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ORIGINAL PAPER

Yesterday's Work–Home Conflict and Actigraphically Recorded Sleep-Onset Latency as Predictors of Today's Cognitive Failure

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Abstract
Cognitive failures are errors in routine action regulation that increase with higher mental demands. In particular, in occupations where guidance such as teaching or supervision is essential, cognitive failures harm one's performance and also negatively impact knowledge transfer. The aim of this study is to investigate yesterday's work–home conflict (WHC) and objectively assessed sleep-onset latency as antecedents of a next-day increase in cognitive failures. Fifty-three teachers were assessed during a working week, in the morning, after work, and in the evening on each working day, as well as on Saturday morning. Sleep-onset latency was assessed with ambulatory actimetry. The multi-level analyses showed both WHC and sleep-onset latency predict cognitive failures the next working day (controlling for cognitive failures from the previous day, sleep quantity, and leisure time rumination until falling asleep). However, there was no association between yesterday's WHCs and the nightly sleep-onset latency. Thus, nightly sleep-onset latency did not mediate the effects of yesterday's WHCs on today's cognitive failures. Our results highlight the importance of sleep and a good work–life balance for daily cognitive functioning. In order to promote the cognitive functioning of employees as well as occupational safety, good working conditions and recovery should both be considered.

Keywords Occupational stress · Work–home conflict · Sleep quality · Performance

Introduction

In everyday working life, cognitive functioning is a major requirement. Workplace cognitive failures are an expression of diminished performance due to lapses in attention, memory, or motor function (Broadbent et al., 1982; Wallace & Chen, 2005). These failures are "cognitively based error[s] that occur during the performance of a task that the person is normally successful in executing" (Martin, 1983, p. 97). Research has shown that they may lead to further consequences, such as poorer safety behavior or a higher risk of (near-) accidents (Brossoit et al., 2019; Elfering et al., 2013). However, workplace cognitive failures are primarily problematic because they disrupt effective job performance. In particular, for occupations where guidance such as teaching or supervision is essential, cognitive failures harm one's performance and also negatively impact knowledge transfer. For instance, if a teacher is burdened by mental demands, this may hinder effectiveness in the classroom (Cook et al., 2017). Accordingly, this study investigates how teachers' daily balance of non-work time and sleep relates to cognitive failures during the next workday.

The effects of work demands do not stop at the employee's front door; they may affect the functioning of private life leading to conflicts between work and private life (i.e., work–home conflict or WHC; Greenhaus & Beutell, 1985). Several studies have indicated that boundaries between work and private life become more and more permeable, a phenomenon that may affect how individuals can unwind from work demands, as well as how far work demands can reach into private life (Allen & Martin, 2017). In particular, professions such as teaching are characterized by a high permeability of the boundaries between work and private life (Cinamon et al., 2007; Grund et al., 2016).

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Teachers are faced with high socioemotional demands, which may also be a burden at the end of the day, and planning, preparation, and follow-up of tasks often take place at home (Crain et al., 2017; Grund et al., 2016). Work demands, or the response to them, taken home may limit time and energy resources available for recovery to charge one's batteries and to start the next working day fully concentrated (Meijman & Mulder, 1998; Quinn et al., 2012). Thus, teachers may appear highly suitable to investigate how the blurring of boundaries impacts unwinding processes at home. One potential consequence may be that self-regulation at work suffers, making the individual more susceptible to cognitive failures (Barnes, 2012; Wallace & Chen, 2005).

In the last decade, meta-analyses have underlined the association of WHC with well-being and performance (Amstad et al., 2011; Nohe et al., 2015). WHC combines work and private domains and may represent a bottleneck for a wide range of suboptimal working conditions that intrude into recovery. WHC is therefore often modeled as a mediator between work demands and well-being (e.g., Baeriswyl et al., 2016; Montgomery et al., 2006; Noor & Zainuddin, 2011) and employee performance behavior (Jenkins et al., 2016). However, the relationship between WHC and cognitive functioning in daily working life has been under-researched. In our study, we examine the daily relationship of WHC to sleep, as an expression of well-being and recovery, and to cognitive failure on the next day, as an indicator of impaired cognitive performance.

Dealing with work and non-work demands requires time, attention, and concentration, all of which potentially consume energy that has to be recovered. Thereby, the importance of sleep has been increasingly recognized. Indeed, the U.S. federal government lists sleep health as a priority objective of their Healthy People 2020 initiative (U.S. Department of Health & Human Services, 2000). From an occupational perspective, sleep is important for the performance, safety, and health of employees (Barnes & Watson, 2019; Brossoit et al., 2019; Litwiller et al., 2017). According to Crain et al. (2018), good sleep provides energy and activation that is needed for waking physical and cognitive activities and influences work and non-work domains. In this manner, the duration of sleep (*sleep quantity*) and its goodness (*sleep quality*) matter (Barnes, 2012; Crain et al., 2018). When individuals are asked about the quality of their sleep, they report difficulties falling asleep and staying asleep in addition to motivation to get up and fatigue upon awakening and throughout the day (Harvey et al., 2008). Difficulty falling asleep and staying asleep are considered core symptoms of insomnia (Litwiller et al., 2017). Insomnia symptoms refer to the most commonly used indicator of sleep quality in occupational science (Litwiller et al., 2017). Especially problems with falling asleep—indicated by a longer sleep-onset latency—are widespread (Bjorøy et al., 2020; Harvey et al., 2008).

For many employees, sleep is the crossroad between days. Not surprisingly, the association between work–family balance and sleep problems in employees has gained attention in research in recent years (Allen & Kiburz, 2012). Previous research has indicated that work–home interference might prevent employees from falling asleep (Crain et al., 2017). In addition, impaired sleep quality implies that employees will have to begin the new working day in a suboptimal condition and invest compensatory effort in order to perform adequately (Crain et al., 2018; Ganster et al., 2018; Meijman & Mulder, 1998). A recent study found self-reported indicators of poor sleep quality (such as longer sleep-onset latency) to be positively related to cognitive failures 6 months later (Brossoit et al., 2019). However, it is neither clear whether subjective sleep indicators suffice to fully understand the energetic recovery processes, nor how these processes unfold between days. Accordingly, the aim of this study is to investigate yesterday's WHC and objectively assessed sleep-onset latency as antecedents of the next-days' increase in cognitive failures. Thereby, we suggest that WHC may lead to trouble falling asleep, which may trigger workplace cognitive failures. Figure 1 shows our conceptual model as developed in the subsequent sections.

