OSA might restrict the findings about the effects of daytime sleepiness on work withdrawal behaviors to the clinical population studied. However, given that sleepiness affects approximately 35 to 40% of the U.S. adult population (Hossain & Shapiro, 2002), I would expect that the current findings would generalize to the population as a whole.

Second, while this study demonstrated the direct and indirect effects of sleep on work withdrawal, an important next step would be to examine the potential moderators, or boundary
conditions of this relationship. For example, one personality variable that might be an important moderator is conscientiousness, as individuals who are conscientious might be more likely to attend work, and pay attention to their work, irrespective of whether they feel sleepy, and therefore be less likely to withdraw from work. Another potential moderator is absence culture (Nicholson & Johns, 1985), or the degree of absenteeism that has come to be accepted as the norm. Absence culture may moderate the relationship between sleep and work withdrawal as in a culture that is strongly against absenteeism, are individuals who are experiencing excessive daytime sleepiness more likely to attend work and therefore experience higher levels of withdrawal at work?

Third, as the conceptualization of withdrawal at work behaviors is in its initial stages, it is possible that other behaviors need to be included. Specifically, I would suggest that withdrawal at work be expanded to include behaviors that involve freely available technology, over-and-above cyberloafing (Wagner et al., 2012). As technology is continually changing and becoming more advanced, most people have smart phones and take them to work. To what extent does cyberloafing involve smart phones rather than only traditional work computers, and how much of this can be attributed to sleep quality, sleep quantity or sleepiness? With technological advances pervading the workplace, it might well be necessary to understand how the known effects of sleep on withdrawal behaviors are manifest in new ways.

Last, one of the more interesting advances in research on absenteeism in the past few years has been the focus on presenteeism (e.g. Aronsson, Gustafsson, & Dallner, 2000). While absenteeism involves withdrawal from work, i.e., staying away from work when one has no valid reason to do so, presenteeism involves attending work when one probably should not because of illness (Johns, 2010). One question, therefore, is whether the conceptualization of withdrawal at
work should be expanded to include presenteeism. Additionally, might attending work because of external pressures when one is too tired to do so compromise safety and/or the quality of task and contextual performance?.

Practical Application

The results of the current study suggest that sleep affects work-related outcomes and that enhancing sleep has the potential to positively influence work. As such organizational leaders need to recognize that employees’ sleep is an issue of personal and organizational importance. There are a number of ways in which organizations can impact the sleep of their employees. First, organizations could provide opportunities and areas for their employees to take naps, second, organizations need to ensure that they organizational culture and practices are not negatively influencing the sleep of their employees. Such as ensuring their culture promotes the importance of sleep through restricting late night communication about work related issues. Lastly organizations could integrate sleep hygiene into existing health and wellness programs.

Conclusion

Traditionally, management has been reluctant to engage in interventions outside of the workplace, lest it be seen as inappropriate interference in employees’ private lives. This viewpoint is challenged however, by an understanding that sleep problems affects workplace behaviors that are of substantial importance for organizational effectiveness. Acknowledging that the deep-seated reluctance to implement interventions outside of the workplace is unlikely to change soon, or easily, but that factors from outside of the work environment (e.g., daytime sleepiness) effect work withdrawal behaviors, it would be appropriate for management to ensure that it take steps to enhance the quality and quantity of employees’ sleep. This could mean changing their own behaviors or expectations (such as being available on email at all hours,
beliefs about what absence means) so they do not contribute to sleep problems in the first instance, or formally aiding employees access assessment and treatment for sleep-related disorders. The present results highlight the need for greater focus on employee sleep and sleep related problems.
4.6 References


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*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

alpha indicated on the diagonal using boldface.

Cronbach’s alpha indicated on the diagonal using boldface.
Table 4- 2: Means over time and parameter estimates

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Note. Parameter estimates can be understood as the estimated average amount of change in a particular variable at each time point.

