It’s About Time: Empirical and Theoretical Investigations of Temporal Dynamics in Stressor–Strain Relationships

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Abstract

In recent decades, the number of longitudinal and diary studies in the occupational literature has grown substantially, providing deeper insights into how stressors and strain are related over time and addressing questions about their temporal changes. This body of research recognizes that exposure to stressors and the experience of strain can be both chronic and stable, as well as subject to daily, weekly, or yearly fluctuations. Consequently, naturally occurring temporal ups and downs in stressors and strain, along with their reciprocal relationships, are increasingly considered in occupational stress research. Yet, despite these advances, the role of time remains underrepresented in theories that seek to describe and explain stressors, strain, and their interplay.

By explicitly acknowledging time in both empirical research and theoretical frameworks, we can deepen our understanding of how stressor–strain processes unfold and lay the groundwork for time-sensitive theorizing in occupational stress research. Building on this premise, the present dissertation investigates the empirical and theoretical understanding of the temporal dynamics in stressor–strain relationships and promotes the integration of time into occupational stress research and theory development. Specifically, it pursues three research objectives. First, it evaluates to which extent existing occupational stress theories account for time-related effects in stressor–strain research. Second, it examines and extends two established stressor–strain relationships from a time-sensitive empirical and theoretical perspective, focusing on (1) identifying trajectories of time pressure and their well-being relevance, informed by the effort–recovery model and conservation of resources theory, and (2) investigating reciprocal adaptive change processes between time pressure and emotional exhaustion, drawing on propositions from adaptation and conservation of resources theory. Third, it systematically reviews and synthesizes how time has been theoretically and empirically integrated into existing stressor–strain research.

To achieve these aims, two empirical studies and one systematic literature review were conducted. The first study applied an exploratory person-centered approach to examine which latent classes of time pressure trajectories occur for employees across one workweek as well as their relationship with well-being being at the end of the working week and start of the next week. Using data from 254 employees in a daily diary study across five consecutive workdays, findings revealed four qualitatively distinct trajectories that exhibited class-specific differences in Friday evening and Monday morning positive valence, calmness, and energetic arousal as well as Friday night sleep quality.

The second study explored whether employees adapt to emotional exhaustion and time pressure and how changes in levels of emotional exhaustion and time pressure relate over time, considering their reciprocal relationship. Findings of latent change score analyses on weekly diary data across eight workweeks demonstrated that employees ($N = 252$) adapted to both emotional exhaustion and time pressure. Further, this adaptive change was affected by the level of time pressure of the previous week, resulting in a reduced adaptation in emotional exhaustion, and vice versa, providing important information on the simultaneously occurring processes of adaptation and resource loss.

The systematic literature review focused on a synthesis of how time is theoretically and empirically integrated into stressor–strain studies (158 studies in 147 articles) published in four peer-reviewed journals between 2012 and 2021. Five time-related categories were identified that demonstrate how current literature applies time in theoretical propositions and methodology. Here, most research tends to address time-related questions from a methodological perspective rather than a theoretical one. The review identifies seven priorities for what time-sensitive theorizing needs in the future and addresses enduring challenges in capturing the temporal dynamics of stressor-strain relationships.

Together, the studies and review provide new empirical evidence and theoretical guidance on the temporal dynamics of occupational stress. They demonstrate that time is not merely a methodological consideration, but a fundamental dimension in explaining how stressors and strain develop, interact, and change. By embedding temporal thinking into occupational stress research and theory, this work advances a more nuanced and accurate understanding of stressor–strain processes and lays the foundation for future time-sensitive theorizing in the field.

Chapter 1 – General Introduction

> Es gibt ein großes und doch ganz alltägliches Geheimnis. Alle Menschen haben daran teil, jeder kennt es, aber die wenigsten denken je darüber nach. Die meisten Leute nehmen es einfach so hin und wundern sich kein bisschen darüber. Dieses Geheimnis ist die Zeit.[1]
>
> — Michael Ende, *Momo oder die seltsame Geschichte von den Zeit-Dieben und von dem Kind, das den Menschen die gestohlene Zeit zurückbrachte* (1973)

In line with Michael Ende's philosophical approach to time as something that feels so ordinary and yet is deeply mysterious and essential, a central yet often overlooked element in understanding the relationship between stressors and strain in the context of work is the role of time. Time is not merely a backdrop but a dynamic factor that shapes how work-related stressors are experienced, how stressors and strain develop, and how their (reciprocal) relationship evolves over time as stressor–strain processes do not occur in a temporal vacuum. In the last decades, the number of longitudinal and diary studies in the occupational literature has increased enormously to explore how stressors and strain relate over time (Spector & Pindek, 2016) and addressed questions regarding temporal changes therein (Ford et al., 2014; Ohly et al., 2010). While Ohly et al. (2010) stress the relevance of diary designs to account for and examine constructs' instability over time, Ford et al. (2014) assessed the role of time in three types of work-related stressor–strain effects, that are synchronous, lagged and reverse effects. Thus, scholars recognize that the exposure to stressors and experience of strain can be chronic and stable as well as fluctuate and vary daily, weekly, or yearly. With this, naturally occurring temporal ups and downs in stressors and strain experienced by individuals and their reciprocal relationship are being accounted for in occupational stress research. However, the

[1] "Life holds one great but quite commonplace mystery. Though shared by each of us and known to all, seldom rates a second thought. That mystery which most of us take for granted and never think twice about, is time." (translated by Frances Lobb)

role of time has been fairly neglected in theories that aim to describe and explain stressors, strain, and their interplay (Shipp & Cole, 2015; Sonnentag, 2012).

By acknowledging the "mystery" of time in both empirical research and theoretical frameworks, we can better understand how processes of and between stressors and strain unfold as well as lay the groundwork for time-sensitive theorizing in occupational stress research. Accordingly, this dissertation investigates the empirical and theoretical understanding of temporal dynamics in stressor–strain relationships and promotes the role of time in occupational stress research and theory development from a time-sensitive perspective.

The limited research that has addressed the role of time in stressor–strain relationships has typically focused on either one of the following aspects: First, the application of study designs with multiple time points (e.g., longitudinal or diary studies) has expanded during the last decades (Spector & Pindek, 2016), backing away from cross-sectional studies. Herewith, empirical research accounts for the temporal distance between independent variable at time point 1 (i.e., mostly stressor) and dependent variable at time point 2 (i.e., usually strain), while holding the dependent variable constant at time point 1. This enabled the methodological and empirical consideration that stressors and strain change over time, for instance, by assessing within-person effects in multilevel studies (Ilies et al., 2015), and advanced our understanding of time-related effects between stressors and strain, such as the effect of a current stressor on next-day strain and vice versa (i.e., reverse effects; Sonnentag, 2015). As such, empirical evidence suggests that the temporal dynamics of stressors and strain are essential for understanding stressors and strain and how they influence each other (reciprocally). However, previous occupational stress literature has also mainly focused on methodological approaches needed to model temporal effects of or between constructs, for instance, deciding on (optimal) time frames between time points or statistical strategies (Dormann & Griffin, 2015; Ford et al., 2014; Rauvola et al., 2021; Spector & Meier, 2014). Contrastingly, even though scholars propose time-sensitive stressor–strain effects (e.g., lagged effect of stressor on strain), the role of time in theorizing has been mainly neglected in current stressor–strain literature (Shipp & Cole, 2015; Sonnentag, 2012). While some theoretical frameworks already acknowledge temporal aspects (Sonnentag et al., 2024; Sonnentag & Meier, 2024), for example, resource loss and gain spirals in conservation of resources (COR) theory (Hobfoll, 1989, 2001) and prolonged stress reactions in the allostatic load model (McEwen, 1998), they lack time-specific theoretical propositions (Aguinis & Bakker, 2021; Sonnentag, 2012), such as how stressors and strain evolve over time. Thus, the first research objective of this dissertation is to examine to which extent existing occupational stress theories account for time-related effects in stressor–strain research.

Second, and related to the first limitation in literature, empirical evidence underlines the relevance of time in stressors and strain and how they relate to each other (reciprocally; e.g., Rosen et al., 2020; Su et al., 2022). Thus, following the call to consider the temporal context of stressor–strain relationships in theorizing (Shipp & Cole, 2015; Sonnentag, 2012; Sonnentag et al., 2024; Sonnentag & Meier, 2024), this dissertation builds on established stressor–strain relationships, namely time pressure and various indicators of well-being in Study 1, time pressure and emotional exhaustion in Study 2. Herewith, it broadens our understanding of these well-known relationships in the context of work towards the empirical exploration and theoretical explanation of time-related effects. Thus, generally speaking, the second research objective of this dissertation is to examine and extend two specific stressor–strain relationships from a time-sensitive perspective, exploring two distinct perspectives of temporality, both empirically and in theorizing: First, over the last decades, research has mainly focused on within-person effects within the relationship between stressors and employee outcomes, taking into account intraindividual variation in stressors and well-being. However, following numerous calls to examine (systematic) variation of work-related variables over time (Downes et al., 2021), less is known about interindividual differences in intraindividual changes of stressors over time that form systematic temporal patterns as well as their relationship to well-being indicators. Thus, this dissertation aims at identifying time pressure trajectories within one workweek and, drawing from the effort–recovery model (ERM; Meijman & Mulder, 1998) and COR theory (Hobfoll, 1989), their well-being relevance ending and starting a workweek (i.e., research objective 2.1). Second, previous research has consistently shown that work-related stressors lead to detrimental health outcomes, such as feeling emotionally exhausted (Kern et al., 2023; Kunzelmann & Rigotti, 2021), whereas the underlying temporal mechanism of how stressors impact employee health remains rather unknown. Understanding how time pressure leads to emotionally exhausted employees over time is essential, as both theories and empirical studies highlight the importance of examining the time course of this relationship. Following examples of recent literature on adaptive changes (Matthews et al., 2014; Ritter et al., 2016) and resource loss spirals (Ford et al., 2023; Somaraju et al., 2022), this dissertation considers the reciprocal change process of time pressure and emotional exhaustion from a temporal perspective of adaptive change and resource depletion over time. By combining the propositions of adaptation theory (Diener et al., 2006) and resource loss spirals of COR theory (Hobfoll, 1989, 2001), adaptive changes of time pressure and emotional exhaustion over time may not only occur but also be disrupted reciprocally by each other as experiencing time pressure and feeling emotionally exhausted may alter the time course of the respective other variable by preventing a return to baseline levels. This time-based perspective is key to fully gasping how stressors influence employees' health, and vice versa, in a health-impairing manner. Thus, this dissertation aims at investigating reciprocal adaptive change processes in time pressure and emotional exhaustion and how changes in levels relate over eight workweeks (i.e., research objective 2.2).

Finally, given the central role of time in the context of work and stress, previous research has consistently emphasized the need to focus more on temporal aspects in this area (e.g., Aguinis & Bakker, 2021; Roe, 2008). Recent studies began to incorporate time both from an empirical and theoretical perspective. For example, Somaraju et al. (2022) examined a dynamic model of work-related conflict and strain in extreme work settings, herewith testing the theoretical propositions of resource loss and gain spirals in COR theory (Hobfoll, 1989; Hobfoll et al., 2016). They provided empirical evidence for a resource loss spiral in strain triggered by relationship conflict, and vice versa. Additionally, this reciprocal relationship was intensified by high levels of workload, demonstrating the critical role of work settings in the temporally dynamic link between stressors and strain. Furthermore, Rosen et al. (2020) examined the negative effect of fluctuating challenge stressors on employee performance and well-being outcomes, compared to challenge stressors that remain stable over time. This underlined the relevance of temporally varying work characteristics, especially for employee outcomes. While acknowledging the existence of research that begins to fill the temporal void in stressor–strain research, a systematic summary of how time is considered in both theorizing and empiricism of current occupational stress research is needed. By mapping perspectives on time in state-of-the-art stressor–strain literature, this will aid our understanding of how time is currently included when hypothesizing and testing time-related effects of and between stressors and strain, revealing empirical and theoretical gaps in occupational literature as well as what a theory needs in order to be time-sensitive. Thus, the third research objective of this dissertation is to systematically review and synthesize how time has been theoretically and empirically integrated into existing stressor–strain research.

Towards these research objectives, I conducted two empirical studies and one systematic literature review, using a variety of methodological approaches and combining field data and literature to approach the role of time in stressor–strain relationships and theories. Extending a well-established stressor–strain relationship from a time-sensitive perspective, two empirical studies were conducted, applying different approaches to temporality in empiricism and theorizing: Study 1 focused on time pressure as a well-known work-related stressor (Häusser et al., 2010) and its temporal patterns over time. Specifically, Study 1 identified trajectories of time pressure across one workweek and examined their relationship with well-being indicators both when ending and starting a workweek, herewith highlighting the well-being relevance of different time pressure experiences over time by discussing resource loss and gain spirals in accordance with COR theory (Hobfoll, 1989). Drawing on adaptation (Diener et al., 2006; Diener & Diener, 1996) and COR (Hobfoll, 1989) theories, Study 2 focused on adaptive change processes in both strain (i.e., emotional exhaustion) and a stressor (i.e., time pressure) and how these changes relate over eight workweeks, hereby examining reciprocal dynamics between stressors and strain and offering valuable insights into how stressors relate to strain over time in a health-impairing manner. Finally, the systematic literature review synthesized how time has been theoretically and empirically integrated into state-of-the-art stressor–strain research, identifying time-related categories and making recommendations for a time-sensitive theory development of stressor–strain relationships.

Based on the previously established research objectives, this dissertation makes four important contributions to advancing our empirical and theoretical understanding of temporal dynamics in stressor–strain research. First, building on Aguinis and Bakker's (2021) and Roe's (2008) urging to acknowledge temporal aspects in the context of work and stress, this dissertation focuses on the relevance of time in occupational stress theories and theoretical propositions in research. By following recent calls to incorporate time not only in methods but also in theorizing (Shipp & Cole, 2015; Sonnentag, 2012; Sonnentag et al., 2024; Sonnentag & Meier, 2024), this dissertation contributes to a time-sensitive approach to theoretical frameworks anchored in stressor–strain research that explain effects within and between stressors and strain. Second, this dissertation enhances our understanding of the natural evolution of stressors by investigating temporal patterns of time pressure. By taking a person-centered approach to identify stressor trajectories, this reveals novel insights into patterns in how this stressor unfolds over one workweek and demonstrates their significance for well-being, drawing from theories that explain recovery and resource gain and loss processes. Third, this dissertation contributes to stressor–strain research by applying time-related stress theoretical frameworks, namely adaptation and COR theories (Diener et al., 2006; Hobfoll, 1989), to a well-established stressor–strain relationship by examining reciprocal dynamics between time pressure and emotional exhaustion over a period of eight workweeks. This variable-centered approach offers evidence of adaptive changes in both stressor and strain as well as their influence on each other, thereby highlighting bidirectional relationships and advancing our understanding of feedback loops in occupational stress processes and theories. Finally, by systematically reviewing how time has been treated in state-of-the-art stressor–strain research, this dissertation identifies empirical and theoretical research gaps that can guide future research and stimulate time-sensitive theorizing in the context of work and stress. Hereby, I hope to encourage the rethinking of established theories through a temporal lens, supporting more nuanced explanations of stressor and strain fluctuation, accumulation, and adaptation.

Following, to provide an overview of the central theoretical concepts, I will discuss in more detail work-related stressors and strain, their relationship, and theories that explain their link. Then, I will offer different approaches to time in occupational stress research and theories, linking their role to stressors, strain, and their (reverse) relationship. Finally, I will conclude the general introduction by summarizing the research objectives and describing how each of the two empirical studies and the systematic literature review that comprise this dissertation add to the understanding of the time-dynamic relationship of stressors with employee well-being and strain.

Work-Related Stressors and Their Relationship with Strain

Employees face a wide range of work-related stressors which are defined as factors that are significantly related to strain in a given population (Ford et al., 2014). Among these, time pressure as a task-related stressor (Sonnentag & Frese, 2003) is the most frequently reported work characteristic (Häusser et al., 2010). With more than a third of European employees experiencing the need to work under time pressure (Eurofound, 2017), this highlights its high prevalence in today's work environment. Time pressure indicates a high quantitative workload and arises when employees are required to complete work tasks in an insufficient amount of time, often forcing them to increase the pace of work, skip breaks, and work overtime (Baethge et al., 2019; Ohly & Fritz, 2010). Meta-analyses have consistently shown that work-related stressors, such as time pressure, are linked to various forms of strain (i.e., the experience of psychological or physical decrements to well-being; Pindek et al., 2019), for instance, somatic symptoms (e.g., headaches; Nixon et al., 2011) and mental health impairments (e.g., burnout; Guthier et al., 2020). Regarding the relationship between time pressure and strain, previous research has already established consolidated empirical evidence for their linkage. For example, as working under time pressure consumes energy (Meijman & Mulder, 1998), this results in employees feeling emotionally exhausted (Kronenwett & Rigotti, 2019) and less well and content (Vahle-Hinz, 2019), as well as experiencing poorer sleep quality (Van Laethem et al., 2013) on days with high time pressure.

A variety of theories in the field of occupational stress research describe this relationship between stressors and strain from a theoretical perspective. For instance, according to the job demand–control (JDC) model (Karasek, 1979), job strain is the result of a combination of high job demands and low job control, which is defined as "the working individual's potential control over his tasks and his conduct during the working day" (Karasek, 1979, pp. 289–290). Here, job control acts as a buffer, moderating the negative effects of high demands on well-being. The job demands–resources (JD-R) theory proposes that demands affect employee well-being via an underlying health impairment process (Bakker & Demerouti, 2007). Specifically, the theory assumes that job demands consume employees' mental and physical resources, hence, leading to a depletion of energy, which is indicated by feeling exhausted, and detrimental health outcomes (Demerouti et al., 2001). This theoretical assumption of resource exhaustion due to demand exposure with the aim to explain stressor–strain relationships relates to the ERM (Meijman & Mulder, 1998): elevated levels of stressors expend employees' energy and resources, associating their presence with detrimental psychological effects for employees. Alternatively, the effort–reward imbalance model (Siegrist, 1996) suggests that an imbalance between effort (i.e., extrinsic job demands and intrinsic motivation to approach these demands) and reward (e.g., salary or beneficial self-esteem boosts) results in strain. Empirically, the combination of high effort and low reward at work has been shown to be a risk factor for cardiovascular health, subjective health, and burnout (for a review, see Van Vegchel et al., 2005). Further prominent theories that discuss the relationship between stressors and strain are COR theory (Hobfoll, 1989) and allostatic load model (McEwen, 1998), which I will introduce in more detail later. Summarizing, while many theories assume that stressors can cause strain, herewith explaining their relationship, they are rarely sensitive to time-related effects and propositions (Aguinis & Bakker, 2021; Sonnentag, 2012), lacking specificity regarding how stressor–strain relationships unfold over time. Thus, by incorporating time in occupational stress theories, this dissertation examines and advances the theoretical understanding of temporal dynamics in stressor–strain relationships from a time-sensitive perspective.

The Role of Time in Occupational Stressor–Strain Research

Experiencing stressors and strain does not happen in a temporal vacuum: while stressor and strain experiences can be chronic and stable (Ford et al., 2014), they also vary in their level over time, for example, on a daily or weekly basis (Kern et al., 2023; Pindek et al., 2019), which also affects their relationship (over time). For instance, as time pressure fluctuates from day to day or week to week, so does the level of strain, resulting in more fatigued and less content employees on days and in weeks with higher levels of time pressure

(Kern et al., 2023; Sonnentag & Bayer, 2005; Vahle-Hinz, 2019), which demonstrates the dynamic nature of work-related stressors and strain from a temporal perspective.

Relatedly, prior research has consistently underscored the necessity of paying closer attention to temporal aspects in the context of work and stress, as time plays a central role in this area. In his content analysis of articles published in the *Journal of Applied Psychology* and *Journal of Applied Psychology-Review*, Roe (2008) analyzed how scholars in the field of applied psychology conceived time and revealed a major mental obstacle: instead of examining "what is", scholars should focus more on studying "what happens". Thus, in order to fully understand the stressor–strain relationship and account for temporal patterns, dynamics, and processes of stressors and strain, it is necessary to adopt a temporal lens (Aguinis & Bakker, 2021; Ancona et al., 2001; Roe, 2008) and apply temporal thinking (e.g., examining stressors, strain, and their relationship as a process rather than individual states), with time being an explicit element in our research. The following sections will address three approaches to time that have been focused on by occupational stress scholars, highlighting what we already know about time in the context of stressor–strain literature.

Temporal Perspectives in Current Stressor–Strain Literature

Previous time-related research on stressors, strain, and their relationship has mostly focused on one of the following areas: First, stressor–strain effects vary depending on the chosen time lag, resulting in synchronous and time-lagged stressor–strain effects. Synchronous effects are short-term strain reactions to stressor exposure at the same time point (Ford et al., 2014) that can be described by the "initial impact model" (Frese & Zapf, 1988). For example, an increase in time pressure may result in an increase in emotional exhaustion, whereas the feeling of emotional exhaustion decreases as soon as or shortly after the level of time pressure decreases again. Consequently, strain experiences have been described as concurrent reactions to stressors that vary continuously over time in accordance with changes in stressor levels (Garst et al., 2000). Regarding the change of synchronous stressor–strain effects over time, Ford et al. (2014) found in a meta-analysis that these effects showed a tendency to increase through cumulative exposure. Thus, the longer an employee is exposed to a stressor, the stronger the immediate impact on their psychological strain. This demonstrates that strain builds up and is not static. Relatedly, time-lagged stressor–strain effects arise when the impact of a stressor unfolds gradually, leading to a delayed reaction in strain at a later point in time (i.e., “sleeper effect”; Ford et al., 2014; Garst et al., 2000). For example, the stressor’s influence on psychological strain increased over time before declining after three years (Ford et al., 2014). This indicates that strain does not always show up right away, but may accumulate and intensify over time, followed by a diminishing effect after a few years, compared to synchronous short-term reactions to chronic stressors. From a theoretical perspective, both stressor–strain effects can be explained by theories that emphasize resource depletion from prolonged stressor exposure. According to COR theory (Hobfoll, 1989), individuals draw upon their personal and job-related resources to cope with stressors. During chronic exposure to stressors, these resources become increasingly depleted, leading to heightened strain over time. Similarly, the allostatic load model (McEwen, 1998) explains how the body responds to persistent stress through physiological adjustment. As allostatic load (i.e., “wear and tear” of bodily systems; McEwen & Seeman, 1999, p. 30) accumulates, it contributes to long-term deterioration in physical and psychological health by overburdening regulatory systems and depleting adaptive resources. The application of these two theories to time-related dynamics reveals that strain can emerge both immediately and cumulatively after stressor exposure, with effects intensifying over time as resources are gradually exhausted.

Second and beyond synchronous and time-lagged effects, empirical evidence builds up regarding the directionality of stressor–strain effects. Previous literature has shown that stressors and strain impact each other reciprocally and uncovered that strain is not only a result from high stressors, but can also act as a predictor or amplifier of stressors over time, demonstrating the reverse nature of the relationship between stressors and strain (e.g., Demerouti et al., 2004; Guthier et al., 2020). As such, high levels of strain resulted not only in increased stressor levels over time (de Jonge et al., 2001; Ford et al., 2014), for example, feeling emotionally exhausted led to increased levels of time pressure (Kern & Zapf, 2021), but the effect of strain on a stressor tended to increase over time (Ford et al., 2014). This indicates a creation of a reinforcing cycle where strain and stressors exacerbate each other over time, as experiencing strain can generate further stressors (Zapf et al., 1996). From a theoretical perspective, this reciprocal relationship between stressors and strain can be explained by the updated version of the job demands–resources (JD-R) theory which has been extended towards including feedback loops and time-based dynamics (Bakker & Demerouti, 2017), herewith recognizing that strain can impair job performance, which in turn increases stressors, reinforcing the stress cycle and leading to additional strain. This aligns with COR theory's loss spiral (Hobfoll, 2001) which reflects a reciprocal cycle of resource loss that is reflected by strain which makes individuals more vulnerable to further resource loss, reinforcing stressor and, consequently, leading to further strain. Overall, this challenges the unidirectional stressor–strain assumption and suggests that strain can be both a consequence and a cause of stressors, aligning with dynamic theories of occupational stress that argue for stress evolving over time and involving feedback loops between stressors and strain.

Finally, research on between- and within-person effects regarding stressor–strain relationships using experience sampling, daily/weekly diary, or intensive longitudinal studies with multilevel designs has gained significant momentum since the early 2010s (Ilies et al., 2016). Overall, the multilevel approach allows to capture the dynamic nature of occupational stress, examining stability of and fluctuations in stressors and strain over time within individuals (Ilies et al., 2015). On the one hand, between-person effects represent more stable characteristics of the working environment and well-being, comparing average levels between different individuals. Here, research has mainly focused on identifying individual differences in exposure to job demands and resources, and how these relate to relatively stable outcomes across employees. On the other hand, multilevel studies refer to how stressors and strain fluctuate over time within the same individual, herewith describing episodic and short-term experiences on the individual level and providing us with three important empirical insights: First, findings on the within-person level demonstrate that both stressors and strain vary hourly, daily, or weekly (Baethge et al., 2018; Sonnentag & Bayer, 2005; Vahle-Hinz et al., 2019), implying that the stressor–strain relationship is not static as it plays out dynamically in real time. Second, the same person may react differently to the same stressor on different days, depending on their sleep quality, recovery experiences, and available resources (Rydstedt & Devereux, 2013; Tadić et al., 2015; Trougakos & Hideg, 2009). This highlights the role of contextual and temporal moderators in the relationship between stressors and strain. Third, lagged within-person effects reveal that today's stressor exposure can predict strain not only today but also, for example, tomorrow (Nicholson & Griffin, 2015). In line with COR theory (Hobfoll, 2001) and allostatic load model (McEwen, 1998), within-person studies help to explain how strain may accumulate if stressors remain unresolved over a longer period of time, supporting the idea of short-term resource depletion. Overall, this demonstrates that the role of time becomes apparent in multilevel study designs as they account for within-person variation that occurs over time (Ohly et al., 2010), allowing to examine work-related phenomena in a natural setting and capturing life as it is lived (Bolger et al., 2003) and helping us to understand temporal processes that might otherwise be overlooked in traditional cross-sectional between-person designs.

To summarize, this shows that extensive findings on the link between stressors and strain have been accumulated in the last decade, focusing on synchronous and time lagged effects, the directionality of effects, and within-person variation over time. However, investigating interindividual differences (i.e., between-person effects) in intraindividual variation (e.g., systematic patterns over time) and how stressors are related to strain in a health-impairing manner with regard to adaptive change processes from a temporal perspective has been fairly neglected in previous stressor–strain literature. Importantly, this may help us understand how stressors and strain evolve over time and influence each other (reciprocally), herewith both utilizing and examining available time-sensitive information. The following sections will discuss this in more detail.

Temporal Trajectories

Literature on the relationship between stressors and strain has consistently demonstrated that high levels of stressors are linked to high levels of strain, whereas low levels of stressors are related to low levels of strain, both on the within- (Kronenwett & Rigotti, 2019; Sonnentag & Bayer, 2005) and between-person level (De Raeve et al., 2007; Huyghebaert et al., 2018). While stressors and strain are related, which is already proposed theoretically (i.e., JD-R theory, JDC model, ERM) and supported empirically, there is more to this relationship than linking high stressor with high strain or low stressor with low strain, especially considering the role of time. A large number of diary studies has consistently demonstrated that stressors, such as time pressure, show significant daily intraindividual variation over time (Kühnel et al., 2012; Ohly & Fritz, 2010; Teuchmann et al., 1999). This suggests the existence of (systematically) changing levels of time pressure that form quantitatively and qualitatively different temporal trajectories. Despite numerous calls to explore the systematic variation of stressors over time (Downes et al., 2021), only little is known about interindividual differences in intraindividual variation of stressors over time and their well-being relevance. Previous research has primarily focused on systematic patterns of health and well-being indicators, such as neck/shoulder and back pain in a sample of nursing students (Lövgren et al., 2014), mental and physical health (Arnold & Rigotti, 2021), and work-related rumination (Kinnunen et al., 2017). As a result, the emphasis has largely been on modeling the trajectories of outcome variables, with limited attention given to the temporal development of independent variables, such as work characteristics. Exceptions are studies that examined trajectories of job resources and constellations of working conditions, and their relationship with well-being. For example, Mäkikangas et al. (2010) approached systematic trajectories of resources over time, examining resource gains and losses and their levels across three time points with a time lag of six weeks. Applying a person-centered approach, they found four distinct trajectories of job resources, differing in their mean levels and changes over time and relationship with emotional exhaustion. Moreover, in line with the JDC model (Karasek, 1979), changes in job condition constellations were identified in a study with five time points over a time frame of ten years (Igic et al., 2017) and over four years (time points: 2008, 2010, 2012; Bujacz et al., 2018), revealing (un-)favorable relationships of job constellations with well-being. This suggests the importance of applying person-centered methodology to investigate patterns of work characteristics over time, while temporal trajectories depicting the natural ups and downs of stressors within one workweek and their relevance for well-being remain significantly understudied.

Even though theoretical models do not offer propositions regarding possible types of stressor trajectories, several distinct trajectories appear to be theoretically plausible: For example, literature on chronic time pressure suggests that some employees experience high levels of time pressure (Sonnentag & Bayer, 2005), whereas other individuals may experience a low stable trajectory of time pressure. Further, diary studies (Kühnel et al., 2012; Ohly & Fritz, 2010) suggest that some individuals experience changing levels of time pressure within a chosen time frame. This may result in a temporal pattern of increases and decreases within one workweek. However, as empirical evidence and theoretical propositions are limited, trajectories of time pressure need to be identified exploratively (see Study 1). By focusing on time pressure as a major and well-studied work-related stressor, this extends our understanding of the stressor towards its timely nature across one workweek.

Given the well-established link between time pressure and employee well-being (Pindek et al., 2019), this dissertation investigates in Study 1 how temporal trajectories of time pressure relate to well-being outcomes. Drawing on the ERM (Meijman & Mulder, 1998), qualitatively different patterns of time pressure may result in varying degrees of resource depletion, being more or less beneficial for employee well-being. Persistent exposure to high time pressure, as indicated in previous cross-sectional and longitudinal research (e.g., Bakker & Demerouti, 2007), likely leads to continuous resource depletion in order to cope with the experience, leaving fewer opportunities to recover and restore these depleted resources (Meijman & Mulder, 1998; Sonnentag & Bayer, 2005). This may manifest as reduced positive affect, increased emotional exhaustion, and poorer sleep quality (Litwiller et al., 2017; Michielsen et al., 2004; Nixon et al., 2011; Sonnentag & Bayer, 2005). Conversely, low stable time pressure is assumed to be less resource draining, allowing for better maintenance of resources and, consequently, higher levels of well-being.

Beyond stable trajectories, changing patterns of time pressure need to be considered. Prior diary studies demonstrated that time pressure fluctuates on a daily basis (e.g., Kühnel et al., 2012; Ohly & Fritz, 2010), making it plausible that some employees experience unstable trajectories during a workweek. From the perspective of the ERM (Meijman & Mulder, 1998), such fluctuating patterns may offer intermittent opportunities for recovery depending on the direction and timing of changes. However, their impact is likely to differ from both high and low stable trajectories: while not as resource-depleting as consistently high time pressure, unstable patterns may still impose more demands than consistently low pressure.

Importantly, building on COR theory (Hobfoll, 2001), the impact of these unstable trajectories may depend not only on their general variability but also on when and how time pressure increases or decreases occur. According to COR's first principle, that is, "resource loss is disproportionately more salient than resource gain" (Hobfoll et al., 2018, p. 105), the well-being consequences of an unstable time pressure trajectory may depend heavily on how the week ends and on prior experiences of resource loss or gain during the week. For instance, a trajectory that ends in decreasing time pressure may promote well-being, especially if it follows earlier periods of high pressure, as this pattern enables resource restoration. Conversely, a trajectory that ends with an increase in time pressure, even after a relatively low time pressure start to the week, may undermine well-being. This is because the negative impact of late-week resource loss can overshadow any earlier resource gains, due to the psychological salience of loss (Hobfoll et al., 2018).

Finally, trajectories involving both increases and decreases in time pressure may result in conflicting resource dynamics. While some recovery may occur during periods of lower time pressure, the overall benefit might be diminished if those gains are followed by renewed resource loss. Thus, individuals experiencing fluctuating time pressure may report poorer well-being than those with consistently low time pressure, and the net effect of these unstable trajectories may depend on the accumulation and timing of strain and recovery throughout the week. These considerations showcase that trajectories of time pressure may relate distinctively to well-being, applying COR theory (Hobfoll, 2001) and ERM (McEwen, 1998) as theoretical frameworks to link time-related effects of systematic stressor patterns with resource loss and gain.

Adaptive Change Processes

Another approach to time in occupational stressor–strain relationships and theories is the concept of adaptation which considers well-being from a temporal perspective. Adaptation theory (Diener et al., 2006) postulates that individuals return to their individual baseline of well-being after experiencing deviations from it, herewith demonstrating adaptation to both positive and negative stimuli. With this, adaptation theory explicitly recognizes and serves as an opportunity to examine how the dynamic workplace stressor–strain relationship unfolds over time (Zapf et al., 1996). From an evolutionary perspective, the process of adaptation serves crucial and beneficial functionalities, such as protecting against detrimental psychological and physiological consequences of prolonged negative emotional states and disengagement from goals that have low prospects of success (Frederick & Loewenstein, 1999).

Adaptation theory has been well-established in the research field of well-being, consistently finding evidence that individuals tend to return to their baseline after increases or decreases in well-being after being confronted with major life events, such as marriage, death of a spouse, or birth of a child (e.g., Clark & Georgellis, 2013; Luhmann et al., 2012). In the organizational context, empirical evidence suggests that individuals also tend to revert to their general level of well-being after encountering work-related stressors. As already revealed by Ford et al. (2014), the eventual decline of the stressor–strain relationship after three years suggests there might be a natural adaptation process or external changes that reduce strain. Moreover, employees reported increased subjective well-being one month after experiencing workplace incivility (Matthews & Ritter, 2019), as well as higher subjective well-being and reduced burnout six months following work–family conflict (Matthews et al., 2014). Additionally, they exhibited a return to baseline sleep quality by two months post-exposure to role overload (Henderson et al., 2023). In line with adaptation theory, this indicates that individuals tend to be adaptive over time after experiencing decreases of well-being as a response to work-related stressors.

