

Insomnia, Emotions, and Job Satisfaction: A Multilevel Study

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The authors used experience-sampling methodology to investigate the dynamic relationships among insomnia, emotions, and job satisfaction. Over a period of 3 weeks, 45 employees completed surveys each workday, producing a total of 550 observations. Results revealed that, within individuals, insomnia was associated with increased feelings of hostility and fatigue and decreased feelings of joviality and attentiveness. Insomnia was also negatively related to job satisfaction, and this relationship was mediated by the emotions. Finally, gender moderated the within-individual relationships between insomnia and three of the four emotions such that women were more affected by a poor night of sleep than were men.

Keywords: *affect; emotions; sleep; job attitudes; gender*

According to a recent poll of 1,506 randomly sampled adults, Americans are getting less and less sleep (National Sleep Foundation, 2005). On average, adults in America sleep 6.8 hours a night on weekdays, and the number of individuals who sleep 8 or more hours a night on weekdays has steadily decreased during the past few years to 26% in 2005. Adding insult to injury is the finding that about three fourths of individuals report having experienced at least one symptom of a sleep problem a few nights a week or more within the past year. Consequently, 26% of individuals state that they sleep well only a few nights a month or less, and these individuals report experiencing daytime sleepiness on the job at least 3 days a

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week. Considering that Webb and Agnew (1975) asserted more than 30 years ago that Americans are chronically sleep deprived, the situation clearly has not improved.

Given that work is the first place that many individuals go upon awakening and sleep problems may significantly affect individuals at work, it is surprising that the effects of sleep have not been examined more thoroughly within a work context. In this article, we attempt to fill this void in the literature by examining the effects of sleep on employee affect and job satisfaction. Using experience-sampling methodology, we test a dynamic process model interrelating insomnia, discrete emotions, and job satisfaction. Brief and Weiss (2002) called for more experience-sampling studies that examine within-individual outcome or process data. By examining job satisfaction as an outcome of insomnia, and emotions as part of the process through which insomnia affects job satisfaction, our study is a response to this concern. In addition, we examine gender differences in the relationships between insomnia and emotions.

Definition of Constructs

Insomnia

The term *insomnia* is derived from the Latin word *insomnus*, which, literally translated, means “no sleep.” Although there are multiple classifications of insomnia, most include indicators such as sleep quality, sleep latency (time to fall asleep), and sleep maintenance (difficulty maintaining sleep) (Estivill et al., 2003). Given that we are interested in examining sleep problems in a normal, working population, our use of the term *insomnia* differs somewhat from a clinical definition of insomnia, which is difficulty initiating or maintaining sleep for at least 4 weeks (American Psychiatric Association, 1994). In addition, because insomnia tends to be more strongly related to feelings of sleepiness and well-being the next day compared to sleep duration (Pilcher, Ginter, & Sadowsky, 1997), we focus on insomnia rather than sleep duration as our focal predictor of emotions and job satisfaction during work.

The Emotions of Hostility, Joviality, Fatigue, and Attentiveness

Although most individuals understand what is meant by the term *emotion*, researchers have had difficulty settling on a precise definition. However, most scholars agree that the defining feature of emotions is that they are a reaction to a specific event (Frijda, 1994; Lazarus, 1991; Watson, 2000). In contrast, moods are more diffuse in nature and are not necessarily triggered by an object or event. The term *affect* typically is used to capture both mood and emotion and to refer to experiential states in general (e.g., Weiss & Cropanzano, 1996).

In the current study, we adopt the perspective that a poor night of sleep constitutes an “event” that produces a specific emotional reaction. In adopting such a perspective, we note that scholars have disagreed on the duration of emotional experience, with some stating that

emotions are very brief (e.g., Watson, 2000), others asserting that emotions “can last for long periods of time” (Weiss & Cropanzano, 1996: 18), and still others suggesting that emotions can eventually develop into moods (e.g., Frijda, 1994). Although we use the label *emotion* when referring to the affective experiences that follow a poor night of sleep, in doing so, we are focusing primarily on the distinguishing feature of emotions that they are a reaction to a specific event.

Of the numerous emotions that individuals are capable of experiencing, which should be examined in relation to insomnia? To determine this, we draw from Watson’s (2000) hierarchical structure of affect. Watson (2000) described affect along two levels. The first, upper level distinguishes affect according to valence, resulting in two broad dimensions (positive affect and negative affect). The second, lower level specifies various emotions that are related to the broad dimensions yet are distinct from one another. At this lower level, fatigue and attentiveness appear to be natural outcomes of insomnia, and thus it is important to include them in a study of affective reactions to sleep. However, to what extent are other, less apparent affective states affected by insomnia? For example, do individuals actually become angry or less happy as a result of a poor night of sleep? As we elaborate upon in the subsequent sections, the emotions of hostility and joviality may also be influenced by insomnia.

We define fatigue as representing feelings of sluggishness and tiredness (Watson, 2000). Although fatigue is not one of the basic negative emotions according to Watson (2000), it tends to be positively correlated with the broad dimension of negative affect and negatively correlated with positive affect. In contrast to fatigue, hostility does represent one of the basic negative emotions. Barefoot (1992) defined hostility as the experience of anger and disgust. The final two emotions of focus here are considered by Watson (2000) to be components of positive affect. The first, joviality, refers to feelings of happiness and enthusiasm. The second, attentiveness, refers to feelings of alertness and concentration. Although fatigue and attentiveness may be more accurately labeled as states rather than emotions, they fit our working definition of emotion in that they can be affective reactions to a specific event. Thus, we refer to fatigue and attentiveness as emotions throughout the article in accordance with Watson (2000), although we acknowledge that such states tend to fall outside the domain of “basic” emotions such as anger, happiness, fear, and pride (see Ekman & Davidson, 1994).

Job Satisfaction

Hulin and Judge (2003: 259) defined job satisfaction as follows:

Job satisfactions are multidimensional psychological responses to one’s job. These responses have cognitive (evaluative), affective (or emotional), and behavioral components. Job satisfactions refer to internal cognitive and affective states accessible by means of verbal—or other behavioral—and emotional responses.

Although Hulin and Judge noted that past research has tended to consider job satisfaction “as a stable individual difference variable” (2003: 260), they argued that within- and between-variation can coexist as sources of substantive variance (see Fleeson, 2004, for a similar

argument on personality). Thus, we view job satisfaction as both a stable characteristic that varies across individuals and one that also displays within-individual variability.

Development of Hypotheses

Within-Individual Effects of Insomnia

Although it is known that sleep serves restorative functions, particularly for the brain (Horne, 1988), it is less understood how sleep affects emotions and attitudes. Existing empirical evidence suggests a link between sleep and affect. A meta-analysis by Pilcher and Huffcutt (1996) found that mood was more adversely affected by sleep deprivation than either cognitive or motor performance. Interestingly, the effect of sleep deprivation on mood was stronger for short-term (i.e., less than 5 hours in a 24-hour period) than long-term sleep deprivation. However, the effect of sleep deprivation on specific affective states was not examined, nor was insomnia. On this point, between-individual studies by Pilcher et al. (1997) and Pilcher and Ott (1998), in samples of undergraduates, revealed that poor sleep quality (an indicator of insomnia) was associated with greater fatigue and anger, as well as reduced feelings of well-being. Similar results were also found by Lavidor, Weller, and Babkoff (2003), who reported that sleep problems predicted fatigue in a sample of adults, and by Akerstedt (1988), who found that insomnia was positively related to fatigue in a sample of nightshift workers.

