Work, Nonwork, and Sleep:
The Role of Individual Factors and the Social Work Environment

Kumulative Dissertation

zur Erlangung des Doktorgrades der Naturwissenschaften

(Dr. rer. nat.)

dem Fachbereich Psychologie der Philipps-Universität Marburg

vorgelegt von

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Marburg an der Lahn, April 2023

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Vom Fachbereich Psychologie der Philipps-Universität Marburg (Hochschulkennziffer 1180)
als Dissertation angenommen am 24.06.2023

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Tag der Disputation: 12.07.2023

It´s always the small pieces that make a big picture

Unknown

Danksagung

Die Danksagung ist nicht Teil der Veröffentlichung.

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Summaries

English Summary

Employees' sleep often receives too little attention compared to issues such as exercise and nutrition. However, sleep problems among employees are widespread and have even increased in recent years (Kronholm et al., 2016). This information is worrying as restful sleep has a crucial impact on the health, performance and occupational safety of employees (Brossoit et al., 2019; Litwiller et al., 2017). Healthy sleep is therefore of great interest not only to employees, but also to organisations. The overall aim of this dissertation is to analyse the antecedents of employees' sleep quality and the explanatory mechanisms for promoting sleep quality.

So far, it is not well understood why job demands, such as time pressure or a high workload, are important antecedents of reduced sleep quality as a long-term consequence (e.g., Van Laethem et al., 2018) and why they are not necessarily related to sleep impairments in the same night (e.g., Eggli et al., 2022). Therefore, based on the Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015), the present dissertation investigates whether detachment, the mental disconnection from work, mediates the (possible) relationship between job demands and sleep quality in the short and long term (Research Question 1).

Furthermore, little is known to date about the role of employees' individual factors and the social work environment in the relationship between work, nonwork, and sleep (Crain et al., 2018). However, this knowledge is not only important for a better theoretical understanding, but also enables the derivation of tailored interventions to improve the employees' sleep quality. Therefore, following the work, nonwork, and sleep framework model of Crain et al. (2018), this dissertation investigates which individual factors of employees are relevant for their sleep quality (research question 2) and what role the social work environment plays for their sleep quality (research question 3). These three research questions are addressed in four manuscripts, which form the basis of this dissertation.

In Manuscript 1, we examined whether employees who perceive social support from supervisors and colleagues are more likely to detach from work during nonwork and thus sleep better in the long-term during periods of high job demands. Taking into account individual factors such as type of employment (full- and part-time) and supervisor status (with or without) that might influence the associations between work, nonwork, and sleep, we also examined these relationships within subgroups of employees. A total of $N = 1856$ employees participated in a two-wave panel study providing representative data for the German adult population. Results showed that job demands predicted changes in sleep quality over a six-month period and that detachment fully mediated this effect. In addition, perceived social support buffered the indirect effect of job demands on sleep quality via detachment. Subgroup analyses indicated that these effects were particularly relevant for full-time employees and supervisors.

Manuscript 2 examined detachment as a mediator of the relationship between job demands and sleep quality as a short-term outcome. In addition, we investigated whether differences in the generation of daily job demands and detachment explain why socially prescribed perfectionism (SPP; the belief that others expect perfection from oneself and fear of being criticised; Hewitt & Flett, 1991) compared to self-oriented perfectionism (SOP; exceptionally high demands on oneself; Hewitt & Flett, 1991) is associated with poorer sleep quality (e.g., Stricker et al., 2022). A total of $N = 70$ employees participated in a diary study that spanned a period of five consecutive days (day level $N = 233$). Results highlighted that detachment fully mediated the relationship between daily job demands and sleep quality the following night. Moreover, the results indicated that increased job demands and associated lack of detachment explain why SPP is associated with decreased sleep quality. The hypothesised opposite serial mediation for SOP was not confirmed, but these perfectionists were found to sleep better.

In Manuscript 3, we investigated whether a brief and low-dose app-based mindfulness intervention during the workday could be an approach to simultaneously reduce perfectionistic concern cognitions (PCC; thoughts about failure, mistakes, and possible negative consequences; Molnar et al., 2020) and related procrastination (Prestele et al., 2020) and improve detachment and sleep quality. The intervention, consisting of 10 sessions of 9-15 minutes each, was evaluated using a randomised controlled design with pre-, post- and follow-up measurements at two-week intervals each. Sustained increases in mindfulness and sustained reductions in PCC were observed in the intervention group (n = 94) compared with the wait-list control group (n = 87). There were also continuous sustained reductions in procrastination and a short-term improvement in sleep quality. However, no intervention effect was found for detachment.

Manuscript 4 examined the role of leaders' strain symptoms on their employees' sleep quality. Specifically, we tested whether leaders' rumination during nonwork time was associated with employees' sleep quality and whether this association could be explained by a serial process of leaders' health, resource-oriented leadership, and team members' rumination. A total of N = 94 leaders and N = 332 of their employees participated in a three-wave study with time intervals of 14 and 8 months. The results indicated that a serial process can be assumed between leaders' rumination and their employees' sleep quality through leaders' health, resource-oriented leadership, and team members' rumination.

In summary, the manuscripts presented in this dissertation provide insight into the relationship between the three life domains of work, nonwork, and sleep, and highlight the role of individual factors and the social work environment on employees' sleep quality. Consistent with the SDM, our findings provide preliminary evidence that detachment mediates the relationship between job demands and sleep quality in the short and long-term. Our results also suggest that the associations between work, nonwork, and sleep are particularly relevant for full-time employees, supervisors, and socially prescribed

perfectionists. In turn, mindfulness is an important resource that can reduce PCC and improve sleep quality. The reduction of strain symptoms in leaders and resource-oriented leadership behaviour, as well as perceived social support from supervisors and colleagues, offer further approaches to reducing strain symptoms in employees and thus promoting employees' sleep quality. This knowledge can be used to expand and optimise interventions to improve employees' sleep quality.

Deutsche Zusammenfassung

Das Thema Schlaf von Erwerbstätigen erfährt im Vergleich zu den Themen Bewegung und Ernährung oft noch zu wenig Aufmerksamkeit. Dabei sind Schlafprobleme unter Erwerbstätigen weit verbreitet und haben in den letzten Jahren sogar zugenommen (Kronholm et al., 2016). Diese Information ist besorgniserregend, da ein erholsamer Schlaf entscheidende Auswirkungen auf die Gesundheit, die Leistungsfähigkeit und die Arbeitssicherheit von Erwerbstätigen hat (Brossoit et al., 2019; Litwiller et al., 2017). Ein gesunder Schlaf ist demnach nicht nur für Erwerbstätige, sondern auch für Organisationen von großem Interesse. Das übergeordnete Ziel der vorliegenden Dissertation ist, Antezedenzien der Schlafqualität von Erwerbstätigen und erklärende Mechanismen zu analysieren, um die Schlafqualität zu fördern.

Bisher noch nicht ausreichend verstanden ist, warum berufliche Anforderungen wie Zeitdruck oder eine hohe Arbeitsbelastung wichtige Antezedenzien einer verminderten Schlafqualität als langfristige Folge sind (z.B., Van Laethem et al., 2018) und warum sie nicht unbedingt mit beeinträchtigtem Schlaf in derselben Nacht zusammenhängen (z.B. Eggli et al., 2022). In der vorliegenden Dissertation wird daher basierend auf dem Stressor-Detachement Model (SDM; Sonnentag & Fritz, 2015) untersucht, ob Detachement das mentale Abschalten von der Arbeit den (möglichen) Zusammenhang zwischen Arbeitsanforderungen und der Schlafqualität auf kurze und lange Sicht vermittelt (Forschungsfrage 1).

Darüber hinaus ist bisher wenig über die Rolle individueller Faktoren von Erwerbstätigen und des sozialen Arbeitsumfelds in der Beziehung zwischen Arbeit, Nicht-Arbeit und Schlaf bekannt (Crain et al., 2018). Dieses Wissen ist jedoch nicht nur für ein besseres theoretisches Verständnis wichtig, sondern ermöglicht auch die Ableitung passgenauer Interventionen zur Verbesserung der Schlafqualität von Erwerbstätigen. Daher wird in dieser Dissertation in Anlehnung an das Rahmenmodell Arbeit, Nicht-Arbeit und Schlaf von Crain et al. (2018) untersucht, welche individuellen Faktoren von Erwerbstätigen

für ihre Schlafqualität relevant sind (Forschungsfrage 2) und welche Rolle das soziale Arbeitsumfeld für ihre Schlafqualität spielt (Forschungsfrage 3). Diese drei Forschungsfragen werden durch vier Manuskripte, welche die Grundlage dieser Dissertation bilden, adressiert.

In Manuskript 1 untersuchten wir, ob Erwerbstätige die soziale Unterstützung durch Vorgesetzte und Kollegen wahrnehmen, während der Nicht-Arbeit eher mental von der Arbeit abschalten und somit in Zeiten hoher Arbeitsanforderungen langfristig besser schlafen. Unter Berücksichtigung von individuellen Faktoren wie der Art der Beschäftigung (Voll- und Teilzeit) und dem Führungskraftstatus (mit oder ohne), die die Zusammenhänge zwischen Arbeit, Nicht-Arbeit und Schlaf beeinflussen könnten, haben wir diese Beziehungen auch innerhalb von Subgruppen von Erwerbstätigen untersucht. Insgesamt nahmen $N = 1856$ Erwerbstätige an einer Zwei-Wellen-Panel-Studie teil, welche repräsentative Daten für die deutsche Erwachsenenbevölkerung lieferte. Die Ergebnisse zeigten, dass Arbeitsanforderungen Veränderungen der Schlafqualität über einen Zeitraum von sechs Monaten vorhersagten und dass Detachment diesen Effekt vollständig vermittelte. Darüber hinaus pufferte die wahrgenommene soziale Unterstützung den indirekten Effekt der Arbeitsanforderungen auf die Schlafqualität über das Detachment ab. Die Subgruppenanalysen wiesen darauf hin, dass diese Effekte besonders für Vollzeitbeschäftigte und Führungskräfte relevant sind.

In Manuskript 2 wurde Detachment als Mediator des Zusammenhangs zwischen Arbeitsanforderungen und der Schlafqualität als kurzfristige Folge untersucht. Zudem wurde untersucht, ob Unterschiede in der Generierung von täglichen Arbeitsanforderungen und im Detachment erklären, warum Socially Prescriebed Perfectionism (SPP; der Eindruck, dass andere Perfektion von einem selbst erwarten und Angst kritisiert zu werden; Hewitt & Flett, 1991) im Vergleich zu Self-Oriented Perfectionism (SOP; äußerst hohe Ansprüche, die Personen an sich selbst haben; Hewitt & Flett, 1991) mit einer schlechteren Schlafqualität einhergeht (z.B., Stricker et al., 2022). Insgesamt nahmen $N = 70$ Personen an einer

Tagebuchstudie teil, die sich über einen Zeitraum von fünf aufeinanderfolgenden Tagen erstreckte (Tagesniveau $N = 233$). Die Ergebnisse unterstrichen, dass Detachment den Zusammenhang zwischen täglichen Arbeitsanforderungen und der Schlafqualität in der darauffolgenden Nacht vollständig vermittelt. Zudem wiesen die Ergebnisse darauf hin, dass erhöhte Arbeitsanforderungen und ein damit einhergehender Mangel an Detachment erklären, warum SPP mit einer verringerten Schlafqualität einhergeht. Die angenommene entgegengesetzte serielle Mediation für SOP wurde nicht bestätigt, aber es zeigte sich, dass diese Perfektionisten besser schlafen.

In Manuskript 3 untersuchten wir, ob eine kurze und niedrig dosierte App-basierte Achtsamkeitsintervention im Arbeitsalltag einen Ansatz darstellen könnte, um gleichzeitig Perfectionistic Concerns Cognitions (PCC; Gedanken über Versagen, Fehler und eventuelle negative Konsequenzen; Molnar et al., 2020) und damit verbundene Prokrastination (Prestele et al., 2020) zu reduzieren sowie Detachment und die Schlafqualität zu verbessern. Die Intervention bestehend aus 10 Einheiten á 9–15 Minuten wurde durch ein randomisiertes kontrolliertes Design mit Prä-, Post- und Follow-Up-Messungen im Abstand von jeweils zwei Wochen evaluiert. In der Interventionsgruppe ($n = 94$) wurde im Vergleich zur Wartekontrollgruppe ($n = 87$) ein nachhaltiger Anstieg von Achtsamkeit und eine nachhaltige Reduktion von PCC beobachtet. Es zeigte sich auch eine kontinuierliche nachhaltige Reduktion von Prokrastination sowie eine kurzfristige Verbesserung der Schlafqualität. Für Detachment wurde jedoch kein Interventionseffekt festgestellt.

In Manuskript 4 wurde untersucht, welche Rolle Beanspruchungssymptome der Führungskraft für die Schlafqualität ihrer Mitarbeiter spielen. Konkret wurde überprüft, ob die Rumination der Führungskraft während der Nicht-Arbeit mit der Schlafqualität ihrer Mitarbeiter assoziiert ist und ob dieser Zusammenhang durch einen seriellen Prozess, der Gesundheit der Führungskraft, ressourcenorientierter Führung und der Rumination der Teammitglieder erklärt werden kann. Insgesamt nahmen $N = 94$ Führungskräfte und $N = 332$

ihrer Mitarbeiter an einer Drei-Wellen-Studie mit Zeitabständen von 14 und 8 Monaten teil. Die Ergebnisse wiesen darauf hin, dass ein serieller Prozess durch die Gesundheit der Führungskraft, ressourcenorientierter Führung und die Rumination der Teammitglieder zwischen dem Grübeln der Führungskraft und der Schlafqualität ihrer Mitarbeiter angenommen werden kann.

Zusammenfassend geben die in dieser Dissertation vorgestellten Manuskripte einen Einblick in die Beziehung zwischen den drei Lebensbereichen Arbeit, Nicht-Arbeit und Schlaf und zeigen die Rolle individueller Faktoren und des sozialen Arbeitsumfelds für die Schlafqualität von Erwerbstätigen auf. In Übereinstimmung mit dem SDM liefern unsere Ergebnisse erste Hinweise darauf, dass Detachment den Zusammenhang zwischen Arbeitsanforderungen und der Schlafqualität auf kurze und lange Sicht vermittelt. Unsere Ergebnisse weisen auch darauf hin, dass die Zusammenhänge zwischen Arbeit, Nicht-Arbeit und Schlaf insbesondere für Vollzeitbeschäftigte, Führungskräfte und Socially Prescribed Perfektionisten relevant sind. Im Gegenzug stellt Achtsamkeit eine wichtige Ressource dar, die PCC verringern kann und die Schlafqualität verbessern kann. Die Reduktion von Beanspruchungssymptomen der Führungskraft und ein ressourcenorientiertes Führungsverhalten sowie die wahrgenommene soziale Unterstützung durch Vorgesetzte und Kollegen bieten weitere Ansatzpunkte, um akute Beanspruchungssymptome zu reduzieren und somit die Schlafqualität fördern. Dieses Wissen kann zur Erweiterung und Optimierung von Interventionen verwendet werden, welche die Schlafqualität von Erwerbstätigen verbessern.

Introduction

Healthy sleep is essential for human functioning at any age. However, almost one in three people in Western countries suffer from sleep problems (Ohayon & Reynolds, 2009). Particularly among employees, sleep problems have increased in recent years (Kronholm et al., 2016). The consequences of employee sleep problems range from reduced performance and safety to increased physical and mental ill health (Brossoit et al., 2019; Litwiller et al., 2017). Recently, Crain et al. (2018) highlighted theoretically that good sleep provides the energy and activation that is needed for waking physical and cognitive activities, which affect work and nonwork domains, which then affect sleep quality. With this in mind, it is important for both employees themselves and organisations to identify antecedents of impaired sleep quality and underlying mechanisms in order to promote healthy sleep. The present dissertation aims to contribute to this by examining recovery from job demands and the role of individual and contextual factors, as discussed in more detail below.

To date, there is a consensus that job demands such as time pressure or workload are differentially associated with sleep quality depending on the time frame examined (Sonnentag et al., 2016). Longitudinal studies show that particularly high job demands are important antecedents for decreased sleep quality as a long-term consequence (Linton et al., 2015; Van Laethem et al., 2018). When looking at impaired sleep as a short-term response to job demands – as is done in day-level studies – the evidence is mixed, suggesting that high job demands on a workday are not necessarily associated with impaired sleep on the same night (Chawla et al., 2020; Eggli et al., 2022; Gerhardt et al., 2020; Haun & Oppenauer, 2019). Furthermore, previous diary studies have also shown that particularly self-relevant stressors, such as social exclusion (Pereira et al., 2013) or illegitimate tasks (Pereira et al., 2014), which are consistent with the concept of hindrance stressors (Kern et al., 2021; Semmer et al., 2015), predict changes in employees' sleep quality in the short-term. It remains an open question whether job demands (e.g., time pressure or workload), as a common challenging stressor (Le

Pine et al., 2007), also predict changes in employees' sleep quality in the short-term. The present dissertation aims to better understand why job demands are differentially associated with sleep quality depending on the time period examined.

In order to identify a mechanism linking job demands to sleep quality in the short- and long-term, this dissertation used the Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015), in which recovery in the nonwork domain plays an important role. According to the SDM, stressors (e.g., high job demands) lead to a lack of detachment, which in turn leads to strain symptoms such as impaired sleep. Psychological detachment as an important recovery experience implies not thinking about work during nonwork time (Sonnentag & Bayer, 2005). Sonnentag and Fritz (2007) suggested that if employees successfully detach from work during nonwork time, the chances increase that acute or accumulating psychophysiological reactions (e.g., affective stress or increased blood pressure) caused by job stressors can be reduced, thereby preventing acute and chronic strain reactions (Meijman & Mulder, 1998), such as sleep problems.

To date, however, there is no single study that examined recovery in the sense of detachment as a mechanism of the (possible) relationship between job demands and sleep quality in the short- or long-term. Previous two-wave panel studies only report the individual effects of job demands on detachment (Kinnunen & Feldt, 2013) and of detachment on sleep quality (Sianoja et al., 2018) in isolation. Furthermore, previous research has until now not investigated the mediating role of detachment based on a representative sample, so that the results can be generalised to different groups of employees and occupations. In addition, previous diary studies reported only the individual effect of job demands on detachment in isolation (Chawla et al., 2020; Gerhardt et al., 2020), and the evidence for the effect of detachment on sleep quality in the short-term is mixed (Clinton et al., 2017; Gerhardt et al., 2020; Reis & Prestele, 2020).

Crain et al.'s (2018) work, nonwork, and sleep (WNS) framework explicitly addresses sleep as an outcome and suggests that WNS associations are influenced by individual factors and the social work environment. Therefore, in addition to work and nonwork domains, individual factors of employees also appear to affect their sleep quality (Sonnentag et al., 2016). However, the number of studies that have specifically investigated the role of employees' individual factors in the relationship between WNS is still scarce (Crain et al., 2018). Possible risk populations for whom the interplay of WNS may be closely linked include full-time employees, supervisors, and socially prescribed perfectionists, who believe that others expect perfection, evaluate them and, are afraid of being criticized (Hewitt & Flett, 1991). On the other hand, mindfulness, which is described as intentionally and non-judgmentally focusing attention on the perceptions and experiences of the present moment (Kabat-Zinn, 2003), might reduce perfectionistic cognitions and improve detachment and sleep quality.

Moreover, associations between WNS do not occur in a vacuum, but are strongly influenced by the social work environment, however, little is known about the influence to date (Crain et al., 2018). Supervisors and colleagues could therefore contribute to healthy sleep in different ways. One possible way might be that employees who perceive social support from supervisors and colleagues are better able to detach from work during nonwork time and thus sleep better in times of high job demands. Another approach could be that leaders also influence the sleep quality of their employees in an unfavourable way through their strain symptoms and leadership behaviour.

The present dissertation aims to contribute to the occupational health psychology literature by answering the following research questions: 1) Does detachment play a mediating role in the relationship between job demands and employees' sleep quality in the short- and long-term? 2) Which individual factors of employees are relevant for their sleep quality? 3) What role does the social environment in the work context play for the sleep

quality of employees? Knowing the antecedents of impaired sleep quality and the underlying mechanisms will allow researchers to derive timely interventions that organisations can implement to prevent employees from developing sleep problems.

The next section provides an overview of key concepts, theories, and empirical findings. The key concepts are then integrated into a conceptual model before the three research questions and the contributions of this dissertation. I then introduce the four manuscripts on which this dissertation is based and explain how they address each research question. The main findings are then summarised and placed in the context of the current research. Finally, I discuss strengths, limitations, future research directions, and practical implications, and draw an overall conclusion.

Theoretical and Empirical Background

Job Demands and Sleep Quality in the Short and Long Term: Recovery as Mechanism

Employees Sleep Quality

People spend about a third of their lives sleeping, and with good reason. Sleep is a basic biological need, like hunger or thirst, and is therefore inextricably linked to human health. For example, sleep is an important modulator of the immune system (Ibarra-Coronado et al., 2015). For several years, the organisational psychology literature has also been addressing the issue of sleep (Barnes, 2012). Sleep problems are common among employees and have even increased in recent years (Kronholm et al., 2016). Those affected by reduced sleep quality reported difficulty falling asleep and staying asleep, less motivation to get up in the morning, and fatigue on waking and throughout the day (Harvey et al., 2008). Disturbed sleep reduces performance and increases the risk of accidents and mental and physical ill health (Brossoit et al., 2019; Litwiller et al., 2017).

Given the consequences of disturbed sleep quality, identifying the causes of sleep disturbances and potential factors that promote sleep quality in employees is paramount to reducing sleep-related costs to individuals, organisations, and society. Given that working adults spend, on average, another third of their lives at work, it is not surprising that workplace experiences and their cognitive, affective, and physiological consequences also appear to influence sleep (Sonnentag et al., 2016). For example, previous systematic reviews and meta-analyses have identified workplace stress as an important predictor of decreased sleep quality (e.g., Linton et al., 2015; Litwiller et al., 2017). Meanwhile, the empirical understanding of the relationship between workplace processes and employees' sleep quality is slowly growing.

Job Demands as Antecedents of Employees Sleep Quality

At the same time as sleep problems are increasing, employees are feeling increasingly stressed due to high job demands (Eurofound, 2017). In recent years, research has begun to

examine the many ways in which work affects sleep (Barling et al., 2016). Job demands refer to factors of an activity that require continuous physical and/or mental effort or skill and are therefore associated with cognitive, affective, and physiological responses (Bakker & Demerouti, 2007). Job demands are not necessarily negative; they may turn into negative job stressors when they exceed a person's capacity (Sonnentag et al., 2016). In the literature, the terms job demands and job stressors are often used interchangeably. In the following, the term job demands is used to describe a broader category of aspects of work that may include stressors. The potential cognitive, affective, and physiological responses that may be elicited by the stressors are referred to as "strain" (Kahn & Byosiere, 1992).

When employees are faced with high job demands, they can develop acute strain symptoms within a short period of time or over a longer period of time (Sonnentag et al., 2016). This distinction between short-term and long-term reactions is reflected in the design of empirical studies. Diary studies focus on short-term (acute) responses, whereas longitudinal studies tend to focus on long-term (chronic) responses. The strain response is therefore different depending on the time interval considered.

To date, researchers agree that job demands are associated with sleep quality in different ways depending on the time period examined (Sonnentag et al., 2016). Longitudinal studies consistently show that particularly high job demands are important antecedents of decreased sleep quality as a long-term consequence (Linton et al., 2015; Van Laethem et al., 2018). In contrast, diary studies show that high job demands are not necessarily associated with sleep quality on the same night (Chawla et al., 2020; Eggli et al., 2022; Gerhardt et al., 2020; Haun & Oppenauer, 2019). Specifically, no association was found between job demands and sleep quality (Chawla et al., 2020; Gerhardt et al., 2020; Haun & Oppenauer, 2019), but also a negative relationship (Eggli et al., 2022) or even a positive association (Eggli et al., 2022) was revealed.

High job demands, such as time pressure and workload, are often termed challenge demands (Cavanaugh et al., 2000; Le Pine et al., 2005). Workload refers to the amount or difficulty of work tasks that an employee must complete in a given period of time (Spector & Jex, 1998). Time pressure, on the other hand, is defined as the extent to which employees feel they have to work faster than usual or do not have enough time to complete tasks (Ohly & Fritz, 2010). The challenge-hindrance framework proposes that challenging demands hold the potential for mastery, personal growth, and motivation, but also deplete resources and are positively related to the experience of strain (Cavanaugh et al., 2000). Hindrance stressors, on the other hand, present barriers to goal attainment, are associated with strain and feelings of frustration, and threaten personal development (Cavanaugh et al., 2000).

With regard to hindrance stressors, diary studies have shown that particularly self-relevant stressors, such as social exclusion (Kern et al., 2021; Pereira et al., 2013) or illegitimate tasks (Pereira et al., 2014; Semmer et al., 2015), predicted changes in employees' sleep quality in the short-term. The question remains open whether, job demands as a common challenge stressor (Le Pine et al., 2007), also predicts changes in employees' sleep quality in the short-term. Although high job demands may be motivating during the workday, they are likely to be a source of strain after work (Le Pine et al., 2007), as challenge stressors keep employees activated (Bennett et al., 2018) and thus inhibit recovery (Chawla et al., 2020). Therefore, the beneficial effects may be limited to the workplace (Chawla et al., 2020). To better understand why job demands are differentially associated with sleep quality depending on the time period investigated, recovery is discussed below as a possible underlying mechanism.

Recovery as Mechanism Linking Job Demands with Sleep Quality

The Perseverative Cognition Model of Stress (Brosschot et al., 2005) suggests that perseverative cognition is one mechanism by which high job demands (e.g., workload and time pressure) are linked to sleep problems. Perseverative cognition about stressors (e.g., high

job demands) may lead to prolonged affective and physiological activation that inhibits recovery after work and leads to sleep problems at night. Thus, worrying in anticipation of a stressor or rumination in response to a stressor may prevent psychophysiological systems from returning to their baseline state, which may impair sleep quality in the short-term.

According to the Effort-Recovery Model (ERM; Meijman & Mulder, 1998), job demands lead to short-term psychophysiological reactions (e.g., increased blood pressure and affective stress) that are reversible when the person is no longer exposed to the job demands, allowing recovery to occur. However, in the case of persistent job demands and inadequate recovery (e.g., due to rumination or not switching of from work), the psychophysiological reactions persist over time and result in a suboptimal state in employees. As a result, employees have to invest additional effort in order to perform their work tasks, which lead to increased load reaction. This load reaction can accumulate and lead to chronic health complaints, such as persistent sleep problems. Therefore, the absence of job demands (also in thoughts) during nonwork time could be important for the recovery process in the long-term.

The Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015) focuses on a specific recovery experience and, in line with the ERM, suggests that detachment, the mental disconnection from work during nonwork time, may be a protective factor in the stressor-strain process. Sonnentag and Fritz (2015) hypothesized that stressors (e.g., high job demands) can lead to a lack of detachment, which in turn leads to strain symptoms such as impaired sleep. The authors argue that these effects can occur within days or weeks (e.g., day- and week-level studies), as well as over longer periods, such as years (e.g., longitudinal studies). If employees successfully detach from work during nonwork time, the chances of reducing acute or accumulative load reactions specified by the ERM will increase, thereby preventing sleep problems in the short and long-term.

In summary, in addition to the work domain, the nonwork domain, where employees spend approximately another third of their lives, is of enormous importance to their sleep

quality. Previous research theoretically underlined that good sleep provides the energy and activation needed for waking physical and cognitive activities, impacting work and nonwork domains, which then influence sleep quality (Crain et al., 2018). Recent research highlighted several related constructs on stress and recovery, which describe different facets of thoughts about work during nonwork time (Weigelt et al., 2019).

As noted above, rumination refers to recurrent thoughts about problems at work during nonwork time (Mohr et al., 2005), and worry refers to thoughts about future negative events that are difficult to control or dismiss (Segerstrom et al., 2003). In contrast, the concept of psychological detachment refers to mentally switching off from work (Sonnentag & Fritz, 2007). Cropley et al. (2012) further distinguished between affective rumination, the recurrent negative thoughts about work that are experienced as affectively negative, and problem-solving pondering, a less intrusive mental preoccupation with work that can help solve work-related problems. Finally, a distinction was made between positive work reflection – in the sense of thinking about positive aspects of work (Fritz & Sonnentag, 2005) – and negative work reflection – thinking about negative aspects of work (Binnewies et al., 2009). Weigelt et al. (2019) showed that the constructs described above can all be considered empirically as distinct factors.

In the following, empirical evidence is presented that suggests that rumination or detachment may be possible pathways linking job demands and sleep quality in both the short and long-term. Longitudinal studies already identified rumination as a mediator of the relationship between job demands and sleep quality (Van Laethem et al., 2015; Van Laethem et al., 2018). Regarding detachment, longitudinal studies have mainly focused on the individual effects in isolation: the direct effect of job demands on detachment (Kinnunen & Feldt, 2013) on the one hand, and the direct effect of detachment on sleep quality (Sianoja et al., 2018) on the other hand. The mediating role of detachment linking job demands to sleep

quality as a long-term consequence remains to be investigated using a representative sample, so that the results can be generalised to different groups of employees and occupations.

In diary studies, the indirect effect of job demands on sleep quality via rumination remained insignificant (e.g., Cropley et al., 2006; Vahle-Hinz et al., 2014). With respect to detachment, recent diary studies only examined the direct effects of job demands on detachment (Chawla et al., 2020; Gerhardt et al., 2020) and detachment on sleep quality (Clinton et al., 2017; Reis & Prestele, 2020) in isolation, with mixed results. In particular, the evidence for the effect of detachment on sleep quality in the short-term is mixed (Clinton et al., 2017; Gerhardt et al., 2020; Reis & Prestele, 2020). A recent diary study reported that high job demands predicted detachment after work, but not detachment predicted sleep quality in the following night (Gerhardt et al., 2020). In contrast, Reis and Prestele (2020) showed that detachment predicted sleep quality during the day.

Pereira et al. (2014) suggested that thoughts about work occur particularly at bedtime, when people come to rest. Therefore, assessing detachment in the evening survey might be too early to capture it. On the other hand, answering the questionnaire immediately before going to sleep might trigger work-related thoughts – do not think about the pink elephant.

Answering the questionnaire in the next morning gives a chance to capture detachment and would avoid inducing work-related thoughts before sleep. At the day level, the short-term effects of daily job demands on sleep quality and the mediating role of detachment remain to be investigated, focussing on the timing of the detection of detachment.

Moreover, it is still unclear whether job demands as a common challenge stressor (Le Pine et al., 2005), in addition to hindrance demands, also predict changes in employees' sleep quality in the short-term and whether this effect can be explained by detachment. In summary, empirical evidence based on the SDM (Sonnentag & Fritz, 2015) considering high job demands as an antecedent of sleep quality as a short- and long-term consequence and detachment as an explanatory recovery mechanism is still scarce and inconclusive.

The Role of Individual Factors

Compared to theoretical perspectives that make more general predictions about stressor-strain relationships, the WNS framework by Crain et al. (2018) explicitly addresses sleep as an outcome. The authors identify energy and time resources as underlying processes that link the three main areas of employees' lives. Crain et al. (2018) suggest that the relationships between WNS should be investigated across groups of employees and different occupations to establish generalisability. The authors also point out that individual factors, strongly influence the relationships between WNS. In order to be able to design or optimise interventions, it is important to identify groups of employees for whom the proposed relationships are particularly relevant (Crain et al., 2018). However, research examining the role of individual factors in the relationship between WNS is still scarce (Crain et al., 2018). Crain et al. (2018) propose, that individual factors act as predictors of the constructs included in the WNS framework. These factors are categorised at the individual level and refer to person-related antecedents of employee health, including sleep (Nielsen et al., 2018; Crain et al., 2018). Individual factors that determine sleep include, for example, occupational characteristics, personality (Crain et al., 2018) or individuals' cognitive, affective and behavioural resources (Nielsen et al., 2018), which are less stable over time. Individual factors that may be particularly relevant to the relationships between WNS are described below.

Type of Employment

A first individual factor that could be related to time and energy resources and that could play an important role in the relationship between job demands, recovery, and sleep is the type of employment. On average, full-time employees work more hours (35 h/week or more) than part-time employees (Åkerstedt et al., 2003) and they consistently reported higher job demands in recent years (BAuA, 2020). As full-time employees are involved in their work particularly long and intensively (Åkerstedt et al., 2003; BAuA, 2020), this could lead to the use of more time and energy resources, which in turn could affect recovery experiences and

sleep (Crain et al., 2018). In addition, full-time employees in particular report problems switching off from work compared to part-time employees (BAuA, 2020). Previous studies showed that for full-time employees, a reduction in working hours reduces their job demands, increases time for recovery activities (Schiller et al., 2018a), reduces worries at bedtime and improves sleep quality (Schiller et al., 2017).

Supervisor Status

A second individual factor that could be related to time and energy resources and that could play a role in the relationship between job demands, recovery, and, sleep is a supervisor status. A supervisor status is often associated with increased psychosocial job demands (Li et al., 2018). In addition to fulfilling their own tasks, supervisors have to spend a lot of energy supporting their subordinates and pursuing higher-level organisational goals (Yukl, 2012). This is reflected in long working hours and high job demands (Quick et al., 2000). Compared to employees without employee responsibilities, supervisors are more likely to report high job demands (BAuA, 2020). Thus, for supervisors in particular, long work hours and high job demands could also deplete time and energy resources, which in turn could impair recovery experiences and sleep (Crain et al., 2018). Previous studies showed that subordinates think less about work during their nonwork time compared to supervisors (BAuA, 2020; Sonnentag & Schiffner, 2019) and that supervisors report lower sleep quality compared to subordinates (Tariq et al., 2020).

Perfectionism

To date, researchers agree that socially prescribed perfectionism (SPP) in particular, which involves extremely high standards and strict evaluations of oneself (Hewitt & Flett, 1991), is associated with impaired sleep quality (Flaxman et al., 2018; Molnar et al., 2020; Stricker et al., 2022). In contrast, the evidence for self-oriented perfectionism (SOP), in which individuals follow the belief that others have high expectations of them and are heavily criticised if they do not meet these expectations (Hewitt & Flett, 1991), is mixed. For

example, SPP is unrelated (Flaxman et al., 2018) or even positively related (Molnar et al., 2020) to sleep quality. However, research has not yet investigated work (i.e., job demands) and nonwork (i.e., recovery) experiences simultaneously as mechanisms that might explain the different associations between perfectionism and sleep quality.

According to the Cognitive-Affective Personality System (CAPS; Mischel & Shoda, 1995) Theory, personality is viewed as an enduring structure of cognitive-affective units (CAUs) - characteristic patterns of cognition, affect, and behaviour - that are activated when a person encounters relevant situational features. Based on this assumption, different CAUs are activated in the work area by individuals high in SPP and SOP. Individuals high in SPP are more likely to rate tasks as threatening and show a lack of confidence in their abilities compared to individuals high in SOP (Zureck et al., 2015), which leads to stress (Lazarus & Folkman, 1984). Moreover, individuals high in SPP are more likely to engage in maladaptive coping behaviours, such as avoidant coping, compared to individuals high in SOP who use more adaptive styles, such as problem-focused coping (Stoeber & Janssen, 2011). The maladaptive coping behaviours prevent an individual from taking actions to directly deal with stress or even increase stress (Lazarus & Folkman, 1984). In conclusion, employees high in SPP should avoid tasks and contribute to the generation of time pressure, whereas those high in SOP should successfully manage their tasks and experience less time pressure, despite performing tasks accurately.

In line with the SDM (Sonnentag & Fritz, 2015), time pressure in turn affects detachment in the nonwork area and sleep. It can be concluded that employees high in SPP not only experience, but are also tend to contribute to the generation of time pressure in a regular working day, which triggers the cascade of low detachment leading to impaired sleep quality. Focusing on the role of person factors as additional predictors of the SDM adds to the previously limited knowledge of stable individual differences in recovery (Sonnentag et al., 2022) and sleep.

