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When do you procrastinate? Sleep quality and social lag jointly predict self-regulatory failure at work

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Abstract

This study investigates antecedents of procrastination, the tendency to delay the initiation or completion of work activities. We examine this phenomenon from a self-regulation perspective and argue that depleted self-regulatory resources are an important pathway to explain why and when employees procrastinate. The restoration of self-regulatory resources during episodes of non-work is a prerequisite for the ability to initiate action at work. As sleep offers the opportunity to replenish self-regulatory resources, employees should procrastinate more after nights with low-quality sleep and shorter sleep duration. We further propose that people's *social sleep lag* amplifies this relationship. Social sleep lag arises if individuals' preference for sleep and wake times, known as their chronotype, is misaligned with their work schedule. Over five consecutive workdays, 154 participants completed a diary study comprising online questionnaires. Multilevel analyses showed that employees procrastinated less on days when they had slept better. The more employees suffered from social sleep lag, the more they procrastinated when sleep quality was low. Day-specific sleep duration, by contrast, was not related to procrastination. We discuss the role of sleep for procrastination in the short run, and relate our findings to research highlighting the role of sleep for well-being in the long run.

Keywords: procrastination, self-regulation, sleep, chronotype, diary study

When Do You Procrastinate?

Sleep Quality and Social Sleep Lag Jointly Predict Self-Regulatory Failure at Work

Employees frequently experience days when they fail to do the things they had planned. Procrastination, the tendency to delay the initiation or the completion of activities (Howell, Watson, Powell, & Buro, 2006; Lay, 1986), is a prevalent and pernicious form of self-regulatory failure that can result in adverse consequences (Steel, 2007). When employees procrastinate, they may fail to meet deadlines (Van Eerde, 2003), risk the success of projects (Gersick, 1989), and jeopardize safety, for instance, when a worker fails to promptly run a safety check. Moreover, procrastination is frustrating for employees because it implies a discrepancy between intentions and actions, and impedes the positive experience of making progress on work tasks (Amabile & Kramer, 2011). These adverse consequences raise the question of why employees procrastinate. Research on procrastination has not yet provided a satisfying answer to this question (Steel, 2007).

We address this question from a self-regulation perspective, and focus on employees' chronic sleep patterns, as well as day-specific sleep characteristics, as potential antecedents of procrastination (Muraven & Baumeister, 2000). According to this perspective, procrastination is due to depleted self-regulatory resources (Tice & Baumeister, 1997). The restoration of self-regulatory resources during episodes of non-work is a prerequisite for the ability to initiate action and to engage at work (Kazén, Kaschel, & Kuhl, 2008; Kühnel & Sonnentag, 2011). Building on the metaphor coined by Muraven and Baumeister (2000), we assume that the ability to self-regulate resembles a muscle that recovers during sleep. A person's day-specific sleep quality and sleep duration allow for the restoration of self-regulatory resources, and should therefore prevent procrastination at work (Baumeister, Muraven, & Tice, 2000).

The extent to which self-regulatory resources can be replenished during sleep should depend on the *alignment* between people's biological preferences for sleep and wake times (i.e., their chronotype; Horne & Østberg, 1977; Roenneberg, Wirz-Justice, & Merrow, 2003) and people's work schedule as a social requirement. When individuals' work schedule misalign with their biological preference—in particular, when individuals have to start working while they still need to sleep—restoration of self-regulatory resources should be impaired. An example of *misalignment* between individuals' biological preferences for sleep and wake times and the work schedule can be seen when an employee's biologically preferred wake time is around 8 a.m., but the employee is forced to take a *red-eye* flight at 6 a.m. every Monday to be at a client's location on time. The alignment between individuals' biological preferences and their work schedule, or the lack thereof—termed social sleep lag (Wittmann, Dinich, Merrow, & Roenneberg, 2006)—is of high societal relevance: The majority of the population experiences social sleep lag because many employees are faced with work schedules that do not match their biologically preferred sleeping window (Roenneberg, Allebrandt, Merrow, & Vetter, 2012; Wittmann et al., 2006).

Social sleep lag (Wittmann et al., 2006) has not yet gained attention in the field of organizational behavior in spite of its relevance for self-regulation. We argue that social sleep lag should be taken into account because of its significance for sleep quality and sleep duration, and thus the restoration of self-regulatory resources. Social sleep lag may help to explain why some people have more self-regulatory resources at their disposal than do others, which, in turn, should be related to procrastination at work.

Individual Differences and Within-Person Fluctuations in Procrastination

Most research on procrastination has adopted an individual differences perspective and has examined procrastination as a broad and relatively stable behavioral tendency to delay the initiation or completion of an intended course of action. This behavioral tendency has been linked to a variety of antecedents and consequences. With respect to antecedents, meta-analytical evidence has suggested that procrastination is consistently negatively related to conscientiousness and self-efficacy, and positively related to distractibility and impulsiveness (Steel, 2007; Van Eerde, 2003). Regarding consequences of procrastination, procrastinators experience higher stress, more likely miss important deadlines, non-optimally set self-imposed deadlines, and spend less time on preparing important tasks, all of which may result in work of inferior quality (Ariely & Wertenbroch, 2002; Tice & Baumeister, 1997; Van Eerde, 2003). Howell et al. (2006) found a significant negative correlation between procrastination and say–do correspondence. That is, people who report a tendency to procrastinate also display the generalized tendency not to do what they said they will do.

Research on individual differences in procrastination can shed light on the attributes associated with procrastination; however, it does not directly identify the pattern of events and processes that give rise to procrastination. An approach that is more suitable for this endeavor, but one which has rarely been used, is to study fluctuations in procrastination within a person over time (for an exception that examined the completion of daily tasks, see Claessens, Van Eerde, Rutte, & Roe, 2010). The premises of studying procrastination as a within-person phenomenon is that individuals' ability to initiate and complete planned actions varies over time—in the present study, from workday to workday. We argue that most people will display a certain level of procrastination on some workdays, and that sleep plays a critical role in explaining why this occurs. By examining how sleep affects procratination on a day-to-day basis, a more fine-grained understanding of the phenomon can be developed. An improved understanding of the events and processes leading to procrastination can, in turn, help to build predictive models of procrastination and to provide practical recommendations of how to prevent and manage procrastination. As will be elaborated below, we assume that on a daily level, employees succeed in initiating and completing action at work when they have self-regulatory resources available. Because sleep should supply regulatory resources from day to day, we investigate sleep characteristics as predictors of daily procrastination at work.

