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Does Sleep Help or Harm Managers' Perceived Productivity? Trade-offs Between Affect and Time as Resources

Gordon M. Sayre[1], **Alicia A. Grandey**[2], **David M. Almeida**[3]

[1]Department of Organizational Behavior, emlyon Business School

[2]Department of Psychology, Pennsylvania State University

[3]Department of Human Development and Family Studies, Pennsylvania State University

Abstract

Managers often do not get the recommended amount of sleep needed for proper functioning. Based on conservation of resources (COR) theory, we suggest that this is a result of sleep having both resource gains (improved affect) and losses (less time) that compete to determine managers' perceived productivity the next day. This trade-off may, in turn, determine the amount of investment in sleep the next night. In a diary study with hotel managers, we found support for sleep as resource loss. After nights with more sleep than usual, managers reported *lower* perceived productivity due to fewer hours spent at work. In fact, for every hour spent sleeping, managers reported working 31 minutes, 12 seconds less. Further, when perceived productivity is reduced managers withdraw and conserve their resources by getting more sleep the next night (12 minutes, 36 seconds longer for each scale point decrease in perceived productivity), consistent with COR loss spirals. Exploratory analyses revealed that sleep has a curvilinear effect on affect, such that too little or too much sleep is not beneficial. Overall, our study demonstrates the often-ignored trade-offs of sleep in terms of affect and work time, which has downstream implications for managers' perceived productivity.

Keywords

Sleep; Conservation of Resources Theory; Perceived productivity

> "You have to live on this twenty-four hours of daily time. Out of it you have to spin health, pleasure, money, content, respect, and the evolution of your immortal soul."
>
> --Arnold Bennett, *How to Live on 24 Hours a Day*

Getting enough sleep is a critical way to maintain employee health and happiness (see Barnes, 2012; Gaultney & Collins-McNeil, 2009; Gordon, Mendes, & Prather, 2017 for reviews). Despite the accumulation of evidence and increasing media attention regarding the importance of sleep (e.g., Bharanidharan, 2018; Burnett, 2018; Jaffee, 2018), over 30% of Americans are averaging six hours or less of sleep in a given night (Luckhaupt, Tak, & Calvert, 2010)—below the recommended seven to nine hours for adults (Hirshkowitz et al.,

Correspondence concerning this article should be addressed to Gordon M. Sayre, Department of Organizational Behavior, emlyon Business School, 23 Avenue Guy de Collongue, 69134 Ecully, France. sayre@em-lyon.com.

2015). Employees who get sufficient sleep are less irritable, depressed, fatigued and more satisfied with their jobs than those who sleep less (Gordon et al., 2017; Konjarski, Murray, Lee, & Jackson, 2018; Litwiller, Snyder, Taylor, & Steele, 2017), suggesting affective resources are gained when we invest in sleep.

Yet, as the opening quote illustrates, time is a finite resource—such that time spent sleeping necessarily means less time for other activities, such as getting work done, spending time with family, or pursuing a hobby (Barnes, Wagner, & Ghumman, 2012). In short, we propose that sleep may have both resource gains (to affect) and losses (to work time), resulting in countervailing effects. We suggest that this trade-off may represent one reason why individuals are not sleeping for the recommended seven to nine hours. Sleep time is most often exchanged with *work* time (Basner, Spaeth, & Dinges, 2014), especially for managers and professionals with flexible hours and frequent role overload—who may also be pressured from supervisors to sacrifice sleep (Barnes, Awtrey, Lucianetti, & Spreitzer, 2020). As such, we focus specifically on work time as one resource that is lost if managers sleep more, which may hinder managers' productivity—providing insight into why they do not invest in sleep as the research suggests they should.

Our aim is to better understand how sleep impacts workday energy resources, including whether such an investment "pays off" by improving affect, or has hidden costs to work time and perceived productivity. Most sleep research focuses on how sleep benefits employees, with few studies recognizing any costs associated with sleep (Barnes, 2012). Yet, the direct relationship between sleep and job performance is weak—suggesting there may be both resources gained and lost through sleep (Hietapakka et al., 2013; Litwiller et al., 2017). In line with COR, we propose that increasing sleep hours results in certain types of resource gains (i.e., work affect) but other types of resource losses (i.e., work time), with downstream implications for perceived productivity that day and future resource investment in sleep (Hobfoll, 1989).

Our inquiry makes several important contributions to the literature. From a theoretical perspective, we are able to test fundamental and dynamic tenets of COR that are often overlooked in the literature (Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014; Lim, Tai, Bamberger, & Morrison, 2019). First, we explicitly test the *resource investment principle* of COR (Principle 2; Hobfoll, Halbesleben, Neveu, & Westman, 2018), addressing long-standing critiques by being specific about the resources involved (affect, time) and comparing them as predictors of perceived productivity (Ganster & Perrewé, 2011). This simultaneous comparison allows for an examination of the resource trade-offs involved in sleep, in that sleeping more might result in gains to affective resources but losses to time resources. Second, we test *resource loss spirals* (Corollary 2; Hobfoll et al., 2018), examining nightly sleep as a predictor of next day's resources and perceived productivity with implications for sleep the following night. This approach answers recent calls to study sleep as a reciprocal and ongoing process—a predictor as well as an outcome rather than as *either* a predictor *or* an outcome (Barnes et al., 2012; Gordon et al., 2017; Konjarski et al., 2018). In summary, we engage in theory-building by examining key COR theoretical ideas that have previously been overlooked or inadequately tested.

Empirically, we test COR theory using a daily diary design with eight nightly phone interviews of hotel managers, assessing their prior night's sleep and that day's affect, work time, and perceived productivity. This within-person approach is consistent with COR's emphasis on changes in resources over time (Hobfoll et al., 2018), and allows us to see if sleeping more or less than usual predicts fluctuations in affect, work time, and perceived productivity, while also eliminating individual difference confounds (Bolger & Laurenceau, 2013; Gabriel et al., 2019). Although time-separated measurement occasions are ideal to minimize reporting biases, our daily diary design with one measurement per day was practically feasible for these frequently overloaded hotel managers (Mulvaney, O'Neill, Cleveland, & Crouter, 2007). Importantly, our approach provides a fair comparison of our central question by measuring the two resource mechanisms (i.e., time and affect) at the same timepoint, and we conduct lagged analyses to test the implication of this resource tradeoff in a way that minimizes the concerns about same-day measurement.

In practice, our study assesses the possibility of a dilemma faced by managers—weighing the benefits and costs of sleep for —that is rarely addressed in the sleep literature. If our results support that sleep represents a trade-off between improved affect and reduced time to get work done, it offers one potential reason why so many individuals fail to reach the recommended seven to nine hours of sleep per night (Luckhaupt et al., 2010). Documenting such a trade-off would also call into question traditional intervention approaches that focus on educating employees on the benefits of sleep (Redeker et al., 2019). This tactic may not be enough to change employees' behavior, especially if individuals are sacrificing sleep as a means of enhancing perceived productivity at work. Acknowledging this dilemma is likely to resonate with managers, and fostering flexible work practices while reducing "face time" norms of long work hours (Munck, 2001) may help managers navigate this trade-off as a critical first step for improving sleep habits and health.

Conservation of Resources Theory Applied to Sleep

Conservation of resource theory posits that humans are motivated to attain, protect, and maintain valued resources. Stress is experienced when these resources are threatened, lost, or not gained (Hobfoll, 1989). The definition of a resource has evolved over time to address long-stand criticisms about it being overly vague and all-encompassing (Ganster & Perrewé, 2011; Thompson & Cooper, 2001). While resources have long been categorized as objects (e.g., house, car, tools), conditions (e.g., job status), personal characteristics (e.g., positive self-concept) and energy (e.g., vigor, time, money) (Hobfoll, 1989), they have more recently been linked with goal achievement in an effort to more precisely define resources (Halbesleben et al., 2014). In the current study, we conceptualize affect (more positive and less negative affect) as an energy resource at work, consistent with past research (Hobfoll, 2001; Zellars, Perrewé, Hochwarter, & Anderson, 2006). We also examine *time*, defined as an energy resource that is necessary to acquire other resources (Halbesleben et al., 2014; Halbesleben, Wheeler, & Paustian-Underdahl, 2013; Hobfoll, 2001).

