Article

Organizational Psychology Review

Organizational Psychology Review
2(3) 234–257

DOI: 10.1177/2041386612450181
opr.sagepub.com
SAGE

Working in our sleep: Sleep and self-regulation in organizations

Christopher M. Barnes
Virginia Tech

Abstract

A large body of sleep physiology research highlights a broad array of effects of sleep on human functioning. Until recently, this literature has been completely isolated from the organizational psychology literature. The purpose of this paper is to further extend the sleep literature into the organizational psychology literature, with a focus on self-regulation in the workplace. I summarize the sleep literature into a model of sleep self-regulation. Next, I highlight initial research in organizational psychology which has drawn from basic sleep physiology research. Following this, I generate new propositions linking sleep to work withdrawal, goal level, incivility, and defection in workplace social dilemmas. Finally, I close with a discussion of methods for conducting sleep research in organizational psychology, as well as some promising areas for future research.

Keywords

deviant/counterproductive behavior, emotions and moods, job attitudes/beliefs/values

Paper received 1 February 2012; revised version accepted 9 May 2012.

Sleep is a fundamental requirement for human functioning (Siegel, 2005). Indeed, sleep is essential enough that humans and other species have evolved a complex set of physiological processes that cause people to fall asleep (Saper, Scammell, & Liu, 2005), and create pressure to sleep for a large portion of our lives. Large-scale surveys indicate that on average people spend more time sleeping than working (Barnes & Wagner, 2009; Biddle & Hamermesh, 1990). Thus, sleep is a dominant activity in the lives of employees. A large body of research outside of the field of organizational psychology indicates that there are many detrimental effects from depriving oneself of sleep (for reviews, see Harrison &

Corresponding author:
Christopher Barnes, Management Department, Pamplin College of Business, 2106 Pamplin, Blacksburg, VA 24061, USA.
Email: cmbarnes@vt.edu

Horne, 2000; Lim & Dinges, 2010; Pilcher & Hufcutt, 1996).

Negative effects of sleep deprivation are especially problematic in contemporary organizations, given recent research indicating that sleep has decreased at a rate of about 5 minutes per decade for the past three decades (Kronholm et al., 2008). A large-scale study indicates that 29.9% of Americans get less than 6 hours per day; for those in management and enterprises, 40.5% get less than 6 hours (Luckhaupt, Tak, & Calvert, 2010). Large-scale studies from Korea, Finland, Sweden, and England also indicate high proportions of people functioning on low quantities of sleep or poor sleep quality (Groeger, Zijlstra, & Dijk, 2004; Park et al., 2010; Ravan, Bengtsson, Lissner, Lapidus, & Bjorkelund, 2010; Salminen et al., 2010; Westerlund et al., 2008). Probably as a result of insufficient sleep, 29% of Americans report extreme sleepiness or falling asleep at work in the past month (Swanson et al., 2011). Thus, across many countries, there is an abundance of employees who work after a short night of sleep or poor quality sleep.

Thus, it is surprising that, as noted by Barnes and Hollenbeck (2009), there is a dearth of organizational psychology research examining the effects of sleep on work processes and outcomes. However, organizational psychology researchers have recently begun to investigate this topic, highlighting effects of low sleep quantity and poor sleep quality on job satisfaction (Scott & Judge, 2006), unethical behavior (Barnes, Schaubroeck, Huth, & Ghumman, 2011), workplace deviance (Christian & Ellis, 2011), lack of innovative thinking (Harrison & Horne, 1999), and high risk of work injuries (Barnes & Wagner, 2009). Thus, organizational psychology researchers are beginning to uncover the importance of sleep as a driver of employee states and behaviors. This research indicates powerful and important effects that have been previously overlooked in the field of organizational psychology.

Accordingly, the purpose of this paper is to further extend the sleep literature into the organizational psychology literature, with a focus on self-regulation. I first define sleep quantity and quality, highlighting these distinct properties of sleep. I summarize the sleep literature into a model of sleep and self-regulation. In doing so, I state lemmas, which are statements that are already supported by prior research that are used to support following statements. Next, I highlight initial research in organizational psychology, which has drawn from basic sleep physiology research, as well as highlight new propositions about sleep and self-regulation that are relevant to organizational psychology. Finally, I close with a discussion of methodological approaches and potential areas of future research examining sleep and workplace behavior.

Sleep and self-regulation

Defining sleep quantity and quality

Although people may think of sleep as a period of inactivity, research indicates that sleep is a period of heavy physiological activity entailing many restorative processes necessary for brain functioning (Hobson, 2005). Indeed, rats die about as quickly from sleep deprivation as they do from starvation (Greenspan, Tononi, Cirelli, & Shaw, 2001); although such an experiment has not been replicated in humans, there are many similarities in sleep across different species of mammals (Siegel, 2005). Powerful physiological mechanisms regulate sleep (Lavie, 2001; Porkka-Heiskanen et al., 1997). Although to some degree people can thwart these processes and stay awake even when experiencing pressure to fall asleep, this control over sleep–wake patterns is limited. Prolonged periods of waking activity lead to the experience of heavy drowsiness (Breslau, Roth, Rosenthal, & Andreski, 1997; Porkka-Heiskanen et al., 1997), which will eventually lead to sleep despite one's best attempts to stay awake.

Sleep quantity refers to the amount of time an individual spends in a 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). One could sleep many hours in a given night, but have fitful sleep that is frequently punctuated with awakenings. Alternatively, one could sleep a few hours soundly. Thus, sleep quantity and quality are conceptually distinct constructs. Moreover, sleep quantity and quality are empirically distinct constructs as well; Barnes, Schaubroeck, Huth, & Ghumman (2011) report a within-person correlation between sleep quantity and quality of −.14.

