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SPECIAL ISSUE PAPER

Illegitimate Tasks and Sleep Quality: An Ambulatory Study

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Abstract

The current study investigated the short-term effect of illegitimate tasks on sleep quality, assessed by actigraphy. Seventy-six employees of different service jobs participated in a 2-week data collection. Data were analysed by way of multilevel analyses. As predicted, illegitimate tasks were positively related to sleep fragmentation and sleep-onset latency, but not to sleep efficiency and not to sleep duration. Time pressure, social stressors at work and at home, and the value of the dependent variable from the previous day were controlled. Results confirm the predictive power of illegitimate tasks for a variable that can be considered crucial in the development of long-term outcomes of daily experiences. Copyright © 2014 John Wiley & Sons, Ltd.

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Keywords

actigraphy; sleep; recovery; illegitimate tasks; threat to self; occupational stress

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Introduction

This study aims to extend research in the field of occupational stressors and sleep by considering the new concept of daily illegitimate tasks, tasks that cannot properly be expected from an employee, as a predictor of impaired sleep quality.

Sleep is one of the most important recovery mechanisms available to humans (Cropley, Dijk, & Stanley, 2006); it can be considered a critical link in the relationship between occupational stressors and health. Indeed, Pereira and Elfering (2013) showed in a longitudinal study that occupational stressors predicted increased psychosomatic health impairments 6 weeks later, and this effect was fully mediated by physiologically assessed sleep characteristics. Heretofore, most studies investigating the effect of work stressors on sleep have focused on work conditions over fairly long periods (e.g. Åkerstedt, Fredlund, Gillberg, & Jansson, 2002). Such studies do not link fluctuations in working conditions with sleep on a daily basis, but they test whether people who report high work stressors experience lower sleep quality months to years later. In contrast, studies investigating short timeframes, such as diary studies, link work conditions and sleep more immediately. It is reasonable to assume that daily work stressors such as illegitimate tasks have immediate effects, for instance in terms of physiological arousal (e.g. cortisol excretion; cf. Kottwitz et al., 2013) or lack of psychological detachment from work (Sonnentag & Kruel, 2006). These effects may be short lived, but they may also continue into the evening (Judge & Ilies, 2004), and they may lead to impaired sleep quality (Cropley et al., 2006). Long-term health problems often result from an accumulation of short-term problems (Ohly, Sonnentag, Niessen, & Zapf, 2010), implying the necessity to study antecedents of short-term problems. As sleeping problems predict ill health (Åkerstedt, Nilsson, & Kecklund, 2009), and as more permanent sleeping problems may result from an accumulation of short-term sleeping problems, it is important to study the immediate antecedents of daily sleeping problems. Likely candidates for antecedents of sleeping problems are occupational stressors (Pereira, Meier, & Elfering, 2013), including the newly developed concept of illegitimate tasks. It therefore is important to study fluctuations in occupational stressors as potential triggers of fluctuations in sleeping problems. If such a link can be established, the chain leading from short-term stress effects to long-term health problems may be better understood theoretically, and recommendations can be made for prevention.

Work stressors, lack of detachment and sleep quality

The causes of low sleep quality are diverse; however, evidence is increasing that short-term work stress may play an important role in the development of disturbed sleep quality in the upcoming night (Pereira et al.,

2013). Effort-recovery theory (Meijman & Mulder, 1998) and allostatic load theory (McEwen, 1998) offer a framework for conceptualizing such processes. According to these approaches, job demands require effort, which involves adaptive psychophysiological reactions, such as accelerated heart rate and elevated blood pressure. Under normal conditions, these acute reactions are short lived and reversible within a short period. Thus, if the acute load is followed by a period in which the systems concerned are not highly activated, recovery will set in, and the respective psychophysiological systems will stabilize again at baseline (prestressor) level. Under optimal circumstances, recovery sets in after work and is completed by the following morning. However, sometimes stressful work conditions may lead to psychophysiological load reactions that persist after work and are still present when one goes to sleep. Such increased load reactions are incompatible with the deactivation that is a main characteristic of sleep; as a consequence, sleep quality may be impaired.

One psychological experience that prolongs arousal beyond the immediate stress situation is lack of psychological detachment from work (Sonnentag & Fritz, 2007). Psychological detachment might best be described as an individual's subjective sense of being away from the work situation (Etzion, Eden, & Lapidot, 1998). Lack of psychological detachment not only implies that one is still dealing with work-related duties, such as receiving job-related calls, but it also means not being able to disengage mentally from work and to stop thinking about work or work-related problems (Sonnentag & Fritz, 2007). Lack of detachment is thereby often experienced as 'failed switching off' when away from one's work (Sonnentag & Bayer, 2005). According to Sonnentag and Kruel (2006), occupational stressors can be related to lack of detachment from work during work-off time. It therefore is promising to consider lack of detachment as mediating mechanism between occupational stressors and impaired sleep quality.

There has been an increasing amount of research on short-term effects of occupational stressors on sleep quality; these studies have typically focused on the variables emphasized by classical models of occupational stress, such as the demand-control model (e.g. Åkersted, Fredlund, et al., 2002; Åkerstedt, Knutsson, et al., 2002). This work undoubtedly is important. However, it neglects a potentially very powerful aspect of stress at work, that is, social aspects, especially social messages that offend the self; such aspects are emphasized in the 'Stress as Offense to Self' (SOS) concept, introduced by Semmer, Jacobshagen, Meier, and Elfering (2007).

