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A Daily Investigation of the Recovery Paradox: Examining the Dynamic Interplay of Workload, Recovery Experiences, and Microbreaks

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by

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Abstract

Research has highlighted the importance of recovery from work stress during non-work time for employee health and wellbeing. Building on the recovery from work stress literature, this study examines the recovery paradox which suggests that employees may recover from work demands the least when they need it the most. Therefore, the purpose of this study is to shed light on the mechanisms underlying the recovery paradox. Specifically, this study examined whether a common work stressor, workload in the morning, is indirectly related to poorer recovery experiences in the evening through negative states at the end of workday. Furthermore, this study investigated whether microbreaks at work moderated the relationship between workload in the morning and negative states at the end of the workday. Participants were recruited using social media to partake in a five-day daily diary study consisting of three measurement occasions per day. Multilevel analyses were conducted to test the study hypotheses. Results indicated that workload was negatively associated with relaxation in the evening. Further, negative affect at the end of the workday was negatively associated with psychological detachment and relaxation in the evening. Finally, vigor at the end of the workday was positively associated with mastery experiences in the evening. Overall, these findings point to the importance of end of workday states as a predictor of recovery experiences in the evening.

Dedication

I dedicate my dissertation to my parents, both of whom have worked tirelessly to support me in all of my personal and professional endeavors. Thank you for leading by example, supporting me unconditionally, and pushing me to be a better person.

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Introduction

Recovery from work stress refers to a restoration process in which employees replenish resources spent at work (Sonnentag & Fritz, 2007). Meta-analytical evidence has shown that recovery experiences during nonwork time are linked to improved health outcomes such as increased mental wellbeing, better sleep, general health, lower fatigue, as well as higher life satisfaction (Steed et al., 2021). Moreover, recovery from work stress plays a fundamental role in counteracting the negative effects of experiencing stressors at work thereby allowing one to return to a prestressor state (Meijman & Mulder, 1998). However, empirical evidence has suggested that increased exposure to stressors at work may impair individuals' ability to fully recover from work stress, pointing to the recovery paradox (Sonnentag, 2018). The recovery paradox refers to a dilemma where employees may recover the least (i.e., low recovery experiences) when they need it the most (i.e., high exposure to stressors). Several studies have shown that high workload is related to lower psychological detachment from work – i.e., the ability to mentally disconnect from work during non-work time (Sonnentag & Bayer, 2005; Sonnentag & Kruel, 2006; Sonnentag et al., 2010b; Smit & Barber, 2016). This initial evidence suggests that when employees' need for recovery from work stress is highest due to experiencing increased stressors at work, there is a low likelihood of fully experiencing its benefits, leading to poorer health and wellbeing over time. Despite increasing evidence that recovery processes are impaired by high work stressors, the current literature offers little insight as to the mechanisms through which work stressors

are linked to poorer recovery experiences in the evening. Further, research efforts have yet to examine different strategies that can be used to attenuate the negative relationship between daily work stressors and recovery experiences in the evening.

In this study, I aim to shed light on the processes underlying the recovery paradox. Drawing on the Effort Recovery Model (ERM; Meijman & Mulder, 1998), Transactional Model of Stress and Coping (Lazarus & Folkman, 1987), and Conservation of Resources Theory (COR; Hobfoll, 1989; Hobfoll et al., 2018), I propose that a common work stressor, namely, workload in the morning, is indirectly associated with poorer recovery experiences in the evening through two different mediating mechanisms. In doing so, the current study examines two mediational pathways, first examining the indirect effect of workload in the morning on psychological detachment and relaxation in the evening via *higher* negative affect at the end of the workday, and second, examining the indirect effect of workload in the morning on mastery experiences and exercise in the evening via *lower* vigor at the end of the workday. Additionally, I explore whether daily relaxation and physical microbreaks attenuate the relationship between workload in the morning and negative states at the end of the workday (i.e., increased negative affect and decreased vigor), thereby facilitating better recovery experiences in the evening.

This study contributes to the recovery from work stress literature in several ways. First, although studies have provided initial evidence of the recovery paradox, research efforts have yet to directly examine the underlying mechanisms of this process. Therefore, in response to Sonnentag's (2018) call to examine the recovery paradox more

thoroughly, this research seeks to disentangle the link between workload in the morning and recovery experiences in the evening by investigating negative affect and vigor as two potential mediating mechanisms. As such, the goal of proposing both mediating mechanisms is to provide a fine-grained examination of the recovery paradox by accounting for differential relationships between workload in the morning and recovery experiences in the evening.

Second, following Sonnentag's (2018) suggestion to investigate strategies that can be used to minimize negative reactions associated with work stressors, I explore microbreaks, a form of at-work recovery efforts, as a boundary condition of the recovery paradox. Specifically, I examine whether these short breaks at work buffer the relation between workload and negative states at the end of the workday such that engaging in higher relaxation and physical microbreaks at work should weaken the relationship between high workload in the morning and negative states at the end of the workday. Further, I will explore whether the relation between workload in the morning and recovery experiences in the evening via these two ends of workday states differs depending on frequency of microbreaks taken at work. This will elucidate whether microbreaks can help reduce negative states at the end of the workday and facilitate better recovery experiences in the evening, thereby fulfilling employees' daily recovery needs. This research also addresses the call to investigate the dynamic interplay between at-work (e.g., energy management) and out-of-work recovery (e.g., recovery from work stress during non-work time) (e.g., Kinnunen et al., 2015; Parker et al., 2017; Kim et al., 2022).

Most importantly, this research will elucidate how at-work recovery from work stress may be linked to short-term resource gains and how these gains may benefit out-of-work recovery, an important consideration for optimal health and well-being (Hobfoll et al., 2018).

Theoretical Framework

Effort Recovery Model

The Effort Recovery Model (ERM; Meijman & Mulder, 1998) highlights the importance of engaging in breaks (both during and after work hours) to bolster employee health and wellbeing. The model states that exposure to work demands require sustained effort resulting in short-term physiological and psychological load reactions. Load reactions include physiological changes such as increases in hormones (e.g., adrenaline) and changes in mood or affect (Meijman & Mulder, 1998). Recovery from work stress is a critical process through which the impact of these negative load reactions can be reversed, thereby allowing the individual's physiological and psychological systems to stabilize and return to their baseline levels. However, prolonged exposure to job demands without proper recovery may result in a sub-optimal state. This can make it increasingly difficult for individuals to recover from demands in the future as load reactions will continue to accumulate and further impair subsequent attempts to recover from work stress. Over time, insufficient recovery from work stress will lead to an accumulation of negative load reactions manifested as chronic health problems like psychosomatic symptoms, insomnia, as well as chronic tension, and fatigue. In short, recovery from work stress is an essential process that helps return an individual's body to a prestressor state by reducing short-term load reactions. Frequently engaging in recovery experiences is critical as this reduces the likelihood of developing long-term load reactions manifested

as chronic health problems. Therefore, in line with the Effort Recovery Model, recovery from work stress is a critical process that fosters higher health and wellbeing.

Transactional Model of Stress and Coping

The Transactional Model of Stress and Coping (Lazarus & Folkman, 1987) provides an overview of how individuals evaluate and respond to stressful events. According to Lazarus and Folkman (1987), the first component of this model proposes that individuals engage in a primary appraisal. The primary appraisal involves an initial evaluation of an event to determine whether an event is beneficial or harmful; if it is latter, then the event is deemed as a threat, thus stressful (Lazarus & Folkman, 1987). If the event is perceived as stressful, the individual will then engage in a secondary appraisal. The secondary appraisal determines whether individuals can take action to mitigate the stressful situation, and if so, identifies specific coping mechanisms the individual may utilize to cope with the stressful event. As stated by the model, coping mechanisms can broadly be classified as either emotion or problem focused coping. The goal of emotion focused coping is to manage the emotional reaction towards the stressor whereas the goal of problem focused coping aims to directly change the stressful event itself or finding a solution for it.

Research has shown that stressors at work are associated with increases in strain outcomes such as negative affect which in turn can undermine the recovery process (Sonnentag, 2018). In line with the Transactional Model of Stress and Coping, high levels of workload in the morning may be evaluated as a threat and induce a stress response

manifested as an increased experience of negative emotions. As a result, this heightened state of negative emotions may directly impair recovery experiences in the evening through priming individuals to recall more negative information regarding their workday, therefore hindering their ability to refrain from work-related thoughts during non-work time (Sonnentag, 2018).

Conservation of Resources Theory

The Conservation of Resources Theory (COR Theory; Hobfoll, 1989; Hobfoll et al., 2018) argues that individuals are motivated to obtain and retain resources that are centrally valued. Resources may include but are not limited to objects, conditions, and other things deemed valuable to the individual (Hobfoll et al., 2018) and are critical to achieving one's goals (Halbesleben, 2014). COR Theory includes several key principles that describe the process of resource loss and gain and its impact on the stress experience. For instance, COR Theory's Resource Investment Principle asserts that investing resources is a strategy through which one protects against future resource loss and ensures future resource gain. Further, the Gain Paradox Principle states that resource gain becomes increasingly important when resources are threatened. Notably, COR Theory argues that the threat of resource loss alone is sufficient for individuals to experience stress in addition to experiencing an actual loss of resources.

With respect to the current study, I propose that one type of resource, energetic resources, are centrally valued for several reasons. According to COR Theory, energetic resources are a limited resource which should be protected and conserved. Further, high

levels of energetic resources may be an indicator of increased feelings of vigor. Second, research has indicated that energetic resources are boundary-spanning resources which indicates that energetic resources created during work time can spill over into the home domain. As a result, these resources can be invested and acquired to foster additional resources within and across domains (Calderwood et al., 2021). Lastly, energetic resources are crucial for achieving optimal health and wellbeing, a fundamental need across all individuals. Within the work context, engaging in physical microbreaks may be a resource-building strategy that can help maintain high levels of vigor when faced with a high workload in the morning. Moreover, physical microbreaks may become increasingly important under high workload as this can signal potential resource loss and stress. In addition, relaxation microbreaks may help conserve personal resources which may help offset increases in negative emotions due to high workload in the morning. Taken together, the Effort Recovery Model, Transactional Model of Stress and Coping, and Conservation of Resources Theory jointly serve as theoretical frameworks used to guide the development of the study hypotheses.

Hypothesis Development

Daily Relations Between Workload in the Morning and Negative Affect at the End of the Workday

Workload refers to the "amount or difficulty of one's work" (Bowling et al., 2015, p. 98). Stressors like workload are problematic for employees and their wellbeing with recent research indicating that high levels of workload are a leading cause of stress in today's workplace (Mazur, 2023). Consistent with this, meta-analytical evidence has shown the consequences of high workload for organizations and their employees alike. In their meta-analysis, Bowling and colleagues' (2015) found that workload is associated with lower affective commitment, higher turnover intentions, and absenteeism from work. Workload is also associated with higher psychological and physical strain such as poorer mental wellbeing and higher depression as well as distress, fatigue, emotional exhaustion, and physical symptoms. Taken together, these findings imply that high levels of workload can be detrimental for employee attitudes, performance, and most importantly their health and wellbeing.

Based on a review of experience sampling studies, results showed that daily stressors like workload are dynamic and vary across days (McCormick et al., 2020). Fluctuations in daily levels of workload may be associated with within-person variability of negative arousal – that is negative affect – an indicator of strain (Sonnentag, 2018). Negative affective states like negative affect have also been shown to vary day to day (McCormick et al., 2020). Negative affect consists of feelings of irritation, distress, and

hostility (Watson et al.,1998). Moreover, negative affect has frequently been studied as a short-term outcome associated with daily workplace stressors (Volmer & Fritsche, 2016) like experiences of incivility (Zhou et al., 2015), negative work events (Volmer & Fritsche, 2016), and emotional labor (i.e., surface acting) (Scott & Barnes, 2017).