Although the above studies examined differences in insomnia between individuals, it is also productive to consider insomnia as varying within individuals on a day-to-day basis. Indeed, it is important to note that the use of a within-individual design avoids a potentially serious confound that likely is present in between-individual designs. On this point, Larson and Csikszentmihalyi (1983) referred to a “methodological stalemate” where the extant methodology is poorly suited to address the research question at hand. In the area of workplace affect, as Miner, Glomb, and Hulin commented, the methodological stalemate is that “relations among mood and other workplace variables cannot be addressed adequately using results from surveys conducted at one point in time using a standard between-subjects design. (2001: 2).

For example, we might show that individuals who experience insomnia tend to report more negative emotions, fewer positive emotions, and lower job satisfaction. The problem inherent with such a design—the methodological stalemate—is that many individual differences are plausible third-order variables that might explain the relationships. For example, neuroticism has been related to insomnia (Blagrove & Akehurst, 2001), emotions (Watson, 2000), and job satisfaction (Judge, Heller, & Mount, 2002). Thus, one might infer that insomnia is causing emotions and job satisfaction when, in fact, the relationship is spurious (because of neuroticism). A within-individual design avoids this problem and has the potential to “reveal interesting patterns that may be masked at mean levels” (Scollon, Kim-Prieto, & Diener, 2003: 9).

In this regard, two studies are noteworthy. Totterdell, Reynolds, Parkinson, and Briner (1994) reported that sleep quality was more strongly related to feelings of well-being *after*

sleep than well-being *before* sleep. Brissette and Cohen (2002), in a diary study of adults, found that sleep problems were related to general negative affect but not positive affect the following day. Taken together, the existing research suggests a link between sleep and affect. However, specific emotions and work outcomes have not been examined. Weiss stated, "Discrete emotions need to be studied along with general mood states because such discrete experiences have different effects not captured by simple affective sign" (2002: 2). In addition, it remains unclear *why* insomnia should affect emotions and job satisfaction. In the following, we attempt to explain this phenomenon by drawing from a cognitive perspective and a neuropsychological perspective.

From a cognitive perspective, as noted by Harrison and Horne (2000), studies of sleep deprivation suggest that reduced cognitive functioning is a consequence of sleep loss. According to these authors, although previous approaches to sleep deprivation have argued that simple but not complex tasks are negatively affected by sleep loss, recent evidence suggests that as little as one night of sleep deprivation impairs complex tasks such as decision-making ability (e.g., Harrison & Horne, 1999) and ability to control one's emotions (e.g., Pilcher & Huffcutt, 1996). Moreover, Totterdell et al. (1994) suggested that sleep loss causes decreased motivation and thus more difficulty in maintaining performance levels. Supporting this assertion is neuropsychological evidence that the prefrontal cortex, which is responsible for flexible thinking, as well as directing, sustaining, and focusing attention on a given task (see Miller & Cohen, 2001, for a review), is one of the first regions of the brain to suffer as a result of sleep deprivation (Petiau et al., 1998). Although individuals may be aware of cognitive decrements as a result of poor sleep, they may be unable to do anything about it despite trying harder (Dinges & Kribbs, 1991).

It stands to reason that if insomnia impairs cognitive functioning, individuals will have difficulty completing work tasks and making progress toward their goals. According to Lazarus, "The bottom cognitive line that must prevail for an emotion to occur is that a goal is judged at stake in the encounter" (1994: 211). It follows that insomnia and the cognitive decrements associated with it should elicit emotions to the extent that employees are less able to perform their job duties. Moreover, the emotions that result from insomnia will be difficult to self-regulate, as individuals tend to fail at self-control when recent events have depleted their cognitive resources (Muraven & Baumeister, 2000). Thus, not only should insomnia lead to emotion, but also any emotions elicited following a poor night of sleep will be difficult to control (Pilcher & Huffcutt, 1996) and thus should tend to be experienced rather than suppressed.

According to Frijda (1988), events that facilitate goal attainment lead to positive emotions, whereas events that impede goal attainment lead to negative emotions. We thus predict that although individuals should naturally experience increased fatigue and decreased attentiveness as a result of insomnia, feelings of hostility should also result given that goal obstruction may breed frustration, and frustration contributes to the experience of anger and hostility (e.g., Berkowitz, 1989). In addition, just as negative emotions may increase as a result of insomnia, positive emotions may decrease. Lazarus (1991) suggested that happiness (i.e., joviality) is experienced when one strives and makes progress at work. To the extent that progress is impeded, individuals should feel less jovial after experiencing a poor night of sleep.

Hypothesis 1: Within individuals, insomnia is positively related to hostility (Hypothesis 1a) and fatigue (Hypothesis 1b) and negatively related to joviality (Hypothesis 1c) and attentiveness (Hypothesis 1d).

Although it is reasonable to expect that emotions are a proximal consequence of insomnia, they are not the only relevant outcomes. Specifically, we believe that insomnia will be negatively related to daily variation in job satisfaction. In justifying such an effect, a hierarchy of three questions needs to be answered. First, does job satisfaction vary on a daily basis? Second, is this daily variation, if it exists, predictable (i.e., substantive) or stochastic (i.e., transient measurement error)? Third, if this variation is substantive, what are the theoretical mechanisms that might explain its relationship to insomnia? We consider each of these questions in turn.

First, although this literature is still in its incipient stages, a review of the extant research suggests that a minority—though a substantial minority—of the total variation in job satisfaction is within-individual. Of the available studies (e.g., Fisher, 2000; Ilies & Judge, 2002; Judge & Ilies, 2004; Judge, Scott, & Ilies, 2006; Weiss, Nicholas, & Daus, 1999), it appears that roughly one third of the variance in job satisfaction is within-individual. It is notable that the time frame of most of these studies is relatively short, generally one to three weeks; if the time frame were extended, the within-individual variation would surely increase. Thus, the extant evidence suggests that within-individual variation in job satisfaction not only exists but also is far from trivial.

Regarding the second question—whether diurnal variation in job satisfaction is substantive—research suggests that within-individual variability can be explained by affective states. Fisher (2000) found that positive and negative mood dimensions predicted daily variation in job satisfaction, a finding that was replicated by Judge and Ilies (2004). Ilies and Judge (2002) found that the mood dimension pleasantness (see Larsen & Diener, 1992) predicted job satisfaction. Judge et al. (2006) focused on a negative emotion, finding that state hostility significantly predicted within-individual job satisfaction. Thus, it appears that within-individual variation in job satisfaction varies systematically with positive and negative affective states.