The concept of 'Stress as Offense to Self' and sleep quality

On the basis of the well-established fact that people strive to protect their self-esteem (Baumeister & Vohs, 2003; Epstein, 1998; Sedikides & Gregg, 2008; see also the concept of SOS by Semmer et al., 2007), Semmer et al. (2007) argued that anything that signals a lack of appreciation and respect, and thus constitutes a threat to self-esteem, is especially upsetting and frustrating and is likely to play a major role in the experience of stress (see also Lazarus, 1999).

Obviously, a rather direct threat to the self is associated with social behaviour that involves conflict, tension and discrimination. Containing (negative) social evaluations, such stressors have a great potential for inducing prolonged stress (social-evaluative threat; Dickerson & Kemeny, 2004) because they constitute an especially strong threat to the need to belong (Leary & Baumeister, 2000), and thus, to the self (Meier, Gross, Spector, & Semmer, 2013). Pereira et al. (2013) analysed the effect of social exclusion (which also represents a threat to self) on sleep and found that social exclusion was positively related to objectively assessed sleep fragmentation the following night.

Social exclusion can be considered a rather direct message of disrespect that is contained in the behaviour of others in social interactions. In addition to behaviour in social interactions, however, aspects of job design also may indirectly send 'social messages' that are offending (Semmer & Beehr, 2014). An example can be found in the concept of illegitimate tasks, which has been developed in the context of the SOS concept. In this study, we focus on this specific stressor, which contains such an indirect demeaning message.

Illegitimate tasks

The concept of illegitimate tasks was introduced by Semmer et al. (2007) on the basis of role theory, identity theory and justice theory. Roles imply expectations; they specify what may appropriately be expected from a role occupant (Burke & Stets, 2009; Katz & Kahn, 1978). However, if roles specify what may be expected from someone, there also must be things that *cannot* be expected; this consideration constitutes the basis for the concept of illegitimate tasks: Tasks are considered legitimate to the extent that they conform to norms about what can appropriately be expected from a given person, and they are illegitimate to the extent that they violate such norms. Their (perceived) illegitimacy may derive from (i) the perception that a task does not conform to an employee's professional role (*unreasonable* task), as when a company janitor is told to care for the private lawn of his or her boss, or when experienced employees are assigned a novice's work; or (ii) the perception that a task is *unnecessary*, such as having to document information that no one will ever use, which many think cannot be expected from employees (cf. Kottwitz et al., 2013; Semmer et al. (2014); Semmer, Tschan, Meier, Facchin, & Jacobshagen, 2010; Stocker, Jacobshagen, Semmer, & Annen, 2010).

Professional roles tend to become part of one's identity (Burke & Stets, 2009; Sluss & Ashforth, 2007), and therefore, by violating role expectations, illegitimate

tasks offend one's professional identity. They constitute 'identity-stressors' and thus are an offense to the self (Semmer et al., 2007). More specifically, being assigned illegitimate tasks may be interpreted as a demeaning social message, as one's professional role—in terms of a specific profession or in terms of the general role as an employee—is not respected. Such disrespect is likely to be perceived as unjust (Cropanzano, Byrne, Bobocel, & Rupp, 2001), and therefore as stressful (Greenberg, 2010).

Tasks are not illegitimate *per se*; rather, their illegitimacy depends on the context, most notably the professional characteristics of the people involved. Thus, the same task may be legitimate for one person but illegitimate for another one (e.g. caring for the lawn would be perfectly legitimate for a grounds keeper or gardener). Even for the same person, legitimacy may vary depending on the situation and the context (e.g. taking care of the lawn may be legitimate if the boss is hosting a dinner for important company guests; cf. Semmer et al., 2010).

As emphasized ealier, threats to the social self are powerful stressors. If the reasoning behind illegitimate tasks is correct, they should show effects on strain over and above other stressors. As the concept is quite recent, there are not many studies assessing the effects of illegitimate stressors. However, the evidence that does exist shows effects of illegitimate tasks on a variety of outcomes. Thus, Stocker et al. (2010) documented associations with job satisfaction and feelings of resentment towards one's organization; Semmer et al. (2010) showed associations with counterproductive work behaviour; Semmer et al. (2007) report associations with irritation, feelings of resentment and burnout, including a longitudinal prediction of irritation and resentment; Kottwitz et al. (2013) reported illegitimate tasks being associated with increased cortisol levels among participants high in vulnerability in terms of relatively low perceived health. Only the Kottwitz et al. study conducted intra-individual analyses, and none of these studies focused on sleep. However, on the basis of the argument that illegitimate tasks represent a threat to the self and that threats to the self have a high potential for strong and long-lasting stress reactions, it is reasonable to assume that illegitimate tasks induce cognitive reactions that are associated with increased psychophysiological arousal at bedtime; such arousal is incompatible with the deactivation that is a main characteristic of sleep. We therefore postulate that illegitimate tasks are related to lack of psychological detachment and impaired sleep. Showing such an association would constitute another piece of evidence indicating the importance of this new stressor concept.

Note that illegitimate tasks may be considered 'social' stressors because of the demeaning social message they are assumed to imply (social-evaluative threat; Dickerson & Kemeny, 2004). In contrast to directly delivered demeaning messages (e.g. unfair criticism, insults), however, they deliver this message indirectly, through task design. If our reasoning is correct, illegitimate tasks are social stressors, but they should explain variance in outcome variables beyond classical social stressors, which refer to tension and conflict, and thus to more directly depreciative behaviour.

Present study

Previous research on the relationship between occupational stressors and sleep mainly used self-reports (Binnewies, Sonnentag, & Mojza, 2010), which are subject to social desirability and self-serving bias. Furthermore, in studies relying solely on self-reports, common method variance may be a problem (Semmer, Grebner, & Elfering, 2004). Although the problem of common method variance likely has been overstated (Spector, 2006), it seems advisable to show that associations between stressors and outcome variables, such as sleep, can be found when employing measures other than self-report. Furthermore, some sleep parameters (e.g. sleep fragmentation) are not easily assessed by self-observation. Therefore, in this study, we examined the short-term effects of illegitimate tasks on physiologically assessed sleep quality.