In addition to COR's basic premise about resource threat or loss being stressful, the theory contains a number of additional principles and corollaries. A basic yet often overlooked principle of COR is that people must *invest* resources in order to gain resources (Hobfoll et al., 2018). We explicitly examine this resource investment dilemma for employees, where sleeping more requires the investment of time—simultaneously increasing some resources (e.g., positive affect) while decreasing others (e.g., time for work tasks). In most work contexts, employees need both positive affect (Ilies & Judge, 2005; Ilies, Judge, & Wagner, 2010) *and* time (Major, Klein, & Ehrhart, 2002) in order to remain productive at work, making it unclear how or when the investment of resources in sleep impacts employee performance. In summary, the current study advances COR research by conceptualizing sleep as an activity with both resource gains to work affect and resource losses to work time resulting in countervailing effects, rather than focusing on one type of resource and either a loss or gain effect (Trougakos, Beal, Cheng, Hideg, & Zweig, 2015; Uy, Lin, & Ilies, 2016).

Sleep and Resource Gains

Based on COR, sleeping more on a given day should lead to greater perceived productivity reported by employees because of increases in affective resources. Sleep duration is strongly tied to brain functioning—particularly in the prefrontal cortex (Chee & Choo, 2004), an area responsible for attention and enthusiasm (Franzen, Siegle, & Buysse, 2008; Ochsner & Gross, 2005; Schmitt, Belschak, & Den Hartog, 2017). Getting adequate sleep allows the prefrontal cortex to operate at full capacity compared to less sleep, which impairs its functioning and results in downstream costs like cognitive interference (Chee & Choo, 2004; Lee, Buxton, Andel, & Almeida, 2019). Indeed, sleep has been repeatedly shown to increase resources such as affect (Scott & Judge, 2006; Sin et al., 2017; Sonnentag, Binnewies, & Mojza, 2008) and vigor (Clinton, Conway, & Sturges, 2017; Liu et al., 2017; Schmitt et al., 2017).

These relationships do appear to differ for sleep duration and quality—with sleep quality showing more consistent (Konjarski et al., 2018) and stronger (Litwiller et al., 2017) effects. Our interest in the trade-off between time invested in sleep and time available for work, however, necessitates a focus on sleep *duration* in the current model (see also Barnes et al., 2012). Additionally, the time one spends sleeping is often more controllable than the quality of that sleep, meaning that practical recommendations stemming from the current study can be more impactful. Nevertheless, given the importance of sleep quality and its potential impact on our outcomes, we follow recommendations in the literature to consider both sleep duration and quality (Crain, Brossoit, & Fisher, 2018) by controlling for sleep quality in the current study.

To the extent that sleeping improves affect, employees are likely to feel more efficacious and productive at work—due to the motivational energy and improved interpersonal interactions with coworkers (Halbesleben & Wheeler, 2008; Kaplan, Bradley, Luchman, & Haynes, 2009; Rothbard & Wilk, 2011; Tsai, Chen, & Liu, 2007) and customers (Gosserand & Diefendorff, 2005; Kammeyer-Mueller et al., 2013). When employees get less than recommended amounts of sleep, however, feelings of hostility (Christian & Ellis, 2011), fatigue (Sonnentag et al., 2008), and negative affect are increased (Litwiller et al., 2017; Scott & Judge, 2006) impairing interpersonal and task-directed performance (Barnes, Ghumman, & Scott, 2013; Hietapakka et al., 2013; Litwiller et al., 2017).

Overall, we predict that more time spent sleeping enhances employee affect (i.e., increased positive and reduced negative affect) the following day, subsequently increasing perceived productivity. We control for sleep quality to isolate the gains from the hours invested in sleep, given that sleep quality is largely outside individuals' control.

Hypothesis 1a: Sleep duration is positively related to the next day's positive affect, and negatively related to next day's negative affect.

Hypothesis 1b: Sleep duration has a positive indirect effect on next day's perceived work productivity through improved work affect.

Sleep and Resource Losses

Much like how venture capitalists must *spend money* in order to *make money*, sleeping more requires one to *lose* time resources in order to *gain* affective resources. Given that time is a fixed resource—with only 24 hours in a day—the number of hours that an individual sleeps affects the number of hours available for work, family, or leisure (Barnes et al., 2012). Indeed, research has long highlighted the tensions between work and non-work time given limited hours in a day (Feldman, Reid, & Mazmanian, 2019; Milkie, Mattingly, Nomaguchi, Bianchi, & Robinson, 2004). Evidence suggests that individuals do view time as a scarce resource, particularly those who are paid hourly for their work (DeVoe & Pfeffer, 2007)—and this economic evaluation of time can lead to stress in its own right (Pfeffer & Carney, 2018). This idea of time as a limited resource has also been connected to COR theory, such that uncompensated hours represent resource loss (Toker, 2018). We adopt a similar approach, in that sleep utilizes time resources that cannot be put towards other activities.

Indeed, on days managers sleep more, they might cut back on a wide variety of activities to make up for the time invested in sleep. In the current study, however, we are particularly interested in time spent at work—given how important this is for performance, along with past work demonstrating a close link between sleep and work time (Basner et al., 2014). As such, we focus on the link between sleep duration and work time, but also acknowledge that managers could be borrowing time from other activities as well such that a relationship between sleep duration and work time is not guaranteed. Consistent with our reasoning, however, meta-analytic evidence does show that sleep duration is negatively correlated with the number of hours worked per week (Litwiller et al., 2017). Importantly, this meta-analytic relationship is assessed at the person level unlike the current focus on daily fluctuations in sleep and work time. Our emphasis on within-person relationships helps provide a more accurate assessment of how sleep and work time fluctuate from one day to the next, while simultaneously removing any between-person confounds that might affect findings (Gabriel et al., 2019). Nonetheless, we expect that the more time individuals spend sleeping, the fewer hours they will spend at work the following day.

Importantly, work time is needed to be productive, and the amount of time spent at work is associated with career success, salary, and promotions (Feldman et al., 2019; Ng & Feldman, 2008). The impact of work hours are especially strong in industries with a "face time" norm where working longer hours is a signal of high performance and dedication—as is the case in hotels (Cleveland et al., 2007; Munck, 2001; O'Neill, 2012).

Extended presence at work is also associated with being an "ideal worker", according to many commonly held views (Acker, 1990; Kelly, Ammons, Chermack, & Moen, 2010). Managers and professionals are likely to work longer hours today than in prior decades to be productive (Johnson & Lipscomb, 2006), and sacrificing sleep (e.g., staying up late, waking up early) may be one strategy used by managers to allow more time at work. In short, the more time spent sleeping, the less time individuals will have available to spend at work and maintain productivity. Based on this reasoning, investing in sleep impairs perceived productivity via the reduction in available time at work, leading us to predict:

Hypothesis 2a: Sleep duration is negatively related to next day's work hours.

Hypothesis 2b: Sleep duration has a negative indirect effect on next day's work perceived productivity via work hours.

Sleep Trade-off: Net Gain or Loss for Perceived Work Productivity and Future Sleep

We have conceptualized sleep hours as resulting in both resource gains (to affect) and losses (to time), with implications for one's perceived productivity at work. These countervailing predictions raise questions about whether the gains to affect are worth the required investment of time. In other words, do we see a net gain or loss in perceived work productivity as a result of investing in sleep? According to COR theory's first principle, resource loss should be more salient than resource gain, meaning losses are experienced more immediately and persist for a longer period of time (Hobfoll, 1989; Hobfoll et al., 2018). Based on this reasoning, the loss of work time from sleeping longer should overpower any gains one might experience in terms of affect, resulting in a net loss to perceived work productivity. Though in the long run sleep may be adaptive for health and performance (Barnes, 2012), there may be short-term losses to perceived work productivity the next day, which helps to explain why people sacrifice sleep for work.

