



*Special issue paper*

## **A low-dose mindfulness intervention and recovery from work: Effects on psychological detachment, sleep quality, and sleep duration**

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Although playing a crucial role for the prevention of long-term health impairment, interventions aiming at the improvement of employees' recovery processes are still scarce. In this study, we therefore investigated the effectiveness of a low-dose mindfulness intervention for recovery from work. In addition, differential responding to the treatment in terms of treatment-by-baseline interactions was studied. A sample of 140 employees participated in a randomized field experiment with a self-training and a wait-list control group. Three central recovery processes (psychological detachment, sleep quality, and sleep duration) were assessed with event-sampling methodology involving daily measurements over 10 workdays. Growth curve analyses revealed intervention effects on sleep quality and sleep duration. No effects were found for psychological detachment after work and for the proposed treatment-by-baseline interactions. Our findings are discussed in the context of occupational health promotion in general and mindfulness-based interventions in specific.

### **Practitioner points**

- Although daily recovery from the demands of work has been shown to be vital for employee well-being and performance, research on how workplace interventions can help improve recovery is still scarce.
- This study investigated the effectiveness of a brief, economic mindfulness intervention on processes that are vital for recovery – psychological detachment, sleep quality, and sleep duration.
- Findings revealed positive effects of the intervention on sleep quality and duration, but not on psychological detachment.

Resource-oriented interventions at work try to enhance well-being and performance in the workplace by targeting a variety of employees' personal, social, and job-related resources (e.g., Bond, Flaxman, & Bunce, 2008; Luthans, Avey, & Patera, 2008; Ouwenel, Le Blanc, & Schaufeli, 2013). Although these positive psychological interventions have great potential for occupational health promotion, more is to be learned about the resources that qualify for optimal improvement, the dynamics of participants' progress during these interventions as well as the specific boundary conditions that restrict or boost programme effectiveness (Lyubomirsky & Layous, 2013). Thus, questions on what

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to train, how (long) to train, and whom to train in order to get the most out of often costly and time-consuming interventions, need to be addressed.

With this study, we aim to contribute to this line of research by testing the effects of a low-dose self-training mindfulness intervention on recovery processes. Mindfulness describes a state of consciousness characterized by a non-judgmental and attentive state of awareness of momentary events and experiences (Bishop *et al.*, 2004; Brown, Ryan, & Creswell, 2007). Initial evidence on the benefits of mindfulness in the context of work stems from studies that have investigated the role of natural variations in mindfulness (mostly trait mindfulness) and their relations to work-related outcomes, such as work–life balance, job satisfaction, well-being, performance, and recovery (Allen & Kiburz, 2012; Dane & Brummel, 2014; Hülshager, Alberts, Feinholdt, & Lang, 2013; Hülshager *et al.*, 2014; Reb, Narayanan, & Ho, 2015). In addition to these cross-sectional and diary studies on mindfulness in the work context, there is a different line of research investigating the effectiveness of mindfulness interventions for working adults. The majority of these studies tested the effectiveness of comprehensive mindfulness interventions, typically the Mindfulness-Based Stress Reduction programme (MBSR; Kabat-Zinn, 1982, 1990), and typically for health care professionals (e.g., Cohen-Katz *et al.*, 2005). Recently, researchers have started to adapt the MBSR to the demands of the working population (e.g., Michel, Bosch, & Rexroth, 2014; Wolever *et al.*, 2012). With this study, we aim to build upon and extend this line of work.

First, we study the effectiveness of an economic, low-dose mindfulness intervention developed by Hülshager *et al.* (2013) that incorporates core elements of MBSR and is customized to the needs of working adults. In contrast to the mindfulness interventions discussed above, the intervention is self-administered; it only spans a period of 2 weeks (in contrast to typically 8 weeks in MBSR) and involves relatively brief daily mindfulness practices. Research in the field of positive psychology has shown that already small-scale interventions, such as reflecting on blessings (Emmons & McCullough, 2003) or performing kind acts (Lyubomirsky, Sheldon, & Schkade, 2005) each day, may help to enhance individuals' personal resources and their well-being.

Second, in studying the effectiveness of this low-dose mindfulness intervention, we focus on employees' daily recovery processes as outcome variables. Specifically, we test the effects of the intervention on individuals' psychological detachment from work during non-work time as well as subsequent sleep quality and quantity. Although research in the field of occupational health psychology has emphasized the importance of successful daily recovery from the demands of work (Fritz, Yankelevich, Zarubin, & Barger, 2010; Sonnentag, Binnewies, & Mojza, 2008; Sonnentag, Mojza, Demerouti, & Bakker, 2012; Sonnentag & Zijlstra, 2006), research on how employees' recovery processes can be facilitated through training is still scarce (for an exception see Hahn, Binnewies, Sonnentag, & Mojza, 2011). As previous research has indicated that state mindfulness is positively related to successful recovery (Hülshager *et al.*, 2014), a mindfulness intervention may prove especially useful to foster recovery.

Third, scholars have called for research that not only focuses on *whether* mindfulness interventions are effective, but also specifies for *whom* they are most effective (e.g., Roth & Fonagy, 2005; Shapiro, Brown, Thoresen, & Plante, 2011). Knowledge on these contingencies may be an important means for organizations to streamline health programmes, tailor them to specific groups, and spare resources. We therefore investigate treatment-by-baseline interactions – systematic differences in the benefit obtained by individuals with different baseline levels as a result of an intervention (Khoo, 2001).

Fourth, with this study we combine a randomized field trial with event-sampling methodology (Hülshager *et al.*, 2013). This set-up bears a number of advantages over typical set-ups involving only pre- and post-intervention measurements in that it provides valuable insights on how outcome variables change over time during the intervention and allows comparing these change trajectories between the intervention and control group.

### **Mindfulness and mindfulness interventions**

Mindfulness is the English translation of the Pali word 'sati' which connotes 'lucid awareness'. According to Kabat-Zinn (2003), mindfulness is defined as an 'awareness that emerges through paying attention on purpose in the present moment, non-judgmentally to the unfolding of experience moment by moment' (p. 145). Cultivating present-moment attention and awareness allows the practitioner to attain the role of an external agent who observes the constant flow of thoughts, sensations, and emotions and how these are transformed into entities of personal meaning (Williams, 2010). Both awareness and attention allow the practitioner to understand that neither thoughts nor emotions are eternal but subject to change (Dreyfus, 2011). This way of looking at things allows the practitioner to separate what is really experienced in any moment and what is simply the result of internally generated interpretations (Kabat-Zinn, 2003). Consequentially, mindfulness enables to slow down automatic tendencies and, meanwhile, mitigate emotional reactivity (Dreyfus, 2011).

Since the introduction of the MBSR programme (Kabat-Zinn, 1982, 1990), many different types of mindfulness-based interventions have emerged. While they differ in aspects such as the incorporated meditation practices, treatment duration, or target group, each of them aims at cultivating an open-hearted attention towards externally and internally generated experiences and the way people relate to them (Kabat-Zinn, 2003; Baer, 2003). Both, the variety of interventions and the continuously growing popularity of mindfulness is largely due to its effectiveness as a treatment for numerous somatic and psychological disorders, including anxiety and depression, insomnia, or pain (e.g., Hofmann, Sawyer, Witt, & Oh, 2010; Ong, Shapiro, & Manber, 2008; Rosenzweig *et al.*, 2010).