† $p < 0.10$ level (2-tailed).
* $p < 0.05$ level (2-tailed).
** $p < 0.01$ level (2-tailed).
*** $p < 0.001$ level (2-tailed).
<p>| Cyberloafing | 129 | 1.4(.4) | 102 | 1.3(.5) | 96 | 1.3(.4) | -0.014 | 0.017 |</p>
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Table 4-3: Predictors of Partial Absenteeism

† p < 0.10 level (2-tailed).
* p < 0.05 level (2-tailed).
** p < 0.01 level (2-tailed).
*** p < 0.001 level (2-tailed).
Symbol: … = not applicable.
## Table 4-4: Predictors of Turnover Intention

† $p < 0.10$ level (2-tailed).
* $p < 0.05$ level (2-tailed).
** $p < 0.01$ level (2-tailed).
*** $p < 0.001$ level (2-tailed).

Symbol: … = not applicable.

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Table 4-5: Predictors of Absenteeism

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† p < 0.10 level (2-tailed).
* p < 0.05 level (2-tailed).
** p < 0.01 level (2-tailed).
*** p < 0.001 level (2-tailed).
Symbol: … = not applicable.
### Table 4-6: Predictors of Work Neglect

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<th>Variable</th>
<th>Analyses Using a Single Predictor</th>
<th>Analyses Using Multiple Predictors</th>
<th>Indirect effects model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>Estimate</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.245***</td>
<td>0.014</td>
<td>0.600***</td>
</tr>
<tr>
<td>Time</td>
<td>-0.014**</td>
<td>0.005</td>
<td>0.001</td>
</tr>
<tr>
<td>Treatment</td>
<td>-0.161*</td>
<td>0.068</td>
<td>-0.193***</td>
</tr>
<tr>
<td>Time X Treatment</td>
<td>-0.071**</td>
<td>0.025</td>
<td>-0.081***</td>
</tr>
<tr>
<td>Age</td>
<td>-0.003***</td>
<td>0.001</td>
<td>-0.006***</td>
</tr>
<tr>
<td>Psychological well-being</td>
<td>-0.088***</td>
<td>0.020</td>
<td>-0.026</td>
</tr>
<tr>
<td>Daytime Sleepiness (DS)</td>
<td>0.054***</td>
<td>0.011</td>
<td>0.045***</td>
</tr>
<tr>
<td><strong>Indirect Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Depletion (CD)</td>
<td>0.029***</td>
<td>0.010</td>
<td>…</td>
</tr>
<tr>
<td>DS-CD</td>
<td>0.750***</td>
<td>0.097</td>
<td>…</td>
</tr>
<tr>
<td>Indirect effect</td>
<td>0.022**</td>
<td>0.009</td>
<td>…</td>
</tr>
</tbody>
</table>

† p < 0.10 level (2-tailed).
* p < 0.05 level (2-tailed).
** p < 0.01 level (2-tailed).
*** p < 0.001 level (2-tailed).
Symbol: … = not applicable.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Analyses Using a Single Predictor</th>
<th>Analyses Using Multiple Predictors</th>
<th>Indirect effects model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>SE</td>
<td>Estimate</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.130***</td>
<td>0.013</td>
<td>…</td>
</tr>
<tr>
<td>Time</td>
<td>-0.007</td>
<td>0.005</td>
<td>…</td>
</tr>
<tr>
<td>Treatment</td>
<td>-0.546**</td>
<td>0.209</td>
<td>…</td>
</tr>
<tr>
<td>Time X Treatment</td>
<td>-0.303***</td>
<td>0.079</td>
<td>…</td>
</tr>
<tr>
<td>Age</td>
<td>-0.007*</td>
<td>0.004</td>
<td>…</td>
</tr>
<tr>
<td>Psychological well-being</td>
<td>-0.045</td>
<td>0.072</td>
<td>…</td>
</tr>
<tr>
<td>Daytime</td>
<td>-0.001</td>
<td>0.053</td>
<td>…</td>
</tr>
<tr>
<td>Sleepiness (DS)</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Indirect model</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Cognitive Depletion (CD)</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>DS -CD</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Indirect effect</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