The study contributes to the previous literature in various ways. First, although the cognitive functioning of employees is apparently important for performance and job safety, predictors of workplace cognitive failures have been neglected (Brossoit et al., 2019). Cognitive failures are an expression of a reduced ability to regulate one's work behavior (Wallace & Chen, 2005). Thus, identifying day-to-day predictors of workplace cognitive failures is important to protect employees' health and performance. Thereby, the imbalance between work and private life has already been linked to the cognitive functioning of employees. However, the few cross-sectional studies available have focused on conflicts that are carried from private life into work (e.g., Johnson et al., 2019; Lapierre et al., 2012). Yet, strain that arises in the private domain may be beyond any influence of the employer. To complement this literature, we instead focus on the other way around via a perspective on WHC and examine its consequences for the work domain the next day. By doing so, we provide an important starting point for employers to support daily workplace cognitive functioning.

Second, based on the idea that work requires effort and that strain can impair recovery processes (Ganster et al., 2018; Meijman & Mulder, 1998; Sonnentag, 2018) and assumptions about the interplay of work, non-work, and sleep (Crain et al., 2018), we investigate the daily impact of these three domains of life on next day's workplace cognitive failures. According to Crain and colleagues (Crain et al., 2018), the use and recovery of limited human energy

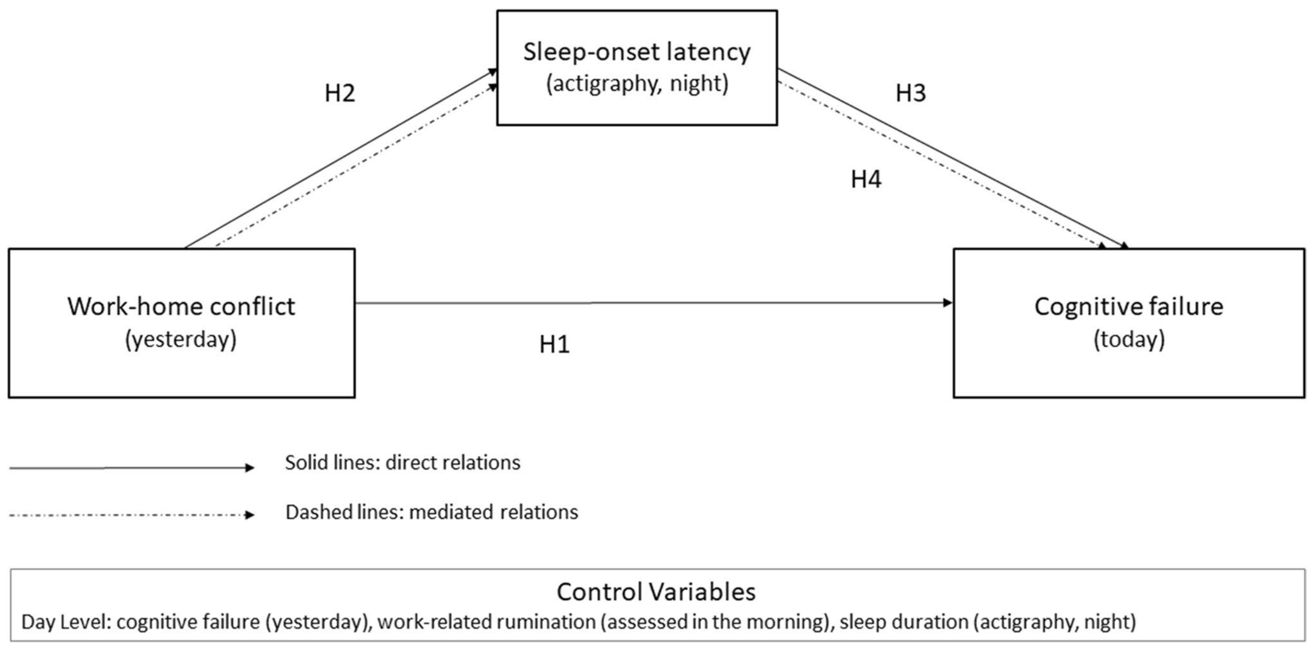

Fig. 1 Conceptual model. H, hypothesis

and time in these three domains is crucial for individuals' attitudes, states, and behavior within a working day. We refer to cognitive functioning as a prerequisite for performance and extend the view beyond one working day to the next. Thus, we investigate WHC and sleep-onset latency as independent predictors of next day's cognitive functioning, but also prolonged sleep-onset latency as a possible underlying mechanism that connects WHC to next day's impaired cognitive functioning.

Finally, we extend the existing occupational research on sleep and work behavior by taking an objective perspective on sleep. We follow the recommendations to consider not only the daily sleep quality (indicated by sleep-onset latency) but also the influence of sleep quantity (Barnes, 2012; Crain et al., 2018). Although employees' self-reports may be beneficial, questions such as "When exactly did I fall asleep yesterday?" and "How long did I actually sleep?" may be hard for the individual to report accurately (Semmer et al., 2004). Existing studies have mostly relied on self-reports to assess both demands and outcomes (Crain et al., 2018; Ganster et al., 2018; Sonnentag, 2018), which might inflate correlations. For example, response styles or participants' lay theories about the relationship between their personal WHC, sleep quality, and cognitive failures at work may create such spurious correlations (Pereira et al., 2016). Thus, in this diary study, we use sleep actigraphy preventing problems associated with common-method variance (Pereira et al., 2014).

Permeable Boundaries of Work, Non-work, and Sleep

In recent decades, work intensification, new communication technologies, and an increasing demand to be flexible have been frequent challenges for the working population (Allen & Martin, 2017; Kompier, 2006). This may increase the risk of work reaching far into the private domain, for instance by work-related strain irritating family life or by answering work-related e-mails during the evening (Allen & Martin, 2017; Becker et al., 2019).

Professions that involve some form of teaching or supervision have rather permeable boundaries between work and private life (Cinamon et al., 2007; Grund et al., 2016; Jacobshagen et al., 2005). For instance, teachers' working hours beyond the time for teaching classes may not be clearly regulated. In addition, teachers can set their own standards for the completion of tasks beyond the classroom. Thus, it may be common for a teacher to undertake planning, preparation, and follow-up tasks at home in the private domain (Grund et al., 2016). Furthermore, due to the involvement of others in occupations that require supervision not only own standards but also external standards (e.g., by parents, students, and mentees) have to be fulfilled. This endeavor may require additional flexibility.

In sum, besides high social–emotional demands, jobs involving supervisory duties are characterized by demands to be flexible and comprise attention-intensive activities that incorporate a wide range of social actors (Crain et al., 2017; Faupel et al., 2016; Zapf, 2002). Imagine Chris, a dedicated young teacher, who is teaching classes of 30 students or more every day. While some of her/his students manage the tasks easily and are already becoming restless, others are overloaded and need intensive support. Chris wants to meet the demands of the less gifted students and at the same time support the gifted ones. Nevertheless, s/he has to pay attention to both the class and the content of the lessons, has to be creative, and has to react flexibly to arising problems. Thereby, Chris has to meet not only her/his personal standards but also those of the students, parents, superiors, and society. Thus, teachers are highly important for the study of the consequences of conflicts between work and private life.