Contrastingly, the empirical evidence and theoretical assumption of a naturally occurring adaptive change process contradicts the accumulation of resource loss and consequent spiraling proposed by COR theory (Hobfoll, 2001). As meta-analyses and longitudinal studies already demonstrated, high levels of time pressure result in emotionally exhausted employees (Ford et al., 2014; Igic et al., 2017). In line with COR theory (Hobfoll, 2001), this indicates the loss of resource as time pressure places demands on the individual and depletes its resources, resulting in increased strain and reduced well-being. However, recent empirical evidence challenged the existence of resource loss spirals. For example, Somaraju et al. (2022) established a dynamic model of task and relationship conflict and strain with the aim to test resource threat and loss spirals for individuals working in extreme work settings. While they found that current-day relationship conflict resulted in next-day strain, and vice versa, they did not identify an unending increase in strain after the experience of resource loss because of relationship conflict. Instead, employees returned to an equilibrium after increased levels of conflict and strain. Relatedly, Ford et al. (2023) found no loss spirals in the relationship between work–family conflict and personal resources that resulted in an ongoing resource loss over four consecutive months and, instead, suggested that employees adapted to work-related stressors over time. Taken together, complex processes appear to play a role in the temporal process of the relationship between work-related stressors and well-being: potential loss spiraling and adaptive change. Specifically, considering the accumulation of resource loss (Hobfoll, 2001) and the natural adaptation over time (Diener et al., 2006), time pressure may change the time course of emotional exhaustion, hindering the natural return to the baseline of emotional exhaustion. By combining and applying two theoretical frameworks that propose time-related effects, namely adaptation and COR theories, Study 2 of this dissertation offers valuable empirical and theoretical insights into the temporal dynamics through which workplace stressors contribute to health impairments (i.e., via reduced adaptation).

Building on previous research on the reciprocal relationship between stressors and strain (Guthier et al., 2020), the reverse directionality in adaptive change processes is also of relevance: the influence of emotional exhaustion on the adaptive change of time pressure. Herewith, another perspective on temporality over and beyond adaptive change processes and resource loss spirals in strain and a stressor is approached in this dissertation, specifically, reverse effects in the stressor–strain relationship, which sheds light on how strain influences the temporal development of a stressor. Empirical findings showed that employees experience periods of high time pressure that are being followed by periods of low time pressure, and vice versa (Baethge et al., 2018; Kern et al., 2023), resulting in temporal dynamics. In line with literature on adaptive change processes of stressors in organizational contexts (Matthews et al., 2014; Ritter et al., 2016), employees may also exhibit adaptation in time pressure from one week to the next, tending to return to their baseline of time pressure. Hereby, with previous research focusing primarily on the adaptive processes of and to well-being and negative work-related experiences (work–family conflict; Matthews et al., 2014; role stressors; Ritter et al., 2016), this extends literature towards the adaptation to a task-related stressor, namely time pressure. Finally, emotionally exhausted employees may lack the necessary resources to deal with time pressure, as suggested by Corollary 1 of COR theory (Hobfoll, 2011). Consequently, this may prevent a decrease of time pressure and, thus, a return to baseline levels of the stressor. Hence, in line with the argumentation on the simultaneously occurring temporal processes of adaptation and resource spiraling, the process of adaptive change of time pressure may be influenced by the experience of emotional exhaustion, resulting in a disruption of adaptation to time pressure.

Integrating Time in Stressor–Strain Theories

With regard to time, previous literature has mainly focused on methodological aspects when examining the relationship between stressors and strain. For example, when deciding for or comparing the effects of time lags between measurement points with regard to the relationship of stressors and strain, time becomes of particular importance as the interpretations and conclusions of study results depend on the chosen time lags (Rauvola et al., 2021). Because time lags can be “too” long or “too” short, resulting in differential effects regarding the relationship between stressor and strain (Rauvola et al., 2021), Dormann and Griffin (2015) proposed “shortitudinal“ studies (i.e., time frame less than four weeks) to determine the optimal time lag in order to detect true effects between stressors and strain. Additionally, scholars discussed the most appropriate research methods for examining directional effects (Ford et al., 2014; for an overview of findings, see p. 11f. of this dissertation), (temporal) processes (e.g., Spector & Meier, 2014), and the concept of time itself (for an in-depth discussion, see Navarro et al., 2015). For instance, Spector and Meier (2014) proposed the (combined) use of qualitative (e.g., content-analysis) and quantitative methods (e.g., diary studies) as helpful approach to address temporal developments of variables themselves and fostering our understanding of underlying processes regarding their relationships. They also argued that researchers need to pay more attention to temporal aspects in theories that address processes of and between work-related variables. Relatedly, other scholars pointed out that the role of time has been fairly neglected in theory-building with regard to stressor–strain literature (Aguinis & Bakker, 2021; Navarro et al., 2015; Shipp & Cole, 2015; Sonnentag, 2012), specifically, in theoretical propositions regarding (time-sensitive) effects of stressors, strain, and their relationship. This aligns with Scholz (2019) who emphasized the need for making an effort in stronger theorizing as "too few theories in health psychology address temporal matters in the specified psychological phenomena, their relationships, and the explanation for these relationships" (p. 173).

Some theories already integrate temporal aspects in their theoretical frameworks (Sonnentag et al., 2024; Sonnentag & Meier, 2024), such as COR theory (Hobfoll, 2001), adaptation theory (Diener et al., 2006), and the allostatic load model (McEwen, 1998). Although these theoretical frameworks acknowledge temporal matters, such as resource loss and gain spirals, adaptive change processes, or stress accumulation, they often lack specificity regarding when effects arise following exposure to stressors or how stressors develop over time (for exceptions, see Rosen et al., 2020; Somaraju et al., 2022). Thus, a systematic synthesis is needed which provides an overview of the integration of time in current stressor–strain literature, identifying empirical and theoretical gaps that help us to further develop time-sensitive research and theorizing.

Overview of Research Objectives and Dissertation Outlook

The overarching aim of this dissertation is to investigate the empirical and theoretical understanding of temporal dynamics in stressor–strain relationships and promote the role of time in occupational stress research and theory development from a time-sensitive perspective. This aim encompasses three central research objectives:

1. Examine to which extent existing occupational stress theories account for time-related effects in stressor–strain research.
2. Explore and extend well-known stressor–strain relationships (i.e., time pressure and well-being; time pressure and emotional exhaustion) from a time-sensitive empirical and theoretical perspective. Specifically:
   2.1. Identify time pressure trajectories within one workweek and their well-being relevance.
   2.2. Investigate reciprocal adaptive change processes in time pressure and emotional exhaustion and how changes in levels relate over eight workweeks.
3. Systematically review and synthesize how time has been theoretically and empirically integrated into existing stressor–strain research.

Towards these research objectives, I took a multi-method approach and conducted two empirical studies and one systematic literature review which I briefly summarize below. First, taking a person-centered approach, Study 1 (Chapter 2) concentrates on temporal patterns of a stressor and aims at extending a known stressor–strain relationship by identifying distinct classes of time pressure trajectories over one workweek and examining their relevance for well-being at the end of the workweek and start of the next week. Hereby, I offer a short-term perspective on temporality in a stressor and its relationship with well-being, based on the ERM (Meijman & Mulder, 1998) and COR theory (Hobfoll, 1989, 2001), focusing on research objectives 1 and 2.1. Given the exploratory nature of a person-centered approach, I pursued two open research questions: (1) which latent classes of time pressure trajectories occurred for employees, and (2) how did these classes differ from each other regarding indicators of well-being ending a workweek and starting the next week? To do so, I used data on 254 employees from a daily diary study which assessed time pressure after work across five consecutive workdays and positive valence, calmness, and energetic arousal (Friday evening and Monday morning) and sleep quality (Friday to Saturday night) as indicators of well-being. I conducted latent class growth analysis to identify time pressure trajectories and Bolck–Croon–Hagenaars approach to examine how each trajectory identified related to the well-being indicators assessed.

Study 2 (Chapter 3) applies time to both theoretical reasoning and empirical research to the relationship between stressors and strain, targeting research objectives 1 and 2.2. Specifically, it aims at exploring adaptive change processes in emotional exhaustion and time pressure and how changes in emotional exhaustion and time pressure relate over eight workweeks. By assessing weekly effects of adaptive change dynamics of and between emotional exhaustion and time pressure, the study takes a mid-term temporal perspective on the stressor–strain relationship and accounts for reverse effects over time, herewith extending Study 1 in terms of the chosen time frame and applied methodological approach (i.e., variable-centered) to examine time-sensitive stressor–strain effects. Drawing on adaptation theory (Diener et al., 2006) and COR theory (Hobfoll, 1989, 2001), I hypothesized that employees return to a baseline level in both emotional exhaustion and time pressure, showing adaptation in strain and stressor over time, as well as that changes in levels of emotional exhaustion and time pressure relate over time, disrupting adaptation in both variables. To test the assumptions, I conducted a weekly diary study over eight consecutive workweeks with 252 employees and applied, first, latent growth curve modeling to investigate the overall time trend in the data and, then, uni- and bivariate latent change score modeling to examine adaptive change processes and the effect of the variables' levels on each other's time courses.

The systematic literature review (Chapter 4) synthesized how time has been theoretically and empirically integrated into current stressor–strain literature and theorizing, identifying time-related categories and making recommendations for a time-sensitive theory development of stressor–strain relationships. Herewith, it helps to cartograph perspectives on time existing in state-of-the-art stressor–strain research and considers research objectives 1 and 3. For this, 158 studies from 147 articles published between 2012 and 2021 in four journals (*Journal of Applied Psychology*, *Journal of Occupational Health Psychology*, *Journal of Organizational Behavior*, and *Work & Stress)* were systematically reviewed according to PRISMA guidelines (Page, McKenzie, et al., 2021; Page, Moher, et al., 2021). Included studies consisted of at least two measurement points in longitudinal, shortitudinal, and diary designs, and investigated the relationship between stressors (e.g., time pressure) and strain (e.g., exhaustion). Time-related categories were identified and described, presenting prime literature examples that incorporated time theoretically and/ or empirically in their study for each category. Building on the results, I present seven key areas for future research, aiming to further devise a time-sensitive theory development of stressor–strain relationships and stimulate time-related theory-building in the context of occupational stress.

Figure 1 provides a summary of the aims, methodological approaches, and results of each study.

Figure 1

Overview of the Studies that Comprise this Dissertation

Study 1

Targets research objectives 1 and 2.1

Aim

Identify latent classes of time pressure trajectories over the workweek and examine their relationship with indicators of well-being. Based on the effort–recovery model and conservation of resources theory, interindividual differences in intraindividual variation of time pressure over time and their relationships with well-being were expected.

Method

Data: 254 employees

Design: Daily diary study over five consecutive workdays followed by a Monday morning assessment between January and May 2016

Measures: Time pressure (after work), positive valence, calmness, and energetic arousal (Friday evening, Monday morning), sleep quality (Friday to Saturday night)

Data analysis: Latent class growth analysis to identify time pressure trajectories and Bolck-Croon-Hagenaars approach to describe the relationships between trajectories identified and well-being indicators

Main results

Four distinct time pressure trajectories emerged: *low stable*, *high unstable*, *medium unstable*, and *increasing unstable* time pressure. The trajectories differed in their relationships with well-being indicators: Employees benefited from experiencing *low stable* and, surprisingly, *increasing unstable*, both when ending and starting a working week, rather than *high unstable* and *medium unstable* time pressure

Study 2

Targets research objectives 1 and 2.2

Aim

Explore adaptive change processes in emotional exhaustion and time pressure and how changes in emotional exhaustion and time pressure relate over eight workweeks, herewith taking into account reverse effects over time in stressor–strain relationships. Drawing on adaptation and conservation of resources theories, it was hypothesized that individuals will return to their baseline levels of emotional exhaustion and time pressure after experiencing deviations from them and that, simultaneously, time pressure disrupts this adaptive change process in emotional exhaustion over time, and vice versa.

Method

Data: 252 employees

Design: Weekly diary study over eight consecutive workweeks between April to December 2021

Measures: Emotional exhaustion, time pressure

Data analysis: Latent growth curve modeling to investigate overall time trend in data; uni- and bivariate multiple-indicator latent change score modeling to investigate adaptive change processes in emotional exhaustion and time pressure as well as the variables' influences on each other's time courses

Main results

Employees adapted to both emotional exhaustion and time pressure, returning to baseline levels over time. These changes were affected by the level of time pressure and emotional exhaustion of the previous week, respectively, herewith demonstrating simultaneously occurring adaptive change and resource loss processes.

Systematic Literature Review

Targets research objectives 1 and 3

Aim

Synthesize how time has been theoretically and empirically integrated into stressor–strain studies, identifying time-related categories and making recommendations for a time-sensitive theory development of stressor–strain relationships.

Method

Data: 158 studies from 147 articles published between 2012 and 2021 in four key journals

Design: At least two measurement points in, e.g., longitudinal, shortitudinal, and diary designs

Measures: Stressors (e.g., time pressure, incivility, role stressors) and strain (e.g., exhaustion, absenteeism, sleep quality)

Data analysis: Systematic literature review according to PRISMA guidelines to extract information on samples, study variables, study designs, methodological approaches, theoretical frameworks, and time-related categories

Main results

Five time-related categories were identified: *Multilevel designs*, *stressor changes as predictor*, *temporal trajectories*, *time lags and directionality*, *variation across time and chaotic fluctuations*. While some articles integrated time in their theoretical background (e.g., applying conservation of resources theory), most research approaches time-related questions from a(n advanced) methodological rather than a theoretical perspective. Finally, the review identifies seven key areas for future research to develop a time-sensitive theory of stressor–strain relationships.

Chapter 2 – Study 1: The Ups and Downs of the Week: A Person-Centered Approach to the Relationship Between Time Pressure Trajectories and Well-Being[2]

Abstract

This study extends previous research on time pressure and well-being by investigating the relevance of distinct time pressure trajectories for indicators of well-being at the end of the working week and start of the next week. Drawing on the Effort–Recovery Model and Conservation of Resources theory, we applied latent class growth analyses and a manual stepwise Bolck–Croon–Hagenaars[3] approach to examine (a) which latent classes of time pressure trajectories occur for employees, and (b) how these classes differ from each other regarding indicators of well-being at the end of the working week and the following Monday. Using data on 254 employees in a daily diary study across five consecutive workdays, the findings revealed a four-class solution characterized by qualitatively different time pressure trajectories: a *low stable* time pressure trajectory and three trajectories with changing time pressure levels (*high unstable*, *medium unstable*, and *increasing unstable* time pressure). Further, the trajectories exhibited class-specific differences in Friday evening and Monday morning positive valence, calmness, and energetic arousal, in addition to Friday night sleep quality. The results indicated that not only did the level of time pressure matter regarding well-being but also the temporal pattern of change across one working week. The present article provides a first step towards understanding different temporal dynamics of time

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[2] This chapter has been published as a research article in the *Journal of Occupational Health Psychology*.

Mühlenmeier, M., Rigotti, T., Baethge, A., & Vahle-Hinz, T. (2022). The ups and downs of the week: A person-centered approach to the relationship between time pressure trajectories and well-being. *Journal of Occupational Health Psychology*, *27*(3), 286–298. https://doi.org/10.1037/ocp0000306

All supplemental material can be obtained in Appendix A of this thesis.

[3] A spelling error in the published version has been corrected here, as it is referred to as the “Block-Croon-Hagenaars” approach.

pressure and their relationship to well-being. Additionally, the findings are discussed from the perspective of resource loss and gain, providing practical recommendations for job design, leadership behavior, as well as individual coping with job demands.

Introduction

Employees are confronted daily with numerous work-related demands, among these time pressure being the most frequently reported job condition (Häusser et al., 2010). Time pressure occurs when employees are confronted with the demand to complete their work tasks while feeling they have insufficient time to do so, causing them to work at a faster pace than usual, skipping breaks, and working overtime (Baethge et al., 2019; Ohly & Fritz, 2010). Empirical findings of a representative study showed that people in most European countries increasingly report that they need to work under time pressure (Eurofound, 2017). A considerable share of 36% report working to tight deadlines and 33% working at high speed (three-quarters of the time or more; Eurofound, 2017), underlining the high prevalence of time pressure in today's work settings. In addition to between-person differences in time pressure, diary studies have revealed that the level of time pressure fluctuates on a daily basis (Kühnel et al., 2012). As time pressure takes its toll on employees' energy and resources, previous research has focused on the detrimental effects, such as increased fatigue on the between- (De Raeve et al., 2007) as well as within-person level (Sonnentag & Bayer, 2005), high emotional exhaustion (between-person: Huyghebaert et al., 2018; within-person: Kronenwett & Rigotti, 2019; Teuchmann et al., 1999), and poor sleep quality at night between-persons (de Lange et al., 2009; Litwiller et al., 2017) as well as within-persons (Van Laethem et al., 2013).

Although diary studies and thereby the study of within-person effects have become quite common in recent years, the focus has been on within-person effects, mainly neglecting temporal trajectories. Within-person effects indicate deviations from the individual average value. Hence, a positive within-person relationship between time pressure and fatigue, for instance, indicates that deviations from the person's average level of time pressure are related to deviations from the average level of fatigue. Between-person effects compare subgroups of persons with different (general) levels in, for instance, time pressure. Less is known about the relationship between the temporal dynamics of demands in terms of their variability as well as individual responses to these changes over time with health and well-being outcomes of employees. With our study, we follow the numerous calls to take a closer look at the (systematic) variation of work-related variables over time (cf. Downes et al., 2021).

Our first aim is to identify distinct latent classes of time pressure trajectories across one working week using a person-centered approach. More precisely, every individual experiences a different trajectory of time pressure within one working week and we want to assign them to classes of trajectories (e.g., increasing time pressure or stable low time pressure across the working week). This allows us to account for intraindividual heterogeneity regarding time pressure experiences over time that go undetected in variable-centered analyses (Wang & Hanges, 2011). Also, this approach captures both quantitative (i.e., level) and qualitative (i.e., pattern) differences between classes. Hence, we can look at interindividual differences in intraindividual changes of time pressure.

Based on the propositions of the Effort–Recovery Model (ERM; Meijman & Mulder, 1998) and Conservation of Resources (COR) theory (Hobfoll, 2001), our second aim is to examine the distinct relationship of the time pressure trajectories identified with employees' well-being, reflected in positive valence, calmness, and energetic arousal both on Friday evening and on the following Monday, as well as Friday night sleep quality.

The present study makes two key contributions to the literature on time pressure and well-being. First, we enhance the understanding of daily time pressure and present, to the best of our knowledge, the first empirical test to demonstrate the presence of qualitatively different classes of time pressure trajectories. Person-centered approaches, or, more precisely, a latent class growth analysis (LCGA), is rarely used in occupational health research. To date, clusters of time trajectories have mainly been studied using health and well-being indicators, like neck/shoulder and back pain in a sample of newcomer nurses (Lövgren et al., 2014), mental and physical health (Arnold & Rigotti, 2021), or work-related rumination (Kinnunen et al., 2017). Hence, the focus so far has been on modeling trajectories of outcome variables, thus neglecting the temporal trajectories of independent variables. Concerning patterns in trajectories over time of demands and resources, we are aware of only one study by Mäkikangas et al. (2010), looking at resource gains and losses and their levels across three time points. In contrast to other recently published articles on job demand variability in general (Downes et al., 2021; Rosen et al., 2020), we propose in the present study that job demands may also follow certain trajectories over the course of a working week. Thus, employing a daily diary study and including data from 254 employees over one working week, we used LCGA to identify classes of time pressure trajectories, thereby modeling the temporal trajectory of the independent variable time pressure. This extends the research on between- and within-person effects of time pressure as well as considers differences in job demand trajectories.

Second, referring to the ERM (Meijman & Mulder, 1998) and COR theory (Hobfoll, 2001), we examine if and how the trajectories classes identified have distinct effects on indicators of well-being, conceptualized as positive valence, calmness, energetic arousal, and sleep quality. Interpreting time pressure trajectories from a well-being perspective will also provide evidence-based practical recommendations for job design, leadership behavior, as well as individual coping with job demands. Our approach helps to draw conclusions on how workload should be spread across the working week in the most sensible way regarding well-being and resources expenditure.

The Choice of Outcome Variables

The unfavorable effects of time pressure on employees' well-being can be explained by the ERM (Meijman & Mulder, 1998). The ERM postulates that job demands, such as time pressure, result in normally short-lived physiological and negative psychological load reactions as they are associated with both psychological and physiological costs (Bakker & Demerouti, 2007). To deal with these demands, effort expenditure at work (e.g., physical work, attention, and concentration) is required, thereby expending physical and/or mental energy. In addition, employees are likely to cope with time pressure by working faster and by skipping breaks (Baethge et al., 2019). The depletion of energy is the reason why people feel fatigued – both energetically and emotionally – at the end of the working day (Meijman et al., 1992).

However, these negative load reactions are usually reversible and not harmful if psychophysiological systems activated during the working day are not called upon during off-job time and return to the individual's baseline level (Geurts & Sonnentag, 2006; Meijman & Mulder, 1998). Taking a break from demands allows individuals to recuperate from the effort investment and, consequently, for their resources to be replenished. However, if an employee is still tired from previous work tasks or periods, and thus, has not fully recovered, and must nonetheless invest effort and resources to meet new demands, load reactions accumulate, leading to allostatic load (McEwen, 1998) and long-term exhaustion (Meijman & Mulder, 1998). This results in chronic health problems such as prolonged fatigue (van Hooff et al., 2005) and persistent sleep complaints (de Lange et al., 2009) which lead to people not feeling refreshed in the morning–causing a vicious circle as fewer resources are available to cope with the demands of the next day (Sluiter et al., 1999).

In order to explore the relationship between distinct time pressure trajectories and well-being, we chose outcome variables that reflect these depleting effects of time pressure, namely positive valence, calmness, energetic arousal, and sleep quality. Multilevel analysis revealed a three-dimensional model of affective well-being at the within-person level, showing that the three dimensions positive valence, calmness, and energetic arousal are highly sensitive to capturing affective states, and thus affective well-being (Kampf et al., 2021; Wilhelm & Schoebi, 2007). The dimensions range from unpleasant to pleasant, restless to relaxed, and tired to full of energy (Wilhelm & Schoebi, 2007). Earlier research on the relationship between time pressure and affective well-being has revealed detrimental effects of time pressure as it leads to lower positive (Sonnentag & Bayer, 2005) and increased negative well-being after work (Fritz & Sonnentag, 2009). Time pressure is related to worries about not being able to accomplish goals (Cropley & Zijlstra, 2011), and thus, likely negatively relates to positive valence. As time pressure usually increases the pace of work (Baethge et al., 2019), it should also show a negative effect on calmness. Finally, as working under time pressure consumes resources (Meijman & Mulder, 1998), it likely also negatively relates to energetic arousal. Empirically, time pressure has been negatively associated with positive valence and is positively related to emotional irritation (as opposed to being calm) and fatigue (as the opposite of energetic arousal): For instance, day-specific time pressure resulted in less well and content (Vahle-Hinz, 2019) and more fatigued employees on returning home from work (Sonnentag & Bayer, 2005) as well as higher emotional irritation in the evening (Baethge & Rigotti, 2013). To summarize, this suggests that individuals experience lower positive valence, energetic arousal, and calmness on days with high time pressure.

Finally, a good sleep quality is considered essential for health and well-being, enabling important psychological and somatic recovery which serves the restoration of depleted resources (Rook & Zijlstra, 2006) and helps to reduce the risk of impaired well-being (Sonnentag, 2018). A meta-analysis revealed that sleep quality is negatively associated with time pressure and health correlates, such as depression and general strain (Litwiller et al., 2017), making it a valuable well-being indicator for our study on time pressure trajectories throughout one working week.

Time Pressure Trajectories Over the Working Week: Interindividual Differences

From a large number of studies, we know that time pressure shows significant intraindividual variation on a daily basis (Kühnel et al., 2012; Ohly & Fritz, 2010; Teuchmann et al., 1999). On days employees experienced peaks in time pressure, they showed less positive affect and higher fatigue when returning home after work (Sonnentag & Bayer, 2005). Additionally, the need for recovery was higher on those days (Siltaloppi et al., 2009).

This shows that the higher the time pressure was on a specific day, the less content and more tired employees felt and the more they were in need of recovery, possibly due to depleted resources. In the present study, we propose that these changing levels of time pressure form quantitatively and qualitatively different trajectories during a certain period of time (here: one working week).

Hence, we expect to find different trajectory classes, differing in their level and pattern. Therefore, we adopted a person-centered approach, namely LCGA, to identify distinct classes of time pressure trajectories that cluster employees experiencing similar changes in time pressure during one working week. Importantly, the inductive nature of LCGA precludes formal predictions regarding the number and patterns of trajectory classes (Bennett et al., 2016; Gabriel et al., 2018). Given that no work to date has investigated the presence of time pressure trajectories, we will explore the following as an open research question:

Research Question 1: Which classes of time pressure trajectories throughout one working week occur for employees?

Although the methodological approach is exploratory in nature, there are some classes that seem intuitively and theoretically plausible. For instance, in line with research on chronic time pressure, it seems likely that some employees may experience an exclusively high level of time pressure (Sonnentag & Bayer, 2005), resulting in a trajectory class characterized by high stable time pressure across the workweek. Similarly, some employees may experience low stable time pressure. Further and in line with the findings of diary studies (Kühnel et al., 2012; Ohly & Fritz, 2010), some employees may experience short-term changing levels of time pressure, resulting in a temporal pattern with ups and downs over the working week. For example, some employees may begin the week with a high level of time pressure which abates as the week progresses, resulting in decreasing time pressure across the workdays. Alternatively, the opposite pattern may emerge: Employees may begin their week with a low level of time pressure that increases during the week, resulting in an increase of time pressure.

Additionally, employees may experience a combination of decreasing and increasing processes throughout the working week, thus forming curvilinear and/or cubic trajectories in which a changing pattern of time pressure is captured. Later, we will go into more detail on those (combined) decreasing and increasing processes.

Well-Being Relevant Trajectories of Time Pressure

Drawing on the ERM, we propose that the time pressure trajectories differ in the amount of depleted resources, and thus, are different in their relationship to well-being, reflected in the variables positive valence, calmness, energetic arousal, and sleep quality. Hence, we explore the relationship between different plausible trajectories of time pressure within one working week with indicators reflecting differences in well-being. We base our reasoning on the ERM (Meijman & Mulder, 1998), which allows us to draw initial conclusions on which types of trajectories are more useful than others in terms of their effect on well-being. Assuming that classes of time pressure trajectories occur, a natural and ERM related question is how they are associated with variables indicating well-being. Even though we cannot draw on earlier findings, we will explore this using an open research question:

Research Question 2: How do distinct time pressure trajectories differently relate to well-being?

Based on theoretical and empirical work, we suggest several well-being relevant time pressure trajectories might occur and could be classified into two broad categories: (high vs. low) stable time pressure and changing time pressure.

(High vs. Low) Stable Time Pressure

Previous cross-sectional and longitudinal research on between-person effects of time pressure suggests that high stable time pressure throughout the working week represents a chronic demand requiring constant expenditure of physical and/or mental energy in order to deal with the demand without any respite from it (Bakker & Demerouti, 2007; Meijman & Mulder, 1998). As a consequence, negative load reactions accumulate and employees’ opportunity to recover and restore depleted resources is impeded (Sonnentag & Bayer, 2005), resulting in employees who are less content and more emotionally exhausted and who experience poorer sleep quality (Litwiller et al., 2017; Michielsen et al., 2004; Nixon et al., 2011; Sonnentag & Bayer, 2005). Contrastingly, a low stable level of time pressure is less aversive than high stable time pressure as employees need not invest as many resources to complete a work task. Hence, and in line with previous between-person findings, we propose that stable high and low levels of time pressure across one working week are distinctive trajectories in terms of their relationship to well-being. The relationships of these trajectories to well-being should differ accordingly: Assuming that we find a low stable and a high stable time pressure trajectory, a low time pressure trajectory should be related to better well-being, reflected in higher positive valence, calmness, energetic arousal, and sleep quality, when compared to a high time pressure trajectory at the end of the working week and on the following Monday.

This aligns with between-person effects reported for time pressure. In order to provide a contribution to the existing evidence, we will discuss in the following how these stable trajectories of time pressure might show a different relationship to well-being indicators when compared to trajectories indicating systematic variation over the course of one working week.

Changing Time Pressure

As diary studies have proposed daily (within-person) fluctuations in time pressure (e.g., Kühnel et al., 2012; Ohly & Fritz, 2010), it seems reasonable also to expect trajectories of time pressure that indicate changes in the level of time pressure across the working week. This means that employees experience days with higher or lower time pressure than they encounter on other days of the working week, resulting in changing temporal trajectories. As an example, an employee may feel that there is not enough time to finish a task and hence a need to work at a pace faster than usual today, expending resources on dealing with the demand, thus feeling energetically and emotionally tired and exhausted. On the next day, however, the level of time pressure is, for instance, lower so that the employee does not need to expend as many resources to pursue the work tasks as yesterday, consequently feeling less tired at the end of the day. Therefore, and in line with the ERM (Meijman & Mulder, 1998), we assume that trajectories with changing levels of time pressure during the working week are associated with fewer depleted resources and, hence, result in higher well-being, both at the end of the working week and on the following Monday, as they hold the opportunity to restore depleted resources in contrast to high stable time pressure, which is characterized by heavily depleted resources throughout the working week. Additionally, employees experiencing low stable time pressure constantly face low demands throughout the week. Hence, they may experience fewer depleted resources than employees with changing time pressure as the latter still encounter some peaks in the trajectory throughout the working week, resulting in lower well-being for trajectories containing changing levels of time pressure, both at the end of the working week and on the following Monday.

In addition, considering changing levels of time pressure, a complex pattern in terms of well-being related time pressure trajectories represents a process of (combined) decrease and/or increase of time pressure over the working week. In accordance with COR theory (Hobfoll, 2001), a decrease in time pressure results in lower investment of resources in order to deal with the demand, leading to a gain of resources. Conversely, increasing time pressure requires more resources when dealing with the demand, resulting in the perception of a loss rather than a gain of resources. This is in line with the first principle of COR theory, which posits that "resource loss is disproportionately more salient than resource gain" (Hobfoll et al., 2018, p. 105), highlighting the negative effect of resource loss.

Hence, based on COR theory (Hobfoll, 2001; Hobfoll et al., 2018), it might be possible that the effect of time pressure trajectories on the well-being indicators depends on the ending of the trajectory as well as previous experience of resource loss or gain during the working week. First, due to the saliency of resource loss over gain (Hobfoll et al., 2018), trajectories ending with decreasing time pressure might only be beneficial if an employee experienced no increase earlier that week as the perception of resource loss overshadows the restoration of depleted resources during declining time pressure. This means that trajectories combining resource loss and gain are less beneficial for employees (i.e., lower positive valence, calmness, energetic arousal, and sleep quality) than trajectories represented by predominantly decreasing time pressure throughout the working week because resources are less depleted and, hence, need less to be restored. Quadratic and cubic trajectories describe possible temporal combinations of decrease and increase. For instance, employees may experience low time pressure at the start of the working week, but an increase until midweek (i.e., loss of resources), followed by a decline until the end of the week (i.e., gain of resources), illustrating an inverted u-shaped trajectory with quadratic trend. Additionally, employees may start the working week with high time pressure that persists until midweek (i.e., loss of resources) and then experience a drop in time pressure at the end of the week (i.e., gain of resources), demonstrating a cubic time pressure trajectory.

Second, on the basis of COR theory (Hobfoll, 2001), trajectories ending with increasing time pressure, regardless of increase and/or decrease during the previous workdays, may be less beneficial in terms of well-being than trajectories that complete the working week with decreasing time pressure due to the depletion of resources at the end of the working week. Consequently, the relationship between changing trajectories and well-being indicators could depend on the endings of the trajectories (decrease vs. increase) and the prior history of time pressure experience. Specifically, trajectories ending with decreasing time pressure could result in better well-being, reflected in higher positive valence, calmness, energetic arousal, and sleep quality if no resources were previously lost while experiencing increasing time pressure, demonstrating that the prior history of time pressure experience matters in this case. Additionally, trajectories ending with increasing time pressure could result in poorer well-being, reflected in lower positive valence, calmness, energetic arousal, and sleep quality than trajectories ending with decreasing time pressure, regardless of previous resource loss and gain history because of the loss of resources at the end of the working week. Therefore, based on COR theory and resource loss saliency (Hobfoll, 2001; Hobfoll et al., 2018), we explore how trajectories containing changing levels of time pressure throughout one working week differ in well-being, reflected in positive valence, calmness, energetic arousal, and sleep quality, both at the end of the working week and on the following Monday.

Methods

Procedure and Sample

The present study follows a daily diary study approach over one working week with an additional assessment the following Monday. Data for this study was collected from January to May 2016. First, an online diary study over five consecutive workdays (Monday to Friday) was conducted to assess time pressure. Every day, participants received three time-separated emails with a link to the questionnaire at time points which were customized to fit employees' preferences and working hours: before starting work, after finishing work, in the evening before going to bed. Additionally, the programming of the questionnaires included time filters which allowed access to each questionnaire only within the designated time frames, for example, preventing participants from completing the evening survey the next morning. This study uses only data on time pressure from the questionnaires completed after finishing work. Our primary reason for selecting one week was that, following (Zerubavel, 1985), for most employees in Western society a regular week consists of seven days, structured into five workdays (i.e., Monday to Friday) and two days of weekend (i.e., Saturday and Sunday; Zerubavel, 1985). As this time frame structures and regulates individuals' work, social, and leisure activities to a large extent, we assumed that one working week was likely to produce meaningful trajectories of time pressure. The outcome variables positive valence, calmness, and energetic arousal were assessed on Friday evening. Later, participants provided data the following Monday to assess their current positive valence, calmness, and energetic arousal at the start of the new working week, as well as sleep quality during the night from Friday to Saturday of the past weekend. Prior to daily assessments, participants completed a baseline questionnaire in which they provided sociodemographic data.