Procrastination as a Self-Regulatory Failure

Self-regulation refers to the ability of a person to autonomously regulate goal-directed behavior, which entails deliberate and implicit processes (Kuhl, 2000; Vohs & Baumeister, 2011). The ability to self-regulate encompasses a variety of specific functions, such as counteracting anticipated obstacles during goal pursuit (Zhang & Fishbach, 2010), resisting temptations to shield a goal (Muraven & Baumeister, 2000), maintaining attentional focus (Beal, Weiss, Barros, & MacDermid, 2005), and allocating effort among multiple goals (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). From a self-regulation perspective, procrastination indicates the impairment of a specific self-regulatory function, namely the ability of a person to initiate an intended course of action. Procrastination implies that a person has formed an intention, but has not managed to move from intention to action (Beswick & Mann, 1994). Procrastination is thus not primarily caused by a lack of motivation, but is due to deficits in self-regulation (Kuhl & Beckmann, 1994) [1].

Research on self-regulation has suggested that the ability to initiate action autonomously is supported by implicit processes that operate within the background of awareness (Kuhl, 2000; Latham, Stajkovic, & Locke, 2010). Impairments in these implicit processes may be the cause of procrastination. For instance, Kazén and Kuhl (2005) examined participants' ability to implement a difficult intention in the face of strong distractions. They showed that implicit primes about achievement improved the ability to initiate action. In another experiment, participants with chronic deficits in action initiation, who were prone to procrastination, were compared to efficient self-regulators (Kazén et al., 2008). Participants with chronic deficits showed performance impairments in moving from intention to action under demanding conditions that overtaxed their ability to self-regulate.

The ability to self-regulate varies not only between people, but also within a person over time, as the person's internal state changes. Acts of self-regulation draw on a common resource, and the depletion of this resource can result in subsequent self-regulatory failure (Muraven & Baumeister, 2000). For instance, a large number of studies have shown that exerting self-control by restraining impulses and resisting temptations leads to ego depletion and decrements in subsequent tasks that require self-regulation (for a meta-analysis, see Hagger, Wood, Stiff, & Chatzisarantis, 2010). In order to maintain control over their actions, people need to replenish self-regulatory resources. We next argue that sleep plays a critical role in the replenishment of the self-regulatory resources required for action initiation, and that sleep therefore prevents procrastination.

The Role of Sleep for Procrastination at Work

Baumeister and colleagues (2000) proposed that sleep is essential for replenishing depleted self-regulatory resources. In support of this proposition, several field and lab studies found that sleep deprivation led to a reduction in self-regulatory resources, both for behavioral measures and survey measures of self-regulation (Barnes, Schaubroeck, Huth, & Ghumman, 2011; Christian & Ellis, 2011; Lanaj, Johnson, & Barnes, 2014; Welsh, Ellis, Christian, & Mai, 2014). Research on neurophysiological correlates of sleep deprivation have supported the link between sleep and self-regulation: Studies consistently have shown that sleep deprivation negatively affects cortical activity, particularly in the prefrontal cortex and thalamus (e.g., Thomas et al., 2000), which have been linked to self-regulation (Durmer & Dinges, 2005; Heatherton & Wagner, 2011). So far, most studies have focused on sleep *deprivation* and self-regulation. However, Harrison and Horne (2000) argued that sleep *quality* should be important for self-regulation as well, because sleep quality is implicated in cerebral recovery (p. 247)—a line of argument that was recently supported by a field study confirming the relationship between poor nightly sleep quality and reduced self-regulatory resources (Barnes, Lucianetti, Bhave, & Christian, 2014).

We argue that sleep during the night ensures that employees come to work with restored self-regulatory resources the next day. We characterize a night's sleep by quantity of sleep, that is, how many hours an employee spent sleeping, and by the subjective quality of sleep, that is, the experience of (non)restorative sleep, awakenings during the night, and difficulties of falling asleep (Åkerstedt, Hume, Minors, & Waterhouse, 1994; Mullins, Cortina, Drake, & Dalal, 2014). Barnes (2012) integrated empirical findings on sleep quality and sleep duration by stating that both diminished sleep quality and diminished sleep duration have detrimental effects on self-regulation in the workplace. Drawing on empirical findings from research on sleep physiology and the few available studies in organizational psychology, he summarized that sleep quality and sleep duration have parallel additive effects, that is, both have distinct functions for self-regulation at work (Barnes, 2012). In other words, both sleep of inferior quality as well as short sleep (sleep deprivation) hamper the restoration of self-regulatory resources. We thus assume that both good and sufficient sleep ensures that employees come to work with replenished self-regulatory resources.

Using the metaphor of Muraven and Baumeister (2000), employees who experienced a night characterized by good and sufficient sleep are able to flex their recovered self-regulatory muscle at work, so they should be able to start doing the things they had planned, and should be less susceptible to procrastination. On days employees come to work with insufficiently restored self-regulatory resources, initiating and maintaining action becomes increasingly difficult (Baumeister, 2002; Muraven & Baumeister, 2000). On these days, employees should be more vulnerable to distractions evoked by task-irrelevant stimuli that interfere with the initiation and the successful accomplishment of tasks (Beal et al., 2005). In their review on sleep deprivation, Harrison and Horne (2000) concluded that sleep-deprived individuals center their attention on peripheral concerns or distractions. Thus, on days with impaired sleep, employees should be less able to shield the accomplishment of important work tasks from attractive alternatives, such as checking private emails or engaging in less important, but more pleasurable, aspects of their work. On these days, employees should also be less able to encourage themselves to perform unattractive and highly demanding tasks (Diestel & Schmidt, 2012). Taken together, on days with impaired sleep, employees should more likely postpone important tasks and fail to finish their work tasks.

Thus, on days employees experience high-quality sleep, they should display less procrastination compared to days on which they experience low-quality sleep. Similarly, on days employees sleep longer, they should procrastinate less compared to days on which they sleep less.

Hypothesis 1(a): On days employees' sleep quality is high, they procrastinate less at work.

Hypothesis 1(b): On days employees' sleep duration is longer, they procrastinate less at work.

The Role of Chronotype and Social Sleep Lag for Procrastination at Work

In addition to day-specific sleep quality and sleep duration, we propose that individuals' general sleep–wake pattern should affect the replenishment of self-regulatory resources, and should thus be of relevance for procrastination. An endogenous biological (circadian) clock controls humans' daily rhythms in fundamental aspects of physiology and behavior (Roenneberg et al., 2003). This endogenous biological clock is entrained (i.e., synchronized with the 24-hour/day–night cycle) by environmental signals, predominantly by sunlight (Roenneberg, Kumar, & Merrow, 2007). Individual differences in entrainment characteristics yield a continuum of so-called *chronotypes* that represent human preferences in the timing of sleep and wake (Roenneberg et al., 2003). The continuum of chronotypes ranges from early *larks* who prefer to go to bed earlier in the evenings and get up earlier in the mornings to late *owls* who prefer to go to bed later in the evenings and get up later in the mornings (also referred to as morningness–eveningness; see Horne & Østberg, 1976). A person's chronotype reflects preferences for sleep–wake patterns that cannot be overridden easily by the person by acts of self-control (e.g., an *owl* forcing herself to go to bed earlier in order to experience less difficulties with getting up early in the morning) because chronotype emerges from a combination of genetic and environmental factors, predominantly sunlight (Roenneberg, 2012). A person's chronotype is reflected in measurable physiological indicators, such as later acrophases of melatonin and body temperature profiles (the daily point in time when values reach their maximum) in later chronotypes, in comparison to earlier chronotypes (Kerkhof, 1985; Nováková, Sládek, & Sumová, 2013).