The final question is whether insomnia is one of the factors that can be expected to predict this variation and, if so, what might support that expectation? Assuming that job satisfaction is an attitude composed of affective and cognitive elements (Hulin & Judge, 2003), the most obvious mediator explaining the effect of insomnia on job satisfaction is affect. According to affective events theory (AET; Weiss & Cropanzano, 1996), affective reactions (i.e., emotions) are a cause of work attitudes. Emotions may influence satisfaction judgments via a mood-congruency effect (Rusting & DeHart, 2000). Derived in part from associative network theory (Bower, 1981), the mood-congruency hypothesis stipulates that emotions provide structure to information stored in memory. Specific emotions are represented by particular nodes within a cognitive framework. When a particular node becomes activated as a result of experiencing a given emotion, memories and cognitions consistent with the emotion are activated. Consequently, during positive emotional experiences, pleasant information is activated and retrieved; during negative emotional experiences, unpleasant information is activated and retrieved. This implies that job satisfaction ratings made during the experience of a particular emotion should be influenced by that emotion. Because hostility and, to a

lesser extent, fatigue, tend to be more negatively valenced emotions, and joviality and attentiveness tend to be more positively valenced emotions (Watson, 2000), it follows that hostility and fatigue should be negatively related to job satisfaction, whereas joviality and attentiveness should be positively related to job satisfaction. Moreover, consistent with the prediction of AET (Weiss & Cropanzano, 1996) that affective reactions mediate the relationship between events and job attitudes, emotions should mediate the relationship between insomnia and job satisfaction.

Although we expect that emotional generalization will explain a significant part of the effect of insomnia on job satisfaction, there may be other, more cognitively oriented, pathways as well. According to Motowidlo's (1996) information-processing model of job satisfaction, individuals retrieve evaluative information from memory when making satisfaction judgments. Given that individuals cannot retrieve the population of events and conditions that relate to their jobs, they rely on a sample of such information. If the sample of information is positively weighted, then individuals will evaluate their job favorably. If the sample is negatively weighted, then individuals will conclude that their job is dissatisfying. This suggests that individuals' daily job satisfaction ratings will depend on the valence of information retrieved when forming satisfaction judgments. However, how might insomnia influence this process?

Insomnia should affect daily satisfaction judgments by influencing the sample of events and conditions that individuals retrieve when forming such judgments. Insomnia has been linked to decreased task interest (Kjellberg, 1977), decreased social cooperation (Pasnau, Naitoh, Stier, & Kollar, 1968), and greater job difficulty and lower achievement (Kageyama et al., 1998); the latter may be due, in part, to the impaired cognitive functioning that accompanies insomnia (Harrison & Horne, 2000). Such adverse affects of insomnia are likely to create a greater proportion of negative than positive events throughout one's workday. As a result, individuals should retrieve more negative information than positive information when assessing their jobs, and dissatisfaction should result (Motowidlo, 1996). Between-individual evidence supports a link between sleep problems and job satisfaction (Raggatt, 1991). Although the within-individual effects of insomnia have yet to be examined, given that within-individual variance in job satisfaction has been documented (e.g., Ilies & Judge, 2002), we expect that the relationship between insomnia and job satisfaction occurs on a daily basis, within individuals.

Whereas the above arguments deal with attitude *formation*, our hypothesis involves attitude change (variation in attitudes). How might insomnia be related to attitude change? According to McGuire's (1985) information-processing paradigm, two key processes underlying attitude change are attention, whether an individual notices information that may lead to attitude change, and retention, whether the information is retained in memory (see Eagley & Chaiken, 1993). Insomnia should affect both of these processes. Individuals are less alert and less likely to attend to information when sleep deprived (Schneider, Fulda, & Schulz, 2004), and they are less able to encode such information into working memory (Varkevisser & Kerkhof, 2005). On average, baseline levels of job satisfaction are positive, and individuals tend to experience more positive than negative events in general (Suh, Diener, & Fujita, 1996). It follows that to the extent that insomnia leads individuals to commit fewer positive events to memory, to recall fewer positive memories, and to recall more negative memories (which is likely if insomnia elicits negative emotions), reduced levels of daily job satisfaction should result.

Hypothesis 2: Within individuals, insomnia is negatively related to job satisfaction.

Hypothesis 3: Within individuals, hostility (Hypothesis 3a) and fatigue (Hypothesis 3b) are negatively related to job satisfaction, and joviality (Hypothesis 3c) and attentiveness (Hypothesis 3d) are positively related to job satisfaction.

Hypothesis 4: The emotions of hostility (Hypothesis 4a), fatigue (Hypothesis 4b), joviality (Hypothesis 4c), and attentiveness (Hypothesis 4d) mediate the relationship between insomnia and job satisfaction.

Moderating Role of Gender

Although we predict that insomnia is associated with increased negative emotions and decreased positive emotions, one question arises: For whom will these relationships be stronger?

Given that women and men may react differently to sleep loss (Blatter et al., 2006), it may be that gender moderates the outcomes of insomnia. Women tend to experience emotions more intensely than men and tend to display both positive and negative emotions more frequently than men (for a review, see Brody & Hall, 2002). According to a social role interpretation of gender differences in emotion, women's greater emotional expression and intensity is the result of normative expectations for gender roles in society (Eagly, 1987; Grossman & Wood, 1993). Gender roles for women stipulate that they should be emotionally expressive and nurturing, whereas gender roles for men specify that they should be emotionally restrained and impassive. Alternatively, gender differences in emotion may be explained biologically. A biological interpretation suggests greater reactivity for women because the orbital frontal cortex, which is associated with emotional modulation, is relatively larger in women than in men (Gur, Gunning-Dixon, Bilker, & Gur, 2002).

How might gender affect insomnia-emotion relationships? According to Mischel and Shoda (1998), individual differences affect within-individual relationships such that some relationships are stronger for certain individuals than others. Regarding gender, Grossman and Wood stated, "Women are attributed both greater emotional expressiveness and greater sensitivity to emotional events" (1993: 1010). This implies that women may be more sensitive to a poor night of sleep than men and may respond with greater emotional intensity.

Hypothesis 5: The positive relationships between insomnia and hostility (Hypothesis 5a) and insomnia and fatigue (Hypothesis 5b) and the negative relationships between insomnia and joviality (Hypothesis 5c) and insomnia and attentiveness (Hypothesis 5d) are stronger for women than for men.

Method

Participants

Participants were 51 administrative employees of a large, national insurance company located southeast of the United States. The sample consisted of 36 women and 15 men, and the average age of the sample was 34.9 years old ($SD = 11.8$).

Procedure

A human resource (HR) representative for the company provided access to the organization's employees and agreed to recruit participants for the study. The study was described as an examination of the effects of sleep on workplace attitudes and feelings. We provided the HR representative with a short description of the study, which included an overview and the amount of money that participants would be compensated for their participation (\$50). The HR representative then recruited participants by e-mailing employees the provided study description. Participation was completely voluntary, and participants were assured that their responses would be confidential. Fifty-one individuals signed up for the study.

Corresponding via e-mail, we provided each participant with instructions on how to complete the study. Participants were instructed to go to a Web site containing an informed consent page and links to the online surveys. Eleven participants, though having access to e-mail, did not have Internet access at work and thus completed all of the surveys on paper, including the informed consent. The remaining participants entered their responses into blank fields next to each item in the online survey. Responses were then downloaded each day to a secure database.