Work–Home Conflict and Cognitive Failures

WHC refers to "a form of interrole conflict in which the role pressures from the work and family domains are mutually incompatible in some respect" (Greenhaus & Beutell, 1985, p. 77). In addition to time-consuming preparation or follow-up tasks, strain experienced at work may also affect activities and available energy in the private domain and even cross over to family or friends through social interactions (Bakker & Demerouti, 2013; Carlson et al., 2018; Crain et al., 2018). As mentioned above, workplace cognitive failures are an expression of impaired performance due to lapses in attention, memory, or motor function (Broadbent et al., 1982; Wallace & Chen, 2005). We propose that WHC is positively related to next day's cognitive failures.

So far, diary studies have shown that greater workload correspond to poorer unwinding in teachers (Cropley & Millward Purvis, 2003; Cropley et al., 2006). A paradox is emerging here: recovery is especially important when working days are stressful. However, the strain that causes the need for recovery impairs the effectiveness of recovery processes. On demanding working days, it is particularly difficult to switch off from work at home or to engage in active leisure activities (Sonnentag, 2018).

Recovery may be particularly difficult if work-related strain, duties, and work role-triggered maladaptive behavior are carried over into the private domain. Once at home, the impact of work may not necessarily stop, a phenomenon that may result in a conflict between work and private life. Thus, functioning (behavior) at home may be influenced by negative load reactions that have built up due to or during work (Geurts et al., 2005).

We propose that WHC interferes with the recovery of energy reducing next days' cognitive performance. Geurts and colleagues (Geurts et al., 2005) described negative interactions between life domains as resulting from insufficient recovery. Recovery takes place in the absence of demands and thus begins under optimal conditions immediately after work (Meijman & Mulder, 1998). However, one important aspect of WHC is that there is not enough energy to deal with work and private obligations. Additional work and private obligations may compete for time (Amstad & Semmer, 2009; Sonnentag, 2018). Thus, the individual may need compensatory effort to meet the demands of the private domain which causes additional strain. These psycho-physiological strain reactions may persist over time (Meijman & Mulder, 1998).

This phenomenon might not only cause tension at home but also affect functioning at work (Amstad & Semmer, 2009; Amstad et al., 2011). Human energy (Quinn et al., 2012) may not be recovered sufficiently because of WHC. The consequences may be diminished self-regulation and a higher susceptibility to cognitive failure at work (Barnes, 2012; Wallace & Chen, 2005).

In sum, we propose that daily WHC reduces the individual's energy and time resources that are needed for the next working day to increase the risk of cognitive failures. Referring to our example, Chris may not be able to focus her/his attention on answering a student's question (i.e., lapses in attention). S/he may even forget the name of this student whom s/he knows well (i.e., lapses in memory). Chris may even accidentally turn off the computer instead of rebooting it (i.e., lapses in motor function).

Hypothesis 1. Yesterday's WHC is positively related to today's workplace cognitive failures controlling for yesterday's workplace cognitive failures.

Work–Family Conflict and Sleep-Onset Latency

We propose that WHC positively relates to sleep-onset latency. Sleep onset marks a complex transition process involving physiological, behavioral, and psychological changes that initiate sleep (Scott et al., 2020). A delay in sleep-onset latency is due to somatic and cognitive arousal, which triggers strain and wakefulness in bed (Robertson et al., 2007; Sonnentag et al., 2016). In addition, the time being awake in bed cannot be used effectively for restful sleep. In their work, non-work, and sleep framework, Crain and colleagues (Crain et al., 2018) emphasize the interplay of these three domains of life. On the one hand, good sleep provides energy and activation, which are needed for waking activities and thus influence both work and non-work time. On the other hand, the exhaustion of human energy during the work and non-work time can in turn affect sleep.

Daily energy and time for work, non-work, and sleep are limited (Amstad & Semmer, 2009; Crain et al., 2018). According to the Effort-Recovery Model (Meijman & Mulder, 1998), expended effort (e.g., by completing work tasks) must be recovered to be re-invested. Thus, one important function of non-work time is recovery. However, the spillover of duties or strain from work into the private domain may reduce opportunities for recovery (Geurts et al., 2005). This means that recovery opportunities may be quantitatively (recovery time is too short, e.g., due to persistent demands) and/or qualitatively insufficient (e.g., individuals recover slowly and remain activated after the exposure period).

Assuming Chris has to complete work tasks after work hours, one way to cope with these demands is to reduce intensive or time-consuming leisure time activities (e.g., meeting friends) in order to fulfill the demands of work and private life. Moreover, Chris might engage in activating, arousing, or disturbing activities near bedtime. Thus, tensions that may build up and lead to adaptive behavioral coping, which may disturb healthy sleep, may increase (e.g., drinking alcohol, watching television, smartphone/computer use at night). This might be similar if Chris is still too strained after work. Confronted with demanding work and non-work experiences, the person may no longer be able and/or willing to mobilize self-control resources to refrain from such behaviors (Sonnentag, 2018). Such coping behavior may result in increased sleep-onset latency.

In sum, Chris may engage in behaviors that lead to physiological arousal and impair sleep quality rather than those that promote sleep quality. This may even be true if Chris ensures s/he sleeps long enough.

Hypothesis 2. Yesterday's WHC is positively related to last night's sleep-onset latency controlling for sleep duration.

Cognitive Failures as a Consequence of Impaired Sleep

We propose that sleep-onset latency mediates the relationship between yesterday's WHC and next day's cognitive failures. Good sleep helps people to feel capable and ready to deal with current demands. Thereby, while sleep quality provides information about the goodness of sleep, sleep quantity refers to the amount of time someone spends asleep (Barnes, 2012; Crain et al., 2018). Both sleep quantity and quality may affect the well-being and performance of employees (Barnes & Watson, 2019; Litwiller et al., 2017; Sonnentag, 2018).

Job performance requires maintaining alertness and attention. However, time and energy throughout the day are limited (Quinn et al., 2012; Sonnentag, 2018). Based on the literature on sleep, one can conclude that impaired sleep implies that the human energy could not be replenished during the night (Crain et al., 2018; Sonnentag, 2018). This phenomenon might affect the alertness and attention during the next day. Poor sleep may impair self-regulation processes that usually guide the individual's effort to goal-relevant and away from goal-irrelevant thoughts, affect, and behavior (Barnes, 2012). As a result, the individual may be more prone cognitive failures at work (Brossoit et al., 2019; Wallace & Chen, 2005). This assumption was recently supported by actigraphy studies showing that sleep-onset latency predicts cognitive failure (Elfering et al., 2020) and problems concentrating (Kottwitz et al., 2019) at work.