A person's preference for a specific sleep–wake pattern (chronotype) can come into conflict with work time schedules. This conflict is apparent among employees working night shifts, a period of time in which most people would prefer to sleep (Åkerstedt, 2003). Non-shift work schedules that start early in the morning are also likely to interfere with sleep preferences of a large portion of employees because moderate to late chronotypes (i.e., owls) represent the majority of the population (Wittmann et al., 2006). Thus, on workdays, employees who start working early in the morning have to adjust their sleep–wake times to their work time schedule. The arising discrepancy in sleep patterns between workdays and free days, when people can sleep according to their biological preferences, is referred to as *social sleep lag*[2] (Wittmann et al., 2006). Social sleep lag quantifies the discrepancy that arises between circadian (biological) and social clocks. Social sleep lag is a chronic phenomenon: It refers to individuals' discrepancy in their general sleep patterns between workdays and free days.

Roenneberg and colleagues (2003) showed that later chronotypes display later sleep-onsets on workdays compared to earlier chronotypes, but that all chronotypes display similar wake-up times on workdays. Thus, these late sleep onsets (controlled by the endogenous biological clock), combined with early wake-up times (controlled by the external social clock; e.g., work schedules), cause late chronotypes to sleep shorter on workdays. Consequently, they accumulate a sleep deficit during the work week, for which they compensate on free days by lengthening their sleep (Roenneberg et al., 2003). However, sleep on workdays and sleep on free days does not only differ with regard to duration, but also with regard to timing, that is, at what time of the day people sleep. Sleeping *outside* the temporal window that is determined by the circadian clock is considered to be less effective than sleep coinciding with this temporal window (Wyatt, Ritz-De Cecco, Czeisler, & Dijk, 1999). Employees experiencing social sleep lag, that is, late chronotypes who have to get up early in the morning, are thus forced to sleep—at least partly—outside their biologically preferred window, or they have to deal with sleeping shorter on workdays. Thus, we propose that the restoration of self-regulatory resources during sleep on workdays may be impeded for employees experiencing social sleep lag. We assume that, in general, they more likely come to work with diminished self-regulatory resources, and thus procrastinate more.

Hypothesis 2: Employees' social sleep lag is positively related to procrastination.

A factor that may offset negative consequences of social sleep lag for self-regulation at work is sleep quality. People who experience social sleep lag may be able to restore their self-regulatory resources during the hours when they sleep if the quality of their sleep is high even when they sleep less than would be ideal or when they sleep partly outside their preferred sleeping window (Roenneberg et al., 2003; Wyatt et al., 1999). A night of good quality sleep may thus compensate for self-regulatory disadvantages resulting from social sleep lag. To put it differently, social sleep lag is a vulnerability factor that should make employees more dependent on the *quality* of their sleep. As employees who experience social sleep lag are forced to sleep partly outside their preferred sleeping window, not experiencing difficulties falling asleep and being able to sleep through the night—both aspects of sleep quality—should be particularly important for their restoration. The combination of social sleep lag and a night of sleep characterized by poor quality should therefore result in the highest levels of procrastination on the following workday. Similarly, a night of sleep characterized by good quality sleep might compensate for self-regulatory deficits resulting from social sleep lag.

Thus, we hypothesize that social sleep lag and sleep quality jointly predict procrastination at work: The relationship between day-specific sleep quality and procrastination should be moderated by social sleep lag. The relationship should be more pronounced for employees who experience social sleep lag because they should be more dependent on catching a good night's sleep.

Hypothesis 3: The negative relationship between day-specific sleep quality and procrastination (Hypothesis 1a) is moderated by social sleep lag, such that the relationship between sleep quality and procrastination is amplified as social sleep lag increases.

Method

Sample and Procedure

Employees from companies in diverse industries participated in our study. They were recruited by psychology students who received credits for recruiting participants as part of a research seminar. To motivate employees to take part in the study, we offered lottery prizes (vouchers for an online retailer) and feedback on the results of the study. Only non-shift-workers and employees without diagnosed sleep disorders were allowed to participate. Employees who gave their consent to participate received emails containing links to online questionnaires. After completion of a general online questionnaire that assessed sociodemographic characteristics, participants were forwarded to the website of the Munich ChronoType Questionnaire (MCTQ). On this website, they answered questions to calculate their chronotype and the amount of social sleep lag (for a detailed explanation, please see Measures section below) they typically experience (Roenneberg et al., 2003). During the next work week, participants received links to online questionnaires over the course of five workdays. Each day, participants were asked to answer a daily questionnaire at the end of the workday. To match participant's data of the general questionnaire, the MCTQ, and the daily questionnaires, participants had to indicate a code each time they filled in a questionnaire. Due to incomplete data (e.g., answering the daily questionnaire only once, failing to provide the general questionnaire), or because participants did not complete the electronic questionnaires after work at the instructed points in time (e.g., belatedly completing the daily questionnaires all at once), 25 participants (86 daily questionnaires) had to be excluded. In addition, 41 participants failed to provide their code when filling out the MCTQ or did not fill out the MCTQ (resulting in additional 187 daily questionnaires that had to be excluded). In total, 66 participants had to be excluded.

The final sample comprised 154 employees who provided data for 740 days. Fifty percent of the sample were women; average age was 38 years (*SD* = 13); and about 40 percent had children. Participants had, on average, 15 years of professional experience, of which 8 years consisted of professional experience in their current organization. Twenty-eight percent of participants held a leadership position. Participants worked, on average, 42 hours/week (S*D* = 7).