In line with the Effort-Recovery Model (Meijman & Mulder, 1998), high levels of workload require individuals to expend a significant amount of effort to complete their work tasks. At the same time, higher effort expenditure may increase load reactions which become visible through higher negative affect as a response to the heightened demands placed on the individual. Further, without proper at-work recovery from work stress – that is the use of microbreaks – these load reactions will continue to accrue throughout the workday leaving the individual in a state of negative affect at the end of the workday. Research has shown that negative affective states are highly variable and are prone to vary in response to situational influences like experiencing stressors (McCormick et al., 2020). Accordingly, studies have shown that daily workload is associated with higher levels of negative affect at work (see Ilies et al., 2007; Kim et al., 2017, Schusterschitz et al., 2018). Therefore, I propose that high levels of workload in the morning will be associated with increased negative affect at the end of the workday.

Hypothesis 1: Workload in the morning will be positively associated with negative affect at the end of the workday.

Indirect Effects of Daily Workload in the Morning on Recovery Experiences in the Evening via Negative Affect at the End of the Workday

Negative affect at the end of the workday may link high levels of workload in the morning to lower psychological detachment and relaxation in the evening. Psychological detachment refers to mentally disconnecting from work during non-work time (Sonnentag & Fritz, 2015). In addition to refraining from work-related thoughts, detachment from work also includes not engaging in work-related tasks after hours such as checking or sending emails. Within the recovery literature, psychological detachment has been the most studied recovery experience and has been linked to a myriad of positive outcomes. Meta-analytical results indicated that psychological detachment is related to increased resources (e.g., home and personal resources; Steed et al., 2021), wellbeing (e.g., general health, lower fatigue, higher vigor; Bennett et al., 2018; Steed et al., 2021), as well as lower demands (e.g., overload, cognitive, and emotional demands; Steed et al., 2021). More recent evidence suggests that detachment from work can be improved through interventions (Sonnentag et al., 2017). A recent meta-analysis by Karabinski and colleagues (2021) found that interventions designed to improve psychological detachment have a positive and significant effect on detachment from work (d = .36). Overall, empirical evidence has emphasized the importance of psychological detachment for health and wellbeing, especially after experiencing stressors or negative events at work.

The recovery from work stress literature has also extensively examined the positive role of relaxation during nonwork time. Relaxation refers to being in a state of low activation and includes activities such as reading a novel, meditating, journaling, and

watching movies. Meta-analytical evidence has shown that relaxation is associated with positive outcomes including improved wellbeing (e.g., mental wellbeing), increased resources (e.g., work, home, personal), positive attitudes (e.g., life satisfaction), and better performance on the job (Bennett et al., 2017; Steed et al., 2021). Similar to psychological detachment, engaging in relaxing activities may be especially important after experiencing stressors at work. In line with the Effort Recovery Model (Meijman & Mulder, 1998), relaxation may help reverse load reactions that have accumulated from experiencing stressors, thereby returning the individual to a prestressor state.

The Transactional Theory of Stress and Coping (Lazarus & Folkman, 1987) is a framework that describes how individuals evaluate and respond to stressful events. This framework may guide our understanding of negative affect as a mediating mechanism linking workload in the morning to poorer psychological detachment in the evening. According to this framework, an individual may evaluate their workload as a threat or a challenge (primary appraisal) which signals the potential for growth and development, yet requires an individual to overcome barriers (Lazarus & Folkman, 1987). As a result, this may evoke outcome appraisals like harm manifested as high negative arousal which in turn may impair an individual's ability to psychologically detach from work in the evening. Subsequently, engaging in secondary appraisals like venting, a form of emotion focused coping, may increase the salience of negative emotions like frustration and irritation which may further hinder detachment in the evening. Growing evidence indicates that broadly, negative affect at the end of the workday, is associated with lower

psychological detachment in the evening (Sonnentag & Lischetzke, 2018; Van Wijhe et al, 2013) and that specific negative emotions such as anxiety at the end of the workday are also related to lower detachment (Cangiano et al., 2018). These findings imply that negative arousal, manifested as negative affect, may link stressors like workload in the morning to poorer recovery experiences in the evening.

Negative affect at the end of the workday may also explain the link between workload in the morning and lower relaxation in the evening. In line with the Effort Recovery Model, experiencing high levels of workload may lead to an accumulation of load reactions manifested as increased negative affect. Without proper at-work recovery from work stress, these load reactions will continue to accumulate leaving individuals in a sub-optimal state indicated by increased levels of negative affect at the end of the workday. Consequently, high negative affect at the end of the workday may impair one's ability to engage in relaxing activities during nonwork time. Further, research has shown that negative affect from work can spill over into non-work time (Ilies et al., 2007). Therefore, when employees finish their workday in a state of elevated negative affect due to high workload that day, these negative feelings and emotions may spill over and continue into non-work time impeding relaxation experiences in the evening. Thus, being in a state of high activation while also experiencing negative emotions may hinder relaxation as relaxation entails being in both a positive affective state in addition to experiencing low activation (Sonnentag & Fritz, 2007). In sum, past research has indicated that negative affect is related to decreased psychological detachment from work

as well as relaxation (Van Wijhe et al., 2013). Therefore, negative affect at the end of the workday may be an important mechanism through which workload in the morning is associated with both lower psychological detachment and lower relaxation in the evening.

> *Hypothesis 2:* There will be an indirect relationship between workload in the morning and (a) psychological detachment and (b) relaxation in the evening, such that on days with *higher* workloads, employees are more likely to experience *higher* negative affect at the end of the workday and thereby experience *lower* levels of psychological detachment and relaxation in the evening.

Daily Relations Between Workload, Negative Affect, Recovery Experiences, and the Moderation of Daily Relaxation Microbreaks

Recent research has highlighted the benefits associated with taking microbreaks at work to enhance wellbeing (see Sonnentag et al., 2022). Microbreaks refer to short (15 minutes or less), informal, and voluntary breaks not related to work during work time (Trougakos et al., 2008). Relaxation microbreaks, a specific type of microbreak, consists of low-effort activities or behaviors that require little to no physical or psychological activation (Kim et al., 2017; Kim et al., 2018). Examples of relaxation microbreaks include stretching, taking a quick nap, and daydreaming. Theory and past research suggest that relaxation microbreaks may moderate the relationship between workload in the morning and negative affect at the end of the workday. In line with the Effort Recovery Model, engaging in relaxation microbreaks provides temporary relief from continuous stressors like workload through facilitating physical and psychological

relaxation. At the same time, this increased temporary state of relaxation returns the individual to a prestressor state through reversing negative load reactions manifested as negative arousal from experiencing high workload (Meijman & Mulder, 1998). Therefore, the positive relationship between workload in the morning and negative affect at the end of the workday may be *weaker* under *higher* levels of relaxation microbreaks. In contrast, the positive relationship between workload and negative affect may be *stronger* on days when employees engage in *lower* levels of relaxation microbreaks. Engaging in low levels of relaxation microbreaks provide little opportunity for employees to relax and return to a prestressor state thereby limiting the reversal of negative load reactions due to high workload. Consistent with this, Kim et al. (2017) found that higher levels of daily relaxation microbreaks weakened the positive relationship between daily workload and negative affect at the end of the workday. Therefore, I propose the following:

> *Hypothesis 3:* Daily relaxation microbreaks at work will moderate the relationship between workload in the morning and negative affect at the end of the workday, such that the *positive* relationship between workload and negative affect will be *weaker* (*stronger*) on days on which employees engage in *higher* (*lower*) levels of relaxation microbreaks.

In sum, high levels of workload in the morning may increase load reactions which become visible through higher negative arousal at the end of the workday. However, engaging in relaxation microbreaks may attenuate the relationship between workload in

the morning and negative affect at the end of the workday through reversing negative load reactions that have accumulated as a response to high workload in the morning. As a result, on days when experiencing lower negative affect at the end of the workday, this may enable individuals to better psychologically detach from work and engage in more relaxation that evening.

> *Hypothesis 4:* The indirect effect of workload in the morning on (a) psychological detachment and (b) relaxation in the evening through negative affect at the end of the workday will be *weaker* (*stronger*) on days on which employees engage in *higher* (*lower*) levels of daily relaxation microbreaks.

Daily Relations Between Workload in the Morning and Vigor at the End of the Workday

Fluctuations in daily levels of workload may also be associated with within-person variability of vigor. Vigor has been shown to vary day to day (McCormick et al., 2020) with low levels of vigor indicating strain associated with stressors like high workload. Vigor, or a sense of vitality, refers to feelings of positive energy and a sense of alertness and liveliness (Shirom, 2011). Experiencing vigor at work is important as this enables individuals to mobilize resources more efficiently to overcome obstacles and facilitate better performance at work (Carmeli et al., 2009). According to the Conservation of Resources Theory, energetic resources are limited and can be depleted from experiencing work stressors (Hobfoll et al., 2018) and thus are considered highly valuable, motivating individuals to conserve and replenish these resources regularly.

However, when employees experience high workload in the morning, this requires a significant amount of energy expenditure throughout the workday in order to complete one's tasks (Sonnentag & Niessen, 2008). Consequently, increased levels of effort consume employees' energetic resources leaving them in a state of energetic resource depletion at the end of the workday. Research findings have suggested that high levels of day-specific workload are associated with lower vigor at the end of the workday (Sonnentag & Niessen, 2008), suggesting that a high workload threatens and consumes energetic resources which is experienced as low momentary vigor. Overall, theory and research support the idea that high levels of workload in the morning may deplete energetic resources throughout the day leaving individuals in a state of low vigor at the end of the workday.

Hypothesis 5: Workload in the morning will be negatively related to vigor at the end of the workday.

Indirect Effect of Daily Workload in the Morning on Recovery Experiences in the Evening via Vigor at the End of the Workday

Low vigor at the end of the workday may link high levels of workload in the morning to lower mastery experiences and exercise in the evening. Mastery experiences during nonwork time are characterized as experiences that challenge and lightly tax the individual's capabilities while also providing learning opportunities (Sonnentag & Fritz, 2007). This includes activities such as learning a new language, playing a musical instrument, and reading a book. Results from a recent meta-analysis found that mastery

experiences are related to important outcomes such as mental wellbeing, positive affect, general health, and higher performance at work (Steed et al., 2021). One study exploring recovery profiles on workplace outcomes highlighted the importance of mastery experiences such that they found that optimal recovery occurs when individuals engage in high levels of *all four* recovery experiences (i.e., psychological detachment, relaxation, control, and mastery experiences) in the evening after work (Chawla et al., 2019). Further, they found that evenings characterized by high detachment, relaxation, and control, but no mastery experiences were associated with lower work engagement, helping behaviors, and initiative the following workday (Chawla et al., 2019). Overall, these findings suggest that daily mastery experiences play a critical role in supporting employee wellbeing as well as facilitating better performance at work.

Exercise, another core recovery experience, has been associated with positive individual health and wellbeing outcomes. Specifically, leisure-time physical activity (LTPA) refers to “exercise, sports, and physically active hobbies done in one's leisure time (The Center of Disease Control (CDC; *n.d.*). LTPA includes mild, moderate, and strenuous exercises like yoga, weightlifting, and indoor cycling, respectively. Meta-analytical research and additional studies exploring the benefits of LTPA found that LTPA is related to higher life satisfaction and positive affect (Wiese et al., 2018) and is indirectly related to next day work engagement through increased vigor in the morning (ten Brummelhuis & Bakker, 2012). In sum, both mastery experiences and exercise in the

evening are linked to important health outcomes, positive work-related attitudes, and enhanced performance.