The participants were recruited through a convenience sampling method, in which one doctoral student, six degree-seeking students as well as the students of a project seminar contacted their personal and work-related networks as well as one organization. To compensate for their effort, all participants had the chance to win one out of five 30-Euro gift certificates in a lottery. According to Demerouti and Rispens (2014), recruitment among one's network leads to heterogeneous samples, increasing the variance of work- and individual-related characteristics. Moreover, those samples do not differ substantively from non-network-recruited samples with the exception of smaller effect sizes (Wheeler et al., 2014).

In total, 408 participants were invited to take part in the study and 391 participants responded at least once to our invitation, which reflects a response rate of 95.8%. In the first step, we excluded 71 participants because they identified themselves as apprentices or students, or worked shifts or part-time. As we aim at identifying trajectories across five consecutive workdays, we only included in the analyses those participants who provided information regarding daily time pressure on at least three days. This results in the exclusion of further 66 participants. Our final sample for analysis, thus, consisted of 254 full-time working employees, of whom 77 belonged to the recruited organization. The final sample provided data of daily time pressure on 1113 days for the LCGA, which reflects a response rate of 87.6% for the daily measures. Fifty-six percent of the final sample provided data on time pressure on all five consecutive working days, while 26% and 18% provided data on four and three days throughout the week, respectively.

Fifty-eight percent of the participants were male, and the mean age was 38 years (ranging from 19 to 64 years). The majority of the participants had a higher education qualification (63%) and had completed either university (42%) or vocational training (32%).

Most of the participants worked in engineering (33%), followed by the health (9%) and service sectors (8%). The average tenure with their current employers was *M* = 11 years (*SD* = 10 years). Weekly working hours were, on average, *M* = 42 hr (*SD* = 5 hr) and *M* = 8 hr (*SD* = 1 hr) on measurement days.

Measures

Time pressure. Time pressure was measured after work during five consecutive workdays, using a three-item scale of the Instrument of Stress Oriented Task Analysis (Semmer et al., 1999). A sample item is "Today I had to work under time pressure." Items were assessed on a five-point rating scale ranging from 1 (*absolutely disagree*) to 5 (*absolutely agree*). Day-level McDonald's omega ranged between .89 and .93 (mean omega was .91).

Positive Valence, Calmness, and Energetic Arousal. Positive valence (V), calmness (C), and energetic arousal (E) were assessed on Friday evening as well as on the following Monday, using the six-item mood scale designed for momentary assessment in daily life (Wilhelm & Schoebi, 2007). During each observation, participants responded to the statement "At this moment I feel:" by means of six bipolar items: content-discontent (V-), unwell-well (V+), agitated-calm (C+), relaxed-tense (C-), tired-awake (E+), full of energy-without energy (E-). Items were assessed on a 6-point rating scale. Prior to the analyses, data from three items were reverse coded to ensure that higher scores indicated higher positive valence, calmness, or energetic arousal. Inter-item correlations for positive valence were .69 on Friday evening and .78 on Monday; for calmness .67 on Friday evening and .83 on Monday; and for energetic arousal .60 on Friday evening and .64 on Monday.

Subjective sleep quality. Subjective sleep quality was measured on Monday to retrospectively record sleep quality from the past Friday to Saturday, using the single-item component of subjective sleep quality of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). Participants rated their subjective sleep quality on a four-point rating scale, ranging from 1 (*very bad*) to 4 (*very good*). As subjective sleep quality correlated highly with the global PSQI score (r = .79 to .83; Carpenter & Andrykowski, 1998), it was measured using a single item.

Data Analysis

In the first step, we identified latent classes of time pressure trajectories and in the second, we examined how those trajectory classes differed from each other regarding the well-being indicators positive valence, calmness, energetic arousal, and sleep quality at different measurement points.

Using LCGA (Andruff et al., 2009; Jung & Wickrama, 2008), we modeled systematic interindividual differences in intraindividual change over time, which allowed us to classify individuals into naturally occurring homogeneous latent classes based on individual response patterns of change over time. To establish model fit, several unconditional models with linear, quadratic, and cubic slopes (to account for different possible patterns of trajectories), ranging from two to seven classes, were estimated in Mplus Version 8 (Muthén & Muthén, 2020), using full-information maximum likelihood (FIML) with robust standard errors to account for missing data (Acock, 2005). According to Little's Missing Completely At Random (MCAR) test, all missing data can be assumed to be missing completely at random, $\chi^2(47) = 41.55$, $p = .697$. To identify time pressure trajectories, the variance of the latent linear, quadratic, and cubic slopes and the intercepts were fixed at zero within each class and allowed to vary across classes. This was done to get a more restrictive model and homogeneous individual growth trajectories within classes (Nagin, 1999). Because parameter estimation in LCGA is an iterative procedure, starting values were specified to help avoid non-convergence issues and settling on local maxima. In these models, 2,000 random sets of starting values and 100 final optimizations were employed.

After model estimation, various criteria were used to determine the number of latent classes: The evaluation of model fit was based on the Bayesian information criteria (BIC) and sample-size adjusted BIC (aBIC), where decreases of values indicate better model fit (Jung & Wickrama, 2008; Wickrama et al., 2016). The quality of the classification, that is the distinctiveness of latent classes, was evaluated with the entropy for the most likely latent profile membership. Entropy values range from 0 to 1, and values of .40, .60, and .80 represent low, medium, and high class separation (Clark & Muthén, 2009). We also inspected the Lo-Mendell-Rubin (LMR) likelihood test and bootstrapped likelihood ratio test (BLRT) that compared the different solutions to the number of trajectories. More specifically, a significant p-value ($p < .05$) indicates an increase in model fit between k-1 and k class models, thus rejecting the k-1 model in favor of the model with at least k trajectories (Nylund et al., 2007). However, in addition to statistical results of model fit, findings should also be balanced with interpretability, parsimony, and meaningfulness of the models when deciding on the number of trajectories classes (Jung & Wickrama, 2008).

To describe the relationships between the classes of time pressure trajectories identified and well-being indicators, we applied the manual stepwise Bolck-Croon-Hagenaars (BCH) approach. This approach estimates class-specific means of the outcomes and tests if the classes differ significantly from each other. The BCH method estimates the latent class measurement model using the identified class solution of the previously performed LCGA, saves the BCH weights, and uses weighted multiple group analysis to estimate class-specific means of the outcomes (Asparouhov & Muthén, 2014). Thereby shifts in class membership were avoided because the class membership was known prior to mean estimation (Asparouhov & Muthén, 2014). In all analyses, missing data were handled using FIML estimation.

Results

Identifying Time Pressure Trajectories

Means, standard deviations, and correlations of the study variables are presented in Table 1. As can be seen, all correlations were in the expected directions, with dependent variables being positively and moderately related to each other.

Table 1

Means, Standard Deviations, and Correlations of the Study Variables (Study 1)

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. Time pressure T1	2.50	0.94	-						
2. Positive valence T2	5.11	0.91	-.11	-					
3. Calmness T2	4.98	1.04	-.17	.72	-				
4. Energetic arousal T2	3.08	1.11	-.15	.36	.27	-			
5. Sleep quality T3a	3.21	0.79	-.21	.37	.34	.10	-		
6. Positive valence T3b	5.07	1.13	-.22	.43	.50	.29	.39	-	
7. Calmness T3b	4.73	1.24	-.24	.45	.61	.28	.46	.77	-
8. Energetic arousal T3b	4.15	1.15	-.25	.34	.40	.34	.46	.61	.61

Note. $N = 254$. T1 = Monday to Friday after work; T2 = Friday evening; T3a = Friday night; T3b = Monday. Correlations $r \geq |.15|$ significant at $p < .05$, $r \geq |.21|$ significant at $p < .01$, and $r \geq |.22|$ significant at $p < .001$.

To address *Research Question 1* regarding which classes of time pressure trajectories occur across one working week and to select the best fitting class solution, we examined several statistical indices as well as practical issues of the interpretability, parsimony, and meaningfulness of the models. Table 2 contains fit statistics for class solutions with different numbers of trajectories using LCGA. The best loglikelihood value for the five-class solution was not replicated. Thus, this solution may not be trustworthy due to local maxima and was not considered as potential class solution for time pressure trajectories.

Table 2

Fit Indices for Latent Growth Class Analysis of Time Pressure Trajectories Testing Different Numbers of Classes (Study 1)

Latent Trajectories	Class Count	Proportion (%)	BIC	aBIC	LMR	BLRT	Entropy
2	120, 134	47, 53	3275.10	3230.72	317.85***	329.34***	.80
3	54, 97, 103	21, 38, 40	3234.65	3174.42	65.76	68.14***	.75
4	*21, 57, 85, 91*	*8, 22, 33, 36*	*3225.29*	*3149.20*	*35.76**	*37.05****	*.78*
6	11, 16, 31, 55, 57, 84	4, 6, 12, 22, 22, 33	3244.03	3136.24	22.12	22.92***	.77
7	11, 13, 28, 35, 42, 53, 72	4, 5, 11, 14, 17, 21, 28	3208.52	3084.88	60.99**	63.19***	.85

Note. $N = 254$. Values in italics highlight indicate the chosen solution; BIC = Bayesian Information Criterion; aBIC = sample-size adjusted Bayesian Information Criterion; LMR = Lo-Mendell-Rubin Likelihood Ratio Test; BLRT = Bootstrapped Likelihood Ratio Test. Best loglikelihood value for the 5-class solution was not replicated. Thus, this solution may not be trustworthy due to local maxima and was not considered as potential class solution for time pressure trajectories.

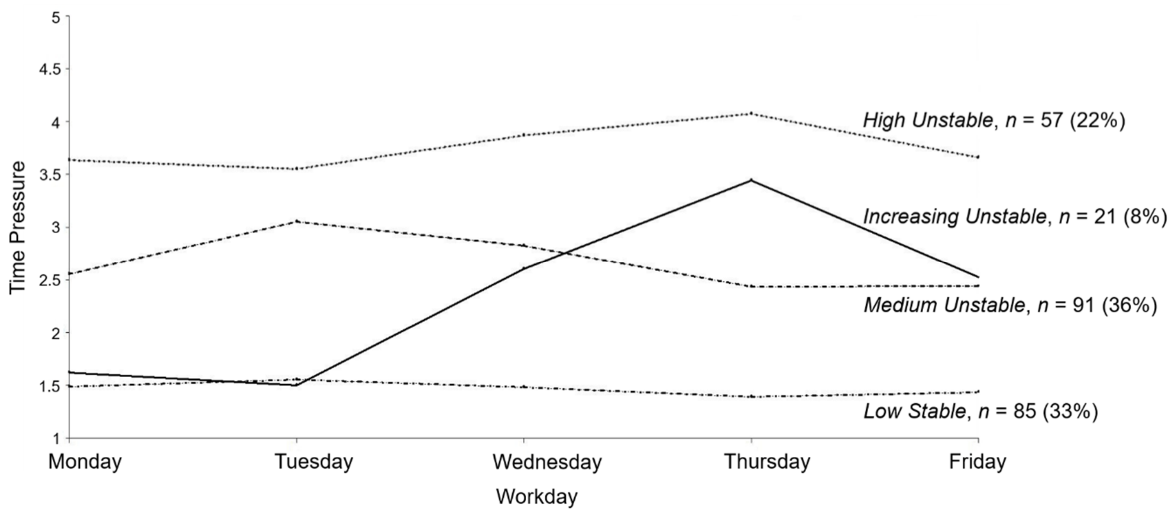
* $p < .05$; ** $p < .01$; *** $p < .001$

Investigating the BICs and sample-size adjusted BICs fit statistics revealed that increasing the number of latent classes resulted in increasingly better (i.e., smaller) BICs; with the exception of increased values for the six-class solution. The entropy values for the two- and seven-class solutions were the highest (.80 and .85, respectively), whereas values for the remaining three solutions represented slightly lower accuracy of class separation (.75 to .78), indicating that there was some inaccuracy in the classification of individuals into their most likely class. Notably, all entropy values were within acceptable range (Clark & Muthén, 2009). We then examined the likelihood ratio tests. The findings showed that the two-, four- and seven-class solutions provided the best fit to the data. Further, we investigated the class solutions in terms of parsimony, meaningfulness, and interpretability. The two-class solution consisted of stable classes with intercept differences, while the three- to seven-class solutions revealed classes with both stable and changing levels of time pressure across the working week (i.e., changing time pressure trajectories). However, as the six- and seven-class solutions contained similarly shaped trajectories with only small intercept differences, those class solutions did not add anything to clearly distinct and interpretable classes (see Figures A1 to A4 in Appendix A; Wickrama et al., 2016). Only in the four-class solution did the classes differ distinctively and qualitatively, consisting of both stable and changing classes of time pressure trajectories. Therefore, by taking all evaluation criteria together, the four-class solution was chosen as the final and most parsimonious model (cf., *Research Question 1*).

Figure 2 depicts the four-class solution with workdays on the x-axis, while the y-axis represents the level of time pressure. The four-class solution consists of one latent class with a stable level of time pressure and three latent classes with unstable levels, specifically cubic trajectories. The latent class we labeled *low stable* showed a constantly low level of time pressure across the timespan ($b_{\text{intercept}} = 1.49$, $p < .001$; $b_{\text{linear}} = 0.19$, $p = .265$; $b_{\text{quadratic}} = -0.14$, $p = .178$; $b_{\text{cubic}} = 0.02$, $p = .200$). In contrast, the *high unstable* time pressure trajectory class showed a generally higher level than the other classes as well as a moderate increase of time pressure until Thursday, where the level of time pressure decreased again slightly until the end of the working week ($b_{intercept}$ = 3.63, $p < .001$; b_{linear} = -0.45, p = .147; $b_{quadratic}$ = 0.45, p = .016; b_{cubic} = -0.09, p = .005). The *medium unstable* trajectory class was characterized by a generally moderate level of time pressure on Monday as well as an increase of time pressure on Tuesday, followed by a decrease of time pressure until the end of the working week ($b_{intercept}$ = 2.55, $p < .001$; b_{linear} = 1.05, $p < .001$; $b_{quadratic}$ = -0.65, p = .001; b_{cubic} = 0.09, p = .002). Finally, members of the trajectory class labeled *increasing unstable* began the working week with a low level of time pressure until Tuesday where it increased strongly until Thursday, indicating a lagged increase of time pressure. From Thursday to Friday, the level of time pressure decreased again ($b_{intercept}$ = 1.62, $p < .001$; b_{linear} = -1.24, p = .046; $b_{quadratic}$ = 1.37, p = .006; b_{cubic} = -0.25, p = .004), ending at a comparable level of time pressure as the *medium unstable* class. All in all, we can conclude that the trajectories identified differed in their general levels of time pressure (e.g., low vs. medium vs. high) as well as patterns across time (i.e., stable vs. unstable).

Figure 2

Estimated Mean Trajectories for Four Cubic Latent Classes of Time Pressure (Study 1)



Time Pressure Trajectories in Relation to Well-Being Indicators

Our first goal was to identify distinct latent classes of time pressure trajectories (*Research Question 1*). The second goal of the study was to examine whether the trajectory classes yielded different well-being indicators. After performing a LCGA with distal outcomes, we implemented a BCH analysis on the class-specific means of the dependent variables positive valence, calmness, energetic arousal, and sleep quality. Z-standardized class-specific means of the dependent variables ordered by time point (i.e., Friday evening, Friday night, and Monday) are depicted in Figures 6 to 8 (see respective class specific means of each dependent variable in Table A1 of Appendix A). When exploring the relationship between trajectory classes and well-being indicators to answer *Research Questions 2*, several class differences emerged.

Mean Differences of Trajectory Classes on Friday Evening

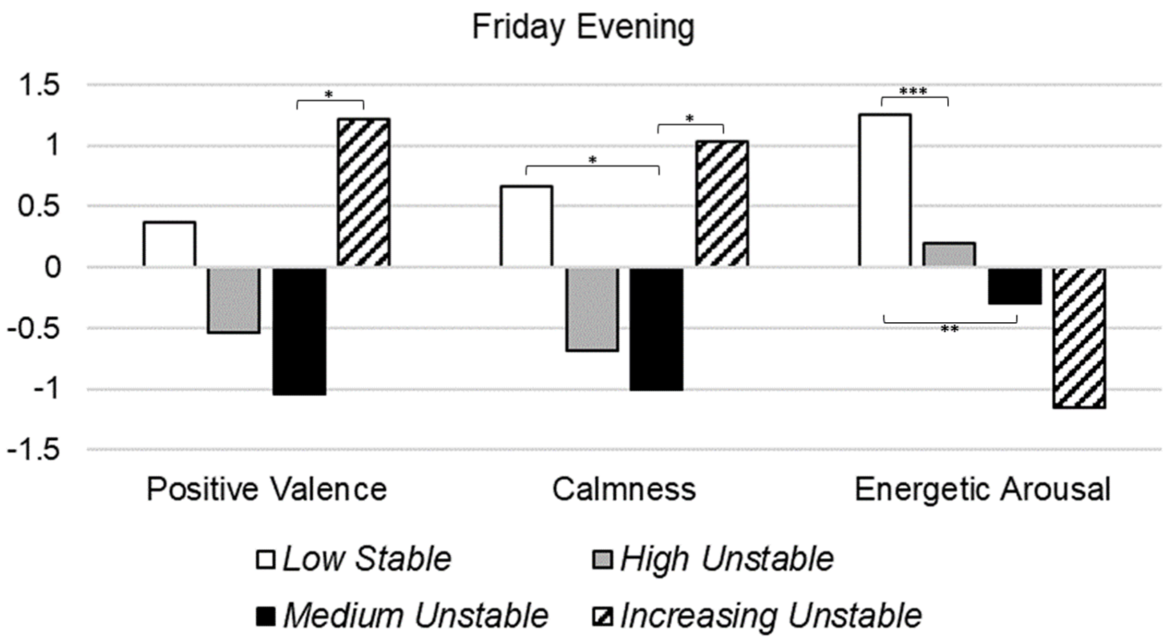
For positive valence, the only significant difference occurred for the *medium unstable* in comparison to the *increasing unstable* class, with the latter showing higher values in positive valence. The *low stable* class showed to have significantly higher values in calmness as well as energetic arousal compared to the *medium unstable* class, which showed significant lower values in calmness compared to the *increasing unstable* class. Furthermore, the *low stable* class had higher values in energetic arousal compared to the *high unstable* class (see Figure 3).

Mean Differences of Trajectory Classes on Friday Night Sleep

Only the mean differences for the comparisons of the *low stable* class with the *high unstable* and *medium unstable* classes reached significance. Employees of the *low stable* class reported the best sleep quality, whereas the *high unstable* class scored lowest, but the latter not being significantly different from the *medium unstable* and *increasing unstable* classes (see Figure 4).

Figure 3

Mean Differences of Trajectory Classes in Dependent Variables on Friday Evening (Study 1)

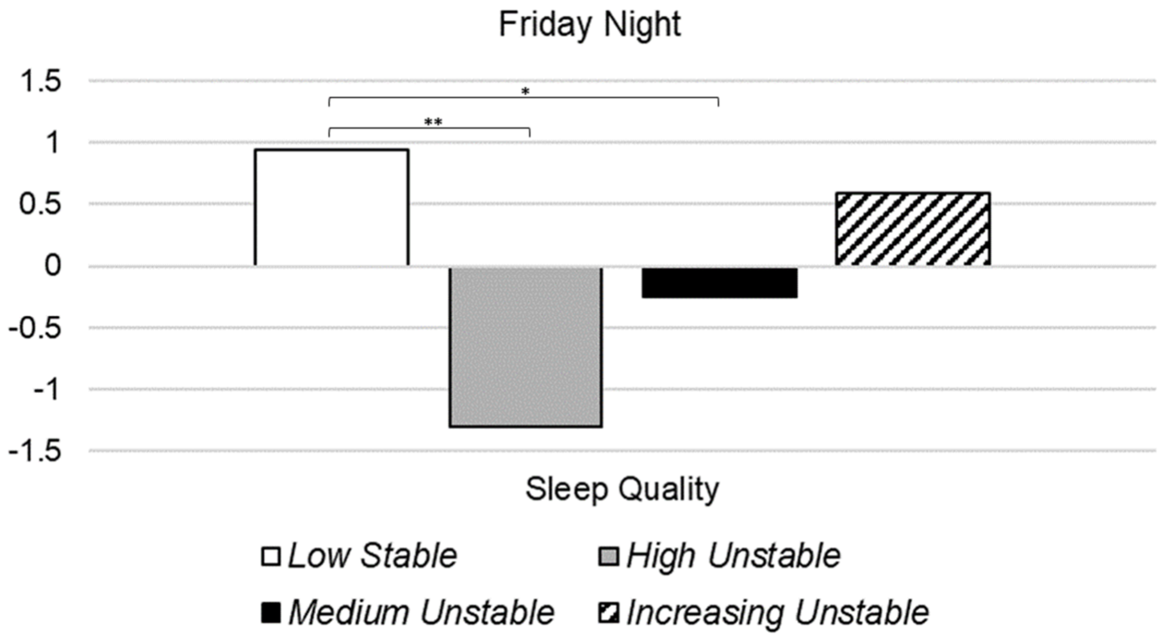


Note. Analyses were run utilizing the manual BCH approach in Mplus. Dependent variables were standardized to the variable's mean across classes. Hence, values above/below 0 indicate higher/lower positive valence, calmness, and energetic arousal compared to the average positive valence, calmness, and energetic arousal. Square brackets indicate significant differences between classes on dependent variables.

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

Figure 4

Mean Differences of Trajectory Classes in Friday Night Sleep Quality (Study 1)



Note. Analyses were run utilizing the manual BCH approach in Mplus. The dependent variable was standardized to the variable's mean across classes. Hence, values above/below 0 indicate higher/lower sleep quality compared to the average sleep quality. Square brackets indicate significant differences between classes on dependent variable.

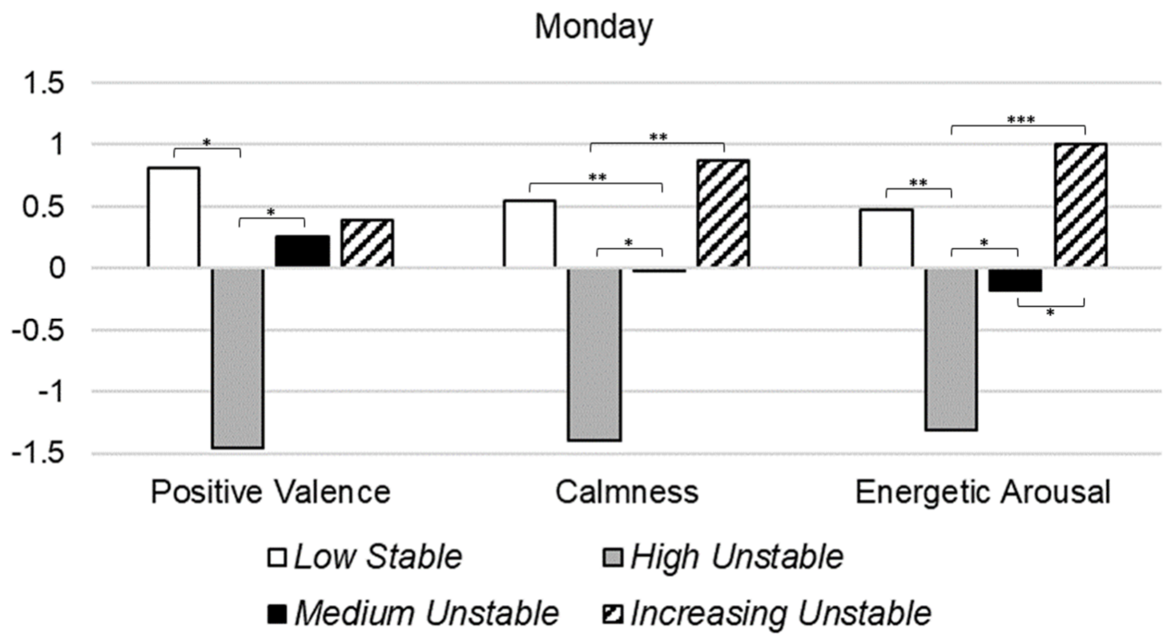
* $p < .05$; ** $p < .01$

Mean Differences of Trajectory Classes on Monday

The most pronounced differences between trajectory classes were found for well-being indicators on Monday. The *low stable* class scored significantly higher in positive valence and energetic arousal compared to the *high unstable* class, and significantly higher in calmness compared to the *medium unstable* class. The lowest values in all indicators resulted for the *high unstable* class, even though not significantly different from the *increasing unstable* class for positive valence and from the *low stable* class for calmness (all other comparisons were significant). The *medium unstable* class showed to have significantly higher values in all three indicators compared to the *high unstable* class, but significant lower values in energetic arousal compared to the *increasing unstable* class. Finally, the *increasing unstable* class showed significantly higher values in calmness and energetic arousal compared to the *high unstable* class, as well as higher energetic arousal compared to the *medium unstable* class (see Figure 5).

Figure 5

Mean Differences of Trajectory Classes in Dependent Variables on Monday (Study 1)



Note. Analyses were run utilizing the manual BCH approach in Mplus. Dependent variables were standardized to the variable's mean across classes. Hence, values above/below 0 indicate higher/lower positive valence, calmness, and energetic arousal compared to the average positive valence, calmness, and energetic arousal. Square brackets indicate significant differences between classes on dependent variables.

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

To summarize, *low stable* and *increasing unstable* time pressure yielded the highest well-being on Friday evening, followed by lower and similar well-being levels shown by *high unstable* and *medium unstable* time pressure. At Friday night, sleep quality was largely similar across classes, with the exception of *low stable* time pressure reporting higher sleep quality than both *high unstable* and *medium unstable* time pressure. On Monday, *low stable* and *increasing unstable* time pressure resulted in the highest well-being, followed by *medium* *unstable* time pressure. Employees experiencing *high unstable* time pressure reported the lowest well-being on Monday. Based on these results, we conclude that different patterns of increasing and decreasing time pressure within latent class trajectories have distinct relationships with well-being.

Discussion

The aim of the present study was to identify trajectories of time pressure across five consecutive workdays and to investigate their relationship with indicators of well-being. Using LCGA, findings revealed a four-class solution characterized by qualitatively different trajectories: *low stable*, *high unstable*, *medium unstable*, and *increasing unstable* time pressure. BCH results demonstrated that the trajectories differed in positive valence, calmness, and energetic arousal, and partly in sleep quality. However, the differences observed between trajectories in calmness, energetic arousal, and positive valence depended on the time point at which the comparisons were made (either Friday evening or Monday). In summary, it can be stated that employees experiencing *low stable* time pressure reported higher well-being on Monday as well as better Friday night sleep quality compared to employees experiencing *high unstable* time pressure, whereas the trajectories differed only in energetic arousal on Friday evening. Further, while employees of the *low stable* trajectory experienced comparable levels of well-being as those in the *increasing unstable* trajectory, *medium unstable* time pressure resulted in less beneficial outcomes on Friday evening and the following night than those experiencing *low stable* time pressure. Considering the temporal trend of unstable trajectories, employees benefited from *increasing unstable* rather than *high unstable* and *medium unstable* time pressure on Monday. On Friday evening and night, however, such differences were not observed – with one exception: *Increasing unstable* time pressure resulted in better well-being than *medium unstable* time pressure on Friday evening. Finally, while *high unstable* and *medium unstable* time pressure reported comparable levels of well-being and sleep quality at the end of the working week, class differences emerged on

Monday, leading to higher calmness and energetic arousal for employees experiencing *medium unstable* time pressure. Next, we discuss our results in more detail.

Theoretical Implications

The identification of distinct trajectories combines already established and novel understandings regarding the effect of time pressure on well-being indicators. First of all, the finding that a low level of time pressure resulted in similarly content and calm employees when starting the weekend compared to *high unstable* time pressure contradicts the existing between-person research on the effect of demand levels (Sonnentag & Bayer, 2005). A possible explanation is that employees who experience time pressure on a high level are elated to leave the resource depleting working week behind them, possibly knowing that they have two days to relax and recover, resulting in content and calm employees despite resource depletion during the working week. This is in line with weekend anticipation being associated with higher positive affect on Fridays (Sonnentag, Mojza, et al., 2008), which was labeled after the commonly held day-of-the-week belief "Thank God, it's Friday" (Stone et al., 2012). That encountering continuously high demand levels still results in resource loss in accordance with COR theory (Hobfoll, 2001) can be found in the class differences regarding energetic arousal on Friday evening, sleep quality at night, and outcomes on Monday, where the detrimental effects of high time pressure surface, reflected in being less energized, experiencing poorer Friday night sleep quality and feeling less content, calm, and awake on Monday. Although resources may have been restored during the weekend, they could have already been drained when starting the new working week (Weigelt et al., 2021), because employees in the *high unstable* trajectory may anticipate that they will also be facing a high demand level during the coming week (Eden, 2001; Rook & Zijlstra, 2006). Importantly, the well-being differences between *low stable* and *high unstable* time pressure on Monday also reveal that experiencing lower well-being at the start of the next working week may depend on the type of time pressure trajectory of the previous week, as employees in the *low stable* and *increasing unstable* trajectories mainly reported higher well-being on Monday than did members of the *high unstable* and *medium unstable* trajectories. This explanation is in line with the inconsistent literature on the transition between weekends and workweeks and the “Blue Monday” effect (Rook & Zijlstra, 2006; Stone et al., 1985; Weigelt et al., 2021) and could explain the lower well-being for employees experiencing *high unstable* time pressure on Monday, compared to *low stable* time pressure.

Second, the *medium unstable* and *high unstable* time pressure classes exhibited differential effects on the outcome variables, depending on the time point. Both trajectories resulted in comparably discontent, tense, and tired employees at the end of the working week, while, on Monday, members of the *medium unstable* class exhibited higher levels of well-being than the *high unstable* class. Because members of the *medium unstable* class already experienced negative well-being outcomes at the end of the working week (comparable to those among the members of the *high unstable* class), the question arises if a threshold of time pressure at a moderate level exists which, when exceeded, results in negative (short-term) consequences. More importantly, and in line with our possible explanation for the class differences between *low stable* and *high unstable* time pressure: Experiencing time pressure on a high level may result in employees anticipating the same demand level for the upcoming working week, resulting in feeling less content, calm, and energized on Monday than those in the *medium unstable* trajectory. This underlines further the detrimental effect of time pressure on a high level.

Finally, employees who encountered a cumulative loss of resources during the increasing demand (*increasing unstable* time pressure) showed similar levels of well-being on Friday evening and sleep quality at night compared to the *low stable* and *high unstable* time pressure trajectories, but were also more content and calmer than the *medium unstable* trajectory. A different picture emerged on Monday: Here, employees with an *increasing unstable* trajectory still reported comparable levels of positive valence, calmness, and energetic arousal than employees in the *low stable* trajectory, but also higher calmness and energetic arousal compared to employees in the *high unstable* trajectory and higher energetic arousal compared to employees in the *medium unstable* trajectory. This pattern of results suggests that employees in the *increasing unstable* trajectory were equally exhausted at the end of the working week, but able to better replenish their resources over the course of the weekend than employees experiencing demand instability on a higher level (see *high unstable*), as well as showed better well-being than a different combination of increase and decrease (see *medium unstable*). One possible explanation for this result lies within the pattern of the *increasing unstable* trajectory: Before encountering increasing time pressure, the employees reported little time pressure on Monday and Tuesday, creating a plateau on a low demand level. Taking it slowly during the first couple of workdays may enable employees to retain the resources, which they can then use to cope with the increasing demand that follows later that week, resulting in comparable and even higher levels of well-being on Friday, and better well-being on Monday. In addition, the positive effect of experiencing *increasing unstable* time pressure is also supported by the finding that even though employees experienced an increase in time pressure during the week, which should have resulted in resource loss, they surprisingly reported similar levels of well-being at any time point compared to the *low stable* class. Thus, our results are not entirely in line with the assumptions based on the salience of resource loss (Hobfoll et al., 2018), as we do not find consistently lower levels of well-being for employees in the *increasing unstable* trajectory[4] on Friday evening, and even better well-being on Monday, even though members experienced a marked increase of time pressure during the working week.

[4] Please note that the means of positive valence and calmness, although not statistically significant, are higher in the *increasing unstable* trajectory compared to the *high unstable* trajectory.

Moreover, the positive effect of *increasing unstable* in contrast to *high unstable* and *medium unstable* time pressure on well-being at the start of the week is in line with the concept of reattachment to work, which describes the mental reconnection with one's work after a nonwork period (e.g., during the weekend; Sonnentag & Kühnel, 2016). According to the authors, reattaching includes mentally preparing oneself for work and the upcoming tasks that need to be accomplished. As the beginning of the working week represents a stressful shift from weekend to work on Monday requiring mental and physical effort (Rook & Zijlstra, 2006), starting the working week with a low level of demand may support the process of reattachment to work as it is less resource consuming. Nevertheless, the interpretation of the effect on well-being of *increasing unstable* time pressure has to be done with caution as the class is relatively small (n = 21; 8%) in contrast to the others (n = 57-91; 22%-36%).

Practical Implications

By interpreting time pressure trajectories from a well-being perspective, the findings of our study offer some practical implications. First, on the organization and individual level, job design regarding the distribution of time pressure across the working week appears to be important. Based on our findings and the concept of job crafting (Tims & Bakker, 2010; Wrzesniewski & Dutton, 2001), managers and organizations are advised to create a work environment which enables employees to shape their job demands according to their own personal needs, specifically shaping increases and decreases in demands so that employees experience the lowest loss of resources and, thus, highest level of well-being. Second, knowing about the different temporal trajectories of time pressure and their consequences on well-being, managers should consider exhibiting leadership behavior which includes social support and appreciation towards their employees who experience *high unstable*, *medium unstable or increasing unstable* time pressure and their demonstrated work effort. On an individual level, this may buffer the detrimental effect of time pressure, aid in coping with the demand, and protect against ill health (Väänänen et al., 2003). Practically speaking and with regard to employees' well-being, time pressure should be distributed on a lower level which either remains stable or also increases during the working week, in contrast to time pressure on a medium and high level.