Mindfulness

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" (Kabat-Zinn, 2003, p. 145). The practice of mindfulness meditation enables the development of mindfulness (Kabat-Zinn, 2003). Recent meta-analyses supported the effectiveness of mindfulness-based interventions in improving the heal tans well-being of employees (Bartlett et al., 2019; Vonderlin et al., 2020). The majority of mindfulness interventions are delivered face-to-face in groups and facilitated by mindfulness trainers (Bartlett et al., 2019). Recently, the COVID-19 pandemic has highlighted the need for flexible interventions that do not rely on face-to-face approaches. In this regard, online and app-based mindfulness interventions may be a promising and cost-effective way for organisations to promote employee well-being, including recovery after work (e.g., Möltner et al., 2018; Querstret et al., 2017).

For example, Althammer et al. (2021) reported that employees were better able to switch off after work following a three-week online mindfulness intervention with modules specifically targeting cognitive-emotional strategies and a minimum duration of approximately 120 minutes (Michel et al., 2014). Meanwhile, employees who participated in an online mindfulness intervention for an average of six weeks and five days, with at least ten sessions of 30 minutes each (Baker et al., 2015), reported higher levels of sleep quality (Querstret et al., 2017). However, it is not yet possible to derive minimum dose or duration required for a beneficial effect from the current evidence base. As time is a limited resource that is shared across the areas of WNS (Crain et al., 2018), the question of whether low-dose and short-duration interventions are as effective as those that require more time is very important (Karabinski et al., 2021).

Moreover, researchers suggested that especially people high in SPP would benefit from increased mindfulness (Flett et al., 2020), as their mindset is directed towards social

evaluation, approval, and avoiding criticism. In addition to a relatively stable disposition of perfectionism (e.g., Stoeber, 2018), researchers have begun to examine perfectionistic cognitions as "state-like manifestations" of this construct (Hill & Appleton, 2011, p. 697). These cognitions may relate to personal standards (perfectionistic strivings cognitions [PSC]) or the concern to make mistakes (perfectionistic concerns cognitions [PCC]; Prestele et al., 2020). Mindfulness as a personal resource (Grover et al., 2017) may reduce the rather dynamic PCC and associated avoidant coping (Stoeber & Janssen, 2011) such as procrastination and recovery deficits (Prestele et al., 2020). To date, however, no study has examined the effects of a mindfulness intervention on perfectionistic cognitions.

The Role of the Social Work Environment

Not only individual factors, but also beneficial and harmful processes in the social work environment are important for health and well-being (Sonnentag et al., 2023). Crain et al. (2018) suggest that the associations between WNS are strongly influenced by the social work environment. Attention to the social work environment could help to improve employees' sleep (Linton et al., 2015). However, the role of the social work environment in the association between WNS is not well understood (Crain et al., 2018). The following describes the role that colleagues and supervisors can play in employees' sleep quality.

Perceived Social Support

The power of social support is evident when looking at the wide range of positive outcomes for both employees and organisations (Jolly et al., 2021) Previous systematic reviews and meta-analyses have identified social support at work as an important predictor of improved sleep quality (Kent de Grey et al., 2018; Linton et al., 2015). Social support refers to the experience or perception of being loved, cared for, esteemed, and part of a social network characterised by mutual help and obligations (Wills, 1991). It follows that social support can also simply be the perception that such resources are available when they are needed (Taylor, 2011). In the workplace, employees may perceive social support from both

supervisors and colleagues. According to the buffering hypothesis (Cohen & Wills, 1985), perceived social support at work promotes sleep quality by buffering the negative effects of job demands (Gadinger et al., 2009; Pow et al., 2017). However, it is not yet known exactly how the perceived availability of support acts as a stress buffer (Pow et al., 2017). Perceived social support may also buffer the negative effect of job demands on detachment and thus positively influence the employees' sleep quality.

The extended SDM (Sonnentag & Fritz, 2015), based on Transactional Stress Theory (Lazarus & Folkman, 1984), hypothesises that that the negative effect of job stressors on detachment can be strengthened or attenuated by primary and secondary appraisal. During primary appraisal, a person evaluates whether a situation is positive, irrelevant, or potentially threatening. During secondary appraisal, a person evaluates whether the situation can be managed with the available personal and job resources, such as perceived social support from colleagues and supervisors. If resources are available, employees will be able to detach more easily in their free time, because they know they will receive support when necessary. In summary, employees who perceive there to be social support from their supervisors and colleagues during periods of high job demands may be better able to detach from work during nonwork time and thus sleep better.

Leaders Rumination, Health and Leadership Behavior

Researchers agree that leadership behaviours specifically aimed at improving employees' sleep, such as encouraging them to get enough sleep, are associated with less sleep disturbance among employees (Gunia et al., 2015; Sianoja et al., 2020). However, it has been largely neglected that leaders can also adversely affect their employees' sleep quality through their strain symptoms. A leader’s role is often associated with increased psychosocial demands (Li et al., 2018) and sense of responsibility (Yukl, 2012), which could lead to strain symptoms such as rumination during nonwork time. As leaders' behaviours and experiences can be passed down on to employees in the organisational hierarchy (Ambrose et al., 2013),

leaders' rumination could lead to rumination in their team members. Incomplete recovery through rumination could in turn lead to persistent sleep problems among employees (Effort-Recovery Theory; Meijman & Mulder, 1998; Van Laethem et al., 2018).

Still unclear are also the mechanisms that might explain a crossover of rumination between a leader and their team members. According to the theoretical framework of Wegge et al. (2014), leaders can influence their team members' rumination through system-focused actions by creating a work environment that makes it difficult to switch off after work. For leaders, incomplete recovery through rumination could lead to health complaints over time (Effort-Recovery Theory; Meijman & Mulder, 1998; Weigelt et al., 2019). These health complaints could in turn lead to passive leadership due to a lack of resources (Conservation of Resources Theory; Hobfoll, 1989; Kaluza et al., 2019; Klebe et al., 2022), which is associated with team members' rumination (Klebe et al., 2021).

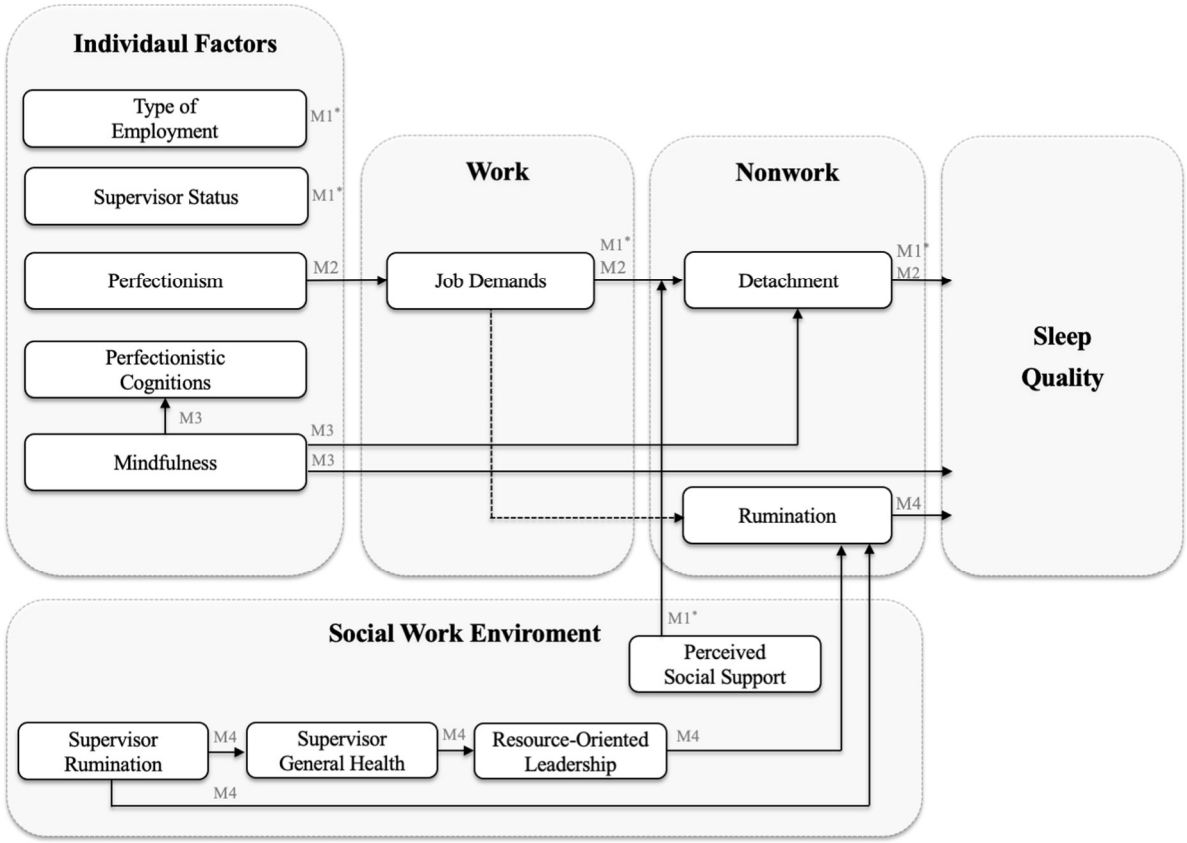
The question arises as to what specific leadership behaviours - as opposed to leadership behaviours aimed directly at improving employees' sleep, which may be problematic in certain contexts - are likely to reduce employees' rumination and improve their sleep quality. Not all constructive leadership behaviours appear to contribute to better sleep quality. For example, contrary to expectations, higher employee ratings of family-supportive supervisor behaviour – leader behaviour that helps employees balance work and nonwork domains – (Crain et al., 2014) were not associated with better sleep quality (Sianoja et al., 2020). One promising approach may be resource-oriented leadership, in which leaders provide resource-oriented working conditions (e.g., influencing the scope of action, conflict management, fairness and participation; Vincent-Höper & Stein, 2019) to their employees. These job resources facilitate the achievement of work goals, reduce job demands and related strain symptoms (Sonnentag & Fritz, 2015), such as rumination, and could contribute to better sleep quality.

Conceptual Framework

The conceptual model resulting from the main concepts and their relationships described in the previous section is shown in Figure 1.

Figure 1

Conceptual Model of the Dissertation



Note. Shown are the main constructs related to the four manuscripts. The depicted effects in solid lines are tested within the four manuscripts (M1 – M4). The dotted line indicates a relation that is not tested in this dissertation, but assumed.

The conceptual model investigated in this dissertation is based on the SDM (Sonnentag & Fritz, 2015) and on the WNS framework (Crain et al., 2018), which considers individual factors and the social work environment as predictors of the constructs included in the WNS framework. This conceptual model provides an overview of the following specific

research questions and the four manuscripts that address them. In line with the theories, empirical findings, and knowledge gaps described above, this dissertation is guided by the following research questions:

Research Question 1: Does detachment during nonwork time play a mediating role in the relationship between job demands and employees' sleep quality in the short- and long-term?

This dissertation aims to understand why job demands, as a common stressor (Le Pine et al., 2007), are important antecedents of decreased sleep quality as a long-term consequence (Linton et al., 2015; Van Laethem et al., 2018), but are not necessarily associated with sleep impairment on the same night (Chawla et al., 2020; Gerhardt et al., 2020; Haun & Oppenauer, 2019). To better understand why job demands are differentially associated with sleep quality depending on the time frame investigated, this dissertation examined detachment as an underlying mechanism.

Investigating job demands as a stressor and sleep quality as a short- and long-term outcome contributes to the literature on the SDM (Sonnentag & Fritz, 2015) and strengthens the SDM or reveals its limitations for specific stressors and outcomes. By using a large representative sample of the German adult population, it was possible to investigate the research question across groups of employees and different occupations in order to establish generalisability, while at the same time identifying risk groups of employees for whom the relationships are particularly closely linked. Examining job demands as an antecedent of employees' sleep quality the following night, and detachment as a mechanism assessed in the morning, could contribute to knowledge about whether the SDM applies to challenge stressors at the day level, in addition to hindrance demands. Moreover, the results provide knowledge about the relationships between the three main domains of life: work, nonwork, and sleep (Crain et al., 2018), which can be used to expand and optimise interventions to improve employees' sleep quality.

Research Question 2: What individual factors of employees are relevant to their sleep quality?

Knowledge of the role of individual factors in the relationship between WNS is important to better understand for whom the proposed relationships are particularly relevant. This is not only important for a better theoretical understanding, but also allows for deriving tailored interventions aimed at improving employees' sleep quality. However, little is known about individual factors in this context (Crain et al., 2018).

Therefore, the aim of this dissertation is to examine full-time employees, supervisors, and socially prescribed perfectionists as possible risk groups of employees for whom the relationship between WNS may be particularly relevant. Understanding why sleep quality may be impaired in these target groups could help to prevent sleep problems. Focusing on the role of individual factors as additional predictors in the SDM (Sonnentag & Fritz, 2015) adds to the previously limited knowledge of individual differences in recovery (Sonnentag et al., 2022) and sleep. By examining the effects of a short (two weeks) and low-dose (10 units á 9–15 minutes) app-based mindfulness intervention on perfectionistic cognitions, procrastination, detachment, and sleep quality, this dissertation contributes to the knowledge of a little time-consuming way for employees and a cost-effective way for organisations to reduce perfectionistic cognitions and improve detachment and sleep quality.

Research Question 3: What Role Does the Social Work Environment Play for the Sleep Quality of Employees?

Recent developments in occupational health psychology have focused on the need to identify the antecedents of employees' health and well-being at different levels in order to develop interventions that can be applied at different levels (Nielsen et al., 2018). In order to refine the picture of the antecedents of employees' sleep quality, this dissertation examines the role of the social work environment in addition to work, nonwork, and individual factors.

However, the number of studies that have specifically examined the role of the social work environment in this context is still small (Crain et al., 2018).

It is not yet well understood how exactly the perceived availability of support from supervisors and colleagues acts as a stress buffer on employees' sleep quality. Knowing whether employees who perceive social support from supervisors and colleagues are better able to detach from work during nonwork time, and thus sleep better in times of high job demands, is important because it adds to our knowledge of why social support contributes to healthy sleep. Organisations and employees could therefore be informed about how they can promote sleep quality in a not-so-common way. This dissertation also contributes to a more comprehensive understanding of the role of leaders and their strain symptoms on employee sleep quality by examining whether leader rumination is negatively associated with employee sleep quality via the serial mediation of leader health, resource-oriented leadership, and rumination perceived by the team members. A better understanding of the underlying mechanisms and inclusion of the concept of resource-oriented leadership expands knowledge of the role of leaders in the relationship between WNS of employees and could provide several starting points for intervention.

Overview of the Manuscripts

The following section presents the four manuscripts and explains which of the three research questions they address. Table 1 provides an overview of the specific research questions and the corresponding manuscripts.

Table 1

Overview of Research Questions and Manuscripts

	Research Question	Manuscript 1	Manuscript 2	Manuscript 3	Manuscript 4
1	Does detachment during nonwork time play a mediating role in the relationship between job demands and employees' sleep quality in the short- and long-term?	X	X		
2	What individual factors of employees are relevant to their sleep quality?	X	X	X	
3	What role does the social work environment play for employees' sleep quality?	X			X

Manuscript 1: How to Sleep Well in Times of High Job Demands: The Supportive Role of Detachment and Perceived Social Support

Citation: Matick, E., Kottwitz, M. U., Lemmer, G., Otto, K. (2021). How to sleep well in times of high job demands: The supportive role of detachment and perceived social support. *Work & Stress*. https://doi.org/10.1080/02678373.2021.1889071.

Rationale and Theoretical Background

Manuscript 1 addressed job demands as an antecedent of sleep quality as long-term consequence and detachment as a mechanism, as previous studies have mainly focused on the individual effects in isolation (Kinnunen & Feldt, 2013; Sianoja et al., 2018). Contextual factors, such as the social work environment (e.g. perceived social support) or individual factors (e.g. type of employment or supervisor status) strongly influence the relationships between work, nonwork, and sleep, but the number of studies considering such factors is still small (Crain et al., 2018). In line with the extended Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015) based on the Transactional Stress Theory (Lazarus & Folkman, 1984), we proposed that detachment mediates the effect of job demands on sleep quality as a long-term consequence and that this negative indirect effect is weaker for employees who perceive high social support at work. Risk groups of employees for whom the relationship between work, nonwork, and sleep is particularly closely linked could be full-time employees or supervisors due to fewer time and energy resources. Therefore, we exploratively investigate how the hypothesised model looks within the groups of employees depending on type of employment and supervisor status. Thus, Manuscript 1 addresses Research Question 1 by investigating whether detachment plays a mediating role in the relationship between job demands and employees' sleep quality in the long-term. Furthermore, Manuscript 1 provides answers to Research Questions 2 and 3 by investigating, whether individual factors - type of employment and supervisor status – are relevant to employees' sleep quality and what role the social work environment – more precisely perceived social support – plays in employees' sleep quality.

Methods

We tested our assumptions in a two-wave-panel study, with a time lag of 6 months between T1 and T2. Data from $N = 1856$ employees were drawn from a representative sample of the German adult population. Overall, 73.5% of the participants were in full- time employees, 26.5% were in part-time employees, 33% were supervisors, and 67% were employees without supervisor status. Job demands as a predictor variable, detachment as a mechanism and perceived social support as a moderator were assessed at T1. Sleep quality as a dependent variable was measured and included at T1 and T2, to control for the autoregressor. In addition, sleep quality was controlled for gender, age, and sleep duration.

Results

Regression analyses confirmed our expectations and showed that detachment mediated the effect of job demands on sleep quality as a long-term consequence and that this negative indirect effect was weaker for employees who perceived above-average social support at work. Exploratory analyses revealed that full-time employees reported higher job demands and lower detachment compared to part-time employees, and supervisors reported higher job demands and lower detachment compared to employees without supervisor status. Subgroup analyses showed that the hypothesised mediation and moderated mediation were particularly important for full-time employees and supervisors.

Discussion

Our findings underline that employees who perceive social support from their supervisors and colleagues, are better able to detach in times of high job demands, and thus, sleep better in the long-term. Therefore, Manuscript 1 provides support for the extended SDM by showing that recovery experiences and the social work environment offer starting points for reducing acute accumulating load reactions and thereby promoting long-term sleep quality, especially when employees are in full-time employment or have a supervisor status.

Manuscript 2: Far from Perfect Sleep – A Diary Study on Multidimensional Perfectionism in the Context of the Stressor-Detachment Model

Citation: Matick, E., Kleszewski, E., Otto, K. (under review). Far from perfect sleep – A diary study on multidimensional perfectionism in the context of the stressor-detachment model. *International Journal of Stress Management*.

Rationale and Theoretical Background

While Manuscript 1 focused on detachment as a mechanism between job demands and sleep quality as a long-term consequence, Manuscript 2 addressed these relationships at the day level. Compared to longitudinal studies (e.g., Kinnunen & Feldt, 2013), diary studies showed that time pressure was unexpectedly not reflected in sleep quality (Gerhardt et al., 2020; Haun & Oppenauer, 2019). According to the Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015), we argue that detachment could be considered as a mediator that bridges daily time pressure and sleep quality during the following night. Moreover, by extending the SDM through the introduction of multidimensional perfectionism as an antecedent of time pressure, Manuscript 2 highlighted the role of perfectionism on differences in daily stress generation and recovery for employees' daily sleep quality. We proposed that socially prescribed perfectionists are prone to actively generate and experience daily time pressure, which triggers a cascade of decreased detachment resulting in impaired sleep quality, explaining why socially prescribed but not self-oriented perfectionists are vulnerable to impaired sleep. Overall, Manuscript 2 provides answers to Research Question 1 by investigating whether detachment plays a mediating role in the relationship between job demands and employees' sleep quality in the short term. Furthermore, Manuscript 2 addresses Research Question 2 by investigating, whether and why perfectionism as an individual factor is relevant to employees' sleep quality.

Methods

We conducted a diary study and collected data from 70 employees using an initial survey and daily surveys before- and after-work for 5 consecutive working days. The initial

survey included measures of demographic variables and perfectionism. After work, the participants' time pressure during the working day and the impact of COVID-19 on their daily work routine were measured. Before work, participants rated their detachment at bedtime and the sleep quality of the previous night. We estimated a multilevel path model with a 2-1-1 design, as we expected the perfectionism dimensions to influence time pressure (Level 2), which is related to detachment at bedtime (Level 1), and detachment at bedtime is related to sleep quality (Level 1). Employees' time pressure, detachment, and sleep quality were controlled for the respective other perfectionism dimension and the impact of the COVID-19 pandemic. Sleep quality was also controlled for gender and age.

Results

Confirming our expectations, the results showed that detachment mediated the effect of daily time pressure on sleep quality during the following night. We also found a negative indirect effect of SPP on sleep quality via a serial mediation of increased daily time pressure and decreased detachment. Contrary to our assumption the expected positive indirect effect of SOP on sleep quality via a serial mediation of decreased time pressure and increased detachment was not confirmed. As expected, the results of SPP and SOP showed descriptively a negative indirect effect on sleep quality through daily detachment, but the effects were not significant. We also found a positive effect of SOP on sleep quality.

Discussion

The results of Manuscript 2 highlighted detachment as a mechanism between daily time pressure and sleep quality as a short-term consequence, strengthening the SDM at the day level. Furthermore, we found support for differences in daily stress generation and recovery for employees' daily sleep quality between the dimensions of perfectionism. SPP are far from perfect sleep due to (perceived) time pressure and subsequent low detachment. In contrast, SOP sleep well, but the underlying mechanism remains to be explored.

Manuscript 3: Mindfulness, Anywhere, Anytime: Effects of an App-Based Intervention on employees' Perfectionism, Procrastination and Recovery

Citation: Kleszewski E., Otto, K., Matick, E. (submitted). Mindfulness, anywhere, anytime: Effects of an app-based intervention on employees' perfectionism, procrastination and recovery. *Journal of Occuoational Health Psychology*.

Rationale and Theoretical Background

Building on the results of Manuscript 2, Manuscript 3 focused on a brief low-dose app-based mindfulness intervention that may provide an approach in everyday work to simultaneously reduce employees' perfectionistic concern cognitions (PCC) and associated procrastination, and improve detachment and sleep quality as indicators of recovery that perfectionism may impede (Molnar et al., 2020; Reis & Prestele, 2020). By introducing perfectionistic cognitions and associated procrastination as targets for mindfulness interventions and implementing a brief and low-dose app-based mindfulness intervention for recovery and sleep, we aimed to extend previous research on online and app-based mindfulness interventions in the workplace (e.g., Möltner et al., 2018; Querstret et al., 2017). Thus, Manuscript 3 provides an answer to Research Question 2 by examining whether mindfulness as an individual factor is relevant to employees' sleep quality.

Methods

We conducted a randomised wait-list control study to test the hypothesised effects of a low-dose app-based mindfulness intervention, consisting of 10 sessions of 9–15 minutes each. Mindfulness, PCC, procrastination, detachment, and sleep quality of the participants in the intervention group (n = 94 employees) were measured pre-treatment (T1), post-treatment (T2, after 2 weeks) and follow-up (T3, after 2 another weeks). At the same time points, the above-mentioned variables were assessed in the wait-list control group (n = 87 employees), except that they received the intervention after T3. The repeated measures were analysed using latent

growth curve models, including gender, working hours, and the other perfectionistic strivings cognitions dimension as covariates.

Results

For both mindfulness and PCC, we found support for a sustainable effect, indicating a change from T1 to T2, but no longer a change from T2 to T3. A greater reduction was observed in the intervention group. For procrastination, our results showed a continuous effect, indicating a linear change over time. There was a steeper negative trajectory for procrastination in the intervention as compared to the control group. However, no intervention effect was found for detachment. For sleep quality, the best fitting model was the short-term effect model, indicating only a short-term intervention effect, apparent at T2 but no longer at T3. In the intervention group as compared to the control group, sleep quality increased from T1 to T2.

Discussion

Manuscript 3 shows that the intervention had a sustainable effect on mindfulness and PCC, as well as a continuous effect on procrastination, providing an opportunity to intervene early in the process between perfectionism and impaired sleep quality. Moreover, a brief and low-dose app-based mindfulness intervention may be a promising, cost-effective way for organisations to directly improve employees' sleep quality. However, the effect was only of short duration and detachment was not improved. Following previous mindfulness intervention studies targeting detachment (Althammer et al., 2021) and sleep quality (Querstret et al., 2017), more time-intensive and/or ongoing mindfulness practice may be required to maintain initial effects on sleep quality and magnify those on detachment.

Manuscript 4: I can't get no Sleep: The Role of Leaders' Health and Leadership Behavior on Employees' Sleep Quality

Citation: Matick, E., Kottwitz, M. U., Rigotti, T., Otto, K. (2022). I can't get no sleep: The role of leaders' health and leadership behavior on employees' sleep quality. *European Journal of Work and Organizational Psychology*. https://doi.org/10.1080/1359432X.2022.2077198.

Rationale and Theoretical Background

In Manuscript 4, we looked in more detail at the role of leaders in employees' sleep quality. Leadership status is often associated with increased psychosocial demands, which could lead to rumination during nonwork time. Leaders' rumination could trigger a cascade of mechanisms leading to employee rumination and, ultimately, persistent employee sleep problems. Based on the Effort-Recovery Theory (Meijman & Mulder, 1998), we proposed that leader rumination leads to health complaints, which, according to the Conservation of Resources Theory (Hobfoll, 1989), could lead to less resource-oriented leadership. Building on Wegge et al.'s (2014) theoretical framework, which describes that leaders can influence the health of employees by creating a stressful work environment through their strain symptoms, we further proposed that less resource-oriented leadership affects team members' rumination, leading to reduced employee sleep quality, which is consistent with the Perseverative Cognition Model of Stress (Brosschot et al., 2005). Thus, Manuscript 4 addresses Research Question 3 by examining the role of the social work environment - leaders' recovery, health and leadership behaviour - on employees' sleep quality.

Methods

We tested our assumptions in a three-wave study, with a time lag of 14 months between T1 and T2 and 8 months between T2 and T3. The final sample across the waves consisted of $N = 94$ leaders from different German organisations and their $N = 332$ employees. We estimated a multilevel path model with a 2-2-2-1-1 design, assuming that leaders' rumination negatively affects leaders' general health (Level 2), which leads to

reduced resource-oriented leadership (Level 2), resource-oriented leadership is negatively associated with rumination of the team members on average (Level 2), and employee rumination (Level 1) leads to reduced employee sleep quality (Level 1). Employee rumination and sleep quality at Level 1 were controlled for the autoregressor, a shared work environment (workload), gender, age, general health, and negative life events at T1.

Results

Confirming our expectations, the results overall showed that leader rumination was negatively related to employee sleep quality via the serial mediation of leader health, resource- oriented leadership, and rumination perceived by the team members. The regression coefficients remained significant when we considered only age and gender as control variables.

Discussion

Overall, our findings highlight the importance of leaders' recovery, health, and resource-oriented leadership behaviour on employees' sleep quality. Therefore, our results extend Wegge et al.'s (2014) assumption that leadership behaviour influences employees' health through the design of the work environment by showing that, in addition to leaders' behaviour and the design of the work environment, leaders' recovery and their health also play an important role for employees' health. Finally, resource-oriented leadership is a promising approach to indirectly improve employees' sleep quality by reducing rumination.

General Discussion

Sleep problems have increased in recent years, especially among employees (Kronholm et al., 2016). This information is particularly worrying as sleep affects employees' performance, safety, and physical and mental health (Brossoit et al., 2019; Litwiller et al., 2017). Given the growing awareness of the interplay between work, nonwork, and sleep, and the role of individual factors and the social work environment on employees' sleep (e.g., Crain et al., 2018), there is a call to identify the causes of impaired sleep and potential factors that can promote employees' sleep quality. Therefore, the main aim of this dissertation was to contribute to the occupational health psychology literature by examining antecedents and explaining mechanism of employees' sleep quality.

Discussion of Research Question 1

The first Research Question 1 of this dissertation was whether detachment during nonwork time plays a mediating role in the relationship between job demands and employees' sleep quality in the short- and long-term. This research question was examined in two studies of this dissertation. Specifically, Manuscript 1 focused on sleep quality as a long-term consequence and Manuscript 2 focused on sleep quality as a short-term consequence.

In line with the Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015), our results in Manuscript 1 provide an initial indication that a lack of detachment is a possible explanation for the negative effect of job demands on sleep quality over time. This finding is consistent with research, showing that high job demands predict a lack of detachment (Kinnunen & Feldt, 2013), and that a lack of detachment in turn predicts reduced sleep quality (Sianoja et al., 2018). Our results in Manuscript 2 strengthen the SDM and its applicability at the day level, by focusing on job demands as a specific job stressor and sleep quality as a specific outcome. The results suggest, that job demands as a challenge stressor (Le Pine et al., 2007) can be considered as another job stressor – in addition to previously identified self-relevant hindrance stressors, such as - social exclusion (Pereira et al., 2013) or illegitimate

tasks (Pereira et al., 2014) – that affects employees' sleep quality through reduced daily detachment at bedtime. Our findings highlight that although challenge stressors may have a short-term beneficial effect on work engagement (Baethge et al., 2018), they may also challenge daily recovery (Chawla et al., 2020) in the nonwork area and affect sleep quality during the following night.

Furthermore, our results in Manuscripts 1 and 2 show a non-significant direct effect of job demands on employees' sleep quality, highlighting detachment as a key mechanism. Assessing detachment at bedtime in the next morning and considering it as a bridge between job demands and sleep quality may explain why recent diary studies found no (Chawla et al., 2020; Gerhardt et al., 2020; Haun & Oppenauer, 2019), a negative (Eggli et al., 2022), or even a positive (Eggli et al., 2022) relationship. In summary, if employees successfully detach from work during nonwork time, the chances increase that acute or accumulating psychophysiological reactions (e.g., affective stress or increased blood pressure) caused by high job demands can be reduced, thereby preventing strain reactions (Meijman & Mulder, 1998), such as acute and chronic sleep problems.

Discussion of Research Question 2

The second Research Question clarified which individual factors of employees are relevant to their sleep quality. Based on the work, nonwork, and sleep (WNS) framework by Crain et al. (2018), which suggests that the associations between WNS are influenced by individual factors, this research question was examined in three studies of this dissertation. Manuscript 1 focused on full-time employees and supervisors, and Manuscript 2 on socially prescribed perfectionists, as potential risk groups for whom the interplay of WNS may be closely linked. Manuscript 3 focused on mindfulness as a personal resource that might reduce perfectionistic cognitions and procrastination, and improve detachment and sleep quality.

Our results in Manuscript 1 suggest, following the WNS framework of Crain et al. (2018), that job demands seem to translate into impaired sleep quality via detachment,

especially when time and energy resources are depleted. In line with previous findings, our results showed that higher job demands and lower detachment might be possible risk factors for full-time employees (BAuA, 2020; Schiller et al., 2017; Schiller, et al., 2018a) and supervisors (BAuA, 2020; Li et al., 2018; Quick et al., 2000; Sonnentag & Schiffner, 2019) compared to part-time employees and employees without supervisor status. Moreover, the results showed that if part-time employees and employees without supervisor status do not detach successfully, this is not reflected in their sleep quality, in contrast to full-time employees and supervisors.

As full-time employees and supervisors are involved in their work particularly long and intensively (Åkerstedt et al., 2003; BAuA, 2020), this could lead to the use of more time and energy resources, which in turn could affect recovery experiences and sleep. For leaders in particular, the content and duration of their thoughts during nonwork time could affect their sleep quality, as they may not be thinking not only about their own tasks, but also about supporting their subordinates and pursuing overarching organisational goals. For example, the belief that one is responsible for the emotional needs of others is associated with rumination (Nolen-Hoeksema & Jackson, 2001). In summary, type of employment and supervisor status seem to be important individual factors that may act as predictors or moderators of the negative effect of detachment on sleep.

According to the results of Manuscript 2, employees high in SPP are especially far from perfect sleep because they experience time pressure and consequent difficulties in detachment. Moreover, the results showed that self-oriented perfectionists sleep well, but the underlying mechanisms linking SOP to better sleep quality remain to be clarified. These findings are in line with the assumption that different cognitive-affective units (CAUs) – characteristic patterns of cognition, affect, and behaviour – are activated in individuals when they encounter relevant situational features (Mischel & Shoda, 1995). Individuals scoring high on SPP may contribute to the generation of time pressure, because they are more likely

to rate tasks as threatening, show a lack of confidence in their abilities (Zureck et al., 2015), and are more likely to engage in maladaptive coping behaviours such as avoidant coping (Stoeber & Janssen, 2011), which leads to stress (Lazarus & Folkman, 1984). Sonnentag et al. (2023) also suggest that individuals are active agents who can influence their thoughts, feelings, and behaviours, and often their job demands. In line with the SDM (Sonnentag & Fritz, 2015), job demands in turn influenced detachment in the nonwork area and sleep. The focus on the role of individual factors as additional predictors in SDM (Sonnentag & Fritz, 2015) adds to the previously limited knowledge on individual differences in recovery (Sonnentag et al., 2022) and sleep.

Manuscript 3 examined whether a short and low-dose app-based mindfulness intervention could reduce perfectionistic concern cognitions (PCC) and procrastination, and improve detachment and sleep quality. Our results showed that a short (two weeks) and low-dose (10 sessions á 9–15 minutes) app-based mindfulness intervention may be a less time-consuming way for employees and a promising cost-effective way for organisations to directly improve employees' sleep quality. As the effect of the intervention on sleep quality was only of short duration, and previous research showed that the effect of a longer-duration online mindfulness intervention (almost seven weeks with 10 units á 30 minutes) was maintained at three and six-month follow-up (Querstret et al., 2017), an ongoing or more time-intensive mindfulness practice may be required to maintain the initial effects on sleep quality.

Contrary to our expectations, detachment was not improved. This may be because the intervention was too short and/or too low-dosed, or because the specific intervention content targeting cognitive-emotional strategies contributes to detachment, which was not included in our intervention. For example, Althammer et al. (2021) showed that a three-week online mindfulness intervention with a minimum duration of approximately 120 minutes and

modules specifically targeting cognitive-emotional strategies, enabled employees to better switch off after work.

Moreover, our results showed that the intervention had a sustainable effect on mindfulness and PCC, as well as a continuous effect on procrastination, providing an opportunity to intervene early in the process between perfectionism and impaired sleep quality. In particular, people with PCC would benefit from increased mindfulness (Flett et al., 2020). Taken together, we can conclude that for full-time employees, supervisors, socially prescribed perfectionists the relationship between WNS are particularly relevant and that mindfulness seems to be a personal resource that can promote employees' sleep quality.

Discussion of Research Question 3

The third research question addressed the role of the social work environment on employees' sleep quality, following Crain et al.'s (2018) Work, Nonwork, and Sleep (WNS) framework. This research question was explored in Manuscript 1 by focusing on perceived social support, and in Manuscript 4 by focusing on the role of leaders' recovery, health, and resource-oriented leadership behaviours on leaders' sleep quality.

The finding in Manuscript 1 that employees who perceive there to be social support from colleagues or supervisors are able to detach more easily in their free time because they know they will receive support when they need it, and thus sleep better in times of high job demands, is consistent with the extended SDM (Sonnentag & Fritz, 2015) based on the Transactional Stress Theory (Lazarus & Folkman, 1984). In contrast to Gadinger et al. (2009) and Pow et al. (2017), we did not find that social support moderated the direct negative effect of job demands on sleep quality. These results contribute to a better understanding of how perceived social support at work helps employees to sleep better in times of high job demands.