Measures

Munich ChronoType Questionnaire (MCTQ). Social sleep lag was assessed with the Munich ChronoType Questionnaire (Roenneberg et al., 2003). The MCTQ determines chronotype and social sleep lag based on sleep behavior. The questionnaire consists of simple questions about sleep timing (separately for workdays and for work-free days), allowing for the calculation of the midpoint between sleep onset and offset. The MCTQ assesses peoples' typical sleep timing on workdays and on work-free days by asking participants to indicate their sleep onset and sleep offset in general. Chronotype is defined as the midpoint of sleep on free days. Social sleep lag is computed as the absolute difference between midpoint of sleep on free days and midpoint of sleep on workdays. Higher values represent more social sleep lag, that is, a greater discrepancy between sleep patterns on free days and workdays. For example, a person whose sleep onset and sleep offset on free days are at 12 midnight and at 9 a.m., respectively, has a midpoint of sleep on free days at 4:30 a.m. When this person's sleep onset and sleep offset on workdays are at 12 midnight and at 7 a.m., respectively, the midpoint of sleep on workdays is 3:30 a.m. The resulting difference between midpoint of sleep on free days (4:30 a.m.) and on workdays (3:30 a.m.) is one hour. Thus, this person experiences a social sleep lag of one (hour).[3] Midpoint of sleep on free days shows high test-retest reliability ($r = .88$, p. 49, Kühnle, 2006) and correlates strongly with sleep logs and wrist actimetry ($r = .92$, p. 54, Kühnle, 2006), as well as with the biochemical marker melatonin (r = .89 with dim light melatonin onset, Martin & Eastman, 2002). In contrast to the Morningness–Eveningness Questionnaire (Horne & Østberg, 1976) that is often used to assess a person's preference for sleep and wake times, the MCTQ differentiates between sleep times on workdays and on free days, and thus allows for the calculation of social sleep lag.

Daily questionnaires over the course of five workdays. Day-specific procrastination was assessed with six items from the procrastination scale of Tuckman (1991), slightly adapted to capture day-specific procrastination at work. Items were "Today, I needlessly delayed finishing jobs, even when they were important", "Today, I delayed making tough decisions", "Today, I was an incurable time waster", "Today, I was a time waster but I couldn't seem to do anything about it", "Today, I promised myself I'll do something and then dragged my feet", and "Today, I got stuck in neutral even though I knew how important it was to get started". Items had to be answered on a 5-point Likert-type scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Cronbach's alpha ranged between .85 and .88 over the days.

Following the procedure of the Pittsburgh Sleep Diary (Monk et al., 1994), we calculated day-specific sleep duration from participants' daily responses regarding the point in time when they went to bed the preceding evening, how long it took them to fall asleep, and the point in time they woke up in the morning. Thus, we used a score of the number of hours and minutes participants slept every night based on participants' self-reports. Barnes (2012) concluded that subjective measures of sleep duration overestimate sleep duration by about 6 to 7 percent (Barnes et al., 2011; O'Donnell et al., 2009), but that subjective and objective measures of sleep duration correlate very strongly (e.g., $r = .88$ in Barnes et al., 2011).

We assessed sleep quality with a single item ("How do you evaluate this night's sleep?") derived from the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). This item has been used successfully in similar diary studies (Hülsheger et al., in press; Sonnentag, Binnewies, & Mojza, 2008). Participants rated their overall sleep quality on a 5-point Likert-type scale ranging from 1 = *very poor* to 5 = *excellent*.

Day-specific time pressure and job control were assessed as day-specific control variables with items developed by Semmer, Zapf, and Dunckel (1999). We assessed day-specific control variables as efficiently as possible and therefore included only two items each. Items had to be answered on a 5-point Likert-type scale ranging from 1 = *never/very rarely* to 5 = *frequently* and from 1 = *very little* to 5 = *very much*, respectively. Correlations of the two items assessing time pressure (e.g., "How often were you pressed for time today?")

ranged between .70 and .74 over the days. Correlations of the two items assessing job control (e.g., "Today, to what extent could you influence the way in which you accomplished your tasks?") ranged between .53 and .79 over the days.

Results

Descriptive Analyses

Table 1 shows means, standard deviations, and intercorrelations. The mean of social sleep lag was 1.64 with a standard deviation of 1. That is, on average, participants' midpoint of sleep on working days noticeably deviated from their midpoint of sleep on free days by 1.64 hours (i.e., by one hour and 38 minutes). We compared the amount of social sleep lag in our German sample to the online MCTQ database, which contained more than 65,000 complete entries of primarily central European participants in July, 2010 (Roenneberg et al., 2012): In the MCTQ database, one-third of the sample experienced 2 hours or more of social sleep lag (see Figure S1B, Roenneberg et al., 2012). As about 36% of our study participants showed 2 hours or more of social sleep lag, the amount of social sleep lag in our sample is comparable to the population represented in the comprehensive MCTQ database. Moreover, mean, standard deviation, and range of social sleep lag of our sample (M = 1.64, SD = 1.00, range = 0-5.17) are comparable to social sleep lag of a random sample with the same age and gender distribution from the MCTQ database (M = 1.49, SD = 1.06, range = 0-6.54, N = 770; T. Roenneberg, personal communication, October 11, 2015).

In Table 1, the between-person correlations below the diagonal show that social sleep lag was negatively related to age (r = -.49, p < .001), professional experience (r = -.44, p < .001), and having a leadership position (r = -.25, p < .01). The negative relationship between age and social sleep lag is in line with previous findings, which showed that, presumably due to endocrine factors (Roenneberg, Kühnle, et al., 2007), adolescents tend to have the latest chronotype. During adulthood, chronotype gets earlier with age; however, rank order between peers stays the same (Roenneberg, 2012). Because professional experience and the possibility of obtaining a leadership position increase with age, we observe negative relationships between social sleep lag and these variables as well.

The between-person correlations below the diagonal further show that age and professional experience were negatively related to procrastination (r = -.32 and r = -.29, respectively, p < .001). Because age and leadership position were also related to social sleep lag, we included them as control variables in our analyses (because age and professional experience are highly correlated, r = .92, p < .001, age was included and professional experience was omitted).

We conducted multilevel analyses using the HLM 7.01 software package (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011). For procrastination, sleep quality, and sleep duration, we ran Null Models to calculate the proportions of variance that were within-person and between-person: Fifty-five percent of the variance in procrastination was within-person, 77% of the variance in sleep quality was within-person, and 56% of the variance in sleep duration was within-person. Thus, all three constructs show both considerable day-to-day (within-person variance) and between-person variation.

Looking at the within-person correlations of the day-specific variables above the diagonal, daily procrastination was negatively related to sleep quality (r = -.22, p < .001) and to time pressure (r = -.10, p < .01). Day-specific sleep quality was only moderately correlated with day-specific sleep duration (r = .28, p < .001). That is, on days employees slept longer, they did not necessarily sleep better.

Day-level procrastination might also be related to day-specific job characteristics. More specifically, employees might procrastinate less on days when they experience higher time pressure. One might also assume that on days with more job control, it is possible for employees to procrastinate more. As both time pressure and job control showed meaningful within-person variability in previous studies (e.g., Kühnel, Sonnentag, & Bledow, 2012), we included them as day-level control variables.