Strengths, Limitations, and Recommendations for Future Research

This study has several strengths. We assessed within-person fluctuations using a person-centered approach, thus identifying distinct classes of time pressure trajectories across one working week. This allowed us to draw between- and within-person conclusions regarding differences in time pressure trajectories and, by connecting these to recovery theories, their relationships with indicators of well-being. Thereby we disentangled the differential effects of time pressure trajectories in terms of their well-being relevance and resource depletion. Further, our study contributes to the growing body of literature on the systematic variation and temporal dynamics of job demands (e.g., Downes et al., 2021; Rosen et al., 2020). Nevertheless, several methodological issues need to be accounted for when interpreting our results, upon which future studies can improve.

First, in order to assess the well-being relevance of trajectory classes we used positive valence, calmness, energetic arousal, and sleep quality as indicators of well-being. However, future studies should also examine the relationship between trajectories and direct recovery experiences, such as mental detachment, relaxation, mastery experience, and control (Sonnentag, Binnewies, et al., 2008), to extend our findings towards research regarding recovery (processes) during the working week. This can, for instance, be achieved by modeling trajectories of both independent and dependent variables during the working week and exploring the relationship between them. Further, we assessed sleep quality for the night from Friday to Saturday. However, this permits no conclusions on how the different time pressure trajectories affect employees' sleep quality at the start of the week, for instance, from Sunday to Monday. Given that in earlier research the lowest sleep quality was found on

Monday morning (Rook & Zijlstra, 2006), anticipation of strain may play a major role in recovery processes such as sleep.

Second, while we did find trajectories of unstable time pressure on different levels, the question arises if it is possible to find involatile job demand trajectories within the studied timeframe of one working week. Hence, an adjustment to the choice of timeframes seems appropriate. For instance, demands could be assessed hourly per workday across workdays to explore trajectories created within each day and their relationship to very short-term effects on well-being. Additionally, daily data collection for at least two weeks could be done because this results in at least two complete data cycles as well as a longer timeframe (Liu & West, 2016). Another option to shed light on the temporal dynamics of job demands is to collect weekly data across longer timeframes, such as eight consecutive weeks, as was recently done by Rosen et al. (2020). This timeframe permits drawing conclusions on the long-term temporal dynamics of demanding work characteristics and may be more appropriate for the proposed effects to unfold. In addition, while this study found the patterns of stable and unstable levels of time pressure described and how they can relate to well-being, the specific findings may depend on the characteristics of our sample. While this may impair the generalizability of the findings, they do show that there are indeed employees who experience such time pressure trajectories, underlining that (systematic) variation and the temporal dynamics of job demands occur and are of importance from a well-being perspective. Thus, we encourage future research to replicate and extend the design of the present study by using different timeframes and samples.

Finally, as the present study assessed the temporal dynamics of time pressure, a recently published meta-analysis found that other job demands, such as role ambiguity and role conflict, also fluctuate across time, moderating the between-person effects of overall job demand levels on employee motivation and well-being (Downes et al., 2021). Thus, we encourage scholars to examine the relationship between the temporal development of other job demands and well-being outcomes, but also to add job resources and boundary conditions into the investigation, under which instability can be beneficial for employee well-being. All in all, job demand and resource research as well as theories, for instance, the Job Demand-Resources model (Demerouti et al., 2001), need to extend towards and account for temporal dynamics of job demands and resources.

Conclusion

In conclusion, the present study contributes to the existing research on job demand variability by showing that employees experience distinct trajectories across a working week which differ in level and pattern: *low stable*, *high unstable*, *medium unstable*, and *increasing unstable* time pressure. Further, drawing on ERM and COR theory, we observed that the trajectories differed in their relationships to well-being indicators, namely positive valence, calmness, energetic arousal, and sleep quality. Overall, stable and combined increasing and decreasing processes of time pressure had distinct effects on the outcomes: Employees benefited from experiencing *low stable* and, surprisingly, *increasing unstable* (i.e., lagged marked increase followed by decrease at the end of the working week), both when ending and starting a working week, rather than *high unstable* and *medium unstable* time pressure regarding employee well-being. We encourage researchers to continue to explore the temporal dynamics of work characteristics to increase our understanding of resource loss and gain and their relation to employee well-being, and to derive evidence-based recommendations for job design, accounting for temporal components.

Chapter 3 – Study 2: I'll be Back! Examining Adaptive Change Processes in Emotional Exhaustion and Time Pressure[5]

Abstract

This study extends previous research on temporal dynamics and change processes of strain and work-related stressors by examining adaptive change in both emotional exhaustion and time pressure. Drawing on adaptation and the conservation of resources theories, we used latent growth and change score modeling to explore (a) whether employees adapt to emotional exhaustion over time and (b) how changes in levels of emotional exhaustion and time pressure relate over time, considering their reciprocal relationship. Using data collected from 252 employees in a weekly diary study spanning 8 consecutive workweeks, our findings revealed that employees adapted to emotional exhaustion, indicated by a negative relationship between previous levels of the construct with its change from one week to the next. This change was affected by the level of time pressure of the previous week, resulting in lower adaptive change in emotional exhaustion when time pressure was high, and vice versa. Specifically, time pressure had a positive effect on the change in emotional exhaustion, and emotional exhaustion had a positive effect on the change in time pressure, while the overall adaptive change process prevailed. This study contributes valuable insights into the temporal process of how time pressure relates to emotional exhaustion in a health-impairing manner (e.g., via reduced adaptation). The implications of our findings are discussed from the theoretical perspective of adaptation and resource loss, and potential directions for future research are proposed.

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[5] This chapter has been published as a research article in the *Journal of Occupational Health Psychology*.

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All additional material can be obtained online (https://osf.io/w7zad/).

Introduction

Time pressure, a key work characteristic (Häusser et al., 2010), is defined as the demand to complete tasks while subjectively perceiving having insufficient time to do so (Roe & Zijlstra, 2000). A representative study showed that one third of employees in European countries frequently work under time pressure and feel emotionally exhausted at the end of the day (Eurofound, 2017). Empirical findings have highlighted the positive relationship between time pressure and emotional exhaustion, showing that employees feel significantly more emotionally exhausted on days and weeks with higher-than-average levels of time pressure (Kern et al., 2023; Kunzelmann & Rigotti, 2021). Emotional exhaustion, a core component of burnout, involves energy depletion, reduced emotional resilience, and a feeling of being overwhelmed by demands (Maslach & Jackson, 1981). It is linked to various health issues, including reduced emotional and physiological functioning, depression, and anxiety disorders (Tuithof et al., 2017). Due to its significant association with long-term and severe negative health consequences (Bakker et al., 2014) and its portrayal as "feelings of being overextended and depleted of one's emotional and physical resources" (Halbesleben & Demerouti, 2005, p. 208), emotional exhaustion is an important strain measure (Bakker et al., 2014).

In this study, we examine the dynamic relationship between time pressure (as a workplace stressor) and emotional exhaustion (as a strain reaction) to advance the scarce previous research on the (reciprocal) change process of stressors and strains (see e.g., Matthews et al., 2014; Ritter et al., 2016; Somaraju et al., 2022). Understanding the temporal process of the relationship between time pressure and emotional exhaustion is crucial, as theoretical models and empirical evidence suggest that the time course of the relationship between workplace stressors and strain is important for understanding how workplace stressors affect employees' health. For example, both the effort–recovery model (Meijman & Mulder, 1998) and the allostatic load model (McEwen, 1998) suggest that workplace stressors lead to detrimental health consequences by impairing recovery processes. Thus, their negative health effect is due to altering the time course of the strain reaction by preventing the return to individual baseline levels of strain. This is mirrowed by empirical evidence that suggests that impaired recovery rather than reactivity to stressors drives health impairments (Geurts & Sonnentag, 2006; Schwartz et al., 2003). Thus, understanding how time pressure relates to emotional exhaustion over time provides insights into the temporal process of how workplace stressors relate to health impairments of employees.

Using weekly diary data from 252 employees over 8 weeks, our study contributes to the literature by addressing two key areas. First, while previous research has established that stressors lead to strain and subsequent health declines (Crawford et al., 2010; Ford et al., 2014; Hatch et al., 2019), our study advances this research by investigating how time pressure impacts the temporal change process of emotional exhaustion. Drawing on adaptation theory (Diener et al., 2006) and conservation of resources theory (Hobfoll, 1989), we propose that time pressure triggers an initial increase in emotional exhaustion *and* obstructs its natural return to baseline, leading to elevated strain levels over time. This way, we are adding a time-sensitive perspective to the established stressor–strain link (Crawford et al., 2010; Ford et al., 2014). This approach sheds light on how time pressure leads to cumulative emotional exhaustion.

Second, previous empirical literature and theoretical assumptions have convincingly shown that the relationship between work-related stressors and strain is reciprocal (Ford et al., 2014; Guthier et al., 2020). We examine these reciprocal relationships by exploring how emotional exhaustion may, in turn, influence the time course of time pressure (Ford et al., 2014; Guthier et al., 2020), contributing to the understanding of feedback loops in stressor–strain interactions. This bidirectional approach provides a more nuanced view of how stressors and strain develop, reinforcing the relevance of examining both adaptation and resource depletion mechanisms within work design frameworks.

Theoretical Model

Adaptive Change in Emotional Exhaustion

Longitudinal stress and recovery research has indicated that stressors increase strain (e.g., Ford et al., 2014; Guthier et al., 2020; Nixon et al., 2011), raising the question of how this process leads to health consequences. According to the effort–recovery and allostatic load models (McEwen, 1998; Meijman & Mulder, 1998), a stressor becomes health-relevant when recovery is impaired, resulting in detrimental strain effects. Strain may remain heightened, increase rapidly due to an inability to deactivate the allostatic system, or show a delayed response to the stressor (McEwen, 1998). This indicates a lack of strain adjustment and impaired recovery, which would be required to restore lost resources (Hobfoll, 1989, 2001). To understand how time pressure as a work-related stressor impacts emotional exhaustion in a health-impairing way, we examine the temporal development in emotional exhaustion.

For this examination, we use adaptation theory (Diener et al., 2006) as our theoretical framework because it considers well-being from a temporal perspective. The theory posits that people have an individual baseline of well-being (Diener et al., 2006) and can adapt to both positive and negative stimuli, generally returning to this baseline after immediate affective responses. This baseline acts as a reference point around which well-being fluctuates over the short-term but eventually returns to over the long-term. Adaptation processes protect against prolonged negative emotional states and promote disengagement from goals that have little chance of success (Frederick & Loewenstein, 1999).

Empirical evidence has shown that individuals revert to their usual levels of subjective well-being, burnout, and sleep quality after experiencing work–family conflict, workplace incivility, and role overload, respectively (Henderson et al., 2023; Matthews et al., 2014; Matthews & Ritter, 2019). These studies suggest that individuals tend to report higher well-being and lower burnout after 1 month (Matthews et al., 2014) and 6 months (Matthews &

Ritter, 2019) and return to previous sleep quality levels 2 months after stressor exposure (Henderson et al., 2023).

Building on this literature, we aim to replicate these adaptive responses for emotional exhaustion. We propose that, holding the situation constant, higher levels of emotional exhaustion in Week t would be followed by a decrease in Week (t + 1), and lower levels of emotional exhaustion in Week t would be followed by an increase in Week (t + 1). Thus, on average, individuals tend to return to their baseline level of emotional exhaustion, exhibiting adaptability from one week to the next. Accordingly, we hypothesize:

Hypothesis 1: An adaptative change effect occurs in emotional exhaustion over time, as indicated by a negative association between previous levels of emotional exhaustion and subsequent changes.

Effect of Time Pressure on Adaptive Change in Emotional Exhaustion

A well-regarded theoretical framework for understanding work-related stressor–strain processes is conservation of resources theory (Hobfoll, 1989, 2001). This theory posits that individuals strive to acquire, maintain, and protect valuable resources (Halbesleben et al., 2014; Hobfoll, 1989, 2001), and stress arises when these resources are threatened or lost (Hobfoll, 1989; Hobfoll et al., 2016). To counter resource loss, individuals must invest existing resources to protect against further depletion, compensate for losses, and gain additional resources (Principle 2 of conservation of resources theory; Hobfoll, 2001). Time pressure imposes demands and depletes resources, leading to increased strain and impaired well-being (Baethge et al., 2018; Bakker & Demerouti, 2017; Prem et al., 2018). This effect creates a vulnerability to further resource depletion (i.e., Corollary 1), resulting in a loss spiral (i.e., Corollary 2; Hobfoll, 2001). Indeed, meta-analyses and longitudinal studies have shown that high time pressure leads to increased emotional exhaustion (Ford et al., 2014; Igic et al., 2017).

Such a spiraling effect runs contrary to the naturally occurring adaptive change process described above. As outlined in our first hypothesis, we expect emotional exhaustion to fluctuate around and return to an individual's baseline (i.e., adaptive change process). However, considering the accumulation of resource losses and the consequent loss spiral (Hobfoll, 2001), we also expect that higher time pressure would positively relate to changes in emotional exhaustion from Week t to Week ($t + 1$). Combining conservation of resources and adaptation theories offers an opportunity to examine the relationship between work-related stressors and strain as it unfolds over time (Zapf et al., 1996). Based on our consideration that both processes (i.e., the adaptive change process of emotional exhaustion and the resource-draining and spiraling effect of time pressure on emotional exhaustion) exist simultaneously, we suggest that while higher emotional exhaustion would lead to a decrease over time (adaptation), prior time pressure slows this decrease. Put differently, these two processes result in a hindered return to baseline emotional exhaustion, indicating a reduced decrease in emotional exhaustion over time rather than a further increase. This premise suggests that time pressure relates to higher emotional exhaustion over time by impairing the natural adaptation process.

Recent studies (Ford et al., 2023; Somaraju et al., 2022) have highlighted the intricate interplay of resource spirals and adaptation in stressor–strain relationships. Somaraju et al. (2022) developed a dynamic model of task and relationship conflict and strain to test resource threat and loss spirals in employees working under extreme conditions. They found that current-day relationship conflict caused next-day strain, and vice versa, while increased workload also had a crucial effect on resource spirals over time, increasing the relationship between current-day relationship conflict and next-day strain. Herewith, Somaraju et al. (2022) presented one of the first tests of spirals as proposed by conservation of resources theory and its second corollary (Hobfoll, 2011). However, Somaraju et al.'s (2022) findings also showed that individuals did not exhibit an unending increase in strain when they experienced resource loss due to relationship conflict. More importantly, they recovered and returned to an equilibrium after a peak of conflict or strain. Relatedly, Ford et al. (2023) found no evidence for resource loss spirals in the context of work–family conflict over 1 month, herewith challenging the proposition of resource loss spirals and supporting the idea of employees adapting to work-related stressors as time passes. Mixed findings were reported for conflict stressors, with well-being returning to baseline after work–family conflict (Matthews et al., 2014) but not after role conflict (Ritter et al., 2016). Taken together, there seem to be two processes, a potential loss spiral and the natural adaptation process. We suggest that these two processes can be observed simultaneously when predicting changes in exhaustion by previous levels of time pressure. Accordingly, we hypothesize:

Hypothesis 2: A negative association between previous levels of emotional exhaustion and changes in emotional exhaustion (adaptation) occurs simultaneously with a positive association between previous levels of time pressure and changes in emotional exhaustion (spiraling), indicating a lower adaptive change in emotional exhaustion over time.

Reverse Effect Over Time

Research has shown that stressors and strain influence each other reciprocally (Demerouti et al., 2004; Guthier et al., 2020). For instance, Matthews et al. (2014) found that greater subjective well-being can reduce future work–family conflict, and Somaraju et al. (2022) demonstrated that current-day strain predicts next-day relationship conflict. To contribute to the literature on reciprocal relationships, we explore how emotional exhaustion relates to the time course of time pressure.

Previous literature has highlighted the dynamic nature of time pressure, with individuals reporting varying levels over time (e.g., Baethge et al., 2018; Kern et al., 2023; Mühlenmeier et al., 2022). This suggests that time pressure does not increase linearly, but that phases with high time pressure are being followed by phases with low time pressure, and vice versa, resulting in ups and downs of quantitative stressors over time. Adaptation theory has been used to investigate adaptive change processes in organizational contexts, showing that previous levels of role clarity were unrelated to subsequent changes, whereas changes in role conflict reversed over time, returning to the baseline level (Ritter et al., 2016). Matthews et al. (2014) also found that increased well-being led to adaptive changes in work–family conflict. Thus, we suggest that employees exhibit adaptation in their time pressure from one week to the next, with individuals tending to revert to their baseline of time pressure. Accordingly, we hypothesize:

Hypothesis 3: An adaptative change effect occurs in time pressure over time, as indicated by a negative association between previous levels of time pressure and subsequent changes.

According to conservation of resources theory, employee well-being is a critical resource and those experiencing higher emotional exhaustion may lack the necessary resources to cope with stressful situations, preventing a decrease in time pressure (i.e., Corollary 1; Hobfoll, 2011). As a result, emotionally exhausted individuals might even encounter heightened levels of time pressure, as the experience of strain can generate further stressors (Zapf et al., 1996). While these individuals may eventually return to their baseline level of time pressure (Ford et al., 2023; Somaraju et al., 2022), this process might be prolonged due to the state of emotional exhaustion. Specifically, higher prior levels of emotional exhaustion might lead to a diminished natural return to baseline time pressure from Week t to Week ($t + 1$) due to resource loss (i.e., Corollary 2; Hobfoll, 2011). Accordingly, we hypothesize:

Hypothesis 4: A negative association between previous levels of time pressure and changes in time pressure (adaptation) occurs simultaneously with a positive association between previous levels of emotional exhaustion and changes in time pressure (spiraling), indicating a lower adaptive change in time pressure over time.

Methods

Procedure and Sample

We collected data from April to December 2021 from a sample of German employees. The study received approval from an institutional research ethics committee (protocol number: EK2021/03), after which we conducted an online diary study over 8 consecutive workweeks. Each Friday, participants received an email containing a link to the questionnaire and were requested to complete it by Monday evening. For each measure included in the study (i.e., emotional exhaustion, time pressure), the instructions reflected a 1-week time frame of reference, specifically referring to the previous workweek (Monday to Friday). Prior to the weekly assessments, participants completed a baseline questionnaire, reporting sociodemographic data.

The choice of a weekly data collection for 8 consecutive weeks was motivated by several factors. First, utilizing a 1-week time frame over 8 consecutive workweeks is a unique aspect of the present study compared to previous studies (for an exception, see Somaraju et al., 2022), which often used longer time frames (e.g., monthly assessments; Henderson et al., 2023; Matthews et al., 2014; Matthews & Ritter, 2019) when analyzing adaptive change processes over time. Thereby, the present study contributes to the literature on stressor–strain relationships by extending studies that use fewer time points with longer time lags, hereby examining short-term temporal dynamics within the occupational health context (Guthier et al., 2020). Second, a 1-week period aligns with the typical workweek rhythm of most employees (Ancona et al., 2001). Third, assessing work experiences and strain over the previous week is in line with previous work stress research (Rosen et al., 2020; Taylor et al., 2017), facilitating comparability across studies (Shipp & Cole, 2015). Finally, an 8-week study period, as proposed by Rosen et al. (2020), strikes a balance between allowing sufficient time for anticipated effects to unfold and avoiding subject attrition (Selig & Preacher, 2009).

Participants were recruited using a convenience sampling method, wherein one PhD student and nine undergraduate students reached out to their personal and professional networks. As an incentive for their participation, all individuals had the opportunity to enter a lottery to win one of 25 vouchers of varying values (i.e., 2 x 50 euros, 8 x 25 euros, and 15 x 15 euros). The more frequently participants responded to the questionnaires, the higher their chances of winning. Notably, this method of recruitment, according to Demerouti and Rispens (2014), can lead to heterogeneous samples and diverse job- and individual-related characteristics, thereby enhancing their variance.

Out of 417 employees invited to participate, 397 participants responded to the baseline questionnaire, resulting in an initial response rate of 95.2%. In the first step, eight individuals were excluded because they did not provide consent, leading to a sample of 389 participants. In addition, 38 participants were excluded because they identified themselves as trainees or students, worked less than 20 hr per week, or worked night shifts, resulting in a sample of 351 participants. To examine the change processes over 8 weeks, we included only those participants in the analyses who provided information on weekly emotional exhaustion and time pressure on at least three occasions. This criterion resulted in the exclusion of an additional 99 participants. The sample for analysis thus consisted of 252 employees, which reflects a response rate of 60.4%. Among them, the majority of participants (n = 68) provided data on the variables for all 8 weeks, while 42, 45, 32, 37, and 28 participants provided data for 7, 6, 5, 4, and 3 weeks, respectively, with a minimum of 122 participants at each time point.

The final sample consisted of 62.3% female participants, with an average age of 41.4 years (ranging from 20 to 68 years). The majority of the participants had completed higher education (72.2%), with 50.8% having attended university and 27.0% having undergone vocational training. The average tenure with their current employer was 13.0 years (SD = 12.8). The average number of hours worked per week was 39.7 (SD = 9.2), and the participants worked in various areas (18.3% in the health and social sector, 10.3% in public administration, 9.5% each in finance and insurance, education, and industry, 8.3% each in other services and the information and communication sector, 6.0% in teaching and research at a university, 4.4% in trading, 2.4% in the construction industry, 0.8% in art, entertainment, and recreational services, 0.4% each in the food industry and agriculture and forestry sector, and 10.7% in other, unknown sectors).

To test for systematic differences between individuals who responded to fewer than 3 weekly questionnaires and were excluded from the analyses ($N = 99$) and those who provided at least three data points and were included in the final sample ($N = 252$), we conducted comparative analyses. Participants in the final sample were found to be older, $t(234.58) = -5.62$, $p < .001$, had a longer tenure with their current employer, $t(244.54) = -3.57$, $p < .001$, and were less emotionally exhausted at baseline than those excluded, $t(138.46) = 2.33$, $p = .02$. However, no significant group differences existed concerning the mean number of hours worked per week and time pressure at baseline, $t(199.11) = 0.61$, $p = .54$; $t(173.36) = 0.53$, $p = .60$, respectively.

Also, as participants were allowed to respond to questionnaires until Monday, we tested for systematic differences in weekly emotional exhaustion and time pressure between participants who responded on a Monday compared to individuals who filled out questionnaires between Friday and Sunday. Mostly, participants answered the weekly questionnaire Friday and Sunday (weekly *n* ranged from 208 to 229), and only a minority responded on Monday (weekly *n* ranged from 23 to 44). Additionally, comparative analyses revealed just one difference at Week 5, with Monday responders being less emotionally exhausted than Friday to Sunday responders, $t(61.3) = 2.032$, $p = .046$. We detected no differences for all other variables and weekly measurement points. Furthermore, we reran our analyses using a restricted sample excluding all Monday responses and found no differences in the statistical inferences. Thus, the larger sample was used for further analyses, as responses did not appear to be contaminated by employees' return to work for the week.

Measures

Emotional Exhaustion

Emotional exhaustion was assessed using five items instead of the original eight items from the Oldenburg Burnout Inventory (Demerouti et al., 2003). Sample items are, "During my work, I often feel emotionally drained." and "There were days when I felt tired before I arrived at work." Items were rated on a 4-point rating scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The weekly McDonald's Ω ranged from .83 to .87 (mean Ω was .85). The scale reduction was necessary due to an item redundancy within the emotional exhaustion scale and a conceptual overlap between emotional exhaustion and time pressure. For emotional exhaustion, we observed that Item 2 exhibited correlations greater than 1 with Item 6 (possibly due to their highly similar wording), and Items 3 and 7 appeared to measure time pressure rather than emotional exhaustion. Due to this discrepancy, we decided to exclude Items 2, 3, and 7 from the emotional exhaustion scale, resulting in a scale reduction to five items. Further information on the establishment of the emotional exhaustion measurement model and a validity comparison of the long and short scale can be obtained from the additional online material (https://osf.io/w7zad/).

Time Pressure

Time pressure was measured using a three-item scale from the Instrument of Stress-Oriented Task Analysis (Semmer et al., 1999). Sample items are, "This week, I had to work under time pressure." and "This week, I had to work faster than normal to complete my work." Items were rated on a 5-point rating scale ranging from 1 (*not true at all*) to 5 (*very true*). The weekly McDonald's Ω ranged from .90 to .94 (mean Ω was .92).

Data Analysis

At each of the eight measurement occasions (T1–T8), we estimated latent variables for emotional exhaustion and time pressure using five and three (ordered categorical) indicator variables, respectively. To investigate the measurement part of our models, we inspected the fit of univariate latent state models for both emotional exhaustion and time pressure.

To examine the temporal dynamics between emotional exhaustion and time pressure, we first used latent growth curve modeling (LGCM; McArdle, 2009) to investigate the overall time trend in our data. In multiple-indicator LGCMs, latent change across time is modeled assuming a functional form of change (e.g., linear or quadratic), with intercept and slope factors capturing interindividual differences in the levels at the first time point and in growth in the latent true scores over time, respectively. Accordingly, higher positive/negative values on the slope variables denote higher positive/negative change for the respective person. Herewith, we examined whether emotional exhaustion or time pressure, on average, shows a systematic increase or decrease across time (e.g., a spiraling effect) and whether interindividual differences exist in these growth trajectories, which would have to be considered in further analyses.

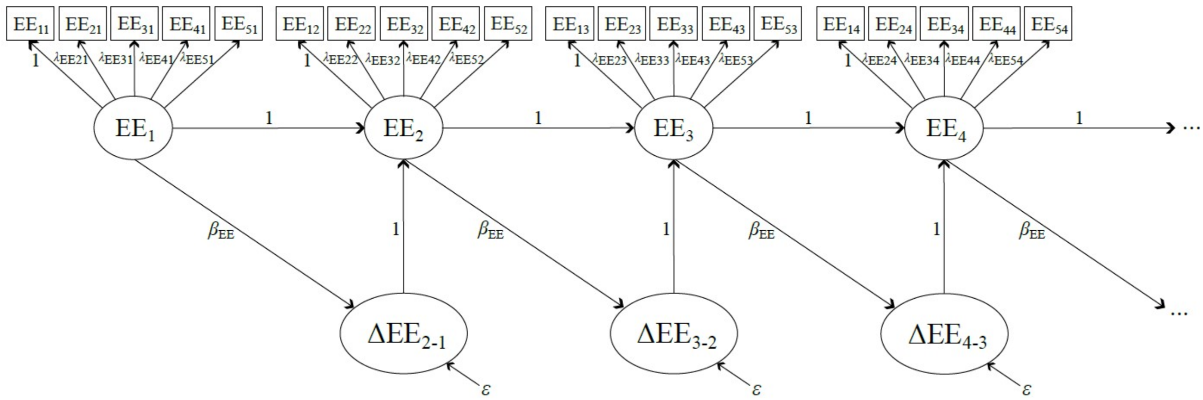
Building on the results of this first step, in a second step, we employed latent change score modeling (LCSM; McArdle, 2009) to investigate the adaptive change processes proposed. In multiple-indicator LCSMs, latent change variables capture the measurement-error-free changes between two latent state variables measured at adjacent time points (i.e., neighbor-change model).[6] Hence, to examine whether adaptation occurs in emotional exhaustion and time pressure (Hypothesis 1 and 3), we conducted univariate LCSMs for each

[6] Note that we fitted stochastic versions of the LCSMs throughout; that is, we allowed for residual true change not predicted by the previous level. Furthermore, we used LCSMs as defined in McArdle (2009) and not a dual change score model (see, e.g., Cáncer et al., 2021) due to the results of the LGCMs, indicating the absence of systematic growth or decline across time in the present data.

construct (see Figure 6 for the example of emotional exhaustion). A univariate LCSM specifies latent change variables (after T1) for, for instance, emotional exhaustion, representing the change in the latent variable from one time point to the next (e.g., $\Delta EE_{2\text{-}1}$, as shown in Figure 6). The latent change variable at T2 is, for instance, composed of the initial variable at T1 and a latent change variable that represents the growth or decline in the construct from T1 to T2 (Reuter et al., 2010; Steyer et al., 1997, 2000). The means of the latent change variables reflect the average changes across individuals, while the variances of the latent change variables capture the degree of interindividual differences in these latent changes. In addition, we regressed the latent change variables on the previous level of the same variable to examine the effect of the level of emotional exhaustion and time pressure at Week *t* on its subsequent change (i.e., proportional change; β_{EE} in Figure 6).

Figure 6

Univariate Latent Change Score Model of Emotional Exhaustion (Study 2)



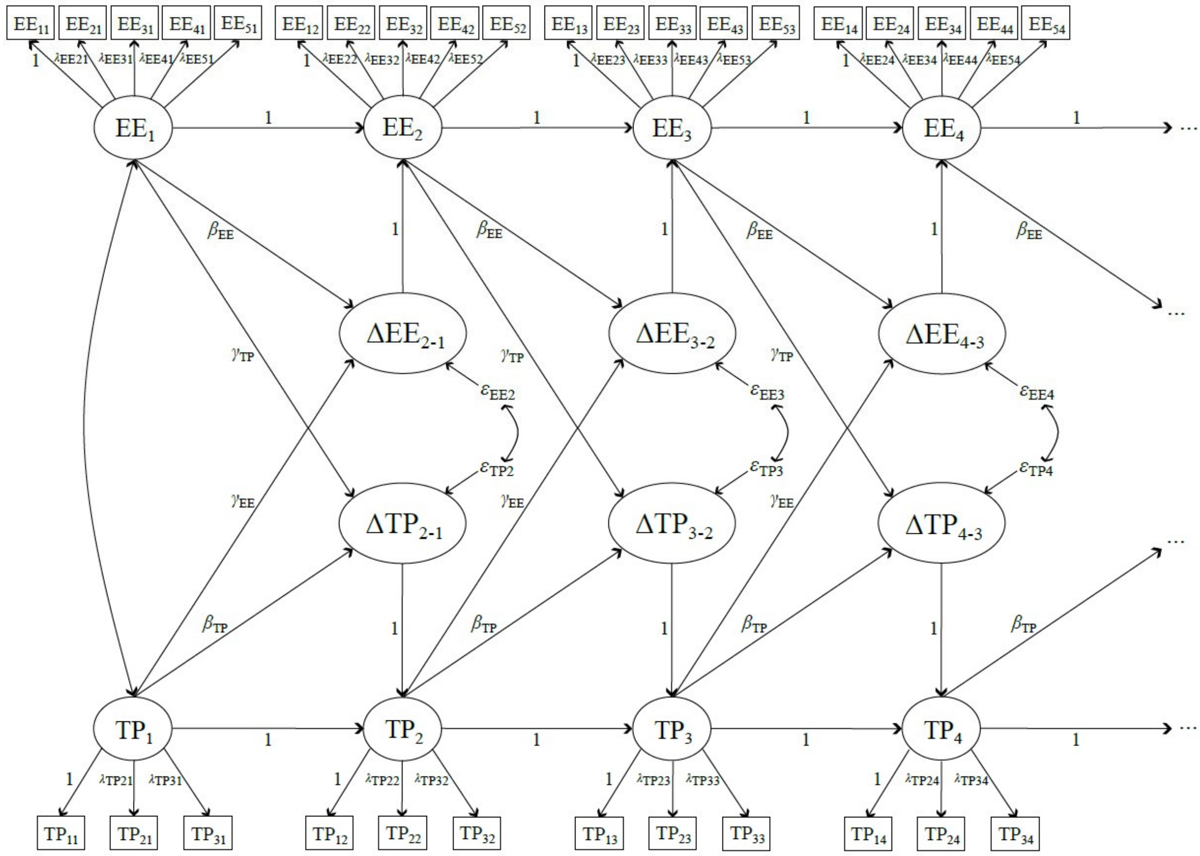
Note. Boxes are observed variables and ovals are latent variables. In favor of presentability, only emotional exhaustion at Time 1 to Time 4 are shown, while the model includes all eight measurement points at which data was collected. EE = emotional exhaustion; Δ = latent change from Week *t* to ($t + 1$); β = regression estimate; λ = item loading; ε = residual.

Specifically, a negative association between the level of emotional exhaustion and its change indicates that individuals with a higher initial level tend to show smaller positive or larger negative changes in emotional exhaustion at the next time point. In the case of an average change of 0, this negative association thereby indicates an adaptation of emotional exhaustion, where individuals tend to return to the baseline of emotional exhaustion from one point in time to another. On the other hand, a positive association indicates that individuals with a higher initial level tend to show larger positive or less negative change, which, in case of an average change of 0, suggests an accumulation, resulting in either an upward growth from elevated levels or a further decline from low levels at these two points in time.

Third, we employed a bivariate LCSM to test whether the weekly levels of emotional exhaustion and time pressure influenced the time course of each other (addressing Hypotheses 2 and 4). As depicted in Figure 7, the univariate LCSM of emotional exhaustion was combined with the univariate LCSM of time pressure to form a bivariate LCSM that examines not only the effect of the level of one variable on its change but also the effect of the level of a variable at time point *t* (e.g., TP_1) on the change in another variable from the same time point *t* to the next time point ($t + 1$; e.g., $\Delta EE_{2\text{-}1}$). This result was achieved by regressing the latent change variables on temporally preceding variables, thereby simultaneously estimating the associations between the level of one variable and its changes (β) as well as the change in another variable (γ; McArdle, 2009). For example, we assessed the level of time pressure in the previous week as a predictor of the change in emotional exhaustion from that week to the following week (γ_{EE} in Figure 10 to answer Hypothesis 2; γ_{TP} to answer Hypothesis 4), while controlling for previous emotional exhaustion and time pressure, respectively. This step enabled us, for instance, to examine whether the proposed positive relationship of time pressure in Week *t* on the change in emotional exhaustion from Week *t* to Week ($t + 1$) and the negative relationship of emotional exhaustion in Week *t* on the change in emotional exhaustion from Week *t* to Week ($t + 1$) exist simultaneously. This pattern would indicate a lowered adaptation process as proposed in Hypothesis 2. The same procedure applies to the adaptation process of time pressure, as proposed in Hypothesis 4. Please note that our findings do not imply causality or an interaction between level and change but rather highlight the associations between the levels and changes in the variables.