Recently, scholars in the field of work and organizational psychology became increasingly interested in the value of mindfulness in the context of work. Initial evidence on the benefits of mindfulness interventions for employees stems from studies investigating traditional mindfulness interventions with samples from the health care professions and focusing on psychological distress and burnout as outcome variables (e.g., Cohen-Katz *et al.*, 2005; Galantino, Baime, Maguire, Szapary, & Farrar, 2005; Irving, Dobkin, & Park, 2009; Krasner *et al.*, 2009). Importantly, traditional mindfulness-based interventions are comprehensive in terms of time investment. For instance, the typical duration of the MBSR programme spans over 8 weeks during which participants attend weekly group meetings for 2 hours or more. Next to this, participants are supposed to devote 45 min to daily meditation practice. However, time commitment is one of the biggest challenges to the feasibility of mindfulness in everyday life (Sears, Kraus, Carlough, & Treat, 2011), especially for individuals with busy work schedules and high workload.

Therefore, recent attempts have been made to adapt mindfulness interventions to better fit the requirements of the working population (Klatt, Buckworth, & Malarkey, 2009; Malarkey, Jarjoura, & Klatt, 2013; Van Berkel, Boot, Proper, Bongers, &

van der Beek, 2013; Wolever *et al.*, 2012). In an endeavour to reduce the time commitment for participants and help them fit mindfulness practices into their busy work lives, weekly group meetings have been shortened, for instance, to 1 hr and daily mindfulness practices have been reduced to 5–15 min (Wolever *et al.*, 2012). Furthermore, daily mindfulness practices that were initially designed for clinical applications and targeted pain and other psychological symptoms were adapted to better fit work-related issues, such as work stress, work–life balance, and self-care (e.g., Michel *et al.*, 2014; Wolever *et al.*, 2012). The condensed intervention used in this study spans two workweeks and involves brief mindfulness practices (about 10 min) that can readily be integrated into participants' (work) life (Hülshager *et al.*, 2013). A unique feature is that it is a pure self-training intervention and does not involve formal group meetings, retreats or contacts with a mindfulness trainer or coach (common elements in traditional mindfulness-based interventions). It is therefore time- and cost-effective both for employees and for organizations. While positive effects of this intervention have already been documented for job satisfaction and emotional exhaustion in a sample of service workers (Hülshager *et al.*, 2013), it remains to be tested whether it also benefits daily recovery processes in terms of psychological detachment, sleep quality, and sleep duration.

### **Recovery from work**

The concept of recovery is crucial in understanding under what conditions the exposure to work demands and work stressors leads to long-term health impairments (Geurts & Sonnentag, 2006). According to the effort–recovery model (Meijman & Mulder, 1998), effort expenditure at work is associated with acute load reactions, as evidenced, for instance, by an elevated heart rate and the experience of fatigue. These acute load reactions become gradually chronic and impair employee health and well-being in the long run when employees are continuously exposed to workload and when recovery is incomplete (Geurts & Sonnentag, 2006). Psychological and physiological unwinding from the demands of work during non-work time are thus vitally important, not only to maintain employee well-being and health (e.g., Fritz *et al.*, 2010; Sonnentag, 2001; Sonnentag & Zijlstra, 2006) but also to facilitate work engagement (Sonnentag *et al.*, 2012), proactivity, and work performance (Binnewies, Sonnentag, & Mojza, 2009; Fritz *et al.*, 2010). While research on factors that help or hinder recovery from work has grown exponentially in recent years, comparatively little attention has been devoted to develop interventions that foster recovery processes (for an exception see Hahn *et al.*, 2011). This is surprising as these interventions would be of great importance for organizations that seek to maintain a healthy, engaged, and productive workforce.

In examining the effects of the self-training intervention on recovery, we focus on three key aspects, namely psychological detachment from work, sleep quality, and sleep duration (Fritz *et al.*, 2010; Pereira, Meier, & Elfering, 2013; Querstret & Cropley, 2012; Sonnentag *et al.*, 2012). Psychological detachment has been defined as an 'individual's sense of being away from the work situation' (Etzion, Eden, & Lapidot, 1998, p. 579). It does not only involve a physical distance from work and the work situation, but also an abstinence of any work-related feelings or thoughts (Sonnentag & Fritz, 2007). Accordingly, psychological detachment has been described to be a core recovery experience (Sonnentag & Fritz, 2015). It has been shown to be related to a range of other important health-, well-being-, and performance-related outcomes, including emotional

exhaustion, work–family conflict, and work engagement (Demsky, Ellis, & Fritz, 2014; Fritz & Sonnentag, 2009; Fritz *et al.*, 2010; Sonnentag, Binnewies, & Mojza, 2010).<sup>1</sup>

Also sleep plays a key role in recovery processes (Querstret & Cropley, 2012; Sonnentag *et al.*, 2008). It is the antipode to working, represents total disengagement from work-related activities and (conscious) thoughts, and is thereby not only relevant for psychological unwinding, but also for physical and physiological recovery.

Although recovery research has typically focused on sleep quality (Querstret & Cropley, 2012; Sonnentag *et al.*, 2008), sleep duration is also an important aspect to consider. While sleep quality is a subjective evaluation of how *well* an individual slept (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), sleep duration captures the total amount of hours a person has slept (which may differ from the time that person has been lying in bed). Although related, sleep quality and sleep duration are theoretically and empirically distinct from one another (Barclay, Eley, Buysse, Tijdsijk, & Gregory, 2010; Buysse *et al.*, 1989). In recent years, researchers in the field of work and organizational psychology have started paying increasing attention to sleep duration as it has been shown to not only be affected by work (Barnes, Wagner, & Ghumman, 2012) but also to relate to work-relevant outcomes, such as job satisfaction and organizational citizenship behaviour (Barnes, Ghumman, & Scott, 2013; Barnes *et al.*, 2012).

Notably, a recent study investigating the effects of a mindfulness-based intervention on work–family balance documented increases in psychological detachment after a 3-week mindfulness intervention (Michel *et al.*, 2014). This study aims to replicate these findings regarding psychological detachment using a different and shorter self-training intervention. Furthermore, our study extends their work by studying sleep quality and duration as outcome variables and by tracking daily intervention-related changes over time by combining an experimental set-up with a diary design.

### **Effects of mindfulness practices on psychological detachment, sleep quality, and sleep quantity**

Theoretical and empirical work on mindfulness suggests that mindfulness-based practices improve self-regulation of psychological, behavioural, and physiological reactions (Brown *et al.*, 2007; Glomb, Duffy, Bono, & Yang, 2011; Shapiro, Carlson, Astin, & Freedman, 2006). It is through these self-regulatory processes that a mindfulness intervention may facilitate successful unwinding from the demands of work and promote recovery in terms of psychological detachment, sleep quality, and sleep duration. Glomb *et al.* (2011) summarized primary and secondary mechanisms explaining how mindfulness-based practices facilitate self-regulation. In the context of recovery, two central primary mechanisms that facilitate self-regulation are the decoupling of the self from experiences and interoceptive awareness.