The Conservation of Resources Theory (Hobfoll, 1989; Hobfoll et al., 2018) provides a theoretical framework that underscores the importance of obtaining and protecting resources to minimize stress. The principles of COR Theory may provide insight to our understanding of vigor as a mediating mechanism linking workload in the morning to lower mastery experiences and exercise experiences in the evening. According to COR Theory, experiencing stressors like workload may threaten and deplete resources which makes individuals more vulnerable to further resource loss and less capable of resource gain. In the current study, high workload in the morning may signal a threat of resource loss through maximizing one's effort to match the demand and may further result in the depletion of energetic resources manifested as low levels of vigor at the end of the workday (Hobfoll et al., 2018). Recent research exploring vigor found that vigor is a boundary-spanning resource that can spill over from the work to nonwork domain (Calderwood et al., 2021). This means that on days when workload is high in the morning, this may lead to low levels of vigor at the end of the workday, which in turn limits energetic resources that can spill over into the nonwork domain and be invested in more effortful non-work activities such as mastery experiences and exercise in the evening. As noted in COR Theory, when resource loss is high as evidenced by low energetic resources at the end of the workday, individuals are more vulnerable to continuous resource loss which may lessen opportunities to ensure resource gain through

engaging in recovery experiences in the evening (Quinn et al., 2012). For instance, several studies have shown that vigor is a predictor of both subjective and objective reports of exercise (Hevel et, 2020; Isoard-Gautheur et al., 2018; Niermann et al., 2016) as well as mastery experiences (Benett et al., 2018). Therefore, low vigor at the end of the workday may be an important mediating mechanism linking workload in the morning to lower mastery experiences and exercise in the evening.

> *Hypothesis 6:* There will be an indirect relationship between workload in the morning and (a) mastery experiences and (b) exercise in the evening, such that on days with *higher* workloads, employees are more likely to experience *lower* vigor at the end of the workday and thereby experience *lower* levels of mastery experiences and exercise in the evening.

Daily Relations Between Workload, Vigor, Recovery Experiences, and the Moderation of Daily Physical Microbreaks

Emerging research on at-work recovery has highlighted the benefits of engaging in physical microbreaks during work (see Sonnentag et al., 2022). Physical microbreaks include activities like going on short walks and going outside for fresh air (Kinnunen et al., 2015; Schulz et al., 2017). Research has found that broadly, physical microbreaks are related to self-reported health and lower emotional exhaustion (Schulz et al., 2017), and specific physical microbreaks like going outside for fresh air have been associated with higher vitality at work (Zacher et al., 2014). Physical microbreaks may moderate the relationship between workload in the morning and vigor at the end of the workday.

According to COR Theory's Gain Paradox Principle, resource gain becomes increasingly important in the context of resource loss. Exposure to high levels of work stressors such as increased workload in the morning may signal the potential loss of energetic resources. Moreover, in line with COR Theory's Resource Investment Principle, employees must invest resources to prevent further resource loss and promote future resource gain. Therefore, on days with high levels of workload, this may be perceived as a threat to one's resources. At the same time, the threat of resource loss may motivate employees to engage in strategies such as engaging in physical microbreaks to further prevent resource loss as well as promote future resource gain.

While engaging in physical microbreaks may require some initial resource investment, such as the investment of energetic resources, these microbreaks may also foster new energetic resources that increase an individual's sense of alertness and liveliness. Physical microbreaks may also provide temporary relief from ongoing exposure to high workload thereby helping one conserve their energetic resources throughout the workday. Therefore, the benefits of engaging in physical microbreaks may *weaken* the negative link between workload in the morning and vigor at the end of the workday by providing an opportunity for employees to replenish energetic resources and offset the loss of these resources from experiencing high levels of workload. In contrast, the negative relationship between workload and vigor may be *stronger* on days when employees engage in *lower* levels of physical microbreaks as this may leave individuals

with fewer resources to compensate for and offset the loss in energetic resources from high levels of workload in the morning. Therefore, I hypothesize the following:

> *Hypothesis 7:* Daily physical microbreaks will moderate the relationship between workload in the morning and vigor at the end of the workday, such that the *negative* relationship between daily workload and vigor will be *weaker* (*stronger*) on days on which employees engage in *higher* (*lower*) levels of physical microbreaks.

In line with the Conservation of Resources Theory, experiencing high levels of workload may consume employees' energetic resources leaving them in a state of low vigor at the end of the workday. However, physical microbreaks may play an important role in weakening the negative link between daily workload and vigor thereby leaving employees in a state of high vigor at the end of the workday. High levels of vigor at the end of the workday may enable employees to engage in more effortful recovery experiences such as mastery and exercise experiences in the evening. For instance, studies have shown that high vigor at the end of the workday is an important predictor of mastery experiences and exercise (Blanco-Donoso et al., 2021; Calderwood et al., 2021; Hevel et al., 2021; Niermann et al., 2016). Therefore, I propose the following:

> *Hypothesis 8:* The indirect effect of daily workload on (a) mastery experiences and (b) exercise in the evening through lower vigor at the end of the workday will be *weaker* (*stronger*) on days on which employees engage in *higher* (*lower*) levels of daily physical microbreaks.

Method

Participants and Procedures

The final sample consisted of 142 participants with 397 unique observation days, with each individual participating in 2.15 observation days on average. Participants were recruited using social media postings (e.g., LinkedIn, Facebook) and had to be at least 18 years of age, work five days a week (Monday - Friday), be employed full-time (40 hours per week), work primarily between the hours of 7:00 AM and 6:00 PM., located in the U.S., and have access to email. Participants were asked to create a six-digit code to serve as a unique identifier to link participant responses. Two weeks after completing the baseline survey, individuals were sent three surveys per day for five consecutive workdays. Daily survey links were distributed via email using the Qualtrics scheduled send feature to ensure all participants received each daily survey at the same time.

The first survey, the lunchtime survey, was sent daily at 11:00 AM and closed at 1:00 PM, where participants reported their workload and microbreak activity that morning. The average completion rate for the lunch survey was 80% (684 of 857). The second survey, the end of workday survey, was sent daily at 4:00 PM and closed at 6:00 PM, where participants reported their level of negative affect and vigor at the end of the workday. The average completion rate for the end of workday survey was 69% (592 of 857). Finally, the evening survey was sent daily at 8:00 PM and closed at 10:00 PM, and participants reported their non-work experiences that evening, including psychological detachment from work, relaxation, mastery experiences, and exercise. The average

completion rate for the bedtime survey was 66% (569 of 857). For each survey participants completed, they could enter into a raffle for one of ten $50 Amazon gift cards.

The majority of participants self-identified as women (56.7%), followed by men (33.7%), no response (5.6%), prefer not to respond (2%), prefer to self-describe (1.2%), and genderqueer, nonbinary, or genderfluid (.8%). Further, the majority of participants self-identified as White (65.5%), followed by Asian (8.7%), Hispanic, Latino/a/é, or Spanish (6.7%), not applicable (5.6%), mixed race (4.8%), Black or African American (4.0%), prefer not to respond (2.8%), prefer to self-describe (.8%), and American Indian or Alaska Native (.4%). On average, participants reported being 36.64 years (*SD* = 11.81). The majority of participants reported having a 4-year college degree (42.1%), followed by an advanced degree (40.1%), some college (6%), 2-year college degree and high school/GED (2.8%), not applicable (6%), .4 (other). Further, participants worked an average of 43.52 hours per week and reported an average organizational tenure of 4.37 years (*SD* = 6.08). In the last three months, participants reported working remotely approximately half of the time (*M* = 54.40%, *SD* = 39.43). Participants reported working in a variety of industries including pharmaceuticals (34.3%), manufacturing (19.4%), technology (13.9%), medical/social services (12.7%), education (7.1%), research (6.48%), no response (6.0%), service (5.2%), finance (4.4%), hospitality (1.2%), and government (.8%), engineering (2.78%), logistics (2.78%), marketing (1.85%), real estate (1.85%), and healthcare (1.85%). Participants' job level also ranged with the majority of

participants reporting employee level (57.1%) followed by managers (17.5%), directors (9.9%), no response (6.0%), supervisors (4.4%), other (3.2%), executives (1.6%), vice presidents (.4%). Participants held a variety of jobs including software engineer, financial analyst, project coordinator, recruiter, business consultant, sales manager, teacher, accountant, and attorney.

Measures

Please see the appendices for the full text of all scales.

Workload. A total of four items were used to measure workload. Two items were from Rodell and Judge's (2009) Challenge and Hindrance Stressor scale and two items were from Spector and Jex's (1998) Quantitative Workload Inventory. Participants were asked to indicate the extent to which they agreed with each statement about their work that morning using a Likert scale ranging from (1) *strongly disagree* to (5) *strongly agree*. A sample item for Rodell and Judge (2009) and Spector and Jex (1998) included "This morning at work, I had to work on a large number of projects and/or assignments" and "This morning at work, my workload was high", respectively (ω_{within} = .81; $\omega_{between}$ = .95).

Microbreaks. Prior to measuring relaxation and physical microbreaks, I conducted a pilot study using cross-sectional data to validate the two scales. Please see Appendix A for an overview of the pilot study. Relaxation microbreaks were measured using Kim et al.'s (2017, 2018, 2021) microbreak scale. The original scale was adapted to include three items (as opposed to two items) to reduce overlap with the physical

microbreak scale. Participants indicated how frequently they engaged in relaxing activities during the morning at work using a scale ranging from *(1) never* to *(5) very frequently*. Past research has indicated that the timing of breaks is crucial for resource recovery at work (Hunter & Wu, 2015). Empirical evidence has found that breaks taken earlier in the day are linked to more post-break resources compared to breaks taken later in the day (Hunter & Wu, 2015). In line with this finding, I assessed relaxation microbreaks in the lunch survey, referencing microbreaks in the morning. A sample item includes "This morning at work, I relaxed briefly by stretching". Physical microbreaks were measured using two items from Kinnunen et al. (2015) based on Fritz et al. (2011). Participants indicated how frequently they engaged in short bouts of physical activity during the morning at work using a scale ranging from (1) *never* to (5) *very frequently*. Similar to relaxation microbreaks, I asked participants to report their physical microbreaks in the morning. A sample item included "This morning at work, I engaged in some form of physical activity, including walks.

End of Workday Negative Affect. To assess negative affect at the end of the workday, I used a short-form of the PANAS (Watson et al., 1998) validated by Thompson (2007). Participants indicated the extent to which they experienced five different negative feelings and emotions at the end of their workday using a Likert scale ranging from (1) *not at all* to (5) *extremely*. A sample item included "Today at the end of my workday, I felt upset" (ω_{within} = .59; $\omega_{between}$ = .86).

End of Workday Vigor. To assess vigor at the end of the workday, I used the vitality subscale from Porath et al.'s (2012) Thriving at Work scale. Participants indicated the extent to which they agreed with five statements using a Likert scale ranging from (1) *strongly disagree* to (5) *strongly agree*. A sample item includes "Today at the end of my workday, I felt alive and vital" (ω_{within} = .84; $\omega_{between}$ = .95).

Recovery Experiences. Recovery experiences in the evening were measured using Sonnentag and Fritz's (2007) Recovery Experiences Questionnaire (REQ). Participants indicated the extent to which they agreed with four statements per recovery experience using a Likert scale ranging from (1) *strongly disagree* to (5) *strongly agree*. Items were adapted for day-level measurement occasions. Sample items for psychological detachment, relaxation, and mastery experiences include "Today after work, I forgot about work", "Today after work, I kicked back and relaxed"**,** and "Today after work, I learned new things", respectively (Psychological Detachment: ω_{within} = .84; $\omega_{between}$ = .97), (Relaxation; ω_{within} = .92; $\omega_{between}$ = .99), and (Mastery Experiences: ω_{within} = .80; $\omega_{between}$ = .96).

Exercise. Exercise in the evening was measured using an adapted version of the Godin-Shephard Leisure Time Physical Activity Questionnaire (LTA; Godin, 2011, Godin & Shepherd, 1985). This questionnaire asked participants to indicate how frequently they engaged in mild (e.g., yoga, easy walking), moderate (e.g., volleyball, barre), and strenuous exercise (e.g., running, indoor cycling) during the evening that day. The frequency of the three categories (e.g., mild, moderate, strenuous) were multiplied by their metabolic

equivalent (MET) values (e.g., 9, 5, 3 respectively) and were used to create a daily exercise score. MET values represent the amount of oxygen used during exercise (The Center of Disease Control (CDC; *n.d.*). (See the following equation: LTA = (9 × strenuous) + (5 × moderate) + (3 × mild)).