Cutting sleep quantity short directly limits the amount of restoration that occurs. Poor quality sleep also hinders restoration in a similar manner. Fitful sleep that is frequently interrupted disrupts the recovery processes that occur during sleep. Sleep cycle architecture consists of cycles through different phases of sleep, which are often divided into overall categories of REM (rapid eye movement) and non-REM sleep (McCarley, 2007). After initially falling asleep, the first REM cycle usually occurs about 70 minutes later and is shorter than later REM cycles. Sleep cycles then repeat about every 90 minutes, with 30 of those 90 minutes in REM sleep (McCarley, 2007). Thus, poor sleep quality disrupts the natural cycle of proceeding through different phases of sleep, each of which has important restorative functions on various outcomes (Punjabi et al., 2002; Smith, 1997; Tucker et al., 2006; Walker et al., 2002). Sleep research indicates that both sleep quantity and sleep quality are important, with similar outcomes of a low quantity of sleep as with poor quality sleep (Barnes, Schaubroeck, et al., 2011; Barnes & van Dyne, 2009; Hursh et al., 2004). For example, both low sleep quantity and poor sleep quality result in lower activation in the prefrontal cortex of the brain (Altena et al., 2008; Thomas et al., 2000).

Although not all outcomes of sleep have been investigated with respect to both sleep quantity and sleep quality, theoretical models (Barnes, Schaubroeck, et al., 2011; Hursh et al., 2004) and existing empirical data (Altena et al., 2008; Barnes, Schaubroeck, et al., 2011; Bower, Bylsma, Morris, & Rottenberg, 2010; Christian & Ellis, 2011; Scott & Judge, 2006; Thomas et al., 2000) indicate that it is reasonable to expect such parallel effects across a broad variety of outcomes. It is important to clarify here that these are not effects that can be substituted; a low quantity of sleep that is of high quality will still result in the negative effects noted in what follows. Research to date indicates that the effects of sleep quantity and quality are additive (Barnes, Schaubroeck, et al., 2011).

> Lemma 1: Sleep quantity and sleep quality have parallel additive effects.

Although there is research examining sleep deprivation over prolonged periods such as 64 hours of continuous waking activity, recent research has focused on more mundane amounts of sleep obtained on a regular basis by normal employees. Harrison and Horne (1999) found that missing a single night of sleep led to decrements in innovative thinking, and similarly Nilsson et al. (2005) found that missing one night of sleep leads to decrements in executive functioning. Elmenhorst et al. (2009) found that four consecutive nights of 5 hours of sleep per night leads to decrements in a cognitive task equivalent to a blood alcohol content of 0.6%. Barnes and Wagner (2009) found that a 40-minute decrement in sleep was associated with a 5.6% spike in work injuries. Lahl, Wispel, Willigens, and Pietrowsky (2008) found that even a nap as short as 6 minutes aids declarative memory. Indeed, the meta-analysis noted above conducted by Lim and Dinges (2010) focuses on studies with sleep deprivation periods of less than 48 hours, meaning many of the studies they examined entailed 1

night or less of missed sleep. Similarly, Pilcher and Huffcutt (1996) conducted separate analyses in their meta-analysis of the sleep deprivation literature, indicating powerful effects of sleep deprivation on affect and cognitive performance even for partial sleep deprivation, which they define as less than 5 hours of sleep in a 24-hour period.

Thus, the sleep literature indicates that even small amounts of lost sleep or poor sleep for a short time period can result in important negative outcomes. Similarly, it is reasonable to expect that even small decrements in sleep quality would have parallel negative effects. Now that I have defined the constructs of sleep quantity and sleep quality I will provide a theoretical framework and brief summary of empirical research that provides detail and support for this framework. Christian and Ellis (2011) indicate that a primary theoretical framework for understanding the effects of sleep—and lack thereof—is self-regulation. Karoly (1993) defines self-regulation as processes that enable an individual to guide his or her goal-directed activities over time. Moreover, Karoly notes that self-regulation can involve modulation of thought, attention, affect, and behavior.

Neurophysiological research indicates that self-regulation relies disproportionately on the prefrontal cortex and amygdala regions of the brain (Banks, Eddy, Angstadt, Nathan, & Phan, 2007; Beauregard, Levesque, & Bourgouin, 2001; Chuah et al., 2010; Nilsson et al., 2005; Ochsner et al., 2004). In other words, the prefrontal cortex and amygdala are heavily utilized in human self-regulation. Glucose fuels such brain activity in general (Fairclough & Houston, 2004), and has been linked specifically to self-regulation (Gailliot et al., 2007). Indeed, meta-analytic data indicate that decrements in glucose lead to impaired self-regulation, and restoration of glucose repairs self-regulation (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

Brain glucose is utilized throughout the day and replenished during sleep, as evidenced by neuroimagery delineating a decrease in cerebral metabolism during sleep deprivation (Thomas et al., 2000). Indeed, sleep difficulties have been clearly linked with decrements in activity in the prefrontal cortex (Altena et al., 2008; Harrison & Horne, 2000). Drawing from this literature, organizational psychology researchers have recently conducted empirical work more clearly linking sleep quantity and quality to self-regulation (Barber & Munz, 2010; Barnes, Schaubroeck, et al., 2011; Christian & Ellis, 2011; Ghumman & Barnes, in press; Wagner, Barnes, Lim, & Ferris, 2012), such that self-regulation is impaired by low sleep quantity and poor sleep quality. In the following sections, I summarize literature indicating how this influences cognitive and affective processes of self-regulation, as well as behavioral outcomes.

Sleep and the cognitive component of self-regulation

Sleep physiologists have dedicated a considerable amount of resources to studying the effects of low sleep quantity and poor sleep quality on cognition. A large portion of this literature has focused on self-regulation from a cognitive standpoint. Some such research has focused on maintaining high levels of alertness, which is an effortful process that requires ongoing exertion. In laboratory studies experimentally manipulating sleep–wake rhythms (Dijk, Duffy, & Czeisler, 1992) and inducing sleep deprivation (Beaumont et al. 2001), researchers have found that prolonged periods of wakefulness lead to a decrease in alertness. Similarly, Buysee et al. (2007) found that poor sleep quality predicted low levels of alertness. Perhaps in part because of these effects, in a sleep deprivation experiment conducted by Basner et al. (2008), the authors found that sleep deprivation led lower levels of detection of threats in a luggage X-ray screening task.