Test of Hypotheses

We centered day-level predictor variables on the respective person mean (group mean centering) because we were interested in how employee's day-specific sleep quality and sleep duration—in comparison to other days—predict procrastination. We centered person-level predictor variables on the grand mean. We specified and compared different hierarchical linear models to predict day-specific procrastination: In Model, 1 we entered the person-level control variables gender, age, and leadership position. In Model 2, we entered the person-level predictor social sleep lag. In Model 3, we entered the day-level control variables time pressure and job control. In Model 4, we entered the day-level predictor variables sleep duration and sleep quality. Following the best practice recommendations for estimating cross-level interaction effects using multilevel modeling of Aguinis, Gottfredson, and Culpepper (2013), we built a random intercept and random slope model (Model 5a) to test if the model with a random slope component (Model 5a) fits the data better than the model without a random slope component (Model 4). Finally, in Model 5b, we tested the cross-level interaction of social sleep lag on the slope of sleep quality. Results of these analyses are presented in Table 2.

Model 4 showed that, as predicted, day-specific sleep quality was negatively related to procrastination (Hypothesis 1a): On days employees slept better, they procrastinated less. Day-specific sleep duration was unrelated to procrastination. Thus, Hypothesis 1b was not supported. Contrary to expectations, Model 2 showed that employees experiencing social sleep lag did not show more procrastination (Hypothesis 2). However, in line with expectations, Model 5b showed that social sleep lag and sleep quality jointly predicted procrastination: Employees experiencing more social sleep lag benefitted more from good sleep quality (in terms of procrastinating less on these days) than did employees who experienced less social sleep lag (Hypothesis 3). The interaction is depicted in Figure 1.

INSERT FIGURE 1 ABOUT HERE.

Please note that only slopes of regression lines should be interpreted. The difference in intercepts between both regression lines, which estimates the social sleep lag main effect, has a 95% confidence interval that includes 0. Inspection of the region of significance of the slope between sleep quality and procrastination showed that the slope was not significant for values of the moderator social sleep lag smaller than -1.05 *SD*, that is, for people with a social sleep lag of less than 35 minutes. Thus, employees' level of procrastination depended on their day-specific sleep quality when they experienced a social sleep lag of more than 35 minutes. In Figure 1, the simple slopes of sleep quality predicting procrastination for low social sleep lag (-1 *SD*) and high social sleep lag (+1 *SD*) are depicted, representing a social sleep lag of 0.64 hours (i.e., of 38 minutes) and of 2.64 hours (i.e., of two hours and 38 minutes), respectively. Both depicted slopes are within the region of significance of the slope between sleep quality and procrastination and were thus significant at $p < .05$ ($t = -2.09$) and at $p < .001$ ($t = -5.38$), respectively (Preacher, Curran, & Bauer, 2006).

Further analyses showed that the curvilinear term of social sleep lag moderated the relationship between sleep quality and procrastination. After entering all lower-order effects, the curvilinear term was a marginally significant predictor of the slope between sleep quality and procrastination (Estimate = 0.031951, $t = 1.810$, $p = 0.072$). The model fit the data marginally significantly better than a model without the curvilinear term (Δ-2 × log likelihood = 3.2300, $df = 1$, $p = 0.069$). Graphical inspection of this curvilinear relationship suggested that employees experiencing high social sleep lag showed particularly high procrastination when sleep quality was low.

Model 3 showed that the day-specific job characteristics (control variables) were related to procrastination in the following ways: On days employees experienced more time pressure, they procrastinated less. Day-specific job control was unrelated to procrastination. Results remain the same when day-specific job characteristics and person-level control variables are not taken into account.

Additional Analyses

We tested whether high-quality sleep compensates for shorter sleep duration, respectively, and whether longer sleep compensates for low-quality sleep. The interaction between day-specific sleep duration and day-specific sleep quality did not significantly predict procrastination (Estimate = 0.031, *SE* = 0.031, *t* = 1.00).

We ran additional analyses to test if our predictors explain incremental variance in procrastination over and above people's conscientiousness, an established predictor of procrastination. Conscientiousness was measured with the five items of the NEO-Five-Factor Inventory (Körner et al., 2008; McCrae & Costa, 1987). Items had to be answered on a 5-point Likert-type scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Cronbach's alpha was .80. In line with previous findings, conscientiousness was a significant negative predictor of procrastination (Estimate = -0.232, *SE* = 0.069, *t* = -3.36), indicating that conscientious employees procrastinate less in general. However, conscientiousness was not a significant cross-level moderator of the relationship between sleep quality and procrastination (Estimate = 0.040, *SE* = 0.050, *t* = 0.81), nor did it change the results when included in the analyses.

We ran additional analyses to control for weekly work hours. Work hours/week was a marginally significant positive predictor of procrastination (Estimate = 0.009, *SE* = 0.005, *t* = 1.75), indicating that employees who work longer hours a week tend to procrastinate more in general. However, work hours/week was not a significant cross-level moderator of the relationship between sleep quality and procrastination (Estimate = 0.001, *SE* = 0.003, *t* = 0.73), nor did it change the results when included in the analyses.

Discussion

This study showed that day-specific sleep quality and social sleep lag jointly predicted procrastination at work. Employees' sleep quality significantly reduced the degree of procrastination employees displayed on a given day. Sleep quality was especially relevant for employees who experience a conflict between sleep–wake preferences and work times, that is, social sleep lag: Employees experiencing a social sleep lag of more than 35 minutes procrastinated more on days they did not catch a good night's sleep. Interestingly, results were specific to sleep quality as variations in day-specific sleep *duration* were unrelated to procrastination.

The study underscores the relevance of sleep for self-regulation at work (Baumeister et al., 2000). Our results show that the quality and timing of sleep have consequences for self-regulation that remain obscured when only sleep duration is examined: Sleep of high quality and sleep that is timed in accordance with one's sleep–wake preferences ensures the availability of self-regulatory resources at work. Results suggest *the more–the better* (i.e., the more that quality sleep is experienced, and the more it aligns with one's sleep–wake preferences, the better the availability of self-regulatory resources the next day). So far, studies have primarily highlighted the importance of sleep *duration* for outcomes related to self-regulation at work, such as workplace and interpersonal deviance (Christian & Ellis, 2011), hostility (Scott & Judge, 2006; Welsh et al., 2014), and cyberloafing (Wagner, Barnes, Lim, & Ferris, 2012). Few studies have examined the relevance of sleep *quality* for organizational behavior (e.g., for unethical behavior at work and for abusive supervision, Barnes et al., 2014; Barnes et al., 2011).