Figure 7

Bivariate Latent Change Score Model of Emotional Exhaustion and Time Pressure (Study 2)



Note. Boxes are observed variables and ovals are latent variables. In favor of presentability, only variables at Time 1 to Time 4 are shown, while the model includes variables at all eight measurement points at which data was collected. EE = emotional exhaustion; TP = time pressure; Δ = latent change from Week t to $(t + 1)$; β and γ = regression estimates; λ = item loading; ε = residual.

All models were estimated with Mplus 8.5 (Muthén & Muthén, 2020) with the weighted least square mean and variance adjusted estimator, given that all observed variables were ordered categorical. To assess model fit, we employed various fit indices, including χ^2-tests, root-mean-square error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI), and standardized root-mean-square residual (SRMR). In line with the recommendations of Schermelleh-Engel et al. (2003), we considered a nonsignificant χ^2-test (or at least a value of $\chi^2 \leq 2*df$), CFI and TLI values of >.95, RMSEA values of <.05, and SRMR values of <.10 indicative of an acceptable model fit. The data used in this study are available from the first author upon reasonable request. To enable exploration of the full details of the model specifications, results, and additional analyses, we have made all model syntaxes and outputs accessible in an additional online material (https://osf.io/w7zad/). While the hypotheses and analysis plan of this study were not disclosed in advance, the data used in this study were part of a larger research project that was preregistered prior to data collection (https://aspredicted.org/R1X_2PL).

Results

The means, standard deviations, and intercorrelations of the scale means of emotional exhaustion and time pressure are presented in Table 3. The results show significant correlations between the variables in the expected directions.

Model Specifications

As a baseline model, we first fit univariate latent state models for both emotional exhaustion and time pressure with an unrestricted (saturated) variance–covariance matrix of the latent state factors (excluding any change/growth variables) to assess the measurement part of the model (see Geiser et al., 2021). With all models, we assumed strict measurement invariance across measurement occasions for each variable, ensuring equal loadings and threshold parameters of the indicators across measurement occasions. This level of measurement invariance is a prerequisite for drawing meaningful inferences about the relationships between the variables over time (Little et al., 2007) and the accurate interpretation of latent change scores (Geiser et al., 2021). The models fitted the data well: emotional exhaustion: $\chi^2(841) = 1202.081$, $p < .001$, CFI = .972, TLI = .974, RMSEA = .041, 90% CI [.036, .046], SRMR = .064; time pressure: $\chi^2(315) = 520.621$, $p < .001$, CFI = .986, TLI = . 988, RMSEA = .051, 90% CI [.043, .059], SRMR = .046.

Table 3

Means, Standard Deviations, and Correlations of the Scale Means of Study Variables (Study 2)

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1.	Emotional Exhaustion T1	2.32	0.66	(.83)									
2.	Time Pressure T1	2.79	1.22	.35***	(.91)								
3.	Emotional Exhaustion T2	2.40	0.69	.79***	.29**	(.83)							
4.	Time Pressure T2	2.68	1.27	.21**	.63***	.23**	(.92)						
5.	Emotional Exhaustion T3	2.37	0.69	.73***	.30***	.75***	.21**	(.84)					
6.	Time Pressure T3	2.66	1.19	.26**	.37***	.30***	.55***	.37***	(.92)				
7.	Emotional Exhaustion T4	2.31	0.71	.80***	.37***	.76***	.32***	.79***	.30***	(.84)			
8.	Time Pressure T4	2.69	1.15	.28**	.35***	.27**	.46***	.26**	.43***	.41***	(.92)		
9.	Emotional Exhaustion T5	2.24	0.67	.68***	.35***	.72***	.32***	.70***	.31***	.84***	.31***	(.84)	
10.	Time Pressure T5	2.62	1.11	.04	.28**	.12	.41***	.11	.39***	.23**	.52***	.28**	(.90)
11.	Emotional Exhaustion T6	2.28	0.73	.72***	.37***	.70***	.29**	.78***	.36***	.84***	.39***	.78***	.22**
12.	Time Pressure T6	2.57	1.07	.01	.22**	.00	.20*	.16*	.22**	.26**	.44***	.26**	.51***
13.	Emotional Exhaustion T7	2.24	0.67	.71***	.35***	.70***	.28**	.69***	.29**	.77***	.39***	.75***	.29**
14.	Time Pressure T7	2.60	1.16	.34***	.30**	.22*	.31**	.25**	.20*	.36***	.35***	.28**	.46***
15.	Emotional Exhaustion T8	2.33	0.71	.66***	.36***	.68***	.28**	.68***	.26**	.79***	.32***	.75***	.29**
16.	Time Pressure T8	2.78	1.20	.30**	.40***	.21**	.38***	.25**	.37***	.33***	.43***	.21*	.46***

Note. The presented statistics refer to the scale means as averages across the respective scales' items per measurement time point. n = 122–218. T1–T8 = Week 1 to Week 8.

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

Table 3 (continued)

Means, Standard Deviations, and Correlations of the Scale Means of Study Variables (Study 2)

	Variable	*M*	*SD*	11	12	13	14	15	16
11.	Emotional Exhaustion T6	2.28	0.73	(.87)					
12.	Time Pressure T6	2.57	1.07	.30***	(.92)				
13.	Emotional Exhaustion T7	2.24	0.67	.81***	.23*	(.84)			
14.	Time Pressure T7	2.60	1.16	.30**	.42***	.42***	(.94)		
15.	Emotional Exhaustion T8	2.33	0.71	.79***	.31**	.79***	.41***	(.86)	
16.	Time Pressure T8	2.78	1.20	.26**	.36***	.35***	.61***	.36***	(.93)

Note. The presented statistics refer to the scale means as averages across the respective scales' items per measurement time point. $n = 122–218$.

T1–T8 = Week 1 to Week 8.

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

Note that the measurement error variances of the ordinal indicators were set to 1 by definition of the ordered probit model parameterization and were held constant across measurement occasions (Geiser et al., 2021). During the examination of latent state model results for emotional exhaustion, we noticed indicator-specific effects, where certain items exhibited higher correlations with themselves compared to other items across time (Eid et al., 1999; also see Geiser et al., 2021). To address this issue, we included indicator-specific stable trait (method) factors for three of the five items in the subsequent models of emotional exhaustion. This step aimed to eliminate the stable component and focus on within-person change as captured by all indicators.[7] In the subsequent LCSMs, we allowed emotional exhaustion and time pressure at the initial level (first time point) as well as the residuals of the latent change variables of emotional exhaustion and time pressure at later time points to correlate within time points. Overall, model fit indicated that all models fitted the data well (see Table 4).

Linear and Quadratic Growth

In the univariate LGCM for emotional exhaustion, we did not observe interindividual differences in linear or quadratic growth in emotional exhaustion over time, as indicated by latent (linear and quadratic) growth factor variances equal or close to 0 (with a variance of 0.000, $p = .88$, in the linear LGCM; and variances of -0.007, $p = .43$, [Heywood case; i.e., a nonpermissible parameter estimate, such as a correlation estimate greater than 1 or factor variances ≤ 0] and 0.000, $p = .51$, in the quadratic LGCM). The slope factor mean was close to 0 in the linear LGCM (-0.015, $p = .04$).

[7] As latent emotional exhaustion variables at T4 and T5 showed a correlation greater than 1, we formed a common latent variable across T4 and T5 in the respective latent state model. In the univariate LCSM for emotional exhaustion, which makes stricter assumptions, both time points could be estimated separately.

Table 4

Model Fits (Study 2)

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA (90% CI)	SRMR	Warnings
Latent State								
Emotional Exhaustion	1202.081	841	< .001	.972	.974	.041 ([.036; .046])	.064	-
Time Pressure	520.621	315	< .001	.986	.988	.051 ([.043; .059])	.046	-
Linear Latent Growth Curve								
Emotional Exhaustion	1153.298	862	< .001	.978	.980	.037 ([.031; .042])	.066	[a]
Time pressure	494.924	351	< .001	.990	.992	.040 ([.032; .048])	.072	-
Quadratic Latent Growth Curve								
Emotional Exhaustion	1135.233	855	< .001	.979	.980	.036 ([.030; .042])	.065	[a,b]
Time pressure	465.241	347	< .001	.992	.994	.037 ([.027; .045])	.065	[a]
Univariate Latent Change Score								
Emotional Exhaustion	1195.139	865	< .001	.975	.977	.039 ([.033; .044])	.067	-
Time pressure	797.075	342	< .001	.969	.975	.073 ([.066; .079])	.103	-
Bivariate Latent Change Score								
Emotional Exhaustion and Time Pressure	2837.285	2175	< .001	.965	.968	.035 ([.031; .038])	.084	-

Note. To improve model fit, a 2-week lag was included in the univariate model for time pressure in addition to a 1-week lag autoregressive effect. As the key results remain unchanged and hypotheses can be supported by both models, the more complicated model including a 2-week lag is not further reported in favor of presentability, but its model fit and results can be found in the additional online material (https://osf.io/w7zad/). $N = 252$. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval; SRMR = standardized root-mean-square residual.

[a] Nonpositive definite covariance matrix due to a negative or zero slope factor variance estimate. [b] Nonpositive definite residual covariance matrix.

For time pressure, we observed small interindividual differences in the linear growth (with a variance of 0.004, p = .04, and a mean slope of -0.008, p = .47) but not in the quadratic growth over time (with a variance of 0.001, p = .22) with a positive variance in the linear slope (0.075; p = .04). Note that the latter model also produced a Heywood case and should, therefore, not be substantially interpreted. The changes indicated by these results are slight reductions in emotional exhaustion and time pressure over time with no or small differences between persons in the trajectories of emotional exhaustion and time pressure, respectively. The results suggest the absence of spiraling effects for emotional exhaustion and potentially slightly different trajectories across individuals for time pressure with an average trajectory of time pressure that does not show a clear upward or downward trend. This interpretation was descriptively supported by the individual trajectories depicted per person in the Bertin plots, which can be accessed in the additional online material (https://osf.io/w7zad/) and do not depict individuals with marked upwards (or downwards) spirals in the sample. Detailed results are provided in the outputs that can be found in the additional online material (https://osf.io/w7zad/).

Adaptive Change

The LCSMs to investigate adaptive change processes supported the results from the LGCM, that is, on average across persons, emotional exhaustion and time pressure did not systematically increase or decrease over time. Both constructs showed little mean change over time, as indicated by the latent state factor means being close to 0 at each time in the latent state models (min_{EE} = -0.112, max_{EE} = 0.116; min_{TP} = -0.185, max_{TP} = 0.000, all not significantly different from 0, i.e., in comparison to T1), except for T2 for emotional exhaustion and T6 for time pressure. The same picture is given by the means of the latent change score variables (model without proportional change; mean change with a minimum of -0.134, p = .01 and a maximum of 0.117, p = .07 for emotional exhaustion and mean change with a minimum of -0.084, p = .23 and a maximum of 0.156, p = .05 for time pressure), with means differing from 0 at T2 (0.116, $p = .04$) and T4 (see minimum) for emotional exhaustion only, with no systematic pattern across time.

As shown in Table 5, the results of the univariate LCSMs for emotional exhaustion and time pressure provide support for Hypothesis 1 and 3, indicating that employees adapted to their emotional exhaustion and time pressure over the 8 consecutive workweeks. Specifically, emotional exhaustion in the previous week was negatively associated with the subsequent changes in emotional exhaustion ($B = -.039$, $SE = .008$, $p < .001$). In the absence of average change across time, this implies that individuals starting from higher levels of emotional exhaustion demonstrated a decrease in emotional exhaustion or a less substantial increase in emotional exhaustion over time, signifying a tendency for employees to return to their baseline levels. Similarly, we observed that time pressure in the previous week was negatively associated with subsequent changes in time pressure ($B = -.248$, $SE = .024$, $p < .001$). This suggests that individuals starting from higher levels of time pressure experience a decline in time pressure or a less substantial increase in time pressure over time, indicating a tendency for employees to revert back to baseline levels of time pressure.[8]

The results of the bivariate LCSM in Table 5 show whether the weekly levels of emotional exhaustion and time pressure were associated with each other over time (addressing Hypotheses 2 and 4). As can be seen, we observed a weekly adaptation to emotional exhaustion over the 8 weeks ($B = -.053$, $SE = .011$, $p < .001$), after controlling for prior time pressure. Additionally, when considering a constant level of previous emotional exhaustion, we observed an increase in emotional exhaustion for individuals with higher levels of previous time pressure ($B = .046$, $SE = .015$, $p = .002$). This pattern of results provides

[8] To improve model fit, a 2-week lag was included in the univariate model for time pressure in addition to a 1-week lag autoregressive effect. As the key results remain unchanged and hypotheses can be supported by both models, the more complicated model including a 2-week lag is not further reported in favor of presentability, but can be found in the additional online material (https://osf.io/w7zad/).

support for Hypothesis 2, that is, that high weekly levels of time pressure lowered the adaptation process in emotional exhaustion over time.

Table 5

Parameter Estimates Predicting Latent Change in Emotional Exhaustion and Time Pressure (Study 2)

Model	Δ_{EE} und Δ_{TP}		
	B (*SE*)	*p*	R^2 (min/max)
Univariate LCSMs			
β_{EE} (EE on Δ_{EE})	-.039 (.008)	< .001	.016/.018
β_{TP} (TP on Δ_{TP})	-.248 (.024)	< .001	.105/.141
Bivariate LCSM of EE and TP			
β_{EE} (EE on Δ_{EE})	-.053 (.011)	< .001	.039/.040
β_{TP} (TP on Δ_{TP})	-.335 (.025)	< .001	.162/.168
γ_{EE} (TP on Δ_{EE})	.046 (.015)	< .001	
γ_{TP} (EE on Δ_{TP})	.111 (.024)	< .001	

Note. R^2 values for the observed variables in the univariate LCSMs of emotional exhaustion and time pressure and for bivariate LCSM of emotional exhaustion and time pressure range between .598–.818, .754–.905, and .582–.891, respectively. The latent correlation between time pressure and emotional exhaustion at T1 is $r = .29$, $p < .001$. $N = 252$. EE = emotional exhaustion; TP = time pressure; *B* = unstandardized regression value; *SE* = standard error; LCSM = latent change score model; Δ = latent change from Week *t* to ($t + 1$); β and γ = regression estimates.

Additionally, employees demonstrated weekly adaptation to time pressure over the 8 weeks ($B = -.335$, $SE = .025$, $p < .001$), after controlling for prior emotional exhaustion. However, when holding prior time pressure constant, we also found that an increase in time pressure for individuals with higher levels of prior emotional exhaustion occurred ($B = .111$, $SE = .024$, $p < .001$). This pattern of results shows that high weekly levels of emotional exhaustion lowered the adaptation process of time pressure over time, thus supporting

Hypothesis 4. Additionally, it should be noted that we observed a significant latent correlation between time pressure and emotional exhaustion at T1 ($r = .29$, $p < .001$).

After accounting for the autoregressive and cross-lagged effects, the unexplained latent changes in time pressure and emotional exhaustion were not significantly associated within time points ($r = .095$, $SE = .098$, $p = .332$). However, the largest amount of interindividual differences in changes across time could not be explained by previous levels of emotional exhaustion and time pressure. That is, only up to 4% of the variance in true change in emotional exhaustion was explained by previous levels of both variables, leaving the remaining part "unsystematic" changes within the model. In contrast, up to 16.8% of interindividual differences in the changes in time pressure across time could be explained by both previous time pressure and previous emotional exhaustion (see Table 5).

Discussion

Drawing upon both adaptation and conservation of resources theories, we investigated how time pressure is associated with increased emotional exhaustion in a health-impairing manner over time. In addition, we assessed their reciprocal relationship by examining how emotional exhaustion influences time pressure over time. Using LCSMs, our findings reveal that employees exhibit weekly adaptive responses to emotional exhaustion (Hypothesis 1) and time pressure (Hypothesis 3) over 8 consecutive workweeks. However, these adaptive change processes were lowered by the previous weekly level of the respective other variable. In other words, employees' return to their baseline levels of emotional exhaustion and time pressure is counter-balanced by experiencing higher levels of time pressure (Hypothesis 2) or being highly emotionally exhausted (Hypothesis 4) during the previous workweek, respectively. Overall, the results highlight that, from a temporal perspective, emotional exhaustion and time pressure relate via a lowered adaptive process. Our study provides valuable insights into the dynamic interplay between work-related stressors and strain and contributes to a deeper understanding of the temporal aspects underlying this relationship.

Theoretical Contributions

In our data, we found support for an adaptation process in emotional exhaustion occurring over time. Consistent with the propositions of adaptation theory (Diener et al., 2006; Diener & Diener, 1996), we observed that employees tend to return to their baseline levels of emotional exhaustion in the subsequent workweek, following any deviation from that baseline (i.e., an increase or decrease) in the previous week, supporting Hypothesis 1. This result largely replicates previous literature, showing that individuals possess a personal baseline of well-being to which they gravitate after experiencing changes in well-being due to specific events (Diener et al., 2006). For example, previous research has demonstrated adaptive changes in response to various stressors, such as returning to a sleep quality baseline after increased role overload (Henderson et al., 2023), adapting in subjective well-being and burnout after workplace incivility (Matthews & Ritter, 2019), and reverting to previous levels of job satisfaction after role conflict (Ritter et al., 2016) as well as to well-being after work–family conflict (Matthews et al., 2014).

In addition to supporting adaptation theory for emotional exhaustion, we present evidence supporting conservation of resources theory (Hobfoll, 1989, 2001) in the relationship between time pressure and change in emotional exhaustion over time, as revealed by the bivariate LCSM. Specifically, the pattern of results shows that the change in emotional exhaustion from one time point to the next is predicted by both previous levels of emotional exhaustion and previous levels of time pressure, but in opposite directions. Thus, holding the effect of the other variable constant, we see that change in emotional exhaustion is negatively associated with previous levels of emotional exhaustion but simultaneously enhanced by time pressure, as the latter positively relates to changes in emotional exhaustion from one week to the next, supporting Hypothesis 2. We interpret these results as the temporal process of how time pressure relates to emotional exhaustion via a lowered adaptive change process.

From a theoretical point of view, we add to the literature by describing how time pressure increases emotional exhaustion over time by initially increasing emotional exhaustion and simultaneously hindering its reduction. Such a temporal pattern might be especially problematic for employees because the increase in emotional exhaustion over time evolves through a lower decrease, creating a paradoxical situation where employees feel that they are doing better but instead are impaired in the long run. This pattern might explain why employees do not realize faster that their health is impaired because the timely process of health impairment is hindering the reduction of emotional exhaustion.

This interpretation of the results is in line with previous literature on temporal relationships between stressors and strain that demonstrated that work-related stressors do not always result in a complete adaptation of well-being (e.g., after unemployment; Clark & Georgellis, 2013; Lucas et al., 2004) but rather complex processes are involved in adaptation. Hereby, our study sheds some new interesting light on the temporal process of how work-related stressors relate to strain in a health-impairing manner (via reduced adaptation). We encourage further research to examine the intricate interplay of both the adaptive change process of emotional exhaustion and the resource-draining effect of time pressure on emotional exhaustion, as they appear to exist simultaneously and lead to an inability to return to the emotional exhaustion baseline, herewith emphasizing the relevance of time pressure to employees' health.

Relatedly, certain person characteristics may play a crucial role in supporting successful adaptation over time. For instance, engaging in recovery experiences, such as psychological detachment from work, may accelerate adaptive change in emotional exhaustion by replenishing lost resources. Employees who mentally detach from work after facing high demands are likely to experience reduced emotional exhaustion (Sonnentag et al., 2010). Moreover, occupational self-efficacy, in line with the stressor-detachment model (Sonnentag & Fritz, 2015), could be advantageous for the adaptation process over time. Individuals with high self-efficacy are more likely to report elevated levels of detachment from work (Clauss et al., 2021), supporting a return to baseline levels of emotional exhaustion. In conclusion, we encourage future research to examine the mediating and moderating effects of recovery experiences and personal characteristics, such as occupational self-efficacy and coping strategies, to gain deeper insights into the temporal change processes of strain and the impact of a stressor.

In line with literature that emphasizes the interconnectedness of stressors and strain (Ford et al., 2014; Guthier et al., 2020), our findings on the reversed relationship between emotional exhaustion and time pressure demonstrate that the reduced adaptation operated bidirectionally: from stressor to strain and from strain to stressor. Considering the natural development of time pressure over time as a starting point, the finding of the univariate LCSM for time pressure suggests that time pressure also shows an adaptive change process over time and does not accumulate (at least not over 8 weeks), supporting Hypothesis 3. This adaptive process observed for time pressure as a work-related stressor is in line with previous literature on adaptive change of other work-related stressors over time, such as work–family and role conflicts (e.g., Matthews et al., 2014; Ritter et al., 2016). This further extends adaptation theory to workplace characteristics beyond its original assumption of returning to baseline levels of well-being.

Several mechanisms may explain this adaptive pattern in time pressure. For example, individuals might utilize coping strategies, such as independently reducing their workload or engaging in recuperative activities following periods of high time pressure, hereby adjusting their work situation according to their resource levels. Relatedly, and based on the concept of work engagement (Schaufeli et al., 2002) and the challenge–hindrance stressor framework (Cavanaugh et al., 2000), employees who experience lower time pressure may seek to optimize their engagement and performance by taking on more tasks or responsibilities, thus intentionally or unintentionally increasing their time pressure. This behavior is reflective of individuals' pursuit of optimal arousal levels, suggesting that too little stimulation can prompt efforts to increase workload to achieve a more stimulating and engaging work environment. Examining such coping mechanisms would enrich our understanding of how individuals navigate and manage stressors over time.

Additionally, we found that the level of emotional exhaustion of the previous week influences the temporal course of time pressure, again, resulting in an extended process of adaptation over time due to the state of emotional exhaustion, supporting Hypothesis 4. This provides further evidence for both adaptation and conservation of resources theories in the relationship between emotional exhaustion and time pressure. Specifically, employees experiencing higher levels of emotional exhaustion seem to lack the necessary resources to effectively cope with time pressure at work (Corollary 1; Hobfoll, 2011), preventing a complete adaptation over time. This finding underscores the significance of considering and exploring time-dynamic relationships between stressors and strains in both directions and emphasizes the need to incorporate temporal change processes and reciprocal relationships into theories that explain the development of both stressors and strains over time.

Interestingly, our observations reveal that, on average, individuals adapt over time, but with average levels of emotional exhaustion and time pressure remaining rather unchanged in our data. Specifically, we found no indication of interindividual differences in growth over the observed time course, both in the LGCMs and LCSMs, that would imply spiraling effects of emotional exhaustion and time pressure as suggested by the concept of loss spirals that is proposed by conservation of resources theory (Hobfoll, 1989, 2001). According to this theory, individuals aim to conserve their resources and resource depletion leads to stress, necessitating compensatory effort to prevent further resource loss (basic tenet and Principle 2). This vulnerability to ongoing resource loss can trigger a loss spiral, implying an incessant intensification of strain over time (Corollary 1 and 2; Hobfoll, 2001). Herewith, our findings challenge the idea of resource loss spirals (see also Ford et al., 2023). Instead, our study lends support to the idea of reduced adaptive change processes in both variables, suggesting that adaptation might be the natural trajectory for both emotional exhaustion and time pressure and is prolonged by the experience of heightened levels during the previous week. This is in line with Somaraju et al. (2022), who reported that individuals in extreme working conditions did not exhibit an unending increase in strain as they experienced resource loss due to relationship conflict. Instead, they showed the ability to recover and return to an equilibrium after experiencing a peak of conflict or strain. Considering Ford et al.'s (2023) findings on the lack of detecting loss spirals, our study demonstrates that resource spirals may not be as universal as previously thought and a combination of both adaptive change and spiraling may be important when theorizing on and examining temporal dynamics of stressors, strain, and their (reciprocal) relationship.

It is essential to note that the absence of mean change does not imply that spirals of resource loss never occur. Instead, it suggests that these spirals may not be evident when averaging across all individuals but may manifest for specific individuals or subgroups at specific periods. Specifically, why should we expect loss spirals to occur on average in an overall healthy working sample? It might be that spiral processes occur for particularly vulnerable employees whose resources are already at a very low level, illustrating the shift to mental health impairment. Therefore, we believe that not finding evidence for resource loss spirals in the present study does not speak against the existence of spirals in general but calls for a refinement of the statements regarding loss spirals in conservation of resources theory. To gain a more comprehensive understanding of adaptation processes and spiraling behavior, future research could adopt a person-specific approach to modeling across a longer period. Focusing on individual trajectories over a more extended time would allow for a more nuanced exploration of interindividual differences. This approach would provide insights into how specific individuals respond and adapt to the challenges of emotional exhaustion and time pressure. Nevertheless, our results suggest that individuals adapt by returning to preexisting baseline levels of emotional exhaustion and time pressure, and that this adaptive process is affected by the respective other variable, hereby indicating how both stressors and strains reciprocally shape the course of each other in a health-impairing manner.

Practical Implications

From a well-being perspective, this study offers several practical implications. First, the results show that although experiencing high levels of emotional exhaustion and time pressure may lower adaptation over time, these states tend to normalize over time and return to baseline levels on average. This suggests that seasonal peaks associated with periods of high demand, such as busy pre-Christmas sales in retail, year-end closings for corporations, or deadlines for quarterly reports in the financial services sector, can be managed without leading to a complete depletion of resources, as suggested by conservation of resources theory.

However, it is important to acknowledge the need for replenishing lost resources during and after high-demand periods to ensure long-term health. Prior research on recovery has highlighted the necessity of replenishing resources lost due to demanding work conditions (de Lange et al., 2009; Meijman & Mulder, 1998; van Hooff et al., 2005). Our results show that stressors lead to strain via lowered adaptation, indicating an extension of the recovery process needed to fully return to the baseline level of emotional exhaustion when experiencing elevated time pressure, and vice versa. This underlines the importance for organizations to consider the simultaneous occurrence of feeling emotionally exhausted and experiencing time pressure, and its consequences for employees. Therefore, organizations are encouraged to implement interventions that focus on coping mechanisms to support employees in restoring their well-being and managing time pressure, even during demanding work periods. Effective interventions can include the development of time management skills (Aeon et al., 2021) and the promotion of recovery strategies during and after the workday (Chawla et al., 2020; Hunter & Wu, 2016; Kim et al., 2017; Sonnentag et al., 2010, 2022). These practices have proven beneficial for maintaining mental and overall health in the short and long run. Also, it is crucial to minimize stressors and prevent their persistence at high levels (Baethge et al., 2018; Igic et al., 2017) while simultaneously strengthening internal and external resources (Kunzler et al., 2022). In cases when minimizing stressors is not feasible, individuals can alter their reactivity to stressors through stress management techniques (Griffin & Clarke, 2011), adopting a positive reappraisal of the situation (Crum et al., 2017), and implementing resilience strategies (Kunzler et al., 2022). These approaches can help employees to effectively cope with stressful periods at work and decrease their strain to return to their baseline level.

Strengths and Limitations

This study has several strengths. First, the study delves into the natural evolution of stressor–strain relationships over time, with a particular focus on their mutual influence on adaptive change processes. Relatedly, by combining the theoretical frameworks of adaptation and conservation of resources theories, we offer an integrative perspective on adaptation and resource loss over time, shedding light on the complex dynamics of occupational health and stress. This deeper insight provides valuable knowledge on how workplace experiences unfold and are reciprocally interrelated over time in our weekly cyclical routines. Second, the study contributes to the literature on adaptation theory by not only applying it to emotional exhaustion as a strain indicator and replicating previous literature but also by extending its application to the temporal dynamics of time pressure as a major work-related stressor. This approach expands our understanding of adaptation theory within the context of workplace characteristics. Lastly, by choosing a latent modeling approach with multiple-indicator latent factors to define the study variables within each time point rather than using manifest variables, we take advantage of the methodological benefit of latent modeling, namely freeing variables from measurement error representing the level of a construct at a given time point (Curran & Bollen, 2001).

However, we must consider several limitations when interpreting the results. First, while the study extends our understanding of work-related stressors and strains, relying on a "one-size-fits-all" approach to modeling adaptation and detecting spirals may be insufficient. Different time intervals between measurement points could lead to varying findings (Dormann & Griffin, 2015; Voelkle et al., 2012). The weekly diary study design used in this research, covering 8 consecutive workweeks, does not permit the generalization of the findings to different time frames.

Second, emotional exhaustion, when compared to affective states, might not show sufficient variation across short time spans. With the focus on emotional exhaustion, we are limited in generalizing our findings to other cognitive, emotional, or physical indicators of strain. Likewise, we focused solely on time pressure as a frequently reported work-related stressor with well-established associations with strain (Häusser et al., 2010), health impairments (Nixon et al., 2011; Rau & Buyken, 2015), and, specifically, increased emotional exhaustion (Kern et al., 2023; Kunzelmann & Rigotti, 2021). Consequently, the generalizability of the present findings is limited to the (relationship between the) chosen variables.

Third, it is worth considering that the lack of detection of loss spirals in our study may be attributed to the exclusion of individuals who did not participate at least three times during data collection. Group comparisons revealed that those excluded individuals were notably more emotionally exhausted at baseline in comparison to the included sample with a small effect size (Cohen's $d = .29$).

Fourth, the costs to individuals of constantly regulating their working conditions and strain remain unclear. This constant regulation may act as a form of training, leading to improvement over time, or it may result in the wear and tear of a system, akin to a tightly stretched rubber band. Thus, understanding the short- and long-term consequences of dynamic and adaptive change processes on both psychological and physiological health requires further investigation.

Finally, it is essential to acknowledge that we focused on the bivariate adaptive change processes of emotional exhaustion and time pressure over 8 consecutive workweeks. In reality, the dynamics of work and life are far more intricate and interconnected. Employees are often confronted with a multitude of stressors, resources, and contexts that go beyond the scope of our investigation, including factors from their work environment, home life, and other aspects. As a result, it is crucial to exercise caution and refrain from drawing premature practical conclusions regarding employees' adaptation over time and further evaluate the complexity and temporal dynamics of work-related strains and stressors in future research.

Recommendations for Future Research

Examining adaptation to emotional exhaustion and time pressure using weekly data is grounded in the fundamental structure of the weekly work cycle within which most employees operate (Ancona et al., 2001). This structure encompasses the buildup of work-related stressors throughout the workweek and provides natural intervals for recovery during weekends. Such a rhythm sets a practical basis for observing fluctuations in emotional exhaustion and time pressure, allowing for the examination of short-term adaptation processes. Previous studies have successfully used weekly intervals to study work-related phenomena, finding meaningful variations and patterns in how individuals experience their work environment over such periods (e.g., Rosen et al., 2020; Taylor et al., 2017). These studies lend support to the idea that a weekly timeframe is both practical and theoretically justified for examining adaptation processes. Nonetheless, to gain a more comprehensive understanding, future studies should explore the impact of different time intervals, such as shorter (e.g., Burgess et al., 2022, for daily assessments in a 1-week time frame) or longer time frames (e.g., Ritter et al., 2016, for a 6-week time lag). This allows us to determine when specific time intervals may yield adaptive change, in accordance with adaptation theory, or spiraling, with the latter providing insights into the short- and long-term accumulation of stressors and strain described in conservation of resources theory. Relatedly, the length of a successful adaptation process remains unknown, as we do not yet know how long individuals need to return to their baseline level of emotional exhaustion and time pressure. Possibly, these temporal change processes depend on the time sensitivity of the variable, leading to shorter or longer time frames needed to fully adapt, especially in light of simultaneous spiraling due to previous weekly levels of time pressure and emotional exhaustion, respectively. Overall, this would shed light on the effect of varying timeframes in relation to adaptive change processes.

To capture a more dynamic picture of changes over time and to provide a fair test of resource spirals, it would be beneficial to examine more time-variable aspects of well-being, such as affect, as emotional exhaustion showed high stability in interindividual differences in our data. That is, little variability or change was explained by the models, suggesting that most changes in emotional exhaustion are not related to previous levels of emotional exhaustion but due to unobserved factors. Thus, emotional exhaustion may be less susceptible to short-term adaptation in contrast to time pressure, which exhibited more varied temporal patterns in the present study. This premise is supported by the intraclass correlation coefficients of the variables across the examined time frame of 8 weeks, with time pressure demonstrating more fluctuations across time than emotional exhaustion (.39 vs. .73, respectively). Additional time-variable indicators of well-being may reveal more fluctuations and changes in response to varying stressors. Thus, considering varying temporal profiles, differential effects relating to adaptive change over time might appear for other work-related stressors and strains. It is plausible that potential participants who might have experienced a loss spiral chose not to continue participating in the study, highlighting the necessity for more comprehensive investigations of specific subgroups vulnerable to resource loss in future research.

Overall, it becomes imperative for theories and future studies to delineate the conditions under which loss spirals may manifest and potentially investigate interactive relationships between stressors and strain over time. In the present study, we modeled adaptation and spiraling as two simultaneously occurring processes, which resulted in a time dynamical pattern where the relationship between time pressure and emotional exhaustion is described by a hindered return to baseline levels of emotional exhaustion over time. We did not examine the potential role of interactive effects between time pressure and emotional exhaustion, as this would require a different theoretical approach. However, future research could aim at investigating adaptation and spiraling building in the interaction of time pressure with emotional exhaustion.

Conclusion

In conclusion, the present study contributes to previous research on temporal dynamics and adaptive change processes in the context of occupational stress and health. Our findings demonstrate that employees exhibit adaptation concerning emotional exhaustion over 8 consecutive workweeks. By combining adaptation theory and conservation of resources theory, we observed that previous weekly levels of time pressure and emotional exhaustion were negatively associated with the change of the other variable, indicating a lowered adaptation over time. We encourage researchers to build upon these findings and continue investigating the temporal aspects of stressors and strain. This ongoing exploration will undoubtedly contribute to a more comprehensive and nuanced understanding of adaptation and its implications for occupational stress and health. Ultimately, such knowledge will aid in the development of effective strategies and interventions to promote employee well-being and foster a healthier work environment.