We propose that in the daily work routine of healthy adults in jobs with constant work and non-work rhythms (like teachers), the quality of sleep is especially crucial for cognitive performance. Sleep quality and quantity are nevertheless distinct constructs that should both be considered (Barnes, 2012; Crain et al., 2018; Litwiller et al., 2017). Previous research has suggested that, on average, about 7 to 8 h of sleep during the night maintains adequate cognitive functioning (van Oostrom et al., 2018; Watson et al., 2015). Individuals may be aware that a certain sleep duration is important for health and functioning on the job, and as a consequence ensure that they sleep long enough. However, they may still not obtain sufficient sleep quality. Consciously influencing sleep quality is likely to be much more difficult. For example, after a demanding day, it may be particularly difficult to refrain from activating behavior that negatively affects sleep quality (Sonnentag, 2018).

In sum, we expect that WHC negatively affects sleep-onset latency leading to reduced energy resource recovery that, in turn, increases next days' cognitive failure. However, longer sleep-onset latency might simultaneously be associated with shorter sleep duration during the night. Nevertheless, recent studies (Brossoit et al., 2019; Elfering et al., 2020) suggest that sleep-onset latency also predicts workplace cognitive failures beyond controlling for sleep duration. Based on these assumptions, we therefore hypothesize the following:

Hypothesis 3. Last night's sleep-onset latency is positively related to today's workplace cognitive failures controlling for sleep duration.

Hypothesis 4. Last night's sleep-onset latency mediates the association between yesterday's WHC and today's cognitive failures controlling for yesterday's workplace cognitive failures and sleep duration.

Methods

Sample and Procedure

Participants were recruited in three German-speaking cantons of Switzerland. Inclusion criteria were a healthy state, including the absence of insomnia or any other current or chronic disease that could cause sleep problems. Furthermore, the participants were not allowed to take any sleep medication. Participants had to work at least 25 h per week.

Participants gave informed consent. They were informed that all data were stored and analyzed anonymously and that they could end the study without giving reasons. The sleep measurement SenseWear bracelet was given to each participant personally and its proper handling was demonstrated. All participants first had to fill out a general questionnaire in order to assess demographic variables and the general level of cognitive failure. Subsequently, they were asked to wear the SenseWear bracelet at night and to complete an online diary three times a day for five consecutive days (Monday to Friday): (a) after work, (b) before bedtime, and (c) the next morning before going to work.

With the permission of the respective headmasters, 186 teachers from 33 schools were individually addressed. Fifty-six of these teachers (30%) agreed to participate (level 2 N = 56). Of these participants, 7 taught in preschool, 32 in primary education, 16 in secondary I/II or tertiary education, and 9 others in special education. Among these, eight participants gave multiple responses. Due to missing actigraphy and questionnaire data, three people were excluded from the analyses. Thus, the sample included 53 teachers (45 women; 85%) with an average age of 34.51 years ($SD = 12.18$).

For the present analysis, data from four of the five surveyed nights were used because no measure of cognitive failure was available for Saturday (level 1 $n = 212$). However, not all teachers worked full time ($M = 80.45$, $SD = 14.86$ of full-time equivalent). Twenty-five days/nights had to be excluded because they were no working days. Actigraphy data from 12 nights were lost because participants forgot to or did not activate SenseWear bracelets or due to technical malfunction. Three more nights were lost due to missing diary data. Thus, the final sample consisted of 53 teachers who provided 172 complete days/nights.

Measures

Cognitive Failure We assessed workplace cognitive failures both in general and in diary surveys after work was done. The Workplace Cognitive Failure Scale (WCFS; Wallace & Chen, 2005; German version from Elfering et al., 2011) comprises 15 items that ask for the frequency of cognitive failure at work (e.g. "Say things to others that you did not mean to say"). Participants rated each item on a 5-point Likert scale (1 = *never* to 5 = *frequently*). The internal consistency of the WCFS was satisfactory (Cronbach's alpha = 0.86).

These 15 items with a 5-point Likert response format (1 = *never*; 5 = *frequently*) were slightly adapted for daily measurement (e.g. "Today, I said things to others that I did not mean to say"). Cronbach's alpha of today's cognitive failure ranged between 0.79 and 0.90.

Work–Family Conflict We measured WHC daily with four items before bedtime (Geurts et al., 2005). The items were: "Today, how often has it happened that your work schedule makes it difficult for you to fulfill your domestic obligations?", "Today, how often did you find it difficult to fulfill your domestic obligations because you are constantly thinking about your work?", "Today, did you have to work so hard that you do not have time for any of your hobbies?", and "Did your work obligations make it difficult for you to feel relaxed at home today?". Since not every employee has a family life with a spouse and/or children, the items chosen address the conflict between work and private life. The short version used in the current study was developed and validated by Geurts in the context of the Psychological Contracts across Employment Situations Project (PSYCONES, 2004). The response format was a 4-point Likert scale (1 = *never*; 4 = *frequently*). Cronbach's alpha across five working days ranged from 0.75 to 0.87.

Actigraphy-Based Indicators of Sleep In the current study, the actigraph used was the BodyMedia's SenseWear Armband, which is a multi-accelerometer device similar to a regular actigraph[1] (Ganster et al., 2018). *Sleep-onset latency* was coded as the time participants needed to fall asleep after going to bed. *Sleep duration* refers to 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.

Control Variables To investigate dynamics within a workday, it is important to control for the baseline of the outcome variable (Gabriel et al., 2019). Accordingly, we controlled cognitive failure of the previous day to focus on changes from one day to the next.

In addition, a lack of cognitive switching off from work may be a mechanism through which work demands reduces recovery at the end of the day (Sonnentag et al., 2016). That is, rather than work-related strain or demands creating new problems at home (i.e., WHC), work-related rumination might prolong the work-related strain through cognitive processes. In order to exclude this alternative explanation,

[1] The BodyMedia SenseWear Armband is a multi-accelerometer device similar to a regular actigraph. Every minute, 2-axis oscillometric sensors assessed body movements, surface body temperature, galvanic skin response, and heat flux during five working nights. Participants wore the armband on the nondominant arm throughout the night, that is, from lights off until standing up in the morning.