Table 4-7: Predictors of Cyberloafing

† p < 0.10 level (2-tailed).
* p < 0.05 level (2-tailed).
** p < 0.01 level (2-tailed).
*** p < 0.001 level (2-tailed).
Symbol: … = not applicable.
Figure 4-1: Hypothesized relationship between sleep and work withdrawal behaviors

Note. This figure shows the hypothesized relationship between sleep and work withdrawal behaviors and is based off the framework developed by Mullins et al (2014).
Figure 4-2: Mean growth curves of daytime sleepiness and partial absenteeism
Figure 4-3: Mean growth curves of daytime sleepiness and turnover intention
Figure 4-4: Mean growth curves of daytime sleepiness and absenteeism
Figure 4-5: Mean growth curves of daytime sleepiness, cognitive depletion and work neglect
Figure 4-6: Mean growth curves of daytime sleepiness, cognitive depletion and cyberloafing
Chapter 5

General Discussion

The primary goal of my dissertation was to examine the importance of sleep to the experience of work. This is a relatively new area within the organizational behavior literature, and my objective was to contribute to this growing body of literature on sleep and work. I did this by examining how sleep affects diverse work-related outcomes including work stress (Study 1), leadership (Study 2) and withdrawal behaviors (Study 3), using varied populations to investigate each outcome, including a national representative sample (Study 1), a sample of leaders and their followers (Study 2) and a sample of individuals with a clinical sleep disorder (Study 3). Each study asked different questions about the relationship between sleep and work, and relied on unique methodologies to examine this relationship.

The results of my dissertation show that sleep has important effects on work-related outcomes. In my first study, I found that sleep affects perceptions of work stress across a two year time period over a 5 wave cycle, and that this affect was stronger than the reciprocal effects of work stress on sleep. In my second study, I established that daily sleep affects daily abusive supervision through daily self-control across a 15 day diary study. In contrast, this indirect effect was not significant when transformational leadership was the outcome. In my last study, I showed that sleepiness caused by obstructive sleep apnea was related to withdrawal from work (i.e., partial absenteeism, absenteeism) and withdrawal at work (i.e., work neglect) behaviors. I also showed that the relationship between sleepiness and withdrawal at work was mediated by cognitive depletion. Further, I found that receiving treatment for a sleep disorder improved sleepiness and that this improvement in sleepiness lead to declines in work withdrawal.
behaviors, with the decrease in withdrawal at work behaviors being mediated through improvements in cognitive depletion.

**Theoretical Contributions**

My dissertation makes a number of theoretical contributions in shaping the way we think about the interplay between sleep and work. First, while most of the research on the interdependence of work stress and sleep in this area has examined how work stress affects sleep (Sonnentag, Tzschach, & Pinck, in press), I showed that sleep has a stronger influence on perceptions of work stress over a longer period of time than the obverse, pointing to the nuances in reciprocal relationships between sleep and work, and thus suggesting avenues for future research.

Second, I examined leadership on a within-person basis, which differs from much of the leadership research that has examined leadership at the between-person level (Tepper, 2007). By isolating how daily sleep influences within-person changes in abusive supervision, my research potentially steers leadership research in a new direction (see Barnes, Lucianetti, Bhave, & Christian, 2014; Johnson, Venus, Lanaj, Mao, & Chang, 2012), turning the focus of leadership research from leadership styles to leadership behaviors.

Third, I found that sleepiness affects work withdrawal behaviors in a sample of individuals with a clinical sleep disorder. The results of this study suggest that organizational researchers need to examine not only the general population but those employees who are dealing with clinical disorders and how this non-work issues such as having a clinical sleep disorder may affect work.