Hypothesis 3: The negative indirect effect of sleep on perceived work productivity through work time is stronger than the positive indirect effect through improved affect.

Finally, COR proposes that in addition to any immediate resource gains or losses, the net gain or loss also affects future resource investment (Hobfoll, 1989, 2001; Hobfoll et al., 2018). In the current context, we use the extent of perceived productivity to predict sleep duration the next day. One criticism of COR theory is that it is too vague and hard to falsify (Ganster & Perrewé, 2011), and in this same vein we found that COR theory could be used to generate competing predictions. Perceived productivity is similar to daily self-efficacy, a personal resource that thus can feel plentiful or threatened each day (Hobfoll, 1989). In response to the perception of work productivity, employees are expected to be motivated to protect and conserve existing resources (when threatened) or to invest in gaining more resource (when plentiful). Yet, this motivation leads to competing predictions for how employees' perceived productivity predicts the next night's sleep.

On the one hand, daily perceived productivity may have a negative relationship with sleep, such that on days when there is less perceived productivity than usual, one sleeps more than usual. This argument is based on the idea that longer sleep duration allows the employee to avoid the context where one feels threat (i.e., work; Hobfoll, 2001) and to replenish affective resources via sleep as a way of coping (Hobfoll et al., 2018; Sonnentag, Binnewies, & Mojza, 2010; Sonnentag & Fritz, 2007). Similarly, on days when individuals are more productive than usual, that self-efficacy and engagement may motivate increased work hours (Csikszentmihalyi, 2014) and reduce the need for recovery (Xanthopoulou, Bakker, Oerlemans, & Koszucka, 2017), thus reducing sleep time that night. Overall, this reasoning suggests perceived work productivity should be *negatively* related to that night's sleep duration.

On the other hand, daily perceived productivity may have a positive relationship with sleep, such that on days when employees' feel threatened (i.e., lower perceived productivity at work), they may sleep less than normal—opting to sacrifice sleep and complete work tasks to regain their sense of self-efficacy. In other words, after a day with lower perceived productivity, managers may feel that they must invest time in work and cannot "afford" to invest time in sleep, despite the potential gains in energy (Hobfoll, 2001; Hobfoll et al., 2018). Consistent with this view, lower perceived productivity (i.e., feeling overloaded or having unfinished tasks at work) is related to less time spent sleeping (Litwiller et al., 2017) and greater insomnia (Syrek, Weigelt, Peifer, & Antoni, 2017). Conversely, on days when individuals complete more tasks than normal, they are more able to relax and invest in their personal health (Syrek et al., 2017). This argument is also consistent with the resource gain spirals predicted by COR theory, where those with more resources are more capable of future resource gain (Hobfoll et al., 2018). Overall, this logic suggests that perceived work productivity should be *positively* related to that night's sleep duration.

Given these contrasting explanations and a lack of previous studies to draw on, we propose competing hypotheses about how managers' daily perceived productivity is related to the next day's sleep; whether lower perceived productivity (resource threat) means sleeping more (use sleep to recover resources) or less (sacrifice sleep to spend time at work). Importantly, we control for the previous night's sleep duration which likely has an effect on subsequent sleep (Barnes, 2012; Rupp, Wesensten, Bliese, & Balkin, 2009; Van Dongen, Rogers, & Dinges, 2003), as well as work affect and work time in order to assess the unique effect of perceived productivity on subsequent sleep duration.

> **Hypothesis 4a:** Perceived daily productivity is negatively related to subsequent sleep duration.

> **Hypothesis 4b:** Perceived daily productivity is positively related to subsequent sleep duration.

Methods

Participants and Procedure

The current sample was comprised of hotel department managers who took part in the Hotel Work and Well-Being study (Almeida, Davis, O'Neill, & Crouter, 2012), approved by the Pennsylvania State University Institutional Review Board ("Hotel Work and Well Being: The Penn State Hotel Managers Initiative", #00033318). Hotel managers are responsible for overseeing and directing hotel staff, resolving guest complaints, participating in financial decisions (room rates, budgets, revenue), and coordinating hotel activities (renovations, maintenance issues) (O*NET, 2019). The research team spent over a year (2006 to 2007) recruiting participants and conducting interviews at close to 80 full-service hotels. These hotels were located across the United States, with 48% being in cities, 22% in resort areas, 15% in suburbs, and 15% near major airports. The hotels included were high quality establishments (55% received 3-Diamond rating from AAA, 45% received 4-Diamond) run by major companies, with an average of 700 rooms, 475 employees, and 65 managers each.

This sample of hotel managers was an appropriate test of the two mechanisms by which sleep may impact perceived productivity. Hospitality and tourism industries, such as hotels, require both positive affect and time commitment from employees to be successful (Cleveland et al., 2007; Mulvaney et al., 2007). Pleasant social interactions are central to job expectations (Kim, Shin, & Umbreit, 2007), such that managers who are responsible for the hotel's success may find that sleep is necessary in order to be pleasant and avoid negative interactions. Additionally, hotel managers face round-the-clock work demands, given the 24/7 nature of the hotel industry (Kim et al., 2007) and their supervisory roles that make schedules unpredictable. Managers often report having to come in during time off if an employee fails to show for a shift, or when a maintenance problem occurs (Cleveland et al., 2007; Mulvaney et al., 2007). Furthermore, many hotels have deeply ingrained “face time” cultures, where spending more time at the hotel is equated with higher performance—forcing managers to work long hours to maximize their chances at promotions (Munck, 2001; O'Neill, 2012). Given these challenges, hotel managers are often faced with decisions about whether to sacrifice sleep in order to get work done—making them an ideal sample for the current study.

Our sample was 98 hotel managers recruited from a larger cross-sectional survey (Almeida et al., 2012) to participate in an eight-day daily diary study focused on work and home interactions[1]. The 98 participants who agreed to take part in the study received a phone call on 8 consecutive evenings from trained survey research center personnel using a computer-assisted telephone interview procedure. Calls were made each evening at approximately 7 p.m., and participants were asked a series of questions about the previous night's sleep and their work day. The start date of daily data collection was random, such that “day 1” could be a Monday for Participant A, a Thursday for Participant B, and so on. The 98 hotel managers responded to 648 daily phone interviews (83% response rate). Given that we were only interested in how sleep might impact affect and perceived productivity *at work*, we limited our analyses to work days (N_{Person} = 96; N_{Days} = 455, resulting in an average of 4.74 daily responses per person.

Participants in this final sample of 96 individuals were on average, 38 years old (*SD* = 9.58), worked in their current position for 3.55 years (*SD* = 4.18), and earned $60,288 per year (*SD* = $23,667). Our sample was 52% male, 58% completed a bachelor's degree or higher, 69% were White, 13% were Hispanic, 7% were Black or African American, 5% were Southeast

[1]To test for selection bias, we compared the 98 daily diary participants to the 490 participants from the initial survey study who were eligible but did not complete daily surveys. These two groups did not differ significantly on study variables such as sleep, affect, work hours, and perceived productivity, or demographic variables like income, age, tenure, education.

Asian or Asian American, 3% were South Asian or Asian American, and 3% categorized themselves as "other". In total, 75% of our sample reported being married at some point, and 64% were currently married. Overall, 55% of the sample reported having biological or adopted children, with a median of 2 (*Range* = 1–6)[2].

Measures

Responses were obtained in daily interviews, using shortened or single-item measures for more objective constructs related to time, in order to minimize participant response fatigue (Gabriel et al., 2019; Ohly, Sonnentag, Niessen, & Zapf, 2010).

Sleep duration.—Managers reported their sleep duration the prior night with a single item appropriate for this fairly objective construct ("Since this time yesterday, how much time did you spend sleeping, not including time you may have spent napping?") (Litwiller et al., 2017). Participants were asked to respond by listing how many hours and minutes they spent sleeping.