When looking at past research on sleep duration and sleep deprivation on the one hand, and our results on sleep quality on the other hand, one might infer that sleep duration operates like a hygiene factor for the restoration of self-regulatory resources: That is, a personal minimum of sleep duration has to be obtained. Once obtained, sleep duration no longer seems to matter; however, the quality of sleep continues to matter. In this study, we observed naturally occurring sleep without manipulating sleep duration. By contrast, the studies mentioned above observed sleep-deprived subjects or employees experiencing sleep loss due to the change to daylight saving time (DST). Although sleep duration showed considerable day-to-day variation in our study, even on the days with shorter sleep the participants of our study might still have obtained their personal minimum of sleep—explaining why we did not find a relationship between sleep duration and the self-regulatory deficit of procrastination. Sleep researchers agree that the duration of sleep that is sufficient varies between individuals and across the lifespan (Hirshkowitz et al., 2015). Recent recommendations by the National Sleep Foundation are 7 to 9 hours of sleep for young adults (18 to 25 years) and adults (26 to 64 years), and 7 to 8 hours of sleep for older adults (older than 65 years). For young adults and adults, six to seven hours of sleep may be appropriate, and less than six hours of sleep are considered potentially to compromise health and well-being. (Hirshkowitz et al., 2015). We tested whether sleep duration matters only for procrastination when sleep is shorter than the recommended benchmarks, but additional post hoc analyses in our dataset on naturally occurring sleep did not reveal a non-linear relationship between sleep duration and procrastination.[4]

Regarding the benefits and threats of sleep *timing* for self-regulation, our study highlights the importance of the concept of social sleep lag for organizational behavior: A social sleep lag of more than 35 minutes seems to be a vulnerability factor that makes employees prone to display self-regulatory deficits at work *only when* they failed to get a good night's sleep. Contrary to expectations, results showed that employees experiencing social sleep lag did not, in general, procrastinate more than employees experiencing less social sleep lag. The most likely explanation for this unexpected finding is that employees who experience social sleep lag manage to compensate for it.[5] For example, when they feel tired because they have to start the workday before their preferred wake-up time, they might anticipate problems (e.g., difficulties concentrating and getting things done), and thus invest compensatory effort in order to attain their goals (Hockey, 1997). Research indeed has shown that people experiencing social sleep lag activate additional energetic resources by consuming more stimulants, such as caffeine and nicotine, compared to people experiencing less social sleep lag (Randler, 2008; Wittmann et al., 2006). A plausible hypothesis is that the investment of compensatory effort triggers accumulative effects that harm employees' health and performance in the long run. Research has indicated that accumulative long-term effects of social sleep lag seem to be likely because social sleep lag is related to elevated cortisol levels, increased resting heart rate (Rutters et al., 2014), depressive symptoms (Levandovski et al., 2011), and overweight and obesity (Parsons et al., 2015; Roenneberg et al., 2012). For example, with every hour of social sleep lag, the chances of being overweight or obese increase by 33% (Roenneberg, 2013). Looking at this phenomenon from a physiological perspective, researchers have assumed that being active during one's circadian window for sleep, and sleeping outside of one's circadian window, results in an imbalanced glucose metabolism that is associated with the metabolic syndrome (Roenneberg et al., 2012; Thaiss et al., in press). On a psychological level, sleeping outside of one's circadian window for sleep may result in inadequate self-regulatory resources, which impede individuals' intentions to exercise or to ensure a balanced diet.

Taken together, we conclude that a mismatch between individuals' implicit physiological regulation of the self in terms of sleep–wake patterns (chronotype) and external social requirements (work schedules) can substantially affect outcomes relevant for employees and organizations alike. Future research in organizational behavior might investigate indicators of latent decrement associated with compensatory effort (e.g., risky decision making at work) as well as longer-termed consequences, such as fatigue (Hockey, 1997). In addition, it might be useful to further investigate under which circumstances employees who experience social sleep lag are able to compensate, for example, by having a job that allows for within-workday activities during which the self-regulatory muscle is not taxed (Trougakos, Hideg, Cheng, & Beal, 2013; Zacher, Brailsford, & Parker, 2014). Social sleep lag may also be a critical variable to consider for research on other phenomena in organizational behavior that are closely connected to sleep and self-regulation, such as workplace deviance, cyberloafing, and abusive supervision—an area of research that has recently gained increasing attention (e.g., Barnes et al., 2014; Christian & Ellis, 2011; Wagner et al., 2012).

Future studies might more precisely address whether sleep and procrastination show reciprocal relationships. Whereas our study was focused on how sleep quality is related to procrastination the following workday, procrastination at work, in turn, might diminish employees’ subsequent sleep. Postponing the completion of activities at work may result in unfinished tasks weighing heavily on one’s mind during off-job time, potentially threatening recovery during non-work activities (Sonnentag & Fritz, 2007) as well as one’s sleep (Syrek & Antoni, 2014). Additional analyses in our dataset showed that day-specific procrastination at work was not a significant predictor of sleep quality the following night. However, whether incomplete work tasks result in impaired psychological detachment from work (Sonnentag & Fritz, 2007) or rumination about work-related issues (Syrek & Antoni, 2014) might depend on boundary conditions, such as specific characteristics of the tasks and the employee, which go beyond the focus of this study.

A limitation of the present study is that we used procrastination as an indicator of whether or not self-regulatory resources are available, but did not provide a direct measurement of self-regulatory resources as the explanatory construct. According to our theoretical rationale, the self-regulatory resources that prevent procrastination and enable efficient action initiation are closely tied to physiological processes and are only partly accessible through verbal self-report. Future research is thus needed that not only measures verbal manifestations of self-regulation (for instance, with questionnaire scales on self-control strenghts similar to what was done by, e.g., Lanaj et al., 2014), but implicit and physiological measures as well. Moreover, a promising strategy is to link within-person changes in the availability of self-regulatory resources to affective dynamics because self-regulation is closely tied to the regulation of positive and negative affect (Bledow, Schmitt, Frese, & Kühnel, 2011).

Practical Implications

We suggest two levers to diminish procrastination: improving sleep quality and reducing social sleep lag. Fostering sleep quality might be especially useful when employees anticipate a day on which procrastination is particularly harmful. Improving the quality of one's sleep could be achieved by following guidelines, such as not drinking caffeinated beverages before going to bed or not using the bed for activities such as eating or watching television (sleep hygiene behaviors; Mastin, Bryson, & Corwyn, 2006). Research on the relationships between mindfulness and sleep quality (e.g., Hülsheger et al., in press) has suggested that mindfulness may be another starting point to improve sleep quality. In a randomized control trial, Wolever and colleagues (2012) showed that employees' mindfulness can be fostered via mindfulness-based interventions in the workplace: Employees received a 12-week mindfulness-based stress management intervention that lasted 1 hour per week and was provided either in-person or online at the workplace. Participants' sleep quality improved two weeks after class (compared to a baseline two weeks before class), and compared with a control group, the intervention group had a greater improvement in sleep quality.