Our results in Manuscript 4 showed that leader rumination is negatively associated with employee sleep quality through the serial mediation of leader health, resource-oriented

leadership, and rumination perceived by the team members. These findings are consistent with the Effort-Recovery Theory (Meijman & Mulder, 1998) and previous research (Weigelt et al., 2019; Wendsche & Lohmann-Haislah, 2017), which suggests that leaders who ruminate during nonwork time have higher levels of health complaints over time. In line with the CoR Theory (Hobfoll, 1989), leaders with health complaints may lack a resource that directly facilitates constructive leadership behaviours (Kaluza et al., 2019; Klebe et al., 2022); thus, according to Wegge et al.'s (2014) theoretical framework, they may create a stressful work environment that makes it difficult for employees to switch off from work. Moreover, our findings are consistent with previous findings indicating that rumination can lead to persistent sleep problems among employees (Van Laethem et al., 2018). These findings contribute to a better understanding of how leaders unfavorably influence their employees' sleep quality through their strain symptoms, and highlight that resource-oriented leadership is suitable for reducing employees' rumination and improving their sleep quality. In summary, these findings broaden our understanding of how the social work environment may be beneficial or harmful to employees' sleep quality and provide multiple and new starting points to develop interventions at a different level.

Strengths, Limitations and Future Directions

This dissertation has several strengths, but also limitations, which should be considered when interpreting the results and considered in future research. A major strength of this dissertation is that the four manuscripts are based on different research designs, such as a two-wave design with a representative sample of the German adult population (Manuscript 1), a daily diary design (Manuscript 2), a randomised controlled wait-list control design (Manuscript 3), and a three-wave design with data obtained from leaders and employees (Manuscript 4). These study designs make it possible to overcome some of the limitations of cross-sectional designs and to gain more insight into the longer- and shorter-term processes (Sonnentag et al., 2023) that contribute to healthy sleep by using different time lags.

Specifically, by controlling for baseline levels of sleep quality, as is the case in both multi-wave designs, these studies can answer the question of whether job demands or leader rumination predict changes in sleep over time (Sonnentag et al., 2016). The daily diary design allows job demands, detachment, and sleep quality to be captured in naturally occurring situations over five consecutive workdays, thus examining short-term relationships while increasing the generalisability of the findings. However, in the two-wave study (6 months apart), job demands and detachment were measured simultaneously as well as detachment and sleep quality in the daily-diary study. The simultaneous assessment may lead to a common bias (Podsakoff et al., 2003). Therefore, the mediation results should be interpreted with caution, because the temporal order of the construct cannot be fully disentangled.

In order to draw conclusions about the direction of the associations and to account for possible reverse or reciprocal effects, future longitudinal studies could include three waves, allowing for cross-lagged analyses. At the day level, detachment was assessed retrospectively and concurrently with sleep quality in the daily survey the next morning. This approach was chosen to avoid initiating work-related thoughts by having participants complete the survey just before sleep (Van Laethem et al., 2016) and missing thoughts that may only arise at bedtime in an evening survey (Pereira et al., 2014). Due to the simultaneous measurement and the fact that sleep quality was only subjectively assessed, no conclusions on causality can be drawn. Future diary studies could use objective methods to record sleep during the night, e.g. actigraphy (Kottwitz et al., 2019; Sianoja et al., 2020), and measure detachment during bedtime in the next morning. The advantages of this approach would be to avoid common method biases, not to initiate work-related thoughts before sleep, and not to miss thoughts that may only arise at bedtime. However, this approach would not solve the problem that detachment is measured temporally after sleep, which does not allow conclusions about causality.

Other research designs, such as an experimental design, might shed more light on the causal relationships between detachment during bedtime and sleep quality. For example Sonnentag and Niessen (2020) successfully manipulated two different types of detachment from work in a laboratory setting, through thinking about a hobby and an explicit introduction to detach. In two recent experiments (Kundro et al., 2023), the manipulation of high evening detachment (where one detaches more than one usually does on a given evening) and average detachment (where one detaches as much as one usually does on given evening) also worked. These successful manipulations provide an approach for future studies that could help draw causal conclusions.

Furthermore, all results based on self-reported measures, which are associated with memory distortions or socially desirable behaviour (Podsakoff & Organ, 1986). Future research could use a combination of subjective and objective methods to record sleep, such as actigraphy (Kottwitz et al., 2019; Sianoja et al., 2020) or polysomnography (Barnes et al., 2013). Because slow-wave sleep, body temperature or melatonin are important markers of sleep (Borbély et al., 2016), organisational researchers may increasingly collaborate with sleep, cognitive and neuroscience researchers to advance techniques in the future (Crain et al., 2018).

Particularly in multi-wave surveys, single items have been used to operationalise the constructs, which has several advantages. They minimise the respondent burden (Fisher et al., 2016), increase the overall response rate, and reduce missing data and drop outs (Stanton et al., 2002). Further, a short processing time and increased face validity can lead to more accurate responses from participants (Nagy, 2002). Bias that may result from nonresponse or inaccurate responses can thus be minimised (Fu, 2005; Rogelberg & Stanton, 2007). However, single-item measures, especially for complex constructs, may not be able to assess all facets and cannot provide estimates of internal consistency reliability (Fisher et al., 2016).

For example, sleep quality is a multifaceted construct (e.g., sleep latency, sleep duration, sleep efficiency) that was assessed by one item in all studies except the daily diary study. Such a global assessment of sleep is useful when overall quality is of interest, which can then be adequately assessed with one item (Atroszko et al., 2015). Future research could focus on the individual facets and also examine sleep quality and quantity together (Crain et al., 2018) to get a more differentiated picture of employees' sleep.

A strength can be seen in the generalisability of the findings. Each of the samples consisted of employees from several occupational groups in different organisations, which contributes to the generalisability of the findings. In particular, the sample in Manuscript 1 consisted of a large representative sample of the German adult population. A shortcoming is that the study samples in Manuscript 2 (71.4%) and in Manuscript 4 (leaders: 57.4% and employees: 82.50%) were predominantly female, which limits the generalisability of the results. Possible explanations could be that women are more willing to participate in psychological studies, or that recruitment was focused on the health, social, and service sectors, where women are predominantly working. In addition, the dropout analyses in Manuscript 4 showed that among leaders and among employees, a higher percentage of women than men participated in multiple measurement points. The higher proportion of women seems critical, because poor sleep is more common in women than in men (Zhang & Wing, 2006), even when gender was considered as a control variable in the manuscripts. Therefore, future research should try to include a more heterogeneous sample in terms of gender.

Another limitation is that it is not known which types of thoughts affect sleep and how when employees do not detach. Work-related thoughts can differ in their valence (negative, neutral, positive), temporal orientation (past-, present-, future-oriented), content, duration, and timing (e.g., Casper et al., 2019). In terms of the valence of work-related thoughts, Sonnentag and Niessen (2020) showed that, compared to detachment from work, thinking positively

about work led to more favourable affective states during after-work hours (Jimenez et al., 2022, for a meta-analysis). Thus, research on detachment has often ignored different ways of thinking about work with their beneficial effects on recovery (Wendsche et al., 2021). It is concluded that a differentiated view of detachment is needed (Sonnentag & Niessen, 2020). In terms of temporal orientation, future-oriented thoughts in particular were associated with high levels of arousal and meaningfulness compared to past- or present-oriented thoughts (Rutten et al., 2022). Future research could examine for which groups of employees detachment or different types of work-related thoughts might be more or less harmful or even beneficial (Wendsche et al., 2021) to employees' sleep quality.

In particular, attention should be paid to the timing of work-related thoughts. If the cognitive process is engaged in close to bedtime, any work-related thoughts, whether positive or negative, should negatively affect sleep (Crain et al., 2018). Cognitive arousal often co-occurs with physiological (Cropley et al., 2017) and affective arousal which delays sleep onset and leads to poorer sleep (Cropley et al., 2006; Parker et al., 2020). Thus, positive work-related thoughts may have a beneficial effect two hours before sleep, but a harmful effect just before sleep due to the physiological arousal - similar to exercise. Therefore, future research could consider the timing of work-related thoughts and physiological and affective arousal.

In the daily diary study, detachment was measured using the German version of the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007), in which one of the four items includes a motivational component of detachment ("I am able to distance myself from my work"), in contrast to the English version ("I distance myself from my work"). Employees who do not want to switch off from work during nonwork time because they like to focus on their work may have been unsure how to answer the item, which may have affected internal validity. Future studies could use the item without the motivational component and independently assess the preference to detach to examine it as a moderator of the relationship between detachment and sleep quality.

To better understand why recent diary studies found no (Chawla et al., 2020; Gerhardt et al., 2020; Haun & Oppenauer, 2019), a negative (Eggli et al., 2022) or even a positive (Eggli et al., 2022) relationship between job demands and sleep quality, future studies could investigate fatigue as another possible underlying mechanism. High job demands require a high levels of human energy and therefore lead to a high levels of fatigue (Zohar et al., 2003), which may contribute to a good night's sleep (Eggli et al., 2022; Sonnentag et al., 2016).

In addition, future research could consider other individual factors of employees in the WNS relationship. The majority of participants in all manuscripts were white-collar workers. Thus, it remains an open question for future research whether the relationship between job demands, detachment, and sleep quality is specific to white-collar workers or whether it can be generalised to blue-collar workers in industrial settings as well. For example, Pravettoni and colleagues (2007) suggested that blue-collar workers ruminate significantly less than creative workers in knowledge occupations such as computer science, engineering, architecture or research. Future research should also focus more on why certain individual factors of employees are relevant to their sleep quality, taking into account different mechanisms.

Finally, future research could increase knowledge of the role of the social work environment on sleep. In particular, it is important to investigate which social environment variables are most strongly associated with sleep and how to trickle-down and trickle-up processes in organisations affect sleep (Crain et al., 2018). First, with regard to social support, future studies could investigate which specific source of perceived support is needed to facilitate detachment and sleep quality. Distinguishing between support from colleagues or supervisors, between work and nonwork support (Nordin et al., 2012), between emotional, instrumental, and recovery support (Bennett et al., 2016; Mathieu et al., 2019), and between perceived and received support could help researchers derive appropriate interventions.

Second, future research could take into account the social (e.g., norms and values) and economic (e.g., income and status) conditions in which individuals live and organisations operate (Sonnentag et al., 2023). For example, Kundro et al. (2023) suggest that performance pressures in organisations influence the extent to which those who detach experience shame. Therefore, future studies could also examine social and economic conditions in the relationships between work, nonwork, and, sleep. Third, in addition to trickle-down processes, future research might also examine trickle-up processes (Wo et al., 2019), in which employees' rumination might influence the rumination and the sleep of their leader. For example, if employees think about work-related problems during nonwork time, they might be more inclined to continue working and contact their leaders by phone or email during their leisure time. The resulting contact could make it difficult for the leader to switch off after work and lead to rumination and sleep problems.

Practical Implications

Although awareness of the importance of sleep in workplace health promotion has increased in recent years, organisations still pay too little attention to promoting healthy sleep compared to promoting healthy eating and adequate exercise. Based on the findings of this dissertation and in line with the IGLOO framework, which suggests that multiple levels in organisations (i.e., individual, group, leadership, organisational, and overarching contextual levels) should be considered when developing interventions (Nielsen et al., 2018), organisations could implement sleep interventions at the following levels:

At the individual level, organisations and HR managers should raise awareness of full-time employees, supervisors and socially prescribed perfectionists as potential risk groups. At the organisational level, a first step, could be to conduct an organisational risk analysis to identify increased job demands. Organisations should optimise job demands and limit exposure to high job demands. Workplace sleep interventions should be extended and optimised by also considering the leadership and group level. Therefore, interventions could

raise leaders' awareness of their role as (co-)designers of employees' work characteristics and highlight practical approaches to enhance resources: scope for action, conflict management, fairness, and participation (Vincent-Höper & Stein, 2019). Increased attention should also be paid to reducing leaders' rumination and promoting the leaders' general health, as this is not only relevant for leaders themselves, but also for promoting employees' sleep quality. Mindfulness-based and cognitive behavioural interventions may be helpful in reducing work-related rumination (Querstret & Cropley, 2013). In addition, at the group level, perceived social support from supervisors and colleagues offers a promising approach for promoting employees' sleep quality. To promote social support from colleagues, cooperative activities can be carried out while achieving a common goal (Wolgast & Fischer, 2017).

Organisations should also provide interventions at an overarching contextual level to help their employees to detach from work during nonwork time, as high job demands cannot always be completely avoided. Central components of detachment training should be boundary management strategies and emotional regulation techniques (Karabinski et al., 2021). Boundary management strategies include behavioural (e.g., using technology to facilitate boundary work), temporal (e.g., controlling work time or purposefully disconnecting), physical (e.g., manipulating physical space) or communicative (e.g., setting expectations) tactics to separate work and nonwork (Allen et al., 2021; Kreiner et al., 2009). Emotion regulation refers to techniques such as for example muscle- and breathing-relaxation exercises or acceptance of negative emotions (Heber et al., 2016), that help individuals calm down by managing difficult emotions that may arise from work-related thoughts (Karabinski et al., 2021). Another less time-consuming way for employees, and a cost-effective way for organisations, to directly improve sleep quality is a low-dose app-based mindfulness intervention.

In addition to these specific implications in response to the findings of this dissertation, previous studies in the general working population provide initial promising

evidence for the efficacy of face-to-face (Nakada et al., 2018; Schiller, et al., 2018b) and internet-delivered (Behrendt et al., 2020) cognitive-behavioural therapy for insomnia (CBT-I) in reducing work-related rumination and sleep problems (Behrendt et al., 2020). These sleep-focused interventions include the following components: psychoeducation, relaxation exercises, bedtime restriction and/or stimulus control, and cognitive techniques. Organisations should also set up information-, training-, and, counselling-services as part of occupational health management to promote employees' sleep quality.

Conclusion

The studies presented in this dissertation provide insight into the relationship between the three main areas of life: work, nonwork, and sleep (WNS), and highlight the role of individual factors and the social work environment on employees' sleep quality. Sleep is a complex process that can be influenced by many factors. However, as someone once said, "It's always the small pieces that make a big picture" (author unknown). Overall, the results of this dissertation contribute to the refinement of the big picture. They shed light on important antecedents of employees' sleep quality and underlying mechanisms, and offer several practical implications for improving employees' sleep quality.

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Appendix A: Manuscript 1

How to Sleep Well in Times of High Job Demands:

The Supportive Role of Detachment and Perceived Social Support

Authors: Eva Matick, Maria U. Kottwitz, Gunnar Lemmer, and Kathleen Otto

Status: Published in *Work & Stress*

Matick, E., Kottwitz, M. U., Lemmer, G., Otto, K. (2021). How to sleep well in times of high job demands: The supportive role of detachment and perceived social support. *Work & Stress*. https://doi.org/10.1080/02678373.2021.1889071.

How to Sleep Well in Times of High Job Demands:

The Supportive Role of Detachment and Perceived Social Support

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Routledge
Taylor & Francis Group

Work & Stress
An International Journal of Work, Health & Organisations

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/twst20

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To cite this article: Eva Matick, Maria U. Kottwitz, Gunnar Lemmer & Kathleen Otto (2021) How to sleep well in times of high job demands: The supportive role of detachment and perceived social support, Work & Stress, 35:4, 358-373, DOI: 10.1080/02678373.2021.1889071

To link to this article: https://doi.org/10.1080/02678373.2021.1889071

WORK & STRESS
2021, VOL. 35, NO. 4, 358–373
https://doi.org/10.1080/02678373.2021.1889071

How to sleep well in times of high job demands: The supportive role of detachment and perceived social support

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ABSTRACT

This study aims to examine whether employees who perceive there to be social support from supervisors and colleagues would be better able to detach from work during non-work time and thus sleep better in times of high job demands. Considering contextual factors, such as type of employment (full- and part-time) and supervisor status (with and without), which could influence the associations between work, non-work, and sleep, we also explored these relationships within subgroups of employees. A total of 1856 employees participated in a two-wave-panel study representative of the German adult population. Controlling for the baseline level of sleep quality, regression analyses revealed that job demands predicted changes in sleep quality over a 6-month period and that detachment fully mediated this effect. Furthermore, perceived social support buffered the indirect effect of job demands on sleep quality via detachment. In summary, the results suggest that the interplay of job demands, detachment, and perceived social support is important in promoting sleep quality. Type of employment and supervisor status seem to be factors shaping the above-mentioned effects and should, therefore, be considered in future research.

ARTICLE HISTORY
Received 8 April 2020
Accepted 8 February 2021

KEYWORDS
Sleep quality; job demands; detachment; perceived social support; stressor-detachment model

Sleep problems have increased in recent years, especially among employees (Kronholm et al., 2016). This information is particularly worrying, as sleep affects performance, safety, and the physical and mental health of employees (Brossoit et al., 2019; Litwiller et al., 2017). Given stronger awareness of the interplay between work, non-work, and sleep (e.g. Crain et al., 2018), there is a call for organisations to identify causes of impaired sleep and potential factors that can promote the sleep quality of employees. Recently, Crain and colleagues (2018) theoretically underlined that good sleep provides the energy and activation that is needed for waking physical and cognitive activities, impacting work and non-work domains, which then influence sleep quality. Previous research showed that particularly high job demands (e.g. high workload, time pressure) are important antecedents of reduced sleep quality as a long-term consequence (Linton et al., 2015; Van Laethem et al., 2018).

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To minimise persistent sleep problems, it is important to uncover the underlying mechanism of this effect. There are indications from two-wave panel studies that detachment, the mental disconnection from work during non-work time, may explain the existence of the relationship between job demands and detachment (Kinnunen & Feldt, 2013; Sianoja et al., 2018). While previous research looked at the individual effects of job demands on detachment and of detachment on sleep quality in isolation, to the best of our knowledge, there is no single study that examined the mediating role of detachment based on a representative sample so that the results can be generalised across various groups of employees and occupations.

Perceived social support at work, as a protective factor from the work domain, has been found to promote sleep quality, as it buffers against the negative effect of job demands (Gadinger et al., 2009; Pow et al., 2017). However, it is not yet known how exactly the perceived availability of support acts as a stress buffer (Pow et al., 2017). We hope to gain new insights by analyzing whether perceived social support from colleagues and supervisors might help employees detach from work and thus sleep better in times of high job demands.

In order to be able to design or optimise interventions, it is also important to identify groups of employees for whom the proposed relationships are particularly relevant (Crain et al., 2018). People facing a higher risk could be found among full-time employees or supervisors. However, little is known about potential risk groups in this context.

The current study contributes to the literature by (a) analyzing whether job demands predict changes in sleep quality over a period of 6 months and whether this effect is mediated by detachment; (b) exploring whether perceived social support contributes to facilitating detachment and thus to promoting long-term sleep quality; (c) investigating exploratory whether the above-mentioned effects are universal or specific for individual groups of employees.

Job demands, detachment, and sleep quality

The question arises as to how the negative effect between job demands and sleep quality as a long-term consequence occurs. The effort-recovery theory (Meijman & Mulder, 1998) provides a framework for this process. According to this theory, job demands lead to short-term psychophysiological reactions, which are reversible as soon as the person recovers after work. In cases of continued exposure to job demands and incomplete recovery, the psychophysiological reactions persist over time, resulting in a suboptimal state in employees. To perform their work tasks in this suboptimal state, employees have to invest more effort. This additional effort leads to an increased load reaction, which can accumulate and result in chronic health problems, such as persistent sleep problems. Recovery, a process of psychophysiological unwinding after expending effort, thus plays an essential role in the relationship between acute job demands and sleep quality as a long-term consequence (Geurts & Sonnentag, 2006).

Sonnentag and Fritz (2015) assume in their stressor-detachment model that psychological detachment is an important recovery experience. Detachment implies not thinking about work during non-work time (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2007). High work-related stressors are associated with a lack of detachment, which in turn is associated with strain symptoms and reduced well-being. Sonnentag and Fritz

(2015) further propose that the effects of a lack of detachment do not only appear within days or weeks but also over longer periods of time, such as years. When employees successfully detach from work during non-work time, the chances increase that the acute accumulating load reactions specified by the effort-recovery model can be reduced, thereby preventing a chronic strain reaction over time (Sonnentag & Fritz, 2007). In contrast, the authors argue that if employees do not detach, the reactions will persist and a full recovery may not occur.

Previous research indicates that detachment may explain the existence of the relationship between job demands and sleep quality (Kinnunen & Feldt, 2013; Sianoja et al., 2018). The few two-wave panel studies investigating job demands as antecedents of detachment and strain as an outcome, however, have mainly focused on the individual effects in isolation, yielding mixed results: Kinnunen and Feldt (2013) found that job demands predicted detachment across a year; however, they did not find that detachment predicted well-being one year later. The study of Sianoja et al. (2018) is one of the first showing effects of detachment on exhaustion and sleep quality across one year. Going beyond these prior findings, and in line with effort-recovery theory (Meijman & Mulder, 1998) and the stressor-detachment model (Sonnentag & Fritz, 2015), we assume that the negative effect of job demands on sleep quality as a long-term consequence is mediated by detachment. The hypothesised model can be seen in Figure 1.

Hypothesis 1: The effect of job demands on sleep quality 6 months later will be mediated by detachment.

The role of perceived social support

Social support is defined as the perception or experience that one is loved, cared for, esteemed, and part of a social network characterised by mutual assistance and obligations (Wills, 1991). This definition makes clear that social support can also simply involve the perception that such resources are available when they are needed (Taylor, 2011). Overall, employees can perceive social support at work from supervisors as well as colleagues. This perceived social support might buffer the negative effect of job demands on

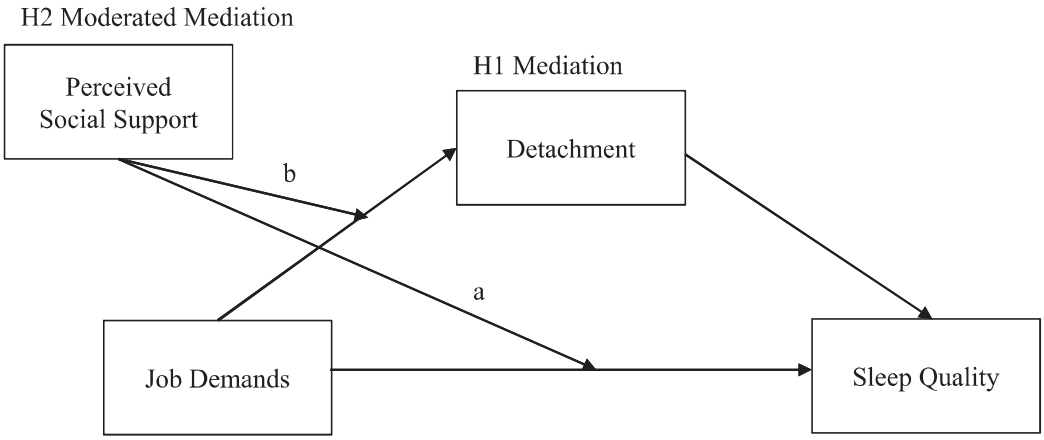

Figure 1. Hypothesized model.

sleep quality of employees (Gadinger et al., 2009; Pow et al., 2017) as the buffering hypothesis suggests (Cohen & Wills, 1985). Accordingly, we assume that perceived social support from colleagues or supervisors buffers the negative direct effect of job demands on sleep quality (see hypothesised model – path a).

The extended stressor-detachment model (Sonnentag & Fritz, 2015) provides indications that perceived social support could also buffer the negative effect of job demands on detachment and thus positively influence the sleep quality of employees. The authors assume, on the basis of transactional stress theory (Lazarus & Folkman, 1984), that the negative effect of job stressors on detachment can be influenced by primary and secondary appraisal. During primary appraisal, a person evaluates whether a situation is positive, irrelevant, or potentially threatening. During secondary appraisal, a person evaluates whether the situation can be managed with the available personal and job resources, such as perceived social support from colleagues and supervisors. If resources are available to employees, they will be able to detach more easily in their free time because they know they will receive support when necessary, and, thus, the effect between job stressors and detachment can be attenuated. In line with the extended stressor-detachment model (Sonnentag & Fritz, 2015), transactional stress theory (Lazarus & Folkman, 1984), and previous research, we assume a model in which the negative effect of job demands on sleep quality via detachment is buffered by perceived social support from supervisors and colleagues (see hypothesised model – path b).

Hypothesis 2: The indirect effect of job demands on sleep quality via detachment depends on the perception of social support at work. The indirect effect is weaker for employees who perceive high social support at work compared to those who perceive low social support.

Crain et al. (2018) suggest that the relationships between work, non-work, and sleep should be investigated across groups of employees and various occupations to establish generalizability. However, they also point out that contextual factors, such as occupational characteristics (e.g. type of employment or supervisor status) strongly influence the relationships between work, non-work, and sleep. It is therefore important to find out for which target groups the relationships are particularly relevant. In the following sections, we describe two possible risk populations for which the interplay of work, non-work, and sleep could be closely linked.

First, since full-time employees work more hours on average (35 h/week or more) than part-time employees (Åkerstedt et al., 2003) and time is a limited resource that is shared between the areas of work, non-work, and sleep (Crain et al., 2018), full-time employees may have less time for the areas of non-work and sleep. Next to decreased recovery time, full-time employment seems to be associated with an increased workload. Previous studies showed that for full-time employees, a reduction in working hours reduced their workload, extended time for recovery activities (Schiller et al., 2018), diminished worries at bedtime, and increased sleep quality (Schiller et al., 2017).

Second, in regard to position, a supervisor status is often associated with increased psychosocial job demands (Li et al., 2018). Apart from fulfilling their own tasks, supervisors must also expend considerable energy supporting their subordinates and pursuing overriding organisational goals (Yukl, 2012). This is reflected not only in longer working hours but also in high workload (Quick et al., 2000). However, in the past, researchers, the public, and policymakers have mainly focused on the health of subordinates (Barling

& Cloutier, 2017). There are descriptive indications from previous studies that subordinates think less about work during their non-work time (Sonnentag & Schiffner, 2019) compared to supervisors and that supervisors report lower sleep quality compared to subordinates (Tariq et al., 2020).

To identify possible risk factors, we examined whether the respective associated subgroups (full-time vs. part-time employees, and employees with supervisor status vs. employees without supervisor status) differed in job demands and detachment at the first measurement point. The mediation effect of job demands on sleep quality via detachment could be especially decisive for full-time employees and supervisors. Regarding moderated mediation, possible risk groups of employees may be more vulnerable and thus more likely to benefit from perceived social support to facilitate detachment and thereby promote long-term sleep quality, while others benefit from perceived social support may to a lesser degree.

In summary, there is little knowledge about how relevant the hypothesised effects are in relation to the different groups of employees. Given the exploratory nature, we investigate how the hypothesised model looks within the groups of (1) full-time and (2) part-time employees (research question 1), and how it looks within the groups of employeees (1) with and (2) without supervisor status (research question 2).

Method

Participants and Procedure

Data provided by the respective panels of the GESIS Leibniz Institute for the Social Sciences in Mannheim were taken from a representative sample of the German adult population (GESIS, 2019). For this study, we used two waves comprising $N = 1978$ German-speaking adults who lived in Germany and were in part-time or full-time employment with a time lag of 6 months (T1: data assessment between October and December 2015; T2: between April and July 2016). Participants were invited by mail and could participate online (web-based) or offline (paper and pencil). They received 5€ as a monetary incentive.

Out of 1978 participants, 122 did not participate in the second survey. This corresponds to a response rate of 94%. Dropout analyses were conducted, comparing participants who participated in both measurement points (completers) with participants who did not participate at the second measurement point (dropouts). The analyses showed that completers and dropouts did not differ in gender, 48% men vs. 46% women, $\chi^2(1, N = 1978) = .26$, $p > .05$, or workload at the first measurement point, 3.70 vs. 3.63, $t(1.976) = .64$, $p > .05$. However, the completers were significantly older than the dropouts, 46 vs. 42 years old, $t(1.976) = 3.62$, $p < .001$.

The final total sample thus comprised $N = 1856$ participants, of whom 896 were women (48.3%) and 960 were men (51.7%). The age of the participants was between 24 and 76 years ($M = 50.42$, $SD = 11.06$), and 52 participants continued to work after the retirement age of 65. Overall, 73.5% of the participants were in full-time employment, 26.5% were in part-time employment, 33% were supervisors, and 67% were employees without supervisor status. The majority of participants were white-collar workers (65.7%), followed by blue-collar workers (11.8%), and civil

servants (8.9%). Moreover, 14.5% of the participants were employed in the field of health and social work, 12.0% worked in the manufacturing sector, and 10.0% provided other services.

Measures

All study variables were assessed at the first measurement point with the exception of sleep quality, which was measured at both measurement points.

Job demands were assessed following Theorell et al. (1988). Time pressure and workload were combined to measure job demands comprehensively and reliably. Participants were required to indicate on a 5-point Likert scale the extent to which the following statements apply to their current work. Time pressure was measured with the item "In my job, I have to work fast." Workload was measured with the item "In my work, I have a lot of work to do." The alternative responses were *not true at all* (1) up to *totally true* (5). The mean value of the two items reflected the job demands score. The internal consistency (Cronbach's α) for this measure was .78.

Perceived social support was measured with the item "My colleagues and supervisors help me at work when it becomes necessary." Participants rated the statement along a 5-point Likert scale ranging from *not true at all* (1) up to *totally true* (5).

Detachment was assessed with one item, "How often do you think about your job in your free time?" (reverse coded), as used by Scholz et al. (2009, p. 9), with a 5-step answer format varying from *never* (1) to *very often* (5).

Sleep quality was measured with the item "How satisfied are you with your sleep?," with the response choices ranging from *completely dissatisfied* (0) up to *completely satisfied* (10).

Control variables. Age (in years) and sex (1 = male, 2 = female) were included as control variables in our analyses, as both relate to sleep. Poor sleep increases with age and is more common among women than men (Zhang & Wing, 2006). Furthermore, sleep duration on a normal weekday was also entered as a control variable to ensure that the effect of detachment on sleep quality was not due to reduced sleep duration. Crain et al. (2018) suggest that it is important for sleep research within the organisational sciences to consider both sleep quality and quantity. A single item with an open answer format was used to assess sleep duration: "How many hours do you sleep during the night on a normal weekday?" Finally, we controlled for the preceding measure of the outcome variable (autocorrelation; sleep quality of the first point of measurement).

Results

Descriptive statistics and correlations between all study variables are reported in Table 1. Job demands at T1 were negatively related to detachment at T1, $r = -.25$, $p < .001$, and sleep quality at T2, $r = -.09$, $p < .001$. Higher ratings of detachment at T2 were related to a better sleep quality at T2, $r = .15$ $p < .001$, and higher perceived social support at T1 was related to more detachment at T2, $r = .11$, $p < .001$. The stability of sleep quality over time was high, $\beta = .56$, $t(3) = 28.10$, $p < .001$.

Table 1. Means, Standard Deviations, and Pearson Correlations among Study Variables.

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1	Age	50.42	11.06	–							
2	Sex	–	–	−.03	–						
3	Job Demands (T1)	3.68	0.88	−.03	.04	–					
4	Perceived Social Support (T1)	3.46	1.11	−.15***	−.07**	−.03	–				
5	Psychological Detachment (T1)	2.62	0.94	−.01	−.02	−.25***	.11***	–			
6	Sleep Quality (T1)	6.24	2.45	−.02	−.01	−.09***	.10***	.17**	–		
7	Sleep Quality (T2)	6.43	2.31	.04	.01	−.09***	.07**	.15**	.60***	–	
8	Sleep Duration (T1)	6.66	1.02	−.03	.03	−.15***	.04	.11**	.35***	.30***	–

Note. Age was measured in years. For sex, 1 = male; 2 = female. T1 = Time 1; T2 = Time 2. The scale values of job demands, perceived social support and psychological detachment ranged from 1 to 5. The scale values of sleep quality ranged from 0 to 10. Sleep duration was measured in hours. $^{**}p < .01$; $^{***}p < .001$.

Hypothesis testing

All hypotheses and subgroup analyses were tested using Model 8 in the macro PROCESS by Hayes (2017) in SPSS 22.0. The regression parameters were estimated using the ordinary least squares method and the significance test of the mediation, moderated mediation, and the index of moderated mediation was performed using the bootstrapping method with 10,000 bootstrap samples and a 95% confidence interval, following Preacher et al. (2007) and Hayes (2015). If the confidence interval does not include zero, the indirect effect is significant. The index of moderated mediation is a significance test of moderated mediation that indicates whether two conditional indirect effects differ significantly from each other (Hayes, 2015). Age, sex, sleep quality, and sleep duration were included as control variables.[1] To examine whether the respective associated subgroups differed in job demands and detachment at the first measurement point and to conduct separate subgroup analyses of the study hypotheses, participants were divided into four subgroups by employment situation (in full-time employment and part-time employment) and supervisor status (with and without).

Main analyses

Mediation results

The results showed a significant negative indirect effect of job demands on sleep quality via detachment, $\beta = -.0097$, 95% CI [−0.0199, −0.0007]. Job demands led to a lack of detachment, $\beta = -.2428$, $t(3) = -10.79$, $p < .001$, which in turn led to reduced sleep quality, $\beta = .0401$, $t(8) = 2.07$, $p < .05$. Furthermore, the direct effect was not significant after controlling for the indirect effect, $\beta = -.0133$, $t(8) = -.69$, $p > .05$. These results support hypothesis 1.

Moderated mediation results

The negative indirect effect of job demands on sleep quality via detachment was weaker for employees who perceived above-average (+ 1 *SD*) social support, $\beta = -.0074$, 95% CI [−0.0162, −0.0008], compared to employees who perceived below-average (−1 *SD*) social support, $\beta = -.0121$, 95% CI [−0.0247, −0.0008]. Furthermore, the index of moderated mediation, $\beta = .0024$, 95% CI [0.0002, 0.0065], showed that two conditional indirect effects differed significantly from each other. These results support hypothesis 2. The effect size, according to Cohen's criteria (1988), was small to medium for detachment ($f^2 = .08$) and large for sleep quality ($f^2 = .60$).

Based on previous research, it was further tested whether the negative direct effect of job demands on sleep quality (hypothesised model – path a) would be moderated by the perception of social support. The results indicated that perceived social support did not significantly moderate the direct effect of job demands on sleep quality, $\beta = -.0032$, $t(8) = -.20$, $p > .05$.

Explorative analyses

To identify possible risk factors, it was examined whether the respective associated subgroups differed in job demands and detachment at the first measurement point. The

analyses demonstrated that full-time and part-time employees differed significantly in job demands, 3.72 vs. 3.57, $t(709.312) = 3.09$, $p < .01$, $d = .17$; 95% CI [0.273, 0.066], and detachment, 2.58 vs. 2.71, $t(936.863) = -2.84$, $p < .01$, $d = .14$ CI [0.035, 0.242]. Similarly, supervisors and employees without supervisor status reported substantial differences in job demands, 3.79 vs. 3.63, $t(1.846) = 3.69$, $p < .001$, $d = .18$, CI [0.278, 0.083], and detachment, 2.36 vs. 2.75, $t(1.846) = -8.61$, $p < .001$, $d = .42$ CI [0.326, 0.522]. The effect sizes, according to Cohen's criteria (1988), were small.

In addition, it was exploratory examined how the hypothesised model looks within the respective groups of employees. The results of the indirect effect and the conditional indirect effects of the four subgroups are shown in Table 2.

Mediation results

The results showed that detachment significantly mediated the negative effect of job demands on sleep quality of full-time employees and supervisors but not of part-time employees and employees without supervisor status. More specifically, in the latter subgroups, the positive effect of detachment on sleep quality was not significant.

Moderated mediation results

The index of moderated mediation showed that two conditional indirect effects differed significantly among full-time employees and supervisors. These findings indicated that the negative indirect effect of job demands on sleep quality via detachment was significantly weaker for full-time employees or supervisors who perceived above-average (+ 1 *SD*) social support compared to full-time employees or supervisors who perceived below-average (−1 *SD*) social support.

In contrast, the index of moderated mediation showed that no conditional indirect effects differed significantly among part-time employees and employees without supervisor status. The effect size for full-time employees, according to Cohen's criteria (1988), was small to medium for detachment ($f^2 = .09$) and large for sleep quality ($f^2 = .61$). For supervisors, the effect size was also small to medium for detachment ($f^2 = .09$) and large for sleep quality ($f^2 = .65$).. In regard to research questions 1 and 2, the results of

Table 2. Subgroup Analyses, Conditional Indirect Effects.