Table 1 Means, SDs, and Pearson correlations between study variables

	M	*SD*	1	2	3	4	5	6
1. Cognitive failure today (1–5)	1.50	0.46	–	.88***	.60***	.32*	.11	−.01
2. Cognitive failure yesterday (1–5)	1.53	0.49	.56***	–	.56***	.39**	.06	.02
3. Rumination last evening (1–7)	2.18	1.42	.51***	.37***	–	.46***	−.04	.29*
4. WHC yesterday (1–4)	1.60	0.61	.29***	.37***	.25**	–	−.14	.05
5. Sleep duration last night (min)	378.06	63.08	.01	.03	−.13	−.08	–	−.15
6. Sleep-onset latency last night (min)	9.53	10.15	.07	−.02	.05	.11	−.21**	–

Correlations above the diagonal are person-level correlations ($N=53$). Correlations below the diagonal are day-level correlations ($n=172$; person-mean-centered)

*$p<.05$; **$p<.01$; ***$p<.001$

WHC work–home conflict

we controlled for daily work-related rumination before going to bed by two out of three items of the cognitive irritation scales by Mohr et al. (2006). We assessed this rumination the next morning because Pereira and Elfering (2014) suggested that employees could be distracted after work so that perseverative thoughts might not occur in the evening but recur before falling asleep, when distractions are reduced. The items are: “I had difficulties relaxing after work”, “Even at home I often thought about my problems at work”, and “Even on my vacations I think about my problems at work”. We skipped the last item because it did not fit daily measurement during work days. Individuals had to indicate their agreement with these statements on a 7-point Likert scale (1 = *strongly disagree*; 7 = *strongly agree*). Cronbach’s alpha across four working days ranged from 0.68 to 0.89.

In addition, we controlled for actigraphy-based sleep duration. Given that sleep quantity is a necessary part of and influences sleep quality, researchers have recommended to measure both categories together (e.g., Crain et al., 2018; Pereira et al., 2013).

Analytical Strategy

Given that the daily data (level 1) were nested within person (level 2), we computed multilevel models using MLwiN software (Rasbash et al., 2017). The focus of the analyses was on within-person relationships. All level 1 predictors were centered at their respective person mean. We used the restricted maximum-likelihood procedure to estimate the parameters. Note that unstandardized coefficients are reported. To test for mediation, we used a multilevel 1–1-1-mediation model that only included level 1 variables as fixed effects with the software tool MLmed macro (Rockwood & Hayes, 2017). Monte Carlo stimulations were used to estimate 95% CIs for the indirect effects (Rockwood & Hayes, 2017).

Results

Descriptive Results

Descriptive statistics and correlations for all study variables are reported in Table 1. Sleep-onset latency averaged 9.5 min ($SD=10.2$). The mean level of cognitive failure as reported in the general questionnaire ($M=2.0$, $SD=0.5$) was higher than the reported daily level of cognitive failures ($M=1.5$, $SD=0.5$).

The intraclass correlation coefficient (ICC) analysis shows that a substantial part of the variance in sleep-onset latency (27.9%) and workplace cognitive failures (55.7%) is due to variation within the person.

Hypothesis Testing

The results of the multilevel analyses without controlling for work-related rumination are displayed in Table 2 and with controlling for work-related rumination in Table 3. Supporting our first hypothesis, WHCs of the previous day were a significant predictor of workplace cognitive failures of the next day ($B=0.13$, $SE=0.06$, $t=2.17$, $p<0.05$). This result holds when controlling for last night’s rumination ($B=0.16$, $SE=0.06$, $t=2.87$, $p<0.01$), which was also positively related to next day’s cognitive failures ($B=0.10$, $SE=0.02$, $t=4.22$, $p<0.001$).

In a second step, we tested whether WHC predicts sleep-onset latency (model 2). Contrary to expectations, we found no significant association of WHC and sleep-onset latency ($B=0.85$, $SE=1.67$, $t=0.51$, $p=0.610$). Again, under the control of work-related rumination, neither WHC ($B=0.13$, $SE=1.89$, $t=0.07$, $p=0.944$) nor rumination ($B=0.74$, $SE=0.90$, $t=0.82$, $p=0.412$) was negatively related to

Table 2 Multilevel regression analyses to predict today's cognitive failure and sleep-onset latency

	Model 1			*Model 2*			*Model 3*		
	Cognitive failure			Sleep-onset latency			Cognitive failure		
Predictor	*B*	*SE*	*t*	*B*	*SE*	*t*	*B*	*SE*	*t*
Constant	1.51**	0.05	28.42	9.61**	1.01	9.49	1.51**	0.05	28.42
Cognitive failure yesterday	−0.22**	0.08	−2.75	−1.56	2.39	−0.65	−0.21**	0.08	−2.63
WHC yesterday	0.13*	0.06	2.17	0.85	1.67	0.51	0.12*	0.06	2.02
Sleep duration last night (min)				−0.05**	0.02	−3.26	<0.01	<0.01	0.90
Sleep-onset latency last night (min)							0.01*	<0.01	2.21
Var level 2	0.12	0.03	4.14	31.82	10.82	2.97	0.12	0.03	4.14
Var level 1	0.09	0.01	8.18	69.37	69.57	8.99	0.09	0.01	7.82
RIGLS	153.44			1261.28			150.27		

Level 2, $N=53$; level 1, $n=172$

*$p<.05$; **$p<.01$

WHC work–home conflict, *Var* variance, *RIGLS* restricted iterative generalized least squares

sleep-onset latency. Our second hypothesis is therefore not supported.

When simultaneously included into the multi-level model (model 3), both previous day's WHC ($B=0.12$, $SE=0.06$, $t=2.02$, $p<0.05$) and a more delayed sleep onset from the previous night ($B=0.01$, $SE=0.00$, $t=2.21$, $p<0.05$) emerge as significant predictors of next day's cognitive failure. Furthermore, even when controlling for work-related rumination, all predictors showed a unique association with today's cognitive failure (Table 3). These data are in line with our third hypothesis.[2] However, there was no sign of potential mediation, i.e., the link between WHC and cognitive failure was not mediated by sleep-onset latency. A test of that multilevel 1–1-1-mediation model including only level 1 variables as fixed effects did not confirm the indirect path, neither as within-effect nor as between-effect (within-indirect effect—$B<0.01$, $SE=0.01$, $p=0.668$, 95% CI [−0.02, 0.03]; between-indirect effect—$B<0.01$, $SE=0.01$, $p=0.978$, 95% CI [−0.02, 0.02]). Thus, the fourth hypothesis was not supported.

Additional Analyses

In additional analyses, we examined alternative mechanisms as explanations of an increase in workplace cognitive failure. The central question was to what extent WHC (and sleep-onset latency) actually represents independent predictor(s) of cognitive failure (and sleep-onset latency) or if the relationship is strengthened by rumination after work or each other.

Notably, instead of mediation, one might expect a moderation with higher WHC to be strongly associated with next-day cognitive failure on days when people ruminate more. Therefore, we multiplied the person-mean centered variables and added the interaction term at the within-person level (level 1). The test in multilevel regression analysis of the interaction term between WHC and rumination in prediction of cognitive failure was not significant ($B=0.06$, $SE=0.05$, $t=1.31$, $p=0.095$).

