Virginia Commonwealth University
VCU Scholars Compass

Theses and Dissertations
Graduate School

2015

Take five? Examining the impact of microbreak duration, activities, and appraisals on human energy and performance

Andrew Bennett
Virginia Commonwealth University

Follow this and additional works at: https://scholarscompass.vcu.edu/etd

Part of the Organizational Behavior and Theory Commons

© The Author

Downloaded from

https://scholarscompass.vcu.edu/etd/3913

This Dissertation is brought to you for free and open access by the Graduate School at VCU Scholars Compass. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of VCU Scholars Compass. For more information, please contact libcompass@vcu.edu.

© Andrew A. Bennett 2015

All Rights Reserved

TAKE FIVE? EXAMINING THE IMPACT OF MICROBREAK DURATION, ACTIVITIES, AND APPRAISALS ON HUMAN ENERGY AND PERFORMANCE

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

Andrew A. Bennett
Master of Arts
Gonzaga University, 2008

Co-Director: Dr. S. Douglas Pugh
Associate Professor of Management

Co-Director: Dr. Allison S. Gabriel
Assistant Professor of Management

Dr. Frank A. Bosco
Assistant Professor of Management

Dr. Jeffrey D. Green
Associate Professor of Psychology

Virginia Commonwealth University
Richmond, Virginia
June 24, 2015

Acknowledgement

“Not everything that can be counted counts, and not everything that counts can be counted”
– William Bruce Cameron

With the quantitative emphasis of this dissertation, I placed this quote on my desk for over a year to remind me of two things. First, I will not try to number the amount of people who have helped me along this journey, and certainly believe that if I tried I would leave out someone unintentionally. Second, and more importantly, all of them have given me more than I can define with data or numbers. For all of those in my life who have given me something that counts – parents, family, teachers, friends – I am truly grateful.

Table of Contents

List of Tables

List of Figures

Abstract

TAKE FIVE? EXAMINING THE IMPACT OF MICROBREAK DURATION, ACTIVITIES, AND APPRAISALS ON HUMAN ENERGY AND PERFORMANCE

By Andrew A. Bennett, M.A.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2015

Co-Director: Dr. S. Douglas Pugh, Associate Professor of Management
Co-Director: Dr. Allison S. Gabriel, Assistant Professor of Management

Employees in many occupations deplete cognitive resources of attention and energy (Dodge, 1913; Kahneman, 1973), impacting performance on subsequent work tasks (Dalal, Bhave, & Fiset, 2014). Individuals spend upwards of 10% of formal work time taking a break completing non-work tasks (Esteves, 2013; McGehee & Owen, 1940) in an effort to replenish these resources (Fritz, Lam, & Spritzer, 2011; Kim et al., 2014). This study used a randomized controlled experiment to answer three questions that are new contributions to the literature. First, I explored if engaging in a specific activity (watching a funny video, meditating, or completing a different work task) during the microbreak helped induce recovery processes. Second, I questioned if an individual's appraisal (psychological detachment, relaxation, and enjoyment) of the break impacted outcomes in addition to, or potentially more than, engaging in a break activity. Third, I investigated if the time duration (1-minute, 5-minute, or 9-minute) of the microbreak impacted outcomes. Results show that taking any break between work tasks allowed individuals to feel less fatigued, more energized, and more attentive. Surprisingly, in many

instances a 1-minute break was just as effective as taking a longer break of 5 or 9 minutes, and for these shorter break periods, engaging in a different work task for a short period rather than disengaging from work was the best at improving attention. In addition, to increase feeling energized at work, appraising the break as being enjoyable was more important than the actual break activity. Combined, this study has both an academic and practical impact, finding that just like with work that depletes physical resources, short breaks also benefit employees engaging in work that depleted cognitive resources.

Chapter 1: Introduction

Imagine the following scenario: two employees go to work doing the same job for the same company. At the beginning of the day, both employees complete their work tasks at the same pace. But as the day goes on, one employee feels more tired and is not performing their work as well, whereas the other employee still has a high level of energy and is completing tasks as effectively as he or she was earlier in the day. Is this just a difference between the two individuals, meaning that one employee just naturally feels more tired each day? Maybe, but suppose that the employees have similar personalities and lives outside of work, so there are no confounding factors. What explains this variation that two employees in the same job have each day in their energy levels and work performance? In this study, I consider that one employee might take more effective *microbreaks*, or work breaks less than ten minutes in duration (Sluiter, Frings-Dresen, Meijman, & van der Beek, 2000). Many organizations have policies or norms that encourage microbreaks, often in accordance with state laws (e.g., California Industrial Welfare Commission, 2001). I propose that the employee with higher energy and better performance at the end of the day better utilizes these short break periods in between work tasks to *recover*, or replenish resources used to complete work tasks (Meijman & Mulder, 1998). That is, it might be that short breaks during work time, not just lunch breaks or other authorized breaks, can have a substantial impact on employee well-being and performance at work.