Sleep quality represents a phenomenon that is difficult to define and to measure objectively (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989); it includes a variety of aspects, such as sleep-onset latency, sleep efficiency, sleep fragmentation and sleep duration. However, there is no consensus about which of these aspects are especially important for recovery (Åkerstedt et al., 2009). Empirical studies (e.g. Pereira et al., 2013, Pereira and Elfering, 2014) have not yielded a clear picture, with some studies showing an effect on one parameter, and others on another one; sleep fragmentation was the only variable that was always affected. Currently, therefore, we see no theoretical or empirical basis for assuming that any of these parameters should be affected more (or less) than the other ones.

Our diary study extends previous research on sleep by focusing on the short-term effect of the new concept of illegitimate tasks on several sleep quality parameters, and by using physiological assessments rather than self-report measures.

Illegitimate tasks are believed to represent a threat to the self; to the extent that this is true, they should be powerful stressors. Thus, they should impair psychological detachment after work and when one goes to sleep, making the deactivation that is a main characteristic of sleep difficult to accomplish; as a consequence, sleep quality may be impaired.

In sum, we postulate that illegitimate tasks are related to impaired sleep quality (H1) in terms of increased fragmentation (H1a), increased onset latency (H1b), decreased efficiency (H1c) and decreased sleep duration (H1d). Furthermore, we postulate that lack of detachment should mediate the relationship between illegitimate tasks and sleep quality (H2).

Materials and methods

Participants and design

Participants were recruited via personal advertisement by six master's degree students. Potential participants from a variety of occupations were contacted via snowball sampling by telephone or mail, or personally. They received initial information about the study, such as topic, duration and design, and were asked if they were interested in participating. To be eligible, participants had to work at least 60% of a full-time equivalent (FTE). To compensate participants for their time and to encourage participation, we offered them individual feedback about their work situation and well-being at the end of the study.

After participants gave their consent, survey packages were handed to them. These packages included a general questionnaire containing demographic variables, diary booklets and the Sensewear Armband (BodyMedia, Inc., Pittsburgh, PA) as well as instructions about the use of the daily surveys and the ambulatory assessment. Furthermore, in face-to-face meetings, research assistants instructed participants in how to use the ambulatory assessment device and asked them to put them on when going to sleep. They further instructed participants to complete the general questionnaire and to return it before the diary study started. At the beginning of the following week, they began completing time-based daily surveys and using continuous ambulatory assessment for two consecutive working weeks (including weekends). Note that only weekdays were included in the current analyses and that the number of diaries varies depending on the amount of work days and missing values.

To ensure anonymity, and to match the data collected, participants were asked to provide a personal code on the questionnaire and the diaries. At the end of the study, the research assistants collected the diary booklets and the Sensewear Armbands and debriefed the participants.

The final sample consisted of 76 employees of several Swiss organizations (as we contacted participants via snowball sampling, we do not know the exact response rate). Participants held a variety of jobs, all of which were service jobs, such as cashiers at supermarkets and call-centre agents. Participants were mostly female (75%); age ranged from 19 to 63 years [standard deviation (SD) = 10.57]. About one fourth (24%) of the participants had completed primary education (9 years), 68% had completed secondary education and 7% held a college or university degree. Average job tenure was 4.3 years (SD = 5.87). Most participants worked full-time (range 60–100% of an FTE). Sample size on level 2 was 76, which exceeds the recommended minimum sample size of 50 (Maas & Hox, 2005). Owing to missing values (i.e. participants did not work on a particular day, forgot to fill in one of the diaries or did not wear the device, the device did not collect data correctly), the size on level 1 varies for the different variables; for most analyses, N is 403; however, for analyses involving sleep efficiency, which is a function of actual sleep duration and time spend in bed, it is 194. Multilevel analysis can deal with varying numbers of observations, but standard errors increase as the number of missing values becomes higher.

Measures

General questionnaire

The general questionnaire contained questions about the demographic background, e.g. gender and age, as well as trait negative affectivity; it was filled in before the diary study began.

Diary

Time-based diaries were used to assess illegitimate tasks, time pressure, social stressors at work and work-related negative affect on a daily level. The diary was to be completed daily, shortly after quitting the workplace. Furthermore, another diary was used to assess social stress after work, psychological detachment, alcohol consumption and use of medication. This diary also was to be completed daily, shortly before going to sleep.

Daily illegitimate tasks

Daily illegitimate tasks were measured by the *Bern Illegitimate Tasks Scale* (BITS; Semmer et al., 2010). The BITS consists of eight items, which were adapted to refer to the specific day (e.g. 'Today, did you have work tasks to take care of, which you believe should be done by someone else?'; 'Today, did you have work tasks to take care of, which kept you wondering if they make sense at all?'). Participants rated each item on a five-point Likert scale, ranging from 1 (*very rarely/never*) to 5 (*very often*). Cronbach's alpha ranged from 0.87 to 0.89 across the days ($M = 1.91$; SD = 0.73).

Psychological detachment

We argued earlier that stressors might impair sleep through prolonged reactions in terms of arousal and/or cognition. We therefore included lack of psychological detachment from work on the day level as a potential mediator. Psychological detachment was measured with a four-item scale developed by Sonnentag and Fritz (2007), adapted for use in a diary study. The items used were 'Today I forgot about work', 'Today I didn't think about work at all', 'Today I distanced myself from work' and 'Today I got a break from the demands of work'. The items were scored on a five-point scale ranging from *strongly disagree* (1) to *strongly agree* (5). Cronbach's alpha ranged from 0.87 to 0.94 ($M = 3.81$; SD = 1.12). Psychological detachment was assessed daily, shortly before going to bed.