Chapter 4 – The Role of Time in Stressor–Strain Relationships: A Systematic Literature Review[9]

Abstract

Research has previously emphasised the need to better integrate the role of time into stressor–strain relationships. While some reviews and meta-analyses have discussed methodological approaches to incorporate time, theoretical development remains limited, with few articles or theories including specific propositions about its role. This systematic review synthesises how time is theoretically and empirically integrated into stressor–strain studies, identifying time-related categories and making recommendations for a time-sensitive theory development of stressor–strain relationships. The review includes articles published between 2012 and 2021 in four key journals, analysing 158 studies in 147 articles based on their application of time and temporal propositions. Five time-related categories were identified, illustrating the diverse ways in which time is considered in stressor–strain research and showing the breadth of research addressing time. However, most research approaches time-related questions from a methodological rather than a theoretical perspective. This review concludes by highlighting seven key topics that can guide the development of a time-sensitive theory and addresses persistent challenges in understanding the temporal dynamics of stressor–strain relationships.

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[9] This chapter is based on a manuscript that has been submitted for publication at the journal *Work & Stress*.

Peter, M., Rigotti, T., Arnold, M., & Vahle-Hinz, T. (under review). The Role of Time in Stressor–Strain Relationships: A Systematic Literature Review.

Although the dissertation is written in American English, please note that this chapter is written in British English, as the manuscript was submitted to a European journal that requires it.

All supplemental material can be obtained online (https://osf.io/x3un4/?view_only=c3a4e2752eba4b8182268a7f55eab9c4).

Introduction

Phenomena occur in time (Slife, 1993), but they "do not change, evolve, or develop because of time; rather they do so over time" (Ployhart & Vandenberg, 2010, p. 98). This also applies to stressor–strain relationships in organisational and health research. Employees face chronic and varying levels of workplace stressors, which can lead to physical and/or psychological strain (Mühlenmeier et al., 2022; Nixon et al., 2011; Sonnentag & Bayer, 2005). Longitudinal and diary studies have explored how stressors and strains relate over time and addressed the temporal changes therein (Ford et al., 2014; Ohly et al., 2010). Rauvola et al. (2021) emphasised that "studying phenomena over time [...] does not automatically translate into studying phenomena with respect to time", with the latter referring to time being a "substantive factor in the research design, analysis, and interpretation" (p. 3). Stressor–strain relationships occur in a temporal context, involving critical temporal issues at each stage of the stress process, from stressor occurrence and impacts to system reactions (McGrath & Beehr, 1990).

Given the centrality of time in the context of work and stress, scholars have called for greater attention to be paid to temporal aspects (e.g., Aguinis & Bakker, 2021; Roe, 2008), including optimal lags in study design (Dormann & Griffin, 2015; Rauvola et al., 2021) and methods to better examine directional effects, processes, and time itself (Ford et al., 2014; Navarro et al., 2015; Spector & Meier, 2014). For example, Ford et al. (2014) analysed synchronous, lagged, and reverse causation effects meta-analytically to show how stressor–strain relationships vary with time, emphasising the importance of time lags. Similarly, Dormann and Griffin (2015) proposed "shortitudinal" studies to determine optimal time lags, while Spector and Meier (2014) called for combining qualitative and quantitative methods to capture real-time processes.

Focusing on time in theorising, Sonnentag (2012) and Shipp and Cole (2015) noted that studying time can advance theories by revealing new insights into constructs and processes.

Recent reviews and editorials (e.g., Sonnentag et al., 2024; Sonnentag & Meier, 2024) have discussed temporal aspects within frameworks like the conservation of resources (COR) theory (Hobfoll, 1989), but stressor–strain studies have still not paid due theoretical attention to the role of time. While theories like COR and the allostatic load model (McEwen, 1998) acknowledge temporal relationships (e.g., resource loss spirals, accumulation of stress), they often fail to specify when effects occur following stressor exposure.

To advance the field, this review examines longitudinal (e.g., monthly or yearly assessment), shortitudinal (e.g., weekly assessment), and diary designs (e.g., hourly or daily assessment) exploring stressor–strain research, identifying research gaps and making recommendations for integrating time into theorising and empirical studies, complementing existing reviews, meta-analyses, and theoretical papers on the role of time in the context of work and stress (e.g., Dormann & Griffin, 2015; Ford et al., 2014; Ohly et al., 2010; Spector & Meier, 2014). By addressing these research gaps, we aim to guide future research and stimulate theory-building on the role of time in work stress.

Review Method

The present systematic literature review was conducted according to the PRISMA guidelines (Page, McKenzie, et al., 2021; Page, Moher, et al., 2021). All supplementary material (e.g., detailed protocol of decision steps) is available at this OSF-link: https://osf.io/x3un4/?view_only=c3a4e2752eba4b8182268a7f55eab9c4.

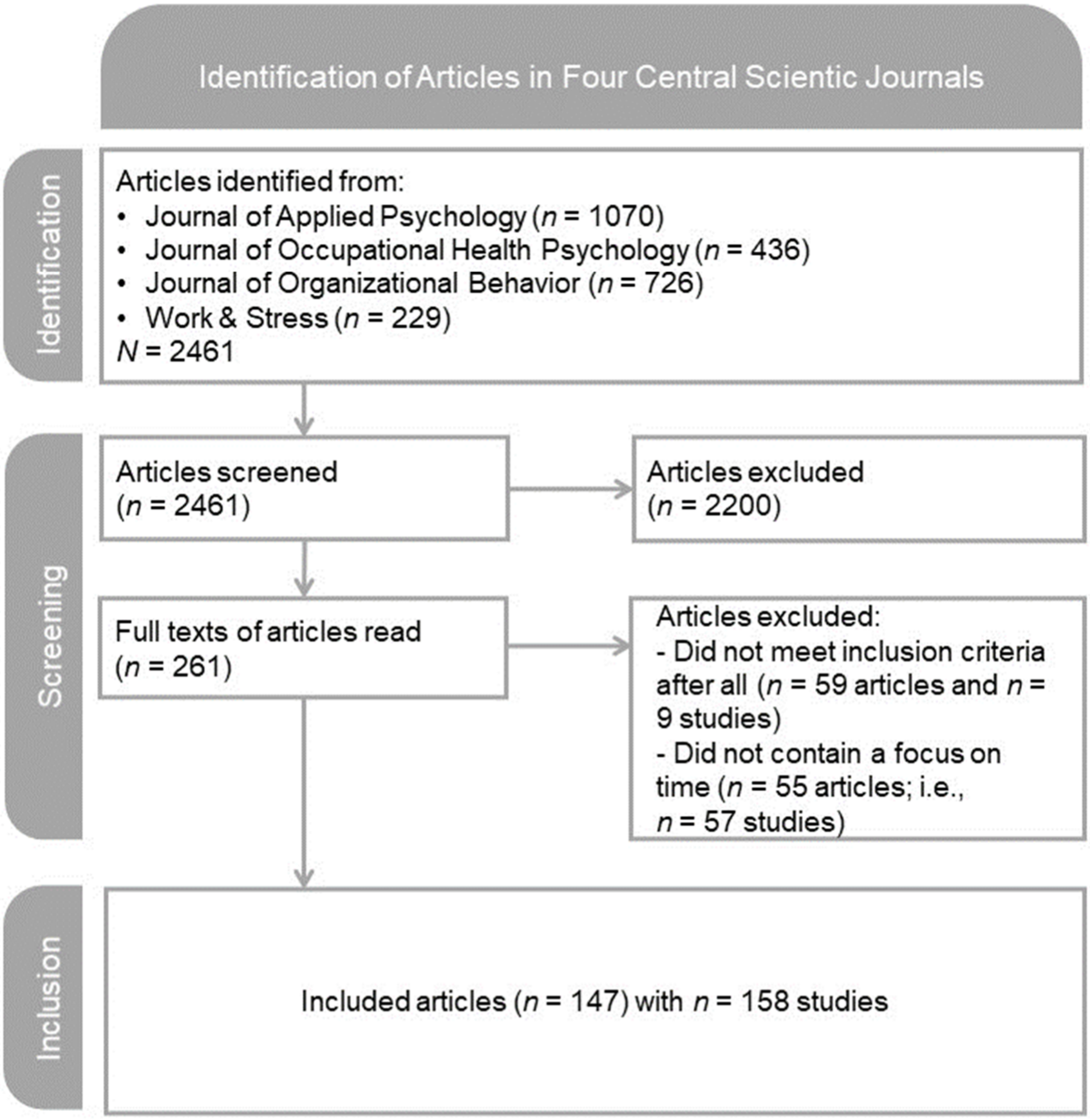
Search Strategy

We do not aim to provide an exhaustive review of time in occupational stress research, but focus on how time is incorporated into studies, particularly in their theoretical reasoning of the stressor–strain relationship at work. The literature search was limited to articles published in four leading peer-reviewed journals – *Journal of Applied Psychology*, *Journal of Occupational Health Psychology*, *Journal of Organizational Behavior*, and *Work & Stress* – which maintain rigorous publication standards and emphasise occupational health and stress.

The review covers articles published between 2012 and 2021, extracted from the PsycINFO database. The initial search yielded 2,461 articles (final data export: 24 January 2022). Figure 8 presents a flow diagram of the article selection process.

Figure 8

Prisma Diagram Showing Identification Process of Suitable Articles (Review)



Note. N/*n* = number of articles and studies.

Data Extraction Process and Analytical Procedure

The four authors independently screened the titles and abstracts of all articles using the platform Rayyan (Ouzzani et al., 2016). Articles were included if they met all the following criteria: a) the sample consisted of a working population, b) the study design included at least two measurement points, and c) the study examined stressor–strain relationships. Stressors were defined as stressful working conditions (e.g., time pressure, incivility, role stressors; Ford et al., 2014) and strain as personal well-being reactions involving psychological or physical decrements of well-being (e.g., exhaustion, absenteeism, sleep quality; Pindek et al., 2019). All included stressors and strain can be found online in the detailed study protocol (Figure S1). Disagreements on inclusion were resolved through discussion, resulting in 261 eligible articles.

During this initial step, abstracts addressing time in stressor–strain relationships in an especially innovative way were flagged, creating a subsample of 24 articles[10] (see list of references available online). These were read in full to calibrate the analysis of all 261 articles, decide on relevant information to extract, and draft initial time-related categories. These *a priori* categories were applied in subsequent analyses, with flexibility to add new categories if needed. Articles containing multiple studies were differentiated accordingly, as 17 articles included more than one study.

In the second step, the full texts of the 261 articles were reviewed and relevant data extracted, including bibliographic details, theoretical frameworks, hypotheses related to time, study design, sample descriptions, stressors and strains assessed, methodologies, key findings, and fit into time-related categories. During this process, 59 articles and nine studies were excluded upon reconsideration for not meeting inclusion criteria. An additional 55 articles (57 studies) were excluded for lacking time-related insights despite meeting the initial criteria. Ultimately, the final sample comprised 158 studies from 147 articles.

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[10] Please note that five articles that mentioned a time-relating focus were excluded from the review later as they did not meet the inclusion criteria described above. References can be obtained online in the OSF repository.

Results

In the following, we first describe the final categorisation of studies based on their study designs, methodological approaches, theoretical frameworks, and time-related categories. Second, we present an overview of studies, including information on where published, sample descriptions, geographical origins of samples, study designs, methodological approaches, and theoretical frameworks. Finally, we summarise the theoretical and methodological content of each time category, highlighting noteworthy examples from the review that illustrate these categories.

Categorisation of Data

While we extracted sample descriptions, measures of stressors and strains, and key findings from each study, our primary focus was on categorising the study designs applied, methodological approaches, theoretical frameworks, and time-related categories.

First, *study designs* were categorised to differentiate temporal lengths and types: diary (i.e., hourly or daily), event sampling, shortitudinal (i.e., time frame less than 4 weeks; Dormann & Griffin, 2015), longitudinal (i.e., time frame longer than 4 weeks), combined shortitudinal and longitudinal, meta-analyses, and theory papers. Second, *methodological approaches* were grouped into categories: multilevel approach, structural equation modelling (SEM), mixture modelling, trajectories (e.g., latent growth curve modelling), cross-lagged analysis with or without autoregressive effects, regression, correlation, group-differences (e.g., analysis of variance), meta-analyses, transition analysis, or any combination of these. For the sake of clarity, related statistical methods were organised under umbrella terms, for instance, mixture modelling encompassing latent profile analysis and factor mixture modelling. Third, the *theoretical frameworks* category documented theories used to explain or test relationships or whether propositions were made to adapt a theory. We also noted whether studies incorporated *time-specific hypotheses* (e.g., time-lagged effects, change across time, trajectories). Lastly, studies were categorised into five key time-related themes based on an initial analysis of 24 articles: (1) *multilevel designs* examining within- and between-effects across time points, (2) *stressor changes as predictors* linking changes in stressors to strain, (3) *temporal trajectories* analysing stressor and strain progression, (4) *time lags and directionality* focusing on causal or reciprocal effects, and (5) *variation across time and chaotic fluctuations* studying variability and stability over time. These categories are elaborated on below.

Overview of Studies

This review includes 147 articles comprising 158 studies[11], with data from 77,035 employees in the original studies, and sample sizes from 32 to 8,925. Meta-analyses included 395 to 37,324 individuals, totalling 72,258. Two theory papers without original data were included for their theoretical contributions. Most studies (87.97%) were conducted in the Global North (e.g., 23.42% in the United States, 20.25% in Germany, and 6.96% in China) and 12.03% at unspecified or mixed locations.

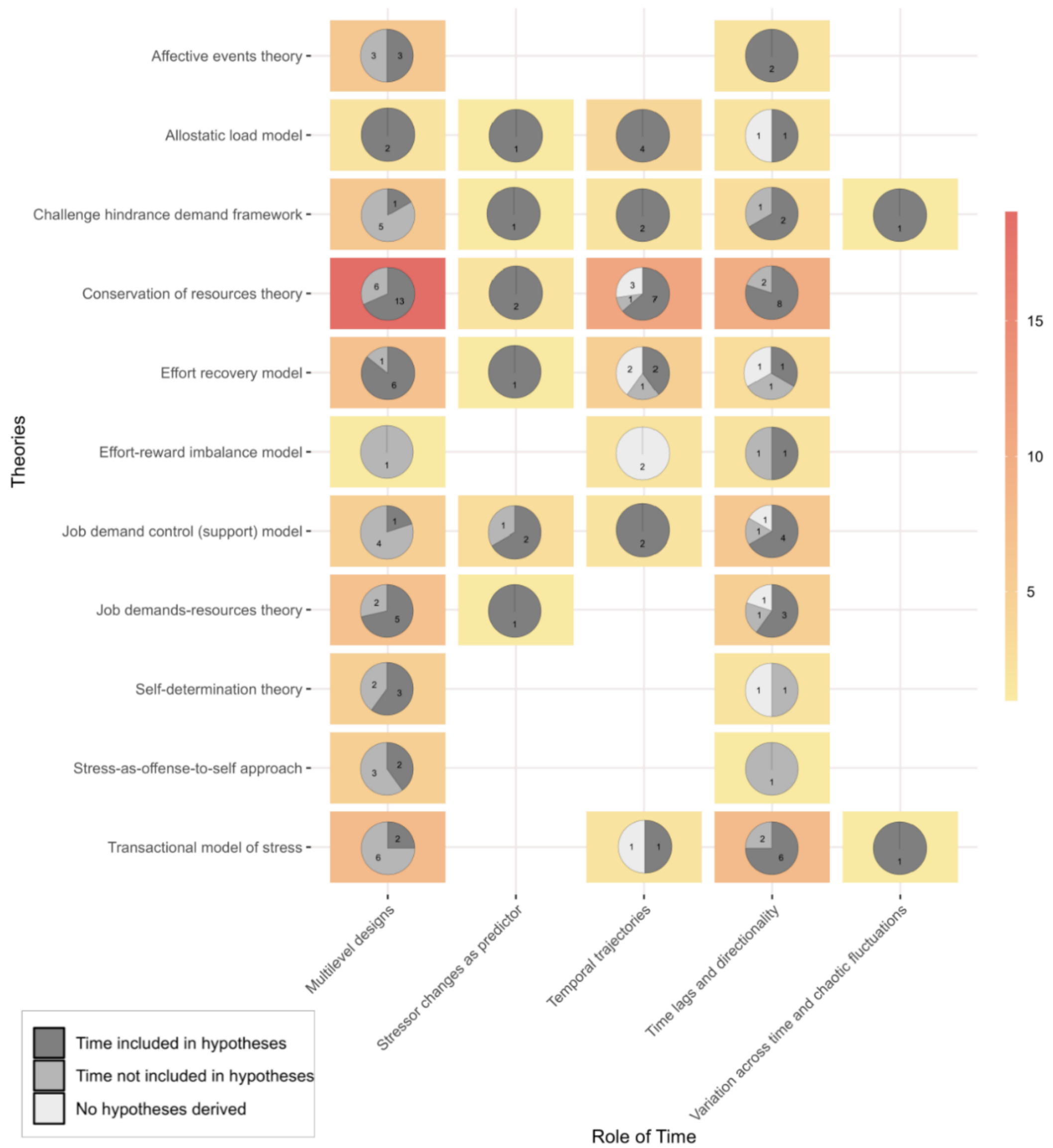
To map commonly used study designs and methods, descriptive statistics are presented. Daily diary (43.04%) and longitudinal designs (36.71%) predominated, followed by shortitudinal (12.03%), event-sampling studies (3.16%), meta-analyses (3.16%), theory papers (1.27%) and one study combining shortitudinal and longitudinal design (0.63%). Most of the studies applied SEM with and without multilevel modelling (46.84%; e.g., growth modelling and path analysis), especially in longitudinal and diary studies (44.59% and 41.89%, respectively), followed by multilevel regression (32.91%; mainly in diary studies: 61.54%), mixture modelling (7.59%), regression (4.43%; both predominantly used to analyse longitudinal data, 75.00% and 71.43%, respectively), group differences (3.16%; e.g., analysis of variance), and one transition analysis with longitudinal data (0.63%). Details on study designs and methods of all studies are shown in Table S1 in the OSF repository.

[11] Eleven articles were published online first in 2021 and appeared in print in 2022. In those cases, year of publication is reported as 2022.

Theoretical references were concentrated on a few models (see Figure 9), with COR theory most cited (46 studies), followed by the transactional model of stress (21 studies; Lazarus & Folkman, 1984), job demand–control(–support) (JDC(-S)) models (17 studies; Johnson & Hall, 1988; Karasek, 1979), effort–recovery model (ERM; 16 studies; Meijman & Mulder, 1998), job demands–resources (JDR) theory (14 studies; Demerouti et al., 2001), and the challenge–hindrance demand framework (13 studies; Cavanaugh et al., 2000).

Figure 9

Theories Used Most Often in Identified Studies Structured by Time-Related Categories (Review)



Note. Absolute number of studies depicted.

Theories were primarily used to explain hypotheses (375 studies), while fewer tested specific propositions (20 studies) or proposed adaptations (7 studies). Many studies referenced multiple theories, resulting in more theoretical citations than the total number of studies in the review. Full details are available online (Figures S2 to S7).

Foci of Time

We report below the results of the systematic literature review, focusing on how the studies identified time in their theoretical reasoning, study designs, and methodological approaches. Each category concludes with a summary of two to three noteworthy studies that effectively incorporate time. Note that five studies address multiple time foci and are included in more than one category. A summary of the studies' key characteristics, organised by category, is available online (Tables S2 to S6).

Multilevel Designs

In this category, we summarise studies using multilevel designs to examine stressor–strain relationships, focusing on within- or between-person variation, or both. These designs leverage multilevel modelling to capture variation within and across individuals (Brown, 2021), enabling comparisons of short-term (within-person) and more stable (between-person) effects depending on the timeframe of the study. Of the 158 studies reviewed, 63 fit this category (see Table S2). Research questions often explored day-specific stressor effects on same-day or next-day strain or differences in individuals' stressor responses, accounting for intraindividual changes and interindividual differences (Raudenbush & Bryk, 2002). Most studies (42 studies) focused on within-person variation, three examined between-person variation, and 18 combined both levels.

Frequently used theoretical frameworks included COR theory (20 studies), the challenge–hindrance demand framework, ERM, JDR theory, and transactional model of stress (7 studies each). For example, Koopmann et al. (2016) extended COR theory with the cognitive-affective processing system framework (Mischel & Shoda, 1995, 1998), proposing that daily events contribute to well-being fluctuations over time. Of the 63 studies, 36 included a temporal information in their hypotheses, specifying synchronous effects (17 studies) or time-lagged effects (19 studies).

Study designs were predominantly diary studies (49 studies) with an average of 19.88 time points (*SD* = 14.91; range: 5-80), followed by shortitudinal study designs (6 studies; *M* = 16.50; *SD* = 8.98; range: 8-26), longitudinal study designs (4 studies; *M* = 4.25; *SD* = 3.86; range: 2-10), event sampling designs (3 studies; *M* = 410.33; *SD* = 339.06; range: 75-753), and one meta-analysis on daily data. Analytical methods included multilevel regression (38 studies), SEM (24 studies), and one meta-analysis.

Two noteworthy examples demonstrated time integration in multilevel designs. Syrek et al. (2017) examined how unfinished tasks impact sleep via rumination, using a 12-week diary design and multilevel modelling to explore acute (2-week) and meso-term (3-month) effects. Building on Zeigarnik's effect (Zeigarnik, 1927, 1938) and Lewin's field theory (Lewin, 1939), they argued that "unfinished work at the end of the week builds up a tension that cannot be released on the next day and is prolonged over the weekend" via an enhancement of rumination (Syrek et al., 2017, p. 228), resulting in less restful sleep. The authors also argued that it may be a matter of time until rumination commences and that this need not happen instantly, resulting in differential stressor–strain effects over time. Applying the allostatic load model, they argued that repeated stress leads to chronic health issues over time. Similarly, Pindek et al. (2019) conducted a meta-analysis of diary studies, using theories like the sleeper effect, initial impact, and stress reaction models to ascertain when strain occurs: prolonged, immediately, or after removal of a stressor (Frese & Zapf, 1988).

In summary, studying fluctuating variables requires designs with numerous time points and robust methods (e.g., multilevel modelling) to model within- and between-person effects. While some studies specified when effects occur, further research grounded in theory is needed to examine various levels of stressor–strain relationships with diverse time lags, thereby advancing our understanding of their temporal dynamics.

Stressor Changes as Predictor

Twelve studies examined the change in stressors across at least two time points to predict strain (see Table S3). This focus on temporal dynamics included transitions between latent stressor profiles (Bujacz et al., 2018; Vaziri et al., 2020), modelling changes or anticipated changes in stressors (DiStaso & Shoss, 2020; Leroy et al., 2021), and exploring whether prior and concurrent stressors influenced present strain (Diefendorff et al., 2019), or whether changes in stressors corresponded to changes in strain (Chen et al., 2018; Moen et al., 2013; Ritter et al., 2016; Sianoja et al., 2018; Su et al., 2022; Tims et al., 2013; Wickrama et al., 2018). For example, Vaziri et al. (2020) studied how the COVID-19 pandemic influenced work–family profile transitions, identifying predictors (e.g., technostress) of negative transition and their effects on job satisfaction. DiStaso and Shoss (2020) showed that anticipated workload decrease moderated the relationship between workload and emotional strain. Diefendorff et al. (2019) revealed that event-level profiles, such as unpleasant customer interactions with emotion suppression, were linked to subsequent event strain. Most studies in this category, however, examined how stressor changes impacted strain changes. For example, Su et al. (2022) used latent change score modelling to show that change in experienced incivility predicted change in negative affect, which in turn influenced change in perpetrated incivility. Tims et al. (2013) explored workload as a mediator between job crafting and strain, implying a link between changes in stressors and strain.

Although various theoretical frameworks informed these studies, no clear pattern emerged. Of the 12 studies, 11 used theoretical frameworks (Leroy et al., 2021, being an exception). Three studies applied COR theory, such as explaining anticipated workload decreases as opportunities for recovery or threats of resource loss if workload increases (DiStaso & Shoss, 2020). The JDC and JDC-S models were each used in two studies (Bujacz et al., 2018; Chen et al., 2018; Moen et al., 2013), but not to explain stressor–strain relationships over time. Other frameworks included ERM for cumulative strain (Sianoja et al., 2018), the challenge–hindrance demand framework for well-being changes (Tims et al., 2013), adaptation theory (Diener et al., 2006) for strain changes due to stressor exposure (Ritter et al., 2016), and event system theory (Morgeson et al., 2015) to explain behavioural changes during disruptive events like COVID-19 (Vaziri et al., 2020).

One study did not mention any temporal information in its hypotheses (Chen et al., 2018), and another did not present any hypotheses (Diefendorff et al., 2019). The remaining ten studies incorporated time-specific hypotheses, specifying whether an increase or decrease in stressors or strain over time was expected (3 studies), whether changes in stressors were expected to relate to changes in strain (5 studies), or whether profile transition will occur over time (2 studies).

Most studies employed longitudinal designs (10 studies) with an average of 3.80 time points (*SD* = 3.05; time lags ranged from 1 month to 1 year). Other designs included a daily diary study with three daily assessments over 10 days and a study combining shortitudinal and longitudinal approaches with three time points spaced 3 to 6 weeks apart. Methods used included SEM (5 studies; e.g., latent change score modelling), multilevel regression (2 studies), (multilevel) mixture modelling (2 studies), as well as single applications of regression, analysis of variance, and transition analysis.

Two studies stood out as exemplary in integrating change into theory, hypothesis development, and methodology. Sianoja et al. (2018) applied the stressor-detachment model (Sonnentag & Fritz, 2015) and ERM to explain why stressors accumulate strain over a year, incorporating the moderating role of detachment. Using a two-wave longitudinal design, they disentangled within-person change from between-person differences with latent change score modelling to test both synchronous effects (e.g., change in stressor from T1 to T2 relates to concurrent change in strain) and lagged effects (e.g., stressor at T1 relates to change in strain from T1 to T2). This approach allowed them to specify time-sensitive effects, enhancing our understanding of the stressor–strain relationship over time. They justified their time lag choice to avoid seasonal effects and to capture long-term impacts, as shown in earlier studies, although further theory-driven arguments could strengthen this rationale.

Su et al. (2022) examined how changes in experienced incivility related to changes in perpetrated incivility. Drawing on self-control depletion theory (e.g., Rosen et al., 2016) and the dual process model (Metcalfe & Mischel, 1999), they found support for an affective pathway, showing that changes in experienced incivility influenced changes in perpetrated incivility via changes in negative affect – particularly among employees with low detachment. Importantly, the study demonstrated that changes in stressors between time points matter beyond the absolute levels of experienced stressors, as individuals experiencing similar stressor levels but differing changes responded differently in terms of strain.

This category of research underscored the value of examining stressor changes over time (e.g., Wickrama et al., 2018). Studies like Su et al. (2022) showed that changes in stressors predicted changes in strain, contributing to reciprocal stressor–strain dynamics. Similarly, Sianoja et al. (2018) highlighted how change perspectives can offer fresh insights into classic longitudinal relationships like synchronous effects (Zapf et al., 1996). Both studies employed latent change score modelling, thereby demonstrating its potential to advance the understanding of stressor–strain dynamics (see also Ritter et al., 2016).

Additionally, three studies used person-centred approaches, such as mixture modelling and profile transition analysis, to explore stressor–strain relationships (Bujacz et al., 2018; Diefendorff et al., 2019; Vaziri et al., 2020), emphasising the importance of shifts in stressor patterns. Macro-level events, such as the COVID-19 pandemic, also provided opportunities to explore how external changes drive stressor–strain dynamics (Leroy et al., 2021; Vaziri et al., 2020). Other studies in this category underlined that past experiences in stressors are a unique part in explaining present experiences of stressor–strain relationships (Diefendorff et al., 2019; DiStaso & Shoss, 2020). In summary, this research category highlighted the importance of examining changes in stressors and strain, going beyond mean-level analyses to deepen our understanding of stressor–strain dynamics over time.

Temporal Trajectories

Twenty-six studies focused on temporal trajectories of job demands, strain, or both (see Table S4), examining how one or multiple variables developed over time. Examples of research questions included whether the effects of job demands on strain accumulated over time (e.g., Igic et al., 2017), whether changes in job demands correlated with changes in strain (e.g., Kramer & Chung, 2015), or whether a third variable, like job demands, moderated strain trajectories (e.g., French & Allen, 2020; Reh et al., 2021).

Theories used to derive these questions and hypotheses varied widely. Conservation of resources theory was often cited to explain resource gains or losses due to job demands or strain (e.g., Perko et al., 2017; Rodríguez-Muñoz et al., 2020). Other frequently applied frameworks included the ERM and allostatic load model (e.g., French & Allen, 2020; Horan et al., 2021). For example, Somaraju et al. (2022) used COR theory to discuss resource threat spirals leading to resource loss. Similarly, Wickrama et al. (2018) applied the transactional model of stress to link job insecurity to strain with primary appraisal as a mediator culminating in health impairment.

Four studies did not consider temporal information in their hypotheses, six studies lacked relevant hypotheses entirely, and 16 studies included time-specific hypotheses. Many studies without explicit hypotheses reflected the exploratory nature of statistical modelling of temporal trajectories. When a temporal information was included, hypotheses typically addressed relationships between job demands and strain trajectories, the form and direction of these trajectories, synchronous or delayed effects, and the timeframes or points when effects occur.

This focus on time in study design typically required "high intensity" approaches, with the number of time points ranging from three to 37 ($M = 9.04$, $SD = 8.97$). Common methods included person-centred approaches (9 studies; e.g., growth mixture modelling or latent class growth analysis), combinations of SEM and trajectory methods (8 studies; e.g., latent or discontinuous growth curve modelling), and multilevel growth or path modelling (4 studies).

Two articles with strong rationales for a temporal perspective illustrated this category. Halbesleben et al. (2013) examined emotional exhaustion and performance trajectories during furloughs. Using COR theory, they linked resource threats (job insecurity before the furlough) to resource loss (furlough start), predicting increased emotional exhaustion and decreased job performance. Their four-time-point design (two before, two after furlough) highlighted how transitions in stressors affected strain trajectories, offering a new temporal perspective on furloughs as economic stressors.

Igic et al. (2017) used the JDC, stress reaction and allostatic load models to explore persistent work strain. Their 10-year longitudinal study (six waves) showed how work characteristics related to somatic complaints, rumination, and job satisfaction. Using growth mixture modelling, they identified "history of exposure" clusters, showing that unfavourable work characteristics led to higher strain through cumulative and chronic effects. Their work enriched the JDC model by detailing how work characteristics evolved over time to influence strain. In summary, studying temporal trajectories often involved numerous time points and sophisticated statistical methods, with the temporal dimension frequently integrated into hypothesis development.

Time Lags and Directionality

Extensive research on the significance of time lags and effect directionality has greatly advanced our understanding of stressor–strain relationships. Our review covers 46 articles encompassing 49 studies, fitting this category (see Table S5). Of these, 27 studies used longitudinal designs ($M = 2.78$ time points; $SD = 2.21$, range: 2-13), with the majority (25 studies) employing two or three time points. Notable exceptions include Hatch et al. (2019) and Tuckey et al. (2015), with 13- and 6-wave designs, respectively. Additionally, nine studies used daily diary designs with an average of 21.44 time points (*SD* = 10.70; range: 6-37), six applied a shortitudinal design (*M* = 3.67, *SD* = 1.51; range: 2-6), and one adopted an event sampling method with 40 time points. The collection also included four meta-analyses and two theoretical papers. While diary and shortitudinal designs have become popular in occupational health research, traditional longitudinal studies with time lags of 4 weeks to 4 years predominated in this category of time lags and directionality.

For studies with multiple measurement points, we assessed whether authors justified their chosen time lags. Nine studies cited prior research using similar time intervals but lacked theoretical or methodological rationale. For example, Dicke et al. (2018) anchored their 2-year lag in empirical findings from Aloe et al. (2014) and Skaalvik and Skaalvik (2014) on long-term job demands and outcomes like emotional exhaustion. Similarly, Matthews and Ritter (2019) argued for a 1-month lag in workplace incivility research, citing prior studies on temporal resolution. Other studies (e.g., Dettmers, 2017; Vahle-Hinz, 2016) justified shorter lags to reduce participant attrition, a practical concern also noted by Vander Elst et al. (2014).

Some studies provided a clear methodological rationale. Elovainio et al. (2015) noted that autoregressive effects weaken over repeated follow-ups, and cross-lagged effects often peak within specific timeframes, making varied timeframes susceptible to inconsistent associations. While they used fixed follow-up periods, they acknowledged that more measurement points help mitigate biases caused by temporal stability differences between job characteristics and well-being. Hershcovis et al. (2018) mentioned that time lags help reduce common method bias. Many studies justified time lags as sufficient for hypothesised processes to occur while avoiding excessive intervals that could introduce bias or distortions.

Two papers cited Dormann and Griffin (2015) or Dormann and Van De Ven (2014), recommending short yet adequate intervals in longitudinal studies to capture changes effectively. Crane and Searle (2016) conducted a pilot study to determine an appropriate lag, selecting a 3-month interval for their main study. Similarly, Vander Elst et al. (2018) used 2- and 3-year lags, referencing Ford et al. (2014)'s findings that stressor effects on strain peak around 3 years.

The most frequently used theories included COR theory (13 studies), the transactional model of stress (11 studies), JDR theory (6 studies) and the JDC model (5 studies). Thirty-five out of 49 studies included time-specific hypotheses, mostly proposing positive or negative time-lagged effects between stressor and strain (28 studies) or reciprocal relationship (4 studies). For example, Dudenhöffer and Dormann (2013) used the transactional model of stress to link acute, temporary and chronic stressors to short-, mid-, and long-term stress reactions. Häusser and Mojzisch (2017) extended the JDC model by integrating self-regulation (Baumeister et al., 1998) and self-determination theories (Deci & Ryan, 1985) to explore dynamic processes linking job demands, control, and well-being. Kern and Zapf (2021) applied the challenge–hindrance demand framework to argue that job demands exert lagged effects on employee strain, using the transactional model as a foundation.