Last, my dissertation highlights the importance that non-work factors (in this instance, sleep) have on work-related phenomenon. Findings from the three studies suggest that
organizational practitioners need to pay special attention to the influence of non-work factors on work related outcomes, despite the difficulties in doing so given their lack of control over employees’ lives outside of the workplace.

**Methodological Contributions**

Along with the theoretical contributions of this dissertation, there are also a number of important methodological contributions. The first important methodological implication from across my three dissertation studies is that timing of measurements matters (Mitchell & James, 2001). In my first study, the finding that sleep affected work stress across a two year period while work stress did not affect sleep across the same time period runs counter to previous research findings in this area. One possibility is that work stress does affect sleep, but across a shorter time lag. Thus, researchers need to pay more attention to the time lags chosen, as the time lags chosen may have significant implications on the findings (Mitchell & James, 2001; Dormann & Griffin, 2015).

In the second study, the timing of the measurement occasion (daily) was much shorter than most research that examines antecedents of leadership, and this study showed that daily sleep affects daily abusive supervision. This points to the possibility that leadership can be thought of as more dynamic, again pointing to the importance of time in research. Last, unlike much existing research. I chose the timing of the two follow-up measurements in my third study based on a careful consideration of how long changes in sleepiness would take to exert effects on withdrawal from, and at work. Taken together, therefore, timing of measurements is an important issue that needs to be given more thought by organizational researchers. In calling attention to this, I echo calls in established (e.g., Mitchell & James, 2001) and recent journal articles that advocate for this (e.g., Dormann & Griffin, 2015).
A second important methodological contribution of my dissertation research is to demonstrate the usefulness of within-person designs in the study of sleep and work. As our statistical methods have become more advanced, researchers can now ask more refined conceptual research questions. The has allowed an examination of daily sleep and how it affects a variety of outcomes, as well as an examination of reciprocal/cross-lagged relationships among variables such as sleep and work stress.

Practical Implications

The most important practical implication of this dissertation is that organizations need to acknowledge and act upon the importance of sleep for the success of their organizations, and the well-being of their members. To do so, organizations will need to carefully reconsider their traditional apprehension of influencing non-work areas of their employees’ lives. One practical step organizations and their leaders could take to improve employees’ sleep is to stop evening, late night and early morning work-related email communication. Along with changing the norms around after-hours work communication, organizations can also provide education about the negative effects of sleep loss, and information on positive sleep hygiene. Organizations could also allow nap breaks, provide nap rooms, and generally make sleep an important focus within their organization. Sleep and work will always be incompatible as the time spent working naturally takes away from time spent sleeping; thus, the more organizations can facilitate and promote sleep, the more both organizations and their members will benefit.

Conclusion

The goal my dissertation was to examine how sleep affects work. To do so, I examined this relationship across different organizational outcomes, diverse populations and disparate time lags in three separate studies. The results show that sleep affects work stress, leadership
behaviors and work withdrawal behaviors. The conclusion I draw from this is that sleep matters for optimal work experiences, and the interdependence of sleep and work needs to be a greater priority for both organizational scholars and management practitioners.
5.1 References


Appendix A – Study 1: Full questionnaire

Sleep Measures:

Sleep quality.
1. How often do you have trouble going to sleep or staying awake? and
2. How often do you find sleep refreshing?
Items rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree).

Sleep quantity.
1. How long do you usually spend sleeping each night?” that uses a
Items rated on a 12 item response scale ranging from less than 2 hours to 12 hours or more.

Work Stress:

Work Stress (Karasek & Theorell, 1990).
1. Your job requires that you learn new things. (Demands)
2. Your job requires a high level of skill. (Demands)
3. Your job allows you freedom to decide how you do your job. (Control)
4. Your job is very hectic. (Demands)
5. You have a lot to say about what happens in your job. (Control)
6. Your supervisor is helpful in getting the job done. (Support)
7. The people you work with are helpful in getting the job done. (Support)

Items are rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree).
Appendix B – Study 2: Full Questionnaires

Leader demographic and control variables:

Gender
Age
Years of Education
Income
Job tenure (length of employment)
Type of work
Hours weekly worked
Years of leadership experience,
Number of subordinates.