Beyond alertness, directing and controlling attention is critical in self-regulation (Kaplan & Berman, 2010); distracting stimuli can divert an

individual away from goal-directed activity. Sleep physiology research has indicated that sleep is important for directing and focusing attention on specific tasks and stimuli. Smith, McEvoy, and Gevins (2002) found that sleep loss compromises the function of neural pathways critical to attention allocation in tasks utilizing working memory. Chuah et al. (2010) conducted a sleep deprivation experiment, finding that sleep deprivation leads to increased susceptibility to distraction by emotional stimuli. This effect was linked to reduced connectivity between the amygdala and the prefrontal cortex regions of the brain. Indeed, meta-analytic data directly link sleep deprivation to lapses in attention (Lim & Dinges, 2010).

Risk analysis and management is an important process in self-regulation, as individuals make choices among alternative strategies for goal-directed action (Murray, Holmes, & Collins, 2006). Gianotti et al. (2009) note that avoiding choices where risks are disproportionately higher than rewards requires utilizing the prefrontal cortex. As noted above, the prefrontal cortex is disproportionately negatively influenced by low sleep quantity and poor sleep quality (Altena et al., 2008; Thomas et al., 2000). Thus, it is perhaps not surprising to see that sleep deprivation leads to increased propensity to select choices that entail high levels of risk (Hockey, Maule, Clough, & Bdzola, 2000; Killgore, Balkin, & Wesensten, 2006; Killgore, Kamimori, & Balkin, 2011). Research indicates that this effect may not be consistent with regard to both gains and losses; Venkatraman, Chuah, Huettel, and Chee (2007) found that sleep deprivation increases expectations of gain in risky decisions and makes people less sensitive to loss. Similarly, McKenna, Dickinson, Orff, and Drummond (2007) found that sleep deprivation led participants to especially high levels of risk when participants were considering a gain, but lower levels of risk when participants were considering a loss.

Self-regulation also often involves navigating different decisions that entail differential payoffs for differential levels of investments of time, effort, or resources. For example, eating a candy bar may give an individual pleasure now but have a longer term cost of decreasing health, whereas eating a celery stick may do the opposite. Such choices have been clearly linked with self-regulation, with decrements in self-regulation tied to poorer tradeoffs between immediate payoffs and long-term costs and immediate costs/long-term payoffs (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000).

A related topic is delay discounting, which is an index of an individual's preference for immediate payoff and avoidance of options that entail a payoff later (Green & Myerson, 2004). High levels of delay discounting are associated with impulsivity, such that choices with payoffs that are immediate are highly valued and selected, whereas choices with temporally distant payoffs are valued near zero (Reynolds & Schiffbauer, 2004). As an individual engages in decision making in the context of goal-directed activity, delay discounting is an important cognitive process that influences choice. Overruling the temptation to engage in high delay discounting requires suppressing impulsivity. This form of active self-regulation requires executive functioning, which is impaired by low quantities of sleep and poor quality sleep (Altena et al., 2008; Harrison & Horne, 2000; Nilsson et al., 2005). Consistent with this contention, Reynolds and Schiffbauer (2004) found that low quantities of sleep lead to high levels of delay discounting.

> Lemma 2: Low levels of sleep quantity and poor sleep quality have detrimental effects on cognitive components of self-regulation. This is manifested in outcomes such as low alertness, impaired attention management, distorted risk analyses, and heavy delay discounting.

Parallel to the cognitive effects of insufficient or poor-quality sleep, there are also negative effects on affective self-regulation. People encounter stimuli and events that may naturally elicit moods and emotions (Weiss & Cropanzano, 1996). However, goal-directed activities often require regulating this affect, either by changing the experienced affect or the displayed affect (Grandey, 2003; Scott, Barnes, & Wagner, in press). Most commonly this involves suppressing negative emotions or enhancing positive emotions (VanMaanen & Kunda, 1989; see also Wharton & Erickson, 1993). The amygdala and prefrontal cortex are centrally involved in regulating affect (Beauregard et al., 2001; Ochsner et al., 2004), and as noted before, these regions are disproportionately negatively influenced by low levels of sleep and poor quality sleep (Chuah et al., 2010). Moreover, actively regulating one's own affect requires continual exertion and effort, which requires energy and is generally exhausting (Grandey, 2003). It is reasonable to expect that those who are low in sleep quantity or are experiencing poor sleep quality will not have the energy to engage in such emotional regulation, and will thus be especially likely to experience and display poor moods and negative emotions.

A large literature supports this contention. Poor sleep and short sleep lead to high hostility, low joviality, high frustration, high anxiety, high paranoia, and even depression (Caldwell, Caldwell, Brown, & Smith, 2004; Christian & Ellis, 2011; Kahn-Green, Killgore, Kamimori, Balkin, & Killgore, 2007; Kahn-Green, Lipizzi, Conrad, Kamimori, & Killgore, 2006; Scott & Judge, 2006). Other research has indicated similar effects on the broader constructs of positive affect and negative affect (Bower et al., 2010; Franzen, Siegle, & Buysse, 2008; Sonnentag, Binnewies, & Mojza, 2008), such that low sleep quantity and poor sleep quality lead to low positive affect and high negative affect. Moreover, a meta-analysis indicates that sleep has a powerful influence on mood across a broad variety of studies (Pilcher & Huffcutt, 1996). This may be due to changes in functioning in brain regions such as the amygdala and the prefrontal cortex (Chuah et al., 2010; Nilsson et al., 2005). Overall, this literature indicates powerful and broad effects of sleep on positive and negative affect.

> Lemma 3: Low levels of sleep quantity and poor sleep quality have detrimental effects on experienced and displayed affect.