Control Variables

All control variables were measured in the baseline survey. Specifically, negative affectivity served as a control variable in this study. Research evidence has shown that trait negative affect is associated with poorer recovery experiences such as lower psychological detachment from work during nonwork time (Wendsche & Lohmann-Haislah, 2017). Additionally, individuals higher in negative affectivity may evaluate stressors more negatively, therefore, impacting their perceptions of daily workload (Sonnentag et al., 2018; Spector et al., 2000). Negative affectivity was assessed using a short-form version of the PANAS (Watson et al., 1998) validated by Thompson (2007). Participants were asked to indicate how frequently they experience five different negative feelings and emotions in general. A sample item included “In general, I feel nervous” ($\omega_{between}$ = .73).

General microbreak autonomy also served as a control variable in this study. Microbreak autonomy refers to “individuals' perceived ability to choose freely when to take short respites and how long they will spend their breaks at work” (Kim et al., 2022, p. 10). Research on break characteristics shows that break activities that were preferred and taken earlier in the day were linked to more resource recovery post-break (Hunter &

Wu, 2016). Therefore, microbreak autonomy may be an important factor to control for when assessing the moderating role of microbreaks as microbreak autonomy enables employees to fulfill their own recovery needs at work in their preferred time or ways (Kim et al., 2017). Microbreak autonomy was measured using four items adapted from Sonnentag and Fritz's (2007) nonwork control subscale from the Recovery Experiences Questionnaire (REQ). These items were originally adapted and used by Kim et al. (2022). A sample item includes "During my breaks, I can decide my own break schedule during my workday" ($\omega_{between}$ = .81).

Analytic Strategy

Multilevel random coefficient path modeling was used to test the study hypotheses. Analyses were conducted using Mplus 8 (Muthén & Muthén, 1998–2017). Daily workload was person-mean centered and was modeled using random slopes (Algina & Swaminathan, 2011) whereas the control variables, trait negative affect and general microbreak autonomy, were grand-mean centered (Hofmann et al., 2000). In addition, daily workload was also controlled for at the between-person level (Zhang et al., 2009) as well as vigor at the end of the workday (i.e., alternative mediator) when testing hypotheses focused on workload and negative affect, and vice versa. Finally, in line with previous organizational research, day of the week was also controlled for with Wednesday as the referent (Yang et al., 2016).

Results

Missingness

A total of 59 participants completed only the baseline survey whereas 189 participants completed both the baseline and some daily surveys. A dummy code was created and participants who completed only the baseline survey were coded as zero whereas participants who completed both the baseline and some daily surveys were coded as 1. A series of independent *t*-tests were conducted to assess missingness and potential non-respondence biases within the sample (Rogelberg et al., 2003; Rogelberg et al., 2007). The two groups were compared based on age, organizational tenure, and hours worked per week. Results indicated no significant differences between the two groups for age [$t(42.247) = -1.05$, $p = .30$], tenure [$t(53.46) = -.09$, $p = .93$], and hours worked per week [$t(48.83) = .26$, $p = .80$].

Multilevel Confirmatory Factor Analyses

Multilevel confirmatory factor (MCFAs) analyses were conducted to examine the measurement structure of the focal variables. Data were analyzed using MPlus Version 8 (Muthén & Muthén, 1998). Model 1 consisted of an eight-factor model (i.e., daily workload, relaxation microbreaks, physical microbreaks, negative affect, vigor, psychological detachment, relaxation, and mastery). The 8-factor model fit the data adequately ($\chi 2 = 1364.88(812)$, $p < .00$, $SRMR_{within} = .05$, $SRMR_{between} = .09$, RMSEA = .03, CFI = .93. Model 2 consisted of a 6-factor model that combined the three recovery experiences into one factor (i.e., psychological detachment, relaxation, and mastery). The 6-factor model yielded poor fit ($\chi 2 = 2817.33(838)$, $p < .00$, $SRMR_{within} = .09$,

$SRMR_{between}$ = .15, RMSEA = .05, CFI = .76. Finally, the 1-factor model also yielded poor fit ($\chi 2$ = 5903.06(868), p < .00, $SRMR_{within}$ = .15, $SRMR_{between}$ = .26, RMSEA = .09, CFI = .40 (Hu & Bentler, 1999).

Descriptive Statistics

Descriptive statistics, scale reliabilities, and bivariate correlations are reported in Table 1. On average, participants reported low levels of negative affect (M_{within} = 1.19, SD_{within} = .33) and relaxation microbreaks (M_{within} = 1.72 SD_{within} = .61), physical microbreaks (M_{within} = 2.03, SD_{within} = .99), and mastery experiences (M_{within} = 2.62, SD_{within} = .93), whereas participants reported moderate levels of workload (M_{within} = 2.99, SD_{within} = 1.01), vigor (M_{within} = 3.21, SD_{within} = .83), psychological detachment (M_{within} = 3.32, SD_{within} = 1.09), relaxation (M_{within} = 3.57, SD_{within} = 1.03), and exercise (M_{within} = 140.11, SD_{within} = 199.47) Notably, negative affect had a fairly low standard deviation at the within-person level when compared to the other focal variables. Upon inspection of the within-person correlation matrix, workload in the morning was negatively related to psychological detachment (r = -.08, *ns*) and relaxation in the evening, (r = -.11, p < .05) and unrelated to exercise (r = -.07, *ns*) and mastery experiences in the evening (r = .00, *ns*). Workload in the morning was also negatively related to both relaxation (r = -.20, p < .01) and physical microbreaks (r = -.08, p < .05). Finally, workload in the morning was also negatively associated with vigor (r = -.13, p < .01), but unrelated to negative affect (r = -.01, *ns*) at the end of the workday.

Test of the Hypotheses[1]

As shown in Model 2 in Table 3, workload in the morning was not significantly related to higher negative affect at the end of the workday (B = -.01, p = .73). Therefore, Hypothesis 1 was not supported. The indirect relationship between workload in the morning and psychological detachment in the evening through negative affect at the end of the workday was not significant (B = .003, p = .77, 95% CI = [-.01, .02]). Therefore, Hypothesis 2a was not supported. Further, the indirect relationship between workload in the morning and relaxation in the evening through negative affect at the end of the workday was not significant (B = .003, p = .77, 95% CI = [-.01, .02]). Therefore, Hypothesis 2b was not supported. Additionally, the workload by relaxation microbreak interaction term was not significant (B = .002, p = .97). Therefore, Hypothesis 3 was not supported.

[1] Participants reported engaging in low levels of stretching (M_{within} = 2.03, SD_{within} = 1.01), psychological relaxation (M_{within} = 1.91, SD_{within} = .99), and napping (M_{within} = 1.13 SD_{within} = .49) during work. On average, across all three relaxation microbreak items, participants reported engaging in low levels of relaxation microbreaks (M_{within} = 1.72 SD_{within} = .61). Participants also reported engaging in low levels physical activity, including walks (M_{within} = 2.06 SD_{within} = 1.09) and going outside for fresh air (M_{within} = 2.01, SD_{within} = 1.11). On average, across the two physical microbreak items, participations reported engaging in low levels of physical microbreaks (M_{within} = 2.03, SD_{within} = .99). Overall, participants reported engaging in relaxation and physical microbreaks at work never (1) or rarely (2). Further, within-person inter-item relaxation and physical microbreaks correlations were examined between items within each microbreak scale. Results indicated that relaxing briefly by stretching and relaxing briefly by engaging in psychological relaxation were positively correlated (r = .31, p < .01) whereas relaxing by stretching was unrelated to relaxing briefly by taking a nap (r = .00, *ns*). Further, relaxing briefly by engaging in psychological relaxation and relaxing briefly by napping demonstrated a weak and positive, but non-significant relationship (r = .07, *ns*). Results indicated that engaging in some form of physical activity, including walks was positively corelated with going outside for fresh air (r = .47, p < .01). Since the third relaxation microbreak item (i.e., Relax briefly by taking a nap) was weakly correlated with the other relaxation microbreak items, supplemental analyses were conducted without the third relaxation microbreak item. Overall, the pattern of results remained the same.

Finally, for Hypothesis 4a, I tested the conditional indirect effects of workload in the morning on psychological detachment in the evening. When relaxation microbreaks in the morning were *higher*, the indirect effect of workload on psychological detachment through negative affect at the end of the workday was not significant (estimate = .003, 95% CI = [-.03, .03]). Similarly, when relaxation microbreaks in the morning were *lower*, the indirect effect of workload on psychological detachment through negative affect at the end of the workday was also not significant (estimate = .003, 95% CI = [-.03, .03]). Further, the difference between these two indirect effects was not significant (estimate = -.001, 95% CI = [-.04, .04]). Thus, Hypothesis 4a was not supported.

For Hypothesis 4b, I tested the conditional indirect effects of workload in the morning on relaxation in the evening. When relaxation microbreaks were *higher*, the indirect effect of workload on relaxation through negative affect at the end of the workday was not significant (estimate = .003, 95% CI = [-.03, .03]). Similarly, when relaxation microbreaks were *lower*, the indirect effect of workload on relaxation through negative affect at the end of the workday was also not significant (estimate = .004, 95% CI = [-.03, .04]). Further, the difference between these two indirect effects was not significant (estimate = -.001, 95% CI = [-.05, .05]). Thus, Hypothesis 4b was not supported.

As shown in Model 2 in Table 4, workload was not significantly related to lower vigor at the end of the workday (B = -.07, p = .17). Therefore, Hypothesis 5 was not supported. The indirect relationship between daily workload and mastery experiences in

the evening through vigor at the end of the workday was not significant (*B* = -.02, *p* = .20, 95% CI = [-.04, .01). Therefore, Hypothesis 6a was not supported. The indirect relationship between daily workload and exercise in the evening through vigor at the end of the workday was not significant (*B* = .47, *p* = .67, 95% CI = [-1.53, 2.14]). Therefore, Hypothesis 6b was not supported. The workload by physical microbreak interaction term was not significant (*B* = -.22, *p* = .17). Therefore, Hypothesis 7 was not supported.

For Hypothesis 8a, I tested the conditional indirect effects of workload on mastery experiences in the evening. When physical microbreaks were *higher*, the indirect effect of workload on mastery experiences through vigor at the end of the workday was not significant (estimate = -.06, 95% CI = [-.12, .01]). Similarly, when physical microbreaks were *lower*, the indirect effect of workload on mastery experiences through vigor at the end of the workday was also not significant (estimate = .01, 95% CI = [-.04, .07]). Further, the difference between these two indirect effects was not significant (estimate = -.07, 95% CI = [-.18, .04]). Thus, Hypothesis 8a was not supported.

For Hypothesis 8b, I tested the conditional indirect effects of workload on exercise in the evening. When physical microbreaks were *higher*, the indirect effect of workload on exercise through vigor at the end of the workday was not significant (estimate = 1.25, 95% CI = [-4.33, 6.83]). Similarly, when physical microbreaks were *lower*, the indirect effect of workload on exercise through vigor at the end of the workday was also not significant (estimate = -.32, 95% CI = [-2.15, 1.52]). Further, the difference

between these two indirect effects was not significant (estimate = 1.57, 95% CI = [-5.56, 8.71]). Thus, Hypothesis 8b was not supported.

Discussion

This study explored the recovery paradox which suggests that an individual's ability to recover from work stress is hindered when experiencing high levels of job demands at work. Specifically, this study investigated whether workload in the morning was indirectly related to recovery experiences in the evening through two mediating mechanisms, namely negative affect and vigor at the end of the workday. In addition, microbreaks, a common workplace behavior, were examined as boundary conditions of the recovery paradox by investigating whether these behaviors buffered the stressor-strain relationship. Although the results indicated little support for the overall hypothesized model, results did indicate a significant negative relationship between negative affect at the end of the workday and psychological detachment and relaxation in the evening. Further, vigor at the end of the workday was also significantly and positively associated with mastery experiences in the evening. Finally, workload in the morning was negatively associated with relaxation in the evening. Overall, these results point to the impact of stressors on recovery experiences as well as the importance of end of workday states in predicting recovery experiences later that day.