This study addresses the call from other scholars to explicitly examine if the combination of duration, activities, and appraisals have a systematic difference in outcomes (Trougakos, Hideg, Cheng, & Beal, 2014). In other words, is there an optimal combination of break time, break activity, or break appraisal for the “best” recovery of resources and subsequent performance? There are three research questions embedded within this inquiry. First, does the duration of a microbreak matter? Is it possible that a shorter duration of a microbreak could be more beneficial for employee energy and performance? Second, does the activity during the microbreak matter? What actually benefits an employee more: relaxing at one’s desk, mentally detaching from work by watching a funny video or checking Facebook, or simply changing work tasks? A recent qualitative study has found that employees use all three types of break activities when they desire to take a break (Kim et al., 2014). I therefore ask: are some microbreak activities better or worse than not having a break, and are certain microbreak activities more or less effective than switching tasks? Third, does the microbreak activity itself matter, or is it only how one appraises the microbreak? If two employees meditate at their desk during a break, but one employee finds meditating to be relaxing while the second employee is bored while meditating, does the appraisal of that same activity matter more than activity itself?

Human energy is a moment-to-moment assessment of how much an individual feels energized (Quinn, Spreitzer, & Lam, 2012) and is considered a proximal indicator of well-being (Sonnentag, 2012). Momentary fluctuations in energy predict long-term well-being outcomes that are important for organizations. For example, studies show that employees who have low energy, sometimes defined as feeling fatigued or exhausted, also had increased employee burnout (Maslach, Schaufeli, & Leiter, 2001), turnover (Wright & Cropanzano, 1998), and health complaints like headaches and insomnia (Hunter & Wu, 2013). In addition, momentary fluctuations in energy have the potential to have a short-term impact on individual job performance (Dalal, Bhave, & Fiset, 2014).

The impact of work breaks on employee energy and performance has been theoretically important to academics for over century (e.g., Clark, 1916; Cooke, 1913), but there are also practical implications for organizations. States like California have labor laws specifying the duration and frequency of work breaks for employees (California Industrial Welfare Commission, 2001). In addition, organizations implement new break programs and policies to improve the performance of their employees, such as providing rooms where employees can play video games (Edelhauser, 2007) or take a nap (Diamond, 2011). However, there is limited empirical support for these laws and workplace changes. Individuals within the workplace appear to be looking for ways to increase energy and productivity as well. There are a myriad of articles written for business professionals on the topic, with titles like "Worn-out employees? 5 ways to crank up the energy" (Olguin, 2013), "Refuel, recharge and reenergize your employees" (Durkin, 2014), and "5 ways to boost your energy at work" (Tarkan, 2012). In addition, there exist products that claim to improve employee energy. The supplement brand 5-hour Energy starts a television commercial asking "You know what 2:30 in the afternoon feels like, right? Sleepy. Groggy. Dying for a nap". This commercial tapped into the need for increased energy at work, and led to more than $1 billion in retail sales within a decade (O'Connor, 2012). Overall, employee energy and performance matters to employees, managers, and organizations.

To examine how microbreaks impact employee energy and performance, I used an experimental design that manipulates microbreak durations and activities, assessing how different durations, activities, and appraisals impact individual resources and performance. There are two strengths to using an experimental design. First, most research on work recovery uses a daily diary or cross-sectional research design. These studies by scholars of management, psychology, and engineering have provided a wealth of information regarding relationships between recovery activities, appraisals, and durations with a multitude of work-related outcomes. In addition, most utilize naturally occurring workplace settings. However, in a workplace study, other reasons could explain differences in energy and performance. Daily interactions with coworkers or different pay structures for each employee could explain the variation rather than recovery periods. The strength of an experiment is that these confounding variables are eliminated and there is a more direct, causal test of changes occurring from each duration and break activity manipulation. Second, I use an experiment is because it allows for a randomized controlled trial, the "gold standard" of research in the social sciences (Reay, Berta, & Kohn, 2009). By randomly assigning individuals to different groups, we assume that individual differences are placed equally into each group (e.g., different microbreak times and activities). In sum, these two key strengths of a controlled experiment allow me to infer causality to determine what is, or is not, a beneficial microbreak. The potential to discover how break durations, activities, and appraisals impact employee energy and performance can create a unique and compelling contribution to the field.

An overview of the study design is as follows. First, participants engaged in a work episode requiring the use of attentional resources, simulating the processes required for employees at a Fortune 500 power company. Some participants were then prompted to engage in a microbreak, with each group having a different break activity and duration manipulation. This is followed by a second period of work requiring the use of attentional resources. A control group did not receive a break period between the first and second work periods. The outcome variables assessed are subjective feelings of energy at the end of each work and break period, attentional resources after each work and break period, and task performance during the two work periods. The study used a 3x3 experimental design, whereby break activity manipulations (psychological detachment, relaxation, and task change) are crossed with duration manipulations (1 minute, 5 minutes, and 9 minutes). These break activity manipulations were chosen to induce specific recovery experiences drawn from the Sonnentag and Fritz (2007) framework, as well as to correspond with recovery activities from previous studies. The duration manipulations are a dosage manipulation similar to organizational and medical interventions (Toker & Biron, 2012), and are based on both theoretical and practical findings.