Subgroup	*n*	Values of moderator PSS	Conditional indirect effect	*SE*	Lower CI	Upper CI
Full-time employees	1.365	−1 *SD*	−.0152	.0076	−.0315	−.0014
		M	−.0124	.0063	−.0254	−.0010
		+ 1 *SD*	−.0095	.0051	−.0214	−.0011
		Index	.0029	.0020	.0002	.0085
Part-time employees	491	−1 *SD*	−.0027	.0113	−.0259	.0198
		M	−.0021	.0086	−.0194	.0152
		+ 1 *SD*	−.0014	.0064	−.0162	.0104
		Index	.0006	.0030	−.0042	.0091
Supervisors status	610	−1 *SD*	−.0388	−.0388	−.0670	−.0172
		M	−.0285	−.0285	−.0506	−.0124
		+ 1 *SD*	−.0182	−.0182	−.0418	−.0046
		Index	.0097	.0052	.0019	.0229
No supervisors status	1.238	−1 *SD*	−.0054	.0072	−.0201	.0081
		M	−.0044	.0058	−.0161	.0066
		+ 1 *SD*	−.0034	.0045	−.0133	.0048
		Index	.0011	.0017	−.0012	.0059

Note. PSS = perceived social support; Index = index of moderated mediation.

the exploratory mediation and moderated mediation analyses indicated that the hypothesised model is especially decisive for full-time employees and supervisors.

Discussion

The present representative study deals with the question of how high job demands lead to persistent sleep problems. It provides an initial indication that a lack of detachment is a possible explanation for the negative effect of job demands on sleep quality over time. Furthermore, the results show that perceived social support at work buffers the indirect effect of job demands on sleep quality via detachment. Additional exploratory analyses suggest that the above-mentioned effects seem to depend on the type of employment and supervisor status. Each of these results will be discussed below.

Theoretical implications

First, the finding that detachment mediates the negative effect of job demands on sleep quality supports the first hypothesis and is in line with effort-recovery theory (Meijman & Mulder, 1998) and the stressor-detachment model (Sonnentag & Fritz, 2007, 2015). In other words, when employees successfully detach from work during non-work time, the chances increase that acute accumulating load reactions can be reduced, thereby preventing chronic strain reactions, such as persistent sleep problems. This result is consistent with the research findings, indicating that high job demands predict a lack of detachment (Kinnunen & Feldt, 2013) and that a lack of detachment in turn predicts reduced sleep quality (Sianoja et al., 2018). Moreover, our results reveal a non-significant direct effect, highlighting detachment as the underlying mechanism.

The second hypothesis is supported by the finding that employees who perceive there to be social support from colleagues or supervisors will be able to detach more easily in their free time, because they know they receive support when they need it and thus sleep better in times of high job demands. This finding is consistent with the extended stressor-detachment model (Sonnentag & Fritz, 2015), which integrates the model of Lazarus and Folkman (1984). Employees might perceive high job demands as threatening in the primary appraisal and assess in the secondary appraisal whether they have the necessary personal or job resources, such as social support, to cope with the job demands. Moreover, job demands might also be perceived as challenging because employees know that they rely on the necessary social support when they need it. In contrast to Gadinger et al. (2009) and Pow et al. (2017), we did not find that social support moderates the direct negative effect of job demands on sleep quality. These results broaden our understanding of how perceived social support at work helps employees sleep better in times of high job demands.

Following the work, non-work, and sleep framework by Crain et al. (2018), job demands seem to translate into impaired sleep quality via detachment particularly when time and energy resources are depleted. In line with previous findings, the additional exploratory analyses suggest that higher job demands and lower detachment might be possible risk factors for full-time employees (Schiller et al., 2017; Schiller et al., 2018) and supervisors (Li et al., 2018; Quick et al., 2000; Sonnentag & Schiffner, 2019) compared to part-time employees and employees without supervisor status.

Regarding mediation, all subgroups seem to have less ability to detach from work as job demands increase. However, if part-time employees and employees without supervisor status do not detach successfully, this is not reflected in their perceived sleep quality, in contrast to full-time employees and supervisors. Full-time employees and supervisors are particularly long and intensively involved in their work (Åkerstedt et al., 2003; Yukl, 2012). This could lead to using more time and energy resources, which in turn could affect recovery experiences and sleep. Particularly for leaders, the content and duration of their thoughts during non-working time might affect their sleep quality. They may not only think about their own tasks but also about supporting their subordinates and pursuing overarching organisational goals. For example, the belief that one is responsible for the emotional needs of others is associated with rumination (Nolen-Hoeksema & Jackson, 2001). In relation to moderated mediation, the exploratory analyses show that, especially for full-time employees and supervisors, perceived social support at work is an important resource to facilitate detachment and thus allows them to sleep better in times of high job demands. These vulnerable groups may particularly benefit because perceived social support could reduce the stress reaction by increasing self-esteem and perceived personal control (Uchino, 2009).

In summary, type of employment and supervisor status seem to be important contextual factors that could influence the negative effect of detachment on sleep as predictors or moderators and should therefore be considered in future research.

Practical implications

High job demands cannot always be completely avoided. Therefore, two important approaches to promote sleep quality are to strengthen the perceived social support by supervisors and colleagues and to facilitate detachment, especially for the respective risk groups. For example, social support from colleagues can be promoted by frequent cooperative activities while a common goal is achieved (Wolgast & Fischer, 2017). In contrast, supervisor support for recovery also seems to play an important role in helping employees detach from work (Bennett et al., 2016). Moreover, detachment can be promoted in daily experience through building implementation intentions (Smit & Barber, 2016) and mindfulness (Haun et al., 2018). Previous research showed that both face-to-face (Hahn et al., 2011) and web-based (Thiart et al., 2015) recovery interventions have positive effects on detachment.

Strengths, potential limitations, and suggestions for future research

Using a large representative sample of the German adult population, it was possible to investigate the hypothesised model across groups of employees and various occupations to establish generalizability and at the same time to identify risk groups of employees for whom the relationships are particularly closely linked. At first sight, the effect sizes were rather small; however, when interpreting them, it must be noted that we controlled for age, gender, sleep duration, and the baseline level of sleep quality to depict changes across a time span of 6 months. Moreover, sleep, for example, is a complex process that can also be influenced by other factors, such as non-job demands and resources,

as well as personality (Crain et al., 2018; Reis & Prestele, 2020). Future research should account for such factors in order to refine the picture. Another important strength of the study is the use of a two-wave panel design (6 months apart), which provides clues to the direction of the associations. However, job demands and detachment were both measured at the same time, which may result in a common bias. In future research, crossed-lagged analyses or experimental designs could help with drawing causal conclusions.

Despite the strengths of the study, there are also limitations regarding the operationalisation of the examined variables. First, we cannot draw conclusions about which thoughts influence sleep when employees do not detach. Work-related thoughts can differ in their valence, temporal orientation, content, duration, and timing (e.g. Casper et al., 2019). Therefore, future studies should pay attention to these characteristics of work-related thoughts, especially in potential risk populations. Second, this study is based exclusively on self-report measures. However, self-report measures can lead to memory distortions or socially desirable behaviour (Podsakoff & Organ, 1986). Future research could use a combination of subjective and objective methods to record sleep (Sianoja et al., 2020), for example, actigraphy.

Moreover, the data for the current analyses were taken from a multi-wave survey in which single items were used to operationalise all constructs with the exception of job demands. In multi-wave surveys, single items offer several benefits, such as minimising the respondent burden (Fisher et al., 2016), increasing the overall response rate, and reducing missing data and drop outs (Stanton et al., 2002). Furthermore, a short processing time and increased face validity can lead to more accurate responses from participants (Nagy, 2002). Bias, which can arise from nonresponse or inaccurate answers, can, thus, be minimised (Fu, 2005; Rogelberg & Stanton, 2007). However, single item measures have also been criticised because they may not adequately represent the content domain of conceptually complex constructs and they cannot yield estimates of internal consistency reliability (Fisher et al., 2016). For example, we are limited to one item for sleep quality, which does not allow us to differentiate between different sleep characteristics (e.g. sleep-onset latency, sleep interruptions). Such a global evaluation of sleep is useful if the overall quality is of interest. This can then adequately be assessed by one item (Atroszko et al., 2015).

Furthermore, we assumed that full-time employees work more hours on average than part-time employees (Åkerstedt et al., 2003), but the contractual working time does not necessarily correspond to the actual working time. In addition, based on our data, we do not know which work activities and activities similar to work are performed by part-time employees during non-work time. Therefore, future research should also take actual working time into account. Finally, social support was recorded through measuring the perceived social support of supervisors and colleagues. Future studies could analyze which specific source of perceived support – colleagues or supervisors – is needed to facilitate detachment and sleep quality. Further distinctions between work and non-work support (Nordin et al., 2012), between emotional, instrumental, and recovery support (Bennett et al., 2016; Mathieu et al., 2019), and between perceived and received support could also help researchers derive appropriate interventions.

Conclusion

In times of high job demands, employees who perceive there to be social support from their supervisors and colleagues are better able to detach from work during non-work time and thus sleep better in the long run. Therefore, quantitative job demands, perceived social support at work, and detachment offer starting points for reducing acute accumulating load reactions, thereby promoting sleep quality in the long term, especially when employees are in full-time employment or have a supervisor status. Future research should pay more attention to these contextual factors.

Note

1. Since sleep quality and sleep duration correlated moderately bearing a risk of over-controlling, we also analysed the hypotheses without sleep duration as control variable. The regression coefficients remained significant when the regression analyses were ran without sleep duration included.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are openly available in GESIS Panel – Standard Edition at https://doi.org/doi:10.4232/1.13301, ZA5665.

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Appendix B: Manuscript 2

Far from Perfect Sleep – A Diary Study on Multidimensional Perfectionism in the Context of the Stressor-Detachment Model

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Status: Submitted to *International Journal of Stress Management*

Far from Perfect Sleep – A Diary Study on Multidimensional Perfectionism in the Context of the Stressor-Detachment Model

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Abstract

- Socially prescribed perfectionism but not self-oriented perfectionism makes individuals vulnerable for impaired sleep quality. However, the mechanisms that link multidimensional perfectionism to varying sleep remain unclear, especially in applied settings, such as the workplace. Integrating the cognitive-affective personality system theory and the stressor-detachment model, we proposed time pressure and detachment as relevant mechanisms. We expected socially prescribed perfectionism to have a negative indirect effect on daily sleep quality through detachment and a serial mediation of time pressure and detachment. Further, we expected self-oriented perfectionism to show ambivalent effects, displaying a negative indirect effect on daily sleep quality through detachment, but also a positive indirect effect through serial mediation. We tested our hypotheses with data from 70 employees that participated in a diary study over 5 consecutive days (day level $N = 233$). Results from multilevel path analyses provided support for the expected serial mediation linking socially prescribed perfectionism to impaired sleep quality. Additional exploratory analyses confirmed this serial mediation for all four components of sleep quality. Further, a direct positive effect of self-oriented perfectionism on sleep quality was found. Our findings highlight the conjoint role of mechanisms in the work and non-work area, i.e., time pressure and subsequent detachment, for the association between socially prescribed perfectionism and sleep quality. Thus, the results suggest an active role of individuals in contributing to job stressors. We discuss personality as an additional predictor in the stressor-detachment model and how organizations may include individual and organisational sources of stress in comprehensive intervention approaches.

Keywords: multidimensional perfectionism, time pressure, detachment, sleep quality, diary study

Far from Perfect Sleep – A Diary Study on Multidimensional Perfectionism in the Context of the Stressor-Detachment Model

Perfectionism has been described as a personality disposition comprising striving for flawlessness, exceptionally high-performance standards, and the tendency towards a highly critical evaluation of one's behaviour as core characteristics (Frost et al., 1990; Stoeber, 2018a). While perfectionism is increasing among individuals, especially in industrialised countries (Curran & Hill, 2019), it is the workplace that is most frequently affected by this personality disposition (Stoeber & Stoeber, 2009) because goal achievement, performance appraisal, and feedback are ubiquitous in this context (Brown & Heywood, 2005). Organisations might call the rise of perfectionism a "blessing," considering that employees high in perfectionism put much effort into their work (Stoeber et al., 2013). However, whereas a link to workplace performance has not been established, growing evidence indicates that perfectionism may put employees at risk for stress and a variety of strain issues, such as impaired sleep quality (Harari et al., 2018; Molnar et al., 2020). Notably, healthy sleep is crucial for daily recovery and an important predictor of employees' health, performance, and occupational safety (Brossoit et al., 2019; Litwiller et al., 2017). Against this background, the topic of perfectionism seems to be equally relevant for employees and how they individually deal with perfectionism as well as for organisations that inevitably face increased perfectionism among their staff.

To date, researchers agree that perfectionism is multidimensional and that especially perfectionistic concerns, including the key dimension of socially prescribed perfectionism (SPP; the belief that others have exceedingly high expectations towards the person and the fear of being criticised; Hewitt & Flett, 1991) are linked to impaired sleep quality (Molnar et al., 2020; Stricker et al., 2022). Evidence on perfectionistic strivings and key dimensions, such as self- oriented perfectionism (SOP), which is defined as holding exceedingly high standards for oneself (Hewitt & Flett, 1991), on the contrary, is mixed and indicates that this

dimension is not necessarily linked to sleep problems (Molnar et al., 2020; Stricker et al., 2022).

In the present study, we draw on the Stressor-Detachment Model (SDM; Sonnentag & Fritz, 2015) to obtain a more detailed understanding of why the dimensions of perfectionism are differently related to sleep quality and derive relevant mechanisms in the work and non-work areas. According to the SDM, job stressors, such as time pressure, translate into sleep problems via a lack of detachment. Psychological detachment refers to the non-work experience of "switching off" mentally as a core recovery experience (Sonnentag & Bayer, 2005). Previous studies examining the association between perfectionism and sleep quality have either focused on the mediating role of stress, without referring to a specific life domain (Molnar et al., 2020), or on rumination in the non-work area (Flaxman et al., 2018). A more comprehensive understanding of relevant mechanisms, however, allows scholars to derive timely interventions for organisations to prevent perfectionistic employees from experiencing sleep problems.

We propose that individual differences, such as perfectionism, may already play an active role in shaping job stressors and integrate the argumentation of the SDM with the Cognitive-Affective Personality System (CAPS; Mischel & Shoda, 1995) theory. CAPS theory describes personality dispositions as enduring structures of cognitive-affective units (CAUs) that guide the activation of specific cognitions, affects, and behaviours in situations and views individuals as "in part creating situations themselves" (Mischel & Shoda, 1995, p. 252). Especially the CAUs associated with SPP should contribute to time pressure as a specific job stressor, which triggers the cascade of low detachment resulting in impaired sleep quality. On the contrary, we expect employees high in SOP to experience low daily time pressure and thus to detach and sleep better. In addition, we propose employees high in SPP and those high in SOP to experience difficulties in detachment because of a tendency towards ruminative cognitive styles (e.g., Xie et al., 2019).

To summarise, the study contributes to and extends the Occupational Health Psychology and Personality Psychology literature in three important ways: First, concerning the literature on perfectionism, we broaden the knowledge on mechanisms in the work (i.e., stressors) and non-work area (i.e., recovery) that explain the different associations between perfectionism and sleep quality by examining time pressure and detachment as a potential serial mechanism. Drawing on CAPS theory, we complement the dynamic perspective from previous research which demonstrated that situational cues, such as time pressure, may trigger daily fluctuations of perfectionism (Mohr et al., 2022). Thus, we enhance knowledge on how perfectionism shapes work experiences and is mutually shaped by these experiences. Further, we contribute to a better understanding of whether both dimensions of perfectionism are related to daily impaired sleep quality via a personality-dependent tendency to a lack of detachment independent of time pressure. The contrasting indirect effects of SOP on sleep quality via the serial mechanisms of time pressure and detachment (positive indirect effect) and SOP on sleep quality via detachment (negative indirect effect) might explain the mixed findings regarding the role of SOP in sleep quality and contribute to the debate of the adaptiveness of SOP.

Second, we extend the SDM by focusing on the role of person factors as additional predictors. As Sonnentag et al. (2022) stated, we have limited knowledge on the role of comparatively stable individual differences in recovery. This paucity is reflected in a rather small number of studies that have investigated the role of personality in the SDM (e.g., Clauss et al., 2021; Reis & Prestele, 2020). Further, scholars have pointed toward the need to conceive a broader SDM, including additional predictors (Clauss et al., 2021). We address this call by attributing an active role to individuals in contributing to the presence of job stressors to gain comprehensive knowledge of individual and organisational sources of stress.

Third, our study contributes to the literature on the SDM by analysing whether, in addition to job hindrance stressors such as unfinished tasks (Reis & Prestele, 2020), time

pressure as a common challenge stressor (Le Pine et al., 2005; Smith et al., 2011) also predicts changes in employees' sleep quality in the short term and whether this effect can be explained by detachment. Previous diary studies examined the specific effects of time pressure on detachment (e.g., Gerhardt et al., 2020) and detachment on sleep quality (e.g., Reis & Prestele, 2020) in isolation, yielding mixed results. To the best of our knowledge, no single diary study has examined the mediating role of detachment. By focusing on daily time pressure, we gain new insights into whether the SDM also applies to challenge stressors at the day level.

The Stressor-Detachment Model as a Theoretical Framework

The SDM is an established framework that explains how impaired sleep develops from stressful work experiences. According to the SDM, a broad range of job stressors (e.g., time pressure or interpersonal conflicts) can lead to a lack of detachment, which causes strain symptoms, such as impaired sleep (Sonnentag & Fritz, 2015). Psychological detachment implies not thinking about work during non-work time (Sonnentag & Bayer, 2005). Detachment can reduce acute psychophysiological responses (e.g., affective stress or elvated blood pressure) to job stressors, thereby preventing work-related sleep problems (Meijman & Mulder, 1998). Sonnentag and Fritz (2015) stated that the effects in the SDM can appear within days or weeks but also over longer periods, such as years. A previous diary study showed that unfinished tasks (Reis & Prestele, 2020) as hindrance stressors (e.g., Peifer et al., 2020), are associated with a lack of detachment and, in turn, affect sleep quality. Other diary studies have investigated cognitive demands as challenge stressors and how they relate to detachment (e.g., Kubicek et al., 2022) but not if these challenge stressors translate into poor sleep quality at the day level.

Time pressure, a common phenomenon in today's working life (Smith et al., 2011), is typically suggested to be a challenge stressor (Le Pine et al., 2005). This means that time pressure can have short-term motivating potential (Baethge et al., 2018), and time pressure

during the workday can be beneficial for employee thriving (Prem et al., 2017). However, such pressure may be a source of strain after work (Le Pine et al., 2007) and inhibit daily detachment (Chawla et al., 2020) because challenge stressors keep employees activated after work (Bennett et al., 2018). Thus, beneficial effects may be limited to the workplace (Chawla et al., 2020).

A recent longitudinal study has shown that detachment could explain the effect of time pressure on sleep quality as a long-term consequence (Matick et al., 2021). However, at the day level, the short-term effects of daily time pressure on sleep quality and the mediating role of detachment remain to be investigated. Recent diary studies reported only the direct effects of time pressure on detachment (e.g., Gerhardt et al., 2020) and detachment on sleep quality (Reis & Prestele, 2020) in isolation, yielding mixed results. Specifically, only Reis and Prestele (2020) found the association between daily detachment and sleep quality the following night, whereas, for example, Gerhardt et al. (2020) did not. Following the SDM (Sonnentag & Fritz, 2015) and consistent with initial empirical evidence, we expect that employees have difficulty detaching after days when they were pressed for time and, therefore, have poorer sleep quality.

In line with Van Laethem et al. (2016), we assessed detachment in the morning to avoid the emergence of work-related thoughts by answering the questionnaire before sleep and referring to detachment during bedtime. Sonnentag and Fritz (2007) noted that the time reference must be added when assessing detachment. Pereira et al. (2014) suggested that thoughts about work might arise especially during bedtime when people come to rest. Thus, assessing detachment in the evening survey may be too soon to capture it, which could explain the mixed findings concerning the association between detachment and sleep quality.

Hypothesis 1: The effect of daily time pressure on sleep quality during the following night is mediated by detachment.

Multidimensional Perfectionism and Differences in Sleep Quality

Differences in sleep quality can be attributed to the multidimensional nature of perfectionism, which is often described with the metaphor of a "double-edged sword" (Molnar et al., 2006). Different models of perfectionism (e.g., Frost et al., 1990; Hewitt & Flett, 1991) share the idea of two superordinate and related factors. Researchers typically refer to them as *perfectionistic strivings*, which include setting high-performance standards, and *perfectionistic concerns*, encompassing concern over mistakes and negative evaluation and doubts about the qualities of one's actions (see Stoeber & Otto, 2006, for a review).

Drawing on Hewitt and Flett's (1991) perfectionism model, two dimensions can be distinguished based on the source of the perfectionistic demands: SOP comprises exceedingly high standards and strict evaluations directed towards oneself. In contrast, SPP follows the belief that others have high expectations and that one will be highly criticised if failing to meet these expectations. SOP and SPP are considered key indicators of perfectionistic strivings and concerns (Stoeber & Gaudreau, 2017), given that SOP and SPP are, at their core, also characterised by the striving towards extraordinarily high standards and fear of failure and negative evaluations by significant others, respectively. Further, the specific dimensions show the same, but sometimes opposite, patterns of relationships with various outcomes as the superordinate factors (Stoeber & Otto, 2006). Against this background, we focused on SOP and SPP as two specific dimensions of perfectionism in the present study.[1]

Perfectionistic concerns have consistently been related to a variety of sleep problems, whereas perfectionistic strivings have been mostly unrelated to sleep quality in previous research (see Molnar et al., 2020; Stricker et al., 2022; for reviews on perfectionism and

[1] As noted by Stoeber and Damian (2016), the variety of perfectionism models and scales is a challenge, especially for readers unfamiliar with this research. Reviews and meta-analyses commonly integrate findings from studies with different operationalisations of perfectionism and refer to the superordinate factors perfectionistic strivings and concerns (e.g., Ocampo et al., 2020). Thus, depending on the respective studies and operationalisation used, we will describe findings for the superordinate factors or refer to findings based on Hewitt and Flett's (1991) conceptualisation of SOP and SPP in building our argumentation.

sleep). To date, two studies have investigated and confirmed these findings in samples of employees (Flaxman et al., 2018; Reis & Prestele, 2020). Some researchers debate on whether SOP should be considered adaptive (Molnar, 2006, Stoeber & Otto, 2006). Specifically, in a sample of adults, Molnar et al. (2020) found a positive indirect effect of SOP on both sleep efficiency and quality via lower levels of perceived stress, whereas they found the opposite pattern for SPP. However, Stricker et al. (2022) recently concluded in their review that little convincing evidence exists to support the adaptiveness of SOP concerning sleep. These findings point towards a need for gaining more knowledge on the different mechanisms.

Why Perfectionism May Differently Shape Time Pressure

The present study builds on the premise that personality can predict work experiences (Judge et al., 2014). CAPS theory (Mischel & Shoda, 1995) provides a comprehensive perspective on both the stability of personality and the variability of behaviour across situations and attributes a central role to cognitive-affective units (CAUs) - characteristic patterns of cognition, affect, and behaviour. These CAUs are activated when an individual encounters relevant situational features. However, CAPS theory begins with the premise that stable individual differences exist in the organisation and chronic availability of these CAUs that "interact as the individual selects, interprets, and generates situations" (Mischel & Shoda, 1995, p. 253). We argue that different CAUs are activated in individuals high in SPP and SOP when they are confronted with tasks at work, resulting in different mindsets and behaviours that differentially shape time pressure as a stressful work experience.

In the present study, we conceptualised time pressure as a stressor that is not only shaped by job conditions, such as leaders and their behaviours (Hentrich et al., 2017), but also to some extent by individuals. To obtain a comprehensive understanding of sources of job stressors, such as time pressure, we believe it is important to consider individual as well as organisational sources. Moreover, we considered time pressure an appropriate job stressor to investigate in this context because perfectionism can be described as a time-consuming trait.

Previous research shows that both individuals high in perfectionistic strivings and those high in perfectionistic concerns spend a high amount of time completing tasks (Harari et al., 2018; Stoeber & Eismann, 2007). Nevertheless, we assumed that individuals high in SPP but not those high in SOP are likely to actively generate and experience time pressure because they differently approach tasks and manage the increased time they spend on tasks at work.

For perfectionists, each task may provide the possibility of success or failure. However, while individuals high in SPP appraise tasks as threats and show a lack of confidence in their abilities, the opposite is the case for those high in SOP (Zureck et al., 2015). Employees high in SPP fear falling short of others' expectations and aim to avoid imperfection, failure, and disapproval (Slade & Owens, 1998). Thus, they engage in maladaptive coping behaviours, such as avoidant coping and denial, and show difficulties enacting problem-focused coping and using emotional and instrumental social support (Dunkley et al., 2000; Stoeber & Janssen, 2011). These coping strategies prevent an individual from taking actions to directly deal with stress or even increase stress (Lazarus & Folkman, 1984). Striving toward their own demands and aiming to pursue perfection and success (Slade & Owens, 1998), individuals who score high in SOP use adaptive styles, such as problem-focused coping and planning, and make use of social support (e.g., Dunkley et al., 2000; Stoeber & Jannsen, 2011).

Considering their different types of appraisal and coping, we describe employees high in SPP as "insecure avoiders" and those high in SOP as "confident planners" at work. Employees high in SPP should avoid tasks and contribute to the generation of time pressure, whereas those high in SOP should successfully manage their tasks and experience less time pressure, despite performing tasks precisely. These arguments are supported by findings linking SPP to low self-efficacy, procrastination, and task failure and SOP to high self-efficacy and task mastery (Flett et al., 1992; Mills & Blankstein, 2000; Stoeber et al., 2015). Also, a recent meta-analysis found that SPP but not SOP was related to stress (Smith et al.,

2020). Molnar et al. (2020) even revealed a negative relationship between SOP and perceived stress. These general findings underline that SOP and SPP may show different, sometimes even opposing, associations with stress.

To complete the bridge, we come back to the core assumption of the SDM. The roots of impaired sleep, according to the SDM, can be found in the presence of job stressors as stressful work experiences, which may be considered inevitable. However, we propose that individuals high in SPP contribute to the generation and experience of daily time pressure, which triggers the cascade of low detachment resulting in impaired sleep quality. On the contrary, those high in SOP should experience low time pressure and thus detach from work and sleep better.

Hypothesis 2: SPP has a negative (*Hypothesis 2a*) and SOP has a positive (*Hypothesis 2b*) indirect effect on sleep quality through serial mediation of daily time pressure and detachment.

Detachment as Another Mechanism Linking Perfectionism with Sleep Quality

Regardless of the daily time pressure experienced in the work area, both dimensions of perfectionism could entail a personality-dependent tendency towards low daily detachment in the non-work area, which leads to impaired sleep quality. CAPS theory (Mischel & Shoda, 1995) assumes that stable individual differences exist in characteristic patterns of cognition. Both dimensions of perfectionism are proposed to engage in a ruminative cognitive style (Hewitt & Flett, 2002). A recent meta-analysis (Xie et al., 2019) indicated that both dimensions of perfectionism are linked to rumination[2] and described perfectionists as "chronic overthinkers" (p. 302). However, findings from research in the workplace context are mixed. For example, Flaxman et al. (2018) found positive associations between perfectionistic

[2] As described by Sonnentag and Fritz (2015), detachment is conceptualised as the absence of work-related thoughts during non-work time and thus refers to a certain content of thoughts in a defined temporal context. They point out that detachment is not simply the opposite of rumination but often comes along with rumination. Thus, we also consider previous findings from studies investigating the association of perfectionism and rumination as indicators for deriving our hypotheses.

concerns and rumination about work as well as perfectionistic strivings and positive thinking about work. As highlighted by Reis and Prestele (2020), these cognitive processes mean that employees are not mentally detaching from work in the non-work area. In their diary study, both perfectionistic strivings and concerns were negatively related to detachment in bivariate correlations. However, this effect did not hold when job stressors and fatigue were included as additional predictors of detachment. Considering these findings, the associations between perfectionism and detachment must be reinvestigated. We argue that individuals high in perfectionism continue to think of their work due to their general tendency towards a ruminative cognitive style, which leads to reduced sleep quality. We, therefore, assumed direct paths linking perfectionism and detachment.

Hypothesis 3: SPP (*Hypothesis 3a*) and SOP (*Hypothesis 3b*) have a negative indirect effect on sleep quality through daily detachment.

Methods

Procedure

The local ethics committee approved the diary study, and three undergraduate students involved in the project supported the data collection. The study was advertised via social media, personal contacts, and the university staff mailing list for surveys. As an incentive for study participation, a lottery with gift cards (100 Euro and twice 50 Euro) as prizes and feedback on the study results were offered. Data were collected in Germany via the online platform SoSci Survey from January to May 2020. Employees first received information about the diary study, provided informed consent, and indicated that they do not work in shifts or suffer from any mental or physical illness that could affect their sleep. After answering the initial online survey, which assessed all study variables including perfectionism, employees were asked to enter their email addresses on a separate website and indicate the time they would like to receive daily surveys just before and just after work for 5 consecutive workdays. At the beginning of the following week, employees received the daily online surveys and

were asked to answer them as soon as possible. Employees provided a personal code for each survey to ensure that collected data could be matched without compromising anonymity. In the after-work survey, time pressure and the impact of the COVID-19 pandemic on the daily work routine as a control variable were assessed. Each morning before work, the employees rated their detachment during bedtime and sleep quality of the last night.

Participants

A total of 171 participants completed the initial survey; however, only 70 participants answered both the initial questionnaire and at least one complete daily questionnaire (time pressure after work, detachment, and sleep quality before work on the next day). This corresponds to a response rate of 41%. Dropout analyses were conducted, comparing participants who participated in the initial survey and at least one complete daily questionnaire (completers) with those who only participated in the initial survey (dropouts). The analyses showed, that completers and dropouts did not differ in any of the study variables of the initial survey, with the exception that completers were significantly older than dropouts, 39 vs. 35 years, $t(169) = -2.29$, $p < .05$. The results of the dropout analyses can be found in the supplemental material in Table S1. On average, participants filled out questionnaires on 4.73 days (range: 4 to 5 days). Given that we were interested in the effect of daily time pressure (assessed after work, starting on Monday) on detachment and subsequent sleep (assessed in the before-work questionnaire the next morning until Friday), the cluster size ranged from 1 to 4 and was 3.84 on average. A total of 269 data points at the within-subject level were collected, including 217 diary entries with matching after- and before-work questionnaires.

The final total sample, which was used for the analyses, consisted of 70 participants (71.4% women), whose ages ranged from 21 to 63 years ($M = 38.79$, $SD = 12.32$). Overall, 75.7% of the participants were employed full-time (>34 hours per week), 22.9% were employed part-time (15–34 hours weekly), and one person was employed on an hourly basis (<15 hours per week). Most participants were employed in health and social work (24.3%) or

the service sector (22.9%). On average, the employees had an organisational tenure of 7.77 years (*SD* = 9.33).

Measures

Initial Survey Measure

Perfectionism. The two dimensions of SOP (e.g., "I strive to be as perfect as I can be") and SPP (e.g., "People expect nothing less than perfection from me") were assessed with five items each from the short version (Cox et al., 2002) of the Multidimensional Perfectionism Scale (Hewitt & Flett, 1991; German translation: Altstötter-Gleich, 1998). Participants responded on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). The scale was reliable for both SOP (α = .84) and SPP (α = .84).

Daily After-Work Survey Measure

Following the recommendations of Geldhof et al. (2014), reliabilities for all daily measures are reported separately for the within and the between levels.

Time Pressure. Time pressure was assessed after the workday using three items (ZD1, ZD2, ZD6) from the time pressure subscale of the Instrument for Stress-Related Job Analysis (Semmer et al., 1999). The items were adapted to the day level ("Today I had to work under time pressure") and were rated on a 5-point scale ranging from *does not apply* (1) to *fully applies* (5). The scale was reliable at the within (α = .91) and between (α = .96) levels.

Daily Before-Work Survey Measures

Detachment. Detachment during bedtime was measured before the workday with the respective four items from the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007). The instruction of this questionnaire included the possibility to choose a time reference for detachment. Participants answered items such as, "When I was in bed yesterday, I forgot about work" on a 5-point scale ranging from *does not apply* (1) to *fully applies* (5). The scale was reliable at the within (α = .93) and between (α = .97) levels.

Sleep Quality. We used five items from the Pittsburgh Sleep Quality Index (Buysse et al., 1989; German translation: Riemann & Backhaus, 1996) to assess the last night's sleep quality. For each participant and each night, a day-specific sleep quality score was calculated, which included four components: sleep latency, sleep duration, sleep efficiency, and subjective sleep quality. The items are shown in the supplemental material in section B. Following Buysse et al. (1989), values between *very good* (0) and *very bad* (3) were assigned to each component. Next, the four components were added to create a day-specific sleep quality score, which could range from *very good* (0) to *very bad* (12). Since higher Pittsburgh Sleep Quality Index values imply lower sleep quality, we recoded the score for all components except latency and for the index so that higher values reflected better day-specific sleep. Thus, solely high latency values reflect poor sleep quality. The scale was reliable at the within ($\alpha = .87$) and between ($\alpha = .74$) levels.

Control Variables

Since the current study took place during the COVID-19 pandemic, we included one item to assess the impact of this situation on the employees' daily work routine ("How strongly did the current situation regarding the coronavirus affect your daily work routine today?"). The item was rated on a 6-point scale ranging from *not at all* (1) to *very strongly* (6) and was included as a control variable for time pressure, detachment, and sleep quality. To determine the unique contribution of SOP and SPP, we controlled for the overlap with the respective other dimension (Stoeber & Gaudreau, 2017). In order not to overcontrol our model and to provide a parsimonious solution (Van Laetham et al, 2016), we controlled sleep quality for age (in years) and gender (0 = female, 1 = male) because sleep problems increase with age (Ohayon, 2002) and are more common among women (Zhang & Wing, 2006).

Data Analyses

Due to the hierarchically structured data - daily measures (Level 1) nested within persons (Level 2) - we analysed the variance composition at the within- and between-person

levels using intraclass correlations (ICCs (1)). The ICC (1) for time pressure was .49, for detachment it was .53, and for sleep quality it was .32, indicating that between 32% and 53% of the total variance of the Level 1 variables was between-person variance. Thus, the ICCs (1) justified the adequacy of a multilevel approach for hypotheses testing.

We estimated a multilevel path model using Mplus Version 7.4 to test all hypotheses simultaneously. Since Preacher et al. (2010) highlighted the problem of conflated within- and between effects in multilevel models, which can create essential bias, a cross- and unique cluster-level mediation model with a 2-1-1-1 design was specified following Matick et al. (2022), and Pituch and Stapleton (2012). The model is illustrated in Figure 1.