In predicting longer sleep-onset latency, moderation could be expected between WHC and rumination when the relationship is stronger on days when the person tends to ruminate in the evening. The test of moderation did not show significant results for the interaction term between WHC and rumination ($B=1.37$, $SE=1.47$, $t=0.93$, $p=0.176$).

Finally, in predicting the next day's cognitive failures, there was no moderation at the within-person level (level 1) between WHC and sleep-onset latency ($B<0.00$, $SE=0.01$, $t=0.08$, $p=0.468$).

[2] Non-parametric estimation in RIGLS bootstrapping with bias-corrected estimates yield similar results: First, WHCs of the previous day were a significant predictor of workplace cognitive failures of the next day ($B=0.16$, $SE=0.07$, $t=2.31$, $p<.05$). Second, we found no significant association of WHC and sleep-onset latency ($B=0.24$, $SE=0.70$, $t=0.34$, $p=.734$). Finally, both previous day's WHC ($B=0.14$, $SE=0.07$, $t=1.97$, $p<.05$) and a more delayed sleep onset from the previous night ($B=0.01$, $SE=0.00$, $t=2.25$, $p<.05$) emerge as significant predictors of next-day's cognitive failure.

Table 3 Multilevel regression analyses to predict today's cognitive failure and sleep-onset latency, controlling for rumination

	Model 1			*Model 2*			*Model 3*		
	Cognitive failure			Sleep-onset latency			Cognitive failure		
Predictor	*B*	*SE*	*t*	*B*	*SE*	*t*	*B*	SE	*t*
Constant	1.51**	0.05	28.42	9.61**	1.01	9.49	1.51**	0.05	28.42
Cognitive failure yesterday	−0.25**	0.08	−3.17	−1.81	2.41	−0.75	−0.24**	0.08	−3.05
Rumination yesterday evening	0.10**	0.02	4.22	0.74	0.90	0.82	0.10**	0.02	4.36
WHC yesterday	0.16**	0.06	2.87	0.13	1.89	0.07	0.16**	0.06	2.82
Sleep duration last night (min)				−0.05**	0.02	3.16	<0.01	<0.01	0.90
Sleep-onset latency last night (min)							0.01*	<0.01	2.21
Var level 2	0.12	0.03	4.14	31.82	10.82	2.97	0.12	0.03	4.14
Var level 1	0.08	0.01	7.60	69.77	9.02	7.74	0.07	0.01	7.72
RIGLS	136.99			1260.62			132.04		

Level 2, $N=53$; level 1, $N=172$

$^{*}p<.05$; $^{**}p<.01$

WHC work–home conflict, *Var* variance, *RIGLS* restricted iterative generalized least squares

Discussion

This diary study investigates the interface between yesterday's work and non-work time, nightly sleep-onset latency, and cognitive functioning on the next working day. The multi-level analyses showed that both WHC and sleep-onset latency predict cognitive failures for the next working day. These results are beyond controlling for cognitive failures of the previous day, sleep quantity, and leisure time work-related rumination until falling asleep. However, there was no association between yesterday's WHCs with the nightly sleep-onset latency. Thus, there was no evidence that sleep-onset latency mediated the effect of WHC on cognitive failures. Rather, WHC and sleep-onset latency seem to be independent predictors of next days' cognitive functioning.

According to Wallace and Chen (2005), cognitive failures occur as a result of impaired self-regulation. Supporting our first hypothesis, we found that previous day's WHC is positively related to today's workplace cognitive failures. In the course of the increasing flexibility of work, combined with the possibility of being able to perform many work tasks from anywhere and at any time, the boundaries between work and private life are also becoming increasingly permeable (Allen & Martin, 2017). If demands or strain are taken home, it could cause conflicts between work and private life draining and hindering recovery of human energy resources. For example, high effort at work has been found to reduce active leisure time activities and make work and home activities more straining (Van Hooff et al., 2007). While work-related activities are detrimental to well-being before bedtime, Sonnentag (2001) found that physical activities—as well as those that involving less effort and social activities—promote daily well-being. In line with our results, WHC implies that work intrudes into the private domain, limiting time and energy resources needed to cope with private obligations and for recovery (Amstad & Semmer, 2009). However, impairment of cognitive functioning on the next working day might be due to diminished capacity for self-regulation, as well as motivational aspects (Grund et al., 2016; Sonnentag, 2018).

Our results show a positive relationship between WHC and cognitive failures on the next working day independent of leisure time work-related rumination. Not surprisingly, we found an effect of work-related rumination on cognitive failures on the next day; these results indicate impaired behavioral regulation. Work-related rumination is known to impair executive function, especially for switching attention, thinking about different solutions, or dealing with and accepting change (Cropley & Collis, 2020). However, WHC and rumination contribute independently to the cognitive failures the next day. Both processes may hinder recovery of human energy during leisure time. While rumination refers to cognitive processes within the person that prolong work-related strain, WHC refers to conflicts that arise from the work role in the private domain and thus require additional resources. For example, work interferes with family life because the individual continues to perform work tasks at home or is not completely focused on home activities (e.g., spending time with family, cleaning). By contrast, rumination may keep the work demands mentally present. Similarly, Dettmers (2017) found in a longitudinal study that the perceived expected availability for work during leisure time is positively related to emotional exhaustion. This effect was mediated by both the conflict between work and private life and a lack of psychological detachment (i.e., not switching off from work).

Surprisingly, we found no within-person effect of yesterday's WHC on nightly sleep-onset latency. Previous work has shown that WHC is an important mediator between work demands and well-being or performance (Baeriswyl et al., 2016; Jenkins et al., 2016; Montgomery et al., 2006; Noor & Zainuddin, 2011), which usually is explained by WHC having the potential to maintain high arousal and hinder successful unwinding. Previous studies have revealed both cross-sectional and longitudinal correlations between work–family conflicts and self-reported indicators of reduced sleep quality (such as a longer time to fall asleep). For example, Ng and Feldman (2014) showed in their U.S. sample (but not their Singapore sample) that WHC predicted chronic insomnia. In a large Norwegian longitudinal study, negative spill-over between work and private life predicted insomnia over 2 years (Vedaa et al., 2016).

However, only a few studies have investigated daily relationships between WHC and sleep quality. Furthermore, most studies have only subjectively assessed sleep quality. Crain and colleagues (Crain et al., 2014) found cross-sectional relationships between WHC and indicators of reduced sleep quality. Buxton and colleagues (Buxton et al., 2016) also found a positive correlation between daily WHC and indicators of impaired sleep quality. However, in both studies, the results only hold for self-reported sleep quality and not for indicators of sleep quality assessed by actigraphy. In line with this pattern, our results indicate that objectively assessed, WHC is not predicting sleep quality in the short term.