Affect.

PANAS Questionnaire (Watson, Clark, & Tellegen, 1988)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate the extent you have felt this way over the past week.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Slightly or Not at All</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>

| 1. Interested | 11. Irritable |
| 2. Distressed | 12. Alert |
| 3. Excited | 13. Ashamed |
| 5. Strong | 15. Nervous |
| 7. Scared | 17. Attentive |
| 8. Hostile | 18. Jittery |
| 9. Enthusiastic | 19. Active |
Leader Daily Measures:

Sleep Quantity.

Pittsburgh Sleep Diary (Monk et al., 1994)

Last night:
1. What time did you go to bed?
2. How long did it take you to fall asleep?
3. What time did you wake up this morning?
4. How long were you awake after initially falling asleep? (for example, if you were asleep until 1am, woke at 1am and fell back asleep at 1:20am for the rest of the night, your answer would be 20 minutes)

Sleep Quality.

Karolinska Sleep Questionnaire (Akerstedt, et al., 2002; 2008)

Have you perceived any of the following complaints about your sleep today?

<table>
<thead>
<tr>
<th>Have you perceived any of the following complaints about your sleep today?</th>
<th>None</th>
<th>A little</th>
<th>Some</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last night, how much difficulty did you have going to sleep?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This morning, how much difficulty did you have waking up?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How refreshing did you find sleep last night?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How exhausted did you feel upon awakening today?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ego depletion.

State Self-Control Capacity Scale (Christian & Ellis, 2011)

1. My mental energy is running low.
2. Right now, it would take a lot of effort for me to concentrate on something.
3. I need something pleasant to make me feel better.
4. I feel motivated.
5. If I were given a difficult task right now, I would give up easily.

Items will be rated from 1=very slightly or not at all and 5=very much.
**Subordinate Demographic and Control Variables:**

Gender  
Age  
Years of education  
Income  
Job tenure  
Type of work  
Hours worked weekly  
Type of work  
Tenure under leader

**Subordinate Daily Measures:**

**Positive leadership behaviors.**

*Transformational Leadership Behavior Scale (Podsakoff, MacKenzie, & Bommer, 1996; Podsakoff, MacKenzie, Moorman, & Fetter, 1991; Rubin, Munz, & Bommer, 2005)*

Today my leader…
1. Communicated a desirable goal or vision to a work group member today.
2. Inspired others with his/her plans for the future.
3. Lead by “doing” rather than simply by “telling.”
4. Provided me with new ways of looking at something which was puzzling me.

Items will be rated from 1=strongly disagree and 5=strongly agree.

**Negative Leadership Behaviors.**

*Abusive Supervision (Tepper, 2000)*

Today my leader:
1. Ridiculed me
2. Expressed anger at me when he/she is mad for another reason
3. Was rude to me
4. Lied to me

Items will be rated from 1=strongly disagree and 5=strongly agree.
Appendix C – Study 3: Full Questionnaires

**Demographic variables:**

Gender  
Age  
Years of Education  
Income  
Job tenure (length of employment)  
Type of work  
Hours weekly worked

**Control Variables:**

**Psychological well-being.**

*General Health Questionnaire-12 (Goldberg et al., 1997)*

1. Lost much sleep over worry  
2. Felt that you are playing a useful part in things  
3. Felt you couldn’t overcome your difficulties  
4. Been able to enjoy your normal day to day activities  
5. Been able to face up to your problems  
6. Been feeling unhappy and depressed  
7. Been losing confidence in yourself  
8. Been thinking of yourself as a worthless person  
9. Been feeling reasonably happy, all things