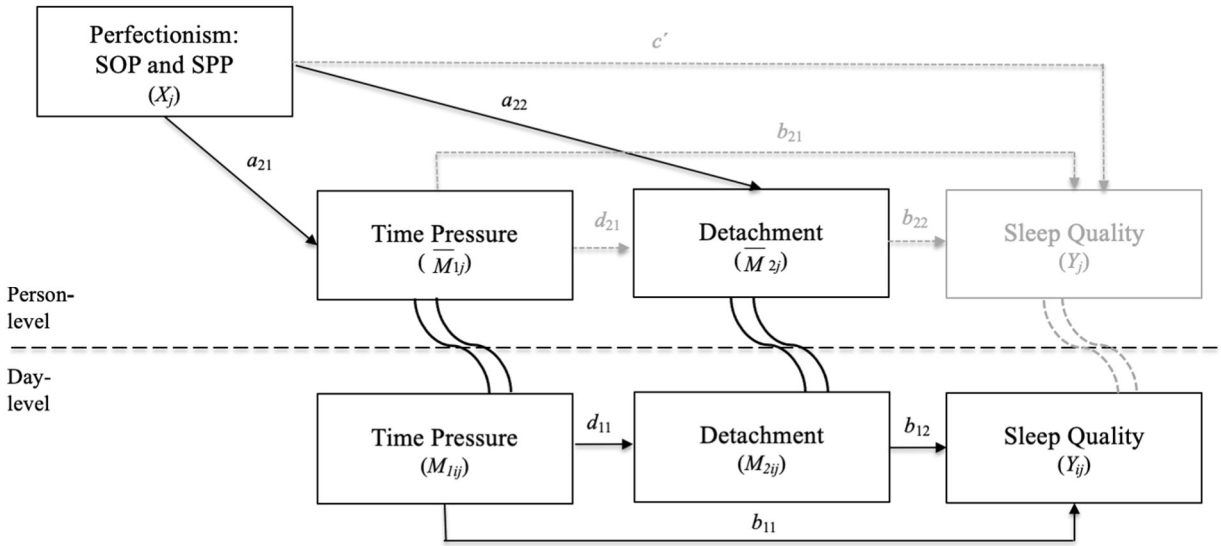

Figure 1. Cross- and unique cluster-level mediation model with a 2-1-1-1 design. Within-person indirect effects (a_{21} x d_{11} x b_{12}; a_{22} x b_{12}) and the between-person indirect effects (a_{21} x d_{21} x b_{22}; a_{22} x b_{22}), where the soild lines represent the paths relevant to the hypotheses and the curved lines illustrate the change between the levels. M_{1ij}, M_{2ij}, and Y_{ij} represent time pressure, detachment and sleep quality, respectively for employee *i* on day *j*, X_j, $\overline{M}_{1j}$, $\overline{M}_{2j}$, *and* Y_j represents self-oriented perfectionism (SOP), socially prescribed perfectionism (SPP), time pressure and detachment (aggregated to the person level), and sleep quality for a particular employee *j*.

In comparison to the approach of Preacher et al. (2010), which considers only the between-person indirect effects, this approach allows distinguishing between the within-

person indirect effects (cross cluster-level mediation) and the between-person indirect effects (unique cluster-level mediation) and has greater power (Pituch & Stapleton, 2012). In the current study, the within-person indirect effects (cross cluster-level mediations; a_{21} x d_{11} x $b_{12;}$ a_{22} x $b_{12;}$) were of special interest because the hypothesised model assumed (a) that the perfectionism dimensions affect time pressure (a_{21}; Level 2), which is related to detachment during bedtime (d_{11}; Level 1) and detachment during bedtime is associated with sleep quality (b_{12}; Level 1), and (b) that perfectionism dimensions are related to detachment during bedtime (a_{22}; Level 2), which is associated with sleep quality (a_{12}; Level 1).

The approach of Pituch and Stapleton (2012) assumed that the a_{21} and d_{11} paths as well as the a_{22} path and the b_{12} path are located on different levels and do not have to be directly connected. We aggregated time pressure and detachment at the person level to separate the within- and between-person indirect effects. As mentioned, the ICCs (1) justified the mean aggregation at the person level. Perfectionism, the aggregated variables at the person level (time pressure and detachment), and the control variables of age, gender, and the aggregated impact of the COVID-19 pandemic on the daily work routine (ICC (1) = .88) were specified as between-person variables (Level 2) and were grand-mean centred (Aiken et al., 1991), except for gender.

The control variable of the impact of COVID-19 on the daily work routine was specified as the within-person variable (Level 1) and was also grand-mean centred along with the variables of daily time pressure and detachment. This procedure is in line with recommendations for testing cross-level mediations (e.g., Ohly et al., 2010). The model was tested using Bayesian estimation (Muthén, 2010), which is often used in two-level settings (e.g., Kubicek et al., 2022) because it provides unbiased confidence intervals (CIs) for the indirect effects, which are rarely normally distributed. Even if the between-person indirect effects are not of interest to the hypotheses, they are reported for transparency in the supplemental material in Table S2. In multilevel studies, explained variance measures (R^2) are

useful indicators of effect sizes (La Huis et al., 2014). To consider the substantial between-person variance in Level 1 predictors and the possibility of different within- and between-person effects for our variables, we report R^2-values for each level of analysis (Snijders & Bosker, 2012).

Results

Descriptive statistics and correlations between all study variables can be found in Table 1. At the person level, SPP was positively related to time pressure, $r = .33$, $p = .003$, and negatively related to detachment, $r = -.32$, $p = .008$, whereas SOP was not related to time pressure, $r = .08$, $p = .539$, or detachment, $r = -.20$, $p = .067$. At the day level, higher ratings of time pressure were related to less detachment, $r = -.27$, $p = .000$, and higher ratings of detachment were related to better sleep quality, $r = .60$, $p < .001$.

Table 1
Descriptive Statistics, ICCs, and Correlations Between Study Variables

		Response Scale	*M*	*SD*	1	2	3	4	5	6	7	8
1	Age		38.79	12.32	-	.12	.19	-.25*	.23*	.26*	-.17	.03
2	Gender	0-1	.29			-	-.15	.07	.13	.22	.00	-.02
3	Impact of the COVID-19 pandemic	1-6	3.17	2.13			(.88)	-.02	-.08	-.01	.03	.21
4	SOP	1-7	5.10	1.04				-	.13	.08	-.20	.33*
5	SPP	1-7	2.64	1.08					-	.33**	-.32**	-.07
6	Time Pressure	1-5	2.44	1.15			.02			(.49)	-.30**	.03
7	Detachment	1-5	3.86	1.18			.03			-.28**	(.53)	-.27
8	Sleep Quality Index	0-12	9.53	2.12			.08			-.22*	.60***	(.32)

Note. For gender, 0 = *female*, 1 = *male*. SOP = self-oriented perfectionism. SPP = socially-prescribed perfectionism. Standardized correlations at the within-level ($N = 269$ days) below the diagonal and at the between-level ($N = 70$ employees) above the diagonal. ICCs (1) are reported along the diagonal in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

Results of the Multilevel Path Model

The results of the multilevel path analysis are shown in Table 2.[3] We report the unstandardised results (*b* coefficients) for the specific paths and indirect effects in the model. Thus, the reported indirect effects must be interpreted in relation to the metrics of the scales. The standardised results (β coefficients) for the specific paths can be found in the supplemental material in Table S3. These values allow the strength of the associations to be compared across the different constructs in this study and across studies (Hunter & Hamilton, 2002).

Table 2

Results of Multilevel Path Analysis - Direct paths and Within-Indirect Effects

	Time Pressure	Detachment	Sleep Quality
		b [95% CI]	
Controls			
IC (Person Level)	.02 [-0.10; 0.14]	-.01 [-0.12; 0.12]	
Age			.01 [-0.01; 0.02]
Gender[a]			-.10 [-0.45; 0.25]
IC (Day Level)	.01 [-0.05; 0.06]	.01 [-0.06; 0.07]	.05 [-0.02; 0.13]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.23; 0.24]		
SPP → Time Pressure	.34 [0.08; 0.55]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.39; 0.11]	
SPP → Detachment		-.23 [-0.47; 0.02]	
b_{11}-path			
Time Pressure → Sleep Quality			-.02 [-0.23; 0.17]
b_{12}-path			
Detachment → Sleep Quality			.52 [0.34; 0.71]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.42;-0.14]*	
c'-paths			
SOP → Sleep Quality			.18 [0.01; 0.36]*
SPP → Sleep Quality			-.09 [-0.28; 0.09]
Within-Indirect Effects			
Time Pressure → Detachment → Sleep Quality (d_{11} x b_{12})			-.14 [-0.24;-0.06]*
SOP → Time Pressure → Detachment → Sleep Quality (a_{21} x d_{11} x b_{12})			.01 [-0.05; 0.07]
SPP → Time Pressure → Detachment → Sleep Quality (a_{21} x d_{11} x b_{12})			-.05 [-0.10;-0.01]*
SOP → Detachment → Sleep Quality (a_{22} x b_{12})			-.08 [-0.17; 0.03]
SPP → Detachment → Sleep Quality (a_{22} x b_{12})			-.12 [-0.25; 0.01]
R^2 day level	.01 [0.00; 0.02]	.08 [0.02; 0.16]*	.37 [0.18; 0.52]*
R^2 person level	.14 [0.02; 0.31]*	.21 [0.08; 0.40]*	.31 [0.09; 0.56]*

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

[3] We also analysed the hypotheses without the control variables of gender, age, and impact of COVID-19. The regression coefficients remained significant and largely unchanged. The only exception was the path linking SPP to Level 2 detachment, which was significant without the control variables, *b* = -.21, 95% CI [-0.47, -0.03]. Further, we ran the path model with gender and age as control variables for all variables in an additional analysis. Significance of the results remained unchanged, except for the association of SOP with sleep quality, *b* = .28, 95% CI [-0.04., 0.62]. On a minor note, we also checked whether including gender and age as control variables for all variables changed results from the exploratory analyses. All paths remained significant.

In line with Hypothesis 1, the results showed a significant negative indirect effect of daily time pressure on sleep quality via detachment, $b = -.14$, 95% CI [-0.24, -0.06]. Higher ratings of daily time pressure were related to reduced ratings of detachment, $b = -.28$, 95% CI [-0.42, -0.14], which were associated with poor sleep quality, $b = .52$, 95% CI [0.34, 0.71]. The direct effect of daily time pressure on sleep quality was not significant, $b = -.02$, 95% CI [-0.23, 0.17]. We also found a significant negative indirect effect of SPP on sleep quality through a serial mediation of daily time pressure and detachment, $b = -.05$, 95% CI [-0.10, -0.01], supporting Hypothesis 2a. By contrast, Hypothesis 2b was not supported, as the positive indirect effect of SOP on sleep quality through the serial mediation of daily time pressure and detachment was not statistically significant, $b = .01$, 95% CI [-0.05, 0.07]. Contrary to Hypotheses 3a and 3b, no significant negative indirect effect of SPP, $b = -.12$, 95% CI [-0.25, 0.01], or SOP, $b = -.08$, 95% CI [-0.17, 0.03], on daily sleep quality via daily detachment was found, although we did note a descriptive tendency in favour of our hypotheses.[4]

Exploratory Analyses of the Sleep Quality Components

Following Kühnel et al. (2021), we investigated the proposed hypotheses for the respective components of sleep quality in four separate multilevel models, because the components are differently related to various antecedents. Descriptive statistics, ICCs, and correlations between all variables included in the exploratory analyses can be found in Table S4. The results of the exploratory analysis are shown in Tables S5-S12. The results for the individual sleep components were not different from the results for the sleep quality index. However, the results showed, that only the direct effect of SOP on sleep duration was positive

[4] In an additional analysis, we ran the path model without time pressure included. In this model, the negative indirect effect of SPP on sleep quality through detachment was significant, $b = -.24$, 95% CI [-0.47, -0.05], but the negative indirect effect of SOP on sleep quality via detachment was not, $b = -.14$, 95% CI [-0.36, 0.06].

and statistically significant. Thus, it might be important to look at the separate sleep quality components, especially concerning the role of individual differences.

Discussion

Drawing on the CAPS theory (Mischel & Shoda, 1995) and the SDM (Sonnentag & Fritz, 2015), this study investigated time pressure and detachment as mechanisms that may explain why SPP and SOP are differently related to employees' daily sleep quality. Overall, the results provide mixed support for our hypotheses.

Theoretical Implications

Our first hypothesis was supported by the finding that the association between daily time pressure and sleep quality was mediated by detachment. This finding strengthens the SDM and its applicability at the day level and indicates that time pressure in the work area may be considered as another job stressor - in addition to previously identified stressors, such as unfinished tasks (Reis & Prestele, 2020) - that affects employees' sleep quality via reduced daily detachment. As previously stated, time pressure is considered a common challenge stressor (Le Pine et al., 2005). Our study highlights that although challenge stressors may have a short-term beneficial effect regarding work engagement (Baethge et al., 2018), they may equally challenge daily recovery in the non-work area and affect sleep quality during the following night.

Concerning the underlying mechanisms between perfectionism and sleep quality, we found that SPP but not SOP puts employees at risk for high daily time pressure and, consequently, low daily detachment, which is related to impaired sleep quality (Hypotheses 2a and b). The results from the exploratory analyses reflect this pattern of findings for all sleep components. We integrate the assumptions of CAPS theory and the SDM, and complement research on daily fluctuations of perfectionism (Mohr et al., 2022). Thus, not only is dynamic perfectionism shaped by stressful work experiences but also perfectionism as a fairly stable trait shapes these experiences. Moreover, this finding on SPP highlights the importance of

simultaneously investigating mechanisms in the work and non-work areas and identifies time pressure and detachment as relevant serial mechanisms. Thus, we extend previous findings on the mediating role of stress and rumination in the association of perfectionism and sleep quality (Flaxman et al., 2018; Molnar et al., 2020) in referring to specific applied contexts and taking a more comprehensive view. The findings on SPP align with previous research linking SPP to impaired sleep via increased stress (Molnar et al., 2020).

With regard to the SDM, this finding highlights the importance to consider person factors as additional predictors (Clauss et al., 2021) and contributes to the limited knowledge on the role of comparatively stable individual differences for recovery (Sonnentag et al., 2022). Importantly, we attribute an active role to individuals in shaping job stressors. From a more comprehensive perspective, however, it is important to note that person factors should be understood as an additional risk factor besides job conditions, such as leadership (e.g., Hentrich et al., 2017), or structural factors such as understaffing (Hudson & Shen, 2018).

In our study, SOP was unrelated to time pressure. We argued that individuals high in SOP will appraise tasks as less threatening, show confidence in their abilities, and effectively cope with the arising stress from aiming to perform tasks precisely (e.g., Stoeber & Janssen, 2011). Based on this finding, however, we may speculate that the increased amount of time invested may balance out their favourable appraisals and effective coping, which is why employees high in SOP experience neither high nor low time pressure. Our focus on time pressure as a specific stressor may explain why our findings differ from the findings of Molnar et al. (2020). They choose the Perceived Stress Scale as a rather broad operationalisation of stress and found SOP to show a negative association with stress in samples of students and adults. We considered it important to identify specific stressful work experiences as mechanisms in the perfectionism-sleep association to design precise interventions.

Concerning Hypotheses 3a and b, SPP displays a significant bivariate correlation with detachment. In the path analysis, SOP and SPP were unrelated to detachment. These findings are contrary to meta-analytical evidence linking both perfectionism dimensions to rumination (Xie et al., 2019) but in line with findings that the associations of the perfectionism dimensions with detachment were not significant once job stressors and fatigue were included as additional predictors of detachment (Reis & Prestele, 2020). In our additional analysis, the association between SPP and sleep was mediated by detachment after removing time pressure from the model, indicating stressors have a key role in bridging the association between SPP and low detachment. Although employees high in SPP may have a general tendency towards a ruminative cognitive style, they may primarily fail to detach after work because they continue to think about the stress (i.e., time pressure) they have experienced that day.

Concerning the debate on the adaptiveness of SOP, we found an unexpected positive association of this dimension with sleep quality in the main analyses and employees high in SOP reported longer sleep duration in the exploratory analyses. These associations are in line with findings of Molnar et al. (2020) and point towards an adaptive tendency of this dimension. Thus, our study adds to the discussion on whether SOP has a mixed adaptive and maladaptive nature (e.g., Stoeber, 2018b). Further, the findings indicate that different mechanisms may apply to SPP and SOP. Simply assuming different associations with the same mediators may fall short in considering the conceptual differences of perfectionism dimensions.

Strengths, Limitations, and Future Research Directions

A major strength of our study is the diary design, which enables the assessment of processes in natural contexts, such as the workplace, and reduces the risk of retrospective biases (Ohly et al., 2010). We thus address calls for more diary studies in the research area of perfectionism where cross-sectional studies are predominant (Stoeber, 2018a).

Concerning the generalisability of our findings, it can be noted that our sample consists of several occupational groups. However, the sample consisted largely of women (71.4%) and the dropout analysis indicates completers were significantly older than dropouts, which limits the generalisability of the results. Possible explanations for the increased proportion of female participants could be a higher willingness to participate in psychological studies or that the recruitment focused more on health, social, and service sectors in which women are predominantly working. It could be that younger (<35 years) participants among the predominantly female sample have dropped out because they already have to fulfil family obligations in the non-work area (e.g., taking care of small children) and participation in a diary study would mean another demand for them. Reasons for the dropout could rather lie in the non-work area and not in our study variables. This would also explain why no significant differences in time pressure in the work area were found. We consider it unlikely that dropout led to a systematic under- or overestimation of the results. However, systematic differences between completers and dropouts cannot be completely ruled out.

Another limitation is that a larger sample may have increased power to detect between-level effects. Scherbaum and Ferreter (2009) recommended 30 between-level units to avoid bias in multilevel designs and highlighted that increasing the sample size at the between level is considered especially relevant for statistical power. Arend and Schäfer (2019) recently recommended a minimum sample of 40 participants with three diary entries as a rule of thumb when aiming to detect medium-sized bivariate relationships at the lower level. In the present study, we focused on within-level relationships, which is why sample size might be less of a problem for testing our hypotheses. Our sample of 70 participants who provided an average of 3.84 diary entries is well above this minimum. Thus, our study should be adequately powered to identify medium- and large-sized effects. Nevertheless, we collected data on 5 consecutive days only, which is a limited period.

In this study, we assess detachment retrospectively and concurrently with sleep quality in the daily survey the next morning. The advantages of this procedure are that we avoid initiating work-related thoughts by having participants complete the survey directly before sleep (Van Laethem et al., 2016) and missing thoughts that may only arise at bedtime in an evening survey (Pereira et al., 2014). However, the disadvantages are the simultaneous measurement and the same source of information which bear the risk of a common method bias and may have led to the high intercorrelation between daily detachment and sleep quality. It is not uncommon that similar constructs, such as rumination, show high correlations with sleep quality (Syrek & Antoni, 2014). Nevertheless, no conclusions can be drawn about the causality of the relationship between detachment and sleep quality. If employees had sleep problems, they may also rate the previous day's detachment lower. Future diary studies could use objective methods to assess sleep (Kühnel et al., 2021) and measure detachment during bedtime the next morning to avoid common method bias, not initiating work-related thoughts before sleep, and not missing thoughts that may only arise at bedtime (Pereira et al., 2014). However, this approach would not solve the problem that detachment is recorded temporally after sleep, which does not allow conclusions regarding causality. In sum, there is probably no solution to the assessment of detachment and sleep without any disadvantages.

Moreover, we chose to operationalize job stressors as time pressure because such specific stressors may be especially relevant for perfectionists (Reis & Prestele, 2020). Future research should focus on further relevant stressors in the perfectionism-sleep association such as unfinished tasks, performance expectations, or receiving negative performance feedback. For example, SPP has been linked to high sensitivity to social stressors (i.e., co-worker conflicts; Kleszewski & Otto, 2020), which are known to inhibit detachment in employees (Pereira & Elfering, 2013). Future research could assess different groups of workplace stressors, such as task-related, social, and role stressors, as suggested by Sonnentag and Frese (2012) and investigate whether the present findings generalise across different groups of

stressors. Further, the scale we used to assess time pressure should be considered a subjective measure. Thus, no conclusions about objective workload can be drawn.

With our focus on the construct of detachment, we cannot draw conclusions about which thoughts influence sleep when employees do not detach. Work-related thoughts can be distinguished in terms of their valence, temporal orientation, content, duration, and timing (e.g., Casper et al., 2019). Therefore, for future studies, it might be interesting to investigate whether SPP and SOP differ in these characteristics of work-related thoughts and whether different mediators should be considered for each dimension of perfectionism. Previous research linking perfectionistic strivings to positive thinking about work provides initial evidence for this idea (Flaxman et al., 2018). For example, the interplay among stressors and negative work-related thoughts may explain why SPP is related to impaired sleep, whereas resources and positive work-related thoughts may explain the positive association between SOP and sleep quality. In particular, attention should be paid to the timing of work-related thoughts because the timing may be especially relevant for beneficial or harmful effects on sleep.

Further, future research should focus on the interplay of individual and organisational factors and how they affect employees' stress and recovery. A recent study (Lin et al., 2023) found that perfectionistic leader expectations promote fear of failure among perfectionistic employees by reinforcing early life experiences. In line with this, researchers could investigate which organisational factors add "fuel to the fire" by amplifying concerns inherent in SPP or may act as buffers in this regard. For example, an open error culture may be an important condition, as it allows employees to grow from their mistakes (Frese & Keith, 2015).

Practical Implications

Our findings concerning SPP have practical implications. First, they highlight that comprehensive approaches to organisational stress prevention may also consider individual

sources of stress. This is in line with the IGLO framework suggesting that multiple levels in organisations (i.e., individual, group, leader, and organisational levels) should be addressed when developing actions (Nielsen & Noblet, 2018). Given the focus on individual sources of stress in this study, we provide suggestions for this level that could be included in broader programmes. As a first step, we suggest that experts help employees high in SPP become aware of their cognitions, affects, and behaviours using psychoeducation. They should learn that these might increase time pressure, which affects their recovery. However, this must not be understood by these persons as criticism, as they especially tend to be afraid of making mistakes and not being accepted by others (Hewitt & Flett, 1991). Also, behavioural interventions aimed at strengthening their self-efficacy and further personal resources could be important to reduce avoidance behaviour. Finally, mindfulness interventions may be a promising approach for practitioners to reduce simultaneously SPP (Flett et al., 2020) and time pressure (Marais et al., 2020) and increase detachment (Karabinski et al., 2021) and sleep quality (Bartlett et al., 2019). Certainly, plenty of established interventions exist promoting boundary management and detachment (e.g., segmenting work and non-work areas; Kinnunen et al., 2016) that may also support employees high in SPP.

Conclusion

With this study, we provide evidence that employees high in SPP are especially far from perfect sleep because they experience time pressure and resulting difficulties in detachment. In contrast, our results indicate that employees high in SOP show a tendency toward less sleep impairment and thus seem to enjoy comparatively restful sleep. Mechanisms linking SOP with higher sleep quality remain to be uncovered. In addition to organisational sources of stress, it seems important to consider how employees' personalities may contribute to stressors in the work area and how these workplace experiences may translate to non-work areas. We hope that our findings encourage researchers to investigate further mechanisms

underlying the association between multidimensional perfectionism and functional or dysfunctional sleep.

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Supplemental Material

A. Dropout analyses

Table S1

Dropout Analyses

Variables at initial survey					Independent sample *t*-tests		
		N	*M*	*SD*	*t*	*df*	*p*
SOP	Dropouts	101	5.27	0.98			
	Completers	70	5.08	1.04	1.22	169	.225
SPP	Dropouts	101	2.91	1.29			
	Completers	70	2.64	1.08	1.50	163	.136
Time Pressure	Dropouts	101	3.32	0.82			
	Completers	70	3.14	0.84	1.39	169	.168
Detachment	Dropouts	101	3.14	1.11			
	Completers	70	3.38	1.10	-1.42	169	.159
Sleep Quality Index	Dropouts	101	8.82	2.55			
	Completers	70	9.10	2.48	-.71	169	.480
Impact of the COVID-19 pandemic	Dropouts	101	.50	1.49			
	Completers	70	.49	1.50	.04	169	.968
Age	Dropouts	101	34.61	11.26			
	Completers	70	38.79	12.32	-2.29	169	.023
					2x2-χ^2-test		
		N	% *female*		χ^2		*p*
Gender	Dropouts	101	72				
	Participants	70	50		.015		.903

Note. SOP = self-oriented perfectionism, SPP = socially prescribed perfectionism.

B. Detailed information on how the sleep components were assessed

Sleep latency was assessed in minutes by the item, “How long did it take you to fall asleep last night?” Participants’ sleep duration was measured in hours by the item, “How many hours did you actually sleep during the last night? (This does not have to be the same as the number of hours you spent in bed).” Sleep efficiency reflects the percentage ratio of sleep duration to the number of hours spent in bed. To calculate the number of hours spent in bed, the participants were asked about the time they went to bed (“What time did you go to bed last night?”) and the time they got up (“What time did you get up this morning?”). Subjective sleep quality was measured by the single item, “How would you rate the quality of your sleep last night?” with the response alternatives ranging from *very bad* (1) to *very good* (4).

C. Between level indirect effects

Table S2

Results of Multilevel Path Analysis – Between Indirect Effects

	Sleep Quality Index
	b [95% CI]
SOP → Detachment → Sleep Quality Index	.02 [-0.026; 0.089]
SPP → Detachment → Sleep Quality Index	.02 [-0.030; 0.107]
SOP → Time Pressure → Detachment → Sleep Quality Index	.00 [-0.022; 0.024]
SPP → Time Pressure → Detachment → Sleep Quality Index	.01 [-0.011; 0.034]

Note. $N = 233$ days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. For neither of the four sleep quality components significant between indirect effects were found. Thus, we only report the effects for the overall sleep quality index.

D. Standardized direct paths

Table S3

Results of Multilevel Path Analysis – Standardized direct paths

	Time Pressure	Detachment	Sleep Quality Index
		β [95% CI]	
Controls			
IC (Person Level)	.04 [-0.214; 0.274]	-.01 [-0.250; 0.200]	
Age			.13 [-0.141; 0.468]
Gender[a]			-.07 [-0.353; 0.193]
IC (Day Level)	.01 [-0.103; 0.122]	.02 [-0.118; 0.137]	.11 [-0.037; 0.282]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.226; 0.252]		
SPP → Time Pressure	.33 [0.078; 0.541]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.384; 0.103]	
SPP → Detachment		-.23 [-0.462; 0.023]	
b_{11}-path			
Time Pressure → Sleep Quality			-.02 [-0.241; 0.200]
b_{12}-path			
Detachment → Sleep Quality			.58 [0.422; 0.684]*
d_{11}-path			
Time Pressure → Detachment		-.27 [-0.396;-0.139]*	
c'-paths			
SOP → Sleep Quality			.32 [0.012; 0.581]*
SPP → Sleep Quality			-.15 [-0.463; 0.165]

Note. $N = 233$ days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Standardized estimates are depicted. For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

E. Exploratory analyses for the sleep quality components

Table S4

Descriptive Statistic, ICCs and Correlations Between Variables Included in the Exploratory Analyses

		Scale	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1	Age		38.79	12.32	-	.12	.19	-.25*	.23*	.26*	-.17	.03	-.34**	.00	.13	.10
2	Gender	0-1	.29			-	-.15	.07	.13	.22	.00	-.02	-.03	.04	.06	.14
3	Impact of the COVID-19 pandemic	1-6	3.17	2.13			(.88)	-.02	-.08	-.01	.03	.21	-.01	.17	.28	.15
4	SOP	1-7	5.10	1.04				-	.13	.08	-.20	.33*	-.03	.31*	.25	.38**
5	SPP	1-7	2.64	1.08					-	.33**	-.32**	-.07	.00	-.20	-.20	-.06
6	Time Pressure	1-5	2.44	1.15			.02			(.49)	-.30**	.03	.01	-.18	-.06	.23
7	Detachment	1-5	3.86	1.18			.03			-.28**	(.53)	-.27	-.05	-.51***	-.18	-.05
8	Sleep Quality Index	0-12	9.53	2.12			.08			-.22*	.60***	(.32)	-.67***	.57***	.88***	.66***
9	Sleep Latency	0-3	0.51	0.81			-.12			-.04	-.50***	-.72***	(.50)	-.50***	-.35**	-.47***
10	Sleep Duration	0-3	2.50	0.73			.00			-.11	.41***	.80***	-.44***	(.29)	.67***	.36**
11	Sleep Efficiency	0-3	2.56	0.80			.01			-.04	.45***	.82***	-.57***	.68***	(.34)	.52***
12	Subjective Sleep Quality	0-3	1.98	0.66			.06			-.05	.46***	.62***	-.37***	.40***	.33***	(.20)

Note. For gender, 0 = *female*, 1 = *male*. SOP = self-oriented perfectionism. SPP = socially-prescribed perfectionism. Standardized correlations at the within-level ($N = 269$ days) below the diagonal and at the between-level ($N = 70$ employees) above the diagonal. ICCs (1) are reported along the diagonal in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S5

Results of Multilevel Path Analysis Predicting Sleep Latency – Direct paths and Within-Indirect Effects

	Time Pressure	Detachment	Sleep Latency
		b [95% CI]	
Controls			
IC (Person Level)	.01 [-0.121; 0.127]	.00 [-0.121; 0.097]	
Age			-.02 [-0.031;-0.004]*
Gender[a]			.07 [-0.285; 0.415]
IC (Day Level)	.01 [-0.073; 0.076]	.01 [-0.063; 0.084]	-.01 [-0.105; 0.052]
a_{21}-paths			
SOP → Time Pressure	.06 [-0.177; 0.242]		
SPP → Time Pressure	.28 [0.085; 0.505]*		
a_{22}-paths			
SOP → Detachment		-.14 [-0.374; 0.033]	
SPP → Detachment		-.19 [-0.421; 0.005]	
b_{11}-path			
Time Pressure → Sleep Latency			-.06 [-0.117; 0.026]
b_{12}-path			
Detachment → Sleep Latency			-.24 [-0.326; -0.142]*
d_{11}-path			
Time Pressure → Detachment		-.27 [-0.447;-0.160]*	
c'-paths			
SOP → Sleep Latency			-.05 [-0.207; 0.134]
SPP → Sleep Latency			.02 [-0.168; 0.145]
Within-Indirect Effects			
Time Pressure → Detachment → Sleep Latency (d_{11} x b_{12})			.06 [0.030; 0.111]*
SOP → Time Pressure → Detachment → Sleep Latency (a_{21} x d_{11} x b_{12})			.00 [-0.011; 0.019]
SPP → Time Pressure → Detachment → Sleep Latency (a_{21} x d_{11} x b_{12})			.02 [0.004; 0.036]*
SOP → Detachment → Sleep Latency (a_{22} x b_{12})			.03 [-0.009; 0.094]
SPP → Detachment → Sleep Latency (a_{22} x b_{12})			.05 [-0.001; 0.098]
R^2 day level	.01 [0.000; 0.024]	.08 [0.028; 0.147]*	.23 [0.089; 0.372]*
R^2 person level	.16 [0.029; 0.369]*	.21 [0.074; 0.337]*	.24 [0.058; 0.425]*

Note. *N* = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S6

Results of Multilevel Path Analysis Predicting Sleep Latency – Standardized Direct Paths

	Time Pressure	Detachment	Sleep Latency
		β [95% CI]	
Controls			
IC (Person Level)	.01 [-0.269; 0.300]	.00 [-0.235; 0.208]	
Age			-.34 [-0.628;-0.104]*
Gender[a]			.06 [-0.197; 0.341]
IC (Day Level)	.02 [-0.121; 0.139]	.02 [-0.107; 0.150]	-.03 [-0.342; 0.181]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.226; 0.252]		
SPP → Time Pressure	.33 [0.078; 0.541]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.414; 0.039]	
SPP → Detachment		-.22 [-0.476; 0.008]	
b_{11}-path			
Time Pressure → Sleep Latency			-.11 [-0.230; 0.058]
b_{12}-path			
Detachment → Sleep Latency			-.48 [-0.584; -0.310]*
d_{11}-path			
Time Pressure → Detachment		-.27 [-0.40;-0.14]*	
c'-paths			
SOP → Sleep Latency			-.08 [-0.342; 0.230]
SPP → Sleep Latency			.03 [-0.252; 0.302]

Note. *N* = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Standardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S7

Results of Multilevel Path Analysis Predicting Sleep Duration – Direct paths and Within-Indirect Effects

	Time Pressure	Detachment	Sleep Duration
		b [95% CI]	
Controls			
IC (Person Level)	.02 [-0.092; 0.131]	-.01 [-0.112; 0.110]	
Age			.00 [-0.011; 0.011]
Gender[a]			-.02 [-0.319; 0.240]
IC (Day Level)	.01 [-0.057; 0.067]	.01 [-0.066; 0.075]	.03 [-0.026; 0.088]
a_{21}-paths			
SOP → Time Pressure	.03 [-0.198; 0.213]		
SPP → Time Pressure	.28 [0.065; 0.463]*		
a_{22}-paths			
SOP → Detachment		-.15 [-0.356; 0.097]	
SPP → Detachment		-.21 [-0.413; 0.016]	
b_{11}-path			
Time Pressure → Sleep Duration			-.06 [-0.210; 0.072]
b_{12}-path			
Detachment → Sleep Duration			.21 [0.096; 0.347]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.418;-0.134]*	
c'-paths			
SOP → Sleep Duration			.15 [0.022; 0.288]*
SPP → Sleep Duration			-.08 [-0.210; 0.054]
Within-Indirect Effects			
Time Pressure → Detachment → Sleep Duration (d_{11} x b_{12})			-.06 [-0.110;-0.020]*
SOP → Time Pressure → Detachment → Sleep Duration (a_{21} x d_{11} x b_{12})			.00 [-0.022; 0.039]
SPP → Time Pressure → Detachment → Sleep Duration (a_{21} x d_{11} x b_{12})			-.02 [-0.038;-0.002]*
SOP → Detachment → Sleep Duration (a_{22} x b_{12})			-.03 [-0.088; 0.018]
SPP → Detachment → Sleep Duration (a_{22} x b_{12})			-.04 [-0.099; 0.005]
R^2 day level	.01 [0.000; 0.016]	.08 [0.020; 0.166]*	.22 [0.045; 0.382]*
R^2 person level	.14 [0.023; 0.341]*	.21 [0.076; 0.400]*	.44 [0.214; 0.703]*

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S8

Results of Multilevel Path Analysis Predicting Sleep Duration – Standardized Direct Paths

	Time Pressure	Detachment	Sleep Duration
		β [95% CI]	
Controls			
IC (Person Level)	.04 [-0.214; 0.274]	-.01 [-0.205; 0.200]	
Age			.00 [-0.257; 0.312]
Gender[a]			-.02 [-0.278; 0.219]
IC (Day Level)	.01 [-0.103; 0.122]	.02 [-0.117; 0.134]	.08 [-0.085; 0.265]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.226; 0.252]		
SPP → Time Pressure	.33 [0.078; 0.541]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.384; 0.103]	
SPP → Detachment		-.23 [-0.462; 0.023]	
b_{11}-path			
Time Pressure → Sleep Duration			-.11 [-0.354; 0.135]
b_{12}-path			
Detachment → Sleep Duration			.38 [0.184; 0.543]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.395;-0.131]*	
c'-paths			
SOP → Sleep Duration			.32 [0.048; 0.554]*
SPP → Sleep Duration			-.17 [-0.478; 0.117]

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Standardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S9

Results of Multilevel Path Analysis Predicting Sleep Efficiency – Direct paths and Within-Indirect Effects

	Time Pressure	Detachment	Sleep Efficiency
		b [95% CI]	
Controls			
IC (Person Level)	.02 [-0.092; 0.131]	-.01 [-0.112; 0.110]	
Age			.00 [-0.015; 0.010]
Gender[a]			.01 [-0.294; 0.300]
IC (Day Level)	.01 [-0.057; 0.067]	.01 [-0.066; 0.076]	.04 [-0.016; 0.108]
a_{21}-paths			
SOP → Time Pressure	.03 [-0.198; 0.213]		
SPP → Time Pressure	.28 [0.065; 0.463]*		
a_{22}-paths			
SOP → Detachment		-.15 [-0.356; 0.097]	
SPP → Detachment		-.21 [-0.413; 0.016]	
b_{11}-path			
Time Pressure → Sleep Efficiency			-.03 [-0.186; 0.110]
b_{12}-path			
Detachment → Sleep Efficiency			.25 [0.127; 0.389]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.418;-0.133]*	
c'-paths			
SOP → Sleep Efficiency			.10 [-0.047; 0.246]
SPP → Sleep Efficiency			-.06 [-0.209; 0.089]
Within-Indirect Effects			
Time Pressure → Detachment → Sleep Efficiency (d_{11} x b_{12})			-.07 [-0.125;-0.025]*
SOP → Time Pressure → Detachment → Sleep Efficiency (a_{21} x d_{11} x b_{12})			.00 [-0.018; 0.013]
SPP → Time Pressure → Detachment → Sleep Efficiency (a_{21} x d_{11} x b_{12})			-.02 [-0.044;-0.002]*
SOP → Detachment → Sleep Efficiency (a_{22} x b_{12})			-.04 [-0.098; 0.021]
SPP → Detachment → Sleep Efficiency (a_{22} x b_{12})			-.05 [-0.113; 0.006]
R^2 day level	.01 [0.000; 0.016]	.08 [0.020; 0.165]*	.23 [0.060; 0.405]*
R^2 person level	.14 [0.023; 0.314]*	.21 [0.076; 0.400]*	.26 [0.066; 0.513]*

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S10

Results of Multilevel Path Analysis Predicting Sleep Efficiency – Standardized Direct Paths

	Time Pressure	Detachment	Sleep Efficiency
		β [95% CI]	
Controls			
IC (Person Level)	.04 [-0.214; 0.274]	-.01 [-0.250; 0.200]	
Age			-.08 [-0.366; 0.276]
Gender[a]			.01 [-0.256; 0.269]
IC (Day Level)	.01 [-0.103; 0.122]	.02 [-0.116; 0.135]	.12 [-0.051; 0.302]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.226; 0.252]		
SPP → Time Pressure	.33[0.078; 0.541]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.384; 0.103]	
SPP → Detachment		-.23 [-0.462; 0.023]	
b_{11}-path			
Time Pressure → Sleep Efficiency			-.05 [-0.289; 0.191]
b_{12}-path			
Detachment → Sleep Efficiency			.42 [0.232; 0.572]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.396;-0.133]*	
c'-paths			
SOP → Sleep Efficiency			.22 [-0.097; 0.509]
SPP → Sleep Efficiency			-.13 [-0.437; 0.192]

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Standardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S11

Results of Multilevel Path Analysis Predicting Subjective Sleep Quality – Direct paths and Within-Indirect Effects

	Time Pressure	Detachment	Subjective Sleep Quality
		b [95% CI]	
Controls			
IC (Person Level)	.02 [-0.092; 0.131]	-.01 [-0.112; 0.110]	
Age			.00 [-0.009; 0.008]
Gender[a]			-.12 [-0.367; 0.083]
IC (Day Level)	.01 [-0.057; 0.067]	.01 [-0.066; 0.077]	.03 [-0.013; 0.081]
a_{21}-paths			
SOP → Time Pressure	.03 [-0.198; 0.213]		
SPP → Time Pressure	.28 [0.065; 0.463]*		
a_{22}-paths			
SOP → Detachment		-.15 [-0.356; 0.097]	
SPP → Detachment		-.21 [-0.413; 0.016]	
b_{11}-path			
Time Pressure → Subjective Sleep Quality			.00 [-0.131, 0.129]
b_{12}-path			
Detachment → Subjective Sleep Quality			.25 [0.144; 0.369]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.417;-0.134]*	
c'-paths			
SOP → Subjective Sleep Quality			.08 [-0.027; 0.187]
SPP → Subjective Sleep Quality			-.02 [-0.128; 0.093]
Within-Indirect Effects			
Time Pressure → Detachment → Subjective Sleep Quality (d_{11} x b_{12})			-.07 [-0.127;-0.027]*
SOP → Time Pressure → Detachment → Subjective Sleep Quality (a_{21} x d_{11} x b_{12})			.00 [-0.019; 0.013]
SPP → Time Pressure → Detachment → Subjective Sleep Quality (a_{21} x d_{11} x b_{12})			-.02 [-0.044;-0.002]*
SOP → Detachment → Subjective Sleep Quality (a_{22} x b_{12})			-.04[-0.098; 0.021]
SPP → Detachment → Subjective Sleep Quality (a_{22} x b_{12})			-.05 [-0.114; 0.005]
R^2 day level	.01 [0.000; 0.016]	.08 [0.019; 0.165]*	.26 [0.091; 0.408]*
R^2 person level	.14 [0.023; 0.314]*	.21 [0.076; 0.400]*	.31 [0.090; 0.606]*

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Unstandardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Table S12

Results of Multilevel Path Analysis Predicting Subjective Sleep Quality – Standardized Direct Paths

	Time Pressure	Detachment	Subjective Sleep Quality
		β [95% CI]	
Controls			
IC (Person Level)	.04 [-0.214; 0.274]	-.01 [-0.250; 0.200]	
Age			.02 [-0.329; 0.335]
Gender[a]			-.17 [-0.462; 0.101]
IC (Day Level)	.01 [-0.103; 0.122]	.02 [-0.118; 0.135]	.10 [-0.043; 0.264]
a_{21}-paths			
SOP → Time Pressure	.04 [-0.226; 0.252]		
SPP → Time Pressure	.33 [0.078; 0.541]*		
a_{22}-paths			
SOP → Detachment		-.16 [-0.384; 0.103]	
SPP → Detachment		-.23 [-0.462; 0.023]	
b_{11}-path			
Time Pressure → Subjective Sleep Quality			.01 [-0.236; 0.239]
b_{12}-path			
Detachment → Subjective Sleep Quality			.47 [0.296; 0.612]*
d_{11}-path			
Time Pressure → Detachment		-.28 [-0.396;-0.134]*	
c'-paths			
SOP → Subjective Sleep Quality			.27 [-0.077; 0.617]
SPP → Subjective Sleep Quality			-.07 [-0.450; 0.296]

Note. N = 233 days nested in 70 employees; SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IC = impact of the COVID-19 pandemic. [a] 0 = *female*, 1 = *male*. Standardized estimates are depicted; For reasons of parsimony, the correlations between the initial survey variables are not reported but were included in the model. * 95% confidence interval excluding zero.