Work affect.—In order to assess changes in affect as an energy resource, we used items from Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). To capture the idea of energy resource, participants were asked, "How much of the time today did you feel…" "…interested", "…enthusiastic", "…attentive" (i.e., positive affect that supports work functioning), and "…distressed", "…irritable", "…upset" (i.e., negative affect that is counter to work functioning). Given that the current analyses included only work days, this measure captured work-day affect. Responses ranged from "Very slightly/not at all" to "Extremely". The reliability of change estimates (R_C) were calculated to determine how reliable these daily measures could capture change within a person over time, and can be interpreted using similar guidelines to Chronbach's alpha (Cranford et al., 2006; Shrout & Lane, 2012). Results indicated that both positive affect (R_C = .80) and negative affect, (R_C = .79) were reliable indicators of change.

Work time.—Work hours was measured with the item, "Since this time yesterday, how many hours did you spend at work?". Participants were asked to respond by listing how many hours and minutes they spent working. We focused on physical presence at work since the work tasks of hotel managers (e.g., maintenance duties, inventory management, and interpersonal concerns of employees and guests) require them to be present at the hotel.

Perceived work productivity.—Perceived productivity at work was measured by the item "Please rate how much work you got done today, compared to normal", with responses on a 5-point Likert scale ranging from "much less than average" to "much more than average". Similar measures have been used in past work (Rogelberg, Leach, Warr, & Burnfield, 2006), including experience sampling research (Koopman, Lanaj, & Scott, 2016; Rosen et al., 2018), and shown to be negatively related to demands and positively related

[2]While parental status may impact sleep patterns, our within-person relationships remove such between-person confounds and focus on each individual's deviation from their own average (Bolger & Laurenceau, 2013; Gabriel et al., 2019). Though children may impact sleep duration, this should occur randomly and thus reduce sleep duration's ability to predict subsequent resource gain and loss—meaning our design is a conservative test of predictions.

to productive outcomes like job satisfaction, commitment, and transformational leadership behaviors. Furthermore, this item averaged across the eight study days was positively correlated to a baseline single-item measure of global job performance ("How would you rate your job performance over the last year?") ($r = .31$, $p < .01$) providing evidence of convergent validity.

Controls

Importantly, our hypothesized model focuses exclusively on the within-person level of analysis, eliminating the need to control for any stable individual difference which, by definition, cannot affect our results (Bolger & Laurenceau, 2013; Gabriel et al., 2019). In all analyses, we controlled for the *day of the study* to remove systematic trends in responses over the study period, as is recommended in daily diary research (Bolger & Laurenceau, 2013). The current paper is focused on understanding the trade-offs associated with sleep duration, which is a more observable measure (Litwiller et al., 2017) and is more controllable than sleep quality—providing more actionable practical implications. To better isolate the unique effects of sleep duration, we also controlled for *sleep quality* in the current model. This is important given sleep quality's relationship with both sleep duration, affect, and performance (Litwiller et al., 2017). We measured sleep quality with a single item asking participants to, "describe your sleep since this time yesterday", with responses on a five-point Likert scale ranging from "very unsatisfactory" to "very satisfactory".

To determine whether sleep duration specifically affects work time, we also asked participants how much time since the prior assessment they spent on household tasks ("such as cleaning, doing laundry, preparing meals, etc."), personal recovery ("relaxing or doing leisure time activities"), and time with children ("taking care of or doing things with your children"). We directly compare the impact of sleep duration on time spent at work, time on household tasks, and time on personal recovery in the *Sleep as resource loss* section.

Analyses

Given the nested nature of our data (hotel managers responding to repeated daily surveys), we calculated intra-class correlations for the study variables (see Table 1 for details) and found substantial variability at the person level (17–60%), suggesting non-independence of errors[3] and the need for multilevel modeling to account for this non-independence (Bryk & Raudenbush, 1992; Raudenbush, Bryk, & Congdon, 2002). We used multilevel path analysis in Mplus version 8 (Muthén & Muthén, 2017) through the MplusAutomation package (Hallquist & Wiley, 2018) in R version 3.6 (R Development Core Team, 2018) to test the hypothesized model. We also person-mean centered all variables except our study day control and lagged sleep duration outcome to cleanly separate out between and within person effects (Hofmann & Gavin, 1998; Zhang, Zyphur, & Preacher, 2009). As a result,

[3]The 96 managers also came from 36 hotels, such that there was possible non-independence at a third level. We calculated the ICC for our focal variables at the hotel level. As shown in Table 1, a small amount of variance existed at the hotel level in our outcome variables (perceived work productivity and sleep outcome ICC < .001%), thus we proceeded with the more parsimonious two-level analysis (days nested in employees).

no stable trait or between-person construct can confound our relationships (Gabriel et al., 2019).

Consistent with recommendations, we adopted a model-building approach using nested comparisons to determine whether slopes should be specified as fixed or random (Beal, 2015; Bliese & Ployhart, 2002). Results indicated that the model was not improved when any of the slopes were allowed to vary randomly for each individual, thus we kept them fixed in the hypothesized model. Mediational hypotheses were tested using the framework developed by Preacher, Zyphur, and Zhang (2010) for testing a 1-1-1 mediation model with fixed slopes. To test hypotheses regarding the relative strength of indirect effects, pairwise indirect effect contrasts were calculated (Preacher & Hayes, 2008).

Results

Table 2 presents the means, standard deviations, and correlations among study variables. On average, participants reported sleeping 6.62 hours per night, with variability around that average ($SD = 1.37$) showing that managers sleep duration sometimes fell below recommended amounts (Hirshkowitz et al., 2015) suggesting that managers might be sacrificing sleep to get work done. This is particularly true given that managers reported spending 9.55 hours at work on average each day, confirming that managers must often work long hours. The within-person correlation matrix showed mixed support for predictions, in that sleep duration was uncorrelated with affect ($r_{Positive\ Affect} = .04$; $r_{Negative\ Affect} = -.07$) but was negatively correlated with work time ($r = -.26$, $p < .001$). As expected, work time was positively correlated with perceived work productivity ($r = .13$, $p < .01$), which was then negatively correlated with sleep duration the following night ($r = -.13$, $p < .05$). Sleep duration on day t was also negatively correlated with sleep duration on day $t + 1$ ($r = -.15$, $p < .01$), consistent with the notion of sleep debt and compensatory effects of sleep (Barnes, 2012; Rupp et al., 2009; Van Dongen et al., 2003). Below we describe the results from the complete and more rigorous tests of hypotheses. See Figure 1 for hypothesized model and results.

Hypothesis Testing

Sleep duration as resource gain: Work affect.—Hypothesis 1a predicted that sleep improves work affect. As shown in Table 3, sleep duration the night before was unrelated to both measures of affect after controlling for day of the study, sleep quality, and work time (Positive affect: $\Upsilon = -.01$, $SE = .03$, $t = -.33$, $p = .74$, 95% CI [−.06, .04]; Negative affect: $\Upsilon = -.01$, $SE = .02$, $t = -.55$, $p = .59$, 95% CI [−.04, .02]), failing to support Hypothesis 1a. Given this lack of support, Hypothesis 1b, which predicted that affect would mediate the effect of sleep on perceived work productivity, was also unsupported. Overall, sleep hours did not increase perceived work productivity via affect[4].