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<sup>1</sup> Rather than including all four recovery experiences defined by Sonnentag and Fritz (2007; psychological detachment, relaxation, mastery experiences, and control), we chose to focus on psychological detachment exclusively: Psychological detachment has been shown to be the recovery experience with the strongest relationship with other important psychological health outcomes, such as emotional exhaustion, health complaints, or depressive symptoms (Sonnentag & Fritz, 2007), and it has therefore been playing a central role in the recovery literature (Pereira & Elfering, 2014; Sonnentag, Arbeus, Mahn, & Fritz, 2014). Furthermore, theoretical work on mindfulness suggests that mindfulness should have strongest effects on psychological detachment, while relations with the other three recovery experiences are less obvious. Accordingly, previous research has revealed significant relationships between self-reported mindfulness and psychological detachment (Hülshager *et al.*, 2014), while relationships with relaxation, mastery experience, and control have been shown to be non-existent or small (Marzuq & Drach-Zahavy, 2012).

*Decoupling of the self from experiences* (also referred to as *reperceiving* or *cognitive decentering*) has been described as the cornerstone of mindfulness practice (Shapiro *et al.*, 2006). It describes a shift in perspective on what individuals experience: 'Rather than being immersed in the drama of our personal narrative or life story, we are able to stand back and simply witness it' (Shapiro *et al.*, 2006, p. 377). Mindfulness practices promote reperceiving as participants learn to focus on present-moment experiences and to simply notice external as well as internal events (thoughts, sensations, and emotions) in a non-judgmental way. The goal of mindfulness practices is to strengthen the ability to observe what we are experiencing rather than being completely embedded in it (Shapiro *et al.*, 2006). This, in turn, creates meta-awareness, the ability to be aware of the things dominating the mind at any present moment (Shapiro *et al.*, 2006). Together these qualities facilitate a more objective assessment of external and internal events whereby radical emotional or behavioural reactions to these events can be mitigated. In fact, mindfulness has been shown to enhance adaptive forms of emotion regulation (Arch & Craske, 2006; Erisman & Roemer, 2010; Glomb *et al.*, 2011; Hülshager *et al.*, 2013) and decrease rumination (Glomb *et al.*, 2011; Jain *et al.*, 2007; Shapiro, Brown, & Biegel, 2007). As employees frequently experience negative events or stress at work, the ability to stand back and simply notice what *is* with a non-evaluative attitude will help them to keep their emotions on an even keel. It makes them less likely to get caught up in perseverative cognitions regarding the causes and potential implications of these negative events. This will preserve mental resources during work and help them to be less inclined to ruminate, thus helping them to psychologically detach from work during non-work time. Links with sleep quality and duration are twofold: First, reduced rumination will facilitate falling asleep and promote sleep quality (Querstret & Cropley, 2012). Second, difficulties with falling asleep are often preceded by rigid and controlling attempts to enforce sleep. However, as sleep is not under full voluntary control, trying to enforce sleep has paradoxical effects as it increases pre-sleep cognitive activity, arousal, and anxiety which are incompatible with sleep (Broomfield & Espie, 2003; Ong, Cardé, Gross, & Manber, 2011). Reperceiving, the ability to step back and observe, promotes a non-striving attitude and acceptance that one may not fall asleep immediately. It helps to let go of the idea that one has to fall asleep, and it reduces cognitive activity, arousal, and anxiety which helps that sleep comes naturally (Ong *et al.*, 2008).

Apart from decoupling the self from experiences, another mechanism through which mindfulness may benefit recovery processes is through strengthening an individual's *interoceptive awareness*. Interoceptive awareness refers to individuals' sensitivity to stimuli that originate inside the body (visceral sensations associated with, e.g., respiration, digestion, circulation, or proprioception) and that are involved in maintaining homeostasis (Craig, 2003). As mindfulness meditation practice involves sustained attention to bodily sensations, such as respiratory sensations and feelings of tension, pain, or physiological arousal, mindfulness has been argued to promote interoceptive awareness (Glomb *et al.*, 2011; Hölzel *et al.*, 2008; Kerr, Sacchet, Lazar, Moore, & Jones, 2013; Kristeller, Wolever, & Sheets, 2013). Indeed, neuropsychological research confirmed that mindfulness practice was associated with increased grey matter concentration in brain areas associated with interoceptive awareness (Hölzel *et al.*, 2008). Interoceptive awareness, in turn, may influence self-regulation of behaviour as visceral sensory impulses that reach awareness are likely to affect behaviour, thought, and emotion (Cameron, 2001). This argument is supported by research showing that interoception is

associated with adaptive self-regulation in general and emotion regulation in particular (Füstös, Gramann, Herbert, & Pollatos, 2013; Van 't Wout, Faught, & Menino, 2013). For instance, interoceptive awareness has been shown to be negatively related to obsessive compulsive drinking behaviour (Schmidt, Eulenbruch, Langer, & Banger, 2013) and positively with the ability to respond adaptively to unfair treatment by others (Van 't Wout *et al.*, 2013).

A heightened awareness of bodily sensations may thus foster recovery. Employees who are aware of early symptoms of stress, exhaustion, or fatigue are more likely to adapt their behaviour and engage in activities that facilitate rather than impede recovery compared with employees who are unaware of their bodily sensations. They may, for instance, avoid stressful work situations and overtime hours, deliberately take a break from work, and engage in leisure activities that have been shown to promote recovery (e.g., physical and social activities; Sonnentag & Zijlstra, 2006). In doing so, psychological detachment and, in turn, sleep quality may be facilitated. Similarly, becoming aware of the physiological signals of tiredness, employees may go to bed earlier, leading to longer sleep duration.

Taken together, we therefore expect that psychological detachment, sleep quality, and sleep duration increase as a result of the self-administered low-dose mindfulness intervention.

*Hypothesis 1:* There will be an interaction between time and condition in predicting (a) psychological detachment, (b) sleep quality, and (c) sleep duration. Specifically, (a) psychological detachment, (b) sleep quality, and (c) sleep duration will increase over time in the intervention group, while remaining stable in the control group.

#### *Treatment-by-baseline effects*

Mindfulness researchers have argued that studies into the effectiveness of mindfulness interventions not only need to investigate whether mindfulness interventions are effective, but also for whom they are most effective (Shapiro *et al.*, 2011). Learning more about differential effects of workplace health promotion programmes in general is vital in order to tailor interventions to employees' needs and invest time and money effectively. In investigating differential effects, we will focus on treatment-by-baseline interactions.

Intervention research has frequently documented situations in which individuals with high versus low baseline levels show differential reactions to interventions (Khoo, 2001; MacKinnon, Fairchild, & Fritz, 2007). Typically, clinical interventions as well as interventions in the field of work and organizational psychology (e.g., Eden & Aviram, 1993; Eden & Kinnar, 1991) have had stronger effects for individuals who are more at risk and display low levels of initial functioning. The underlying idea is that those with low baseline levels may have more to gain from an intervention, while ceiling effects may hamper the benefits for those with high baseline levels (Shapiro *et al.*, 2011). For mindfulness-based interventions, findings have been mixed: Jacobs *et al.* (2011) did find a treatment-by-baseline interaction when investigating the effectiveness of meditation training among healthy participants – those who displayed poorer psychological functioning at baseline benefitted more from the intervention than their higher functioning counterparts. In contrast, Wolitzky-Taylor, Arch, Rosenfield, and Craske (2012) found no interaction effect. Notably however, they examined the effectiveness of

acceptance and commitment therapy (ACT), which includes not only elements of mindfulness, but also of cognitive behavioural therapy. Thus, the dependence of the effectiveness of mindfulness interventions on participants' baseline levels may differ according to the components of the intervention and the outcome variables that are taken into account. In sum, theoretical arguments and the empirical literature suggest that benefits from mindfulness interventions may differ depending on participants' baseline levels on outcome variables.