The daily survey portion of the study began and ended in February 2005. For 3 weeks, Monday through Friday (15 days total), participants completed a daily survey by logging onto the Web site and following the link to the daily survey. Participants chose and entered a four-digit ID number each time they completed a daily survey in order to maintain confidentiality and anonymity. We used interval-contingent experience-sampling methodology (EMS) (e.g., Ilies & Judge, 2002), whereby a daily e-mail sent by the authors served as a signal to complete a daily survey for that day. The e-mail instructed participants to complete a daily survey "at or near the end of your workday." We chose this phrase to allow for some flexibility in the event that participants could not complete the survey immediately. Time stamps recorded at the time that the survey was submitted verified that the daily surveys were completed as instructed. Participants also had a significant other (e.g., spouse, partner, close relative) complete a survey assessing each participant's job satisfaction by providing their significant other with the link to the study's Web site. Although our primary interest was in explaining within-individual variation in job satisfaction, by aggregating the daily self-reports of job satisfaction and correlating them with the significant-other reports, we were able to provide evidence of convergent validation to an independent report. Internet Protocol (IP) addresses recorded for each survey provided evidence that the significant-other surveys were not completed by the participants themselves.

Given that ESM is more demanding on participants than traditional cross-sectional methodology, 6 participants withdrew from the study. Five of these participants completed the initial demographic information (gender and age), and a comparison of this information to the remaining 45 participants revealed no significant differences. We obtained 550 usable daily responses (scale ratings) out of a possible 675. This corresponds to a response rate of 81.5% across individuals and time periods. On average, participants completed 12 of the 15 possible surveys, with a range of 8 to 15. An examination of the data revealed that there was no day in particular in which participants failed to complete a daily survey, suggesting that the missing surveys were distributed randomly across the 15 days. We obtained complete data from significant others for all 45 participants included in the final sample.

Measures

Insomnia. Insomnia was measured with a scale developed by Jenkins and colleagues (Jenkins, Jono, & Stanton, 1996; Jenkins, Stanton, Niemcryk, & Rose, 1988), with instructions modified to reflect the daily nature of the survey. Each day, participants were asked, "To what extent did you experience the following symptoms last night?" Participants responded to the four statements using a 1-to-5 scale (1 = *to a very small extent*, 5 = *to a very large extent*): "Had trouble falling asleep," "Had trouble staying asleep (including waking up too early)," "Woke up several times during the night," and "Woke up after your usual amount of sleep feeling tired and worn out." The items were averaged so that higher scores indicate greater insomnia. The average coefficient alpha for this scale, across the days of data collection, was $\bar{\alpha} = .79$.

Emotions. We measured hostility, fatigue, joviality, and attentiveness using the Positive and Negative Affect Schedule (PANAS-X; Watson & Clark, 1994). Each day, participants indicated whether they were experiencing each emotion using a 5-point scale with anchors 1 = *very slightly or not at all* to 5 = *very much*. Sample adjectives for hostility included "angry" and "hostile." Adjectives for fatigue included "tired" and "sluggish." Sample adjectives for joviality included "happy" and "joyful." Adjectives for attentiveness included "alert" and "attentive." Scores were calculated by averaging the items for each scale. Average coefficient alphas for each scale, across the days of data collection, were as follows: hostility ($\bar{\alpha} = .82$), fatigue ($\bar{\alpha} = .94$), joviality ($\bar{\alpha} = .96$), and attentiveness ($\bar{\alpha} = .85$).

Job satisfaction. We measured job satisfaction using five items from the Brayfield and Rothe (1951) scale. Each day, participants indicated the extent to which they agreed with each item using a 1 = *strongly disagree* to 5 = *strongly agree* scale. Items were modified slightly to reflect the daily nature of the survey. An example item was, "At this very moment, I am enthusiastic about my work." The average coefficient alpha for this scale, across the days of data collection, was = .86. Participants' significant others also responded to the above job satisfaction measure, with statements modified to refer to the participant (e.g., "Most days he or she is enthusiastic about his or her work"). Coefficient alpha for this scale was $\bar{\alpha} = .93$.

Analyses

We used hierarchical linear modeling (HLM; Byrk & Raudenbush, 1992) to analyze the data. In the current study, the daily measures over time (insomnia, emotions, and job satisfaction) constitute the within-individual level of analysis (Level 1), whereas gender is at the between-individual level of analysis (Level 2). More important, we centered the Level 1 predictors at each individual's mean when testing our hypotheses. This form of "group-mean" centering (Hofmann & Gavin, 1998) removes all between-individual variance from the Level 1 variables, meaning that the within-individual relationships are unconfounded by individual differences. Thus, alternative explanations such as differences in individual response tendencies or personality traits are eliminated when using this form of centering.

Table 1
Correlations Among Variables Both Within and Between Individuals

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1. Insomnia	2.18	0.97	—	.22*	.38*	-.18*	-.17*	-.11*
2. Hostility	1.22	0.49	.17	—	.26*	-.30*	-.09	-.22*
3. Fatigue	2.12	1.13	.49*	.04	—	-.34*	-.38*	-.12*
4. Joviality	2.73	1.02	-.11	-.36*	.03	—	.43*	.27*
5. Attentiveness	3.13	0.85	-.13	-.26	-.23	.63*	—	.16*
6. Job satisfaction	3.47	0.90	-.15	-.48*	-.27	.57*	.44*	—
7. Job satisfaction (other)	3.53	0.96	-.10	-.17	-.11	.41*	.26	.61*

Note: Variables 1 through 6 are within-individual (Level 1) variables, and Variable 7 is a between-individual (Level 2) variable. Job satisfaction ratings marked by "other" were completed by each participant's significant other. Correlations below the diagonal represent between-individual (aggregated) scores ($n = 45$). Correlations above the diagonal were calculated by standardizing the Level 1 hierarchical linear modeling coefficient between one predictor and one criterion ($n = 550$).

* $p < .05$

Results

Correlations

Table 1 presents descriptive statistics and correlations among study variables. Two types of correlations are presented. Those below the diagonal represent between-individual correlations. To correlate the Level 1 variables at the between-individual level of analysis, we first aggregated the Level 1 variables across the 15 days of data collection and then correlated the aggregated results. Those above the diagonal represent within-individual correlations and were necessarily computed only for the Level 1 variables. These correlations were calculated by standardizing the regression coefficients computed from simple regressions in HLM (i.e., between one predictor and one criterion). Of note is the correlation between the aggregated within-individual ratings of job satisfaction and the significant-other ratings of job satisfaction ($\hat{r} = .61, p < .001$). This convergence between independent ratings of job satisfaction suggests that the self-ratings are externally valid. In addition, the mean level of insomnia (2.18) was similar to means reported in existing studies of working adults (e.g., Greenberg, 2006; Raggatt, 1991; Totterdell et al., 1994), suggesting that our sample was typical in terms of insomnia.