Highlighting the insidious nature of sleep problems, the sleep literature also indicates that the effects of low sleep quantity and poor sleep quality accumulate over time, growing worse as sleep deprivation and poor nights of sleep continue. Haavisto et al. (2010) conducted a laboratory study in which the experimental group had their sleep restricted to 4 hours per night for 5 consecutive nights. Compared to the control group that was allowed to sleep for 8 hours each night, multitasking performance of the experimental group progressively deteriorated. Belenky et al. (2003) conducted a similar study over the course of 7 experimental days. Belenky et al. found that cognitive performance declined gradually but eventually stabilized at a lower level. This led Belenky et al. to speculate that human brains may have some capacity to adapt to chronic sleep loss, albeit at a sacrificed level of functioning. Van Dongen, Maislin, Mullington, and Dinges (2003) conducted a prolonged study of sleep restriction, entailing 14 consecutive days of 6 hours or less of sleep per night. They found performance decrements from this manipulation that were equivalent to 2 nights of total sleep deprivation.

Sleep physiologists use the metaphor of sleep debt to indicate an accumulation of lost sleep (Rupp, Wesensten, & Belkin, 2010; Rupp, Wesensten, Bliese, & Belkin, 2009). This research indicates that recovery sleep is the means to pay off sleep debt. For example, Dinges et al. (1997) conducted a study in which

they restricted the sleep of participants to 5 hours a night for 7 consecutive days. They found cumulative effects over the duration of this sleep restriction period on sleepiness, confusion, tension, mental exhaustion, and stress; full recovery to baseline required 2 full nights of sleep. Similarly, Banks, van Dongen, Maislin, and Dinges (2010) conducted a study of 5 consecutive nights of 4 hours of sleep per night, and found that the negative effects on mood and cognitive performance that had accumulated were still not entirely eliminated even after a night of 10 hours of sleep. This indicates that another full (or longer than usual) night of sleep would have been required for full recovery. Indeed, Rupp et al. (2009) found that compared to people spending a week with their normal sleep patterns, having people spend 10 hours in bed for a week led to increases in performance. This suggests that the people in the typical sleep pattern condition were probably already carrying sleep debt, which is consistent with data indicating the prevalence of low sleep quantity and poor sleep quality in the general population (cf. Luckhaupt et al., 2010; Swanson et al., 2011). Indeed, there are diminishing returns to obtaining abnormally high amounts of sleep (Barnes & van Dyne, 2009; Hursh et al., 2004), indicating that sleep extension to 10 hours per night would only be beneficial if the Rupp et al. (2009) participants were already carrying sleep debt.

In summary, this literature indicates that the effects of low sleep quantity and poor sleep quality accumulate over time. Moreover, these cumulative effects can be reversed by accumulating the positive effects of high sleep quantity and good sleep quality.

> Lemma 4a: Over time, low sleep quantity and poor sleep quality accumulate as sleep debt; this sleep debt is discharged by obtaining high quantities of sleep and high quality sleep.

> Lemma 4b: Accumulated sleep debt will impair self-regulation.

Sleep and organizational psychology

Existing research

Although employees and employers may downplay the effects of a lack of sleep (Barnes, 2011), a large body of research indicates the robustness of the effects noted above across a broad variety of samples and criteria. Even elite U.S. Navy Sea-Air-Land (SEAL) trainees are vulnerable to the effects of sleep deprivation (Lieberman, Tharion, Shukitt-Hale, Speckman, & Tulley, 2002). The sleep literature has progressed to the point where precise mathematical models can describe the effects of sleep on task performance (Hursh et al., 2004; Jewett & Kronauer, 1999; Rajaraman, Gribok, Wesensten, Balkin, & Reifman, 2009). Thus, it is ripe for integration into the organizational psychology literature.

Low sleep quantity or quality has been associated with low job satisfaction (Scott & Judge, 2006) and poor motivation (Baranski, Cian, Esquievie, Pigeau, & Raphel, 1998). Research specifically conducted in workplace settings indicates that a lack of sleep or poor sleep leads to workplace absences, poor concentration at work, difficulty with organization, impatience, workplace deviance, cyberloafing, and unethical behavior (Barnes, Schaubroeck, et al., 2011; Christian & Ellis, 2011; Salo et al., 2010; Wagner et al., 2012). Other research links a lack of sleep and poor quality sleep to both 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; Salminen et al., 2010; Salo et al., 2010).

Moreover, management researchers are beginning to examine the influence of low sleep quantity and poor sleep quality in the contexts of groups and teams (Barnes & Hollenbeck, 2009). Empirical research indicates that low sleep quantity and poor sleep quality are linked to impatience at work (Swanson et al., 2011),

lack of trust (Anderson & Dickinson, 2010), and interpersonally inappropriate behavior (Horne, 1993). A lack of sleep hinders how well people recognize emotion in others (van Der Helm, Gujar, & Walker, 2010), hinders emotional intelligence in general (Killgore et al., 2008), and leads to increased levels of social loafing (Hoeksema-van Orden, Buunk, & Gaillard, 1998). Based on such findings, Barnes and Hollenbeck (2009) speculate that sleep deprivation will lead to increased levels of conflict in groups and teams.

New propositions

It is clear that not only is the sleep literature ripe for integration with the organizational psychology literature, but also that researchers have already made initial steps in such a direction. Having provided a brief summary of this literature, in this section I seek to expand this integration by generating novel propositions that link to the theoretical framework of self-regulation and which also highlight on organizationally relevant outcomes. I focus on the outcomes of work withdrawal, goal level, incivility, and defection in workplace social dilemmas. In developing these propositions, I draw heavily from the lemmas noted above that summarize much of the relevant sleep research.

Sleep and work withdrawal. As employees regulate their work behavior, they can vary in how engaged they are at work. Especially when work is unpleasant, employees face temptations to avoid work, and must actively engage in self-control to overcome this temptation (Wagner et al., 2012). When employees are unsuccessful in engaging in such self-regulation, they may withdraw from work. Work withdrawal is defined as attempts of employees to remove themselves from their work tasks or environment (Hanisch & Hulin, 1991; Kaplan, Bradley, Luchman, & Haynes, 2009). Work withdrawal behaviors, such as absenteeism, tardiness, and daydreaming clearly undermine productivity, as indicated in meta-analytic data revealing a negative relationship between work withdrawal and performance in both individual- and unit-level analyses (Whitman, van Rooy, & Viswesvaran, 2010).