*Hypothesis 2:* There will be an interaction between condition (intervention vs. control group) and baseline levels for (a) psychological detachment, (b) sleep quality, and (c) sleep duration such that gains in recovery processes due to the intervention are stronger for participants with low baseline levels.

### **The present study**

To investigate the ideas developed above, we used a randomized field experiment in combination with experience sampling methodology (ESM), a set-up previously employed by Hülshager *et al.* (2013). Specifically, participants were randomly assigned to the intervention group or a wait-list control group. Both groups participated in a diary study spanning 10 workdays and involving three daily measurement occasions (in the morning, at the end of work, and at bedtime). This set-up bears a number of advantages and allows for a comprehensive evaluation of the self-training intervention, both in terms of outcomes and processes involved. Typically, studies investigating positive psychology interventions in the context of work use randomized pre-test post-test control group designs, involving pre- and post-intervention measurements, and sometimes a follow-up measurement (for an overview see Meyers, van Woerkom, & Bakker, 2013). Although such a set-up is valuable as it allows making causal inferences and excluding a number of threats to external and internal validity (Cook & Campbell, 1979), extending this set-up by including daily measurement occasions over two workweeks bears important advantages: First, in the context of recovery, where outcome variables have been shown to be dynamic and to fluctuate from day to day within persons (Sonnentag *et al.*, 2008), it is important to assess them as they occur rather than relying on one-point-in-time retrospective assessments which do not capture day-to-day fluctuations and are prone to recall biases (Ohly, Sonnentag, Niessen, & Zapf, 2010).

Second, change patterns in outcome variables can be monitored over the entire study period, providing insights into the processes involved in the intervention: For instance, change may occur linearly, such that the control group remains stable while the intervention group shows a linear increase in outcome variables. Yet, it is also possible that largest gains may be reaped in the beginning of the intervention and remain stable once a certain level is reached. Alternatively, a certain period of training may be necessary before the intervention has an effect on outcome variables such that intervention and control group remain similar in the beginning and then start to grow apart. These differences in the processes involved in an intervention are only detectable if outcome variables are repeatedly measured in small time intervals during the intervention. In this study, we therefore use event-sampling methodology, involving daily measurements of mindfulness, psychological detachment, sleep quality, and sleep duration, and analyse change trajectories in outcome variables over 10 workdays.



## Method

### Procedure

Participants were randomly assigned to the self-training intervention or the wait-list control group. Both groups received a paper-and-pencil diary booklet consisting of the introductory survey and diary surveys for 10 workdays. Participants were asked to fill in the introductory survey before starting with the diary part.

For participants in the intervention group, the self-training intervention was integrated into the diary while participants in the control group received a booklet with the self-training intervention after completion of the study.

### *The self-training intervention*

We used the self-training intervention developed by Hülshager *et al.* (2013) that builds upon key elements and exercises of Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) and MBSR (Kabat-Zinn, 1982, 1990). First, participants received some general information about mindfulness and mindfulness meditation along with instructions when and how to perform the exercises. Similar to MBCT and MBSR, the self-training intervention consisted of daily guided mindfulness meditations and informal mindfulness exercises. Specifically, participants were sequentially familiarized with the following mindfulness practices: The Body Scan, the Three-minute Breathing Space, the Mindful Routine Activity exercise, and a Loving Kindness Meditation exercise. All of these exercises aim at cultivating an open-hearted attention towards externally and internally generated stimuli. As an essential part of mindfulness trainings, participants were encouraged to develop an open and compassionate mindset in performing all of these exercises. Table 1 provides brief descriptions of the exercises and an overview when each exercise was introduced and how often participants were asked to perform them. For each exercise, participants first received some brief written information as well as audio files with guided meditations. When performing mindfulness meditation exercises, participants typically realize how difficult it is to stay focused on the present moment and how easily one gets distracted by thoughts. This may cause frustration and make it even more difficult to stay focused on the present moment. Participants were therefore repeatedly encouraged to not criticize or blame themselves but to simply realize when they get distracted and to be kind and indulgent to themselves and their weaknesses.

### **Participants**

The sample was a convenience sample recruited from a broad range of organizations in Germany. The majority of participants was approached directly and mostly in person. Some participants were contacted via mail first. Others received a flyer with an invitation to the study from colleagues or supervisors. Overall, 220 diary booklets were distributed, 148 of which were returned (75 intervention group, 73 control group), resulting in an overall response rate of 67.3%. Notably, the actual response rate is likely to be lower because some supervisors forwarded information on the study and flyers to an unknown number of individuals and some individuals who were approached individually may not have accepted a diary booklet in the first place.

As a compliance check, participants in the intervention group were asked every day to indicate whether they had engaged in their daily mindfulness meditation exercises. A total of eight participants either indicated on all 10 days to not have engaged in the mindfulness

**Table 1.** Schedule and description of mindfulness exercises involved in the self-training intervention

Day		Three-minute breathing space	Body scan	Mindful routine activity	Loving kindness			
					Me	Friend	Neutral person	Disliked person
1	Morning							
	Evening	x	x					
2	Morning	x		x				
	Evening	x						
3	Morning	x		x				
	Evening	x			x			
4	Morning	x		x				
	Evening	x			x			
5	Morning	x		x				
	Evening	x				x		
6	Morning	x		x				
	Evening	x				x		
7	Morning	x		x				
	Evening	x					x	
8	Morning	x		x				
	Evening	x						x
9	Morning	x		x				
	Evening	x						x
10	Morning	x		x				
	Evening	x	x					
Three-minute Breathing Space	Participants learn to strengthen the focus on the present moment. Central to this exercise is the breath which functions as an anchor. Whenever distracting thoughts appear, attention is gently brought back to the act of breathing. This exercise is relatively short, and it can easily be implemented into individuals' (work-) life. It helps to disrupt automatic behaviour and thinking patterns and to reconnect with the present moment (Siegel, 2010; Williams, Teasdale, Segal, & Kabat-Zinn, 2007)							
Body Scan	Participants are instructed to bring attention and awareness to different body parts by sequentially 'scanning' through them, starting with the feet and moving up from there. Doing so, participants pay attention to the physical sensations (pleasant and unpleasant) that they recognize while focusing on the respective body part							
The Mindful Routine Activity	Participants pick a routine activity (e.g., preparing breakfast, taking a shower) and try to perform it in a mindful rather than automatic way by bringing full attention to it. Whenever distracting thoughts cross the mind, attention is gently brought back to the activity							
Loving Kindness	Goal of the Loving Kindness exercise is to cultivate love and kindness for others and oneself (Shapiro & Carlson, 2009). The exercise begins with focusing on the breath, thereby bringing attention to the present moment. In the central part of the exercise, participants send loving and compassionate feelings and wishes to themselves or others and try to vividly picture these tender feelings. First, the Loving Kindness Meditation focuses on the self, and it is then extended to others – First to individuals with which one has a positive relationship, then to a neutral person, and finally to a person with which one has a difficult relationship							