Our results underscore the importance of flexible work schedule arrangements for reducing social sleep lag, for example, in the form of idiosyncratic deals (“i-deals”), which allow for working arrangements that are better tailored to an employee’s personal needs (Hornung, Rousseau, & Glaser, 2008). To the best of our knowledge, so far, employee’s chronotype explicitly has not been taken into account (for a recent exception with shift-workers, see Vetter, Fischer, Matera, and Roenneberg, 2015, who aligned work time with chronotype in an intervention study). It needs to be noted, however, that a shift of mindset is necessary in order to avoid disadvantages for employees who make use of flexible work times and decide to come to work later in the morning and finish work later in the evening. In a recent study, Yam, Fehr, and Barnes (2014) showed that employees’ start times influence supervisor performance ratings: Employees starting earlier were perceived as being more conscientious and better performers, even when accounting for total work hours and objective job performance. The authors argued that these relationships arise because of a pervasive morning bias, that is, an association between beginning the day’s activities early in the morning and goodness. Interestingly, supervisors who themselves are late chronotypes are less likely to hold negative stereotypes of employees with late start times, compared to supervisors who are early chronotypes (Yam et al., 2014).

Another way to reduce social sleep lag is to support the entrainment processes of one’s biological (circadian) clock to the 24 hour-day-and-night rhythm. A strong *zeitgeber* (i.e., an environmental cue that entrains the biological clock) in the form of a large difference between daytime and nighttime light intensity can serve this purpose (Roenneberg et al., 2012). This can be achieved by exposing oneself to more natural light during the day (e.g., being outdoors instead of staying indoors all day long), and by avoiding light during the night (Wright et al., 2013). According to Roenneberg and colleagues (2003), on average, each additional hour spent outdoors per day corresponds to an advance of sleep onset of almost 30 minutes. Because being outdoors during work times might not be possible, working in an office that provides natural daylight exposure is advisable (Boubekri, Cheung, Reid, Wang, & Zee, 2014).

Conclusion

Humans' daily cycle consists of two complementary, interactive phases: sleep and wakefulness. This study shed light on the relevance of one phase, sleep, for the other, wakefulness, in terms of investigating the restorative character of high-quality sleep that prevents procrastination during subsequent wakefulness. Moreover, we introduced the concept of social lag to the field of organizational behavior, showing its relevance for effective self-regulation.

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Footnotes

[1] In this manuscript, we adopt a self-regulation perspective and focus on what Chun Chu and Choi (2005) termed "passive procrastination". We acknowledge, however, that there can also be positive forms of procrastination: For example, Chun Chu and Choi (2005) entitled individuals who intentionally put of work because they prefer to work under time pressure, are able to meet deadlines, and are satisfied with their outcomes as "active procrastinators" (see also p. 66 in Steel, 2007).

[2] Originally, this was termed "social jetlag" to emphasize that the difference in sleep timing between workdays and free days resembles the situation of traveling long distances across several time zones to the West on Friday evenings and flying back on Monday mornings (Roenneberg et al., 2012). Roenneberg and colleagues (2012) stated that "The symptoms of jetlag (e.g., problems in sleep, digestion, and performance) are manifestations of a misaligned circadian system. In travel-induced jetlag, they are transient until the clock re-entrains. In contrast, social jetlag is chronic throughout a working career" (page 939). In this paper, we will use the term "social sleep lag" to refer to the discrepancy that can arise between circadian and social clocks. We are grateful to an anonymous reviewer who suggested this term.

[3] As an alternative to measuring social sleep lag with difference scores, we also used residual scores. That is, we regressed the midpoint of sleep on free days on the midpoint of sleep on workdays. Using the residuals of the regression as a measure of social sleep lag, we repeated analyses presented in this paper: The results were the same. For the following three reasons, we use the difference score throughout this paper: (1) Because results were the same, but the interpretation of the difference score is easier (in number of hours); (2) because using residual change scores is generally not superior to using difference scores (Rogosa, 1995); and (3) because the difference score is commonly used in research on social sleep lag.

[4] We examined both curvilinear effects of sleep duration and a split-sample approach in order to test whether there was an inflection point for sleep duration in our sample. Results of regression analyses showed that neither a curvilinear term of person–mean centered sleep duration (Estimate = 0.019, *SE* = 0.014, t = 1.36), nor a curvilinear term of sleep duration aggregated over days (β = .011, t = 0.13, ΔR^2 = 0.00), was a significant predictor of procrastination. With the split-sample approach, we compared employees who slept, on average, less than six hours with those employees who slept, on average, six hours or more (Hirshkowitz et al., 2015). In our sample, mean sleep duration was seven hours and 15 minutes (*SD* = .87) and ranged between 5 to 9.9 hours (daily data aggregated over days). Only 6.5% of our sample slept less than six hours. Regarding procrastination, they did not significantly differ from employees who slept more than six hours ($t(152) = 0.245$, p = .81). Visual inspection of the scatterplot visualizing the relationship between sleep duration and procrastination did not point to any systematic relationship.

[5] One might speculate that compensation becomes progressively more difficult as social sleep lag becomes larger. However, results of regression analyses showed that a curvilinear term of social sleep lag was not a significant predictor of procrastination (Estimate = -0.025, *SE* = 0.025, t = -1.02).

Table 1

Means, Standard Deviations, and Intercorrelations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Daily procrastination	1.64	0.66		-.22***	-.05	-.10**	.01				
2. Daily sleep quality	3.48	0.96	-.19*		.28***	.05	.04				
3. Daily sleep duration (in hours)	7.15	1.13	-.01	-.09		.01	.04				
4. Daily time pressure	2.31	0.98	-.10	.12	-.03		-.16***				
5. Daily job control	3.70	0.89	-.02	-.02	.07	-.21**					
6. Social sleep lag (in hours)	1.64	1.00	.07	-.08	-.04	-.07	-.08				
7. Gender	1.50	0.50	.07	.03	.18*	.00	-.09	.06			
8. Age (in years)	38.36	13.48	-.32***	.15	-.13	.17*	.02	-.49***	-.03		
9. Professional experience (in years)	14.78	12.44	-.29***	.09	-.16*	.10	.03	-.44***	-.02	.92***	
10. Leadership position	0.28	0.45	-.08	.17*	-.12	.24**	.11	-.25**	-.19*	.28***	.22**

Note. Correlations below the diagonal are person-level correlations. Day-level data below the diagonal were averaged across days ($N = 154$). Correlations above the diagonal are day-level correlations ($N = 740$). Above the diagonal, day-level data were centered around the respective person-mean. 7. Gender: 1 = female, 2 = male. 10. Leadership position: 0 = no leadership position, 1 = leadership position.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2