Although much of the work withdrawal literature focuses on between-individual differences in work withdrawal that are driven by either individual differences or contextual effects (e.g., Kaplan et al., 2009; Kristof-Brown, Zimmerman, & Johnson, 2005; Podsakoff, LePine, & LePine, 2007), recent research has taken a more dynamic, within-individual approach to examining work withdrawal (Scott & Barnes, 2011). Thus, work withdrawal can vary over time within people as well. One key dynamic antecedent is affect.

Theories of emotions indicate that affective experiences are accompanied by action tendencies, which are automatic urges to achieve a particular goal (Frijda, 1994, 2007). Negative affective states have action states that address current problems to improve the situation, which is generally accomplished through avoidance (Cacioppo, Gardner, & Bernston, 1999; Elfenbein, 2008; Fitness, 2000). Positive affective states prompt the opposite: an approach motivation that includes creativity and search, as well as an expansion of action repertoires (Cacioppo et al., 1999; Fredrickson, 2001). Consistent with these contentions, Scott and Barnes (2011) conducted a within-individuals study of work withdrawal in bus drivers. They found that on days in which a given bus driver was high in negative affect, that bus driver was especially likely to withdraw (e.g., daydream while driving); they found the opposite effect for positive affect.

Beyond the role of affect, I contend that avoiding the temptation to engage in work withdrawal has a purposeful cognitive component as well. Employees may face an explicit choice between working or withdrawing from work. For example, an employee may have an opportunity to deliberately extend a lunch break beyond the approved length of time. Overriding

this temptation requires active engagement of self-control, which involves the utilization of the prefrontal cortex. As noted above, the prefrontal cortex is disproportionately negatively influenced when an individual is low in sleep quantity or experiences poor sleep quality. As a result, an employee should be less able to resist the temptation to purposely withdraw from work.

Although to date no research has directly examined the relationship between sleep and work withdrawal as a whole, sleep physiologists have examined smaller pieces of this relationship. Westerlund et al. (2008) found that sleep disturbances were correlated with absenteeism. Moreover, lack of sleep has been linked with lapses in attention (Lim & Dinges, 2010); it is reasonable to expect a lack of sleep to lead to daydreaming at work, which is another form of work withdrawal. Finally, Wagner et al. (2012) found that a lack of sleep and poor quality sleep predicted cyberloafing, which is a specific form of loafing behavior in which employees spend work hours and company Internet access to check personal e-mails or visit websites not related to their work (Lim, 2002). Therefore, for the reasons noted before, I propose that sleep will influence work withdrawal.

> Proposition 1: (a) Low sleep quantity and (b) poor sleep quality will be positively related to work withdrawal.

Sleep and goal level revision. Employees often work toward the pursuit of specific goals at work. For example, a professor may begin the work day with a "to do list" that has several goals for work that day, such as revising the front end of a manuscript and conducting a journal review. Goals are a primary mechanism of self-regulation, which direct attention, effort, and persistence toward a specific task (Locke & Latham, 2002). A large literature indicates the power of goals (Austin & Vancouver, 1996; Locke & Latham, 2002; Tubbs, 1986; Wood, Mento, & Locke, 1987). Indeed, goals have been among the most heavily studied topics in organizational psychology over the past decades (Cascio & Aguinis, 2008). Among the most established findings in goal theory is that specific, difficult goals have been empirically established as powerful tools for motivation (Locke & Latham, 2002).

Research indicates that the levels of daily work goals are dynamic over time (Ilies & Judge, 2005), such that people can revise the goal level for a given goal upward or downward. Two noted antecedents of goal level revision are goal progress (Donovan & Williams, 2003) and affect (Ilies & Judge, 2005). Specifically, Donovan and Williams found that when an individual is failing to reach a goal, that individual will tend to lower the level of the goal. Similarly, Ilies and Judge found that when individuals receive negative feedback, they tend to adjust their goals downward. Moreover, Ilies and Judge found that the experience of negative affect was linked to a downward adjustment in goals. This is consistent with research linking affect to goal expectancy (Erez & Isen, 2002), and goal expectations to goal level (Donovan & Williams, 2003; Wofford, Goodwin, & Premack, 1992). Thus, poor goal progress and negative affect are important antecedents of goal level revision.

As indicated above, low sleep quantity and quality have broad and negative implications for human functioning, which manifest themselves in poor performance (Harrison & Horne, 2000; Pilcher & Huffcutt, 1996). When an employee works after a short night of sleep or a night full of interrupted sleep, he or she will find it difficult to concentrate and engage in taskwork (Lim & Dinges, 2010). This is especially problematic for complex jobs requiring deep concentration (Barnes & Hollenbeck, 2009; Harrison & Horne, 1999, 2000). However, even for simple jobs that require staying on task, insufficient sleep can leave employees especially vulnerable to distractions (Franzen et al., 2008). Thus, employees will be less

effective when low in sleep quantity or when experiencing poor sleep quality. As suggested by Scott and Judge (2006), this should result in a hindrance to goal progress. As individuals fail to reach a goal, a common response will be to revise the goal downward (Donovan & Williams, 2003). Thus, when employees come to work after a short night of sleep or a poor night of sleep, their lower level of effectiveness and missed goals should lead them to lower the difficulty of their goals.

Also noted above, low sleep quantity and quality have broad and negative implications for affect. For example, Scott and Judge (2006) found that poor sleep quality on a given night leads to high hostility and low joviality the next day at work. Other research has linked sleep quantity and quality broadly to negative and positive affect (Bower et al., 2010; Franzen et al., 2008; Sonnentag et al., 2008). Thus, an employee who comes to work after a poor night of sleep will experience negative affect, which will lower expectancies for success on a given work goal. As a result, the employee will be likely to lower the goal difficulty in order to increase the perceived likelihood of reaching the goal.

Thus, an integration of research indicating that goal progress and affect are important antecedents of goal level revision with research indicating that low sleep quantity and poor sleep quality influence goal progress and affect suggests that sleep will influence goal level revision. Specifically, I propose that low sleep quantity and poor sleep quality will lead to downward goal level revision. Although to date no empirical research has examined such relationships, Engle-Friedman et al. (2003) found that low quantities of sleep led participants to select easier versions of tasks, which is a choice similar to lowering goal level. This provides indirect support for a relationship between sleep and goal level.