Theoretical Implications

In this study, I hypothesized that a common workplace stressor, workload in the morning, would be positively associated with negative affect at the end of the workday, an indicator of strain. In line with the Effort-Recovery Model (Meijman & Mulder, 1998), experiencing high levels of workload in the morning requires a significant amount

of energy expenditure which may increase load reactions and result in experiencing negative emotions. Unexpectedly, this direct relationship was not statistically significant, and results indicated that workload in the morning was very weakly and negatively associated with negative affect at the end of the workday. The non-significance of this relationship is surprising given that past evidence indicates a significant link between workload and negative emotional states (Kubicek et al., 2020; Rosen et al., 2020). A possible explanation for the weak relationship between workload and negative affect may be attributed to the measurement of these focal variables. A recent meta-analysis examining stressor-strain relationships in daily diary studies found that both the time precedence and type of strain influence the stressor-strain effect size, such that measuring stressors concurrently with emotional strain outcomes demonstrates a higher effect size compared to measuring stressors as a predictor of subsequent or time-lagged emotional strain outcomes (Pindek et al., 2019). Given that workload in the morning was measured as a *predictor* of negative affect at the end of the workday, this does not account for the level of workload in the afternoon and may in part explain the weak association between workload in the morning and negative affect at the end of the workday found in the present study. In addition, individuals may have many different experiences in the afternoon at work which may influence their level of negative affect. Further, relative to workload in the morning, these experiences in the afternoon may have a stronger influence on their responses to the negative affect measure due to recency bias (Yang et al., 2016) which could also add noise when assessing the relationship between these focal

variables. In addition, descriptive statistics suggest potential range restriction of the negative affect scores within the current sample. Specifically, the average score and standard deviation for negative affect was low (M_{within} = 1.19, SD_{within} = .33) which roughly corresponds with strongly disagree on the 5-point Likert scale. Further, the correlation (r = -.01) and regression coefficient (b = -.01; see Table 3) between workload in the morning and negative affect in the afternoon were low. Overall, range restriction may have attenuated this relationship making it difficult to detect a meaningful relationship between these two focal variables (Mendoza & Mumford, 1987).

Research has also shown that the most common negative emotions that individuals experience in organizational settings include frustration, worry, disappointment, annoyance, anger, unhappiness, embarrassment, sadness, disgust, fear, and bitterness (Ashkanasy & Dorris, 2017; Basch & Fisher, 2000). In this study, high activation negative affect was measured using five emotions including feeling hostile, upset, nervous, ashamed, and afraid (Thompson, 2007). Therefore, there may have been a gap between the measurement of negative emotions captured in the current study and the most common negative emotions experienced in the workplace. Therefore, the inclusion of other negative emotions such as feelings of distress or sadness may be important to capture as outcomes associated with high levels of workload in the morning. Further, individuals may have experienced social desirability bias when completing the measure of negative affect. This may in part be influenced by workplace norms that determine which emotions are appropriate for the workplace (Ashkanasy & Dorris, 2017).

In this study, I also hypothesized that workload in the morning would be negatively associated with vigor at the end of the workday, an indicator of high energetic resources. In line with COR Theory, when employees experience high workload in the morning, this may consume employees' energetic resources over time leaving them in a state of energetic resource depletion. Results indicated that this relationship was negative and non-significant. Research exploring energy throughout the workweek suggests that individuals experience natural fluctuations in energy that vary day to day (Weigelt et al., 2021). Specifically, these findings indicated that energy levels drop from Sunday to Monday and remain fairly low from Monday to Thursday whereas energy levels start to rise and remain high from Thursday to Sunday (Weigelt et al., 2021). These findings may suggest that the relationship between workload and vigor at the end of the workday may be obscured by natural fluctuations in energy levels. Taken together, this may suggest that natural changes in energy levels across the workweek may account for a larger amount of variance in vigor day to day as opposed to the experience of workload itself (Weigelt et al., 2021). Further, individuals may have other experiences in the afternoon which can obscure or override the effects that workload may have on an individual's levels of vigor at the end of the workday (Sonnentag & Niessen, 2008).

Another alternative explanation for the lack of significant relationships between workload in the morning and end of workday states in the overall model may be that

these relationships are not linear, but rather curvilinear (Podsakoff et al., 2023)[2]. For instance, Pindek and colleagues (2022) found that daily workload had a curvilinear, *J-shaped* association with strain outcomes in the evening and the following morning indicating that both work underload and overload hinder wellbeing. Therefore, it may be possible that low (work underload) and high (work overload) levels of workload in the morning may be associated with lower vigor and higher negative affect, respectively, whereas moderate levels of workload may be associated with the highest levels of vigor and lowest levels of negative affect. Future research may benefit from examining non-linear relationships between work stressors and end of workday states.

This study also examined whether workload in the morning was indirectly related to (a) lower psychological detachment and (b) relaxation in the evening through higher negative affect at the end of the workday, contingent on the frequency of relaxation microbreaks. While neither the indirect effect nor the conditional indirect effect was significant, consistent with previous findings, higher negative affect at the end of the workday was moderately and significantly associated with lower psychological detachment in the evening, suggesting that negative affect may prime individuals to recall

[2] Supplemental analyses were conducted to examine whether workload in the morning demonstrated a curvilinear relationship with negative affect and vigor at the end of the workday. Workload in the morning was centered prior to computing the quadratic term and both linear and quadratic terms were included in the model (Cohen et al., 2003). Results indicated that neither the linear nor quadratic terms for the relationship between workload and negative affect were significant, b = -.004, p = .83 and b^2 = -.01, p = .86, respectively. In addition, neither the linear nor quadratic terms for the relationship between workload and vigor were significant, b = -.09, p = .08 and b^2 = .05, p = .52, respectively. Overall, the current sample demonstrated no support for a curvilinear relationship between workload in the morning and negative affect and vigor at the end of the workday.

more negative thoughts during their non-work time which hinders an individual's ability to mentally let go of work-related thoughts (Sonnentag, 2018). Along these same lines, higher negative affect at the end of the workday was moderately and significantly associated with lower relaxation in the evening, suggesting that negative affect at the end of the workday may impair an individual's ability to relax in the evening through increasing load reactions which prolongs activation and strain in the evening (Meijman & Muelder, 1998; Steed et al., 2019). These findings are in line with previous meta-analytic evidence indicating that both detachment (r = -.31) and relaxation (r = -.*36*) are negatively associated with state negative affect (Steed et al., 2021). Moreover, the link between negative affect at the end of the workday and psychological detachment in the evening is well supported in other daily diary studies (e.g., Sonnentag & Lischetzke, 2018; Van Wijhe et al., 2013; Cangiano et al., 2018).

I also examined whether workload in the morning was indirectly related to lower (a) mastery experiences and (b) exercise in the evening through lower vigor at the end of the workday, contingent on the frequency of physical microbreaks. Although neither the indirect effect nor conditional indirect effect were significant, results indicated that vigor at the end of the workday was positively associated with mastery experiences in the evening. In support of this finding, meta-analytic evidence has shown that vigor is positively associated with mastery experiences (r = .29) (Bennett et al., 2018). In the context of COR Theory, high vigor at the end of the workday, an indicator of energetic resources, may enable individuals to utilize and invest these energetic resources to ensure

future resource gain through engaging in mastery experiences that evening. This finding is consistent with COR Theory which suggests that having access to more resources - that is energetic resources - makes you more capable of future resource gain through resource investment. While I hypothesized a positive relationship between vigor at the end of the workday and exercise in the evening, unexpectedly, this relationship was non-significant. This may in part be explained by the measurement of exercise in the current study. Participants were asked to report the number of minutes they engaged in exercise in the evening only. Given that individuals may exercise during other times of the day such as before work, at lunch, or at the end of the workday, (ten Brummelhuis et al., 2022) this is not accounted for in the current study design or analyses and may account for a lack of significant findings.

Relaxation and physical microbreaks were hypothesized to moderate the direct relationship between workload and negative affect and workload and vigor, respectively. The non-significant interaction effects may partially be explained by previous research focusing on the timing of measuring the microbreaks, the type of microbreak, and the combination of energy management strategies. First, microbreaks were measured in the lunchtime survey and participants were asked about the frequency in which they engaged in microbreaks that morning. Kim et al. (2017) measured microbreaks in the afternoon (as opposed to morning) and found that relaxation microbreaks buffered the direct relationship between daily workload and negative affect at the end of the workday. Therefore, it may be possible that measuring microbreaks at lunchtime was not enough

time to see the potential buffering effect of these daily behaviors. However, research on break characteristics has shown that microbreaks taken earlier in the day as opposed to later in the day are associated with greater resources post-break (Hunter & Wu, 2015). Additional research is needed to understand when microbreaks should be measured in order to understand their potential effects.

Second, research has also pointed to the importance of engaging in microbreaks that are *preferred* which has been shown to be a predictor of post-break resource recovery (Hunter & Wu, 2015). In their study, Hunter and Wu (2015) asked whether participants engaged in a preferred microbreak during work and found that preferred microbreaks were linked to higher motivation, energy, and concentration post-break (Hunter & Wu, 2015). Therefore, perhaps it is not a specific type of microbreak (i.e., relaxation versus physical microbreaks) that can buffer the effect of workload in the morning on end of workday states, but rather individuals engaging in their preferred microbreak which may be most beneficial. Consistent with this, researchers found that person-break fit, defined as when one's break fits their needs and preferences, is associated with more positive outcomes compared to breaks that do not fit one's needs (Venz et al., 2019).

Furthemore, prior research has also pointed to the importance of assessing patterns of daily energy management at work by examining combinations of work-related energy management strategies and microbreaks at work (Kinnunen et al., 2015; Sonnentag et al., 2022). Work-related energy management strategies foster intrinsic motivation through fulfilling one's needs and include organizing, meaning-related, and

prosocial strategies such as setting a new goal, reflecting on the meaning of one's work, as well as helping others at work, respectively (Parker et al., 2017). In their study, Kinnunen and colleagues (2015) compared four energy management profiles, namely, passives (i.e., seldom work-related strategies and private microbreaks [reading and listening to music] and rare physical microbreaks [e.g., walks and stretching]), actives (i.e., frequent work-related strategies and physical microbreaks, infrequent private microbreaks), casuals (i.e., casual use of work-related strategies, physical, and private microbreaks), and averages (i.e., average use of all three strategies). The results of their study found that actives experienced the highest levels of vigor followed by casuals compared to passive and averages. Overall, these findings point to the importance of considering which *combinations* of energy management strategies, both work-related strategies and microbreaks, are most beneficial for boosting energy levels at work. Therefore, it may be beneficial to examine the role of work-related energy management strategies in addition to physical microbreaks to detect the energizing effects of these microbreaks throughout the workday.

Finally, it may be possible that the lack of significant findings is attributed to low statistical power. Participants were asked to complete three surveys per day across five workdays. While this research design reduces issues with temporal precedence and recall bias, the number of surveys required for participants to complete may be burdensome and result in greater missing data (Beal et al., 2015). Beal and colleagues (2015) state that "even among participants who are exceedingly motivated and interested in the study, it is

not always possible to respond to every signal" (p. 392) due to reasons such as poor timing or busy schedules. In this study, I collected 397 unique observation days which is well below the recommended average Level 1 sample size range from 835 to 880 (Gabriel et al., 2019; Nguyen et al., 2019). Therefore, the large amount of missing data may limit the ability to detect significant relationships.