Sleep duration as resource loss: Work time.—Hypothesis 2a predicted that sleep duration is negatively related to time spent at work the next day. As shown in Table 3, sleep

[4] Omitting sleep quality from the model did not change the relationship between sleep duration and affect, (Positive affect: $\Upsilon = .01$, $SE = .03$, $t = .45$, $p = .66$, 95% CI [−.04, .07]; Negative affect: $\Upsilon = -.02$, $SE = .02$, $t = -1.30$, $p = .19$, 95% CI [−.06, .01]).

duration was negatively related to work time after controlling for day of the study, sleep quality, and affect, ϒ= −.52, *SE* = .15, *t* = −3.42, *p* = .001, 95% CI [−.81, −.22]. For each hour spent sleeping, participants spent, on average, 31 minutes and 12 seconds less time than normal at work. Moreover, work time predicted perceived work productivity, ϒ= .06, *SE* = .02, *t* = 2.88, *p* = .004, 95% CI [.02, .10], and the indirect effect of sleep duration on perceived work productivity through work time was weak but significant, ϒ= −.03, *SE* = .01, *t* = −2.22, *p* = .03, 95% CI [−.06, −.003], supporting Hypothesis 2b that work time explains the link of sleep duration and perceived productivity.

We further tested the assumption behind this prediction by examining whether managers specifically reduced time at work or "borrowed" time from other nonwork domains (Barnes et al., 2012). We tested a model where sleep duration predicted work time, household chore time, personal recovery time, and time with children[5] while controlling for day of the study and sleep quality[6]. We found that sleep duration still significantly predicted work time (ϒ= −.52, *SE* = .15, *t* = −3.49, *p* < .001, 95% CI [−.82, −.23]), and did not predict chore time (ϒ= .07, *SE* = .04, *t* = 1.54, *p* = .12, 95% CI [−.02, .15]), personal recovery time (ϒ= .13, *SE* = .11, *t* = 1.18, *p* = .24, 95% CI [−.09, .35]), or time with children (ϒ= .19, *SE* = .23, *t* = .80, *p* = .42, 95% CI [−.27, .64]). Additionally, the indirect effect of sleep duration on perceived productivity through work time remained significant (ϒ= −.04, *SE* = .02, *t* = −2.32, *p* = .02, 95% CI [−.06, −.01]), while no other indirect effect was. Thus, when managers sleep more than normal, they are more likely to borrow time from work, and not from household chores, personal recovery, or time with children.

We also tested the reverse effect—whether work time, household chore time, personal recovery time, and time with children predicted sleep that night, as measured the following day. None of the time use variables predicted sleep that night (Work time: ϒ= −.10, *SE* = .09, *t* = −1.10, *p* = .27, 95% CI [−.27, .07]; Chore time: ϒ= −.13, *SE* = .13, *t* = −.97, *p* = .33, 95% CI [−.38, .13]; Recovery time: ϒ= .01, *SE* = .06, *t* = .10, *p* = .92, 95% CI [−.12, .13]; Time with children: ϒ= −.03, *SE* = .05, *t* = −.52, *p* = .61, 95% CI [−.13, .08]), suggesting that nonwork demands do not appear to be driving sleep patterns.

Implications of resource gain and loss from sleep.—Hypothesis 3 predicted that the negative indirect effect of sleep duration on perceived productivity through work time (resource loss) is stronger than the positive indirect effects through affect (resource gain). Pairwise indirect effect contrasts (Preacher & Hayes, 2008) showed that the indirect effect via work time was significantly larger than the indirect effect via negative affect [95% CI −.06, −.004], but not compared to the indirect effect via positive affect [95% CI −.06, .001]. This offers partial support for Hypothesis 3.

Finally, we tested whether daily perceived work productivity is negatively (Hypothesis 4a) or positively (Hypothesis 4b) related to subsequent sleep duration. We tested this with a

[5]Importantly, relationships with "time with children" had a much lower sample size (*N* = 215) given that not all participants had children, and thus were not included.

[6]Based on a model-building approach, all slopes were fixed with the exception of sleep duration predicting recovery time and time with kids, as allowing these slopes to vary randomly significantly improved the model. Additionally, person-mean centering was not used on the mediator variables in order to permit the model to converge. Leaving outcome variables (including mediators) uncentered is also a common approach (Preacher, Zyphur, & Zhang, 2010).

lagged effect, using perceived productivity (day *t*) to predict that night's sleep (night *t*, as measured on day *t + 1*), controlling for day of the study, previous night's sleep duration and quality, affect, and work time. Perceived work productivity was *negatively* related to that night's sleep duration, ϒ= −.21, *SE* = .09, *t* = −2.46, *p* = .01, 95% CI [−.38, −.04], with a one scale-point loss in perceived productivity resulting in individuals sleeping 12 minutes and 36 seconds longer than normal that night. This result supports Hypothesis 4a and the argument that individuals sleep more as a way of conserving and replenishing resources when their goals are threatened. In short, sleeping more results in less perceived productivity, which leads individuals to sleep more the following night—perpetuating a cycle of resource loss. Importantly, sleep duration on day *t* was negatively related to sleep duration on day *t + 1* (ϒ= −.21, *SE* = .11, *t* = −2.02, *p* = .04, 95% CI [−.42, −.01]), suggesting that a compensatory effect may be occurring where people sleep more the night after they sacrifice sleep, in order to "catch up" (e.g., Klerman & Dijk, 2005).

Sleep *quality*.—The hypothesized model also controlled for sleep quality, another predictor of interest in the sleep literature. Results indicate that, in contrast to sleep duration, sleep *quality* was positively related to positive affect (ϒ= .09, *SE* = .04, *t* = 2.45, *p* = .01, 95% CI [.02, .16]), but was unrelated to negative affect (ϒ= −.06, *SE* = .03, *t* = −1.95, *p* = .051, 95% CI [−.12, .00]) or work time (ϒ= −.22, *SE* = .16, *t* = −1.36, *p* = .17, 95% CI [−.54, .10]). The indirect effect of sleep quality on perceived work productivity through positive affect was significant, (ϒ= .02, *SE* = .01, *t* = 1.97, *p* = .049, 95% CI [.00, .05]), although the indirect effects through negative affect, (ϒ= .02, *SE* = .01, *t* = 1.62, *p* = .11, 95% CI [−.004, .05]) and work time (ϒ= −.01, *SE* = .01, *t* = −1.27, *p* = .20, 95% CI [−.03, .01]) were not. Overall, these results are consistent with the assumption that sleep is beneficial for perceived work productivity by enhancing motivational energy, even beyond time spent sleeping.

Exploratory Analyses

Autoregressive controls.—To address concerns about single time-point measurement and to test *changes* in our dependent variables (Gabriel et al., 2019), we conducted an exploratory test controlling for the previous day's work affect, work time, and perceived productivity on each respective outcome. Doing so represents a conservative test, particularly given the loss of power (within-person N decreases from 455 to 287) due to losing the first observation of each individual (cannot lag the outcome variables for the day before the study began) and missing data (one missed observation prevents two days of observations from being used in the analysis). Controlling for these lagged effects does, however, strengthen causal inference and introduce temporal separation that reduces common method bias (Podsakoff, MacKenzie, & Podsakoff, 2012) making it worthwhile to consider as a secondary test.

In general, results remained consistent with the hypothesized model in terms of magnitude, but significance values dropped as a result of decreased power. As in the hypothesized model, sleep duration was unrelated to work affect (Positive affect: ϒ= .04, *SE* = .03, *t* = 1.22, *p* = .22, 95% CI [−.03, .11]; Negative affect: ϒ= −.001, *SE* = .02, *t* = −.06, *p* = .96, 95% CI [−.03, .03]) and negatively related to work time (ϒ= −.44, *SE* = .18, *t* = 2.53, *p* = .01, 95% CI [−.79, −.10]). Contrary to the hypothesized model, work affect no longer predicted perceived productivity (Positive affect: ϒ= .15, *SE* = .14, *t* = 1.11, *p* = .27, 95% CI [−.12, .41]; Negative affect: ϒ= −.36, *SE* = .23, *t* = −1.54, *p* = .12, 95% CI [−.81, .10]), but consistent with the hypothesized model work time did positively predict perceived productivity (ϒ= .07, *SE* = .03, *t* = 2.36, *p* = .02, 95% CI [.01, .12]). The indirect effect of sleep duration on perceived productivity through work time narrowly missed the threshold for significance (ϒ= −.03, *SE* = .02, *t* = −1.95, *p* = .051, 95% CI [−.06, .00]), likely a result of reduced power and sample size. These results increase confidence in our hypothesized findings, given that the magnitude and direction of observed relationships remain largely unchanged, even with this more conservative (and underpowered) test.