Appendix C: Manuscript 3

Mindfulness, Anywhere, Anytime: Effects of an App-Based Intervention on Employees' Perfectionism, Procrastination and Recovery

Authors: Emily Kleszewski, Kathleen Otto and Eva Matick

Status: Submitted to *Journal of Occupational Health Psychology*

Mindfulness, Anywhere, Anytime: Effects of an App-Based Intervention on Employees' Perfectionism, Procrastination and Recovery

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Abstract

App-based mindfulness interventions are a promising approach to reduce stress and increase well-being among employees. In particular, perfectionistic concerns may place employees at risk for many of the outcomes targeted by mindfulness interventions, but have not been addressed in mindfulness intervention studies. Given that mindfulness should lead to improvements in cognitive, emotional, behavioral, and physiological domains, the present study aimed to examine the effects of a brief (two weeks) and low-dose (10 units of 9–15 minutes each) app-based intervention on perfectionistic cognitions, detachment, tension, procrastination, and sleep quality in a sample of employees. A randomized wait-list control group design was used to test the effectiveness of the intervention. Data from 181 full- and part-time employees (75% female) from different industries were analyzed using latent growth curve models. Compared to participants in the wait-list control group (n = 87), participants in the intervention group (n = 94) reported significant increases in mindfulness after completing the app-based course. As expected, the intervention significantly decreased perfectionistic concern cognitions, tension, and procrastination and significantly increased sleep quality relative to the wait-list control group. Most of these effects remained stable at short-term follow-up after two weeks. No intervention effect was found for detachment. Overall, dispositional perfectionism did not affect the effectiveness of the intervention. Our findings are encouraging and suggest positive intervention effects with a relatively small but regular investment of time. The generalizability of our findings and the potential integration of app-based mindfulness-based interventions into comprehensive occupational health programs are discussed.

Keywords: multidimensional perfectionism, perfectionistic cognitions, tension, procrastination, recovery, detachment, sleep quality, app-based mindfulness intervention

Mindfulness, Anywhere, Anytime: Effects of an App-Based Intervention on Employees' Perfectionism, Procrastination and Recovery

We live in an increasingly digital and fast-paced world. In contrast, mindfulness, the awareness that comes from intentionally and nonjudgmentally paying attention to experience in the present moment (Kabat-Zinn, 2003), is becoming more present in people's daily lives. There is a real "hype" around mindfulness (Van Dam et al., 2018), which is reflected in the growing body of research on the topic and the application of mindfulness interventions in the workplace context. Meta-analyses highlight the effectiveness of face-to-face and online-delivered mindfulness-based interventions in reducing stress, and increasing employee recovery and well-being (Bartlett et al., 2019; Vonderlin et al., 2020). Evidence is also accumulating to support the positive effects of app-based mindfulness interventions in employees (e.g., Bostock et al., 2019; Lahtinen et al., 2021). It seems somewhat paradoxical that in times of increasing digitization and technology use, more apps should be the solution. However, app-based interventions offer benefits in terms of accessibility and efficiency, and may individually support employees in their recovery from work (Sonnentag et al., 2022).

Another important development is the rise of perfectionism (Curran & Hill, 2019). Perfectionism, particularly the dimensions summarized as perfectionistic concerns, may place employees at risk for stress, impaired recovery, and poor well-being (Harari et al., 2018; Ocampo et al., 2020). However, while we have a profound understanding of how both dispositional perfectionism and more dynamic perfectionistic cognitions may contribute to stress, procrastination, and poor recovery, knowledge about interventions for employees is scarce (Ocampo et al., 2020). There is evidence that coaching, including cognitive-behavioral techniques, may be effective for reducing perfectionism in non-clinical samples, i.e., students (Kearns et al., 2007); however, the effectiveness of easy-accessible interventions in applied settings remains to be tested. Recently, researchers have suggested that perfectionism is an antipode to mindfulness, as the mindset associated with this disposition is directed towards

social evaluation, approval, and the avoidance of criticism (Flett et al., 2020). Furthermore, many of the negative outcomes associated with perfectionism are common targets of mindfulness interventions. A recent model of mindfulness in the workplace (Good et al., 2016) suggests that mindfulness should affect different domains of functioning, including cognitive, emotional, behavioral, and physiological domains. The present study targets these different domains and examines the effects of a brief and low-dose app-based mindfulness intervention in reducing perfectionistic cognitions as a dynamic form of perfectionism and tension, procrastination, and recovery deficits as outcomes associated with perfectionistic concerns (Prestele et al., 2020; Sirois et al., 2017; Stricker et al., 2022). We contribute to occupational health psychology in three important ways.

First, we extend research on mindfulness interventions by introducing perfectionistic cognitions and procrastination as additional targets. With respect to research on perfectionism, we thus test mindfulness as a practical approach to intervening early in the process of perfectionism, stress, and impaired well-being. Focusing on procrastination, we investigate whether individuals also benefit from increased mindfulness in terms of behavioral functioning and productivity. While positive effects of mindfulness-based interventions have already been documented for stress-related and recovery-related outcomes, scholars have encouraged testing for productivity outcomes, which have rarely been included in randomized controlled trials (Vonderlin et al., 2020).

Second, we contribute to previous research on mindfulness interventions by investigating whether a low-dose app-based intervention has beneficial effects on employee stress, i.e. tension, and recovery, i.e., detachment and sleep quality. Previous studies of app-based interventions conducted with employees have investigated the effects of using apps for at least four weeks (e.g., Bostock et al., 2019; Lahtinen et al., 2021). Evidence from online mindfulness interventions suggests that significant changes in employee stress and recovery can occur within periods as short as two weeks (e.g., Hülsheger et al., 2015; Jamieson et al.,

2022). Given that time is a limited resource for both employees and organizations, the question is whether even short and low-dose app-based interventions have beneficial effects on these outcomes.

Third, we adopt an individual difference perspective on responsiveness to mindfulness interventions, which has recently been encouraged (Tang & Braver, 2020). Specifically, we examine whether individuals high in dispositional perfectionism may find it particularly difficult to develop a state of mindfulness that is inconsistent with their personality or may benefit particularly from mindfulness interventions (Flett et al., 2020). In doing so, we contribute to knowledge about individual variability in the effects of mindfulness training and challenge one-size-fits-all approaches.

Mindfulness and its facets

We draw on the conceptualization of mindfulness as a multifaceted construct that includes observing, describing, acting with awareness, non-judging, and non-reacting (Baer et al., 2006). Observing involves paying attention to internal or external experiences; describing relates to finding words to label internal experiences, e.g., feelings, emotions; acting with awareness includes focusing attention on the activities of the present moment; non-judging involves facing one's thoughts and feelings in a non-evaluative way, and non-reacting refers to allowing thoughts and feelings to occur without being overly involved.

There is meta-analytic evidence that mindfulness can be learned through smartphone apps (Linardon, 2020). Studies investigating the effects of app-based mindfulness interventions in the workplace context, have so far included overall measures of mindfulness as a manipulation check (e.g., Bostock et al., 2019; Lahiten et al., 2021). In a study conducted with adults in a non-clinical context, Emmerik et al. (2018) explicitly focused on the five facets of mindfulness and found that five weeks of app-based mindfulness training increased all facets of mindfulness. As a first step, we sought to explore which facets of mindfulness could be targeted by a brief and low-dose app-based intervention. Given the overall beneficial

effects of app-based interventions on increasing mindfulness, we hypothesized that employees who participated in the app-based mindfulness course would report improvements in observing (Hypothesis 1), describing (Hypothesis 2), acting with awareness (Hypothesis 3), non-judging (Hypothesis 4), and non-reacting (Hypothesis 5) as compared to participants in the waitlist control condition.

Perfectionism is antithetical to mindfulness

Perfectionism is considered to be a multidimensional personality disposition that encompasses both *perfectionistic strivings,* which refer to high-performance standards, and *perfectionistic concerns,* which included the fear of negative evaluation and concern about making mistakes (see Stoeber & Otto, 2006, for a comprehensive review). Recent reviews and a meta-analysis (Harari et al., 2018; Ocampo et al., 2020) highlight that dimensions belonging to perfectionistic concerns (e.g., socially prescribed perfectionism, concern over mistakes, and discrepancy) consistently show an association with increased stress and poor recovery and well-being, such as burnout. Dimensions summarized as perfectionistic strivings (e.g., self-oriented perfectionism, personal standards, and high standards) may have negative associations with stress and even positive associations with well-being, such as high work engagement. It is often debated whether perfectionistic strivings can be considered as adaptive (e.g., Molnar et al., 2020; Stoeber & Otto, 2006). These dimensions have also been linked to negative outcomes, such as negative affective and cognitive responses to failure (Besser et al., 2004), however, and associations with positive outcomes are typically observed when the overlap with perfectionistic concerns is controlled for (Hill et al., 2010).

Dispositional perfectionism has been shown to be relatively stable over years (e.g., Sherry et al., 2013). Scholars have begun to focus on perfectionistic cognitions as "state-like manifestations" of this construct (Hill & Appleton, 2011, p. 697) that may be more easily targeted, especially with low-dose interventions. Reflecting the multidimensionality of dispositional perfectionism, perfectionistic cognitions are best understood in terms of

perfectionistic striving cognitions (PSC) and *perfectionistic concerns cognitions* (PCC). PSC refer to thoughts about the value and importance of high standards, whereas PCC refer to thoughts about failure, making mistakes, and possible negative consequences (Prestele et al., 2020). Given the similarities in conceptualization, dispositional perfectionism and perfectionistic cognitions are moderately to strongly related (e.g., Prestele & Altstötter-Gleich, 2019), and PCC, but not PSC, show similar negative relationships as dispositional perfectionistic concerns with outcomes such as perceived stress, worry, and tension (Prestele et al., 2020).

Regardless of the debate about whether perfectionistic strivings can also be adaptive, both dimensions of perfectionism can be seen as antithetical to the concept of mindfulness. Both perfectionistic strivings and concerns are driven by the tendency to strive for future goals and to be overly critical of one's performance. Mindfulness, on the other hand, is described as intentionally and nonjudgmentally focusing one's attention on experiencing life in the present moment (Kabat-Zinn, 2003). As noted by Flett et al. (2020), individuals high in perfectionism engage intensively in activities and focus on extraordinarily high goals and evaluation. As such, they are characterized by a cognitive mindset and self-view that is incompatible with intentional time for mindfulness and antithetical to mindful awareness. They also tend to be preoccupied with the past, as both dimensions have been shown to be associated with rumination (Xie et al., 2019), and particularly individuals high in perfectionistic concern have difficulty accepting the past (Smith et al., 2020). In previous studies (e.g., Diaz, 2018; Flett et al., 2020), both perfectionistic concerns and perfectionistic strivings were negatively associated with mindfulness, although the associations were more consistent for perfectionistic concerns.

Why mindfulness affects several domains of functioning

It is beyond question that mindfulness has beneficial effects on human functioning (Brown et al., 2007). In the present study, we draw on the framework developed by Good et

al. (2016) , which systematically integrates how mindfulness affects different aspects of workplace functioning. In this framework, mindfulness enhances the stability, control, and efficiency of attention- that is, directing attention on targets, i.e., tasks without mind wandering, appropriately directing attention without getting distracted by competing demands, and thus allocating attentional resources more efficiently. These attentional qualities are proposed to have positive effects on cognitive, emotional, behavioral, and physiological domains of functioning. The outcomes examined in our study are not only areas in which individuals high in perfectionism have difficulty (e.g., Prestele et al., 2020; Sirois et al., 2017; Stricker et al., 2022), but perfectionistic cognitions, detachment, tension, procrastination, and sleep quality also align with the various domains of functioning according to this framework.

In the cognitive domain of functioning, mindfulness is assumed to affect cognitive capacity and flexibility. Specifically, cognitive flexibility may enable employees to notice work-related thoughts and perfectionistic cognitions as they arise, to disengage from these thoughts, or to engage in new, less evaluative cognitive responses. In addition, as noted by Good et al. (2016), increased awareness of cognitive responses to certain situations requires individuals to distance themselves from self-evaluations. Detachment, the mental disengagement from work during non-work time, has been described as a core experience of recovery (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2015). The ability to notice cognitions and disengage should help individuals to be less likely to be caught up in work-related thoughts and their perfectionistic cognitions, past failures, and future goals, and help them to be in the present moment. Consistent with these assumptions, research shows that mindfulness cultivates psychological states of self-acceptance (Thompson & Waltz, 2008) and that interventions may decrease rumination and problem-solving pondering (Querstret et al., 2017). There is also evidence that a three-week online mindfulness intervention supports employees in detaching after work (Althammer et al., 2021).

In terms of emotional functioning, mindfulness appears to affect the reactivity to stressors and the overall emotional tone. Observing one's experiences is assumed to provide a certain distance through more neutral evaluations of stressors, and being present in the here and now should inhibit the revival of negative past experiences and associated emotions. Thus, mindfulness should reduce experiences of aversive tension, which can be understood as an emotional state of stress (Stiglmayr et al., 2008). Evidence indicates that mindfulness buffers affective responses to stressors, enables stressors to be appraised more challenging and less threatening, and has beneficial effects on emotional tone (Brown et al., 2012; Eberth & Sedlmeier, 2012; Jamieson et al., 2022).

Mindfulness is also theorized to impact behavioral functioning because it enables enhanced self-regulation of behavior (Glomb et al., 2011). According to Good et al. (2016), mindfulness, with its increased awareness allows individuals to regulate behavior more consciously rather than following automatic responses. Procrastination has been described as a self-regulatory failure as it involves choosing one task or activity over another and "to voluntarily delay an intended course of action despite expecting to be worse off the delay" (Steel, 2007, p. 66). Thus, we consider mindfulness as a promising approach to reducing employee procrastination by recognizing the tendency for these delays and regulating behavior with increased awareness. Research conducted with students supports the notion that mindfulness leads to lower levels of procrastination (Cheung & Ng, 2019). Additionally, Slutsky et al. (2019) demonstrated that mindfulness training programs can increase employees' perceived productivity.

Finally, mindfulness is proposed to promote functioning in the physiological domain. The assumption that mindfulness reduces physiological responses to stress is supported by evidence of reduced neuroendocrine responses to stressors, i.e., cortisol levels, and faster recovery (Brown et al., 2012). Recovering from physiological activation caused by high job demands is central for employees' healthy sleep (Meijman & Mulder, 1998). Previous studies

have found that online mindfulness training improves sleep quality (Hülsheger et al., 2015; Querstret et al., 2017). Bostock et al. (2019) found a marginally significant decrease in self-measured workday systolic blood pressure among participants in an app-based intervention. However, it remains to be investigated whether a low-dose app-based mindfulness intervention improves employees' sleep quality.

Given these effects across functional domains, we hypothesized that employees who participated in the app-based mindfulness course would report decreases in perfectionistic concern cognitions (Hypothesis 6a), perfectionistic striving cognitions (Hypothesis 6b), tension (Hypothesis 7), procrastination (Hypothesis 8), and improvements in detachment (Hypothesis 9) and sleep quality (Hypothesis 10) as compared to participants in the waitlist control condition.

Dispositional perfectionism – barrier or benefit to engagement in mindfulness?

Dimensions of dispositional perfectionism may play a role in the effectiveness of mindfulness interventions. A growing body of research indicates that individuals high in dispositional perfectionism benefit comparatively less from clinical treatments, and that they tend to be defensive or even resistant in some treatment contexts (see Hewitt et al., 2017). It has been suggested that individuals high in perfectionistic concerns may particularly benefit from increased mindfulness, but some perfectionists may find it particularly difficult to develop a state of mindfulness that is inconsistent with their personality (Flett et al., 2020). Recent research (Biskas et al., 2022) suggests that individuals high in perfectionistic concerns in particular have difficulty being self-compassionate and hold negative beliefs about self-compassion, a construct that includes mindfulness. As noted above, also individuals high in perfectionistic strivings have a mindset and self-view that is not consonant with mindful awareness and focusing on current experiences, given their preoccupation with future goals and their tendency to be highly critical of accomplishments and to ruminate. Thus, individuals high in either of these dimensions could benefit from learning to be in the present moment.

Given this potentially conflicting role and the exploratory nature, we pose the following research question: *Will participants high in dispositional perfectionism show greater or weaker improvements in mindfulness?*

Method

Procedure and design

The study was approved by the local ethics committee. The opportunity to participate in an app-based intervention study for employees was advertised through various social media platforms (e.g., LinkedIn), personal contacts, and the university staff survey mailing list. Five undergraduate students assisted with data collection. As an incentive for participation and study adherence, a lottery with 10 gift cards (worth €20 each) and the possibility to use the app free of charge for two weeks after completion of the mindfulness course were offered. Interested participants registered online for the study using their email address via the online platform SoSci Survey. All assessments were conducted online through this platform.

We used a randomized wait-list control design. Self-reported data were collected before the intervention (T1), immediately after the intervention (T2, after 2 weeks), and at a short-term follow-up after another two weeks (T3). Participants were informed that there were different study procedures depending on when they were given access to the app-based course. They were randomly assigned to the intervention group (INT) or the wait-list control group (WLC), starting with a 1:1 randomization scheme for the first half of the study. Because dropout was higher in the INT group and we wanted to have more data on completers in this group, we changed to a 2:1 ratio favoring the INT group for the second half of the study.

Participants received detailed information about the specific study procedure after registration and randomization via email. After completing the T1 questionnaire, participants in the intervention group were instructed to start immediately with a prescribed mindfulness course in the 7Mind app for the next two weeks. Participants in the WLC group received access to the app after completing the T3 questionnaire.

Participants

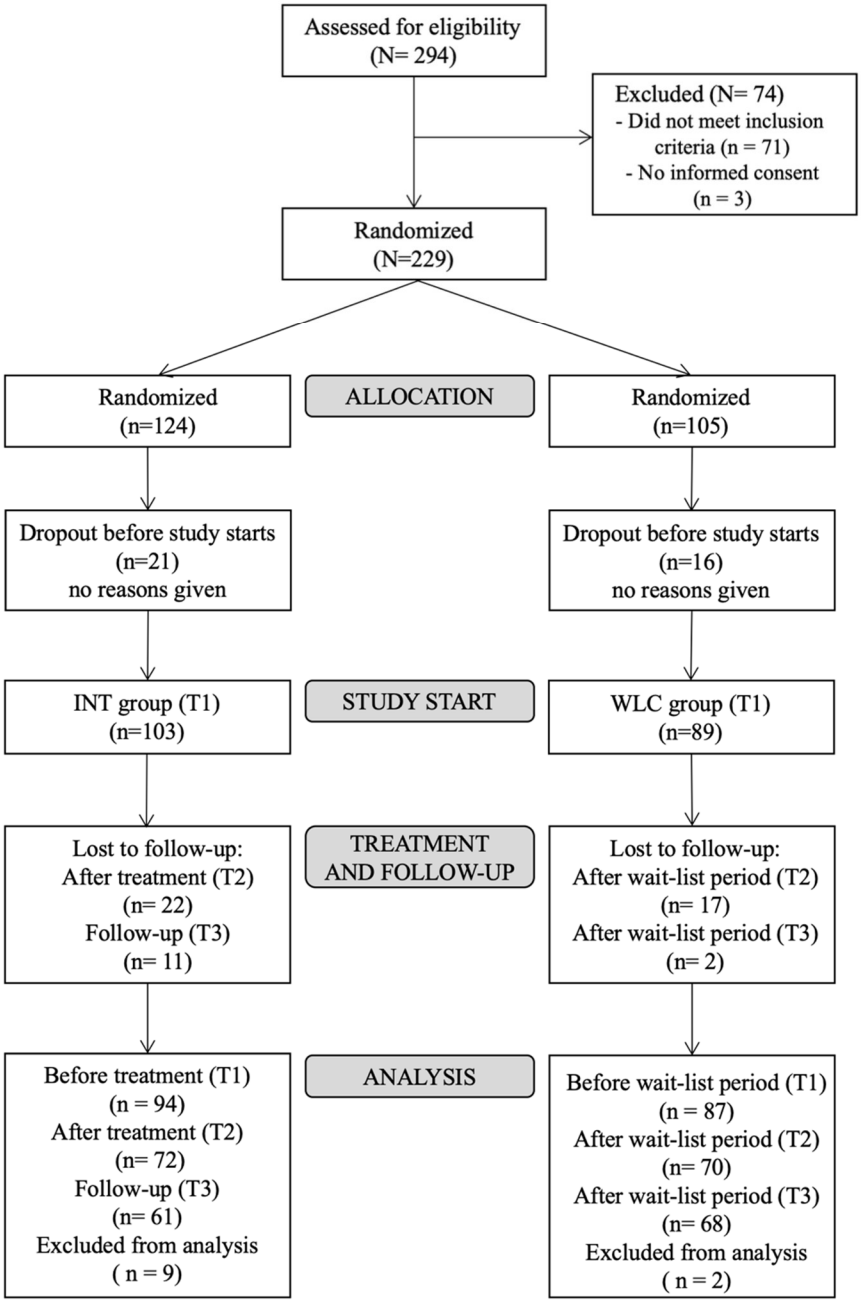
A total of 294 participants were screened for eligibility, of which 229 met the inclusion criteria. These included being at least 18 years old, working full- or part-time, and having an Internet-enabled smartphone with access to Google Play or the App Store. In addition, participants had to indicate that they did not have an acute concurrent psychiatric disorder (e.g., borderline personality, PTSD) or physical illness (e.g., epilepsy), as meditation may be contraindicated for them (Hanley et al., 2016). We also screened participants for familiarity with mindfulness, meditation, or relaxation techniques and only included participants who were unfamiliar with these techniques, as our intervention is delivered at a comparatively low dose. Consistent with Burzler et al. (2019), individuals who practiced either mindfulness, meditation, autogenic training, or progressive muscle relaxation more than once a week were considered regular practitioners.

A total of 192 participants completed the T1 questionnaires (INT=103; WLC=89). At the second assessment (T2), 153 participants completed the questionnaires (INT=81; WLC=72), while 140 participants completed the follow-up assessment at T3 (INT=70; WLC=70). Thus, the response rates relative to participation at T1 were 78.6% in the INT group and 80.9% in the WLC group at T2, and 68.0% in the INT group and 78.7% in the WLC group at T3. These numbers are comparable to common response rates for smartphone-delivered intervention trials, and well below the average 43% attrition rate for fully online enrolled trials (Linardon & Fuller-Tyszkiewicz, 2020).

Given the low-dose nature of our intervention, we adopted a modified ITT approach for our analyses and included all randomized participants who met a minimum standard of criteria, which included receiving at least one dose of the study intervention as a common criterion (Chin & Lee, 2008). Thus, in line with previous intervention studies, we excluded seven participants who reported not carrying out the intervention at all (e.g., Michel et al., 2014) and included those who used the app for at least 12 minutes. We also excluded three

participants who completed the T2 questionnaire with a significant delay (i.e., after the follow-up). As recommended by Tabachnick and Fidell (2007), we tested for multivariate outliers separately in the intervention and control groups. One outlier occurred in the control group. This person reported participating in an alternative intervention during the study and was therefore excluded.

Figure 1
CONSORT flow diagram



The final sample included in the analyses consisted of 181 employees. The majority of the sample (75.8%) was female, with a mean age of 36.57 (*SD* = 12.31) and a mean organizational tenure of 10.22 years (*SD* = 10.44). The mean number of hours worked was 33.90 (*SD* = 10.83), and 26.4% of participants held leadership positions. The sample was highly educated, with 50.0% of participants holding a university degree. Participants worked in a variety of industries, the most common being health and social services (23.6%). Details of demographic variables by group assignment are shown in Table 1. The groups did not differ significantly on any of these variables.

Table 1
Demographic variables for study groups

Demographics	INT group (*n* = 94)	WLC group (*n* = 87)
Total number female (%)	75.8%	75.9%
Mean age in years (SD)	37.34 (12.04)	35.74 (12.63)
Mean weekly working hours (SD)	33.51 (11.08)	34.32 (10.60)
Mean tenure (SD)	10.92 (11.36)	9.48 (9.39)
Total number having a leadership position (%)	26.3%	26.4%
Total number having a university degree (%)	48.4%	51.7%
Total number working in health and social services (%)	21.1%	26.4%

Note. INT = intervention; WLC = waitlist control.

App-based mindfulness intervention

Participants carried out the intervention themselves using the 7Mind app. The app is well established in the German market. In a recent test by Germany's best-known consumer organization, 7Mind was one of only two meditation apps to score well (Stiftung Warentest, 2021). There are also high user satisfaction ratings on Google Play and the App Store. The provider cooperates with German health insurance companies, which can cover the costs of certified prevention courses over a period of 8 weeks. In addition to these prevention courses, the app offers introductory and intensive courses on mindfulness, as well as a wide range of guided meditations derived from established mindfulness training (Kabat-Zinn & Kappen, 2013). Mindfulness shares the characteristics of meditative practice and can be cultivated and

developed through meditation; thus, meditation is a central element in mindfulness-based stress reduction programs (Eberth & Sedlmeier, 2012; Kabat-Zinn, 2003). 7Mind also works with companies that provide their employees with free access to the apps' services. Because we were interested in testing the effects of a low-dose, app-based intervention that can be easily integrated into employees' work routines, we considered this app to be a realistic implementation of mindfulness in the workplace.

Participants were mailed a personal access code to use the app free of charge for 4 weeks and a sample weekly schedule of the 10 app units. The duration of the units ranged from 9 to 15 minutes, with an average duration of 12 minutes. Participants were told that they could adapt this sample schedule flexibly and, for example, complete units on another day if they were unable to participate on a particular day. In addition, consistent with previous programs, participants were given autonomy to choose a time and place for mindfulness practice that suited their work schedules (e.g., Bostock et al., 2019; Jamieson et al., 2022). The first seven units provided an intensive introduction to guided mindfulness meditation. Each followed the structure of a short preparatory phase, a guided mindfulness exercise that allowed participants to experience a particular aspect of mindfulness related to the content of the unit, and a fade-out phase that aimed to transition back and support a sustained understanding of the experiences and practical transfer to everyday life. The guided exercises included conscious attention to sensations, awareness of sensations without judgment, mindful breathing, and bodyscans. Participants were repeatedly instructed not to judge themselves if they were easily distracted by thoughts, as this was normal in the practice and part of the exercises. The following three units were designed to deepen the experiences from the introductory units with further practice of breathing for winding down, bodyscans, and noticing and letting go of thoughts. At the T2 assessment, participants were asked to report the total amount of meditation time tracked by the app. On average, INT participants reported using the app for 101 minutes (SD = 46.79).

Measures

Participants completed all measures at T1, T2, and T3. All scales displayed satisfactory to high reliability across all measurement occasions (α ranging from .72 to .94).

Mindfulness

To assess whether the intervention increased mindfulness as intended and to identify which facets of mindfulness were changed, participants completed a 23-item version (Burzler et al., 2019) of the Five Facet Mindfulness Questionnaire (FFMQ, Baer et al., 2006; German translation: Tran et al., 2013). The questionnaire measures observing (4 items, e.g., “I notice the smells and aromas of things”), describing (4 items, e.g., “I’m good at finding the words to describe my feelings”), acting with awareness (4 items, e.g., “I find it difficult to stay focused on what’s happening in the present”), non-judging (4 items, e.g., “I tell myself I shouldn’t be thinking the way I’m thinking”) and non-reacting (7 items, e.g., "I perceive my feelings and emotions without having to react to them“). Items were rated on a scale from 1 (*never or very rarely true*) to 5 (*very often or always true*). We included this measure as a manipulation check.

Dispositional perfectionism

We measured perfectionistic concerns (5 items, e.g., “People expect nothing less than perfection from me”) and perfectionistic strivings (5 items, e.g., “I strive to be as perfect as I can be”) with the short version (Cox et al., 2002) of the Multidimensional Perfectionism Scale (Hewitt & Flett, 1991; German translation: Altstötter-Gleich, 1998). Participants responded on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7).

Perfectionistic cognitions

Perfectionistic concern cognitions (9 items, e.g., “I am not good enough”) and perfectionistic striving cognitions (4 items, e.g., “I want to perform particularly well at work”) were assessed using items derived by Prestele et al. (2020). Participants rated how often they

had experienced each thought in the past two weeks on a 6-point scale from 1 (*never*) to 6 (*almost all the time*).

Tension

To measure tension, we used a single item by Stiglmayr et al. (2010). On a ten-point scale scale ranging from 1 (*never*) to 10 (*constantly*), participants indicated how often they had "experienced unpleasant, inner tension" in the past two weeks.

Procrastination

We measured procrastination with 6 items from the procrastination scale of Tuckman (1991) used by Kühnel et al. (2016). The statements referred to the past two weeks (e.g. "I needlessly delayed finishing jobs, even when they were important) and were rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

Detachment

To assess detachment, we used 4 items from Sonnentag and Fritz (2007). Participants rated each statement (e.g., "During non-work time, I forgot about work.") on a scale from 1 to (*does not apply)* to 5 (*fully applies)* for the past two weeks.

Subjective sleep quality

Participants' subjective sleep quality was assessed using the corresponding item ("During the last two weeks, how would you rate your sleep quality overall?") from the Pittsburgh Sleep Quality Index (Buysse et al., 1989; German translation: Riemann & Backhaus, 1996) and rated on a scale ranging from 1 (*very bad*) to 4 (*very good*).

Control variables

Because the participants were predominantly female and included full- and part-time employees, we decided to include gender (0= female, 1= male) and average hours worked per week as control variables in all analyses. Meta-analyses suggest that recovery deficits such as rumination and sleep problems are more common in women (Johnson & Whisman, 2013; Zhang & Wing, 2006), whereas men tend to procrastinate more (Steel, 2007). Research has

also shown that reduced work time can improve recovery (Schiller et al., 2017). For perfectionistic striving cognitions and perfectionistic concern cognitions, we included the respective other dimension of perfectionistic cognitions and dispositional perfectionism as additional control variables to account for the overlap between the dimensions of perfectionism (Prestele et al., 2020; Stoeber & Gaudreau, 2017). Finally, for sleep quality, sleep duration was entered as a control variable to ensure that the effect of the intervention on sleep quality was not due to an increase in sleep duration. Crain et al. (2018) suggest that it is important to consider both sleep quality and quantity. A single item with an open answer format was used to assess sleep duration: “How many hours per night have you slept in the last two weeks?”.

Data Analyses

We used Chi-square and t-tests to examine group differences in baseline demographic and study variables, as well as differences between employees who participated in T2 and T3 assessments (completers) and those who did not respond to T2 and T3 measures (dropouts). Particularly in studies of app-based interventions, dropout is a common problem (Linardon & Fuller-Tyszkiewicz, 2020) and indicates the need for a special analysis strategy.