Practical Implications

The results of this study suggest that end of workday states are important predictors of recovery experiences in the evening. Specifically, negative affect at the end of the workday was negatively associated with psychological detachment and relaxation in the evening. In addition, vigor at the end of the workday was positively associated with mastery experiences in the evening. Overall, the results point to the importance of engaging in activities that can reduce negative affect and increase vigor at the end of the workday to facilitate higher levels of detachment and relaxation, and mastery experiences in the evening, respectively. For instance, in this study, relaxation microbreaks were positively and significantly correlated with higher vigor at the end of the workday. Therefore, engaging in voluntary short breaks like stretching or meditating throughout the workday may help promote positive end of workday states. Finally, workload in the morning was negatively associated with relaxation in the evening suggesting that job demands like high workload may impair recovery experiences in the evening. From an organizational perspective, managers should be mindful of the level of workloads they assign to their employees as the mismanagement of workload is problematic for

employees' health (Bowling et al., 2015), and likely hinders employee's relaxation after work, as shown in the present study. From an individual perspective, employees may also benefit from implementing time management strategies and creating to-do lists that prioritize the most important tasks to complete when faced with high workloads that day.

Limitations and Future Research Directions

While the proposed research sought to provide greater insight into the recovery from work stress literature, there are some limitations to note. First, the current study utilized self-report data only raising concerns with common method bias (Podsakoff et al., 2003). Future research may benefit from including objective measures of focal variables. For instance, researchers may utilize accelerometers to measure daily exercise behaviors (e.g., Niermann et al., 2016). Further, researchers could use electrocardiographs to measure arousal, an important indicator of strain that may impact recovery experiences in the evening. For example, Parker and colleagues (2020) used portable electrocardiographs to assess the regulation of physiological arousal at work (as indexed by heart rate variability [HRV]) and found that HRV directly predicted relaxation in the evening. Therefore, utilizing objective measures of study variables may capture fluctuations in focal variables in real-time.

Another limitation is the inclusion criteria required to participate in the current study. Given the nature of daily diary studies and the requirement for participants to work similar hours, this study lacks generalizability to the broader working population. In their

recent review of the recovery from work stress literature, Sonnentag and colleagues (2022) call for future research to investigate recovery from work stress for workers who have alternative work schedules like gig workers or freelancers. This highlights the need to investigate how the recovery paradox unfolds within other work contexts or across different occupations that rely on non-traditional work schedules like shift workers as these workers may suffer from poorer working conditions, lower wages, and higher stress and general health issues (Sonnentag et al., 2022). In a similar vein, approximately 82% of the current sample reported having a 4-year college degree or an advanced degree. Therefore, the current sample was largely WEIRD - that is western, educated, industrial, rich, and democratic (Henrich et al., 2010) - and thus these findings may lack generalizability as WEIRD samples tend to be highly unrepresentative of the broader population (Henrich et al., 2010). Therefore, future research may benefit from exploring the recovery paradox across more diverse samples of individuals.

Given the lack of significant findings, it may be important to consider whether the current data was appropriate for multilevel analyses, whether the study suffered from low statistical power, or whether there were unique characteristics about the sample that influenced the lack of study findings. For example, intraclass correlations [ICC(1)] were calculated to examine whether there was sufficient within-person variability to justify the use of multilevel analyses (Bliese, 1998). It is common for ICC(1) values to range from

.10 to .30 for individuals within groups or in this case individuals across days (Bauer & Curran, 2021; Bliese, 1998). In this study, the ICC(1) values for the focal variables ranged from .40 to .65 suggesting that the use of nested data is appropriate. Specifically, workload [ICC(1) = .51)], negative affect [ICC(1) = .65], and vigor [ICC(1) = .52)] all demonstrated sufficient within-person variability across the five study days, namely 49% (i.e., 1-.51), 35% (i.e., 1-.65), and 48% (i.e., 1-.52) of the total score variance, respectively for workload, negative affect and vigor. Relatedly, a review of within-person research by McCormick et al. (2020) found that job stressors like daily workload [ICC(1) = .52] and individual states such as negative affect [ICC(1) = .45] and vigor [ICC(1) = .39] exhibit meaningful within-person variation in past empirical research, namely 48% (i.e., 1-.52), 55% (i.e., 1-.45), and 61% (i.e., 1-.39) of the total score variance, respectively for workload, negative affect and vigor. Thus, the focal phenomena examined in my study seem to have a level of within-person variability comparable to that reported in the past literature. However, some focal variables in my study showed low within-person variability across days (i.e., low standard deviations). For example, on average, participants reported experiencing low levels of negative affect (M_{within} = 1.19, SD_{within} = .33) and this stayed fairly consistent across days. In my study sample negative affect (ICC(1) =.65) seems to have relatively low absolute levels of within-person variability (i.e., 35%, 1- ICC(1)), which may in part be attributed to sample error (e.g.,

low levels of fluctuations in negative emotions during the study period) or measurement issues (e.g., potential gap between the measurement of negative emotions captured in the current study and the most common negative emotions experienced in the workplace). However, in line with McCormick et al. (2020), workload across days showed sufficient within-person variability with scores ranging from neither agree nor disagree to agree (M_{within} = 2.99, SD_{within} = 1.01).

It may also be possible that the current study suffered from low statistical power making it difficult to detect significant relationships among focal variables. Based on a review of 90 experience sampling studies (ESM) from top-tier journals, Gabriel and colleagues (2019) recommend an average Level 1 sample size of 835 and a Level 2 sample size of 83. Similarly, in another review of over 100 ESM studies of top I/O Psychology, Management, and Occupational Health Psychology journals, Nguyen and colleagues (2019) recommend an average Level 1 sample size of 880 and a Level 2 sample size of 176 for a medium effect size. In the current study, I collected 397 unique observation days, roughly half (45% to 48%) of the recommended number of Level 1 observations (Gabriel et al., 2019, Nguyen et al., 2019). Further, participants completed an average of 2.15 observation days which is less than half of the total possible observation days in this study. Unfortunately, high amounts of missing data may impact power and according to Beal (2015), missing data in experience sampling studies can

often range from 20-30% or more. Therefore, in order to maximize statistical power, future studies may benefit from utilizing strategies aimed at increasing survey participation rates such as encouraging participants to pledge a specific level of participation which in turn may increase the likelihood of meeting one's pledge (Gabriel et al., 2019). Participation may also increase by observing or hearing that other individuals are actively participating in the study (Gabriel et al., 2019). Active participation signals acceptance of the behavior and likely will increase participation. However, this may be most effective in settings where researchers are collecting data from one organization and able to share overall response rates of the group during the data collection process, in effort to motivate the potential participants and boost individual participation.

Future research may also benefit from examining whether the relationship between workload in the morning and end of workday states is best represented by a curvilinear relationship. Pindek and colleagues (2022) argue that the relationship between workload and attitudinal and wellbeing outcomes are small due to being incorrectly specified. Further, their recent study found that workload had a curvilinear effect on job satisfaction and mental wellbeing (Pindek et al., 2022). Their work supports the view that workload and strain outcomes may not be best represented by a linear relationship, but rather these relationships may be more nuanced than originally thought. Therefore, future

research may benefit from exploring curvilinear relationships between workload and end of workday states.

Another limitation of this study includes the inclusion of only negative affect and vigor at the end of the workday as mediating mechanisms of the recovery paradox. For instance, Sonnentag (2018) proposed that constant technological connectivity to work may indirectly link daily stressors to lower levels of psychological detachment and sleep, two core recovery experiences. Assessing technological connectivity is especially relevant in today's workplace given that work and non-work boundaries have become increasingly blurred due to the reliance on work-related technology during and outside of formal work hours. Future research may also consider alternative cognitive mediators like challenge and hindrance appraisals as these appraisals may elicit certain emotional responses and coping mechanisms which may facilitate or undermine recovery experiences (Podsakoff et al., 2023). Therefore, future research may expand the recovery from work stress literature by exploring additional mediators linking different stressors to poorer recovery experiences in the evening.

Finally, while the current study examined the frequency of workload in the morning across five workdays, recent research has highlighted the importance of examining the link between the unpredictability or fluctuation of daily stressors and strain outcomes. In other words, stressor characteristics like how much the stressor varies day

to day may be a stronger predictor of strain as opposed to the mere presence of the stressor itself. For instance, Rosen et al. (2020) found that individuals experienced increased levels of anxiety on weeks when challenge stressors fluctuated compared to weeks with stable levels of challenge stressors. Therefore, future research may benefit from examining the fluctuation of workload from across workdays. Further, given that the current study only spanned five workdays, future research may benefit from implementing daily diary studies over a longer period of time such as multiple weeks to capture fluctuations in stressors and their impact on daily recovery experiences over time.

Conclusion

A breadth of research on recovery from work stress suggests that individual's recovery from work stress is impaired when experiencing high levels of stressors at work (Sonnentag et al., 2018). Using a five-day daily dairy study with three timepoints per day, the current study sought to directly test this by examining whether daily workload was indirectly related to lower recovery experiences through higher negative affect and lower vigor at the end of the workday. Despite the lack of statistically significant findings in the present study, this study suggests that future research should continue examining the recovery paradox at the within-person level using research designs like experience sampling studies with more observations. In addition, future research may benefit from designing studies aimed at maximizing participation through offering incentives and encouraging participants to make pledges to promote participation rates to increase statistical power for a more thorough investigation of the recovery paradox (Gabriel et al., 2019). Finally, this study suggests that the recovery paradox may be nuanced, and that future research may benefit from examining a wider array or combination of stressors – that is interpersonal, role, and environmental stressors – at work to better understand their relative impact on recovery experiences in the evening.

Table 1. *Means, Standard Deviations, Reliabilities, and Correlations*

	Mean	SD	ICC(1)	ω_{within}	$\omega_{between}$	1	2	3	4	5	6	7	8	9	10	11
Within-level variables																
13. Workload	2.99	1.01	.51	.81	.95	-	-.20**	-.08*	-.01	-.13**	-.08	-.11*	.00	-.07		
14. Relaxation Microbreak	1.72	.61	.57	-	-	-.22**	-	.31**	-.04	.11*	-.11*	-.01	.07	-.04		
15. Physical Microbreaks	2.03	.99	.49	-	-	-.05	.47**	-	.04	.03	-.04	.04	.06	-.08		
16. Negative Affect	1.19	.33	.65	.59	.86	.25**	.01	-.17**	-	-.27**	-.07	-.08	-.04	-.03		
17. Vigor	3.21	.83	.52	.84	.95	-.08*	.19**	.25**	-.37**	-	.01	.004	.10*	-.03		
18. Detachment	3.32	1.09	.50	.84	.97	-.51**	.21**	.002	-.23**	.16**	-	.38**	.13**	.10*		
19. Relaxation	3.57	1.03	.39	.92	.99	-.38**	.31**	.16**	-.13**	.18**	.62**	-	-.003	-.04		
20. Mastery Experiences	2.62	.93	.40	.80	.96	.01	.21**	.13**	-.01	.27**	.15**	.07	-	.26**		
21. Exercise	140.11	199.47	.50	-	-	-.06	.17**	.05	.19**	-.02	.07	.07	.17**	-		
Person-level variables																
22. Negative affectivity	1.80	.56	-	-	.73	.07	-.01	-.23**	.53**	-.30**	-.17**	-	-.01	.10**	-	
23. General Break Autonomy	4.10	.74	-	-	.81	-.31**	.02	.05	-.29**	.18**	.25**	.11** .20**	-.19**	-.08*	- .26**	-
24. General Workload	4.49	1.23	-	-	.77	-.22**	.08*	-.04	-.18**	.10**	.06	.11**	-.10**	.01	-.07*	.05

Notes. Correlations above the diagonal represent within-person associations whereas correlations below the diagonal represent between-person associations. ω_W represents within-person omegas whereas ω_B represents between-person omegas.
$^*p < .05$, $^{**}p < .01$.

Table 2. *Model Fit Results for Two-Level Confirmatory Factor Analyses of Other Focal Measures*

Models	$\chi 2$	*df*	SRMR (Within)	SRMR (Between)	CFI	RMSEA
Model 1: Hypothesized eight-factor model	1364.88	812	.05	.09	.93	.03
Model 2: Combining recovery experiences (detachment, relaxation, and mastery)	2817.33	838	.09	.15	.76	.05
Model 3: Combining all variables	5903.06	868	.15	.26	.40	.09

Note. We ran all CFAs as two-level models. The hypothesized eight factors are workload, relaxation microbreaks, physical microbreaks, negative affect, vigor, psychological detachment, relaxation, and mastery. CFI = comparative fit index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.