Sleep actigraphy

There are many ways to objectively assess sleep, such as polysomnography (PSG), electroencephalography

(EEG), electrooculography and electromyography. Sleep evaluation in humans has usually been performed with PSG, which has been considered the gold standard for detecting sleep impairments in humans (De Souza et al., 2003). However, during the last decade, actigraphy has become an accepted tool in sleep research and sleep medicine (Sadeh & Acebo, 2002). The term actigraphy refers to methods using miniaturized computerized wristwatch-like devices to monitor movements. Through integrated algorithms, sleep parameters can be derived. Compared with the 'gold standard' of PSG, actigraphy can be seen as a good way to provide low-cost, non-invasive, objective and continuous data for the diagnosis of sleep disorders in ambulatory settings (Kushida et al., 2001). The comparison of actigraphy with PSG has yielded agreement rates between 78% and 95% (Kushida et al., 2001). According to a study conducted by Morgenthaler et al. (2007), actigraphy is a valid way to determine sleep patterns in normal, healthy populations as well as in patients suspected of sleep disorders. These findings are corroborated by Germain, Buysse, and Kupfer (2006), who found that the algorithm correctly identified 93% of all sleep episodes and 83% of all wakefulness episodes when compared with the gold standard of EEG measurements in the sleep laboratory. In a recent study, Kawada et al. (2011) compared Sensewear-detected rotational body movements at night with video recordings and showed 72% agreement without systematic deviation; there were equal percentages of undetected movements (false negatives; 15.3%) and false-positive detection of movements (13.5%). Moreover, a recent study by Wouwe, Valk, and Veenstra (2011) also showed Sensewear armbands to be sensitive, accurate and specific. The validity of BodyMedia Sensewear Armband has also been shown in the laboratory (Lotjonen et al., 2003).

In the current study the actigraph used was BodyMedia's Sensewear Armband, a multi-accelerometer device similar to a regular actigraph. Every minute, two-axis oscillometric sensors assess body movements, surface body temperature, galvanic skin response and heat flux. Participants wore the armband on the non-dominant arm throughout the night, that is, from lights off until standing up in the morning. Data were analysed with BodyMedia software, which estimates sleep phases and wake phases using computer algorithm-defined thresholds of activity. From these data, sleep-onset latency, sleep efficiency, sleep fragmentation and sleep duration can be derived (Littner et al., 2003).

Sleep-onset *latency* was coded as the time participants needed to fall asleep after going to bed. Sleep *efficiency* is defined as the percentage of time spent asleep between sleep onset and last awakening in the morning. Sleep *fragmentation* was coded as the number of awakenings that lasted 5 min or longer *and* were preceded and followed by at least 15 min of uninterrupted sleep (Sadeh, Keinan, & Daon, 2004). Sleep *duration* represents the time in minutes of sleep until waking up.

We controlled our data for inaccurate measurements (e.g. malfunction of the actigraphs) by evaluating visual graphs produced by the software and by evaluating the exported raw data; such inaccurate measurements were coded as missing data. Note that naps during the day were not included in the analyses.

Control variables

To make sure that results would not be due to sleep impairment leading to more illegitimate tasks (e.g. participants are given such tasks because they appear tired and not fully capable to perform as usually), we controlled for the preceding measure of the outcome variable (autocorrelation; sleep quality indicator of the previous day). Furthermore, daily use of medication and alcohol consumption were entered as control variables. Additionally, we controlled for daily social stressors at work and social stress after work. As we postulated that illegitimate tasks have a certain conceptual overlap with social stressors in terms of social-evaluative threat, and as direct social-evaluative threat has been found to reliably predict sleep impairments (e.g. Åkerstedt et al., 2002; Pereira et al., 2013), we controlled for social stressors in order to be sure that illegitimate tasks are able to predict sleep impairments over and above these stressors. To make sure that effects are not due to time pressure, which is one of the most common stressors, and linked to poor unwinding (Sonnentag & Kruel, 2006) as well as to impaired sleep (e.g. Åkerstedt et al., 2002; Pereira et al., 2013), we controlled for daily time pressure as well. Finally, to ensure that BITS values actually reflect illegitimate tasks and not simply work-related negative affect, we also controlled for state negative affect.

Use of medication

Use of medication was assessed with the single item: 'Did you use any medical drugs today?'; participants could answer with *no* (0) or *yes* (1).

Alcohol consumption

Alcohol consumption was assessed using the single item: 'Did you consume alcohol today?', to which the participants could answer *no* (0) or *yes* (1).

Social stressors at work

Social stressors refer to negative interactions with colleagues and supervisors and were measured with a scale by Frese and Zapf (1987), containing 10 items, which were adapted to the day level (e.g. 'Today at work, I had a conflict with some colleagues'), using a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha ranged from 0.68 to 0.79 ($M = 1.13$; $SD = 0.22$).

Time pressure at work

Time pressure was measured by four adapted items (e.g. 'Today, I had time pressure at work') on the basis

of the *Instrument for Stress Oriented Task Analysis* (Semmer, Zapf, & Dunckel, 1995). The items require a response on a five-point scale ranging from 1 (*very seldom/never*) to 5 (*very often*). Cronbach's alpha ranged from 0.72 to 0.77.

Social stress after work

Social stress after work was assessed with three items developed for this study (e.g. 'Today, after leaving work, I let my frustration out on my partner'; 'Today, after leaving work, I let my frustration out on my children'; 'Today, after leaving work, I let my frustration out on my colleagues'). The items require a response on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha ranged from 0.78 to 0.92 ($M = 1.10$; SD = 0.30).