> Proposition 2: (a) Low sleep quantity and (b) poor sleep quality will be negatively related to goal level.

Sleep and workplace incivility. Workplace incivility is a topic gaining research attention in organizational psychology. Incivility is defined as low-intensity deviant behavior with ambiguous intent to harm the target, in violation of workplace norms for mutual respect (Andersson & Pearson, 1999). In the context of the current model, incivility is often a failure of self-regulation; employees may experience temptations to behave toward each other in an uncivil manner, and self-regulation is required to avoid such behavior. Workplace incivility has been tied to important employee outcomes, such as increased strain (Raver & Nishii, 2010), decreased well-being (Lim & Cortina, 2005), increased turnover intentions (Lim, Cortina, & Magley, 2008), decreased health (Lim et al., 2008), emotional exhaustion (Leiter, Laschinger, Day, & Oore, 2011), and low job satisfaction (Leiter et al., 2011).

To date, research on workplace incivility has focused primarily on outcomes of incivility rather than antecedents. The minority of research that does examine antecedents of incivility tends to focus on trait-based antecedents (e.g., Hebl, King, Glick, Singletary, & Kazama, 2007). However, given that other types of negative work behaviors do vary on a daily basis, such as organizational deviance and unethical behavior (Barnes, Schaubroeck, et al., 2011; Christian & Ellis, 2011), it is reasonable to assume that workplace incivility is also dynamic over time, with dynamic antecedents.

One antecedent of workplace incivility that has been examined as an individual difference but also varies within individuals is self-control. Thau and Mitchell (2010) found that poor self-regulation, in the form of poor self-control, predicted workplace incivility. This is perhaps not surprising; workplaces can engender frustration, irritation, anger, and other forms of negative affect. Without self-control, such negative affect could potentially manifest itself as uncivil behavior towards others, such as verbal or physical abuse.

As noted by Christian and Ellis (2011), a lack of sleep leads to both the experience of negative affect and a hindered ability to exert self-control. Indeed, in their study, sleep deprivation led to high levels of interpersonal deviance; interpersonal deviance may include some behaviors that are uncivil in nature. Moreover, sleep physiologists have noted that sleep deprivation leads to an increase in interpersonally inappropriate behaviors (Horne, 1993); although the Horne (1993) study was conducted in a laboratory setting, it is reasonable to assume that such effects may carry over to the workplace as well. Swanson et al. (2011) found that people experiencing poor sleep are especially likely to show impatience at work, which may be linked to subsequent incivility. Accordingly, based on literature linking sleep to affect and self-control, I contend that sleep quantity and quality will predict general workplace incivility.

> Proposition 3: (a) Low sleep quantity and (b) poor sleep quality will be positively related to workplace incivility.

Sleep and workplace social dilemmas. Social dilemmas are situations in which members of a group or collective are faced with a conflict between maximizing personal interests and maximizing collective interests (Komorita & Barth, 1985). Aram (1989) provides some common examples of workplace social dilemmas: departments in a firm may horde resources of information to the detriment of the firm as a whole; employees who have problems of conscience with an organizational action may experience conflicting obligations to self, to supervisor, to the firm as a whole, or to society; social regulation of business reduces freedom of action for firms in the name of social goals; worldwide recession may result from individual countries' attempts to gain trade advantages. Work teams may be unwittingly structured as social dilemmas, where goals at the individual and team level are contradictory (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). For example, a team member may have to choose between maximizing his/her own benefit by working on his/her own taskwork or maximizing the team's benefit by engaging in backing up behavior aimed at helping other team members (Barnes, Hollenbeck, Jundt, DeRue, & Harmon, 2011).

Self-regulation is important in the context of social dilemmas. Social dilemmas involve the temptation to put one's own interest above the group despite the fact that this action harms the group. This is known as the temptation to defect (Axelrod, 1984; Goehring & Kahan, 1976), and self-regulation is clearly involved in avoiding temptations (Gino, Schweitzer, Mead, & Ariely, 2011). Coombs (1973) notes that there are two major motivations for defection: fear and greed. Greed refers to the active pursuit of self-interest, and fear refers to a lack of trust in others that produces an assumption that others will defect (Yamagishi & Sato, 1986). Empirical research provides support for greed and fear as causal mechanisms of defection in social dilemmas (Yamagishi & Sato, 1986), although it appears that greed may be a more powerful antecedent than fear (Komorita, Sweeney, & Kravitz, 1980; Rapoport & Eshedlevy, 1989).

There is no research directly linking sleep to greed. However, as noted by Gino et al. (2011), self-control is necessary to override temptations that may come along. Self-regulation research clearly indicates that self-control is a key process for overcoming temptations (Gino et al., 2011). And sleep is a key antecedent of self-control (Barnes, Schaubroeck, et al., 2011; Christian & Ellis, 2011), such that low quantities of sleep or poor qualities of sleep result in hindered ability to avoid temptations to engage in negative behaviors (Barnes, Schaubroeck, et al., 2011; Wagner et al., 2012). Similarly, although there is no research directly linking sleep to fear that others will defect, a recent laboratory study conducted by Anderson and Dickinson (2010) indicates that a lack of sleep

leads people to be less likely to trust others in bargaining situations. Although Anderson and Dickinson's study of sleep and trust was exploratory, it may be that the reason for this effect is that when people are in a negative affective state, they have more pessimistic predictions of the behaviors of others. This would be consistent with previous research noting an affective component of trust (McAllister, 1995). It is reasonable to assume that a lack of trust would lead to an expectation that other people will not place common interests above their own; thus, a lack of sleep should lead to fear of defection by others.

Accordingly, based on research linking sleep to self-control and trust, I propose that sleep will predict defection in workplace social dilemmas.

> Proposition 4: (a) Low sleep quantity and (b) poor sleep quality will be positively related to defection in social dilemmas in the workplace.