Partitioning of Variance Within and Between Individuals

Before testing our hypotheses, we first examined the amount of within-individual variance in our dependent variables. To partition the variance of each variable into between- and within-individual components, we analyzed null models for each Level 1 outcome variable. In HLM, the null model is simply a regression of the dependent variable at the within-individual level of analysis with no Level 1 or Level 2 predictors. Results revealed that a

Table 2
HLM Results of Regressing Emotions on Insomnia

	Unstandardized Coefficient	Standard Error	T Value	Standardized Coefficient
Outcome: Hostility				
Intercept (β_0)	1.22	.04	34.60*	—
Insomnia (β_1)	.11	.04	3.19*	.22
R^2	.137	—	—	—
Outcome: Fatigue				
Intercept (β_0)	2.12	.11	19.26*	—
Insomnia (β_1)	.45	.05	8.34*	.38
R^2	.182	—	—	—
Outcome: Joviality				
Intercept (β_0)	2.73	.12	22.97*	—
Insomnia (β_1)	-.19	.05	-4.16*	-.18
R^2	.093	—	—	—
Outcome: Attentiveness				
Intercept (β_0)	3.13	.09	34.60*	—
Insomnia (β_1)	-.14	.03	-4.68*	-.17
R^2	.031	—	—	—

Note: Insomnia scores were centered at individuals' means to eliminate between-individual variance. β = Level 1 regression coefficients (within-individual estimates); R^2 = Level 1 variance explained by predictors ($n = 550$); HLM = hierarchical linear modeling.

* $p < .05$

substantial percentage of the variance in each outcome was within-individual: hostility (82.6%), fatigue (59.7%), joviality (39.6%), attentiveness (51.9%), and job satisfaction (21.6%). These results suggested that HLM was appropriate for the data, and thus we proceeded with hypothesis testing.

Tests of Hypotheses

Main effects. To test our hypothesized main effects (Hypotheses 1-3), we regressed each Level 1 outcome on the appropriate individual-mean-centered predictor(s). In Hypothesis 1, we predicted that, within individuals, insomnia is positively related to hostility and fatigue and negatively related to joviality and attentiveness. Table 2 displays the results of the four HLM regressions of insomnia on each emotion. Both unstandardized (B) and standardized (β) estimates are presented to facilitate comparison, although we report only standardized effects in the text to follow. Supporting Hypothesis 1a, insomnia was positively related to hostility ($\beta_1 = .22, p < .05$) and explained 13.7% of the within-individual variance in hostility. Supporting Hypothesis 1b, insomnia was positively related to fatigue ($\beta_1 = .38, p < .05$), explaining 18.2% of the within-individual variance. Insomnia was also associated with feelings of less joviality ($\beta_1 = -.18, p < .05$) and less attentiveness ($\beta_1 = -.17, p < .05$), supporting Hypotheses 1c and 1d, respectively. Insomnia explained 9.3% of the within-individual

Table 3
HLM Results of Regressing Job Satisfaction on Insomnia and Emotions

	Unstandardized Coefficient	Standard Error	T Value	Standardized Coefficient
Model 1 (direct effects)				
Intercept (β_0)	3.47	.12	29.06*	—
Insomnia (β_1)	-.10	.03	-3.56*	-.11
R^2	.043	—	—	—
Model 2 (direct effects)				
Intercept (β_0)	3.47	.12	29.06*	—
Hostility (β_1)	-.31	.07	-4.31*	-.17
Fatigue (β_2)	-.02	.02	-0.72	-.02
Joviality (β_3)	.11	.04	3.24*	.13
Attentiveness (β_4)	.09	.03	2.77*	.09
R^2	.334	—	—	—
Model 3 (mediated model)				
Intercept (β_0)	3.47	.12	29.07*	—
Insomnia (β_1)	-.05	.03	-1.77	-.05
Hostility (β_2)	-.30	.07	-4.13*	-.16
Fatigue (β_3)	-.01	.03	-0.22	-.01
Joviality (β_4)	.12	.03	3.53*	.13
Attentiveness (β_5)	.09	.03	2.78*	.09
R^2	.366	—	—	—

Note: All Level 1 predictors were centered at individuals' means to eliminate between-individual variance. β = Level 1 regression coefficients (within-individual estimates); R^2 = Level 1 variance explained by predictors ($N = 550$); HLM = hierarchical linear modeling.

* $p < .05$

variance in joviality and 3.1% of the within-individual variance in attentiveness. Taken together, these results provide support for Hypothesis 1.

In Hypothesis 2, we predicted that, within individuals, insomnia is negatively related to job satisfaction. Supporting Hypothesis 2, as shown in the top panel of Table 3, insomnia was indeed associated with reduced job satisfaction ratings ($\beta_1 = -.11$, $p < .05$) and explained 4.3% of the within-individual variance in job satisfaction. In Hypothesis 3, we predicted that, within individuals, hostility and fatigue are negatively related to job satisfaction, and joviality and attentiveness are positively related to job satisfaction. The middle panel of Table 3 demonstrates that, of the negative emotions, hostility was negatively related to job satisfaction ($\beta_1 = -.17$, $p < .05$), supporting Hypothesis 3a; however, the results for fatigue did not reach significance ($\beta_2 = -.02$, *ns*). As for the positive emotions, both joviality ($\beta_3 = .13$, $p < .05$) and attentiveness ($\beta_4 = .09$, $p < .05$) were positively related to job satisfaction, supporting Hypotheses 3c and 3d, respectively. Together, the emotions explained 33.4% of the within-individual variance in job satisfaction.

Mediating effects. In Hypothesis 4, we predicted that emotions mediate the relationship between insomnia and job satisfaction. To test this hypothesis, we regressed the within-individual