State negative affect

State negative affect was assessed with 12 items from the *PANAS-X* scale (Watson and Clark, 1994) that were adapted to represent a work-related state measure. Example items are as follows: 'Today, after leaving work, I felt upset'; 'Today, after leaving work, I felt displeased'. The items require a response on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha ranged from 0.81 to 0.89 ($M = 1.15$; SD = 0.28).

Sex and age

Furthermore, we entered age and gender as control variables in the analyses.

Procedure/analysis

Because the daily data (level 1) were nested within person (level 2), we computed multilevel models using the HLM 6.08 program (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004). The focus of the analyses was on the within-person relationships between daily illegitimate tasks and sleep impairments. With the exception of two dichotomous variables (medication and alcohol consumption), level 1 predictors were group mean centred. Thus, the effects of these variables can be interpreted relative to the persons' own mean across all days. Except for gender, which was dichotomous, level 2 variables were grand mean centred. We used the restricted maximum-likelihood procedure to estimate the parameters. Unstandardized coefficients are reported.

Lack of detachment was entered last; if it was significant, and if illegitimate tasks were significant before lack of detachment was entered, we proceeded to test if lack of detachment mediated the effect of illegitimate tasks on the respective indicator of sleep quality, including calculating the indirect effect with the Sobel test tool devised by Preacher and Leonardelli (2014).

Results

Means and SDs for the measures are presented in Table I. Before testing our hypotheses, we calculated null models to estimate the proportion of variance accounted for the day and person level, respectively (Nezlek, 2001). The intraclass correlation (ICC) obtained was 0.38 for daily illegitimate tasks, 0.29 for sleep fragmentation, 0.15 for sleep-onset latency, 0.43 for sleep efficiency and 0.94 for daily sleep duration; except for sleep duration, these values indicate that there is substantial variation within individuals in the dependent variables.

To test if daily illegitimate tasks are negatively related to sleep quality during the following night, we regressed sleep-onset latency, sleep efficiency, sleep fragmentation and sleep duration on daily illegitimate tasks in four separate analyses. We tested each hypothesis with four models. Model 1 was the null model; we then successively added predictors: control variables (model 2), illegitimate tasks (model 3) and lack of psychological detachment (model 4). The improvement of each model over the previous one was tested with the difference between the respective likelihood ratios. In line with our assumptions, daily illegitimate tasks were positively related to sleep fragmentation ($\gamma = 3.38$, $p < 0.05$) and to sleep-onset latency ($\gamma = 2.44$, $p < 0.05$). However, daily illegitimate tasks were not significantly related to sleep efficiency ($\gamma = -3.08$, $p > 0.10$), and to sleep duration ($\gamma = -3.82$, $p > 0.10$). Thus, two of our four hypotheses were supported (Tables II–V).

Our second hypothesis postulated that lack of psychological detachment at bedtime would mediate the relationship between illegitimate tasks and sleep quality. However, lack of detachment did not significantly predict any of the four sleep parameters. Thus, a central prerequisite for a mediation to occur was not present, and we therefore did not proceed to analyse mediation effects.

Discussion

Sleep quality has been considered an intervening variable in the relationship of acute reactions to stress and the development of health impairments in the long run (Geurts & Sonnentag, 2006; Pereira & Elfering, 2013). To prevent poor health, short-term effects of occupational stressors on sleep quality should be analysed and understood. Previous research on the effects of stressors on sleep has been dominated by variables proposed for classical stressors such as time pressure. The aim of the present study was to extend this research by focusing on a new stressor, namely the concept of illegitimate tasks. We argued that illegitimate tasks represent a threat to the self, and that threats to the self have a high potential for increasing psychophysiological load reactions at bedtime, which are incompatible with the deactivation that is a main characteristic of sleep. We therefore postulated that illegitimate tasks

Table I. Descriptive statistics among the study variables

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
General measures (level 2)																	
1	Sex[a]	0.75	—	—	−0.10	0.09	−0.06	0.06	0.19	−0.07	−0.26*	0.24*	−05	0.14	−0.01	−0.08	0.04
2	Age	30.24	10.57	−0.10	0.64**	0.06	0.14	0.03	0.09	0.03	−0.13	−0.16	0.02	−0.12	0.04	0.13	−0.33*
Daily measure (level 1)																	
3	Medication[b]	0.16	—	0.11*	0.05	—	0.04	0.21	0.31	0.32	0.17	0.13	−0.16	−0.25	−0.08	0.22	−0.05
4	Alcohol use[c]	0.31	—	0.12**	0.06	0.60	—	−0.07	−0.03	0.08	0.12	0.13	0.04	0.04	0.00	−0.16	0.19
5	Sleep duration	340.98	110.62	−0.04	0.11*	−0.01	−0.04*	—	0.18	0.04	0.13	−0.02	0.03	0.09	0.24*	0.12	0.06
6	Sleep efficiency	83.86	10.50	−0.06	0.10*	−0.03	−0.09	0.28**	—	−0.12	−0.43**	−0.09	−0.08	−0.21	0.12	0.10	0.02
7	Sleep-onset latency	8.39	8.21	−0.03	0.18**	0.02	0.01	−0.04	−0.24	—	0.08	0.02	0.20	−0.02	0.18	0.12	−0.08
8	Sleep fragmentation	9.86	6.18	−0.02	0.17**	0.06	0.09*	0.29**	−0.17	−0.00	—	−0.06	−0.01	−0.08	0.07	0.06	0.07
9	State neg. affect	1.15	0.28	−0.03	−0.04	0.00	−0.06*	−0.08	0.01	0.03	−0.00	—	0.41**	0.51**	0.27*	−0.36**	0.31**
10	Time pressure	2.40	1.10	−0.03	−0.05	−0.02	−0.11	0.01	0.05	0.05	−0.07	0.06	—	0.38**	0.25*	−0.24*	0.18
11	Social stressors at work	1.13	0.22	0.15**	0.10*	0.03	−0.01	0.02	−0.02	0.03	−0.03	0.11	0.11	—	0.48**	−0.36**	0.29**
12	Illegitimate tasks	1.91	0.73	−0.03	−0.04	−0.05	0.03	0.10	−0.01	0.12*	0.14*	−0.03	0.15	0.28	—	−0.09	0.19
13	Detachment	3.81	1.12	−0.03	−0.05	0.04	0.02	−0.03	−0.03	0.01	0.06	−0.11*	−0.07	−0.04	0.05	—	−0.31**
14	Social stress after work	1.10	0.30	−0.03	−0.05	0.02	−0.05	−0.02	−0.01	0.02	−0.08	0.21*	0.05	0.17	−0.05	−0.11	—