Nonlinear effects.—Our results indicated that sleep duration did not significantly predict affect the next day, despite a wide array of findings to the contrary (e.g., Bower, Bylsma, Morris, & Rottenberg, 2010; Schmitt et al., 2017; Scott & Judge, 2006; Sonnentag et al., 2008). Consistent with calls in the organizational sciences broadly (Grant & Schwartz, 2011), we conducted exploratory analyses to see if sleep duration had *nonlinear* effects on affect (a so-called "Goldilocks effect"). Several studies have raised the possibility of curvilinear effects of sleep duration (Barnes, 2012; Barnes, Jiang, & Lepak, 2016; Barnes et al., 2012), with sleeping too little or too much putting individuals at risk for detrimental health effects (Gallicchio & Kalesan, 2009). The idea comes from the reservoir model of fatigue, which suggests that there are diminishing returns for sleep once basic sleep needs are met (Barnes & Van Dyne, 2009)—consistent with COR notions regarding resource loss and replenishment (Hobfoll et al., 2018). As such, one alternative explanation for our null findings of sleep duration on affect is that our analyses did not test for curvilinear effects. To examine this, we first squared the sleep duration variable and then person-mean centered this squared term. We then tested a model identical to the hypothesized model, but with the addition of the squared sleep duration term predicting each mediator and outcome, and calculating indirect effects for this squared term in place of hypothesized indirect effects.

Results indicate that the squared term for sleep duration was significantly related to positive affect (ϒ= −.01, *SE* = .01, *t* = −2.44, *p* = .02, 95% CI [−.03, −.003]) and work time (ϒ= −.06, *SE* = .02, *t* = −2.55, *p* = .01, 95% CI [−.11, −.01]), but not negative affect (ϒ= .01, *SE* = .003, *t* = 1.83, *p* = .07, 95% CI [.00, .01]). Indirect effects of squared sleep duration on perceived productivity through positive affect (ϒ= −.004, *SE* = .002, *t* = −1.75, *p* = .08, 95% CI [−.01, .00]), negative affect (ϒ= −.002, *SE* = .001, *t* = −1.36, *p* = .18, 95% CI [−.01, .001]), and work time (ϒ= −.003, *SE* = .002, *t* = −1.79, *p* = .07, 95% CI [−.01, .00]) were all not significant.

These multilevel curvilinear effects were graphed using the sjPlot package (Lüdecke, 2019), in combination with the ggplot2 package (Hadley, 2016) in R version 3.6 (R Development Core Team, 2018). Examination of the nonlinear effects (see Figure 2) support the "Goldilocks effect" of sleep on positive affect (i.e., inverted "U" slope), such that too little or too much sleep resulted in lower positive affect while the highest positive affect occurred on days individuals slept at or slightly above their average level of sleep. Sleeping less did not appear to impact the amount of time spent at work, while sleeping more than normal was strongly negatively related to work time. In short, these results demonstrate that

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sleeping more *does* result in resource gain, but that the relationship may be obscured if nonlinear effects are not examined.

Interaction of sleep duration and quality.—Our results indicate that sleep did not significantly predict affect the next day, despite a wide array of findings to the contrary (e.g., Bower et al., 2010; Schmitt et al., 2017; Scott & Judge, 2006; Sonnentag et al., 2008). One explanation for this null finding is that the ultimate effect of sleep duration on affect may be dependent on the *quality* of sleep, given that both sleep duration and quality may be needed for sleep to have its restorative effects (Barnes, 2012; Crain et al., 2018). In contrast to predictions, however, sleep quality did not moderate the effect of sleep duration on positive affect, ($\Upsilon = -.03$, $SE = .02$, $t = -1.86$, $p = .06$, 95% CI [−.07, .002]), negative affect, ($\Upsilon = .01$, $SE = .02$, $t = .53$, $p = .59$, 95% CI [−.03, .05]), or work time, ($\Upsilon = -.12$, $SE = .10$, $t = -1.29$, $p = .20$, 95% CI [−.31, .06]).

Discussion

Every day we face a number of competing demands for our time and attention. This is especially true of hotel managers, given the round-the-clock nature of their industry. We conceptualize sleep as the investment of a valuable resource (time), and apply COR theory to understand the consequences of this behavior. More specifically, we focused on the differential effects this investment might have, given that sleep has been linked to a wide range of beneficial outcomes (Barnes, 2012; Gordon et al., 2017) but consumes time resources none-the-less.

Results demonstrate that sleeping longer hampers perceived work productivity by leaving managers with less time at work to accomplish tasks (31 minutes, 12 seconds less, on average). Assuming a standard eight-hour workday, this amounts to 6.5% of available working time. Interestingly, managers did not spend less time on chores, personal recovery, or time with children after sleeping more the previous night. While there may be other non-work demands not represented in the current analyses (e.g., elder care, time with friends), our findings showcase a general pattern where managers tend to “borrow” time from work and not family or free time. The inverse is also true, managers who sacrifice an hour of sleep typically spend half an hour more at work. This relationship calls attention to a rarely addressed aspect of the sleep literature that deserves more attention, which is *why* individuals are not getting sufficient sleep despite the benefits.

The affective mechanisms we proposed—positive and negative affect—did not receive support as mediators of the relationship between sleep duration and perceived work productivity. Exploratory analyses, however, showed that the curvilinear effect of sleep duration did predict both affect outcomes, suggesting that sleep may be most beneficial in moderation and more sleep is not always better. Finally, perceived work productivity predicts time spent sleeping that night. For every one scale point decrease in perceived productivity, individuals reported sleeping 12 minutes, 36 seconds longer on average—perhaps as a way to protect against additional resource loss.

Theoretical Implications

Examining sleep in a unique sample of hotel managers afforded us the opportunity to consider several important tenets of COR theory. First, we test the resource investment principle (Hobfoll et al., 2018) by considering sleep as a means through which individuals might invest time resources. In doing so, we extend COR by considering resource gain (through affective resources) and loss (through time resources) mechanisms simultaneously. Doing so helps to understand the trade-offs of sleep—something that is seldom considered in either the COR or sleep literatures. Our results show evidence of this resource trade-off, as sleep resulted in (nonlinear) gains to affective resources and losses to work time resources. This finding advances COR by demonstrating how resource investment results in *both* resource gain and resource loss, in contrast to past work that has largely focused on resource gain (Halbesleben & Bowler, 2007; Halbesleben & Wheeler, 2015; Wheeler, Harris, & Sablynski, 2012) *or* resource loss (Halbesleben, Harvey, & Bolino, 2009).

Second, our findings are among the first to document *nonlinear* resource gains. Although COR has referenced the momentum and magnitude of resource gains and losses (Hobfoll et al., 2018), they are rarely conceptualized or tested as such in existing work. Indeed, it is possible that non-significant linear relationships observed in past work have obscured a significant nonlinear effect, and these effects should be explicitly considered in future work looking to test notions of resource gain or loss. These findings also extend the sleep literature by highlighting the competing forces surrounding sleep and the dilemma many managers are faced with—whether to get enough sleep or spend the time being productive at work.

Third, we test the notion of resource loss spirals proposed by COR, which suggest that losing resources makes one more susceptible to additional resource loss in the future (Hobfoll et al., 2018). Consistent with this idea, our results indicated that on days individuals slept more, they tended to report lower productivity. Subsequently, on days they reported being less productive, they slept more the following night—likely as an avoidant way to conserve resources threatened by a lack of perceived productivity (Hobfoll, 2001). As such, they would have less time to spend at work the following day, perpetuating the cycle of resource loss begetting further loss. The current study extends prior work by demonstrating the existence of loss spirals within a person and over a short timeframe, compared with the traditional focus on two or three timepoint lagged designs over longer time periods (Lim et al., 2019). This finding is also consistent with literature on “flow” (Csikszentmihalyi, 1999), where managers who are feeling productive may continue to work—sacrificing sleep in order to take advantage of the resource gains associated with such progress. Future research should seek to replicate this effect and examine the mechanism underlying this perceived productivity to sleep relationship.