Table 3. *Multilevel Estimates for the Relationship Among Workload, Negative Affect, Psychological Detachment and Relaxation, and Moderation of Relaxation Microbreaks*

	Negative Affect		Psychological Detachment	Relaxation
Measure	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Intercept	1.19 (.02)***	1.18 (.02)***	3.99 (.24)***	4.16(.23)***
Day-level control variables				
Monday	.07 (.03)*	.06 (.03)	.06 (.03)	.06 (.03)
Tuesday	.04 (.03)	.06 (.03)	.06 (.03)	.06 (.03)
Thursday	.04 (.03)	.07 (.04)	.07 (.04)	.07 (.04)
Friday	-.002 (.04)	-.01 (.02)	-.01 (.02)	-.01 (.02)
Person-level control variables				
General workload	-.11 (.09)	.02 (.08)	.003 (.04)	.003 (.04)
Trait negative affect	.002 (.04)	.01 (.04)	.01 (.06)	.01 (.06)
General break autonomy	.003 (.05)	.003 (.05)	.12 (.08)	.12 (.08)
Day-level focal variables				
Workload		-.01 (.02)	-.01 (.02)	-.01 (.02)
Relaxation microbreak		-.01 (.04)	-.02 (.05)	-.02 (.05)
Interactions				
Workload x Relaxation microbreaks		.02 (.05)	-.001 (.05)	-.001 (.05)
Mediator				
Negative affect			-.51 (.19)**	-.50(.18)**
Workload			-.25 (.08)**	-.30(.10)**
Vigor			-.01 (.09)	-.04(.09)

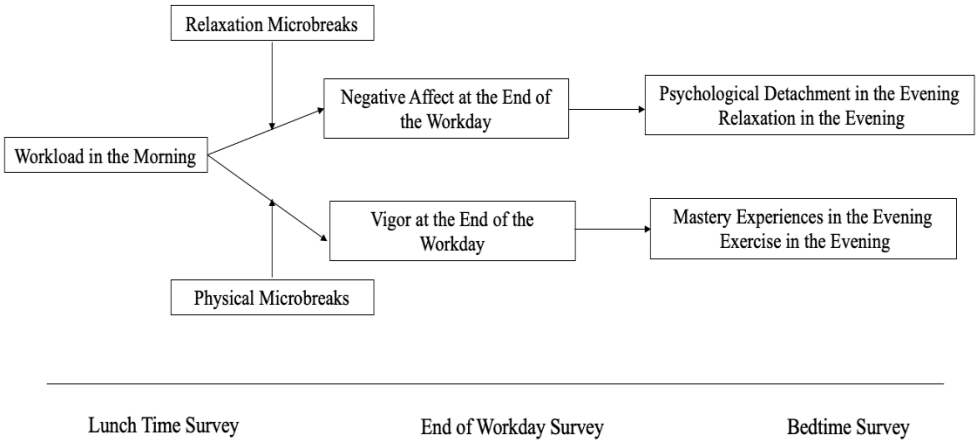
Note. N=569-684 at the day level. * $p < .05$, ** $p < .01$, *** $p < .001$. For Model 1, there was no predictor in the model and workload was included in the Full model as an independent variable. For Model 2, workload, relaxation microbreaks, and their interaction term were included in the Null model. For Model 3, this included all predictor and outcome variables.

Table 4. *Multilevel Estimates for the Relationship Among Workload, Vigor, Mastery Experiences and Exercise, and Moderation of Physical Microbreaks*

	Vigor		Mastery Experiences	Exercise
Measure	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Intercept	3.29(.05)***	3.26(.05)***	1.82(.25)***	158.21(47.77)**
Day-level control variables				
Monday	-.17(.08)*	-.22(.08)*	-.21(.08)*	-.21(.08)*
Tuesday	-.19(.08)*	-.26(.08)**	-.26(.08)*	-.26(.08)*
Thursday	-.03(.08)	-.12(.08)	-.12(.08)	-.12(.08)
Friday	.06(.09)	-.07(.04)	-.07(.04)	-.07(.04)
Person-level control variables				
General workload	-.11(.09)	.01(.04)	.12(.08)	.12(.08)
Trait negative affect	.002(.04)	.01(.04)	.003(.04)	.003(.04)
General break autonomy	.003(.05)	.003(.05)	.01(.06)	.01(.06)
Day-level focal variables				
Workload		-.07(.04)	-.07(.04)	-.07(.04)
Physical microbreak		.04(.05)	.05(.05)	.05(.05)
Interactions				
Workload x Physical microbreaks		-.18(.13)	-.22(.15)	-.22(.15)
Mediator				
Vigor			.25(.07)***	-4.53(13.55)
Workload			.05(.07)	-9.78(17.70)
Negative Affect			.03(.20)	-48.02(52.79)

Note. N=569-684 at the day level. * $p < .05$, ** $p < .01$, *** $p < .001$. For Model 1, there was no predictor in the model and workload was included in the Full model as an independent variable. For Model 2, workload, physical microbreaks, and their interaction term were included in the Null model. For Model 3, this included all predictor and outcome variables.

Figure 1. *Hypothesized Research Model*



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Appendix A: Adaption of Relaxation and Physical Microbreak Scales

Kim et al. (2017) developed a scale to measure four types of microbreaks including relaxation, nutrition, social, and cognitive microbreaks. These subscales were developed from a pilot study by Kim and colleagues (2017) and have been utilized in published studies in Journal of Organizational Behavior (Kim et al., 2018) and Journal of Applied Psychology (Kim et al., 2018; Kim et al., 2022). The initial list of microbreak activities were created through examining past literature on energy management (Kim et al., 2017). Subject matter experts including psychology faculty and graduate students were then used to revise the initial list of microbreak activities. Finally, the authors conducted interviews with office workers to confirm the use of these microbreaks. The physical microbreak scale was validated by Kinnunen et al. (2015) through exploratory and confirmatory factor analysis. These scales were used and adapted for the current study and therefore, the purpose of this pilot study is to validate the adapted relaxation and physical microbreak scales.

Step 1: Adapting the microbreak scales

The original relaxation microbreak scale includes two items with several relaxation microbreak examples. The two items include “Stretching, walking around the office, relaxing briefly” and “Daydreaming, gazing out the office windows, taking quick naps, any other psychological relaxation”. First, to clarify the intention of the microbreak, I added “Relaxed briefly by…” as the introduction of each relaxation microbreak item. The goal of this change was to ensure that participants responded to each item with the

intention of engaging in each microbreak with the goal of relaxation. Second, I separated the two microbreak items to create three items with two items referring to physical relaxation and one item referring to psychological relaxation. Additionally, the instructions indicated the following "Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work in general". Response options remained unchanged from the original validation study and participants were asked to respond to each item using a 5-point Likert scale ranging from (1) *never* to (5) *very frequently*. The final updated relaxation microbreaks items included "Relaxed briefly by stretching", "Relaxed briefly by using psychological relaxation strategies (e.g., meditating, daydreaming, gazing outside the window)", and "Relaxed briefly by taking a quick nap".

The original physical microbreaks scale also included two items. The two items included "Engage in some form of physical activity, including walks or stretching" and "Go outside for fresh air". To reduce overlap with the relaxation microbreak scale, I removed stretching from the first item. Additionally, the Likert scale options were changed from (1) *very seldom/never* (5) *very often* to (1) *never* to (5) *very frequently* to ensure consistency across the measurement of different microbreaks. The instruction indicated the following "Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work in general." The final updated physical microbreaks

items included “Engage in some form of physical activity, including walks” and “Go outside for fresh air”.

Step 2: Participants and Procedure

Participants were recruited through convenience sampling and data was collected through a cross-sectional survey. The final sample consisted of 198 participants. The majority of participants were women (56.7%) and White (65.5%) and the average age of participants was 36.64 years old (*SD* = 11.81). In addition to modifying the relaxation and physical microbreak scales, I also investigated whether these two scales demonstrated convergent, discriminant, and criterion validity. For convergent validity, I examined whether both relaxation and physical microbreaks were related to social and cognitive microbreaks. For discriminant validity, I examined whether relaxation and social microbreaks were related to negative affect. Finally, for criterion validity, I examined whether both microbreaks were related to adaptive work behavior.

Social and Cognitive Microbreaks. To assess social and cognitive microbreaks, I used two scales validated by Kim et al. (2017). Participants indicated how frequently they generally engaged in specific behaviors at work using a Likert scale ranging from (1) *never* to (5) *very frequently*. A sample item for social and cognitive microbreaks include “Text, using instant messenger, or phone friends or family members” and “Read nonwork-related books, newspapers, and magazines”, respectively.

Trait Negative Affect. To assess trait negative affect, I used a short-form of the PANAS (Watson et al., 1998) validated by Thompson (2007). Participants indicated the

extent to which they generally experienced five different negative feelings and emotions in general using a Likert scale ranging from (1) *not at all* to (5) *extremely*. A sample item included "In general, I feel upset".

Adaptive Work Behavior. To measure adaptive work behavior, I used a 3-item measure from Griffin et al. (2007). Participants were asked to report how often reported different experiences at work in general using a 5-point Likert scale ranging from (1) *not at all* to (5*) a great deal*. A sample item included "I adapt well to changes in core tasks."

Step 3: Exploratory Factor Analyses and Item Reduction

An exploratory factor analysis with principle axis factoring was conducted to examine the factor structure of the 3-item relaxation and 2-item physical microbreak scale. The Scree plot suggested two factors which were rotated using the Direct Oblimin rotation. Upon examination of the pattern matrix, results indicated that all physical microbreak items loaded onto their own factor. Results also indicated that relaxation microbreak item #1 and item #2 loaded onto a second factor whereas relaxation microbreak item #3 ("Relaxed briefly by taking a nap") loaded poorly onto both factors (Factor 1 $\lambda = .14$ & Factor 2 $\lambda = .14$). Factor 1 (physical microbreak factor) accounted for 29.93% of variance and Factor 2 (relaxation microbreak factor) accounted for 11.68% of variance. The two factors were moderately and positively correlated, $r = .48$.

A follow-up exploratory factor analysis with principle axis factoring was conducted with the 2-item relaxation and 2-item physical microbreak scale. The Scree plot suggested two factors which were rotated using Direct Oblimin rotation. The pattern

matrix suggested that physical microbreak item #1 (λ = .81) and physical microbreak item #2 (λ = .71) loaded onto one factor. In addition, results showed that relaxation microbreak item #1 (λ =.60) and relaxation microbreak #2 (λ = .53) loaded onto a separate factor. Factor 1 (physical microbreaks) accounted for 34.68% of variance and Factor 2 (relaxation microbreaks) accounted for 10.32% of variance. The two factors were moderately and positively correlated, r = .48.

Step 4: Confirmatory Factor Analysis

To examine the structure of the microbreak items, I conducted a confirmatory factor analysis (CFA) in MPlus (Muthen & Muthen, 2006). Model 1 consisted of a hypothesized 2-factor model (i.e., relaxation and physical microbreaks). The 2-factor model yielded adequate fit ($\chi 2 =$ 4.24(1), p = .04, SRMR = .02, RMSEA = .13, CFI = .97) whereas the 1-factor model yielded poor fit ($\chi 2 =$ 17.67(2), p = .0001, SRMR = .07, RMSEA = .20, CFI = .86). Overall, results indicated that the 2-factor model fit the data best.

Step 5: Convergent, Discriminant, and Criterion Validity

To examine convergent validity for both the relaxation and physical microbreak scales, I examined the inter-correlations between each scale and social and cognitive microbreak scales (Kim et al., 2017, 2018). Relaxation microbreaks were positively related to social (r = .17, p < .01) and cognitive microbreaks (r = .24, p < .01). Similarly, physical microbreaks were positively related to social (r = .13, p < .01) and cognitive microbreaks (r = .29, p < .001). The positive association between relaxation microbreaks

and cognitive and social microbreaks aligns with previous findings by Kim et al. (2017, 2018). Additionally, the positive relationship between physical and social and cognitive microbreaks has been supported by de Bloom et al. (2014).