Note. Correlations below the diagonal are day-level correlations ($N = 403$). Correlations above the diagonal are person-level correlations ($N = 76$).

SD: standard deviation.

[a]0 = *female*, 1 = *male*.

[b]0 = *no medicaments*, 1 = *medication*.

[c]0 = *no alcohol*, 1 = *alcohol*.

**$p < 0.01$;

*$p < 0.05$;

Table II. Predicting physiologically assessed sleep fragmentation by illegitimate tasks

	Model 1		Model 2		Model 3		Model 4	
Variables	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Intercept	9.75**	0.48	10.15**	1.10	9.76**	1.09	9.74**	1.09
Level 2 variables								
Sex[a]			−0.61	1.21	−0.39	1.23	−0.40	1.24
Age			−0.02	0.04	−0.02	0.04	−0.02	0.04
Level 1 variables								
Medication[b]			−0.37	1.10	0.12	1.08	0.22	1.08
Alcohol use[c]			0.15	1.18	0.44	1.12	0.52	1.12
Time pressure			−0.09	0.41	−0.23	0.42	−0.23	0.41
Social stressors at work			−1.02	2.81	−5.00*	2.85	−5.25*	2.86
Social stress after work			2.20	1.49	2.39*	1.40	2.38*	1.37
State neg. affect			0.11	1.88	0.48	1.78	0.43	1.76
Autocorrelation@p[d]			−0.12	0.11	−0.14	0.11	−0.15	0.11
Illegitimate tasks					3.38*	1.74	3.58*	1.88
Detachment							−0.24	0.62
−2 × log		2218.880		1316.293		1292.531		1285.90
Diff −2 × log				902.587*		23.762*		6.634
df				9		1		1

Note. Unstandardized coefficients are reported.
SE: standard error; df: degrees of freedom.
[a]0 = *female*, 1 = *male*.
[b]0 = *no medication*, 1 = *medication*.
[c]0 = *no alcohol*, 1 = *alcohol*.
[d]Sleep quality parameter previous night (*N* level 1 = 402; *N* level 2 = 76).
**$p < 0.01$;
*$p < 0.05$, one tailed.

should be related to various indicators of impaired sleep quality, namely increased sleep fragmentation, increased sleep-onset latency, decreased sleep efficiency and decreased sleep duration. Furthermore, we assumed that lack of psychological detachment should mediate this relationship. To test our hypotheses, we conducted a diary ambulatory study.

Supporting our first hypothesis for two of the four indicators, multilevel regression analyses showed that daily illegitimate tasks predicted more sleep fragmentation and longer sleep-onset latency. However, daily illegitimate tasks were not related to sleep efficiency or to sleep duration. Note, however, that ICC for sleep duration was 0.94, indicating that most of the variance in this variable is between individuals. Thus, people differ in the number of hours they typically sleep on work days, but each individual's sleep duration is fairly constant across work days, leaving not much variance in sleep duration to be explained. According to Wesensten, Balkin, and Belenky (1999), some sleep quality indicators (e.g. sleep fragmentation) may systematically affect recuperation independently of total sleep time. Thus, one may stay longer in bed to get some extra sleep after having difficulties falling asleep (sleep-onset latency) and staying asleep (sleep fragmentation, more movements during sleep).

Overall, our results confirm that illegitimate tasks are related to sleep impairments, even after controlling for time pressure, social stressors at work and social stress after work, as well as for the effect of the dependent variable from the day before. Thus, our results corroborate that illegitimate tasks are a stressor construct that explains variance in sleep impairments even after controlling for classical stressors.

Contrary to our second hypothesis, lack of psychological detachment did not mediate the relationship of illegitimate tasks on sleep quality; in fact, it was not associated with any of the sleep parameters at all. One reason for this result might be that detachment is not the most appropriate measure because the assumed mediating mechanisms relate to a negative preoccupation with work (e.g. affective rumination; Cropley & Zijlstra, 2011). Lack of detachment, however, may also result from positive thoughts about work (Binnewies, Sonnentag, & Mojza, 2009b), or from thinking about problems in a problem-solving style (problem-solving pondering; Cropley & Zijlstra, 2011).