Practical Implications

As numerous articles have detailed, hotel managers face challenges when attempting to balance work and home lives. These individuals work long, irregular hours in a culture where “face time” on the job is often valued (Munck, 2001). Our research considers the very real trade-offs that managers must navigate when balancing a desire for a healthy lifestyle and adequate sleep with the demands placed on them by their industry and organization. Acknowledgement of this dilemma is likely to resonate with managers given the recent attention paid to the interplay of sleep and work in the popular press (e.g., Barnes, 2018; Mohan, 2019). Our results highlight one (of likely many) reasons why so many individuals do not get enough sleep (Luckhaupt et al., 2010)—they may be sacrificing sleep to increase productivity at work. Understanding the choices and implications of those choices is a first step to developing policies and procedures aimed at improving the physical and mental health of managers and their families.

To address this concern, organizations could explicitly acknowledge the sleep dilemma for managers and educate them about the short-term and longer-term trade-offs (sleeping an hour less leaves 31 more minutes for work on average, but has nonlinear costs to work affect). Perhaps more importantly, organizations could actively combat the "face time" culture present in many jobs (Munck, 2001; O'Neill, 2012), which may pressure managers to sleep less in order to spend more time at work. This could involve carefully evaluating the present culture of an organization—including how managers' performance is assessed and incentivized (Feldman et al., 2019). Role modeling appropriate work-life balance from top leadership is also undoubtedly important to creating healthy norms around sleep and work (Berkman, Buxton, Ertel, & Okechukwu, 2010). Future research on sleep and interventions to enhance sleep should keep in mind the real-world challenges faced by employees (e.g., work and family demands), instead of assuming that all individuals will get the recommended amount of sleep after learning about the importance of reaching such a threshold.

Finally, our results show that increasing sleep *quality* can help reduce the problems by enhancing perceived productivity through improved positive affect. If one must sacrifice sleep time for work time, our findings show the importance of reducing things that impair the quality of that limited sleep, such as screen time, caffeine, and alcohol (Christensen et al., 2016; Drake, Roehrs, Shambroom, & Roth, 2013; Ebrahim, Shapiro, Williams, & Fenwick, 2013). Further, the curvilinear relationship between sleep duration and affect indicates a "sweet spot", where a moderate amount of sleep (e.g., 7–8 hours) is ideal for affect, while too much or too little sleep results in poorer affect.

Limitations and Future Directions

Our study is unique in that it demonstrates the costs of sleep—such that sleeping longer results in nonlinear resource gains to affect, and resource losses to perceived work productivity through less time being spent at work. Conclusions from the current study should be considered in light of several key limitations, however. Our single measurement occasion per day curtailed our ability to separate all variables in the model temporally, leaving open the possibility that common method variance may be contributing to our effects. Notably, sleep duration's null linear relationships with both positive and negative affect suggests that inflated correlations are unlikely to be an issue. On the other hand, the assessment of work affect in the evening leaves open the possibility for other factors beyond sleep duration are impacting affect, representing a conservative test of our hypotheses.

While many of our measures contained simple, concrete questions that are appropriate for "self-reported facts" like time use (Gabriel et al., 2019) and also minimize concerns about common method bias (Doty & Glick, 1998; Podsakoff et al., 2012), our reliance on single-item measures means we may have been unable to fully capture all aspects of our constructs of interest, particularly perceived work productivity. This construct was also self-reported, although we note that the within-person nature of our analyses eliminates any person-level tendencies to over-inflate perceived productivity due to social desirability, for example (Bolger & Laurenceau, 2013; Gabriel et al., 2019). Nonetheless, future work should strive to temporally separate measures and gather reports from other sources (e.g., supervisor-rated performance, actigraphy reports of sleep) to further minimize common method biases.

It is also difficult to determine the extent to which managers are making deliberate decisions to sacrifice sleep in order to spend more time at work, or if this linkage is simply a consequence of the limited amount of time in a given day. If time spent at work is largely at the discretion of the manager, this suggests that managers may be making more conscious decisions about whether or not to sacrifice sleep. If, however, work hours are more compulsory in nature it suggests that the trade-off between sleep duration and work time may be unintentional. While our perception of this sample of hotel managers is that they had scheduling autonomy, we did not measure or formally incorporate this degree of autonomy into the model. Furthermore, extraneous factors like waking to take care of a child or ruminating about work the next day may also affect one's degree of self-determination when it comes to sleep duration. Future work may want to look more closely at whether sleep duration relates differently to affect and health when it is due to choices (e.g., scheduling autonomy, choosing to stay up to read) versus constraints (e.g., child wake-ups, strict work schedule) and should also consider constraints that may limit the degree of autonomy one has over sleep duration.

Additionally, we were unable to account for daily fluctuations in workload in the current study, which may be affecting observed relationships. For example, low workload might explain why managers sleep more on days they have lower perceived productivity. Instead of being a way to conserve resources in the face of some threat, it may be a deliberate decision to catch up on sleep when workload is low and perceived productivity is not critical. We cannot rule out this possibility with the current data, as we lack a measure of daily workload. To the extent that daily workload and negative affect are related (Bowling, Alarcon, Bragg, & Hartman, 2015; Spector, Dwyer, & Jex, 1988), we should expect to see negative affect associated with shorter subsequent sleep duration, yet this is not the case. While this provides some initial evidence that workload may not be a critical driver of sleep duration, this conclusion is far from definitive. As a result, future work should account for daily fluctuations in workload to determine its effect on perceived productivity as well as sleep duration. Future work should also account for other potential influences on perceived productivity, including work time pressure, organizational support, abusive supervision, among others.

Finally, while our hypothesized model only provided support for resource losses occurring through reduced work time, nonlinear gains to affect were observed in the exploratory analyses. This represents one possible source of resource gains, but individuals may also be experiencing gains to other resources that were not documented in the study. Future work should consider alternative indicators of resource gains as a result of sleep, such as positive customer interactions (Zhan, Wang, & Shi, 2016) or self-control resources (Lanaj, Johnson, & Barnes, 2014), that facilitate greater productivity. Another possibility is that managers are taking naps during the day to compensate for sacrificed sleep. While not included in our current measure of sleep, naps might explain the null effect of sleep duration on work affect, while simultaneously detracting from work time. As such, they may represent a practical way to limit the effects of sleep loss (e.g., Barnes, 2011; Takahashi, 2003), and should be examined in more detail in future work.

Conclusion

Managers and other professionals with flexible schedules are faced with decisions about how best to allocate their time. While sleep quality is linked to better affect and perceived productivity (consistent with past work), managers in the current sample were barely getting the necessary hours of sleep (averaging 6.5 hours per night). Our results help to explain why, as sleeping more hours leaves less time at work and this hampers managers' sense of perceived productivity at work that day. This, in turn, results in managers sleeping more that night to recover from the threat, creating the possibility of a loss spiral where managers consistently feel behind. Our results also show the importance of following recommendations for a high quality and efficient (e.g., 7–8 hours) night's rest to maximize both personal well-being and productivity for managers.