When taking objective sleep quality assessment seriously, one explanation for the missing relationship of WHC with sleep-onset latency may be that WHC does not impair recovery during sleep, but negatively impacts cognitive functioning due to decreased motivation the next day. It may also be advisable to distinctively consider the daily influence of work and non-work on sleep beyond WHC (Crain et al., 2018). Future studies should also examine whether daily resources, such as family support behavior (e.g., Odle-Dusseau et al., 2016), might buffer the daily experience of work or family demands on the measured sleep quality.

The previous night's sleep-onset latency related positively to cognitive failures the next working day; these results support our third hypothesis. According to the framework model of Crain and colleagues (Crain et al., 2018), sleep influences attitudes, behavior, and states at work via resources such as human energy. Reduced sleep quality may impair self-regulation at work. Poor sleep may influence cognitive functioning because recovery of energetic resources during the night may affect the next day's alertness and attention. This consequence may become visible in temporary impairments of cognitive functioning, such as memory gaps for task-related information, not paying enough attention to relevant information, or engaging in unintended behavior (Wallace & Chen, 2005).

This result is in line with previous findings from the literature. For example, in their longitudinal study, Brossoit and colleagues (Brossoit et al., 2019) revealed a positive relationship between insomnia symptoms (e.g., difficulty in falling asleep) and cognitive failures at work 6 months later. In a large cross-sectional study conducted by the National Sleep Foundation in 2008, involving 1000 U.S. employees, individuals with insomnia symptoms reported more difficulties with cognitive tasks at work, including concentration and problems organizing (Swanson et al., 2011). The present study goes beyond the previous literature by showing a relationship between sleep-onset latency and cognitive functioning the next day on the intraindividual level.

Moreover, similar to the longitudinal study by Brossoit and colleagues (Brossoit et al., 2019), the positive relationship between sleep-onset latency and workplace cognitive failure was independent of sleep duration. Sleep duration represents the time spent on sleep. This time is often reduced in favor of waking activity, especially for work activities (Crain et al., 2018). Even if the person intends to sleep long enough, a longer sleep-onset latency also reduces the length of sleep if there is a fixed bedtime and getting up schedule (e.g., due to work). Recently, the occupational literature has stressed that sleep quantity and quality should both be considered in the context of employee well-being and performance (Barnes, 2012; Crain et al., 2018; Litwiller et al., 2017). In order to be able to show the effect of sleep-onset latency beyond the duration of sleep, we controlled for sleep duration. On average, our rather young sample of teachers slept 6.3 h at night. This value is below the recommended sleep duration of 7 h per night on average (van Oostrom et al., 2018; Watson et al., 2015). While in the study by Brossoit and colleagues (Brossoit et al., 2019) the participants slept sufficiently long on average, in our study we can assume a restricted quantity of sleep. However, an average sleep duration of about 6 h per night is not uncommon in studies that use actigraphy to measure daily sleep duration on working days (Pereira & Elfering, 2014; Pereira et al., 2013, 2014). Moreover, this recorded value is comparable to the self-reported daily sleep duration of teachers described by Cropley and colleagues (Cropley et al., 2006). In general, it is assumed that both the quality and quantity of sleep may affect performance (Barnes & Watson, 2019; Litwiller et al., 2017; Sonnentag, 2018). Although there is substantial variance in sleep duration across workdays, our data did not reveal a relationship between daily sleep duration and workplace cognitive failures. This is consistent with recent actigraphy studies that emphasize the importance of sleep-onset latency for cognitive functioning problems beyond sleep duration (Elfering et al., 2020; Kottwitz et al., 2019). Future studies might also examine the extent to which sleep duration can be compensated, for example, due to longer sleep on the weekend (Kubo et al., 2011), in order to maintain daily cognitive functioning.

Finally, although there was a direct effect of yesterday's WHC on next day's workplace cognitive failures, this effect was not mediated by sleep-onset latency. As described above, we found no correlation between WHC and sleep quality measured by actigraphy. This result is in contrast to previous studies on self-reported sleep quality. However, if both WHC and sleep quality are assessed by self-report, there is a risk that lay theories of the respondents or the anticipation of an upcoming demanding day will change the reported sleep quality. These changes could happen quite unintentionally. Our results show no relationship between WHC and sleep latency measured by actigraphy.

Strengths, Limitations, and Future Directions

Taken together, the current report represents the first actigraphy study across one working week that shows WHC and sleep-onset latency as antecedents of next-day cognitive functioning. However, there are also several limitations to our study.

First, the use of activity-based sleep assessment allows a cost-effective naturalistic examination of the sleep–wake system. Previous studies have mainly used self-reported data regarding sleep quality and duration (Crain et al., 2018; Ganster et al., 2018; Sonnentag, 2018). Using an objective ambulatory sleep measurement reduces problems related to common method variance and valid construct assessments (Pereira et al., 2014). However, there are limitations with this method. For example, wearing the actigraph may disturb sleep. Although some sleep researchers have questioned the reliability and validity of the data collected in this way, the bracelets are considered sensitive, accurate, and specific (Kawada et al., 2011; Sadeh & Acebo, 2002; Wrzus et al., 2012).

Second, our sample size is relatively small and may suffer from limited power (i.e., increased risk to miss an effect; Maas & Hox, 2005). For example, the relationship between WHC and sleep-onset latency might have been underestimated. Nevertheless, we still find daily effects of WHCs and sleep-onset latency on our outcome workplace cognitive failure. Hence, we encourage replication with increased sample size optimally on both levels to further corroborate our findings (Gabriel et al., 2019).

Third, our results may suffer from range restriction and limited generalizability. Specifically, we found low levels of WHC and cognitive failure as well as short sleep-onset latency on average (see Table 1). Whereas the level of cognitive failure (e.g., Louch et al., 2017) and WHC are similar to the existing literature (Derks et al., 2015), the latency to fall asleep was comparatively low (cf. Melo et al., 2021). Although this may limit the generalizability of our results to populations suffering from problems with falling asleep, it may also serve to make our results more conservative. Therefore, relationships may be even stronger in more heterogeneous samples. However, future research should replicate our results in a heterogeneous sample.

Our study focused on WHC; we did neither survey extent nor exposure to work or private demands. Although work and non-work are interrelated and can therefore be captured by combined measures such as WHC, they are also distinct constructs (cf. Crain et al., 2018). Separating work and private demands (e.g., workload and childcare responsibilities) would allow future studies to more precisely explicate the underlying processes connecting work, non-work, and sleep. However, beyond work demands, conflicts between the different life domains have been discussed as an important predictor of teacher's well-being as well as the intention to quit (Claflin et al., 2019; Grund et al., 2016; Rajendran et al., 2020). Future studies might want to extend this approach and examine the incremental validity of WHC beyond job demands or investigate interaction effects between WHC and other job demands. For example, time pressure at work might impair cognitive functioning specifically when the person experiences a high level of WHC.