The repeated measures were analyzed using latent growth curve modeling (LGC; Duncan et al., 2013). LGC is a powerful statistical tool for studying trajectories over time because it incorporates both mean and covariance structure within one model (Willett & Bub, 2005). In contrast to repeated measurement ANOVA, latent growth models use all available information, thus a list-wise deletion is not necessary. In these models, the latent intercept is defined by fixing all paths to the observed variables over time at 1.0. The latent slope, which is the trajectory over time, can be modelled using different fixing values. Since we were interested in obtaining a detailed understanding of the change over time, we tested three different models: A model indicating a linear change by fixing the paths from the latent slope to the observed variable at 0, 1, and 2 (*continuous effect*); a model indicating a *sustainable*

effect, which we define as a change from T1 to T2, but no change from T2 to T3, by fixing the paths at 0, 1, and 1; and finally, a model indicating only a *short-term intervention effect* that is apparent at T2, but not at T3, by fixing the paths at 0, 1, and 0.

Conventional criteria (Browne & Cudeck, 1993; Hu & Bentler, 1999) were used to assess acceptable ($\chi 2$/df ratio < 3.00, CFI ≥ .90, RMSEA ≤ .08) or good ($\chi 2$/df ratio < 2.00, CFI ≥ .95, RMSEA ≤ .06) model fit to the data. Because the different slope models are not nested and cannot be tested using chi-squared difference test, the Aikake Information Criterion (AIC) was additionally used. Absolute AIC values cannot be interpreted, but when comparing models, lower values indicate a better fit to the data (Burnham & Anderson, 2004).

To test for different slopes in the intervention group compared to the control group, a dummy variable (0 = WLC, 1 = INT) was introduced to the model with paths to the latent intercept and latent slope. A significant path from this dummy variable to the latent slope indicates a different trajectory over time for the two groups.

To address our research question of whether participants high in dispositional perfectionism benefited more or less from the mindfulness intervention, we conducted additional analyses. In these models, we included T1 dispositional perfectionistic strivings and dispositional perfectionistic concerns and the multiplicative interaction between these two measures and the dummy variable (0 = WLC, 1 = INT) and estimated paths from these variables to the latent intercept and latent slope. A significant path from the perfectionism x group interaction to the latent slope indicates that the difference in trajectory over time for the two group varies as a function of dispositional perfectionism. All analyses were conducted using AMOS 27.0.

Results

Dropout Analyses

First, we tested whether the two groups differed in the study variables at T1. No significant differences were found, except for dispositional perfectionistic strivings and

perfectionistic striving cognitions, which were significantly higher in the WLC group, t(179) = 2.36, p = .019 and t(179) = 2.22, p = .028, respectively. We then inspected differences between employees who did not respond to T2 and T3 measures (dropouts) and those who participated in T2 and T3 assessments (completers). We found no significant differences between T2 and T3 dropouts and completers on their T1 study variables, with one exception. Compared to dropouts, T2 and T3 completers reported significantly lower initial procrastination scores, t(179) = -1.99, p = .048 and t(179) = -2.50, p = .013, respectively. Also, T3 completers were significantly older than dropouts, t(179) = -2.71, p = .008. We also examined missing data using Little's (1988) Missing Completely at Random test, which indicated that the missing data were random (p > .05). Table 2 presents means and standard deviations for the INT and WLC groups based on observed data.

Table 2

Means and standard deviations of study variables across time points for the intervention group and waitlist-control group

	Intervention Group			Waitlist-Control Group		
	T1 – before intervention	T2 – after intervention	T3 – follow up	T1	T2	T3
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Perfectionism						
PCC	2.56 (1.05)	2.24 (0.94)	2.34 (1.01)	2.78 (0.95)	2.62 (1.01)	2.63 (0.95)
PSC	3.60 (1.23)	3.62 (1.30)	3.57 (1.21)	3.97 (1.02)	3.83 (1.11)	3.94 (1.07)
Tension	6.45 (2.70)	5.69 (2.93)	5.46 (2.87)	6.44 (2.90)	6.01 (2.80)	6.42 (2.52)
Procrastination	2.45 (1.04)	2.19 (0.92)	2.16 (0.94)	2.56 (1.10)	2.58 (1.02)	2.68 (1.07)
Detachment	3.19 (1.14)	3.47 (1.14)	3.57 (1.10)	2.97 (0.99)	3.16 (1.04)	3.09 (1.04)
Sleep Quality	2.75 (0.67)	2.94 (0.69)	2.90 (0.72)	2.81 (0.66)	2.83 (0.59)	2.89 (0.59)
Mindfulness						
FFMQ total	3.39 (0.47)	3.56 (0.51)	3.57 (0.51)	3.29 (0.52)	3.36 (0.47)	3.37 (0.47)
Observing	3.53 (0.83)	3.74 (0.76)	3.78 (0.79)	3.46 (0.81)	3.39 (0.82)	3.34 (0.78)
Describing	3.52 (0.85)	3.75 (0.74)	3.63 (0.78)	3.40 (0.70)	3.44 (0.71)	3.44 (0.68)
Acting with awareness	3.20 (0.89)	3.33 (0.75)	3.40 (0.82)	3.29 (0.85)	3.38 (0.82)	3.29 (0.85)
Non-judging	3.72 (0.84)	3.87 (0.87)	3.88 (0.94)	3.51 (0.88)	3.68 (0.91)	3.78 (0.84)
Non-reacting	3.19 (0.72)	3.30 (0.68)	3.33 (0.67)	3.00 (0.68)	3.10 (0.69)	3.13 (0.65)

Note. PCC = perfectionistic concern cognitions, PSC = perfectionistic striving cognitions, FFMQ = Five Facet Mindfulness Questionnaire.

Manipulation check

Mindfulness. For the FFMQ total scale the best fitting model was the sustainable effect model. The significant positive path from group to the latent slope (b = .10, p = .012) indicates a steeper positive trajectory for the intervention group as compared to the control group. Considering the mindfulness facets, the best fitting model was the sustainable effect model for all facets except for acting with awareness, where the continuous effect model

provided the comparatively best fit. The significant positive paths from group to the latent slope for observing (b = .26, p = .003) and acting with awareness (b = .13, p = .007) indicate steeper positive trajectories for the intervention group as compared to the control group. For describing (b = .14, p = .058), non-judging (b = -.06, p = .504), and non-reacting (b = .06, p = .424), the paths from group to the latent slope were not significant. Thus, we can conclude that our intervention increased mindfulness, particularly the facets observing and acting with awareness (Hypotheses 1 and 3).

Table 3
Results of the latent growth analysis for mindfulness

		FFMQ_total	Observing	Describing	Acting with awareness	Non-judging	Non-reacting
Model A	Intercept	3.14***	3.76***	3.64***	**2.84*** **	3.07***	2.73***
0/1/2	Slope	-.03	.01	-.09	**-.09**	.07	-.02
Continuing	Group→int.	.12	.08	.14	**-.10**	.23	.20*
effect	Group→slope	.06*	.16***	.05	**.13** **	-.04	.03
	X2/df	2.91**	2.41*	2.59**	**1.55**	2.40*	2.49**
	CFI	.96	.96	.95	**.98**	.95	.96
	RMSEA	.10	.09	.09	**.06**	.09	.09
	AIC	62.20	57.73	59.32	**49.92**	57.57	58.39
Model B	Intercept	3.08***	3.70***	3.55***	2.73***	3.04***	2.69***
0/1/0	Slope	.18**	.25	.10	.17	.36*	.11
Short-term	Group→int.	.15*	.19	.14	.02	.18	.20*
effect	Group→slope	.04	.06	.14	-.06	-.01	.04
	X2/df	4.18***	3.26**	2.13*	2.33*	3.08**	3.32***
	CFI	.93	.93	.97	.96	.93	.94
	RMSEA	.13	.11	.08	.09	.11	.11
	AIC	73.64	65.31	55.18	56.99	63.70	65.06
Model C	Intercept	**3.10*** **	**3.70*** **	**3.62*** **	2.80***	**2.99*** **	**2.70*** **
0/1/1	Slope	**.03**	**.11**	**-.09**	-.07	**.27**	**.01**
Sustainable	Group→int.	**.11**	**.07**	**.11**	-.08	**.23**	**.19**
effect	Group→slope	**.10***	**.26** **	**.14**	.16*	**-.06**	**.06**
	X2/df	**2.21***	**1.67**	**1.86**	1.96*	**2.25***	**1.83**
	CFI	**.97**	**.98**	**.97**	.97	**.96**	**.98**
	RMSEA	**.08**	**.06**	**.07**	.07	**.08**	**.07**
	AIC	**55.91**	**51.07**	**52.71**	53.67	**56.28**	**52.50**

Notes. Bold: the relatively best fitting model, using AIC as criteria, group: 1 = intervention group / 0 = waitlist-control group

Main Analyses

Perfectionistic cognitions. The best fitting model for perfectionistic concern cognitions was the sustainable effect model. The significant negative path from group to the latent slope (b = -.20, p = .039) indicates that perfectionistic concern cognitions decreased in the intervention group compared to the wait-list control group from T1 to T2. For perfectionistic striving cognitions, the relatively best-fitting model was the short-term effect model. However, the path from group to the latent slope was not significant (b = -.02, p = .854).

Tension. For tension, the sustainable effect model showed the best fit. The significant path from group to the latent slope (b = -.71, p = .013) indicates a steeper decline in tension in the intervention group from T1 to T2.

Procrastination.

The best fitting model was the continuous effect model. The significant negative path from group to the latent slope (b = -.21, p = .003) indicates that procrastination decreased in the intervention group compared to the wait-list control group from T1 to T3[5].

Detachment.

For detachment, the sustainable effect model provided the best fit to the data, but the intervention and control groups did not differ in their trajectories over time (b = .15, p = .271).

Subjective sleep quality.

The best fitting model was the short-term effect model. The significant positive path from group to the latent slope (b = .18, p = .030) indicates a steeper positive trajectory for the intervention group compared to the control from T1 to T2.

We can conclude that we found support for a sustainable effect of the app-based intervention on perfectionistic concern cognitions and tension, a continuous effect on procrastination, and a short-term effect on sleep quality. Thus, Hypotheses 6a, 7, 8, and 10 were supported.

[5] Because T2 and T3 completers reported significantly lower initial procrastination scores, we also ran the model including only employees who completed all study assessments. The path from group to the latent slope (b = -.21, p = .005) was also significant and negative. Thus, the effect is not due to attrition.

Table 4
Results of the latent growth analysis for study outcomes

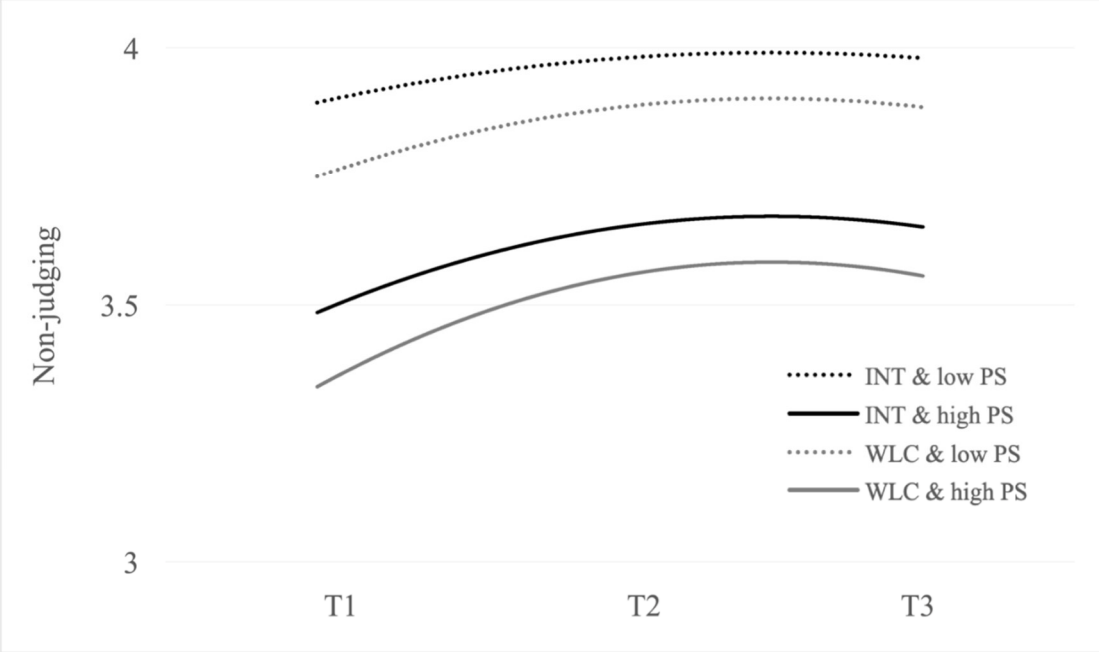
		Perfectionistic concern cognitions	Perfectionistic striving cognitions	Tension	Procrastination	Detachment	Subjective sleep quality
Model A	Intercept	1.61***	2.33***	7.32***	**2.49*** **	3.14***	1.69***
0/1/2	Slope	.34	.25	.32	**.19**	.05	.21
Continuing	Group→int.	-.14	-.26	-.02	**-.13**	.20	-.04
effect	Group→slope	-.09	.02	-.46*	**-.21****	.12	.06
	X2/df	1.94**	2.79***	2.36*	**1.53**	1.92*	2.12*
	CFI	.95	.90	.94	**.98**	.95	.92
	RMSEA	.07	.10	.09	**.05**	.07	.08
	AIC	106.71	124.61	57.25	**49.74**	53.31	72.23
Model B	Intercept	1.76***	**2.29*** **	7.59***	2.64***	3.12***	**1.89*** **
0/1/0	Slope	.43*	**.55***	-.05	.05	.29	**-.03**
Short-term	Group→int.	-.16	**-.25**	-.32	-.27	.30*	**-.04**
effect	Group→slope	-.18*	**-.02**	-.18	-.11	-.04	**.18***
	X2/df	1.94**	**2.27****	3.12**	2.39*	2.25*	**1.83***
	CFI	.95	**.93**	.91	.94	.93	**.93**
	RMSEA	.07	**.08**	.11	.09	.08	**.07**
	AIC	106.69	**113.56**	64.08	57.51	56.21	**68.09**
Model C	Intercept	**1.53*** **	2.13***	**7.36*** **	2.48***	**3.08*** **	1.70***
0/1/1	Slope	**.46***	.73**	**.47**	.32	**.20**	.31
Sustainable	Group→int.	**-.11**	-.26	**.00**	-.11	**.22**	-.08
effect	Group→slope	**-.20***	.01	**-.71***	-.35**	**.15**	.16
	X2/df	**1.47**	2.68***	**1.93***	1.54	**1.59**	2.06*
	CFI	**.98**	.91	**.96**	.98	**.97**	.92
	RMSEA	**.05**	.10	**.07**	.06	**.06**	.08
	AIC	**96.81**	122.32	**53.40**	52.33	**50.29**	70.85

Notes. Bold: the relatively best-fitting model, using AIC as a criterion, group: 1 = intervention group / 0 = waitlist-control group

Moderating effects of dispositional perfectionism

We also examined whether dispositional perfectionism affected differences in trajectories over time between the two groups. Overall, we found no significant paths from the perfectionism x group interaction to the latent slope indicating that individuals high in dispositional perfectionism did neither benefit more nor less from the mindfulness intervention. However, for the non-judging facet, the path from the perfectionistic striving x group interaction to the latent slope was positive and significant (b = .19, p = .046), indicating that perfectionistic strivings affected the non-judging trajectory more strongly in the INT group, such that participants high in perfectionistic strivings reported steeper trajectories as compared to those low in perfectionistic strivings in the INT group.

Figure 2
Growth trajectories of non-judging over the course of the study



Note. INT = intervention group; WLC = waitlist control group; high PS = high perfectionistic strivings; low PS = low perfectionistic strivings.

Discussion

We investigated whether employees who participated in the intervention would report higher levels of mindfulness and its facets (Hypotheses 1-5): observing, describing, acting with awareness, non-judging, and non-reacting. The primary purpose of this study was to examine whether employees who participated in a brief (two weeks) and low-dose (10 units of 9–15 minutes each) app-based mindfulness intervention would report reductions in perfectionistic cognitions (Hypothesis 6), tension (Hypothesis 7), procrastination (Hypothesis 8), and improvements in detachment (Hypothesis 9) and sleep quality (Hypothesis 10), compared with participants in the waitlist control condition. In an additional analysis, we examined whether participants high in dispositional perfectionism showed greater or weaker improvements in mindfulness.

Our results highlighted that our intervention increased mindfulness, and in particular the facets of observing and acting with awareness. Observing thoughts and feelings and focusing attention on the activities of the present moment might imply having more control

over thoughts, feelings, and behaviors. Results for the facets describing, non-judging and non-reacting showed only small descriptive improvements. It may be that some facets of mindfulness take longer to develop than others (Querstret et al., 2017), or that a longer and/or more intensive mindfulness practice is required to develop some facets of mindfulness.

The results showed that the app-based intervention had beneficial effects on all functional domains according to the comprehensive framework by Good et al. (2016). In terms of cognitive functioning, the intervention had a sustainable effect on PCC, providing an opportunity to intervene early in the process between perfectionism and impaired recovery. Given the variety of negative outcomes associated with perfectionistic concerns, their reduction is generally desirable, and the positive findings on reducing perfectionistic cognitions in employees are a promising starting point for interventions. The results also showed a sustainable effect on tension, an emotional state of stress, supporting a positive impact on emotional functioning and highlighting that low-dose app-based interventions have beneficial effects on employee stress.

The continuous effect on procrastination, indicating a linear reduction over time, highlights that app-based mindfulness interventions can improve employees' behavioral functioning, i.e. improved self-regulation. To the best of our knowledge, this is the first study to examine the effects of mindfulness interventions on procrastination. Thus, our study extends the applicability of mindfulness interventions to this important behavioral outcome. The dropout analysis indicates that the dropouts reported significantly higher initial procrastination than completers. This finding may indicate that dropouts were more reluctant to participate in the intervention, and one might assume that the effect of the intervention on procrastination was driven by this difference. However, the result remained stable when only employees who completed all study assessments were included. However, the question remains whether individuals with high levels of procrastination would also benefit. Thus, an

over- or underestimation of the importance of mindfulness for procrastination cannot be completely ruled out.

Contrary to our expectations no intervention effect was found for detachment. Results showed descriptive improvements in the intervention group, but participants in the wait-list control group also reported some increase in detachment at T2. This finding is consistent with previous research that also found no effect of a 10-day mindfulness intervention with morning and evening mindfulness practice on detachment (Hülsheger et al., 2015). One reason may be that our intervention was too short and/or too low in dose. It could also be that specific intervention content not included in our intervention is more conducive to detachment. For example, a three-week online mindfulness intervention with a minimum duration of approximately 120 minutes and modules that specifically targeting cognitive-emotional strategies, enabled employees to better switch off after work (Althammer et al., 2021).

For sleep quality, the results showed a short-term intervention effect, indicating the effectiveness of app-based interventions also in the physiological domain. Ongoing or more time-intensive mindfulness practice may be required to maintain the initial effects on sleep quality. Previous research showed that the effect of a longer-term online mindfulness intervention (almost seven weeks with 10 sessions of 30 minutes each) was maintained at three and six months follow-up (Querstret et al., 2017).

The results of the additional exploratory analysis indicated that individuals high in dispositional perfectionism did neither benefit more nor less from the mindfulness intervention. However, the results showed that the effect of the mindfulness intervention on the non-judging facet was stronger when participants were high in perfectionistic strivings. Overall, these results are encouraging. While individuals high in dispositional perfectionism may be resistant to treatment in a clinical treatment context (see Hewitt et al., 2017), perfectionism does not appear to be a barrier to engaging in mindfulness in the context of workplace interventions.

Potential limitations, and suggestions for future research

One limitation of the present study is the use of self-report measures, which may be subject to memory distortions or socially desirable behavior (Podsakoff & Organ, 1986). Given our interest in mental states, particularly in relation to PCC and detachment, self-report measures can be considered appropriate for these variables (see also Chan, 2009, for a detailed discussion). Subjective and objective indicators of well-being show high correlations (Oswald & Wu, 2010), but subjective ratings, for example of one's sleep, may differ from objective indicators (Jackowska et al., 2011), and subjective experiences may differ from actual behavior. Future research could use a combination of subjective and more objective methods and, for example, assessing procrastination through external ratings or sleep quality through actigraphy. In addition, we were unable to objectively track when and for how long participants in the intervention group practiced each unit. By including a tracking system in future research, it will be possible to identify the most effective duration and timing of mindfulness practice.

Although our study includes a follow-up after two weeks, the question remains as to how the sustainable effect for PCC, tension, and the continuous effect for procrastination develop over longer periods of time. To extend our findings, future research could include additional follow-up measures after several weeks or even months and examine continued use of the app. These would provide important information about whether and how long participants continue to practice on their own, and how long the effects of the training persist. With regard to detachment and sleep quality, future research could consider a longer and/or higher dose of treatment. By extending the training period to more weeks and/or longer units, it could be investigated whether the effect of detachment develops later and whether the effect of sleep quality remains stable.

Regarding the generalizability of our findings, the sample was predominantly female (75.8%) and half of the participants had a university degree (50.0%), which also limits the

generalizability of the results. Possible explanations for the high proportion of female participants could be a greater willingness to participate in psychological studies, or that recruitment focused more on the health and social service sector, where women are predominantly employed. The highly-educated sample may also have come from recruitment via university staff mailing lists. In future studies, more diverse samples are needed to increase the generalizability of the findings.

In the present study, we used a wait-list control group design, which allows all participants to receive the intervention and is common in the initial evaluation of an intervention. However, such a design can lead to expectation bias (Hülsheger et al., 2013) and does not allow for conclusions about comparative effectiveness. Future studies could consider including an active control group and comparing the app-based intervention with alternative app-based interventions, such as progressive muscle relaxation. As noted by Bostock et al. (2019), it is a challenge to identify active comparison apps that provide an equivalent number and duration of sessions. It would also be important to control for digital placebo effects (Torous & Firth, 2016) and to compare the app-based intervention with other forms of delivery.

Despite the easy accessibility and efficiency of app-based interventions, it should be noted that mindfulness interventions place the responsibility for reducing stress, dysfunctional cognitions and behaviors, and recovery on the individual employee (Bostock et al., 2019). While these interventions can be seen as an important component in improving employee well-being, they should be integrated into comprehensive approaches that also include changes at the organizational level (Jamieson & Tuckey, 2017). Organizations should question their own role in creating an overly demanding climate, and the presence of stressors that may impair recovery.

Conclusion

This study advances both the perfectionism and the mindfulness literatures by providing evidence that a brief, low-dose, app-based mindfulness intervention, that can be practiced anywhere, anytime may be a less time-consuming way for employees and a promising, cost-effective way for organizations to reduce multiple outcomes associated with perfectionism. This intervention can reduce PCC, tension, and procrastination, while simultaneously improving sleep deficits in the short term. These findings are encouraging and demonstrate that a comparatively small and regular investment of time can lead to positive intervention effects. Thus, our findings suggest that the "hype" surrounding mindfulness-based interventions seems to justified, as these interventions can impact different functional domains. App-based interventions may be integrated into comprehensive occupational health approaches.

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Appendix D: Manuscript 4

I can't get no Sleep:

The Role of Leaders' Health and Leadership Behavior on Employees' Sleep Quality

Authors: Eva Matick, Maria U. Kottwitz, Thomas Rigotti, and Kathleen Otto

Status: Published in *European Journal of Work and Organizational Psychology*

Matick, E., Kottwitz, M. U., Rigotti, T., Otto, K. (2022). I can't get no sleep: The role of Leaders' health and leadership behavior on employees' sleep quality**.** *European Journal of Work and Organizational Psychology*. https://doi.org/10.1080/1359432X.2022.2077198.

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European Journal of Work and Organizational Psychology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/pewo20

I can't get no Sleep: The Role of Leaders' Health and Leadership Behavior on Employees' Sleep Quality

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To cite this article: Eva Matick, Maria U. Kottwitz, Thomas Rigotti & Kathleen Otto (2022) I can't get no Sleep: The Role of Leaders' Health and Leadership Behavior on Employees' Sleep Quality, European Journal of Work and Organizational Psychology, 31:6, 869-879, DOI: 10.1080/1359432X.2022.2077198

To link to this article: https://doi.org/10.1080/1359432X.2022.2077198

EUROPEAN JOURNAL OF WORK AND ORGANIZATIONAL PSYCHOLOGY
2022, VOL. 31, NO. 6, 869–879
https://doi.org/10.1080/1359432X.2022.2077198

I can't get no Sleep: The Role of Leaders' Health and Leadership Behavior on Employees' Sleep Quality

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ABSTRACT

A leader's role is often associated with increased psychosocial demands, which could lead to rumination during nonwork time. Leader rumination might trigger a cascade of mechanisms causing employee rumination and eventually persistent employee sleep problems. In a three-wave study, we examined whether leader rumination predicts changes in employee sleep quality linked by employee rumination. As a possible serial mechanism underlying the trickle-down effect of leader rumination on employee rumination, we investigated leaders' general health and resource-oriented leadership behaviour. Based on self-report data from 94 leaders and their 332 employees, we found support for a multilevel mediation model in which leader rumination negatively affected employee sleep quality via employee rumination while controlling for baseline measures and a shared work environment (workload). Finally, leader rumination was negatively related to employee sleep quality via the serial mediation of leader health, resource-oriented leadership, and rumination perceived by the team members. The results demonstrate the importance of leader rumination for employees' sleep quality nearly 2 years later and provide knowledge that can be used to expand and optimize interventions.

ARTICLE HISTORY
Received 6 July 2021
Accepted 6 May 2022

KEYWORDS
Rumination; trickle-down effect; leader health; leadership behaviour; sleep quality

Most adults have experienced the effects of not being able to fall asleep or sleep through the night. Restful sleep has critical implications for employees' health, performance, and occupational safety (Brossoit et al., 2019; Litwiller et al., 2017). However, sleep problems are common among employees and have even increased in recent years (Kronholm et al., 2016). Identifying causes of impaired sleep and potential factors promoting employees' sleep quality is, therefore, of utmost importance. In addition to adequate job demands (Van Laethem et al., 2018) or perceived social support (Matick et al., 2021), leaders also play an important role in improving employees' sleep quality (Sianoja et al., 2020). For example, they may engage in leadership behaviours specifically aimed at improving sleep, such as asking employees about their sleep habits and encouraging them to get enough sleep (Gunia et al., 2015).

However, leaders could also influence the sleep quality of their employees unfavourably through their strain symptoms. Due to their high psychosocial demands and sense of responsibility, leaders are prone to having thoughts about work during nonwork time (Matick et al., 2021). Next to the explicit leadership behaviour on which previous research has focused (Sianoja et al., 2020), strain symptoms, such as leader rumination during nonwork time (i.e., recurring thoughts about problems at work), might start a process leading to the rumination of members in the team. According to the effort-recovery theory (Meijman & Mulder, 1998), incomplete recovery through rumination might ultimately lead to persistent sleep problems of employees (Van Laethem et al., 2018). By examining leader rumination as a potential antecedent for employees' sleep quality and employees' rumination as a mechanism of this effect, our study broadens our understanding of the role of leaders in employees' sleep quality.

Moreover, we explored the mechanisms that might explain a cross-over of rumination between a leader and their team members. Based on the theoretical assumption that leaders can influence employee health by creating a work environment that includes features of the work design (Wegge et al., 2014), we propose that leader rumination leads to a higher level of leader health complaints (Weigelt et al., 2019), which shapes leadership behaviour (Kaluza et al., 2019; Klebe et al., 2021a) and affects the rumination of the team members (Klebe et al., 2021b). Leaders' health and their consequences for their leadership behaviour might explain the trickle-down effect, in which leader behaviours can be passed on to employees down the organizational hierarchy.

Finally, by incorporating the concept of resource-oriented leadership, we provided an alternative and more indirect pathway to explain how leaders affect the sleep quality of employees, which, to the best of our knowledge, has not yet been investigated. The resource-oriented leadership concept is based on the idea that leaders shape the task characteristics of their employees; as such, they can be a source of resources. In contrast to leadership behaviours that directly aim at improving employees' sleep (e.g., the leader asks employees about their sleep habits), which could be problematic in certain contexts, resource-based leadership focuses on broadly designing healthy work environments that increase job resources and sustain well-being.

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/1359432X.2022.2077198

We make three important contributions to the occupational health psychology literature. First, our study contributes to the literature on the role of leaders for employees' sleep quality by analysing whether, next to explicit leadership behaviour, the rumination of leaders during nonwork time also predicts changes in employees' sleep quality over time and whether this effect can be explained by employee rumination. Second, we contribute to a better understanding of the processes underlying the trickle-down process of leader rumination on employee rumination by analysing the role of leaders' general health and their leadership behaviour. Finally, by considering resource-oriented leadership, we gained new insights into the importance of this specific leadership behaviour for the sleep quality of employees. Overall, these results provide knowledge that can be used to expand and optimize interventions to improve the sleep quality of employees.

Leader and employee rumination

We suppose that leaders' and their team members' ruminations are positively related. Rumination can be seen as a strain symptom that mediates acute stress and health symptoms (Mohr et al., 2005). Moreover, rumination indicates recurring thoughts about problems at work during nonwork time and is caused by an experienced imbalance between resources and demands.

Besides rumination, researchers have highlighted several related constructs on stress and recovery that describe different facets of thoughts about work during nonwork time. The concept of psychological detachment, for example, refers to mentally switching off from work (Sonnentag & Fritz, 2007). Cropley et al. (2012) further distinguished between affective rumination, the recurring negative thoughts about work, and problem-solving pondering (i.e., a less intrusive mental preoccupation with work that can help solve work-related problems). A further distinction was made between positive work reflection – in the sense of thinking about positive aspects of work (Fritz & Sonnentag, 2005) – and negative work reflection – thinking about negative aspects of work (Binnewies et al., 2009). Weigelt et al. (2019) found that the constructs described above can all be empirically viewed as distinct factors correlating to varying degrees with indicators of employee well-being. Thereby, negative aspects of work-related thoughts (e.g., negative work reflection) better predict impaired employee well-being (e.g., sleep problems) than the positive aspects (e.g., positive work reflection).

Based on Wegge et al. (2014) theoretical framework describing how leaders can influence employee health, we hypothesized that leader rumination could lead to employee rumination through system-focused action. System-focused action represents a possible way in which leaders indirectly affect rumination among their employees by creating a stressful working environment through their strain symptoms. Leaders who ruminate about problems at work during nonwork time often show strain symptoms, such as sleep problems or fatigue (Mohr et al., 2005; Van Laethem et al., 2018), which are associated with more destructive and less constructive leadership behaviour – a behaviour that has negative consequences for employees (Kaluza et al., 2019; Klebe et al., 2021a, 2021b).

Recently, Sonnentag and Schiffner (2019) showed a trickle-down effect of leader detachment on employee detachment in a sample of 59 dyads. In their study, employees' and leaders' ratings of detachment were gathered at similar time points. If employees do not detach from work, the valence of thoughts is not defined, compared to rumination, where thoughts about work are more related to problems and are recurring. We aimed to replicate and extend the findings of Sonnentag and Schiffner (2019) using a larger sample, a longitudinal design (in which leader rumination precedes employee rumination), and longer time intervals while focusing on rumination instead of detachment, considering autoregressor employee rumination, and controlling for the shared work environment. Thus, we proposed the following hypothesis:

Hypothesis 1: Leader rumination at T1 will lead to increased rumination of their team members on average at T2 (a_2; Level 2).

The hypothesized model can be seen in Figure 1.

Employee rumination and employee sleep quality

According to the perseverative cognition model of stress (Brosschot et al., 2005), perseverative cognition about stressors (e.g., ruminating about deficits in leadership quality or high job demands) may lead to prolonged affective and physiological activation that inhibits recovery and leads to the development of sleep problems. Thus, rumination may prevent psychophysiological systems from returning to their initial state, which may impair sleep quality. Meijman and Mulder (1998) suggested in their effort-recovery theory that short-term psychophysiological reactions (e.g., increased blood pressure and affective distress) are reversible when the person recovers after work. In cases of continued exposure to job demands and incomplete recovery (e.g., due to rumination), the psychophysiological reactions persist over time and result in a suboptimal state in employees. Therefore, employees must invest additional effort to perform their work tasks, which leads to an increased load reaction. This load reaction can accumulate and result in chronic health complaints, such as persistent sleep problems.

Previous longitudinal research identified rumination as a mechanism explaining the relationship between several work stressors (i.e., deficits in leadership quality or high job demands) and sleep problems (Kinnunen et al., 2017; Van Laethem et al., 2018). Building on this previous research and theoretical assumptions, we proposed the following hypothesis:

Hypothesis 2: Employee rumination at T2 will lead to reduced sleep quality at T3 (b_1; Level 1).

Combining the reasoning that led to the first two hypotheses, an indirect effect of leader rumination on employees' sleep quality through employee rumination is plausible, which led us to the following hypothesis:

Hypothesis 3: The negative effect of leader rumination at T1 on employee sleep at T3 will be mediated by employee rumination at T2. Specifically, leader rumination will lead to increased

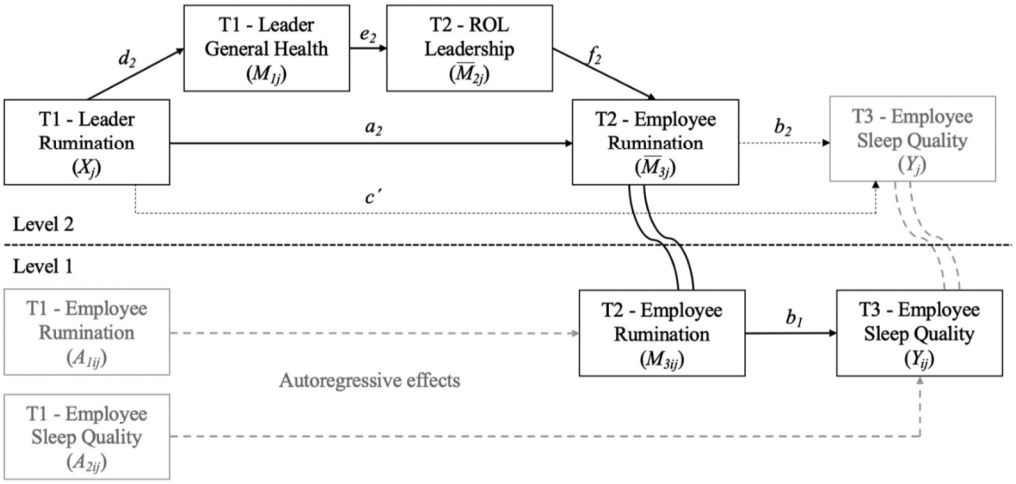

Figure 1. Design of the 2-2-2-1-1 model with cross- and unique cluster-level mediation.
Note: Within-team indirect effects (a_2x b_1; d_2x e_2x f_2x b_1) and the between-team indirect effects (a_2x b_2; d_2x e_2x f_2x b_2), where the solid lines represent the paths relevant to the hypotheses and the curved lines illustrate the change between the levels. X_j,M_{1j}, and Y_j represent leader rumination, leader general health, and employee sleep quality for a particular team j, $\bar{M}_{2j}$, and $\bar{M}_{3j}$ represent resource-oriented leadership and employee rumination aggregate to the team level for a particular team, M_{3ij}, and Y_{ij} represent employee rumination and sleep quality, respectively, for employee i in team j.

rumination of their team members on average (a_2; Level 2) and employee rumination will lead to reduced sleep quality (b_1; Level 1).

Leaders' and employees' rumination: leaders' health and leadership behaviour as mechanisms

In the following section, we shed light on possible mechanisms linking leader rumination to their team members' sleep quality. We propose that leader rumination predicts employee rumination via leader health and leadership behaviour. Specifically, we suggest that leader rumination is negatively associated with leader general health. Based on the perseverative cognition model of stress (Brosschot et al., 2005) and the effort-recovery theory (Meijman & Mulder, 1998), rumination during nonwork time may lead to prolonged affective and physiological activation in the short term, which inhibits recovery and leads to health complaints in the long term (Weigelt et al., 2019; Wendsche & Lohmann-Haislah, 2017). For leaders, rumination and incomplete recovery could thus lead to health complaints over time.