Note. The Mindful Routine Activity exercise was introduced on the second evening, and participants were asked to perform it every day at a point in time that suited them best.

meditation exercises or failed to answer the respective question on all 10 days of the study. These eight participants were dropped from analyses. The final sample therefore consisted of 140 participants (67, intervention group; 73, control group), 97 were female (69.3%), one participant failed to indicate his/her gender. Participants held a variety of different jobs. A total of 15.7% were clerks (bank, accounting, insurance, payroll), 10.7% hairdressers, 8.6% merchants, 7.9% consultants, 6.4% kindergarten teachers and pedagogues, 5% health care professionals (e.g., hearing aid acousticians, optometrists), 4.3% civil servants and police officers, 3.6% nurses, 2.9% were managers, HR professionals, physicians, and engineers respectively, 2.1% were secretaries or retail salespersons respectively, 1.4% were physiotherapists, athletic trainers or waiters respectively, the rest held other types of jobs or did not indicate their occupation. On average, they were 37 years of age ( $SD = 13.3$ ) and had an organizational tenure of 11.2 years ( $SD = 11.5$ ). Participants in the intervention and control group did not differ significantly regarding gender, tenure, and baseline levels of sleep quality and psychological detachment. Participants in the control group were significantly older ( $M = 39.96$ ,  $p = .01$ ; Cohen's  $d = -.45$ ) compared to participants in the intervention group ( $M = 34.27$ ). Furthermore, although not reaching statistical significance, baseline levels of mindfulness (control group  $M = 3.66$ , intervention group  $M = 3.47$ ,  $p = .12$ ; Cohen's  $d = -.28$ ) and sleep duration (control group  $M = 6.59$ , intervention group  $M = 6.23$ ,  $p = .09$ ; Cohen's  $d = -.31$ ) tended to differ somehow. On average, participants in the intervention group spent 10.5 min ( $SD = 7.0$ ) on their daily mindfulness practices.

### **Measures**

Data collection consisted of two parts: A general survey and the diary part including brief daily surveys that had to be answered three times a day (in the morning, at the end of work, before going to bed), for 10 workdays. All items were in German and had to be answered on 5-point Likert scales. The general questionnaire was completed before participants started filling in the diary part and before the intervention group received the mindfulness self-training intervention. In the general survey, demographic information and baseline measures were assessed:

#### *Trait mindfulness*

We assessed trait mindfulness with the German version (Michalak, Heidenreich, Ströhle, & Nachtigall, 2008) of the 15-item Mindfulness Attention and Awareness Scale (MAAS; Brown & Ryan, 2003). A (reversed) sample item is 'I find it difficult to stay focused on what's happening in the present'.

#### *Psychological detachment*

General psychological detachment after work was assessed with the respective 4-item scale of the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007). A sample item is 'I don't think about work at all'.

#### *Sleep quality and duration*

Participants' general levels of sleep quality and duration were assessed with the respective items from the Pittsburgh Sleep Quality Index (Buysse *et al.*, 1989): 'On average, how do

you evaluate your sleep?'; 'On average, how many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed.)' These items have been used in studies on recovery from work stress (Hahn *et al.*, 2011; Sonnentag *et al.*, 2008).

In the diary part, sleep quality and duration were assessed in the morning survey, hours worked and mindfulness in the end of work survey, and psychological detachment in the bedtime survey.

#### *Sleep quality and duration*

Sleep quality and duration were assessed with the same items that were used in the general questionnaire, but participants were instructed to refer to the past night.

#### *Mindfulness*

Mindfulness during work was assessed with the German translation (Michalak *et al.*, 2008) of the 5-item state version of the MAAS (Brown & Ryan, 2003). Participants were instructed to refer to their experiences 'today during work' when answering the questions. A sample item is 'I rushed through activities without being really attentive to them'.

#### *Psychological detachment*

Psychological detachment was assessed with the same items used in the general questionnaire but referring to the respective evening.

#### *Control variables (work hours and age)*

In line with previous recovery research (Sonnentag *et al.*, 2014), we controlled for work hours which have been shown to be associated with recovery-related outcomes such as fatigue and psychological detachment (Sanz-Vergel, Demerouti, Bakker, & Moreno-Jimenez, 2011; Shirom, Nirel, & Vinokur, 2009). At the end of work, participants reported the amount of hours they had worked: 'How many hours did you work today?'. Furthermore, we controlled for age, for which we had found significant baseline group differences (see sample description).

#### **Variance decomposition**

For variables that were assessed at the day level, we inspected the relative amount of within- and between-person variation by computing the ICC1 in an unconditional random coefficient model (Bliese, 2006). Results revealed ICC1 values between .23 and .54 (work hours: .54; mindfulness: .51; sleep quality: .23; sleep duration: .40; psychological detachment: .43), indicating that 46% of variance in work hours, 49% in mindfulness, 77% in sleep quality, 60% in sleep duration, and 57% in psychological detachment from work were lying within persons.

#### **Analyses**

Our data had a hierarchical structure with 10 daily reports nested in persons. To test the effects of the self-training intervention, we therefore used a random coefficient modelling

framework that is suitable when one has multilevel data. This allowed us to conduct growth curve analyses and to fully exploit the longitudinal data structure by investigating change on dependent variables over time (i.e., over the 10-day period) and the extent to which these change trajectories were a function of condition (control vs. intervention group). For every dependent variable, we started out with testing how the dependent variable changed over time by modelling the fixed relationship between time (i.e., day of the study) and the dependent variable (Model 1) (Bliese & Ployhart, 2002). Specifically, we modelled a linear relationship first and then progressed to model quadratic and cubic relationships (Bliese & Ployhart, 2002). Once the form of the relationship between time and the dependent variable was established, we included a random slope parameter. We then tested for autoregressive structures (autocorrelation) and for systematic changes in the variance of responses over time (Bliese, 2006). Once error structures were properly specified and included in the model if necessary, we proceeded to test a cross-level interaction between time and condition (Model 2). Model 2 represents a conditional growth model and tests whether differences in change trajectories between participants (slope differences) can be explained by group membership (condition). Model 2 directly tests Hypothesis 1. A significant interaction term would indicate that changes in the dependent variable are a function of time and condition (e.g., values increase in one condition while remaining constant in the other condition). Hypothesis 2 was tested in Model 3 by including a three-way interaction with pre-intervention baseline levels. Hypothesis 2 would be supported if a significant three-way-interaction emerged and showed, for example, steeper increases in sleep quality in the intervention group for participants with low baseline levels compared to participants with high baseline levels.

## Results

Intercorrelations between study variables, means, and *SD* are depicted in Table 2.