Testing sleep propositions in organizational psychology

Although theoretical contributions are key to advancing organizational psychology, empirical research must be included as well. Thus, as organizational psychology researchers continue exploring the topic of sleep, it is important to consider methods of conducting empirical research to test new propositions such as those posed in this paper. In this section, I discuss different research designs and measures for conducting such research.

The large majority of sleep physiology has been conducted in laboratory settings. A common research design in such settings is to randomly assign participants to conditions, deprive one group of sleep, and compare it to the control group. This is a very powerful mechanism for conducting empirical research and making causal inferences. Another powerful laboratory-based design is to conduct a within-participants manipulation of sleep, such that a participant's outcome under a rested condition is compared to that same participant's outcome under a sleep-deprived condition. Indeed, Harrison and Horne (1999) provide a good—albeit rare—example of such a research design in organizational psychology.

Such laboratory research is a powerful tool for organizational psychology as well. Colquitt (2008) provides a clear review of the strengths and purposes of laboratory research. I will not belabor the point here by rehashing such strengths. However, I will note that laboratory studies of sleep not only have the benefits noted by Colquitt, but also the opportunity to manipulate or measure sleep in an especially accurate manner. Laboratory settings provide an opportunity to keep participants awake to create conditions of sleep deprivation. Alternatively, some sleep physiologists combine the physiological measures of electroencephalograms, electrooculograms, and electromyograms into a measure known as polysomnography (Benbadis, 2006; Kryger, Roth, & Dement, 2005). There is no more precise and accurate manner to measure sleep.

However, sleep research can also be conducted in field settings. One such tool for measuring sleep objectively is an actigraph, which is a wrist-worn device similar in size to a watch. Actigraphs utilize accelerometers to measure motion, which is used as a proxy for waking activity. A large body of research indicates the accuracy and precision of actigraphs for measuring sleep quantity and quality (van de Water et al., 2011).

Actigraphs are not the only tool for measuring sleep in field settings. Sleep can also be measured through self-report measures, such as the Pittsburgh Sleep Diary (Monk et al., 1994). Self-report measures of sleep are not as accurate as polysomnography or actigraphy. Empirical data suggest that subjective measures of sleep overestimate sleep by about 6 to 7% (Barnes, Schaubroeck, et al., 2011; O'Donnell et al., 2009). However, subjective and objective

measures of sleep correlate very strongly (Barnes, Schaubroeck, et al., 2011; O'Donnell et al., 2009). Thus, self-ratings of sleep should have very similar relationships with other constructs as do objective ratings of sleep with the same constructs. Therefore, self-ratings of sleep are also helpful tools in conducting organizational psychology research on sleep.

There are two types of field research design that are especially well suited to the study of sleep in organizational psychology, as evidenced by recent research. One such design is experience sampling methodology, sometimes referred to as a diary study. In such a design, there are multiple observations of each participant. Thus, each participant serves as their own control group, similar to within-participants experimental designs but in field settings capitalizing on natural daily variation in the variables of interest. Thus, whereas cross-sectional research may be vulnerable to criticism that different people need different amounts of sleep (e.g., Rusterholz, Durr, & Achermann, 2010), experience sampling method designs hold constant all individual differences. Although daily observations are the norm for experience sampling methods in organizational psychology research, the time scale should be driven by the research question. Many such questions in the context of sleep should vary daily, such as affect and job satisfaction (Scott & Judge, 2006). However, some outcomes may vary over longer periods of time, such that accumulated sleep debt over the course of more than a few days is appropriate to study.

A second type of field research design is a quasiexperiment that occurs every year in over 70 countries around the world; the change to daylight saving time. Barnes and Wagner (2009) analyzed an archival nationally representative sample of over 14,000 Americans. They found that on the Monday following the change to daylight saving time in the Spring, people slept on average about 40 minutes less the previous night. This is likely a slight underestimate, given that not every state in America participated in daylight saving time, but participants from all states were included in the sample. Nevertheless, on that one day per year people come to work with less sleep than normal. That day has been linked with a spike in workplace injuries (Barnes & Wagner, 2009) and an increase in cyberloafing (Wagner et al., 2012). This naturally, annually occurring quasiexperiment is available every year for organizational psychology researchers to utilize in studying the effects of lost sleep.

Regardless of the research design utilized, Babkoff, Caspy, Mikulincer, and Sing (1991) caution sleep researchers to be careful to disentangle the effects of sleep quantity (and presumably quality) from the effects of circadian rhythms. Borbely and Achermann (1999) note that the circadian rhythm is a major process that underlies sleep regulation, acting as a clock-like mechanism that is basically independent of prior sleep and waking and determines the alternation of periods with high and low sleep propensity. This circadian rhythm conforms to the 24-hr rotation cycle of the Earth. Low points in circadian rhythms can influence people in a manner parallel to sleep deprivation. Thus, researchers examining sleep should not confound the two. Holding circadian rhythm constant or controlling for time of day effects are appropriate in investigating the effects of sleep.

Recommendations for future research

In addition to testing the propositions set forth by this paper, there are other potential avenues for future research on the topic of sleep in organizational psychology. Most of the sleep literature to date has focused on main effects of sleep. However, a growing portion of this literature has considered the potential of individual differences as moderators of such effects. Some researchers have simply noted that there are individual differences in the magnitude of the effects of sleep (Wong, Marshall, Grunstein,

Dodd, & Rodgers, 2008). Others have noted more specifically individual differences that include physiologic characteristics such as prefrontal cortex functioning (Killgore, Grugle, Reichardt, Killgore, & Balkin, 2009), white matter distribution (Rocklage, Williams, Pacheco, & Schnyer, 2009), brain activation during a working memory task at rested baseline (Mu et al., 2005), and baseline prefrontal cortex functioning (Mu et al., 2005). Others include more familiar individual differences such as age (Bliese, Wesensten, & Balkin, 2006), gender (Scott & Judge, 2006), neuroticism (Blagrove & Akehurst, 2001), extraversion (Blagrove & Akehurst, 2001; Killgore, Richards, Killgore, Kamimori, & Balkin, 2007), and conscientiousness (Wagner et al., 2012).