In diary and event sampling studies (10 studies), specific time lags were rarely discussed or justified, although it is argued that the variables typically vary daily. Hypotheses were consistently formulated at the day level. Most diary studies (6 studies) used three daily measurement points - in the morning, after work, and bedtime - across 2 days (1 study), 5 days (3 studies), or 10 days (4 studies). One study extended this to 35 to 40 days in an experimental setting with isolated teams (Somaraju et al., 2022). Two studies measured heart rate variability (Shockley & Allen, 2013; Vahle-Hinz et al., 2014), and only one controlled for the day of measurement, including sine and cosine (Gabriel et al., 2021). While no studies reported between-person effects, some included cross-level interactions, and half included autoregressive effects to measure changes within a day or to the following morning. Reversed causation, testing the effects of strain on stressors, was addressed in only two studies

(Dudenhöffer & Dormann, 2013; Vahle-Hinz et al., 2014), with the former testing it in a separate 2-week lag study.

The directionality of relationships and justification for time lags depended on the constructs, study context, and theoretical framework. While reasons for chosen time lags ranged from methodological to practical, the time dimension remains crucial for capturing the interplay between job demands, resources, and strain. This research advances theoretical understanding in occupational health and offers practical insights for interventions and policies to reduce strain.

Variation Across Time and Chaotic Fluctuations

Aligned with the literature on emotion dynamics (Kuppens & Verduyn, 2017), stressors are expected to fluctuate over time, making fluctuation a key characteristic of the stressor time perspective. This category focuses on studies examining temporal stressor characteristics such as variation, instability, or inertia to predict strain, differing from typical within-person relationships by analysing fluctuations at the between-person level.

Initially, 13 studies were identified as possibly fitting this category (see Table S6). However, most did not investigate temporal fluctuations or variations of stressors as between-person characteristics. For example, Clark et al. (2021) examined within-person fluctuations of workaholism, while Elfering et al. (2018), Gorgievski et al. (2019), and Hershcovis et al. (2017) did not assess temporal variation or chaotic fluctuations. Other studies, such as Matthews et al. (2014), Mauno et al. (2015), and Meier and Gross (2015), focused on time lags rather than variations or fluctuations, and Rantanen et al. (2012) explored systematic variations in trajectories over time. Peng et al. (2015) analysed self-efficacy fluctuations as a moderator in the stressor–strain relationship, reporting that high but variable self-efficacy buffered the effects of job responsibility on depression, anxiety, and sleep quality. However, they did not examine stressor fluctuations directly.

According to our review, only one study fits this category. Rosen et al. (2020) examined challenge stressor fluctuations as a predictor of anxiety and, through stressor anticipation and challenge or hindrance appraisals, experienced stress. Using multilevel path analysis, they conducted two studies: a weekly diary study over 8 weeks and a three-wave study with 3-week intervals. Grounded in the challenge–hindrance demand framework and transactional model of stress, they argued that greater fluctuation reflects situational uncertainty, exacerbating threat appraisal. Their findings showed that week-to-week fluctuations in challenge stressors were positively related to anxiety, and indirectly to stress via reduced anticipation, which led to lower challenge appraisal and higher hindrance appraisal. In contrast, high and stable challenge stressors were negatively related to stress through increased anticipation, higher challenge appraisal, and reduced hindrance appraisal.

Rosen et al. (2020) highlighted the relevance of temporal change characteristics, such as fluctuation in stressor–strain relationships. Similarly, Peng et al. (2015) demonstrated that fluctuations in person-related moderators, like self-efficacy, can influence these relationships. However, the limited research in this area underscores the need to explore other temporal characteristics, such as instability and inertia, which have proven important in emotion dynamics but remain underexplored in occupational stress research.

Discussion

This systematic review examined how time is theoretically and empirically incorporated in stressor–strain studies, complementing earlier reviews, meta-analyses, and theoretical work on time in the context of work and stress (e.g., Dormann & Griffin, 2015; Ford et al., 2014; Ohly et al., 2010; Spector & Meier, 2014). We focused on identifying time-related categories in the literature and highlighting theoretical and empirical gaps. Below, we summarise key findings on what is known and unknown about time in stressor–strain relationships, discuss how time can be better integrated into theory development and frameworks, and address challenges for future research in this area.

Summary of Main Findings

The studies included in this review employed various theoretical models to investigate stressor–strain relationships, with COR theory, the transactional model of stress, JDC-S model, and ERM being the most common. However, most research approached time-related questions from a methodological rather than theoretical perspective (e.g., Elovainio et al., 2015; Hershcovis et al., 2017), and some widely used frameworks (e.g., JDC, JDC-S) offered limited support for addressing the role of time in the stress process.

Notable exceptions showed that certain theories inherently support time-related stressor–strain relationships. For example, Syrek et al. (2017) used the allostatic load model to explain cumulative effects of unfinished tasks on sleep impairment and Somaraju et al. (2022) tested the second corollary of COR theory on resources spirals. Some studies combined theories to develop time-specific hypotheses, such as Igic et al. (2017), who linked the JDC model with stressor reaction and allostatic load models to explore job characteristics over time. Similarly, Rosen et al. (2020) integrated the challenge–hindrance demand framework with the transactional model of stress to investigate how fluctuations in challenge stressors exacerbate threat appraisal. Combining theories to derive time-specific hypotheses effectively addresses the limitations of purely methodological justification and provides a stronger theoretical foundation for studying temporal stressor–strain processes.

The most intriguing finding of this review is the identification of five time-related categories that illustrate the various ways in which time is studied in stressor–strain research. First, studies with *multilevel designs* and multiple time points (e.g., daily diary studies) enable analysis at both within-person and between-person levels, although most focus on within-persons relationships. These studies examine how changes in stressors within individuals drive relationships, while the few that model both levels simultaneously highlight the strength of such designs in distinguishing between short-term, unstable effects from long-term, stable effects (Raudenbush & Bryk, 2002). Within-person analyses provide insights into concurrent effects (e.g., immediate strain reactions to stressor exposure; e.g., Pindek et al., 2022) and lagged effects (e.g., effects of stressors during working hours on strain in the evening or following morning; e.g., Baethge & Rigotti, 2013; Park & Kim, 2019). By considering time-related changes in social environments (e.g., being at work, being at home), these studies also shed light on socially time-dependent effects, such as recovery during or after work.

The second category, *stressor changes as predictor*, consists mostly of longitudinal studies examining how changes in stressors predict (changes in) strain. These studies highlight that not only stressor levels but also changes therein significantly impact strain (e.g., Su et al., 2022), underscoring the need to focus on stressor–strain *changes* rather than on static levels. This would speak for incorporating past stressor experiences into stressor–strain research (e.g., DiStaso & Shoss, 2020).

The third category, *temporal trajectories*, focuses on how variables develop over time, using measurement-intensive designs and statistical approaches like mixture modelling. This category emphasises the importance not only of whether stressors change but also of how they change over time. Some theoretical frameworks provide predictions about the nature of such changes. For example, COR theory explains resource gains or losses due to job demands or strain (e.g., Halbesleben et al., 2013; Somaraju et al., 2022), while the ERM and allostatic load model predict strain evolution over time (e.g., French & Allen, 2020; Horan et al., 2021). The allostatic load model, in particular, offers a basis for understanding trajectories and how deviations from normal patterns can impair health.

The fourth category, *time lags and directionality,* includes longitudinal studies emphasising the importance of time intervals and of the direction of stressor–strain relationships (e.g., causal, reverse, or reciprocal). Findings show that time between measurements is critical for capturing the complex interplay between stressors and strain. However, most studies justify time lags on practical grounds (e.g., reducing participant attrition or conformity with earlier research) rather than theoretical reasoning (exceptions include Kern & Zapf, 2021). Consistent with Guthier et al.'s (2020) meta-analysis, this research underscores the inherently reciprocal nature of stressor–strain relationships.

The fifth category, *variation across time and chaotic fluctuation*, suggests that stressors can also be classified by their temporal patterns. Rosen et al. (2020) investigated the impact of fluctuating challenge stressors over time, using the challenge–hindrance demand framework and the transactional model of stress. Their findings suggest that stressor instability may significantly affect strain outcomes. However, as Rosen et al. (2020) was the sole study in this category, further research is needed to explore the effects of temporal stressor patterns on strain.

What Does a Time-Sensitive Theory on Stressor–strain Relationships Need?

This review reveals that numerous studies address the role of time in stressor–strain relationships supported by advanced methodological approaches. However, there remains a significant gap in well-grounded theoretical frameworks and time-specific predictions for these relationships. Too often is time approached methodologically rather than theoretically. Our review identifies seven key areas for future research to develop a time-sensitive theory of stressor–strain relationships.

1. Investigate similarities and differences of short-term (i.e., fluctuating) and long-term (i.e., stable) effects: Multilevel studies typically focus on short-term within-person effects using daily diary designs, recording fluctuations over days or weeks. However, within- and between-person effects over longer intervals (e.g., months or years) remain underexplored. To better integrate time, future research could test and theorise expected effects at both levels and ascertain whether these effects differ depending on the temporal scope, such as comparing outcomes over days, weeks, months, or years.

2. Consider effects within or between time-related changes in the social environment (e.g., effects of stressors on leisure time): This topic has received significant attention, particularly in recovery research. The literature shows that work experiences may spill over into non-work contexts, with stressors potentially delaying or inhibiting recovery. While this area is well-researched and supported by ample evidence (see Sonnentag et al., 2022), it remains important to examine effects within (e.g., during the workday) and between (e.g., work to leisure, workweek to weekend) contexts. This approach is key to understanding how distinct social environments, following a temporal rhythm (e.g., work, leisure, weekends, holidays), influence recovery.

3. Highlight the effect of change in stressors on strain: This topic highlights that not only the level of a stressor but also its change over time (e.g., increasing or decreasing) significantly impacts strain outcomes. While within-person studies often consider changes from an individual's mean level to be influential, this perspective is not always emphasised (see McCormick et al., 2020). To advance the field, research should explore expected stressor changes. For instance, adaptation theory (Diener et al., 2006) suggests a return to baseline strain after stressor increases or decreases, a concept applicable to stressors (Matthews & Ritter, 2019; Peter et al., 2025; Ritter et al., 2016). Time-sensitive theories must address not only how stressor levels affect strain but also how stressor changes influence it and why.

4. Pay attention to the past: Research on stressor change highlights the need to consider past or average stressor experiences as reference points for evaluating strain effects. To fully address changes in stressors, theories must go beyond explaining norm-oriented effects (e.g., high vs. low levels) and instead predict reference-based effects, considering how an individual's starting level influences outcomes. Additionally, the role of anticipated future changes in stressors remains underexplored, requiring further research to understand how these expectations affect current strain (see DiStaso & Shoss, 2020, for an exception).

5. Determine what temporal trajectories should look like: When considering the temporal trajectories of stressors and strain, time-sensitive theories must determine what constitutes a “normal” or “healthy” development over time. Key questions include: Over a period of 10 years, what type of trajectory of time pressure would give rise to health concerns? What trajectory of emotional exhaustion predicts burnout? How do job demands shape strain trajectories, including initial levels, changes, or time-lagged effects? Here, the allostatic load model (McEwen, 1998) provides a foundation for understanding harmful deviations from normal trajectories. A major challenge lies in gaining further empirical insights into naturally occurring trajectories while also establishing clear theoretical expectations.

6. Investigate the time lag needed to detect relationships and consider different directionalities: Convincing evidence of causal and reverse effects in stressor–strain relationships highlights the need for theories to explain why both directions are possible. Job demand-resources theory is an example of addressing this time-related requirement. However, the question of what comes first – the stressor or the strain – remains unresolved. Alternatively, this question may be irrelevant, as research on workplace incivility suggests a cyclical pattern, where the perpetrator may also be a recipient of earlier incivility (Foulk et al., 2016). Additionally, more theoretical guidance is needed to explain varying effects based on time lag and directionality (e.g., Ford et al., 2014).

7. Consider temporal patterns of stressors and their effects on strain: The study of temporal patterns in stressors, such as variability, instability, and inertia, is lamentably underexplored, with only one study examining the effects of challenge stressor fluctuations across time points and lags (Rosen et al., 2020). While such data are available in studies with multiple measurements, these patterns remain largely unexamined, posing a challenge for theory and research. Additionally, most studies focus on changes in strain alone. Examining changes in both stressors and strain would yield more profound insights into how changes between the two variables relate and how their temporal trajectories and patterns evolve over time.

Some Further Challenges

This review highlights several challenges for future research. First, time lag selection is often based on practicality rather than on theoretical reasoning, although exceptions exist (e.g., Biron & van Veldhoven, 2016; Igic et al., 2017; Rosen et al., 2020). While general assumptions may not always be feasible, studies would benefit from rigorously defined, theory-driven time intervals to capture critical periods of change or stability in stressor–strain relationships. These time lags may vary across individuals, as work-related stressors and strains are experienced differently, making "average" effects insufficient. High temporal resolution (e.g., intensive designs with many measurement points) is essential to map interindividual differences and determine how strongly and for how long stressors influence strain. Person-centred studies, temporal trajectory analyses, and continuous time modelling can help identify outcomes that require shorter or longer timeframes for stressors to have harmful effects. Additionally, time lags should coincide with natural temporal rhythms, such as a workweek or the transition between the end of a workday and evening, particularly in recovery research.

Second, the studies reviewed are context-specific and on the level of the individual. They often overlook how, for instance, cultural differences and social contexts influence stressor–strain relationships over time. Expanding research to diverse cultural settings and the context of teams as a social reference (e.g., Vahle-Hinz et al., 2024) might yield more generalisable insights. Additionally, more theoretical work is needed to uncover psychological correlates (e.g., adaptation, anticipation, uncertainty, recovery opportunity) of temporal processes. Theoretical explanations should clarify whether these correlates have direct effects, moderate relationships between levels and fluctuations, or interact through specific psychological mechanisms.

Finally, while individual stressors are studied, the interaction of multiple stressors and their cumulative impact over time, as well as individual variability in experiencing and processing stressors, is often neglected. Examining these interactions could shed light on the complexity of stress responses. Moreover, personal factors such as resilience, personality traits, and past experiences likely shape these temporal patterns and merit further investigation.

Critical Reflection

While this article systematically identifies and examines time-related theorising and methodologies in stressor–strain studies, it has three notable limitations. First, as only studies from four journals were included, the review is not exhaustive, excluding relevant studies published elsewhere. However, the aim was not to provide a comprehensive review but to assess how time is theoretically addressed in articles focused on occupational health and stress, which justified limiting the scope to peer-reviewed journals emphasising theory development.

Second, this narrative review does not include statistical analyses, as seen in meta-analytical reviews (Siddaway et al., 2019). However, it systematically categorises studies according to their theoretical and methodological approaches, offering a structured synthesis of how time is theoretically and empirically integrated into stressor–strain research.

Finally, most studies reviewed were conducted in the Global North, likely involving WEIRD samples (Henrich et al., 2010), limiting global generalisability. Additionally, the review included articles published between 2012 and 2021, as the work began in early 2022. Despite these limitations, the findings provide a starting point for understanding how time is currently considered in work-related stress and health research and where further theoretical and empirical development is needed.

Conclusion

Interest in stressor–strain research requiring multiple time points has grown significantly over the past decade, with reviews and meta-analyses emphasising the importance of accounting for time. However, most focus was on methodological approaches, largely ignoring theoretical reasoning about time. This systematic review identifies five time-related categories in the occupational stress literature, identifies theoretical and empirical gaps, and makes recommendations for integrating time into theorising and research. The aim is to stimulate theory development on the relevance of time in the context of work and stress.

Chapter 5 – General Discussion

The overarching goal of this dissertation was to investigate the empirical and theoretical understanding of temporal dynamics in stressor–strain relationships and promote the role of time in occupational stress research and theory development from a time-sensitive perspective. By means of two empirical studies and one systematic literature review, I examined how temporal dynamics shape stressor–strain relationships, assessed the adequacy of existing occupational stress theories in accounting for time-related effects, and advanced a time-sensitive perspective in both empirical research and theoretical development within occupational stress. What follows is a brief summary and integration of the main findings of the three studies. Next, I will discuss the theoretical implications and the strengths and limitations of this dissertation upon which directions for future research will be derived. Finally, I will describe the practical implications that can be derived from the findings of this dissertation.

Summary and Integration of Findings

First, in addressing Research Objective 1, that is, to examine to which extent existing occupational stress theories account for time-related effects in stressor–strain research, the systematic literature review revealed that existing occupational stress theories often treat time as a background variable rather than an integral component. Some theories acknowledge dynamic processes, for example, adaptation theory (Diener et al., 2006) and allostatic load model (McEwen, 1998), for understanding trajectories and health-impairing changes from baselines and normal patterns. Further, the combination of theories can serve as a solution to theorize on time-sensitive effects, as did Igic et al. (2017) when linking the JDC model (Karasek, 1979) with stressor reaction (Frese & Zapf, 1988) and allostatic load models (McEwen, 1998) to explore work characteristics over time. However, most theoretical reasoning lacked explicit temporal mechanisms or assumptions, highlighting a theoretical gap in explaining how stressor–strain relationships evolve over time. Additionally, Study 1 demonstrated that the post hoc application of ERM (Meijman & Mulder, 1998) and COR theory (Hobfoll, 2001) is a suitable way to explain the well-being relevance of time pressure trajectories as current theories do not propose specific trajectory classes. Finally, the a priori use of adaptation theory (Diener et al., 2006) and idea of loss spirals in COR theory (Hobfoll, 2001) made it possible to derive propositions regarding adaptive changes and disruptions therein (Study 2).

Second, in line with Research Objective 2, Study 1 and Study 2 demonstrated that time pressure and strain outcomes exhibit meaningful temporal patterns that challenge static assumptions (e.g., Sonnentag & Bayer, 2005), herewith exploring and expanding well-known stressor–strain relationships from a time-sensitive empirical and theoretical perspective. Study 1 identified distinct intra-week trajectories of time pressure, that demonstrate interindividual differences in natural ups and downs of the stressor within a given time frame, and their associations with well-being, suggesting that fluctuations, and not just mean levels, of time pressure matter for employee health. Here, the ERM (Meijman & Mulder, 1998) and COR theory (Hobfoll, 2001) served as theoretical basis to explain distinct temporal effects of time pressure on well-being. Building on the theoretical reasoning of adaptation theory (Diener et al., 2006) and COR theory (Hobfoll, 2001), Study 2 found that high levels of time pressure lowered the adaptive change in emotional exhaustion, and vice versa, resulting in reduced adaptation across eight weeks. This broadens our understanding of reciprocal change processes between time pressure and emotional exhaustion over time, indicating dynamic, bidirectional influences rather than one-way causal chains.

Finally, approaching Research Objective 3, the systematic literature review synthesized how time has been conceptualized and empirically addressed in stressor–strain research. It showed that the interest in research requiring multiple time points has extended intensively, while the majority of studies focused on (advanced) methodological approaches to time, such as systematic change patterns of stressors and strain (e.g., Tims et al., 2013), time-lagged effects and their directionality (e.g., Dudenhöffer & Dormann, 2013), rather than theoretical reasoning about time (for exceptions, see e.g., Igic et al., 2017; Rosen et al., 2020; Somaraju et al., 2022; Syrek et al., 2017). This reinforces the need for more coherent time-sensitive theorizing and theory-driven approaches to examining time-related effects in stressor–strain research. Further, the review identified five time-related categories which represent different ways of how time was considered in literature during the past decade, highlighting diverse opportunities of how time can be considered in empiricism and theory. These categories illustrate the multifaceted nature of time in stressor–strain literature, ranging from analyzing stressor and strain progressions to focusing on causal or reciprocal effects over time. This underscores the potential for more nuanced investigations into how temporal characteristics, such as trajectories, time lags, and directionalities, shape the stressor–strain relationship. By systematically mapping these temporal considerations, the review offers a foundation for advancing more integrative, time-sensitive theorizing.

Taken together, the findings underscore that both empirical and theoretical occupational stress research must move beyond static snapshots to account for the unfolding, reciprocal, and context-sensitive nature of stressor–strain processes over time. This dissertation contributes to that shift by demonstrating how temporal dynamics shape workplace experiences and outcomes, and by calling for stronger integration of time in occupational stress theories.

Theoretical Implications

Following past and recent calls to acknowledge and incorporate time in work-related stress research as well as occupational stress theories (Aguinis & Bakker, 2021; Navarro et al., 2015; Shipp & Cole, 2015; Sonnentag, 2012; Sonnentag et al., 2024; Sonnentag & Meier, 2024), this dissertation advances the empirical and theoretical understanding of temporal dynamics in stressor–strain research through a set of interrelated theoretical implications that address gaps identified in literature und uncovered through empirical investigations.

Collectively, these implications point toward the relevance of dynamic, temporally embedded theorizing that captures how stressors and strain unfold, interact, and evolve over time. Herewith, I hope to promote the role of time in occupational stress research and theory development from a time-sensitive perspective.

Combining Theories to Conceptualize Dynamic Interplays in Stressor–Strain Relationships

This dissertation advances the empirical and theoretical understanding of temporal dynamics in stressor–strain research by addressing the limited attention given to time in occupational stress theorizing. The systematic literature review revealed that most occupational stress research treat time as a background condition rather than as an integral component to their theory development (exceptions include Somaraju et al., 2022; Syrek et al., 2017), with considerations about time primarily driven by methodological decisions, such as the number and length of time lags (e.g., Elovainio et al., 2015; Hershcovis et al., 2017). Widely used theoretical frameworks, including the JDC and JDC-S models (Johnson & Hall, 1988; Karasek, 1979), provide limited support for incorporating the role of time in the stress process. Some theories, such as the allostatic load model (McEwen, 1998) and adaptation theory (Diener et al., 2006), do acknowledge change processes, yet explicit propositions about when effects are strongest, how long they persist, and how they evolve over time remain rare. This gap constraints the explanatory power of stressor–strain research, particularly when attempting to account for when and how effects unfold within and between stressors and strain.

Addressing this gap, the present dissertation contributes to a time-sensitive approach to theoretical frameworks anchored in stressor–strain research, advancing research on temporal patterns of a stressor (Study 1) and reciprocal change effects between stressor and strain (Study 2) over time. Moving the field from time as a statistical feature to time as a conceptual driver, findings from the systematic literature review show that combining theories, such as integrating the JDC model (Karasek, 1979) with the allostatic load model (McEwen, 1998; for an example, see Igic et al., 2017), can bridge temporal blind spots in theorizing, provide richer conceptualizations of change processes, and strengthen the theoretical basis for studying temporal stressor–strain processes.

Building on this, findings from Study 1 illustrate that the post hoc application of frameworks such as the ERM (Meijman & Mulder, 1998) and COR theory (Hobfoll, 2001) can effectively explain the well-being relevance of distinct time pressure trajectories within a workweek from a theoretical standpoint. Similarly, the a priori application of adaptation theory (Diener et al., 2006) and COR theory (Hobfoll, 2001), specifically the proposition of resource loss spirals, in Study 2 enabled the derivation of theoretical propositions regarding both adaptive change and disruptions therein. This showed that multiple temporal processes, such as the gradual return to baseline levels and resource-draining effects in the form of spiraling, can coexist. This complexity suggests that combining complementary theories may be particularly suitable for capturing the interplay between adaptive mechanisms and spiraling processes. As such, pairing process models like COR theory (Hobfoll, 2001) with trajectory concepts from adaptation theory (Diener et al., 2006) offers a nuanced description of how stressors and strain dynamically co-evolve over time.

Recognizing (Natural) Fluctuations as Theoretically Meaningful

This dissertation enhances our understanding of the natural evolution of stressors and strain by investigating their temporal patterns. Across Studies 1 and 2, and in line with the systematic synthesis of existing literature done in the review, the findings demonstrate that stressors and strain are not static experiences but temporally unfolding (interrelated) processes. Building on prior research on clusters of temporal trajectories in health and well-being (Arnold & Rigotti, 2021; Kinnunen et al., 2017; Lövgren et al., 2014), Study 1 identified distinct intra-week trajectories of time pressure that were closely linked to well-being, challenging the notion that mean levels sufficiently reflect the stress experience. These findings highlight that not only health and well-being indicators but also work characteristics follow systematic temporal patterns. Such insights offer valuable guidance for understanding and supporting employee well-being in the context of changing time pressure. Further, Study 2 revealed that emotional exhaustion and time pressure returned to baseline levels across eight weeks. This is in line with previous research on natural adaptation processes in well-being and stressors in the organizational context (Henderson et al., 2023; Matthews et al., 2014; Matthews & Ritter, 2019; Ritter et al., 2016). Additionally, high levels of time pressure also disrupted adaptive changes in emotional exhaustion over time, and vice versa, indicating the simultaneously occurring temporal processes of adaptation and resource spiraling. This provides valuable insights into the temporal process of how time pressure and emotional exhaustion relate in a health-impairing manner (i.e., via reduced adaptation). Overall, the findings of Study 1 and 2 illustrate that the development of a stressor and strain over time is central to understanding stressor–strain relationships.

However, traditional theories, including the JDC model (Karasek, 1979), often conceptualize stressor–strain relationships as static or linear. The present findings advance this perspective by highlighting the relevance to embed time-sensitive perspectives that account for within-person fluctuations, temporal trajectories, and adaptive change. This includes acknowledging that stressors may follow patterns of resource gain and loss, as predicted in COR theory (Hobfoll, 2001), and that change processes may align with the logic of the allostatic load model (McEwen, 1998) and adaptation theory (Diener et al., 2006). By treating intraindividual temporal variability as an integral part of the process through which stress affects health, occupational stress theorizing can move beyond averages to capture the nuanced ways in which stressors and responses unfold. Theoretical models should therefore shift focus from whether stressors change to how they change over time and how that, consequently, affects strain. This includes integrating constructs such as stressor instability, stressor and strain accumulation, and trajectory form directly into theorizing. As the three studies of this dissertation show, adaptation theory (Diener et al., 2006), allostatic load model

(McEwen, 1998), and COR theory (Hobfoll, 2001) offer strong conceptual grounding for this integration, as they address disrupted adaptation, cumulative load, and recovery, and recognize natural fluctuations of stressors and strain as theoretically meaningful.

Integrating Reciprocal and Feedback Processes into Occupational Stress Research and Theories

This dissertation advances the theoretical understanding of bidirectional relationships in occupational stress processes by demonstrating that stressor–strain relationships are not static, one-way chains, but dynamic systems that adapt, accumulate, or recover over time interrelatedly. Study 2 provided empirical evidence for reciprocal influences between time pressure and emotional exhaustion across eight weeks, showing that high time pressure can disrupt adaptive processes in emotional exhaustion, while strain levels can in turn influence subsequent perceptions of time pressure. Relatedly, the review identified the directionality of effects as one way in which time is addressed in current stressor–strain literature, yet noted that these dynamics remain under-theorized.

Traditional stressor–strain models often assume a unidirectional path from stressor to strain. However, the present findings of Study 2, alongside emerging theoretical developments such as the updated version of the JD-R theory incorporating resource loss and gain spirals (Bakker & Demerouti, 2017) underscore that strain can exacerbate or maintain stressors. This demonstrates not only the reciprocal relationship between stressors and strain, consistent with meta-analytic evidence (Guthier et al., 2020) and longitudinal studies (e.g., Ford et al., 2014), but also highlights how such dynamics can create feedback loops between them. The findings supported adaptation theory's principle of adaptive changes to baseline levels over time (Diener et al., 2006) as well as the idea of resource loss (Hobfoll, 2001) as time pressure disrupts the return of emotional exhaustion to baseline levels, due to the simultaneous resource-draining effect of time pressure on emotional exhaustion, and vice versa. However, they did not provide evidence for a continuous, unending loss spiral as proposed by COR theory (see also Ford et al., 2023; Somaraju et al., 2022, for similar conclusions). This suggests that spiraling may arise only under specific temporal or contextual conditions, underscoring the need for more refined research and theorizing on (reciprocal) stressor–strain relationships.

Recent literature supports this move toward time-sensitive, bidirectional theories. For instance, a meta-analysis of daily diary studies by Pindek et al. (2024) integrated concurrent and lagged effects into the challenge–hindrance demand framework (first introduced by Cavanaugh et al., 2000), revealing that same-day stressor–strain associations were typically stronger than lagged effects. The authors discussed that the temporal pattern of effects may differ by stressor type. Aligning with insights on feedback processes, such findings indicate that the timing and persistence of reciprocal effects are not uniform across contexts, and theory developments must reflect this variability. Even if theories cannot specify exact time points at which effects occur, scholars should articulate expectations regarding the pace of change, its duration, and the conditions under which spiraling and feedback loops emerge, intensify, or resolve.

Overall, this dissertation reinforces that empirical and theoretical progress in stressor–strain research hinges on our ability to theorize time-sensitively. By highlighting the theoretical value of temporal concepts, such as trajectories, adaptation, and spiraling, I hope to stimulate a more time-sensitive understanding of occupational stress. Future theorizing should aim to model temporal complexity explicitly and guide empirical implementations accordingly.

Strengths, Limitations, and Directions for Future Research

The present dissertation has several strengths and limitations upon which directions for future research can be derived. Some of these will be discussed in more detail in the following paragraphs. A major strength of this dissertation relates to the in-depth consideration of the role of temporal dynamics in current stressor–strain research and well-established occupational stress theories as well as diverse approaches to time's inclusion in empiricism and theory. Following the urging calls of scholars to integrate the context of time in theorizing and empirical research (Aguinis & Bakker, 2021; Roe, 2008; Shipp & Cole, 2015), this dissertation provides two time-sensitive perspectives to an already well-established stressor–strain link (i.e., time pressure and well-being in Study 1; time pressure and emotional exhaustion in Study 2), hereby taking two empirical paths to approach temporality: (1) trajectories of a stressor over one workweek and (2) reciprocal dynamics between a stressor and strain with regard to their adaptive evolution over time. Importantly, this dissertation assesses the use of theories in the context of temporal effects as well as application of theories to explain time-related effects, specifically applying COR theory (Hobfoll, 2001) and ERM (Meijman & Mulder, 1998) to identify the well-being relevance of stressor trajectories and using adaptation theory (Diener et al., 2006) and COR theory (Hobfoll, 2001) to explain disrupted adaptive changes in a stressor and a strain over time. By systematically synthesizing state-of-the-art research on stressor–strain relationships in the literature review, this dissertation examines how time was previously considered in theory development and methodological approaches and identifies remaining empirical and theoretical gaps needed to be addressed by future research. Building on the review's findings, this dissertation offers propositions on what theories of stressor–strain relationships need to be sensitive to time. Overall, the integration of the two empirical studies and systematic literature review examines the adequacy of currently used occupational stress theories with regard to time-sensitive theorizing.

A second major strength of this dissertation refers to the diversity of advanced methodological approaches related to statistical analyses and study designs, with the aim to consider and model temporal dynamics of work-related variables and their (reciprocal) relationship. While Study 1 takes a person-centered approach, applying latent class growth analyses and manual stepwise Bolck–Croon–Hagenaars approach to identify distinct trajectory classes of time pressure as a major work-related stressor and how they relate to well-being indicators ending and beginning a workweek, Study 2 took a variable-centered approach. Here, uni- and bivariate latent change score modeling were employed to assess adaptive change processes of both a stressor and a strain and their impact on each other over time, providing a bidirectional perspective on their relationship. Both statistical approaches are robust tools for analyzing temporal dynamics, hopefully encouraging the field to adopt temporal modeling strategies to better capture the dynamic nature of workplace stressors and employee outcomes.

Third, this dissertation made varied use of within-person study designs with multiple time points across two different time frames, that is, daily data within one workweek (Study 1) and weekly data over eight consecutive workweeks (Study 2). This diversity in time frames and lags offers the opportunity to capture interindividual heterogeneity in intraindividual variability and change processes, providing richer insights into stressor–strain dynamics. Such a design enhances the temporal resolution and ecological validity of the findings, enabling the identification of short-term fluctuations as well as longer-term adaptation patterns. Moreover, it allows for advancing our understanding of the natural development of time pressure as task-related stressor and the theoretical foundation of its well-being relevance, while also testing theoretical propositions about disrupted adaptation due to resource depletion in both time pressure and emotional exhaustion with greater precision. By aligning methodological choices with the inherently dynamic nature of stress processes, this approach advances both theory and empirical application in occupational health research.

Nevertheless, several limitations need to be addressed, upon which future research can improve. The most central limitation of this dissertation lies in the constrained operationalization of temporal dynamics in the empirical studies (Study 1 and Study 2). Although the overarching aim was to adopt a time-sensitive perspective on stressor–strain relationships, the chosen timeframes, namely, daily assessment within one workweek (Study

1) and weekly questionnaires across eight consecutive workweeks (Study 2), reflect only a subset of the possible temporal patterns relevant to occupational stress. These durations were necessary to target the research objectives of this dissertation (i.e., identification of systematic patters within one workweek and examination of adaptive change processes from one week to the next), yet they cannot capture longer-term developments, delayed effects, or finer-grained intra-day variability. As such, the findings offer important insights into short- and mid-term temporal processes, but their generalizability to longer or more complex time horizons remains limited. This limitation reflects a broader challenge in occupational stress research: developing empirical designs and theoretical models that adequately reflect the multifaceted and evolving nature of time in work-related stress phenomena. Thus, further research is necessary to inform our understanding of temporal dynamics over different time frames, especially with regard to systematic patterns and adaptive change processes.

A second limitation of the dissertation is the narrow focus on one stressor (i.e., time pressure in Study 1 and Study 2) and its relationship with different well-being and strain variables. However, choosing time pressure across multiple studies, rather than switching stressors between studies, allows to build theoretical depth around how a major work-related stressor functions over time, how it evolves, and how it relates to strain. This extends a well-known stressor–strain relationship and strengthens the dissertation's contribution to understanding temporal dynamics of occupational stress from different theoretical and empirical angles (person-centered vs. variable-centered; daily vs weekly). Nonetheless, this approach may limit broader insights into other relevant occupational stressors. In particular, time pressure can be considered a potential challenge stressor, which may elicit growth and achievement in addition to strain (Podsakoff et al., 2023). This raises questions regarding the generalizability of the findings to other stressors, especially clear hindrance stressors (e.g., role conflict), which are more likely to obstruct goal attainment (Podsakoff et al., 2023). It is conceivable that hindrance stressors could influence processes observed in Study 2 differently, potentially hindering adaptive change processes in emotional exhaustion to a greater extent than time pressure. Moreover, work is more complex than examining isolated stressor–strain relationships. Thus, future research should not only investigate dynamics of different work-related stressors and strain, and their (reciprocal) relationship over time, but also consider temporal dynamics of personal and organizational resources, the interactive value of multiple work-related variables under which fluctuations in stressors can be beneficial for employees, and their cumulative impact on strain over time.