We started our set of analyses with a manipulation check, by investigating changes in daily mindfulness. As can be seen from Table 3, Model 1 revealed that there was a significant positive linear relationship between time and mindfulness (there was no evidence for a quadratic or cubic relationship). In Model 2, a random slope parameter for time and a time-by-condition cross-level interaction were included. Results revealed a significant positive interaction between time and condition, showing that change patterns in mindfulness differed significantly between the control and the intervention group. A simple slope analysis was conducted to probe the interaction effect (Preacher, Curran, & Bauer, 2006). There was no significant change in mindfulness for the control group (coef. =  $-.01$ ,  $p = .59$ ), while there was a significant increase in mindfulness for the intervention group (coef. =  $.03$ ,  $p = .009$ ; see Figure 1). Taken together, these results confirm that the self-training intervention had a positive effect on daily mindfulness levels. Although not part of our hypotheses, we tested whether baseline levels of mindfulness interacted with time and condition in predicting daily mindfulness. Yet, as can be seen from Model 3, there was no evidence for a treatment-by-baseline interaction.

For psychological detachment from work, growth curve analyses revealed not only a significant linear relationship between time and psychological detachment, but also evidence for a significant quadratic and cubic relationship (Model 1). In Model 2, we therefore tested interaction effects between condition and linear, quadratic, and cubic

**Table 2.** Intercorrelations between study variables

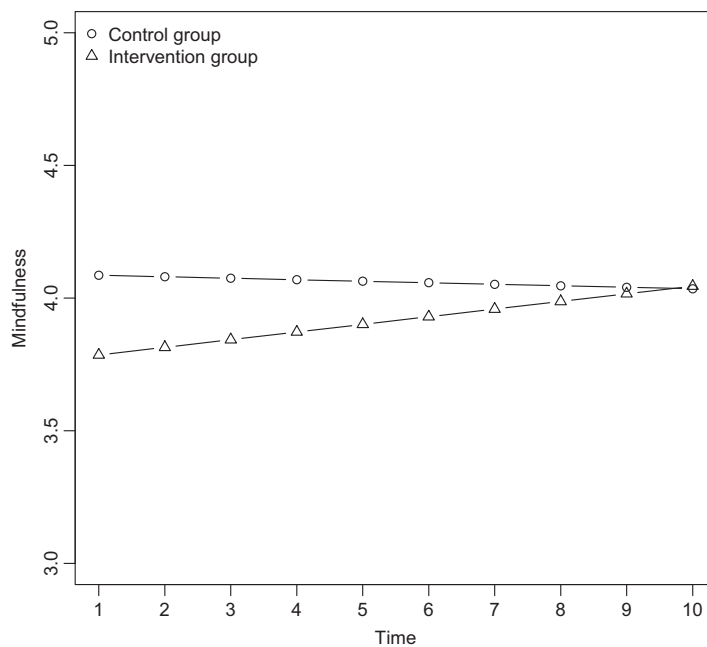
	General questionnaire and daily values aggregated to the person level										Uncentred daily values			
	Age	2	3	4	5	6	7	8	9	10	6	7	8	9
General questionnaire														
2 Trait mindfulness	.20*													
3 Sleep quality	-.02	.23**												
4 Sleep duration	-.11	.16	.33**											
5 Psychological detachment	-.02	.38**	.12	.04										
Daily diary questionnaires														
6 Work hours	-.13	-.06	.07	-.12	-.23**									
7 Mindfulness	.17*	.39**	.28**	.24**	.19*	-.07								
8 Sleep quality	-.03	.15	.36**	.18*	-.03	.16	.13							
9 Sleep duration	-.21*	.04	.34**	.47**	.10	-.24**	.15	.20*						
10 Psychological detachment	.08	.18*	.11	.08	.42**	-.24**	.28**	-.01	.17*					
Cronbach's $\alpha$	—	.88	—	—	.89	—	.85	—	—	.89				
M	37.33	3.56	3.09	6.41	2.98	8.21	3.99	3.47	6.55	3.30				
SD	13.27	0.67	0.90	1.17	0.98	1.52	0.62	0.61	0.91	0.79				

Note.  $n = 121-140$  at the person level (general questionnaire and daily values aggregated to the person level) and  $836-1314$  at the day level (uncentred daily values from the daily diary questionnaires). Relationships between daily values from diary questionnaires have been computed with multilevel modelling in R (nlme package), accounting for nesting in persons; Cronbach's alphas were calculated individually for every day and then averaged across the 10 days of the study. \* $p < .05$ ; \*\* $p < .01$  (two-tailed).

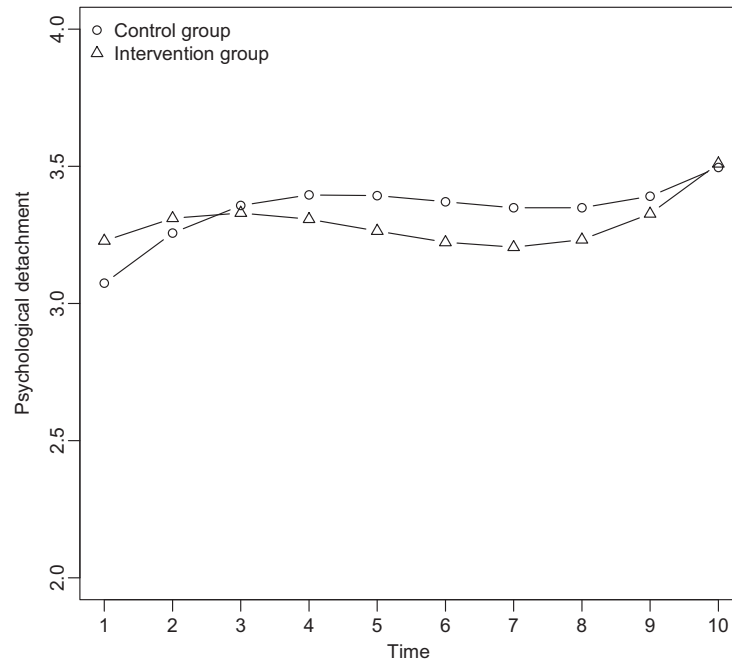
**Table 3.** Multilevel models predicting daily mindfulness and psychological detachment

	Mindfulness			Psychological detachment		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<b>Fixed effects</b>						
Intercept	4.01**	4.08**	4.07**	3.17**	3.07**	3.07**
Age	.06	.05	.05	.07	.08	.08
Work hours	-.04	-.04	-.04	-.07*	-.07*	-.07*
Baseline	.21**	.24**	.33*	.32**	.33**	.46**
Condition	-.15	-.30**	-.28*	-.04	.15	.15
Time	.01*	-.01	.00	.17*	.23*	.23*
Time <sup>2</sup>				-.05*	-.05*	-.05*
Time <sup>3</sup>				.003*	.003	.003
Time × Condition		.03*	.03 <sup>†</sup>		-.11	-.11
Time <sup>2</sup> × Condition					.01	.01
Time <sup>3</sup> × Condition					.00	.00
Time × Condition × Baseline			-.01			-.15
Time <sup>2</sup> × Condition × Baseline						.04
Time <sup>3</sup> × Condition × Baseline						.00
<b>Random effects</b>						
Intercept	.285	.255	.252	.405	.421	.408
Time		.003	.002		.011	.011
Time <sup>2</sup>					.000	.000
Time <sup>3</sup>					.000	.000
Residual	.318	.301	.300	.683	.647	.649

Note. *N* = 1251–1257 observations nested in 135–137 persons. Condition was coded as 0 = control group and 1 = intervention group. Models 2 and 3 for mindfulness and psychological detachment allowed for autocorrelation because they fit the data significantly better than models assuming no autocorrelation. \*\**p* < .01; \**p* < .05; †*p* = .05 (two-tailed).