Each item is rated on a five-point scale from *Much less than usual* to *Much more than usual*
**Affect.**

PANAS Questionnaire (Watson, Clark, & Tellegen, 1988)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate the extent you have felt this way over the past week.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Very Slightly or Not at All</td>
<td>____</td>
<td>1. Interested</td>
<td>____</td>
<td>11. Irritable</td>
<td>____</td>
</tr>
<tr>
<td>5. Extremely</td>
<td>____</td>
<td>5. Strong</td>
<td>____</td>
<td>15. Nervous</td>
<td>____</td>
</tr>
<tr>
<td>7. Scared</td>
<td>____</td>
<td>7. Scared</td>
<td>____</td>
<td>17. Attentive</td>
<td>____</td>
</tr>
</tbody>
</table>
**Sleep Scales:**

**Daytime sleepiness.**

Karolinska Sleep Questionnaire (Akerstedt, et al., 2002; 2008)

Have you perceived any of the following complaints during the last six months?

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Never</th>
<th>Seldom</th>
<th>Occasionally</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleepiness during work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleepiness during free time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental fatigue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unintentional dozing off (naps) during work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unintentional dozing off (naps) during free time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have to fight sleep to be able to stay awake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mediators:**

**Cognitive depletion.**

Cognitive Distraction Scale (Fryer and Warr, 1984)

I have …

1. had difficulty understanding written information (e.g., memos)
2. felt unmotivated to get started on tasks
3. been “rusty” at things I use to do well
4. felt mentally alert and wide awake
5. found remembering work-related information or tasks difficult
6. felt capable of making decisions
7. made mistakes when talking to my colleagues
8. made mistakes when talking to my immediate supervisor

Items will be rated from 1=strongly disagree and 7=strongly agree.
Work Withdrawal:

Withdrawal from work.

Partial Absenteeism Scale (Hepburn & Barling, 1996)

Over the past six months at work, how often did you…

1. come in late?
2. leave work early?
3. spend time on the phone for non work-related reasons?
4. take unauthorized extended lunch breaks?
5. take unauthorized extended breaks?

Items will be rated from 1=never and 5=all of the time.

Turnover intentions (Booth, Johnson, & Edwards, 1983)

Please indicate to what extent each of these describe you using the following scale:

1. I will probably look for a new job in the near future.
2. At the present time, I am actively searching for another job in a different organization.
3. I do not intend to quit my job. (RS)
4. It is unlikely that I will actively look for a different organization to work for in the next year. (RS)
5. I am not thinking about quitting my job at the present time. (RS)

Items will be rated from 1=strongly disagree and 5=strongly agree.

Frequency of Absenteeism Scale (Waldman & Goldberg-Sharak, 1992)

People have many reasons for missing work. Most people miss an occasional day once in a while.

1. How many times did you miss scheduled work in the past six months (a half-day or longer counts as a single day)?

Count two or more consecutive days as one time. For example, if you missed three consecutive days, count this as one time.

Total number of days you missed schedule work in the past six months: ________
Withdrawal at work.


In the past six months at work, how often did you…

1. hope that any work-related problems would resolve themselves?
2. not pass on messages to others?
3. fail to attend scheduled meetings?
4. allow others to do your work for you?
5. do poor quality work?
6. stay out of sight to avoid work?
7. work slower than you should have?

Please answer the following questions by using a 5-point scale from 1-never to 7-all the time.

Cyberloafing Scale (Lim, 2002)

Please rate how often you engage in each activity during working hours:

1. Browse sports-related Web sites
2. Shop online for personal goods
3. Send and receive non-work-related e-mail
4. Browse investment-related Web sites
5. Browse entertainment-related Web sites
6. Browse general news Web sites
7. Chat with other people with instant messenger

Items are rated on a 7 point scale with 1 = 0–5 min to 7 = more than 60 min.