A third limitation of this dissertation is that the data extraction for the systematic literature review took place in January 2022, including articles published between 2012 and 2021 from only four top-ranking journals that highlight strong theoretical reasoning. However, more research being sensitive to time in their theory development and proposition of time effects has been published since then as well as in other scientific outlets. One example is Study 2 of this dissertation that tests theory-based assumptions on how stressors lead to strain, and vice versa (Peter et al., 2025). Further, Ford et al. (2023) examined loss spirals in energy, attentional resources, and work–family conflict over four consecutive months, unable to detect meso-term loss spirals. Also, Vahle-Hinz and Peter (2025) revealed that both the level and variability of illegitimate tasks can influence the satisfaction of their psychological needs, offering a more nuanced understanding of how shifting task demands affect employee well-being. Nonetheless, more research is still needed which focuses on a time-sensitive empirical and theoretical contribution to stressor–strain literature and advances our theoretical understanding regarding the temporal dynamics of stressors and strain.

Finally, a fourth limitation of the dissertation concerns the treatment of time as an objective, rather than subjective, variable. In the present empirical studies and systematic literature review, temporal dynamics were captured by objectively defined intervals (e.g., daily or weekly assessments), allowing systematic measurement of how stressors and strain evolve over fixed periods. This approach offers several strengths: clear comparability across studies, reduced recall bias, and the ability to model temporal patterns using established statistical techniques (e.g., latent class growth and latent change score modeling). However, psychological research has long recognized that subjective time perception can diverge substantially from objective intervals. Earlier work on time perspectives demonstrated that individuals may experience the same clock time very differently depending on context, attention, and emotional states (Brown, 2008; Stolarski et al., 2014, 2015). Phenomena such as anticipation of future stressors (Casper & Sonnentag, 2020; Rosen et al., 2016) and constructs like future-time perspective (Rudolph et al., 2018) or time urgency (Zhu et al., 2018) suggest that the subjective experience of time can shape stressor perception, appraisal, and coping in ways not captured by objective measures. Consequently, while objective measurement enables rigorous analysis of temporal dynamics, it may overlook theoretically meaningful variations arising from individual differences in temporal perception, anticipatory stress, or retrospective evaluations. Future research could complement this approach by incorporating subjective time measures, such as momentary time perception scales, diary-based assessments of perceived duration, or individual differences in time perspective, to better capture the complex interplay between temporal experiences and stressor–strain processes.

Practical Implications

The relevance of work-related stressors, strain, and their interplay is well-established (Ford et al., 2014; Guthier et al., 2020; Nixon et al., 2011; Pindek et al., 2019). This dissertation further underlines the value of temporal dynamics in stressor–strain research. Building on the findings of this dissertation, which demonstrate that stressors, strain, and their relationships unfold and fluctuate over time, this section highlights the practical relevance of these insights. Specifically, organizations, supervisors, and employees should initiate measures that support employee health and well-being. These efforts should not only address stressors in general but also account for the temporal patterns and trajectories through which stressors and strain emerge and interact over time.

First, the findings that Study 1 demonstrated the importance of how time pressure is distributed over one workweek with regard to its link to employee well-being. For instance, time pressure being distributed on a lower level that remains stable or increases during the workweek appeared to be more beneficial for well-being than experiencing time pressure at a medium or higher level that fluctuates during the workweek. Building on this finding and the concept of job crafting (Tims & Bakker, 2010; Wrzesniewski & Dutton, 2001), organizations and supervisors are encouraged to create working environments that empower employees to tailor their job demands to their individual needs, particularly by adjusting increases and decreases in demands in ways that minimize resource loss and, in turn, promote optimal well-being, in response to fluctuating demands and strain levels. Relatedly, results of Study 2 indicated that employees, on average, returned to baseline levels of time pressure and emotional exhaustion, even though this process was prolonged by the previous experience of high levels of emotional exhaustion and time pressure, respectively. This would suggest that seasonal peaks of high demands can be managed in a way that prevents the complete depletion of resources, and, consequently, avoids leaving individuals fully exhausted. However, I would like to stress that this disrupted process of adaptation highlights the importance for organizations and supervisors to recognize the simultaneous experience of emotional exhaustion and time pressure, along with its potential impact on employee well-being. Thus, employees need recovery opportunities to replenish lost resources to avoid chronic fatigue and intensification of working conditions. Accordingly, organizations and supervisors are encouraged to implement interventions that strengthen employees' coping mechanisms, supporting both recovery (Chawla et al., 2020; Hunter & Wu, 2016; Kim et al., 2017; Sonnentag et al., 2022) and effective time management (Aeon et al., 2021), even during high-demand periods. Additionally, recognizing that time pressure builds and fluctuates within a workweek (Study 1), supervisors should adjust workloads, deadlines, and recovery opportunities accordingly, easing time demands toward the end of the week to support recovery and prevent strain accumulation.

Secondly, encouraging open communication about current levels of stressors and strain is a critical practice for fostering a responsive and resilient work culture, particularly when guided by supervisors. Drawing on the findings of this dissertation, which emphasize the temporal dynamics of stressor–strain relationships, it becomes clear that stressors and strain do not emerge in a vacuum or remain static, but rather evolve over time, often in response to changing demands and varying recovery opportunities (Ford et al., 2014; Guthier et al., 2020). Here, supervisors play a pivotal role in creating a psychologically safe environment where employees feel comfortable sharing changes in their workload and emotional state (Detert & Burris, 2007; Edmondson, 1999). Regular and open dialogues through check-ins, team debriefs, or informal conversations, may enable supervisors to identify patterns of accumulating stressors or strain early and to intervene before dynamics escalate. This may not only help to reduce the negative impact of stressors but also empower employees to engage in adaptive behaviors, such as job crafting or recovery activities, when they are most needed. Moreover, fostering open communication, especially by supervisors acting as role models, can normalize the discussion of well-being at work, promote trust and shared responsibility, and ultimately contribute to an organizational climate that is both flexible and attuned to employees' changing needs over time.

Third, at the employee level, practical implications center on strengthening individuals' capacity to proactively manage their well-being in response to fluctuating job demands. One essential skill is the development of awareness regarding personal strain patterns. Employees should be encouraged to reflect on when and how they typically experience stress, such as during (high levels) of specific tasks, deadlines, or interpersonal situations, to better anticipate and manage their responses. This self-awareness fosters early recognition of strain accumulation, allowing for more timely coping efforts (Sonnentag & Fritz, 2015). Building on this, individuals should engage in proactive recovery and self-regulation strategies, including taking strategic breaks, practicing sleep hygiene, and pacing their workload to align with natural energy fluctuations (Meijman & Mulder, 1998; Sonnentag et al., 2016; Trougakos & Hideg, 2009). In cases where minimizing exposure to stressors is not feasible, for example during peak workload periods, employees can focus on altering their reactivity to these stressors. Evidence-based strategies include stress management training (Griffin & Clarke, 2011), the use of positive reappraisal techniques to reinterpret challenging situations in a constructive way (Crum et al., 2017), and cultivating resilience through psychological flexibility and resource-building activities (Kunzler et al., 2022). These approaches can enhance individuals' capacity to cope with stressful periods and support a faster return to baseline well-being after resource-draining work episodes. Importantly, the timing of such strategies is crucial: interventions are most effective when implemented early, before strain has accumulated to harmful levels or immediately following intense demands, when recovery processes are most needed (Ford et al., 2014; Sonnentag & Fritz, 2015). Thus, fostering not only the use of adaptive strategies but also their timely application can help employees sustain resilience in the face of fluctuating job demands. Finally, employees should be encouraged to seek support at the right time, particularly when they detect early signs of sustained strain. Recognizing the temporal nature of stressor–strain relationships enables individuals to reach out, whether to supervisors, colleagues, or mental health resources, before strain becomes chronic or overwhelming (Ford et al., 2014). Taken together, these self-regulatory and temporal awareness practices equip employees to take an active role in maintaining their psychological health and sustaining performance in dynamic work environments. Overall, practical efforts across the organizational, leadership, and employee levels should not only address the presence of job stressors and strain but also consider how their effects unfold over time, underscoring the importance of temporal dynamics in the sustainability and management of well-being.

General Conclusion

Specifically, two empirical studies and one systematic literature review that comprise this dissertation revealed that (1) time pressure trajectories are distinctively relevant for employee well-being which can be explained by recovery and resource theories, (2) employees show adaptive changes in both time pressure and emotional exhaustion, while these processes can be disrupted by the respective other variable, highlighting the simultaneous role of adaptation and resource loss in the occupational stress process, and (3) while the majority of occupational stress theories neglect time-sensitive approaches to explain dynamic stressor–strain relationships time-sensitive theory development, some (combinations of) theories are useful when proposing time-related effects. I hope that, with this dissertation, I can encourage further time-sensitive empirical research and theory-building when proposing stressor–strain relationships over time. Concluding this dissertation with Michael Ende's words from *Momo*, the "great […] mystery […] is time" (1973; p. 57), it is essential to think about time when empirically exploring and theoretically explaining temporal dynamics in stressor–strain relationships.

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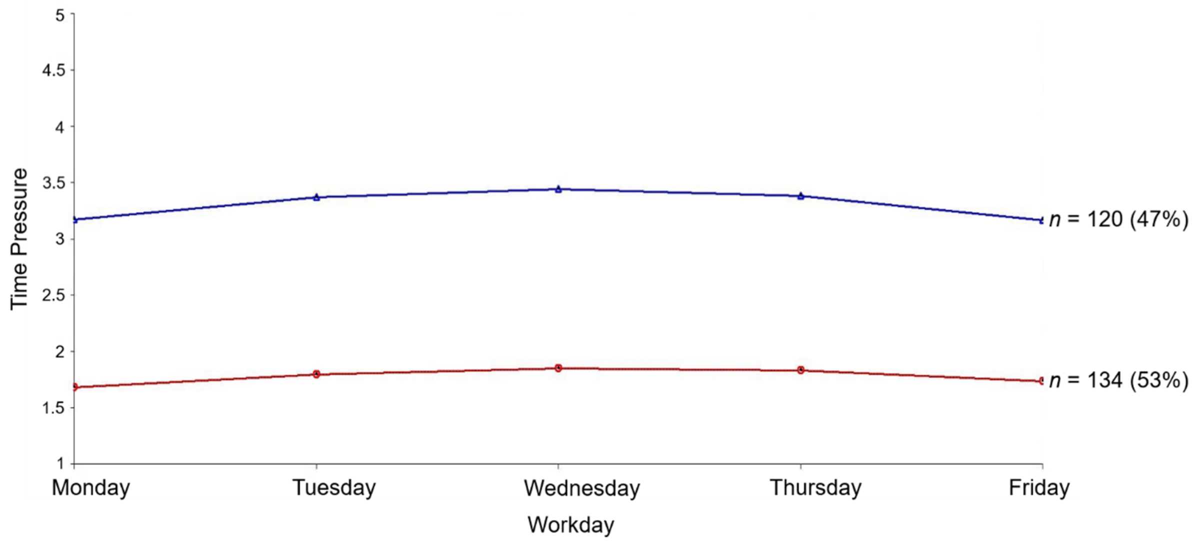
Appendix A. Supplemental Material to Study 1

Figure A1

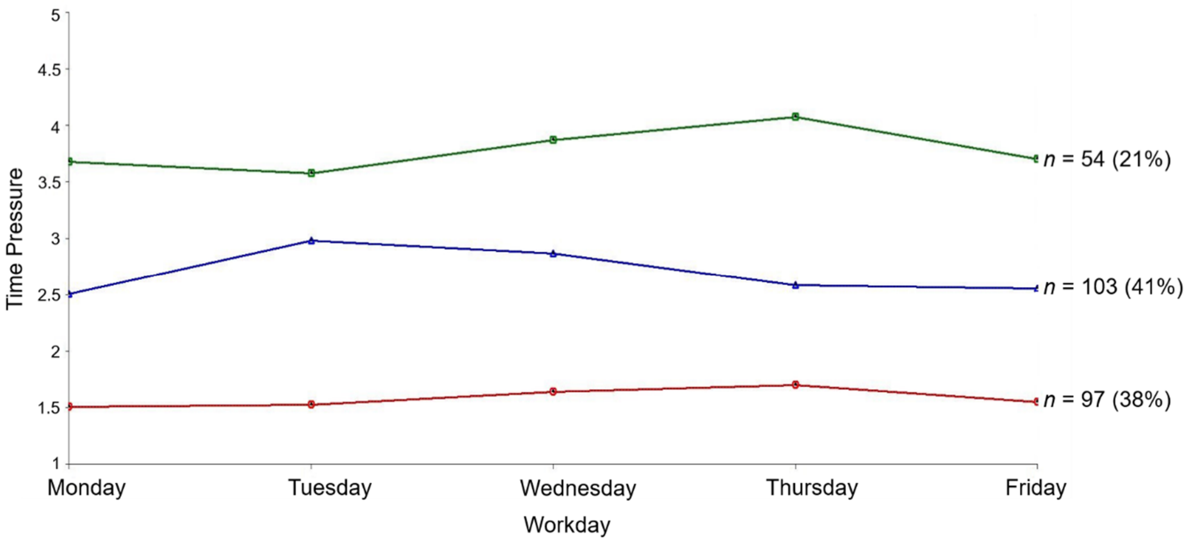
Estimated Mean Trajectories for Two Cubic Latent Classes of Time Pressure (Study 1)



Note. Parameter estimates for trajectories of the two-class solution. Red circle: $b_{\text{intercept}} = 1.68$, $p < .001$; $b_{\text{linear}} = 0.14$, $p = .534$; $b_{\text{quadratic}} = -0.02$, $p = .869$; $b_{\text{cubic}} = -0.01$, $p = .936$; Blue triangle: $b_{\text{intercept}} = 3.17$, $p < .001$; $b_{\text{linear}} = 0.25$, $p = .330$; $b_{\text{quadratic}} = -0.05$, $p = .748$; $b_{\text{cubic}} = -0.01$, $p = .920$.

Figure A2

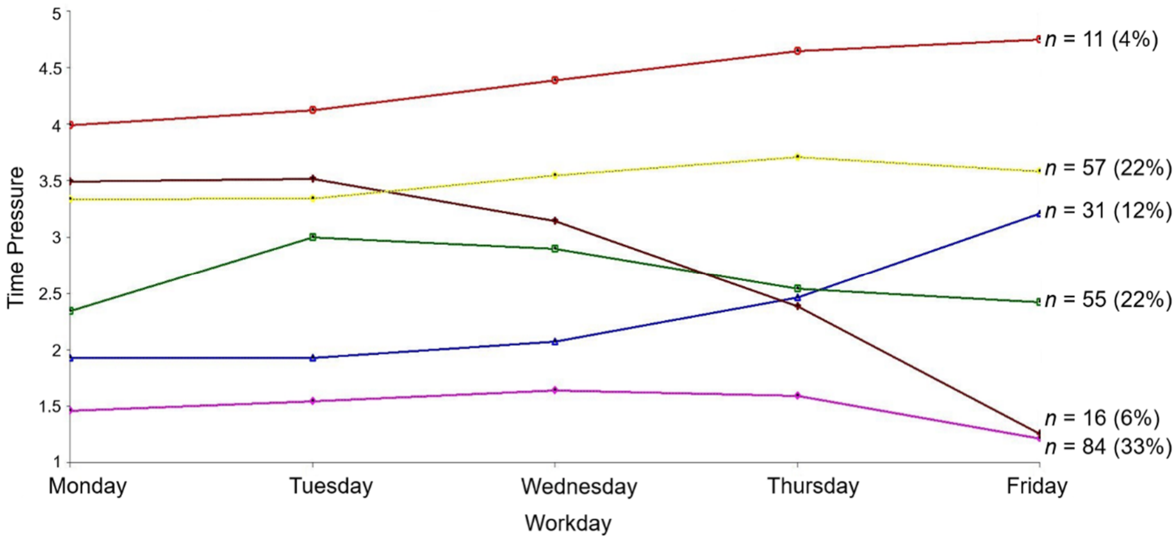
Estimated Mean Trajectories for Three Cubic Latent Classes of Time Pressure (Study 1)



Note. Parameter estimates for trajectories of the three-class solution. Red circle: $b_{\text{intercept}} = 1.50$, $p < .001$; $b_{\text{linear}} = -0.08$, $p = .727$; $b_{\text{quadratic}} = 0.13$, $p = .460$; $b_{\text{cubic}} = -0.03$, $p = .349$; Blue triangle: $b_{\text{intercept}} = 2.51$, $p < .001$; $b_{\text{linear}} = 0.91$, $p = .011$; $b_{\text{quadratic}} = -0.50$, $p = .022$; $b_{\text{cubic}} = 0.07$, $p = .037$; Green square: $b_{\text{intercept}} = 3.68$, $p < .001$; $b_{\text{linear}} = -0.47$, $p = .177$; $b_{\text{quadratic}} = 0.45$, $p = .028$; $b_{\text{cubic}} = -0.08$, $p = .011$.

Figure A3

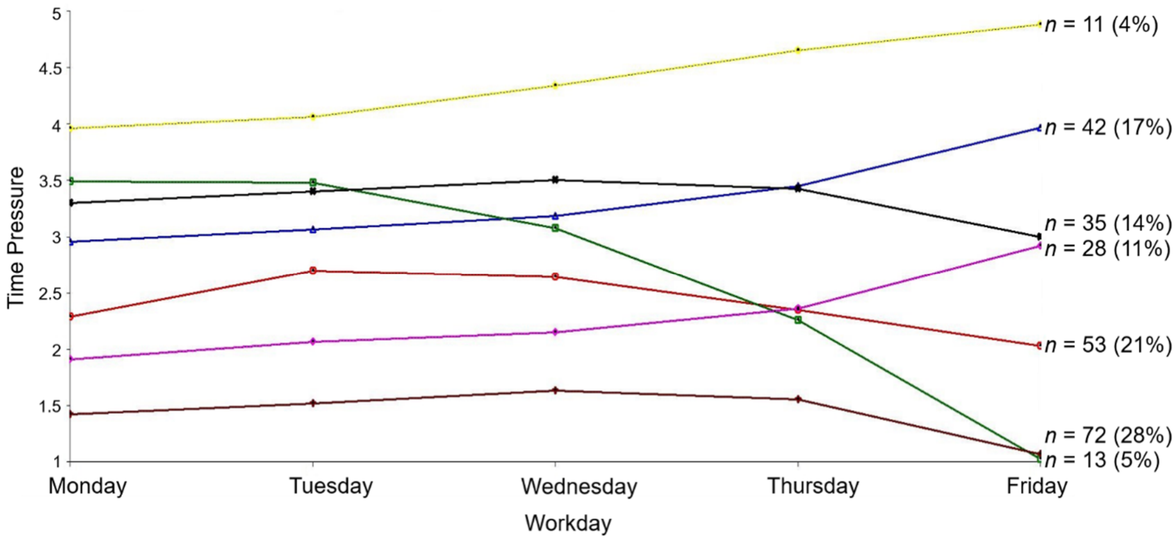
Estimated Mean Trajectories for Six Cubic Latent Classes of Time Pressure (Study 1)



Note. Parameter estimates for trajectories of the six-class solution. Red circle: $b_{\text{intercept}} = 3.99$, $p < .001$; $b_{\text{linear}} = 0.01$, $p = .984$; $b_{\text{quadratic}} = 0.14$, $p = .713$; $b_{\text{cubic}} = -0.03$, $p = .696$; Blue triangle: $b_{\text{intercept}} = 1.92$, $p < .001$; $b_{\text{linear}} = -0.03$, $p = .955$; $b_{\text{quadratic}} = 0.01$, $p = .968$; $b_{\text{cubic}} = 0.02$, $p = .771$; Green square: $b_{\text{intercept}} = 2.34$, $p < .001$; $b_{\text{linear}} = 1.20$, $p = .015$; $b_{\text{quadratic}} = -0.63$, $p = .024$; $b_{\text{cubic}} = 0.08$, $p = .055$; Magenta diamond: $b_{\text{intercept}} = 1.46$, $p < .001$; $b_{\text{linear}} = 0.02$, $p = .942$; $b_{\text{quadratic}} = 0.10$, $p = .481$; $b_{\text{cubic}} = -0.03$, $p = .208$; Maroon plus: $b_{\text{intercept}} = 3.49$, $p < .001$; $b_{\text{linear}} = 0.22$, $p = .802$; $b_{\text{quadratic}} = -0.20$, $p = .688$; $b_{\text{cubic}} = 0.01$, $p = .988$; Yellow star: $b_{\text{intercept}} = 3.33$, $p < .001$; $b_{\text{linear}} = -0.18$, $p = .675$; $b_{\text{quadratic}} = 0.22$, $p = .394$; $b_{\text{cubic}} = -0.04$, $p = .351$.

Figure A4

Estimated Mean Trajectories for Seven Cubic Latent Classes of Time Pressure (Study 1)



Note. Parameter estimates for trajectories of the seven-class solution. Red circle: $b_{\text{intercept}} = 2.29$, $p < .001$; $b_{\text{linear}} = 0.71$, $p = .030$; $b_{\text{quadratic}} = -0.34$, $p = .078$; $b_{\text{cubic}} = 0.04$, $p = .230$; Blue triangle: $b_{\text{intercept}} = 2.95$, $p < .001$; $b_{\text{linear}} = 0.14$, $p = .717$; $b_{\text{quadratic}} = -0.05$, $p = .825$; $b_{\text{cubic}} = 0.02$, $p = .595$; Green square: $b_{\text{intercept}} = 3.49$, $p < .001$; $b_{\text{linear}} = 0.18$, $p = .864$; $b_{\text{quadratic}} = -0.19$, $p = .756$; $b_{\text{cubic}} = -0.01$, $p = .981$; Magenta diamond: $b_{\text{intercept}} = 1.91$, $p < .001$; $b_{\text{linear}} = 0.26$, $p = .550$; $b_{\text{quadratic}} = -0.14$, $p = .645$; $b_{\text{cubic}} = 0.03$, $p = .492$; Maroon plus: $b_{\text{intercept}} = 1.42$, $p < .001$; $b_{\text{linear}} = 0.01$, $p = .950$; $b_{\text{quadratic}} = 0.12$, $p = .444$; $b_{\text{cubic}} = -0.04$, $p = .158$; Yellow star: $b_{\text{intercept}} = 3.96$, $p < .001$; $b_{\text{linear}} = -0.03$, $p = .965$; $b_{\text{quadratic}} = 0.15$, $p = .678$; $b_{\text{cubic}} = -0.02$, $p = .709$.

Table A1

Class-Specific Means of the Dependent Variables (BCH Approach; Study 1)

Dependent Variable	*Low Stable* (A)	*High Unstable* (B)	*Medium Unstable* (C)	*Increasing Unstable* (D)
Positive Valence (T2; 176)	5.20	5.05	4.97^{D}	5.34^{C}
Calmness (T2; 176)	5.15^{C}	4.86	$4.79^{A,D}$	5.23^{C}
Energetic Arousal (T2; 176)	$3.40^{B,C}$	3.05^{A}	2.88^{A}	2.60
Sleep Quality (T3a; 236)	$3.37^{B,C}$	3.00^{A}	3.17^{A}	3.31
Positive Valence (T3b; 235)	5.25^{B}	$4.71^{A,C}$	5.12^{B}	5.15
Calmness (T3b; 234)	4.94^{B}	$4.30^{A,C,D}$	4.75^{B}	5.04^{B}
Energetic Arousal (T3b; 235)	4.38^{B}	$3.71^{A,C,D}$	$4.13^{B,D}$	$4.58^{B,C}$

Note. Analyses were run utilizing the manual BCH approach in Mplus. The values in parentheses represent the measurement point (T2 = Friday evening; T3a = Friday Night; T3b = Monday) and number of participants who reported each outcome. The values for each dependent outcome are means for each trajectory class. Superscripts indicate classes that are significantly different at least at $p < .05$.

Appendix B. Formalities

Appendix B includes the following formally required information and documents:

- An abstract of this dissertation written in German (Zusammenfassung)
- Overview of manuscripts/publications
- Overview of academic teachers
- Curriculum Vitae
- Declaration regarding the doctoral examination procedure
- Declaration of authorship
- Course of higher education

German Abstract: Zusammenfassung

In den letzten Jahrzehnten hat die Zahl der Längsschnitt- und Tagebuchstudien in der arbeitspsychologischen Literatur erheblich zugenommen. Diese Studien liefern tiefere Einblicke in die zeitliche Beziehung zwischen Stressoren und Beanspruchung und befassen sich mit Fragen zu deren zeitlichen Veränderungen. Die Forschung erkennt an, dass sowohl die Exposition gegenüber Stressoren als auch die Erfahrung von Beanspruchung chronisch und stabil sein können, sich aber ebenso auf täglicher, wöchentlicher oder jährlicher Basis verändern können. Folglich werden die natürlich auftretenden zeitlichen Schwankungen von Stressoren und Beanspruchung sowie ihre wechselseitigen Beziehungen zunehmend in der arbeitspsychologischen Stressforschung berücksichtigt. Dennoch bleibt die Rolle der Zeit in Theorien, die Stressoren, Beanspruchung und deren Zusammenhang beschreiben und erklären wollen, bislang unterrepräsentiert.

Durch die explizite Berücksichtigung von Zeit sowohl in der empirischen Forschung als auch in theoretischen Rahmenkonzepten lässt sich unser Wissen zur Entwicklung von Stressor–Beanspruchungs-Prozessen vertiefen und die Grundlage für eine zeitsensitive Theoriebildung in der arbeitspsychologischen Stressforschung legen. Vor diesem Hintergrund untersucht die vorliegende Dissertation das empirische und theoretische Verständnis der zeitlichen Dynamiken in Stressor–Beanspruchungs-Zusammenhängen und fördert die Integration von Zeit in die arbeitspsychologische Stressforschung und Theoriebildung. Konkret verfolgt sie drei Forschungsziele: Erstens wird untersucht, inwieweit bestehende arbeitspsychologische Stresstheorien zeitbezogene Effekte in der Stressor–Beanspruchungs-Forschung berücksichtigen. Zweitens werden zwei etablierte Stressor–Beanspruchungs-Zusammenhänge aus einer zeitsensitiven empirischen und theoretischen Perspektive untersucht und erweitert, mit Schwerpunkt auf (1) der Identifikation von Zeitdruckverläufen und deren Bedeutung für das Wohlbefinden, basierend auf dem Effort–Recovery Model und der Conservation of Resources Theory, sowie (2) der Untersuchung reziproker adaptiver

Veränderungsprozesse zwischen Zeitdruck und emotionaler Erschöpfung unter Rückgriff auf Annahmen der Adaptation Theory and Conservation of Resources Theory. Drittens erfolgt eine systematische Überprüfung und Synthese der theoretischen und empirischen Integration von Zeit in die bestehende Stressor–Beanspruchungs-Forschung.

Zur Erreichung dieser Ziele wurden zwei empirische Studien und eine systematische Literaturübersicht durchgeführt. Die erste Studie nutzte einen explorativen personenzentrierten Ansatz, um zu untersuchen, welche latenten Klassen von Zeitdruckverläufen bei Beschäftigten innerhalb einer Arbeitswoche auftreten und wie diese mit dem Wohlbefinden am Ende der Arbeitswoche und zu Beginn der folgenden Woche zusammenhängen. Anhand von Daten aus einer fünftägigen Tagebuchstudie mit 254 Beschäftigten wurden vier qualitativ unterschiedliche Verläufe identifiziert, die sich in ihrer positiven Valenz, Ruhe und energetischen Aktivierung am Freitagabend und Montagmorgen sowie in der Schlafqualität in der Freitagnacht unterschieden.

Die zweite Studie untersuchte, ob Beschäftigte über die Zeit auf das Ausgangslevel von emotionaler Erschöpfung und Zeitdruck zurückkehren (d.h. Adaptation) und wie sich Veränderungen in den Ausprägungen von emotionaler Erschöpfung und Zeitdruck gegenseitig beeinflussen. Latent Change Score Analysen auf Basis wöchentlicher Tagebuchdaten über acht Arbeitswochen ($N = 252$) zeigten, dass Beschäftigte sowohl bei emotionaler Erschöpfung als auch Zeitdruck auf das Ausgangslevel zurückkehrten. Darüber hinaus wurde diese Adaptation durch das Zeitdruckniveau der Vorwoche beeinflusst, was zu einer verringerten Anpassung der emotionalen Erschöpfung führte, und umgekehrt. Dies liefert wichtige Erkenntnisse zu den gleichzeitig ablaufenden Prozessen von Adaptation und Ressourcenverlust.

Die dritte Studie widmete sich einer Synthese darüber, wie Zeit theoretisch und empirisch in Studien zu Stressor–Beanspruchungs-Zusammenhängen integriert wird. Hierzu wurde eine systematische Literaturübersicht von 158 Studien aus 147 Artikeln durchgeführt, die zwischen 2012 und 2021 in vier führenden Fachzeitschriften erschienen sind. Dabei wurden fünf zeitbezogene Kategorien identifiziert, die aufzeigen, wie die aktuelle Literatur Zeit in theoretischen Annahmen und methodischen Ansätzen berücksichtigt. Es zeigte sich, dass die meisten Arbeiten zeitbezogene Fragestellungen eher aus methodischer als aus theoretischer Perspektive behandeln. Das Review benennt sieben zentrale Schwerpunkte, die eine zeitsensitive Theoriebildung künftig berücksichtigen sollte, und geht auf anhaltende Herausforderungen bei der Erfassung der zeitlichen Dynamiken von Stressor–Beanspruchungs-Zusammenhängen ein.

Zusammen liefern diese Studien neue empirische Befunde und theoretische Orientierung zur zeitlichen Dynamik von Arbeitsstress. Sie zeigen, dass Zeit nicht nur eine methodische Überlegung darstellt, sondern wichtig ist, um zu erklären wie Stressoren und Beanspruchung entstehen, miteinander interagieren und sich verändern. Indem zeitliche Perspektiven in die Forschung und Theorien zu Arbeitsstress integriert werden, trägt diese Arbeit zu einem differenzierteren und genaueren Verständnis von Stressor-Beanspruchungs-Prozessen bei und legt die Grundlage für eine zukünftige zeitsensible Theoriebildung in diesem Forschungsbereich.

Overview of the Manuscripts/Publications

This thesis is based on two empirical studies and one systematic literature review that have either already been published or have been submitted to a peer-reviewed journal. The empirical studies are referred to in the text by their Latin numerals.

Study 1

Mühlenmeier, M., Rigotti, T., Baethge, A., & Vahle-Hinz, T. (2022). The ups and downs of the week: A person-centered approach to the relationship between time pressure trajectories and well-being. *Journal of Occupational Health Psychology*, *27*(3), 286–298. https://doi.org/10.1037/ocp0000306

Study 2

Peter, M., Rigotti, T., Holtmann, J., & Vahle-Hinz, T. (2025). I'll be back! Examining adaptive change processes in emotional exhaustion and time pressure. *Journal of Occupational Health Psychology*, *30*(1), 1–15. https://doi.org/10.1037/ocp0000395

Systematic Literature Review

Peter, M., Rigotti, T., Arnold, M., & Vahle-Hinz, T. (under review). The role of time in stressor–strain relationships: A systematic literature review. *Work and Stress*.

Overview of Academic Teachers

The overview of academic teachers has been removed from the digital version for reasons of data protection.

Curriculum Vitae

The curriculum vitae has been removed from the digital version for reasons of data protection.

The curriculum vitae has been removed from the digital version for reasons of data protection.

Declaration Regarding the Doctoral Examination Procedure

ERKLÄRUNG

gemäß § 6 Absatz 2 f) der Promotionsordnung

der Fachbereiche 02, 05, 06, 07, 09 und 10 vom 04. April 2016

Name (ggf. Geburtsname): Peter (geb. Mühlenmeier)

Vorname: Maren

Haben Sie sich bereits früher einem Promotionsverfahren unterzogen?

X Nein

☐ Ja

☐ Wenn ja, an welcher Universität? ______________________________

☐ zu welchem Zeitpunkt? ______________________________

☐ und mit welchem Erfolg? ______________________________

Haben Sie die vorgelegte schriftliche Prüfungsleistung oder Teile daraus in einem anderen Verfahren zur Erlangung des Doktorgrades oder eines sonstigen akademischen Grades oder einer anderen Prüfung eingereicht bzw. bereits früher eingereicht?

X Nein

☐ Ja

06.02.2026 Maren Peter

Datum Unterschrift

Declaration of Authorship

ERKLÄRUNG

gemäß § 6 Absatz 2 g) und gemäß § 6 Absatz 2 h) der Promotionsordnung der Fachbereiche 02, 05, 06, 07, 09 und 10 vom 04. April 2016

Name (ggf. Geburtsname): Peter (geb. Mühlenmeier)

Vorname: Maren

Hiermit erkläre ich, dass ich die eingereichte Dissertation selbständig, ohne fremde Hilfe verfasst und mit keinen anderen als den darin angegebenen Hilfsmitteln angefertigt habe, dass die wörtlichen oder dem Inhalt nach aus fremden Arbeiten entnommenen Stellen, Zeichnungen, Skizzen, bildlichen Darstellungen und dergleichen als solche genau kenntlich gemacht sind.

Von der Ordnung zur Sicherung guter wissenschaftlicher Praxis in Forschung und Lehre und zum Verfahren zum Umgang mit wissenschaftlichem Fehlverhalten habe ich Kenntnis genommen.

Bei einer publikationsbasierten Promotion:

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06.02.2026 Maren Peter

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