These health complaints may, in turn, affect leadership behaviour. Following the conservation of resources theory (CoR; Hobfoll, 1989), leaders' health may be considered an important resource that directly facilitates constructive leadership behaviours. Leaders who experience a loss of resources due to health complaints may attempt to protect their remaining resources by engaging less in resource-consuming passive leadership (Kaluza et al., 2019). Referring to leaders' health as a resource, Klebe et al. (2021a) showed leader strain reduces health-oriented leadership. Moreover, leader burnout can reduce employees' personal and job resources (i.e., self-esteem and social support), which lead to employee burnout (Huang et al., 2016).

Consequently, the question of which leadership behaviour is suitable for reducing employees' rumination and increasing their sleep quality arises. For example, employees who perceive more health-oriented leadership behaviour report less rumination (Klebe et al., 2021b). Contrary to expectations, higher employee ratings in family-supportive supervisor behaviour – leader behaviour that helps employees balance work and nonwork domains – (Crain et al., 2014) were not related to better sleep quality (Sianoja et al., 2020). Thus, not all constructive leadership behaviours appear to contribute to better sleep quality.

We assumed that resource-oriented leadership leads to reduced rumination of the team members and thus improves employees' sleep quality. Thereby, the leader is seen as (co-) designer of employee resources (e.g., influencing the scope of action, conflict management, fairness and participation; Vincent-Höper & Stein, 2019). These job resources facilitate the achievement of work goals and reduce job demands and related strain symptoms (Sonnentag & Fritz, 2015), such as rumination. Previous research suggested that adequate job demands (e.g., workload) and high levels of resources (e.g., social resources) can contribute to reducing work-related thoughts and promoting employee sleep (Matick et al., 2021). According to Wegge et al. (2014), leaders can use system-focused action to create a healthy work environment. Thus, through resource-focused leadership, leaders may provide their employees with resource-oriented working conditions to reduce rumination and increase sleep quality.

In summary, we proposed that leaders shape team health both as actors and responders. Building on the theoretical framework of Wegge et al. (2014), we proposed that resource-oriented leadership affects rumination of the team members and employees' sleep quality through the design of the work environment. Furthermore, we extended these theoretical considerations of healthy leadership behaviour using common

recovery theories – perseverative cognition model of stress (Brosschot et al., 2005), effort-recovery theory (Meijman & Mulder, 1998), and the CoR theory (Hobfoll, 1989) – to include leaders' strain symptoms and their health as further important antecedents of their leadership behaviour and the associated employee health.

Therefore, we hypothesized that the rumination of the leader shows a negative indirect effect on the sleep quality of employees via serial mediation of health complaints of the leader, a perceived lack of resource-oriented leadership by the team, and employee rumination.

Hypothesis 4: The negative effect of leader rumination at T1 on employee sleep quality at T3 will be serially mediated by leader general health at T1, resource-oriented leadership at T2, and employee rumination at T2. Specifically, leader rumination is negatively associated with leader general health (d_2; Level 2), which leads to reduced resource-oriented leadership (e_2; Level 2). Resource-oriented leadership, in turn, is negatively associated with rumination of the team members on average (f_2; Level 2), and employee rumination will lead to reduced sleep quality (b_1; Level 1).

Method

Procedure

The data reported in this manuscript originated from a larger research project on health-promoting leadership (Rigotti et al., 2014). To recruit participants, organizations from various industries, such as banking, auditing, social services, education, and facility management, in Germany were contacted through their human resource departments or executive management. Employee representatives were involved in the process, and their consent was obtained. Confidential and anonymous treatment of the data was ensured. The study follows the principles of the Declaration of Helsinki, and informed consent was obtained from all participants included in the study. Participants could complete the surveys online (web-based) or offline (paper and pencil) at three time points with a time lag of 14 months between Time 1 (T1 – February 2012) and Time 2 (T2 – August 2012) and 8 months between Time 2 (T2) and Time 3 (T3 – February 2013). The time lags were chosen to fulfil the objectives of the larger research project on health-promoting leadership.

The time it takes for a trickle-down effect to occur depends on the construct being transferred and the mechanisms underlying the transfer (Wo et al., 2019). The trickle-down effect of leader rumination on employee rumination via leaders' general health and leadership that promotes resources takes time to form. Therefore, we assessed leader and employee rumination with a time lag of 14 months and the mechanism leaders' general health at the first measurement point and resource-oriented leadership at the second measurement point. For the time interval of the effect of employee rumination on employee sleep quality (time lag of 8 months), we followed previous studies (e.g., Kinnunen et al., 2017) to investigate long-term processes. One criterion for participation was that leaders should interact regularly and personally with their employees. To match responses across measurement points, leaders and their team members received an individualized code.

Sample

The sample at T1 consisted of 137 leaders and 1,203 employees. When matching participants across teams and measurement points, we excluded (a) leaders who did not provide information about rumination at T1, (b) employees who did not provide information about rumination at T2 and sleep quality at T3, (c) participants who changed their team or role (i.e., employee position to a leadership position), and (d) teams including only the leader. Consequently, the final sample at T1 included data from 122 leaders and their 853 employees. Exclusions and dropouts reduced the sample at T2 (118 leaders, 536 employees) and T3 (94 leaders, 332 employees). Between T1 and T2, the response rates were 96.72% for leaders and 62.84% for employees, and between T2 and T3, they were 79.66% for leaders and 61.94% for employees.

Dropout analyses were conducted comparing participants who participated at both T1 and T2 (completers) with participants who did not participate at T2 (dropouts) in the study variables of T1 as well age, gender, negative life events, and workload. Completers and dropouts of the employees did not significantly differ for any variable. Among leaders, the only differences between completers and dropouts were the higher percentage of women, 59% vs. 0%, $\chi^2(1, N = 120) = 5.57$, $p = .018$ and higher ratings of workload, 3.74 vs. 3.55, $t(120) = -2.70$, $p = .019$ among the completers. Furthermore, participants who also participated at T2 and T3 (completers) were compared with participants who did not participate at T3 (dropouts) in the study variables of T2 as well age and gender. No differences were found between completers and dropouts of the employees except for the percentage of women, 83% vs. 74%, $\chi^2(1, N = 536) = 6.19$, $p = .013$, and ratings of resource-oriented leadership were higher for the completers than for the dropouts, 3.64 vs. 3.48, $t(367) = -2.56$, $p = .011$. Detailed information on the dropout analyses can be found in the supplemental material in Table S1.

The final sample across the waves consisted of 94 leaders (57.4% women), whose ages ranged from 27 to 62 years ($M = 44.23$, $SD = 8.18$) and their 332 employees (82.50% women), whose ages ranged from 20 to 59 years ($M = 40.50$, $SD = 9.59$). Leaders worked on average more hours per week ($M = 44.71$, $SD = 5.94$) than their employees ($M = 39.21$, $SD = 5.24$). From the teams of participants, on average 3.53 members ($SD = 2.16$) took part in the survey and employees worked with their leader for an average of 4.32 years ($SD = 4.20$). The majority of participants worked in the private sector (76.50%).

Measures

Rumination

Leaders' self-reported rumination at T1 and employees' self-reported rumination at T1 and T2 were measured using three items from the corresponding subscale of the Irritation Scale (Mohr et al., 2005). A sample item is, "Even at home I often must

think of my problems at work." Participants responded on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). The scale was reliable for both leaders (T1, α = .79) and employees (T1, α = .79, T2, α = .85).

Leaders' general health

The self-reported general health of leaders at T1 was measured by the item, "In general, how would you say your health is?" from the Copenhagen Psychosocial Questionnaire (Pejtersen et al., 2010). Ratings were given on a 5-point scale ranging from *poor* (1) to *excellent* (5).

Resource-oriented leadership

Resource-oriented leadership at T2 was assessed through employees using 13 items from the Health- and Development-Promoting Leadership Questionnaire (Vincent, 2010). The scale consists of four subscales that describe leadership behaviours (referring to "My immediate superior . . . ") related to the following resources: scope of action (e.g., " . . . allows me to decide for myself how I organize my tasks."), conflict management (e.g., " . . . searches for solutions to conflicts with those involved."), fairness (e.g., " . . . judges my performance justly and fairly."), and participation (e.g., " . . . includes me in decisions that affect my work or workplace environment."). Employees answered the items on a 5-point response scale ranging from *strongly disagree* (1) to *strongly agree* (5). Cronbach's alpha was .89.

We conducted a confirmatory factor analysis to validate the proposed one-factor model for the resource-oriented leadership scale and computed three different models using TYPE = COMPLEX in Mplus. The four-factor model (with separate factors for scope of action, conflict management, fairness, and participation) demonstrated a better fit, $\chi^2(59) = 144.42$, CFI = .953, TLI = .938, RMSEA = .066, than a one-factor model, $\chi^2(65) = 482.02$, CFI = .772, TLI = .726, RMSEA = .139, indicating that leaders show different combinations of the different facets in their behaviour. A model with a second-order factor fitted slightly worse, $\chi^2(61) = 196.78$, CFI = .926, TLI = .905, RMSEA = .082, than the four-factor model but still showed a good fit. Given that (1) we assumed leaders who show more of the various behaviours on average give more resources to their employees overall and (2) we have no differential assumptions regarding the effect of individual facets, we used the resource-oriented leadership scale as a global leadership factor.

Employee s' sleep quality

Employees' self-reported sleep quality at T1 and T3 was assessed by the item, "How often have you had sleep problems at night?" When answering the item, employees were told to refer to the last 2 weeks and indicate how often they had sleep problems on a 6-point scale: *at no time* (0), *some of the time* (1), *slightly less than half of the time* (2), *slightly more than half of the time* (3), *most of the time* (4), *all the time* (5). The item was recoded so that high values indicated good sleep quality and low values indicated poor sleep quality.

Control variables

To show changes in employees' rumination and sleep quality over time, the baseline levels of the mediator and the outcome variable were considered as control variables at the individual level (autocorrelation; initial rumination and sleep quality). All control variables included in this study were regressed on employee rumination (T2) and employee sleep quality (T3) at the individual level. We controlled for age (in years) and sex (0 = female, 1 = male), as previous research has shown that rumination (Nolen-Hoeksema et al., 1999) and sleep problems (Zhang & Wing, 2006) are more common among women. While younger people ruminate more than older people (Sütterlin et al., 2012), sleep problems increase with age (Ohayon, 2002). Furthermore, because many different physical and psychological health outcomes (e.g., cardiovascular or depressive symptoms) are negatively related to rumination (Cropley et al., 2017; Perko et al., 2014) and sleep quality (Newman et al., 1997), we controlled for the general health of employees at T1 using the same single item as for the leaders. Since events in the nonwork area also affect sleep quality (Crain et al., 2018), we controlled for employees' negative life events at T1 using a single item: "Over the past 12 months, have you experienced some major life event which has affected your well-being negatively (e.g., divorce, serious disease, serious disease or death of someone close to you, an accident, economic collapse)?" Participants answered on a 3-point scale: *no* (1), *yes, one* (2), *yes, several* (3).

Finally, a strong predictor of rumination and sleep quality is workload (Kinnunen et al., 2017; Van Laethem et al., 2018). Thus, another alternative explanation of the effect of rumination of leaders on employees could be that both leaders and employees have similarly high job demands leading to increased rumination in both (Westman, 2001). To take a shared work environment into account, we controlled for employee workload (T1) at the individual level as well as for leader workload (T1) at the team level. Therefore, we assessed self-reported workload with four items by Spector and Jex (1998). Participants answered items such as, "How often does your job require you to work very hard?" on a 5-point scale ranging from *very seldom or never* (1) to *very often or always* (5). The scale was reliable for both leaders (α = .81) and employees (α = .84).

Statistical analysis

Due to the hierarchically structured data with employees (Level 1) nested within teams (Level 2), intraclass correlations (ICCs (1)) were calculated to analyse the variance composition at the within- and between-person levels. The ICC (1) for resource-oriented leadership at T2 was .35, employee rumination at T2 was .12, and employee sleep quality at T3 was .02. This suggests that between 2% and 35% of the total variance of the Level 1 variables was between-team variance, justifying the appropriateness of a multilevel approach to hypothesis testing.

All hypotheses were tested using Mplus, Version 7.4 (Muthén & Muthén, 1998-2015). Since Preacher et al. (2010) highlighted the problem of conflated within- and between effects in multilevel models, which can create substantial bias, a cross- and unique cluster-level mediation model with a 2-2-2-1-1 design was specified following Dietz et al. (2020) and Pituch and Stapleton (2012). This model is graphically depicted in Figure 1. Compared with the approach from Preacher et al. (2010), which only considers between-team indirect effects, this model allows distinguishing between the

within-team indirect effect (cross cluster-level mediation) and the between-team indirect effect (unique cluster-level mediation) and has greater power (Pituch & Stapleton, 2012).

In the current study, the within-team indirect effect (cross cluster-level mediation; d_2 x e_2 x f_2 x b_1) was of special interest because the theoretical model assumed that leader rumination negatively affects leaders' general health (d_2; Level 2), which leads to reduced resource-oriented leadership (e_2; Level 2), resource-oriented leadership is negatively associated with rumination of the team members on average (f_2; Level 2), and rumination of employee *i* in team *j* will lead to reduced sleep quality of employee *i* in team *j* (b_1; Level 1). The approach of Pituch and Stapleton (2012) assumes that the f_2 and b_1 paths are located on different levels and do not have to be directly connected.

To build up that resource-oriented leadership perceived by the team is negatively related to the rumination of the team members on average and to separate the between- and within-team indirect effects, resource-oriented leadership and employee rumination at T2 were aggregated at the team level. The ICCs (1) justified the mean aggregation at the team level. All predictor variables at the between- and within-team level were grand-mean centred (Enders & Tofighi, 2007). As a method of estimation, the Bayes estimator was used. This estimator does not assume that the distribution of the parameter estimate is normal and is often used in two-level settings (Baethge et al., 2021; Muthén, 2010). The Mplus syntax can be found in the supplemental material in Table S2.

Results

Descriptive statistics, reliabilities, and correlations between all study variables are shown in Table 1. Leader rumination at T1 was significantly negatively related to leader general health at T1, $r = -.42$, $p < .001$, and significantly positively related to employee rumination at T2, $r = .17$, $p = .004$. Higher leader self-ratings of general health at T1 were only descriptively related to more reported resource-oriented leadership at T2, $r = .15$, $p = .066$. A significant correlation was found between reported resource-oriented leadership at T2 and employee rumination at T2, $r = -.20$, $p = .001$. Higher employee rumination at T2 was related to lower employee reported sleep quality at T3, $r = -.42$, $p < .001$.

Results of the multilevel path model

The results of the overall multilevel path model used to test the hypotheses are presented in Table 2.[1] The posterior predictive p value (PPP value) of .522, 95% CI [−32.987; 33.299], showed a good fit between the model and the data. Regarding to the control variables measured at T1 only, poor general health of employees, β = −.11, 95% CI [−0.192; −0.012], high workload, β = .10, 95% CI [0.018; 0.185], and high rumination, β = .62, 95% CI [0.538; 0.697], were related to increased employee rumination at T2. None of the control variables affected employee sleep quality at T3, except for sleep quality at T1, β = .39, 95% CI [0.285; 0.485].[2]

In line with Hypothesis 1, higher ratings of rumination by the leader at T1 were related to increased rumination at T2 among their team members (a_2), β = .24, 95% CI [0.089; 0.004]. Higher employee ratings of rumination at T2, in turn, were related to reduced employee sleep quality at T3 (b_1), β = −.29, 95% CI [−0.172; −0.407], providing support for Hypothesis 2. We also found a significant negative within-indirect effect of leader rumination on employee sleep quality via employee rumination (a_2 x b_1), *b* = −.04, 95% CI [−0.008; −0.083], supporting Hypothesis 3.

Furthermore, higher ratings of rumination by the leader at T1 were related to reduced ratings of their general health at T1 (d_2), β = −.42, 95% CI [−0.560; −0.236], which were related to reduced resource-oriented leadership at T2 (e_2), β = .30, 95% CI [0.102; 0.467]. Reduced resource-oriented leadership at T2, on the other hand, was related to increased rumination among their team members at T2 (f_2), β = −.30, 95% CI [−0.471; −0.112]. Overall, we found a significant negative within-indirect effect of leader rumination on employee sleep quality via serial mediation of leader general health, resource-oriented leadership, and employee rumination (d_2 x e_2 x f_2 x b_1), β = −.01, 95% CI [−0.001; −0.017]. Therefore, Hypothesis 4 was fully supported.

Discussion

The main goal of our study was to examine whether leader rumination during nonwork time predicts changes in employees' sleep quality over 22 months and whether this effect could be explained by employee rumination as well as leaders' general health and leadership behaviour. The results support our

Table 1. Descriptive statistics, reliabilities, and correlations between study variables.

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Age (T1)	40.50	9.59	-												
2	Sex [a] (T1)	0.17		−.18***	-											
3	GH (T1)	3.17	0.79	−.09	.16**	-										
4	NLE (T1)	1.44	0.66	.03	−.05	−.16**	-									
5	Employee WL (T1)	3.54	0.67	.11	.00	−.28***	.01	(.84)								
6	Employee R (T1)	3.76	1.62	.04	−.11*	−.47***	.04	.38***	(.79)							
7	Employee SQ (T1)	3.66	1.35	−.18***	.11*	.43***	−.11*	−.20***	−.44***	-						
8	Leader WL (T1)	3.68	0.56	−.01	.06	.04	−.10	.09	.01	.07	(.81)					
9	Leader R (T1)	3.91	1.67	−.05	.10	.02	.03	.07	.11	−.05	.13	(.79)				
10	Leader GH (T1)	3.28	0.78	−.03	−.03	.07	−.04	−.03	−.10	.02	−.13	−.42***	-			
11	ROL (T2)	3.63	0.61	−.05	−.03	.20***	−.10	−.09	−.14*	.15*	−.04	.02	.15	(.89)		
12	Employee R (T2)	3.67	1.63	.00	−.14*	−.43***	−.01	.36***	.71***	−.33***	.01	.17**	−.11	−.20**	(.85)	
13	Employee SQ (T3)	3.77	1.30	−.10	.08	.30***	−.04	−.21***	−.34***	.49***	.01	−.07	.07	.16*	−.42***	-

Note: $N = 332$ employees nested in 94 teams. [a] 0 = *female*. 1 = *male*. GH = general health; NLE = negative life events; WL = workload; R = rumination; SQ = sleep quality; ROL = resource-oriented leadership. The scale values of NLE ranged from 1 to 3. The scale values of GH, ROL, SQ, and workload ranged from 1 to 5, and the scale values of CI ranged from 1 to 7. Cronbach´s alphas are reported along the diagonal in parentheses. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. Results of multilevel path analysis.

	Leader GH (T1)	HADPL (T2)	Employee CI (T2)	Employee SQ (T3)
a_2-path				
Leader R (T1) → Employee R (T2)			.24 [0.052; 0.400]*	
b_1-path				
Employee R (T2) → Employee SQ (T3)				−.29 [−0.172; −0.407]*
b_2-path				
Employee R (T2) → Employee SQ (T3)				.12 [−0.920; 0.707]
c′-path				
Leader R (T1) → Employee SQ (T3)				−.11 [−0.531; 0.728]
d_2-path				
Leader R (T1) → Leader GH (T1)	−.42 [−0.560; −0.236]*			
e_2-path				
Leader GH (T1) → ROL (T2)		.30 [0.102; 0.467]*		
f_2-path				
ROL (T2) → Employee CI (T2)			−.30 [−0.471; −0.112]*	
Within-Indirect Effects [c]				
Leader R (T1) → Employee R (T2) → Employee SQ (T3) – a_2 x b_1				−.04 [−0.008; −0.083]*
Leader R (T1) → Leader GH (T1) → ROL (T2) → Employee R (T2) → Employee SQ (T3) – d_2 x e_2 x f_2 x b_1				−.01 [−0.001; −0.017]*

Note: N = 332 employees nested in 94 teams. R = rumination; SQ = sleep quality; GH = general health; ROL = resource-oriented leadership. [a] 0 = *female*. 1 = *male*. Standardized estimates, except for indirect effects. [b] Unstandardized estimates. For reasons of parsimony, the correlations between T1 variables are not reported but were included in the model. * 95% confidence interval excluding zero.

assumption that leader rumination is an important antecedent of employee sleep quality and that leaders' general health, resource-oriented leadership, and rumination of their team members are explanatory serial mechanisms.

Theoretical implications

Our first hypothesis was supported by the finding that leader rumination was positively related to the rumination of their team members. This finding is in line with Sonnentag and Schiffner (2019), who showed a trickle-down effect of leader detachment on employee detachment. We strengthened this finding with a larger sample and extended it with a longitudinal design, consideration of the autoregressor, and control for a shared work environment. This suggests that leader rumination as a negative aspect of work-related thoughts even predicts changes in employee rumination over 14 months.

The result that employee rumination was negatively related to employee sleep quality supports the second hypothesis. Moreover, it is consistent with the perseverative cognition model of stress (Brosschot et al., 2005), the effort-recovery theory (Meijman & Mulder, 1998), and previous findings indicating that rumination can lead to a prolonged affective and physiological activation. Notably, all of these can lead to persistent sleep problems (Kinnunen et al., 2017; Van Laethem et al., 2018).

In our third hypothesis, we further assumed that leader rumination is negatively related to employee sleep quality via employee rumination. In addition to the explicit leadership behaviour, which has been the focus of previous research, this is, to our knowledge, the first study to show that leader rumination is a potential antecedent of employee sleep quality and employee rumination is a mechanism of this effect. Therefore, our results contribute to a better understanding of the role of leaders' strain symptoms in employees' sleep quality.

Furthermore, we provided evidence for the fourth hypothesis. We demonstrated that leader general health and resource-oriented leadership could explain the trickle-down effect of a leader on employee rumination and sleep quality through serial mediation. Following the framework by Wegge et al. (2014), this suggests that leaders can influence the rumination of all their employees indirectly through system-focused action by creating a working environment that makes it difficult to switch off after work.

Based on the perseverative cognition model of stress (Brosschot et al., 2005), the effort-recovery theory (Meijman & Mulder, 1998), and in line with previous research (Weigelt et al., 2019; Wendsche & Lohmann-Haislah, 2017), we found that leaders who ruminate about work-related problems during nonwork time showed a higher level of health complaints over time. In accordance with the CoR theory (Hobfoll, 1989), leaders with health complaints may lack a resource that directly facilitates constructive leadership behaviour (Kaluza et al., 2019; Klebe et al., 2021a); thus, they might create a stressful work environment, which makes it difficult for employees to switch off from work. These considerations are connected to our finding that leaders with a higher level of health complaints showed less resource-oriented leadership behaviour. Less resource-oriented leadership, in turn, implies lower levels of resources for employees, which are associated with increased rumination (Vincent-Höper & Stein, 2019) and indirectly with sleep problems (Matick et al., 2021).

These results contribute to a better understanding of the processes underlying the effect of leader behaviours and employee health (Inceoglu et al., 2018) and provide a theoretical foundation of the trickle-down effect. Our results support Wegge et al. (2014) assumption that leadership behaviour affects employees' health through the design of the work environment. Furthermore, they extend the assumption by showing that, in addition to the leader behaviour and the design of the work environment, the strain symptoms of the leaders and their health also play an important role in the health of employees.

Lastly, previous research showed that only sleep leadership behaviour (Gunia et al., 2015) in comparison to family-supportive supervisor behaviour (Crain et al., 2014) was related to better subjective sleep quality (Sianoja et al., 2020). Our

results imply that resource-oriented behaviour that is not explicitly focused on sleep can also promote the sleep quality of employees through the design of resources.

Practical implications

In addition to sleep interventions at work aimed directly at changing sleep behaviours, such as sleep hygiene education or cognitive behavioural therapy around sleep habits (Barber, 2017), leaders seem to play an important role in employees' sleep. Since leader rumination may lead to the rumination of their team members and poor sleep quality, leaders provide a promising starting point for sleep-related interventions for employees. A first step might be that leaders become aware of their rumination during nonwork time and the consequences for themselves and their subordinates because leaders and employees often are unaware of when and how trickle-down effects take place (Wo et al., 2019). Leaders could try to reduce rumination by building implementation intentions (Smit & Barber, 2016) or practising mindfulness (Haun et al., 2018) in daily experience.

Given that leader rumination also appears to have consequences for their general health and rumination cannot always be completely avoided, increased attention should also be paid to promoting the general health of leaders. This offers a second starting point for promoting employee sleep quality. Specifically, because general health indirectly has a positive effect on employees' sleep quality by enhancing resource-oriented leadership and thus reducing employee rumination.

Finally, resource-oriented leadership represents a starting point to promote interventions, as this leadership behaviour indirectly has a positive effect on employees' sleep quality by reducing rumination. Interventions could raise leaders' awareness of their role as (co-)designers of employees' work characteristics and highlight practical approaches to enhancing employees' work characteristics (Vincent-Höper & Stein, 2019). In sum, sleep interventions at work should be expanded and optimized by also considering and involving leaders.

Strengths, potential limitations, and suggestions for future research

Although our study contributes to the occupational health psychology literature and offers several methodological advantages, it has certain limitations that should be considered when interpreting our results. First, the longitudinal study design and the information obtained from different sources provide clues to the direction of the associations. However, leader rumination and general health as well as resource-oriented leadership and employee rumination were each measured at the same time with information obtained from the same sources, which limits causal inference and may have resulted in common method bias. For leaders, their health could influence how they evaluate their rumination, and for employees, rumination could influence how they evaluate the leader's behaviour. It could also be possible that leaders who have employees with sleep problems in their team ruminate after work because they are concerned about the health or the associated performance of their employees (Kranabetter & Niessen, 2016).

To draw conclusions about the directionality of the associations and to account for conceivable reserve or reciprocal effects, temporal separation of measures in crossed-lagged analyses, experimental designs, or intervention studies that offer leader rumination or resource-oriented leadership might be helpful in future studies. Future research could also use a combination of subjective and objective methods to assess sleep (Sianoja et al., 2020). An example of such methods could be actigraphy to avoid common method bias or memory distortions resulting from self-report measures (Podsakoff & Organ, 1986).

Second, our relatively large sample consists of several occupational groups from different organizations and, therefore, our results will generalize to some degree. However, the majority of both leaders and employees in our sample were women, which limits the generalizability of the results. One possible explanation could be that the willingness to participate in psychological studies is higher among women. Another explanation could be that the recruitment focused more on service professions in the commercial or social sector in which women are predominantly working.

Moreover, the dropout analyses pointed out that, among leaders, a higher percentage of women completed T2. Further, the percentage of women and the ratings of resource-oriented leadership were higher for the completers at T3 among the employees. Therefore, systematic differences between completers and dropouts cannot be completely ruled out. Given that the core characteristics of employment were customer-oriented and high service demands, future research should replicate our findings across other branches.

Third, single items, which offer several benefits in longitudinal studies, were used to operationalize general health, negative life events, and sleep quality. For example, in the current study, we were limited to one item for sleep quality, and thus cannot distinguish between different sleep characteristics (e.g., sleep-onset latency, sleep interruptions). However, such a global evaluation of sleep is useful if the overall quality is of interest and can then adequately be assessed by one item as well as general health (Atroszko et al., 2015).

Finally, to show changes over time and rule out possible alternative explanations of the investigated effects by personal characteristics and work and nonwork domains, we controlled for employees' age, gender, general health, negative life events, the baseline levels of rumination and sleep quality, and a shared work environment (workload). However, trickle-down effects are a complex social process in which several mechanisms may run simultaneously (Wo et al., 2019). In our study, we limited the mechanisms proposed by Wegge et al. (2014) and examined only system-focused action as one mechanism. Future research might examine direct person-oriented action and role modelling as possible additional mediators underlying this effect.

The direct person-oriented action, which means that leaders influence the rumination of their employees directly through their behaviour (e.g., use of information and communication technology after work), could be a second process (Sonnentag

& Schiffner, 2019). If leaders think about work-related problems during their nonwork time, they may be more inclined to continue to work and contact employees by phone or email in their leisure time (Heissler & Ohly, 2018). These resulting contacts could make it difficult for their employees to switch off after work (Park et al., 2011) and could lead to rumination.

A third possible pathway to explain the relationship between leader and employee rumination is role modelling, in which employees learn and imitate the behaviour of the leader by observing behaviours, as suggested by social-cognitive learning theory (Bandura, 1977). Albeit, employees will not be able to directly observe the rumination of leaders during their leisure time, Sonnentag and Schiffner (2019) argued that leaders may send signals (e.g., report that they answered numerous emails last night) to their employees that indicate their ruminative thoughts and related actions. Through these cues, employees could learn that it is appropriate to continue thinking about work-related problems during their nonwork time.

Conclusion

This study examined leader rumination during nonwork time as an antecedent of employee sleep quality and possible explanatory mechanisms. To depict changes across a time span of 22 months, we controlled for the baseline level of sleep quality and beyond for general health, negative life events, and a shared work environment. Our results demonstrated that leader rumination reduces their general health, which leads them to engage in fewer leadership behaviours that promote resources. This makes it difficult for their employees not to ruminate about problems at work during nonwork time, leading to reduced sleep quality. Overall, our findings highlight the importance of leaders' recovery, health, and resource-oriented leadership behaviour for employees' sleep quality and offer several practical implications.

Notes

1. To make full use of the available data, missing values of employees in the control variables general health, negative life events, workload, rumination, and sleep quality at T1 were replaced by mean substitution in 11 cases. The results remain unchanged in pattern if the missing values are not substituted.
2. We also analysed the hypotheses without general health, negative life events, workload, and the autoregressors rumination and sleep quality as control variables, and we only considered age and gender as control variables. The same regression coefficients remained significant.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Grant F 2199 in the context of NEW OSH ERA (New and Emerging Risks in Occupational Safety and Health) within the European Commission Sixth Framework Programme (ERA-NET scheme). [2199].

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Supplemental Material

Table S1
Dropout Analyses

Employee variables at T1					Independent sample *t*-tests		
		N	*M*	*SD*	*t*	*df*	*p*
Rumination	Dropouts	290	3.73	1.68			
	Completers T1 & T2	521	3.70	1.64	0.21	809	.834
Sleep quality	Dropouts	290	3.73	1.41			
	Completers T1 & T2	519	3.69	1.36	0.34	807	.737
Age	Dropouts	316	39.85	11.45			
	Completers T1 & T2	536	40.57	9.96	-0.93	589.76	.354
General health	Dropouts	291	3.17	0.78			
	Completers T1 & T2	522	3.14	0.83	0.55	811	.584
Negative life events	Dropouts	290	1.46	0.68			
	Completers T1 & T2	522	1.47	0.68	-0.14	810	.890
Workload	Dropouts	316	3.56	0.67			
	Completers T1 & T2	535	3.59	0.69	-0.51	849	.608
					2x2-χ^2-test		
		N	% *female*		χ^2		*p*
Sex	Dropouts	315	74.6				
	Participants T1 & T2	536	79.5		2.30		.129
Leader variables at T1					Independent sample *t*-tests		
		N	*M*	*SD*	*t*	*df*	*p*
Rumination	Dropouts	4	3.42	0.88			
	Completers T1 & T2	118	4.05	1.61	-0.80	120	.438
General health	Dropouts	4	3.50	0.58			
	Completers T1 & T2	117	3.25	0.82	0.61	119	.543
Age	Dropouts	4	46.25	11.73			
	Completers T1 & T2	118	44.15	8.43	0.48	120	.629
Workload	Dropouts	4	3.55	0.10			
	Completers T1 & T2	118	3.74	0.56	-2.70	120	.019
					2x2-χ^2-Test		
		N	% *female*		χ^2		*p*
Sex	Dropouts	4	0.0				
	Completer T1 & T2	118	59.3		5.57*		.018
Employee variables at T2					Independent sample *t*-tests		
		N	*M*	*SD*	*t*	*df*	*p*
Age	Dropouts	204	41.69	10.56			
	Completers T2 & T3	332	41.50	9.59	0.21	534	.836
ROL	Dropouts	198	3.48	0.71			
	Completers T2 & T3	331	3.64	0.61	-2.56	367	.011
Rumination	Dropouts	204	3.51	1.62			
	Completers T2 & T3	332	3.67	1.63	-1.11	534	.268
					2x2-χ^2-test		
		N	% *female*		χ^2		*p*
Sex	Dropouts	204	73.5				
	Completers T2 & T3	332	82.5		6.19*		.013

Note. ROL = resource-oriented leadership. * $p < .05$. ** $p < .01$.

Table S2

Used Variable Names of the Measures in the Mplus Syntax

Measures	Wave	Name in the Mplus syntax
Team identifier	T1	TEAM
Age	T1	AGE
Sex	T1	SEX
General health	T1	EGH_1
Negative life events	T1	ENEG_1
Employee workload	T1	EWL_1
Employee rumination	T1	ECI_1
Employee sleep quality	T1	ESL_1
Leader workload	T1	LWL_1
Leader rumination	T1	LCI_1
Leader general health	T1	LHEA_1
Resource-oriented leadership (team level)	T2	ROL_M_2
Employee rumination	T2	ECI_2
Employee cognitive irritation (team level)	T2	ECI_M_2
Employee sleep quality	T3	ESL_3

Mplus Syntax for the Cross- and Unique Cluster-Level Mediation Model With a 2-2-2-1-1 Design:

```
VARIABLE:
CLUSTER = TEAM;
BETWEEN = LWL_1 LCI_1 LHEA_1 ROL_M_2 ECI_M_2;
WITHIN = ECI_2 AGE SEX EGH_1 ENEG_1 ECI_1 ESL_1 EWL_1;
DEFINE:
CENTER AGE EGH_1 ENEG_1 EWL _1 ECI_1 ESL_1 LWL_1 LCI_1 LHEA_1 ROL _M_2
ECI_M_2 ECI_2 (GRANDMEAN);
ANALYSIS:
TYPE = TWOLEVEL;
ESTIMATOR = BAYES;
MODEL:
%WITHIN%
ESL_3 ON ECI_2(B1);
ECI_2 ON ECI_1; !autoregressive effects
ESL_3 ON ESL_1;
ECI_2 ON AGE SEX EGH_1 ENEG_1 EWL_1; !controls
ESL_3 ON AGE SEX EGH_1 ENEG_1 EWL_1;
AGE WITH SEX EGH_1 ENEG_1 EWL_1 ECI_1 ESL_1; !correlations
SEX WITH EGH_1 ENEG_1 EWL_1 ECI_1 ESL_1;
EGH_1 WITH ENEG_1 EWL_1 ECI_1 ESL_1;
ENEG_1 WITH EWL_1 ECI_1 ESL_1;
EWL_1 WITH ECI_1 ESL_1;
ECI_1 WITH ESL_1;
%BETWEEN%
LHEA_1 ON LCI_1(D2);
ROL _M_2 ON LHEA_1(E2);
ECI_M_2 ON ROL _M_2(F2);
ECI_M_2 ON LCI_1 (A);
ESL_3 ON ECI_M_2(B2);
ESL_3 ON LCI_1 (C);
ECI_M_2 ON LWL_1; !control
MODEL CONSTRAINT:
NEW(IND_1W IND_2 IND_3W);
IND_1W=A*B1;
IND_2=D2*E2*F2;
IND_3W=D2*E2*F2*B1;
```

Appendix E: Angaben zur Person

Die Angaben zur Person sind nicht Teil der Veröffentlichung.

Appendix F: Eidesstattliche Erklärung der Verfasserin

Ich versichere, dass ich meine Dissertation „Work, Nonwork, and Sleep: The Role of Individual Factors and the Social Work Enviroment“ selbstständig, ohne unerlaubte Hilfe angefertigt, und mich keiner anderen als der von mir ausdrücklich bezeichneten Quellen und Hilfen bedient habe. Alle vollständig oder sinngemäß übernommenen Zitate sind als solche gekennzeichnet. Die Dissertation wurde in der jetzigen oder ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg, April 2023

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Eva Matick

Appendix G: Anteile der Autor:innen an den Manuskripten

Die Anteile der Autor:innen an den Manuskripten sind nicht Teil der Veröffentlichung.