**Figure 1.** Changes in daily mindfulness over time (day of the study) as a function of condition.



**Figure 2.** Changes in daily psychological detachment over time (day of the study) as a function of condition.

time trends, respectively. Yet, none of these interactions were significant, indicating that change patterns in psychological detachment were similar across conditions (see Figure 2 for a graphic illustration). Furthermore, there was no evidence for a treatment-by-baseline interaction (Model 3). Taken together, hypotheses 1a and 2a were therefore not supported.

For sleep quality, a significant positive fixed linear relationship between time and sleep quality emerged (Table 4, Model 1), while there was no evidence for quadratic or cubic time trends. Model 2 revealed a significant, positive cross-level interaction between condition and time, indicating that time–sleep quality slopes differed significantly between the control and the intervention group. Specifically, there was a decline in sleep quality in the control group (coef. =  $-.03$ ,  $p < .05$ ), while the intervention group experienced a significant increase in sleep quality over the 10-day period (coef. =  $.10$ ,  $p < .01$ ; see Figure 3). Hypothesis 1b was thus supported. As can be seen from Model 3, there was no evidence for a treatment-by-baseline interaction in these change trajectories (Hypothesis 2b).

A similar pattern of results emerged for sleep duration: There was evidence for a significant positive linear relationship between time and sleep duration, while there was no evidence for quadratic or cubic trends (Model 1). Time–sleep duration slopes differed between conditions (Model 2); this difference reached a significance level of  $p = .06$  when applying a conservative two-tailed test of significance. Researchers have argued that power to detect cross-level interaction effects in multilevel designs is typically low, especially when the sample size at Level 1 is relatively small (Mathieu, Aguinis, Culpepper, & Chen, 2012; Snijders & Bosker, 1999). Researchers have therefore suggested that a more lenient criterion of  $p < .10$  may be applied for detecting cross-level interaction effects (Yeo & Neal, 2004). A simple slope analysis showed that sleep duration did not change over time in the control group (estimate =  $.01$ , n.s.), while it significantly increased in the intervention group (estimate =  $.05$ ,  $p < .01$ ; see also Figure 4), supporting Hypothesis



**Table 4.** Multilevel models predicting daily sleep quality and sleep duration

	Sleep quality			Sleep duration		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<b>Fixed effects</b>						
Intercept	3.12**	3.36**	3.36**	6.41**	6.49**	6.46**
Age	.03	.03	.03	-.16*	-.16*	-.17*
Baseline	.16**	.19**	.20**	.41**	.41**	.56**
Condition	.42*	-.10	-.11	.04	-.11	-.10
Time	.03**	-.03	-.03	.03**	.01	.01
Time × Condition		.13**	.13**		.04 <sup>†</sup>	.03 <sup>†</sup>
Time × Condition × Baseline			.00			-.01
<b>Random effects</b>						
Intercept	.133	.045	.048	.439	.439	.429
Time		.002	.002		.000	.000
Residual	.687	.638	.638	.925	.923	.924

Note.  $N = 926$ – $1179$  observations nested in  $122$ – $135$  persons. Condition was coded as  $0 =$  control group and  $1 =$  intervention group.

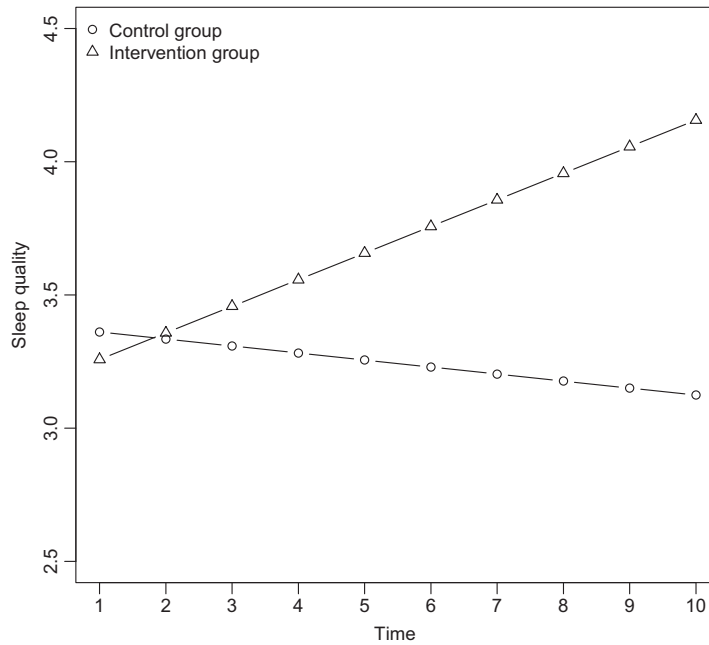
\*\* $p < .01$ ; \* $p < .05$ ; <sup>†</sup> $p < .10$  (two-tailed).

1c. Hypothesis 2c was not confirmed; the treatment-by-baseline interaction was not significant.<sup>2</sup>

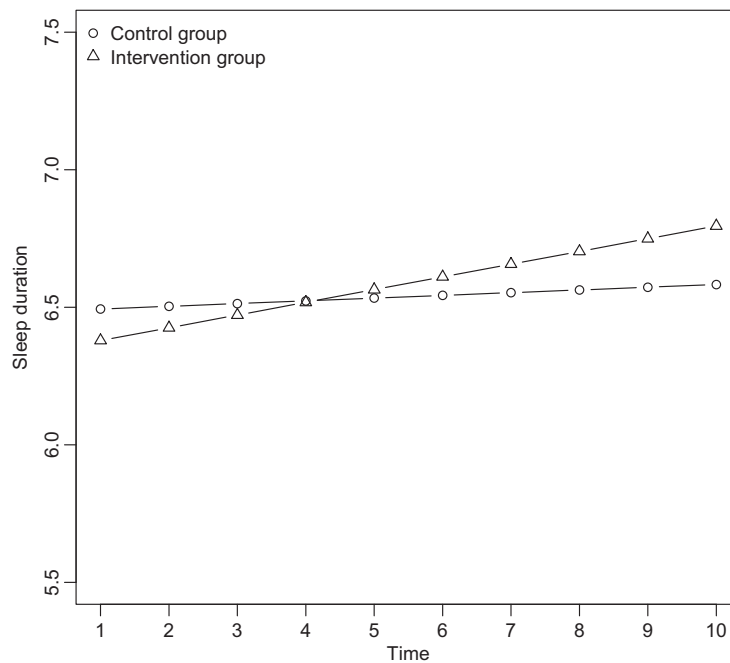
## Discussion

Given the importance of recovery for the prevention of long-term health impairments (Geurts & Sonnentag, 2006) on the one hand and the scarcity of recovery management interventions (Hahn *et al.*, 2011) on the other hand, the present study set out to investigate the effectiveness of a low-dose mindfulness self-training intervention for psychological detachment, sleep quality, and sleep duration. Study findings were mixed, providing support for some but not all hypotheses: Results revealed that a brief self-training mindfulness intervention was effective in increasing daily levels of mindfulness during work, sleep quality, and sleep duration over the course of 10 workdays. However, contrary to expectations, the intervention had no effect on psychological detachment in the evening. This finding is surprising, considering that earlier research suggests that mindfulness facilitates psychological detachment. For instance, Hülshager *et al.* (2014) found that daily self-reported mindfulness during work was significantly related to psychological detachment in the evening. Furthermore, previous studies conducted outside the work context documented that traditional mindfulness-based interventions led to reduced levels of rumination (Jain *et al.*, 2007; Manicavasagar, Perich, & Parker, 2012; Shapiro *et al.*, 2007), a construct that is inversely related to psychological detachment. Similarly, a recent study found a 3-week mindfulness-based intervention to