However, there have been failures in sleep research to confirm a mediating effect of preoccupation with work even in studies assessing preoccupation in negative terms. Thus, Pereira et al. (2013) failed to demonstrate a mediation effect of work-related worries in the

Table III. Predicting physiologically assessed sleep-onset latency by illegitimate tasks

	Model 1		Model 2		Model 3		Model 4	
Variables	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Intercept	8.59**	0.56	8.77**	1.45	8.61**	1.47	8.72**	1.49
Level 2 variables								
Sex[a]			−1.64	1.58	−1.51	1.59	−1.70	1.63
Age			0.05	0.07	0.05	0.07	0.06	0.07
Level 1 variables								
Medication[b]			0.84	1.18	1.02	1.20	1.30	1.23
Alcohol use[c]			1.24	1.19	1.36	1.19	1.57	1.22
Time pressure			0.96	0.67	0.92	0.67	0.89	0.68
Social stressors			1.05	3.07	−0.18	4.08	−0.87	3.90
Social stress after work			2.31	1.98	2.39	1.89	2.37	1.84
State neg. affect			5.49*	2.63	5.86*	2.58	5.54*	2.50
Autocorrelation@p[d]			−0.18*	0.08	−0.18*	0.08	−0.17*	0.08
Illegitimate tasks					2.44*	1.41	3.01*	1.50
Detachment							−0.79	0.63
−2 × log		2410.064		1402.044		1386.91		1285.90
Diff −2 × log				1008.020*		15.14*		6.634
df				9		1		1

Note. Unstandardized coefficients are reported.
SE: standard error; df: degrees of freedom.
[a]0 = *female*, 1 = *male*.
[b]0 = *no medication*, 1 = *medication*.
[c]0 = *no alcohol*, 1 = *alcohol*.
[d]Sleep quality parameter previous night (*N* level 1 = 402; *N* level 2 = 76).
**$p < 0.01$;
*$p < 0.05$, one tailed.

association of occupational stressors with sleep quality. It therefore seems important to think about explanations that do not depend on mediating mechanisms in the sense of perseverative cognitions (Brosschot, Pieper, & Thayer, 2005) or lack of detachment (Sonnentag & Kruel, 2006). We see two possibilities. Firstly, the increased physiological load reactions (e.g. increased heart rate and cortisol excretion) that are triggered by occupational stressors such as illegitimate tasks may be maintained over a prolonged period, even if one is not preoccupied with the stressors that triggered it (cf. Meijman & Mulder, 1998). Since such reactions are incompatible with the deactivation that characterizes sleep, they are likely to impair sleep if they are still present when going to bed.

Secondly, we assessed lack of psychological detachment only once, that is, shortly before going to bed. Proceeding this way, which is very common, might catch the mediating mechanism of detachment (or other mediating mechanisms, such as affective rumination; Cropley & Zijlstra, 2011) only imperfectly if these mechanisms are not continuously present. However, there is a distinct possibility that they might not be continuous. Rather, after leaving work, employees may engage in activities that distract them from what happened at work (e.g. household chores, child care, social activities and reading), thus inducing detachment and preventing affective rumination. Nevertheless, thoughts about work may come back from time to time, for instance, when these other activities are interrupted (e.g. when waiting for the children to put on their pyjamas). Furthermore, and somewhat ironically, detachment may be especially likely to be disrupted by negative thoughts once one has gone bed. It is well known that spontaneous thought, which is not subject to strong attention control, is a characteristic of a deactivated state that occurs as one gets close to falling asleep (Christoff, Gordon, & Smith, 2011). It seems perfectly possible that a wandering mind may encounter a cue that is related to a stressful experience at work and trigger a kind of flashback even if one had not been preoccupied with that experience all evening. In line with this argument, an analysis of thought content while mind wandering by Kane et al. (2007) indicated that worrying thoughts may well occur during mind wandering. Christoff et al. (2011) argued that even during sleep there is mental activity that resembles thought. Thus, such spontaneous flashbacks may even occur during sleep, causing sleep fragmentation. This explanation is rather speculative, but it does seem plausible in light of research on spontaneous thinking. Interestingly, this explanation also is in line with our finding that illegitimate tasks

Table IV. Predicting physiologically assessed sleep efficiency by illegitimate tasks

	Model 1		Model 2		Model 3		Model 4	
Variables	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Intercept	83.88**	1.00	82.36**	1.74	82.55**	1.73	82.63**	1.73
Level 2 variables								
Sex[a]			2.90	2.01	2.73	2.00	2.57	1.98
Age			0.06	0.07	0.06	0.07	0.06	0.07
Level 1 variables								
Medication[b]			1.71	2.00	1.54	2.02	1.56	2.08
Alcohol use[c]			−2.86*	1.49	−2.91*	1.45	−2.56*	1.40
Time pressure			−0.08	0.78	0.06	0.77	0.06	0.77
Social stressors			4.02	4.56	5.38	4.84	4.64	5.02
Social stress after work			−0.92	2.78	−0.71	2.76	−0.64	2.84
State neg. affect			0.35	3.21	−0.39	3.27	−0.63	3.31
Autocorrelation@p[d]			−0.33**	0.09	−0.32**	0.09	−0.33**	0.08
Illegitimate tasks					−3.08	2.76	−2.74	2.72
Detachment							−0.20	0.89
−2 × log		2195.789		1296.32		1284.509		1273.46
Diff −2 × log				899.475*		11.81		11.05
df				9		1		1

Note. Unstandardized coefficients are reported.
SE: standard error; df: degrees of freedom.
[a]0 = *female*, 1 = *male*.
[b]0 = *no medication*, 1 = *medication*.
[c]0 = *no alcohol*, 1 = *alcohol*.
[d]Sleep quality parameter previous night (*N* level 1 = 194; *N* level 2 = 76).
**$p < 0.01$;
*$p < 0.05$, one tailed.

specifically predicted onset latency (which might indicate spontaneous thinking about work-related problems when starting to relax in bed) and fragmentation (which might indicate flashbacks occurring during sleep).