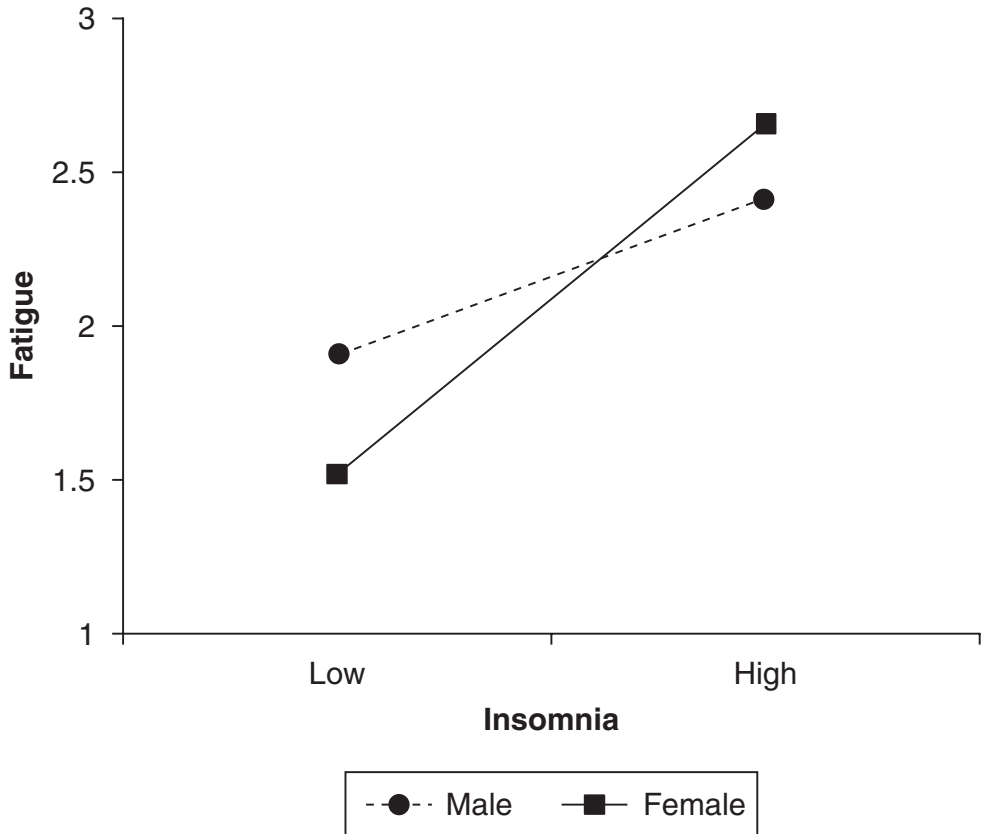
ratings of job satisfaction on the four emotions (hostility, fatigue, joviality, and attentiveness) and insomnia and then compared the regression coefficient for insomnia controlling for the four emotions to the regression coefficient for the direct effect of insomnia on job satisfaction (shown in the top panel of Table 3). According to Baron and Kenny's (1986) approach, mediation is supported if the regression coefficient, controlling for the mediators, is no longer significant. As shown in the bottom panel of Table 3, when the four emotions were entered along with insomnia into the regression equation predicting job satisfaction, the effect of insomnia became nonsignificant ($\beta_1 = -.05$, *ns*). A comparison of the direct effect of insomnia on job satisfaction ($\beta_1 = -.11$) to the effect controlling for the four emotions ($\beta_1 = -.05$) suggests that approximately 54.5% of the within-individual effect of insomnia on job satisfaction was mediated by the emotions. That is, because the addition of the emotions reduced the effect of insomnia on job satisfaction by $-.06$ ($-.11 - .05$), 55.4% ($-.06/-.11$) of the within-individual effect of insomnia on job satisfaction was mediated by the emotions.

Although the above results demonstrate that emotions mediated the relationship between insomnia and job satisfaction, we were interested in determining which emotions in particular were responsible for the effect. As noted above, the nonsignificant results for the relationship between fatigue and job satisfaction imply that the remaining emotions transmitted the effects of insomnia to job satisfaction. To explore this possibility, we conducted Sobel (1982) tests for hostility, joviality, and attentiveness (for details, see MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Results revealed significant indirect effects of insomnia on job satisfaction through hostility ($p < .05$), joviality ($p < .01$), and attentiveness ($p < .05$), supporting Hypotheses 4a, 4c, and 4d, respectively.

Moderating effects. In Hypothesis 5, we predicted that gender moderates the relationships between insomnia and (a) hostility (Hypothesis 5a), (b) fatigue (Hypothesis 5b), (c) joviality (Hypothesis 5c), and (d) attentiveness (Hypothesis 5d). To test these hypotheses, we entered gender at Level 2 as a predictor of the intercept and slope of the Level 1 relationship between insomnia and each emotion. Gender was a significant predictor of the insomnia-fatigue slope ($\gamma_{11} = .35$, $p < .05$), the insomnia-joviality slope ($\gamma_{11} = -.17$, $p < .05$), and the insomnia-attentiveness slope ($\gamma_{11} = -.20$, $p < .05$). However, gender did not significantly predict the insomnia-hostility slope ($\gamma_{11} = -.13$, *ns*). Plots of the significant interactions are shown in Figures 1, 2, and 3, and they illustrate that the within-individual relationship between insomnia and each emotion was stronger for women than for men, supporting Hypotheses 5b, 5c, and 5d, respectively.

Additional analyses. Given the positive relationship between insomnia and sleep duration (Pilcher et al., 1997), we also measured the number of hours that participants slept each night using the sleep duration item from the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Each day, participants responded to the following question: "How many hours of actual sleep did you get last night? (This may be different from the number of hours that you spent in bed)." The within-individual correlation between insomnia and the sleep duration measure was $-.44$ ($p < .05$), supporting the validity of the insomnia scale. Although number of hours slept likely contributes to and is a part of insomnia, we tested our hypotheses controlling for sleep duration. The results for insomnia remained significant and were virtually identical controlling for sleep duration. In addition,

Figure 1
The Moderating Effect of Gender on the Within-Individual Relationship Between Insomnia and Fatigue

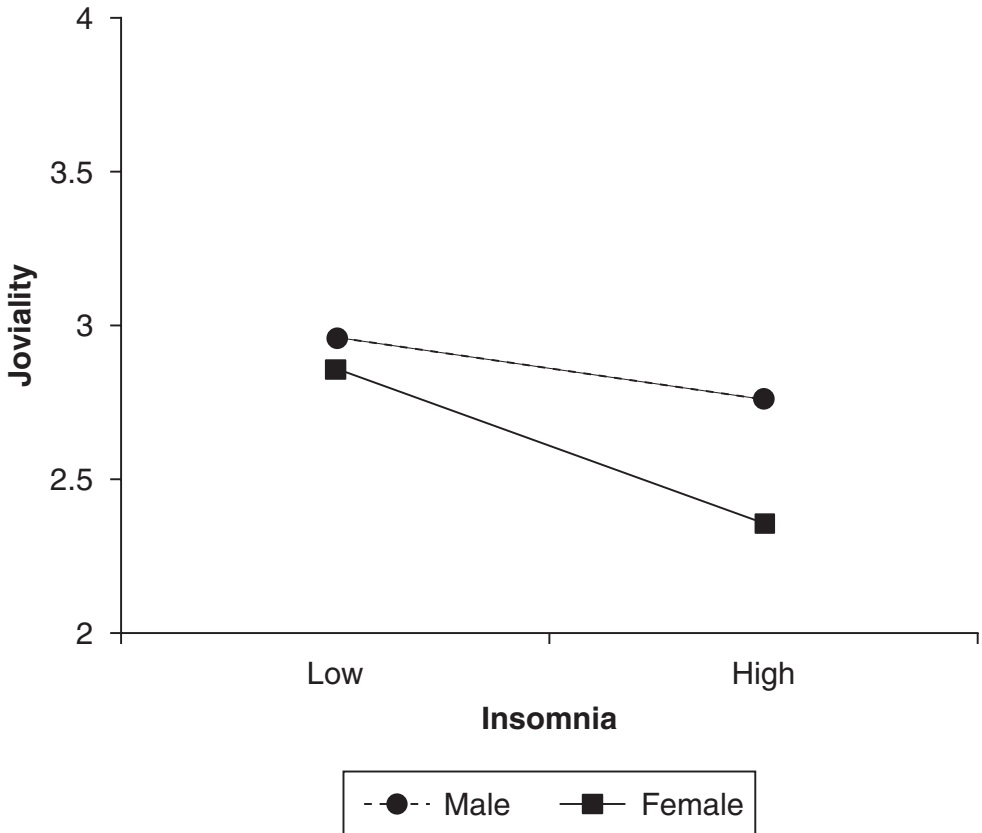


although we predicted that insomnia would affect emotions the following day, it is also possible that emotions on a given day might affect insomnia the following night. To explore this possibility, we conducted a lagged analysis in HLM by regressing insomnia ratings on lagged (previous day) emotions. Consistent with the findings of Totterdell et al. (1994), no significant results emerged.