In addition, conflicts between work and private life should be examined in a differentiated manner. Besides problems in fulfilling domestic obligations or pursuing hobbies, relationship tensions may also arise, which may transfer to the spouse (Carlson et al., 2018). Such tensions might lead to repetitive negative thoughts independently of work. For instance, Clancy and colleagues (Clancy et al., 2020) showed that non–work-related rumination and worry can interfere with sleep. Conceivably, non–work-related rumination might maintain strain and impair recovery, constituting an underlying mechanism. Future studies might look at strain and recovery after work to understand how WHC might be translated into sleep and next-day workplace cognitive failure.

In sum, we found independent intra-individual effects of WHC and sleep-onset latency on cognitive functioning the next working day. In line with the theoretical framework of work, non-work, and sleep by Crain and colleagues (Crain et al., 2018), we argue that energetic processes carry the daily strain, as through WHC, into sleep and via sleep into the cognitive functioning of the next day. Thus, WHC might hinder the recovery of energetic resources via sleep. This might be reflected in a lack of self-regulation, in terms of cognitive failures, the next working day. However, we did not survey the direct response to WHC (e.g., perceived stress) or the quantity of these resources (i.e., physical energy and energetic activation for example through fatigue and vigor;

Crain et al., 2018) through the day. Future research should not only overcome the limitations of our study; they may want to address questions about the underlying mechanism by which strain is carried from one day to the next. In accordance with Crain and colleagues (Crain et al., 2018), due to a lack of energetic resources, it might take a lot of effort for the individual to concentrate the next working day.

In contrast, the impairment of cognitive functioning on the next working day might also be an expression of a motivational adaptive state in management of (competing) goals (Hockey, 2011). Accordingly, impaired cognitive functioning may signal a conflict between work and private goals. The individual notices that the demands of work interfere with her/his private life (i.e., WHC). Once s/he is back at work, these pressures may be salient again and leave the individual less motivated to stay fully concentrated on the task. For example, a teacher may want to have a challenging lesson and at the same time s/he (remembering the WHC of the last day) wants to keep the effort for the follow-up tasks to a minimum. The time at home can be used not only to fulfill duties but also for personal recovery; thus, it might become more relevant in terms of motivational priorities, which might affect the individual's cognitive performance in the job task. These motivational aspects may not be recovered by a good night's sleep. Thus, cognitive functioning may require both a restful evening without WHCs and good sleep quality. In addition to the consumption of energetic resources (e.g., in terms of fatigue and vigor in the morning), more attention might also be paid to motivational explanations (Dust et al., 2021; Hockey, 2011).

Practical Implications

Our results indicate that WHC as well as reduced sleep quality may have an independent effect on next day's cognitive functioning. Cognitive failures are lapses in action regulation that not only diminish performance but may also lead to (near-) accidents (e.g., Brossoit et al., 2019). In order to promote the cognitive functioning of employees as well as occupational safety, both good working conditions and recovery should be promoted.

A reduction of work overload and long working hours should also reduce conflicts between work and private life. This endeavor requires appropriate regulations and resources provided by the organization (Hacker et al., 2008). For example, preparation and follow-up tasks should be explicitly considered, and working time and sufficient space should be available for these activities. Unfortunately, according to Hammer et al. (2016), interventions based on work arrangements, such as flexible working hours and telecommuting, have limited effectiveness in improving the conflict between work and family. This outcome may be due to the blurring of the boundaries between work and private life (Allen & Martin, 2017). Many jobs, such as that of a teacher, involve tasks that can be done from anywhere and at any time. Therefore, it is more important to reduce the feeling of having to be constantly available, to clarify boundaries (Becker et al., 2019; Dettmers, 2017).

Moreover, it might be advisable to focus on situational demands and resources. A promising starting point might be resources such as social support by family or colleagues and supervisors (Amstad et al., 2016; Odle-Dusseau et al., 2016). Even teachers are not necessarily working alone. Thus, the "two teacher principle," mutual supervision and class observation (German *Hospitation*), and suitable forms of division of labor should also be considered (Hacker et al., 2008).

The importance of sleep for employee performance and safety in the workplace is now widely recognized (Czeisler, 2015). This also includes the awareness of cost-related benefits of a good night's sleep (Rosekind et al., 2010). Thereby, improving sleep quality is an important way to intervene in sleep habits. Previous research has shown that this intercession is even possible through online interventions for sleep training (including mindfulness training; Ebert et al., 2015; Thiart et al., 2015). Moreover, mindfulness can also improve the balance between work and private life (Allen & Kiburz, 2012). Cognitive-behavioral stress management has also been shown to improve sleep quality (Querstret et al., 2016). In a randomized controlled trial, Dalgaard and colleagues (Dalgaard et al., 2014) also showed that occupational stress management training has an effect on sleep quality and the reduction of cognitive failure. However, these effects were very small. Nevertheless, the literature so far has been optimistic that such trainings can improve not only the self-reported but also actigraphy-based sleep indicators. For example, Nakada et al. (2018) recently showed that even a rather short, education-based, work-related sleep intervention improves actigraphic-based sleep indicators.

Furthermore, our results underline that occupational safety measures should also consider the work–life balance as well as findings from sleep and recovery research. Occupational safety is not only a question of good work equipment but also of good working conditions.

Conclusion

Cognitive functioning is an important prerequisite in everyday working life. Especially in occupations where instruction such as teaching or supervision is essential, cognitive failures impair performance and also have a negative effect on the transfer of knowledge. Moreover, research has shown that such failures can lead to further consequences, such as poorer safety behavior or a higher risk of (near) accidents. The current paper sought to provide a more comprehensive picture of day-to-day cognitive functioning. Thereby, self-reported WHC as well as actigraphy-based sleep were considered as predictors of cognitive failure. The findings of the present study demonstrated that both a good night's sleep and work and leisure pressure play an important role in daily cognitive functioning, possibly suggesting a combination of energetic and motivational processes.

Author Contributions All authors contributed to the study conception and design. Material preparation and data collection were performed by C.G., D.A.C., and D.S., and analysis was performed by A.E. and M.U.K. The first draft of the manuscript was written by M.U.K. and W.W., and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics Approval The study was conducted in accordance with the Declaration of Helsinki and the code of the Swiss Association of Psychology. The ethical committee of the responsible University faculty has approved the study proposal (proposal 2010-08-00003).

Conflict of Interest The authors declare no competing interests.

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