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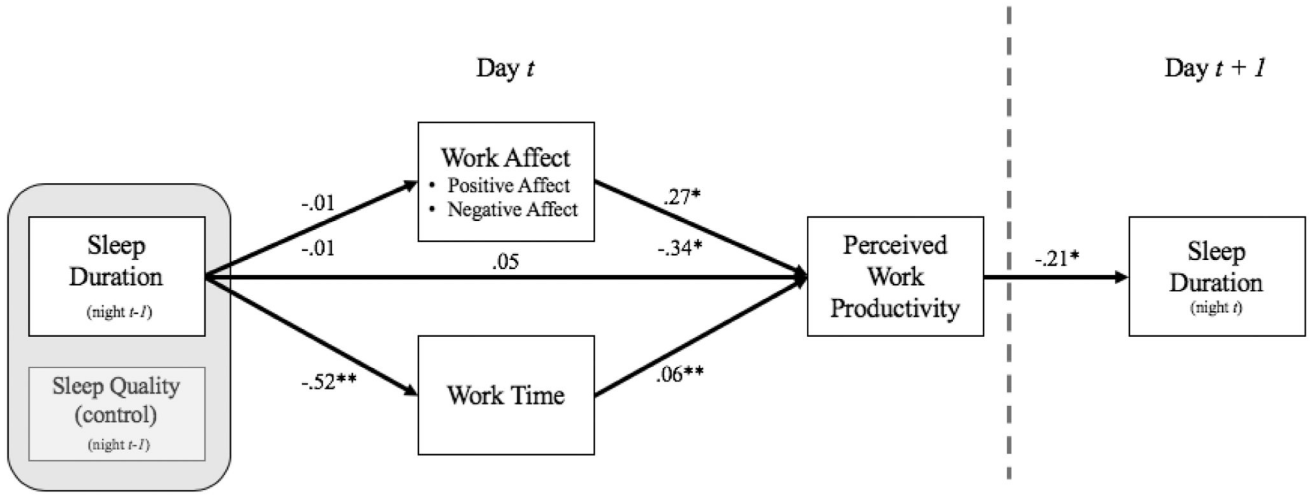

Figure 1.

Results from Hypothesized Model

Note: For relationships with affect, coefficients above the arrow represent positive affect, those below the arrow represent negative affect.

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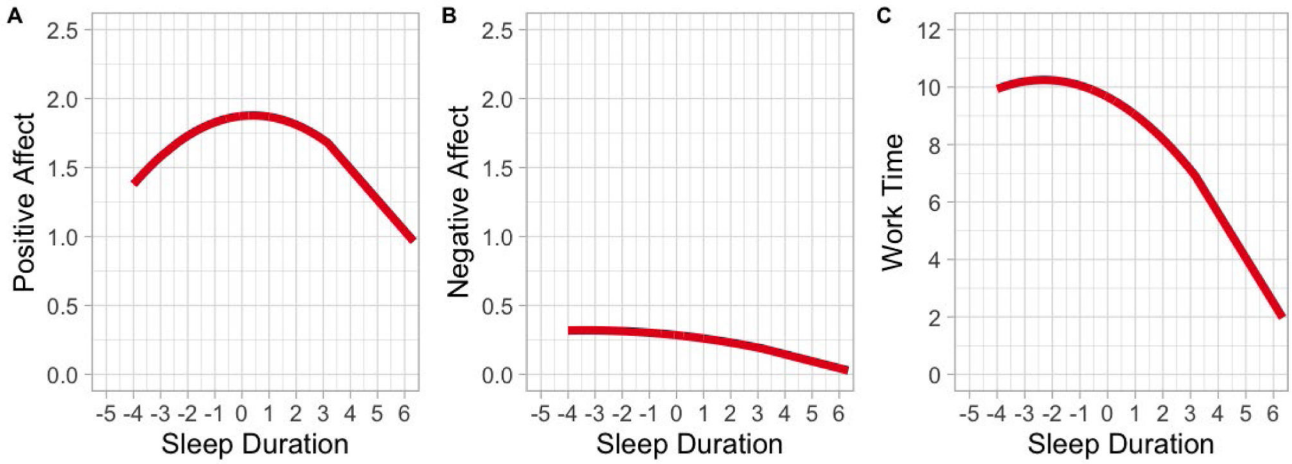

Figure 2.

Curvilinear Effect of Sleep Duration on (a) Positive Affect, (b) Negative Affect, and (c) Work Time

Table 1

Percent of Variability at the Daily, Person, and Hotel Level

Variable	Daily		Person		Hotel
	Two-Level	**Three-Level**	**Two-Level**	**Three-Level**	**Three-Level**
Sleep Duration	65.98%	65.93%	34.02%	30.08%	3.99%
Sleep Quality	69.80%	69.81%	30.20%	28.93%	1.26%
Positive Affect	40.24%	40.38	59.76%	55.71%	3.91%
Negative Affect	82.73%	82.73	17.27%	17.27%	<.001%
Work Time	79.51%	79.37	20.49%	18.62%	2.01%
Perceived Work Productivity	79.70%	79.69	20.30%	20.31%	<.001%
Sleep Duration Lead	74.58%	74.57	25.42%	25.43%	<.001%

Note: Sleep Duration Lead = Sleep Duration measured day $t + 1$.

Table 2

Means, Standard Deviations, and Correlations Among Study Variables

Variable	*M*	*SD*	*Skew*	*Kurtosis*	1	2	3	4	5	6	7	8	9
1. Sleep Duration	6.62	1.37	.58	5.49	--	.58***	.01	−.20	−.34***	.00	.83***	−.15	−.20*
2. Sleep Quality	3.78	1.00	−.83	.55	.33***	--	.17	−.33***	−.25*	.09	.46***	−.01	−.07
3. Positive Affect	1.85	.81	−.04	−.05	.04	.13**	--	−.05	.33**	.23*	−.02	−.07	−.03
4. Negative Affect	.28	.39	2.82	13.75	−.07	−.15**	.03	--	.13	−.15	−.20	.00	−.08
5. Work Time	9.55	2.72	.13	1.70	−.26***	−.16***	.20***	.15**	--	.14	−.34**	.19	.20
6. Perceived Work Productivity	3.12	1.03	−.04	−.36	.05	.09	.17***	−.13**	.13**	--	−.04	.08	.11
7. Sleep Duration Lead	6.84	1.60	1.12	6.28	−.15**	−.04	−.05	−.05	−.02	−.13*	--	−.23*	−.28**
8. Gender	.52	.50	−.08	−2.01	--	--	--	--	--	--	--	--	.10
9. Parental Status	.55	.50	−.21	−1.98	--	--	--	--	--	--	--	--	--

Note. Sleep Duration Lead = Sleep Duration measured t + 1.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Correlations below the diagonal represent pooled within-person correlations, above the diagonal represent between-person correlations. Gender coded such that 0 = Female, 1 = Male. Parental Status coded such that 0 = Do not have kids, 1 = Have kids.

Table 3

Fixed Effects Estimates from Hierarchical Linear Models

	Dependent Variables				
	PA	NA	Work Time	Perceived Work Productivity	Sleep Duration (Lead)
Independent Variables	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (SE)
Between Level					
Intercept	.15** (.05)	.04 (.03)	.36 (.20)	−.13 (.07)	7.04*** (.18)
Within Level					
Day	−.04** (.01)	−.01 (.01)	−.09 (.05)	.03 (.02)	−.05 (.04)
Sleep Duration	−.01 (.03)	−.01 (.02)	−.52** (.15)	.05 (.04)	−.21* (.10)
Sleep Quality	.09* (.04)	−.06 (.03)	−.22 (.16)	.05 (.06)	−.02 (.10)
Positive Affect	--	--	--	.27* (.11)	−.10 (.18)
Negative Affect	--	--	--	−.34* (.15)	−.24 (.21)
Work Time	--	--	--	.06** (.02)	−.02 (.04)
Perceived Work Productivity	--	--	--	--	−.21* (.09)
Residual Variance	.20*** (.02)	.10*** (.02)	4.27*** (.49)	.62*** (.04)	2.47*** (.37)

Indirect Effects	Estimate	*SE*	95% CI
Sleep Duration→Positive Affect→Perceived Productivity	−.002	.01	[−.02, .01]
Sleep Duration→Negative Affect→ Perceived Productivity	.003	.01	[−.01, .02]
Sleep Duration→Work Time→ Perceived Productivity	−.03	.01	[−.06, −.003]

Note: Sleep Duration Lead = Sleep Duration measured t + 1.

* $p < .05$,

** $p < .01$,

*** $p < .001$.