Strengths and limitations

A major strength of our study is the use of a diary and an ambulatory design, which provided insight into the direction of the proposed effects and avoided possible problems of common method variance. A second strength is the focus on neglected daily and short-term effects of illegitimate tasks on sleep, controlling for social stressors at work and social stress after work, and for time pressure. Note that we also controlled for the level of the outcome variable the day before.

Some weaknesses should be noted as well. Firstly, it should be noted that there is still controversy about activity-based sleep assessment, with some authors calling into question the reliability and the validity of actigraphy data (Sadeh & Acebo, 2002). On the other hand, the literature cited in the introduction has yielded positive results, and activity-based sleep assessment is gaining increasing acceptance among sleep researchers. Nevertheless, further validation of Sensewear actigraphy seems necessary, especially in naturalistic settings. In this study, we assessed sleep quality with actigraphs (a) because some aspects of sleep are not easily assessed by self-observation (e.g. sleep fragmentation) and (b) in order to avoid problems of common method variance. The problem of common method variance has likely been overstated; Spector (2006) has provided a new perspective on this issue. Nevertheless, it would have been desirable to include a subjective measure of sleep quality in order to assess its relationship with the actigraph measures and the predictive power of the different measures with regard to sleep (which may well be different; cf. Fietz et al., 2009; Teng, Lastella, Roach, & Sargent, 2011). Including a subjective measure would have been the more important because sleep quality may well include some purely subjective aspects that can only be assessed in self-reports. Future studies should therefore include subjective as well as objective indicators of sleep quality and thus allow triangulating the various measures. They also should include subjective assessments with regard to feeling recovered in the morning (Binnewies, Sonnentag, & Mojza, 2009a), which is important because sleep is only one, albeit an important, influence on recovery. As noted earlier, the detachment measure may not be the optimal measure of the proposed mediating mechanisms.

Even though we instructed our participants to complete the questionnaires at the required times, we cannot

Table V. Predicting physiologically assessed sleep duration by illegitimate tasks

	Model 1		Model 2		Model 3		Model 4	
Variables	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Intercept	197.12**	24.08	126.95**	42.29	127.29**	42.28	127.33**	42.31
Level 2 variables								
Sex[a]			−4.83	53.11	−5.08	53.07	−5.09	53.10
Age			−4.13	2.47	−4.13	2.47	−4.13	2.47
Level 1 variables								
Medication[b]			20.13	11.75	20.09	11.86	19.80	12.15
Alcohol use[c]			−1.60	6.26	−1.94	6.39	−1.98	6.59
Time pressure			−3.01	2.30	−2.88	2.19	−2.91	2.20
Social stressors			−10.49	19.58	−9.00	21.34	−8.24	23.38
Social stress after work			7.90	15.85	8.09	15.88	8.33	15.74
State neg. affect			21.60	18.60	21.05	19.22	21.50	19.79
Autocorrelation@p[d]			−0.31*	0.15	−0.31*	0.15	−0.31*	0.15
Illegitimate tasks					−3.82	10.72	−3.92	10.87
Detachment							0.75	5.25
−2 ×log		3462.100		1568.084		1551.407		1537.223
Diff −2 ×log				1894.016*		16.676		14.184
df				9		1		1

Note. Unstandardized coefficients are reported.
SE: standard error; df: degrees of freedom.
[a]0 = *female*, 1 = *male*.
[b]0 = *no medication*, 1 = *medication*.
[c]0 = *no alcohol*, 1 = *alcohol*.
[d]Sleep quality parameter previous night (*N* level 1 = 402; *N* level 2 = 76).
**$p < 0.01$;
*$p < 0.05$, one tailed.

be sure they followed the instructions correctly. We did give our participants the opportunity to indicate if the questionnaire was completed late/not at all, but, again, we have no way to determine if that information was indicated correctly.

Further research

Future research should include both actigraph and subjective measures of sleep quality. Also, more specific measures of potential mediating mechanisms should be used, such as measures of rumination. Moreover, the proposed mechanism of flashbacks during spontaneous thoughts, or mind wandering, certainly warrants further investigation (e.g. by asking about spontaneous triggering of rumination-like thoughts after periods of distraction or even relaxation). Furthermore, future studies should investigate the cumulative effects of daily experiences of stressors such as illegitimate tasks over longer periods.

Theoretical and practical implications

Our findings have important theoretical and practical implications. In terms of theory, our study adds to the growing evidence that illegitimate tasks are an important stressor that explains variance in various outcome variables over and above existing concepts. Obviously, our data cannot confirm that the postulated mechanisms, which refer to threats to the self through a lack of respect for one's professional role, are indeed responsible for the predictive power of this new stressor concept. However, although further research on these mechanisms is warranted, our results are in line with these mechanisms, and they certainly justify including illegitimate tasks in future studies on work stress and health, including recovery and sleep.

In practical terms, supervisors should be made aware that tasks they assign may be evaluated as illegitimate and may have meaningful associations with sleep, which in the long run may lead to health impairments (see effort-recovery theory, Meijman & Mulder, 1998; Pereira & Elfering, 2013), and to lower performance (e.g. Binnewies et al., 2010). Thus, to prevent long-term negative effects on sleep, recovery and health, illegitimate tasks should be avoided or at least minimized. If their assignment is unavoidable (e.g. owing to organizational necessities), acknowledging the problem of illegitimacy might alleviate its effects, because admitting the problem would constitute an act of interactional justice (Cropanzano et al., 2001).

As illegitimate tasks seem to affect sleep even after controlling for other classical stressors such as time pressure and social stressors, illegitimate tasks should be included more often in research of sleep and

recovery, because they can help to provide more insight into the mechanisms involved.

Conflict of interest

The authors have declared that they have no conflict of interest.

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