<sup>2</sup> In testing treatment-by-baseline interactions, we used trait measures of the respective outcome measures as a baseline. In the case of sleep quality and sleep duration, an alternative baseline measure may be sleep quality and sleep duration assessed in the morning of the first day of the study before the intervention started. The pattern of results was similar to results reported above: No significant treatment-by-baseline effect emerged for sleep quality (estimate = .00, n.s.) and for sleep duration (estimate = .00, n.s.).



**Figure 3.** Changes in daily sleep quality over time (day of the study) as a function of condition.



**Figure 4.** Changes in daily sleep duration (in hours) over time (day of the study) as a function of condition.

be effective in increasing psychological detachment in a sample of employees (Michel *et al.*, 2014). Possibly, the present intervention, being of relatively short duration (2 weeks) and involving a comparatively small amount of daily practice time (on average 10.5 min as opposed to 45 min in traditional mindfulness interventions), may not have been intensive enough to yield effects on psychological detachment. In addition to mindfulness-specific elements, Michel *et al.*'s (2014) intervention contained a non-mindfulness-related module focusing on the importance of psychological detachment

and the segmentation of work and private life which may have driven or strengthened the effects of the overall intervention on psychological detachment.

In addition to studying main effects of the intervention, we explored whether the intervention had differential effects for groups of participants. However, the data provided no evidence for treatment-by-baseline effects, neither for daily mindfulness nor for the three outcome variables. A potential explanation of the missing treatment-by-baseline interactions may lie in the specifics of the present sample. Typically, treatment-by-baseline interactions that have been documented in intervention and prevention research describe a scenario where an intervention has stronger effects on participants who are vulnerable, at risk, or display low psychological functioning before the intervention (Khoo, 2001; MacKinnon *et al.*, 2007). The present sample was a non-clinical sample of employees. It is therefore likely that their overall level of psychological functioning may have been comparatively high and that none or very few participants may have been truly at risk in terms of clinical levels of rumination or insomnia, making it difficult to find the expected treatment-by-baseline interaction. Supplementary analyses provide some support for this view. On average, participants' initial levels of sleep quality, sleep duration, psychological detachment, and neuroticism were of medium size (pre-intervention sleep quality:  $M = 3.09$ ,  $SD = .90$ ; first-day sleep quality:  $M = 3.35$ ,  $SD = .93$ ; pre-intervention sleep duration:  $M = 6.41$ ,  $SD = 1.17$ ; first-day sleep duration:  $M = 6.43$ ,  $SD = 1.21$ ; pre-intervention psychological detachment:  $M = 2.98$ ,  $SD = .98$ ; first-day psychological detachment:  $M = 3.1$ ,  $SD = 1.12$ ; pre-intervention neuroticism:  $M = 2.85$ ,  $SD = .73$ ), suggesting that participants had regular levels of psychological functioning.

Overall, our findings provide additional evidence that mindfulness-based interventions may be a useful supplement to workplace health promotion programmes (Cohen-Katz *et al.*, 2005; Galantino *et al.*, 2005; Wolever *et al.*, 2012). Specifically, our findings show that even a low-dose self-training intervention that only spans two workweeks in contrast to 8 weeks and that only involves written information and audio files instead of weekly group meetings with a mindfulness trainer has the potential to benefit employee health and well-being by promoting daily recovery processes.

Importantly, our study provided additional insights into the processes involved in the present self-training intervention by evaluating it with event-sampling methodology. Typical evaluation studies compare pre-intervention measures to post-intervention and follow-up measures and inform on the overall effectiveness of the intervention. In contrast, evaluating the intervention with daily assessments shed light on what happens between pre- and post-intervention measurements and how effects of the intervention unfold over time. Growth curve analyses revealed that as of the first days of the intervention, gains in mindfulness, sleep quality, and sleep duration appeared. This is not surprising when one considers that even brief 10- to 15-min mindful-breathing exercises have been shown to have immediate positive effects on emotion regulation and positive and negative affect in laboratory experiments (Arch & Craske, 2006; Erisman & Roemer, 2010; Hafenbrack, Kinias, & Barsade, 2014). Furthermore, our analyses showed that these gains gradually increased in a linear fashion over the 10-day period indicating that the benefits of mindfulness practice build up as participants practice and gain experience with it.

### **Limitations and future directions**

Despite these strengths, the present study had limitations and these suggest several possibilities for future research. Although it is an interesting finding in itself that even

after 10 days of mindfulness training, effects emerged, important additional insights could be gained from extending the training period to four or more weeks: It would allow investigating whether effects on psychological detachment develop after a longer period of training. Furthermore, it is likely that training effects on sleep quality and duration stop increasing in a linear fashion after some time of practice and reach a plateau at a certain point. Future research may also include follow-up measurements. These would provide important insights into whether and for how long participants continue practicing independently and how long training effects persist after the formal training phase is over.

Another limitation of the present study is the wait-list control group design which is common for initial tests of psychological interventions but has certain limitations as it may create expectation biases or experimenter demand (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Hülshager *et al.*, 2013). Future research will also benefit from comparing the self-training mindfulness intervention to other interventions, including traditional mindfulness interventions, traditional organizational stress management interventions, or a recovery training programme (Hahn *et al.*, 2011).

As reported in the method section, the control and the intervention group tended to differ regarding baseline levels of mindfulness and sleep duration, although these differences were not statistically significant. Regarding mindfulness, the relative difference in starting values is apparent from Figure 1, which shows that participants in the intervention group started with lower levels of mindfulness on day 1 than participants in the control group. Notably, we controlled for baseline levels in outcome variables to account for these differences. Furthermore, our analyses focus on differences in *changes* in outcome variables between intervention and control group over the 10-day study period rather than on *absolute* differences in outcome variables between intervention and control group.

Finally, we did not focus on the effect of our intervention on *specific* processes involved in recovery from work, such as psychological detachment from negative work experiences by promoting a non-evaluative attitude towards those events. A way to extend knowledge on these processes involved in the effectiveness of mindfulness interventions is to consider daily negative events at work and test whether individuals receiving a mindfulness intervention react more adaptively to negative work events as we suggested in the introduction.

In conclusion, this study advanced both the recovery literature and the mindfulness literature by providing evidence that a brief self-training intervention is effective in improving participants' daily levels of mindfulness during work, their sleep quality, and sleep duration.

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