However promising such research may be, researchers examining such individual differences should take caution for two reasons. First, very little theory currently exists to explain such individual differences as moderators of the effects of sleep. Out of all of the individual differences listed, only extraversion and conscientiousness have clear theoretical grounding (cf. Killgore et al., 2007; Wagner et al., 2012). Second, Frey, Badia, and Wright (2004) noted that although they had evidence that people varied in the effect of sleep deprivation on various outcomes, such variation between individuals was not consistent across outcomes. Thus, there may be different moderators for different effects.

Beyond main and moderated effects, future research should consider the possibility of curvilinear effects. As noted in the reservoir model of fatigue described by Barnes and van Dyne (2009), as an individual fills their need for sleep (i.e., discharges all sleep debt), there is no further benefit from more sleep. It is unlikely that sleeping 14 hours per day will result in more beneficial outcomes than 8 hours per day. Indeed, empirical research notes that abnormally long sleepers are especially likely to experience negative health outcomes (Gallicchio & Bindu, 2009).

Another potential area for future research is lay theories of sleep. Helmreich (2000) notes that many pilots and physicians believe that they are nearly invulnerable to the effects of sleep deprivation. Barnes (2011) notes that many managers have a similar opinion, taking pride in working long hours on short sleep. Given that people have only a moderate ability to predict sleep-based decrements in performance (Dorrian et al., 2003), lay theories of sleep may lead some to work while low on sleep while unaware of the performance impairment that they are suffering. Such individuals may not only set themselves up for the negative outcomes of sleep, but also promote such effects in others. Moreover, such individuals may be averse to using strategic naps to counter sleep deprivation effects, exacerbating the problem.

Sleep research in organizational psychology would also benefit from studying the related topics of jetlag, circadian rhythms, and sleep hygiene. Jetlag and sleep hygiene are both relevant to sleep quantity and quality. Jetlag is a common term for traveling across time zones, especially traveling East (Monk, Buysse, Carrier, & Kupfer, 2000). Research clearly indicates that jetlag is disruptive to sleep cycles (Monk, Buysse, Billy, & DeGrazia, 2004; Monk et al., 2000). Sleep hygiene refers to practices associated with falling and staying asleep. Using sleep-disturbing products (e.g., caffeine), engaging in activating or arousing activities close to bedtime, and the use of the bed for activities other than sleep all inhibit the process of falling and staying asleep (Gellis & Lichstein, 2009). These activities—collectively known as poor sleep hygiene—are associated with poor sleep outcomes (Gellis & Lichstein, 2009; Mindell, Meltzer, Carskadon, & Chervin, 2009; Suen, Hon, & Tam, 2008).

As noted before, circadian rhythm effects are similar in many ways to the effects of low quantities of sleep and poor sleep quality (Babkoff et al., 1991). Circadian rhythms influence both affect (Murray, Allen, & Trinder, 2002), and performance (Monk et al.,

1997), such that nadirs in circadian rhythms are similar to the effects of sleep deprivation. Moreover, circadian rhythms are clearly influential in determining when a given individual falls asleep (Czeisler et al., 1999; Lavie, 2001).

From a practical standpoint, future research should investigate strategies for avoiding and mitigating the effects of low sleep quantity and poor sleep quality. Barnes (2011) and Caldwell, Caldwell, and Schmidt (2008) provide some such recommendations. These include prevention strategies such as managing sleep hygiene, strategic naps, sleep-friendly work schedules, and minimizing stress and anxiety. Also included are mitigation strategies such as assigning sleepy people tasks that are less vulnerable to working while sleepy (such as routine, noncreative tasks), limiting time spent on a given task, scheduling breaks, utilizing stimulants such as caffeine, working in teams, and rotating both team members and leaders. Some of these strategies have been empirically tested, but not in a systematic and exhaustive manner. Most of these strategies have focused on mitigating the effects of lost sleep on task performance. However, as noted before, there are many effects of sleep; it may be that different strategies work to different degrees on different outcomes.

Moreover, future research should work to uncover new strategies for managing the negative effects of low sleep quantity and poor sleep quality. Such research will be crucial for providing practical implications and recommendations for managers. Indeed, given the prevalence of low sleep quantity and poor sleep quality, as well as the broad and important effects of sleep, sleep research in general should be given a high priority in organizational psychology.

Although most research has focused on sleeping during nonwork hours, future research should consider sleep that occurs during work hours. One such form of sleep would be simply oversleeping, such that one does not wake in time for a work shift. This would be a form of sleep that would have outcomes generally considered to be negative. Another form would be naps at work. An emerging literature indicates powerful benefits of naps (Driskell & Mullen, 2005) that could be utilized by organizations.

Finally, as organizational psychology researchers become more well informed of the importance of sleep to the functioning of employees, future research should also consider how work experiences influence sleep. Existing research already indicates that work schedules (Barnes, 2011; Barnes, Wagner, & Ghumman, in press; Swanson et al., 2011), workload and stress (Akerstedt, Fredlund, Gillberg, & Jansson, 2002; Akerstedt, Knutsson, et al., 2002), injustice in the workplace (Greenberg, 2006), and workplace bullying (Niedhammer, David, Degioanni, Drummond, & Phillip, 2009) lead to sleep problems. It is likely that there are other work experiences that cause problems sleeping, either directly or indirectly through stress and anxiety. This not only will empower managers to find ways to minimize work infringement upon sleep, but also identify people who may be slipping into negative spirals where negative work experiences and sleep difficulties reinforce each other.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Acknowledgments

I would like to thank Maartje E. Schouten for her helpful feedback in generating early drafts of this manuscript.

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Author biography

Christopher M. Barnes is an Assistant Professor of Management in the Pamplin College of Business at Virginia Tech. He received his PhD in Organizational Behavior from Michigan State University. His research interests focus primarily on sleep and fatigue in organizations, as well as the topics of emotional labor and team performance. His research has been published in *Academy of Management Review*, *Academy of Management Journal*, *Journal of Applied Psychology*, and other management and applied psychology journals.