Discussion

Considering that declines in sleep quality and quantity among Americans have been documented (National Sleep Foundation, 2005), and individuals spend a large portion of their waking hours at work, it is surprising that so little study has been devoted to sleep in

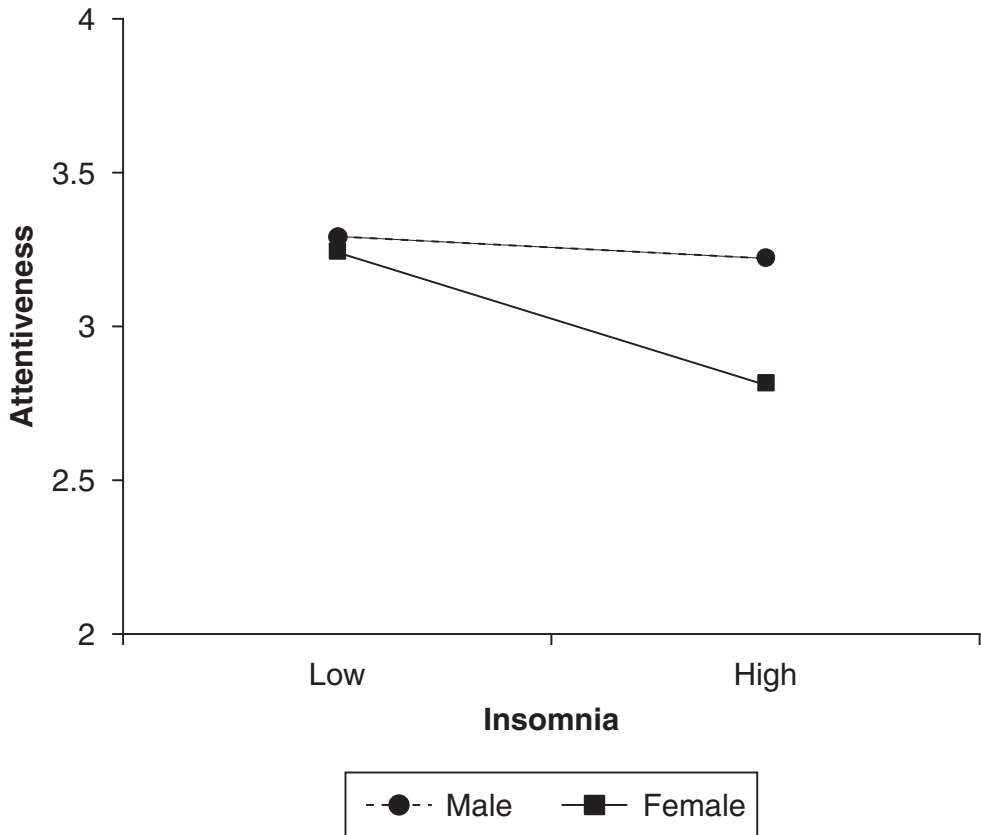
Figure 2
The Moderating Effect of Gender on the Within-Individual Relationship
Between Insomnia and Joviality



organizational behavior research. We attempted to address this void in the literature by examining the effects of insomnia on employee emotions and job satisfaction. Moreover, we used a within-person, ESM design that allowed us to show that the effect of insomnia on emotions and job satisfaction is valid and not confounded with individual differences.

At the within-individual level, results revealed that insomnia the previous night has a contributory effect on negative emotions at work (hostility and fatigue), has a dampening effect on positive emotions at work (joviality and attentiveness), and these emotions appear to explain the negative impact of insomnia on daily reports of job satisfaction. Interestingly, the effects of insomnia were stronger for negative emotions than positive emotions—results that are in accordance with the findings of Gable, Reis, and Elliot (2000), who found that negative events were more strongly related to negative affect than positive affect, whereas

Figure 3
The Moderating Effect of Gender on the Within-Individual Relationship
Between Insomnia and Attentiveness



positive events were more strongly related to positive affect than negative affect. According to Gable et al. (2000), negative events may activate the behavioral inhibition system, leading to increases in negative affect, whereas positive events may activate the behavioral activation system, leading to increases in positive affect.

Our results also revealed gender differences in emotional reactivity to insomnia. Consistent with evidence on emotions, women's fatigue, joviality, and attentiveness were more affected by insomnia than were men's, with the moderation results slightly stronger for fatigue and attentiveness. Given that fatigue and attentiveness have strong arousal components (e.g., Larsen & Diener, 1992), it could be that these states are more affected by a poor night of sleep in women because women, compared with men, tend to assume a greater share of the workload at home (e.g., Stapinski, 1998). That is, because of inequality in the division of household labor, women who experience insomnia may be unable to sufficiently recover

from effort expenditure and as a result may experience a marked decrease in arousal the following day compared with men.

Regarding the nonsignificant finding for hostility, whereas some studies have shown that women express more anger than men, others have revealed no differences or have shown men to convey anger more than women (Brody & Hall, 2000). It may be that because hostility is not socially normative for women (Lerner, 1980), women may attempt to suppress displays of hostility more than men. In contrast, men may display hostility more often than women, perhaps in an attempt to attain or convey social status positions (Tiedens, 2001).

Our results also contribute to recent research demonstrating that job satisfaction contains both a relatively stable, attitudinal component and a more transient, affective component (Fisher, 2000; Ilies & Judge, 2002; Judge & Ilies, 2004; Judge et al., 2006; Weiss et al., 1999). Specifically, 21.6% of the total variation in job satisfaction was within-individual, which supports the affective component of job satisfaction. However, this necessarily implies that the remaining 78.4% of the total variation in job satisfaction was between-individual, which supports the stable, attitudinal component of job satisfaction. The strong correlation between the aggregated daily reports of job satisfaction and the significant-other ratings of job satisfaction augments the above results. That is, aggregating 3 weeks of daily reports should provide a good estimate of participants' general levels of job satisfaction, and the correlation of .61 with the significant-other report (also a measure of participants' general job satisfaction levels) reflects this. Although the majority of the variance in job satisfaction was between individuals, a substantial amount of variation existed within individuals, and this variation was predicted by insomnia and emotions. As Fleeson noted, "Within-person variability is not a threat but an opportunity" (2004: 83). Our results support this notion and suggest that within- and between-individual approaches are not in conflict but rather are both needed to advance our understanding of individual attitudes and behavior.