Multilevel Estimates for Variables Predicting Day-Level Procrastination

	Null Model				Model 1				Model 2			
	Est	*SE*	*t*		Est	*SE*	*t*		Est	*SE*	*t*	
Intercept	1.659	0.040	41.38	***	1.661	0.038	43.70	***	1.660	0.037	43.89	***
Gender [a]					0.062	0.077	0.80		0.065	0.077	0.85	
Age					-0.011	0.002	-4.03	***	-0.013	0.003	-4.18	***
Leadership position [b]					0.029	0.090	0.32		0.015	0.090	0.17	
Social sleep lag									-0.056	0.044	-1.26	
Day-specific time pressure												
Day-specific job control												
Day-specific sleep duration												
Day-specific sleep quality												
Day-specific sleep quality × Social sleep lag												
-2 × log likelihood		1290.882				1274.0166				1272.417		
Δ-2 × log likelihood (*df*)						16.866	(3)***			1.598	(1)	
Level 1 Intercept Variance (*SE*)		.2422	(.0141)			.2421	(.0141)			.2420	(.0141)	
Level 2 Intercept Variance (*SE*)		.1944	(.0283)			.1692	(.0254)			.1671	(.0252)	
Level 2 Slope Variance (*SE*)												
Level 2 Intercept-Slope Covariance (*SE*)												

Note. Est = Estimate. [a]1 = men, 2 = women. [b] 0 = no leadership position, 1 = leadership position. † $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2 (continued)

Multilevel Estimates for Variables Predicting Day-Level Procrastination

	Model 3			Model 4			Model 5a			Model 5b		
	Est	*SE*	*t*	Est	*SE*	*t*	Est	*SE*	*t*	Est	*SE*	*t*
Intercept	1.660	0.038	43.65 **	1.660	0.037	43.90 ***	1.661	0.038	43.81 ***	1.661	0.037	43.85 ***
Gender [a]	0.065	0.078	0.83	0.065	0.077	0.85	0.039	0.074	0.53	0.036	0.075	0.49
Age	-0.013	0.003	-4.09 **	-0.013	0.003	-4.18 ***	-0.0131	0.003	-4.09 ***	-0.013	0.003	-4.10 ***
Leadership position [b]	0.015	0.085	0.18	0.015	0.090	0.16	-0.018	0.087	-0.21	-0.019	0.088	-0.22
Social sleep lag	-0.056	0.040	-1.38	-0.056	0.044	-1.27	-0.076	0.043	-1.75 †	-0.055	0.044	-1.24
Day-specific time pressure	-0.071	0.033	-2.17 *	-0.063	0.029	-2.17 *	-0.056	0.029	-1.95 †	-0.053	0.028	-1.85 †
Day-specific job control	-0.007	0.036	-0.20	0.000	0.032	0.03	-0.003	0.031	-0.10	-0.003	0.031	-0.10
Day-specific sleep duration				0.004	0.024	0.17	0.005	0.024	0.80	0.007	0.024	0.30
Day-specific sleep quality				-0.125	0.024	-5.11 ***	-0.127	0.026	-4.84 ***	-0.130	0.025	-5.04 ***
Day-specific sleep quality × Social sleep lag										-0.058	0.025	-2.31 *
-2 × log likelihood		1266.656			1239.469			1227.856			1222.575	
Δ-2 × log likelihood (*df*)		5.761	(2) †		27.186	(2)***		11.614	(2)**		5.280	(1)*
Level 1 Intercept Variance (*SE*)		.2397	(.0140)		.2288	(.0133)		.2200	(.0140)		.2189	(.0139)
Level 2 Intercept Variance (*SE*)		.1676	(.0252)		.1700	(.0252)		.1730	(.0253)		.1729	(.0253)
Level 2 Slope Variance (*SE*)								.0118	(.0096)		.0099	(.0092)
Level 2 Intercept-Slope Covariance (*SE*)								-0.035	(.0121)		-0.033	(.0119)

Note. Est = Estimate. [a]1 = men, 2 = women. [b] 0 = no leadership position, 1 = leadership position. † $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 1

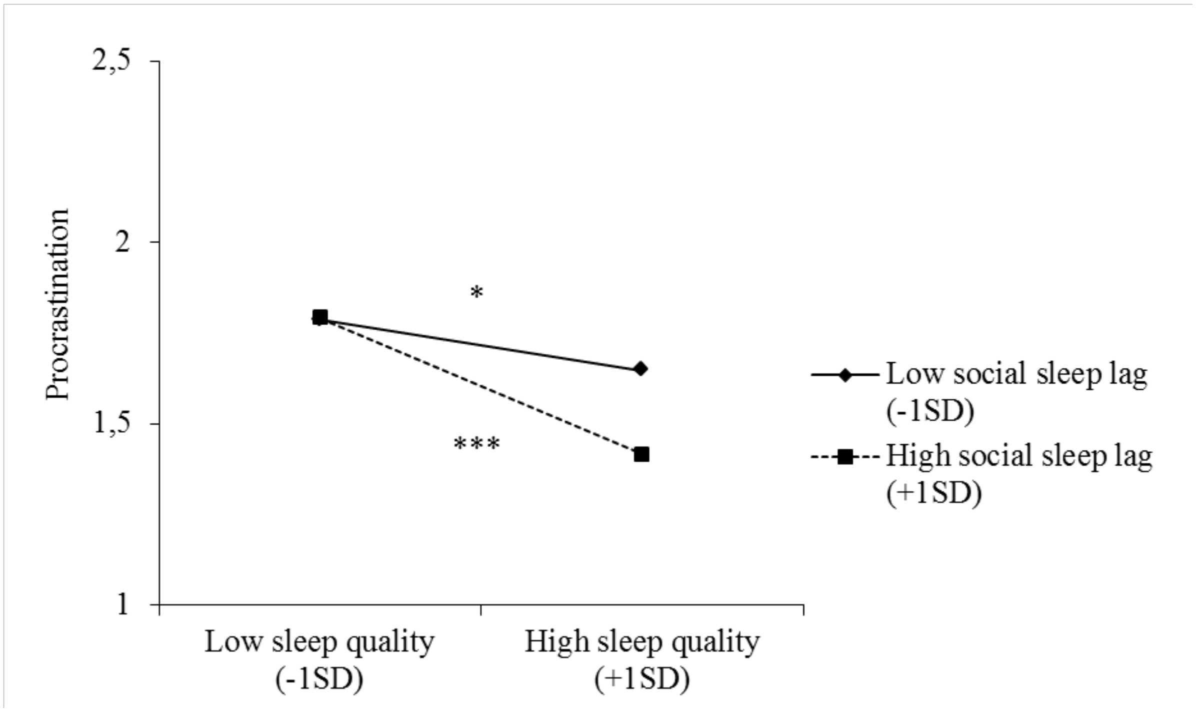

Figure 1. Cross-level interaction of social sleep lag on the relationship between day-specific sleep quality and procrastination at work. Asterisks indicate results of simple slope tests. * $p < .05$. *** $p < .001$.