To examine discriminant validity for both relaxation and physical microbreak scales, I examined the inter-correlations between each scale and negative affect. Overall, research has shown that environmental factors such as stressors at work are often related to the use of microbreaks at work as opposed to specific personality traits. Results indicated that relaxation microbreaks were weakly and non-significantly associated with negative affect (r = .03, *ns*) whereas physical microbreaks were weakly but significantly correlated with negative affect (r = -.17, p < .01).

Finally, to examine the criterion validity for both microbreak scales, I examined the inter-correlation between both microbreak scales and adaptive work behavior. Previous research has shown that relaxation (Kim et al., 2018) and physical microbreaks (de Bloom et al., 2014) are directly and indirectly related to higher levels of performance at work. Results indicated that both relaxation (r = -.08, *ns*) and physical microbreaks (r = .05, *ns*) were not significantly related to adaptive work behavior. Perhaps adaptive work behavior is a specific facet of performance whereas previous research has examined the relationship between microbreaks and broader forms of performance (i.e., task performance, contextual performance, creativity). Overall, we found low criterion validity for both relaxation and physical microbreaks.

Conclusion

Overall, the adapted relaxation and physical microbreak scales showed strong convergent validity with social and cognitive microbreaks. Further, these two scales showed strong discriminant validity when assessing the intercorrelation with negative affect. However, both relaxation and physical microbreak scales showed weak criterion validity when examining the relationship between each microbreak scale and adaptive work performance. A limitation of the current pilot study is the use of one sample to conduct both the exploratory and confirmatory factor analysis. Best practices recommend using different samples or splitting one larger sample in half for each factor analysis. Further, the adapted relaxation and physical microbreak scales were based on between-person results and were used for a within-person research study. However, future research should validate the two microbreak scales at the within-person level.

Table 5. *Model Fit Results for Single-Level Confirmatory Factor Analyses of Microbreak Scales*

Models	**$\chi 2$**	***df***	**SRMR**	**CFI**	**RMSEA**
Model 1: Hypothesized 2-factor model	4.24	1	.02	.97	.13
Model 2: Combining all variables	17.67	2	.07	.86	.20

*Not*e. We ran all CFAs as single-level models. The hypothesized two factors were relaxation microbreaks and physical microbreaks. CFI = comparative fit index; RMSEA = root-mean-square error of approximation;
SRMR = standardized root-mean-square residual.

Table 6. *Means, Standard Deviations, Correlations Between Relaxation and Physical Microbreaks (Pilot Study)*

	Mean	SD	1	2	3	4	5
1. Relaxation Microbreaks	2.58	.81					
2. Physical Microbreaks	2.89	.92	.30**				
3. Social Microbreaks	3.01	.74	.17**	.13*			
4. Cognitive Microbreaks	2.39	.84	.24**	.29**	.44**		
5. Negative Affect	1.81	.60	-.03	-.17**	.10	-.02	
6. Adaptive Work Behavior	3.66	.72	-.08	.05	-.03	-.05	-.10

Notes. N = 198
* $p < .05$, ** $p < .001$

Appendix B: Adapted Microbreak Items

Relaxation Microbreaks (Kim et al., 2017)
Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engaged in the following activities during work **this morning.**
This morning at work, I…

1. Relaxed briefly by stretching
2. Relaxed briefly by using psychological relaxation strategies (e.g., meditating, daydreaming, gazing outside the window)
3. Relaxed briefly by taking a quick nap

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Physical Microbreaks (Kinnunen et al., 2015; Fritz et al., 2011)
Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work **this morning.**
This morning at work, I…

1. Engaged in some form of physical activity, including walks
2. Went outside for fresh air

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Appendix C: Pilot Study Scales

Socialization Microbreaks (Kim et al., 2017)
Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work **in general**.

1. Text, using instant messenger, or phone friends or family members
2. Chat with coworkers on nonwork-related topics
3. Check personal social networking sites (e.g., Facebook, Twitter, and personal blogs)

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Cognitive Microbreaks (Kim et al., 2017)
Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work **in general**.

1. Read nonwork-related books, newspapers, and magazines
2. Surf the web for nonwork purposes (e.g., online shop, banking, check personal emails, and watch short news or video clips), or learn activities

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Adaptive work behavior (Griffin et al. 2007)
How often have you experienced the following at work **in general**?

1. I adapt well to changes in core tasks
2. I cope with changes to the way I have to do my core tasks
3. I learn new skills to help me adapt to changes in my core tasks

Response Options: (1) not at all, (2) a little, (3) a moderate amount, (4) a lot, (5) a great deal

Shortened Positive and Negative Affect Schedule (PANAS) (Thompson, 2007)
This scale consists of a number of words and phrases that describe feelings and emotions. Please indicate to what extent you have felt this way **in general**.

1. Hostile
2. Upset
3. Nervous
4. Ashamed
5. Afraid

Response Options: (1) not at all, (2) a little, (3) moderately, (4), quite a bit (5) extremely

Appendix D: Baseline Survey

Six-Digit Code

Your privacy is of the utmost importance. For this reason, we ask that you do NOT write your name on any part of the survey. To match your responses across surveys, please respond to the following questions such that a confidential unique code may be created.

1. What are the first two letters of your mother's first name? (If this does not work for you, pick someone influential in your life that you will remember for the second survey.)
2. What are the first two letters of the town you were born in? (If you do not know, pick the first town you remember living in.
3. What are the two digits of your date of birth? (ex. March 7th = 07)

Microbreak Autonomy (Sonnentag & Fritz, 2007; Adapted by Kim et al., 2021)

Please think about your job **in general**. To what extent do you agree with the following statements?

During my breaks…

1. I can decide for myself what to do
2. I determine for myself how I will spend my time
3. I can do exactly what I want to do
4. I can decide my own break schedule during my workday

Response Options: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4), agree (5) strongly agree

Short-Form PANAS; Negative Affect (Watson et al., 1988; Thompson, 2007)

This scale consists of a number of words that describe different feelings and emotions. Please indicate to what extent you feel the following emotions **in general**.

1. Hostile
2. Upset
3. Nervous
4. Ashamed
5. Afraid

Response Options: (1) not at all, (2) a little, (3) moderately, (4) quite a bit, (5) extremely

Prescreening

1. **Are you at least 18 years of age?**
    1. Yes
    2. No
2. **Are you currently employed?**
    1. Yes
    2. No

3. **Do you currently work at least 40 hours per week?**
    1. Yes
    2. No
4. **Do you work 5 days a week (Monday – Friday)?**
    1. Yes
    2. No
5. **Do you generally work between the hours of 7:00 AM - 6:00 PM?**
    1. Yes
    2. No
6. **Do you currently reside in the United States?**
    1. Yes
    2. No
7. **What time zone do you currently work in? (Note: This will ensure that the daily surveys are sent at the appropriate times) (Select One)**
    1. Eastern Time
    2. Central Time
    3. Mountain Time
    4. Pacific Time
    5. Hawaii-Aleutian Time
    6. Alaska Time

8. **Please indicate which email address you would like to receive the baseline survey and daily surveys at.** Fill-in: _____

Appendix E: Day-Level Lunch Survey

Six-Digit Code

Your privacy is of the utmost importance. For this reason, we ask that you do NOT write your name on any part of the survey. To match your responses across surveys, please respond to the following questions such that a confidential unique code may be created.

1. What are the first two letters of your mother's first name? (If this does not work for you, pick someone influential in your life that you will remember for the second survey.)
2. What are the first two letters of the town you were born in? (If you do not know, pick the first town you remember living in.)
3. What are the two digits of your date of birth? (ex. March 7th = 07)

Workload (Rodell & Judge, 2009; Spector & Jex, 1998)

To what extent do you agree with the following statements about your work **this morning**?

This morning at work…

1. I had to work on a large number of projects and/or assignments.
2. My workload was high
3. My job required me to work very fast.
4. The volume of work that had to be accomplished in the allocated time was difficult.

Response Options: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4), agree (5) strongly agree

Relaxation Microbreaks (Kim et al., 2017)

Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engaged in the following activities during work **this morning.**

This morning at work, I…

1. Relaxed briefly by stretching
2. Relaxed briefly by using psychological relaxation strategies (e.g., meditating, daydreaming, gazing outside the window)
3. Relaxed briefly by taking a quick nap

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Physical Microbreaks (Kinnunen et al., 2015; Fritz et al., 2011)

Microbreaks refer to short, informal, and voluntary breaks not related to work during work time. Please indicate how frequently you engage in the following activities during work **this morning.**

This morning at work, I…

1. Engaged in some form of physical activity, including walks
2. Went outside for fresh air

Response Options: (1) never, (2) rarely, (3) occasionally, (4) frequently, (5) very frequently

Appendix F: Day-Level End of Workday Survey

Six-Digit Code

Your privacy is of the utmost importance. For this reason, we ask that you do NOT write your name on any part of the survey. To match your responses across surveys, please respond to the following questions such that a confidential unique code may be created.

1. What are the first two letters of your mother's first name? (If this does not work for you, pick someone influential in your life that you will remember for the second survey.)
2. What are the first two letters of the town you were born in? (If you do not know, pick the first town you remember living in.)
3. What are the two digits of your date of birth? (ex. March 7th = 07)

Short-Form PANAS; Negative Affect (Watson et al., 1988; Thompson, 2007)

This scale consists of a number of words that describe different feelings and emotions. Please indicate to what extent you felt the following emotions **today at the end of your workday**.

Today at the end of my workday, I felt…

1. Hostile
2. Upset
3. Nervous
4. Ashamed
5. Afraid

Response Options: (1) not at all, (2) a little, (3) moderately, (4) quite a bit, (5) extremely

Vitality; Thriving at Work (Spreitzer et al., 2005; Porath et al., 2012)

Please think about the end of your workday today. To what extent do you agree with the following statements.

Today, at the end of my workday…

1. I felt alive and vital.
2. I had energy and spirit.
3. I did not feel very energetic. (R)
4. I felt alert and awake.
5. I was looking forward to each new day.

Response Options: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4), agree (5) strongly agree

Appendix G: Day-Level Bedtime Survey

Six-Digit Code

Your privacy is of the utmost importance. For this reason, we ask that you do NOT write your name on any part of the survey. To match your responses across surveys, please respond to the following questions such that a confidential unique code may be created.

1. What are the first two letters of your mother's first name? (If this does not work for you, pick someone influential in your life that you will remember for the second survey.)
2. What are the first two letters of the town you were born in? (If you do not know, pick the first town you remember living in.)
3. What are the two digits of your date of birth? (ex. March 7th = 07)

Recovery Experience Questionnaire (REQ; Sonnentag & Fritz, 2007)

Please think about your time **outside of work this evening**. To what extent do you agree with the following statements?

Today after work...

Psychological Detachment

1. I forgot about work
2. I didn't think about work at all
3. I distanced myself from my work
4. I got a break from the demands of my work

Relaxation

1. I kicked back and relaxed
2. I did relaxing things
3. I used the time to relax
4. I took time for leisure

Mastery

1. I learned new things
2. I sought out intellectual challenges
3. I did things that challenged me
4. I did something to broaden my horizons

Response Options: *(1) strongly disagree. (2) disagree, (3) neither agree nor disagree, (4) agree, (5) strongly agree*

Godin-Shephard Leisure-Time Physical Activity Questionnaire (LAT Questionnaire; Godin, 2011; Godin & Shepherd, 1985)

Please think about your time **outside of work this evening**. Please indicate the frequency (reported in minutes) in which you engaged in the following activities **this evening**. (Please provide only a number, ex. 5; if you did not engage in any exercise, please put 0) (Fill-In):

Mild Exercise (e.g., minimal effort: yoga, leisure walking): _____
Moderate Exercise (e.g., not exhausting: fast walking, easy bicycling, weight lifting): _____
Strenuous Exercise (e., g., heart beats rapidly; running, indoor cycling, swimming laps): _____