Implications

Our results have practical implications for individuals and organizations. For individuals, research suggests that sleep quality may be improved by focusing on factors such as exercise, limiting consumption of caffeine and alcohol, and improving sleeping habits (Morin, Culbert, & Schwartz, 1994). Employers could facilitate some of the above factors, such as exercise, via company-supported wellness programs (Erfurt, Foote, & Heirich, 1992). However, individuals can only do so much to reduce insomnia, and thus organizations should attempt to reduce factors that may lead to poor sleep quality. For example, organizations could provide flexible work schedules and reduce stressors, such as extensive overtime, in order to decrease insomnia and promote recovery following exertion at work (Sonnentag, 2003). Regarding the notion of stressors, a recent study by Greenberg (2006) examining insomnia as a dependent variable found that managers who engaged in fair interpersonal treatment after a pay cut improved sleep quality in a sample of nurses, suggesting that training managers to be fair may also reduce insomnia.

Implementing the above practices may have implications for a number of outcomes. For example, given that negative emotions have been linked to workplace deviance (Judge et al., 2006), organizational interventions that reduce insomnia (and the negative emotions that result)

may aid in preventing such acts from occurring in the workplace. Also, given the link between insomnia and negative emotions, organizational practices that help reduce insomnia may decrease emotional exhaustion, especially for service employees, who may experience strain as a result of displaying positive emotions when they are feeling otherwise (Grandey, 2003).

Limitations and Directions for Future Research

By typical between-individual design standards, our sample size was not large. There are two concerns with a small sample size. First, small sample sizes generate low statistical power, meaning that one is more likely to conclude (falsely) that no relationship exists when, in fact, one truly does. This issue is of no particular concern here because nearly all of the statistical tests were based on within-individual relationships, where the number of observations ($N = 550$) was more than adequate. The other concern with a small sample size is generalizability: Results from small samples are less likely to replicate because of second-order sample error (Hunter & Schmidt, 2004). On this front, too, because most of the results were based on pooled within-individual relationships, the degree of second-order sampling error may be reduced.

Another limitation is that we did not have objective measures of insomnia. Although objective measures of sleep duration, episodes of waking during the night, and amount of REM sleep would certainly be advantageous, the only way to collect such measures would be in the context of an off-site, clinical setting. Given that we were interested in examining the effects of insomnia in a working sample of employees, collection of such measures was not feasible. However, subjective reports of insomnia have been shown to correlate strongly with more objective measures such as polysomnographic reports (Tepas & Mahan, 1989).

The data in the study used to test our hypotheses were self-reported. Given the within-individual nature of the study and the nature of the constructs, there was little practical alternative. However, several concerns applicable to between-individual studies when using self-report measures are eliminated in the current design. First, because each variable in the within-individual analyses was centered at each individual's mean (Hofmann & Gavin, 1998), many of the usual problems with self-reported data such as personality confounds or response-set tendencies (Judge & Ilies, 2004) are ruled out. In fact, one response bias, transient affect or emotion, is a valid source of variance that is of interest and is captured by the current design. Second, according to Robinson and Clore (2002), online emotion reports (i.e., reports of current feelings), such as the type used in the current study, are not subject to the same biases as retrospective reports (e.g., beliefs about one's emotions beliefs about how certain situations are likely to influence one's emotions), suggesting that participants rated their emotions each day on the basis of what they were currently feeling rather than what they thought they should be feeling. Finally, the strong relationship between the significant-other ratings and aggregated self-ratings of job satisfaction provides evidence that the self-ratings of job satisfaction were valid.

In addition, although participants completed the reports of insomnia in reference to the previous night (which implies that insomnia leads to emotions), because our measures of insomnia, emotions, and job satisfaction were completed at the same point in time each day, it is possible that emotions experienced on a given day caused the subjective reports of insomnia. Ideally, the reports of insomnia would have been collected as soon as participants

arrived to work in order to separate them temporally from the reports of emotions and job satisfaction. Unfortunately, given that employees were asked to complete a total of 15 surveys during work hours, our agreement with the participating organization limited us to one survey per day in order to be as unobtrusive as possible. However, we note that, consistent with previous research (Totterdell et al., 1994), emotions were not significantly related to reports of insomnia the following night, suggesting that insomnia leads to emotions.

Although we examined emotions as process variables linking insomnia to job satisfaction, we did not include mediators of the relationships between insomnia and emotion. We hypothesized that insomnia impedes goal attainment, which in turn elicits negative emotions and suppresses positive emotions. Alternatively, it could be that insomnia depletes regulatory resources essential for effective cognitive functioning and self-control at work. On this point, research has shown that individuals who do not sufficiently recover from working have greater difficulty concentrating on subsequent tasks (Krueger, 1989), are less engaged at work (Sonnentag, 2003), and withdraw from present task demands (Westman & Etzion, 2001). Such effects may be due to a decrease in one's ability to engage in self-control, which is impaired when recent demands have drained cognitive resources (Muraven & Baumeister, 2000). Future researchers should directly measure the process variables that link insomnia to emotions.

Given that we focused on work-related variables associated with insomnia, we are unable to rule out the possibility that home-related factors influenced our results. As noted by a reviewer, it is possible that people who have trouble sleeping have more difficulties at home, which lead to negative emotions experienced at work—an interpretation consistent with findings that emotional spillover can occur from one domain to another (Edwards & Rothbard, 2000). In addition, although we treated insomnia as an independent variable, insomnia could also be examined as a dependent variable (e.g., Greenberg, 2006). Future research could thus investigate factors at work and at home that influence insomnia, both between and within individuals.

We chose a 3-week interval in which to study insomnia because such an interval afforded a sufficient number of observations per person while still being within a reasonable time period. Given the intensity of data collection efforts in a daily ESM design, we do not imagine it is feasible to increase the temporal length of the study, particularly in field settings where gaining access to an organization for extended periods of time is difficult. However, if it were feasible, it might be interesting to study insomnia over a period longer than 3 weeks by, for example, collecting observations once or twice per week. This would allow investigation of the degree to which individuals adapt to chronic insomnia or, conversely, the degree to which prior episodes of insomnia take a cumulative toll on employees. Such research would fit well with Sonnentag's (2003) suggestion that sleep quantity and quality likely affect the degree to which individuals are able to recover from exerting effort at work on a daily basis.

In addition, future researchers could examine behavioral outcomes of insomnia. For example, it may be that organizational citizenship behaviors (Smith, Organ, & Near, 1983), because of their discretionary nature, are the first aspects of performance to suffer as a result of insomnia. Likewise, to the extent that insomnia elicits negative emotions and hinders the ability of individuals to engage in self-control, counterproductive behaviors (Sackett & DeVore, 2001) may increase. Moreover, given the relatively weak effect of insomnia on job

satisfaction, other, more proximal outcomes, such as workplace safety, stress, and health should be examined, as these may be affected by insomnia.

Finally, we note that it is likely that one of the reasons Americans are getting less sleep is the growth in dual-career couples. Although technological innovations have, to some degree, lessened the hours required for "household production" (Becker, 1981), there are limits to the degree to which employees can or wish to reduce their involvement in many household and child-rearing activities. With both partners working, the hours that in the past were devoted to one's personal life must now be devoted to work, meaning that sleep is often sacrificed (Bastien, Vallières, & Morin, 2004). Although the literature on work-family conflict has made considerable strides (see Kossek & Lambert, 2005), one area conspicuously absent from this literature is that of sleep. It would be interesting for future research to extend the results presented herein by focusing on the role of insomnia as both an outcome of familial responsibilities and as a source of work-family conflict.

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