Chapter 2: Theory and Hypotheses

As western economies have shifted from an industrial economy to a postindustrial or "knowledge economy" (Adler, 2001), employees are engaging less in physical work and more in mental work, or the use of cognitive resources to complete work tasks (Dodge, 1913) that utilize information and generate knowledge (Hitt, 1998). Recent advances in psychology and neuroscience have found that individuals have several cognitive resources available to them, and that cognitive processes like attention and memory draw from a limited pool of cognitive resources (Spreng, Mar, & Kim, 2009). Just like how there are individual limitations of physical resources, such as the amount of strength one has to lift a heavy object, individuals also have a limited capacity of cognitive resources and energy (Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014). Many occupations draw upon cognitive resources and the self-regulation necessary for the continued use of these resources (Lord, Diefendorff, Schmidt, & Hall, 2010). For example, some jobs require consistent focus to notice visual changes on a monitor, such as technicians at an electrical power company or air traffic controllers (e.g., Kanfer, Ackerman, Murtha, Dugdale, & Nelson, 1994). Lifeguards must notice if a swimmer in the ocean went under a wave but has not come back above the water surface (e.g., Fenner, Leahy, Buhk, & Dawes, 1999). Pilots (e.g., van Dijk, van de Merwe, & Zon, 2011) and truckers (e.g., Charlton & Starkey, 2011) have to recognize and react to changes in their environment, such as vehicles, pedestrians, or other obstacles entering the future travel space. Doctors, nurses, and medical technicians must observe and respond quickly to a change in a patient's breathing, heart rate, and other vital signs (e.g., Schulz et al., 2011). In these occupations, performance on job tasks requires sustained visual focus, which depletes both attentional resources and subjective energy (Kanfer & Ackerman, 1989).

Fortunately, it is possible to recover these individual resources. The term *recovery* is used to describe the process of stopping resource loss and replenishing resources (Meijman & Mulder, 1998). Scholars of exercise physiology and ergonomics found that resources used during physical work can be replenished once the work load ceases (e.g., Weltman, Stamford, & Fulco, 1979). That is, by stopping the task that consumed resources, one can not only stop the depletion of resources, but replenish resources as well. Recovery periods can be as short as a few seconds or as long as several days (Sluiter et al., 2000). From an occupational standpoint, for many years scholars focused primarily on physical work and corresponding physiological resource changes such as muscular fatigue (e.g., Chaffin, 1973). In 1998, Theo Meijman and Gijsbertus Mulder took the classic load-capacity model from physical work and extended it to include mental work, or the tasks that use cognitive and psychological resources. This was termed the Effort-Recovery Model (ERM; Meijman & Mulder, 1998). ERM has three main components. First, individuals mobilize (or consume) psychological resources just like they can consume physical resources. Second, this resource mobilization leads to both task performance and resource depletion. Third, resource recovery must occur or an individual will incur negative effects such as reduced task performance and impaired well-being.

Within the ERM framework, scholars from multiple disciplines have studied recovery processes in relation to energy and performance variations. Sonnentag's seminal work with school teachers in 2001 examined how *recovery activities*, or what an individual engaged in after work, contributed to the recovery process. These activities were measured by asking employees each night to report the duration of time spent on after-work tasks in specific categories, as well as report their subjective well-being. Using a daily diary methodology in which participants responded to survey items for five consecutive working days, the study found that employees engaging in social, relaxing, and physical activities during the evening also reported improved well-being before bed, whereas employees who spent more time each night on work-related activities had reduced well-being before bed. A major weakness of this and subsequent research on recovery activities (e.g., Rook & Zijlstra, 2006; Sonnentag & Zijlstra, 2006) is that one individual can interpret or experience an activity differently than someone else. To address this, researchers began studying *recovery appraisals*, or how an individual feels about time spent during non-work time. In 2007, Sonnentag and Fritz confirmed through factor analysis that individual recovery appraisals fell into four broad categories: how much individuals felt they mentally detached, relaxed, were positively challenged, or in control during a non-work period. Multiple studies have since confirmed that these recovery experiences of psychological detachment, relaxation, mastery, and control are unique predictors of employee energy (e.g., Sonnentag & Fritz, 2007) and job performance (e.g., Binnewies, Sonnentag, & Mojza, 2010; Fritz, Yankelevich, Zarubin, & Barger, 2010). In sum, research in the organizational sciences have provided a wealth of information showing that non-work activities and individual appraisals of these activities can benefit employee well-being and performance.

However, there are several areas of the work recovery literature that are still unclear. Organizational scholars have discussed how *microbreaks*, or brief respites from a work task that are under ten minutes in duration (Sluiter et al., 2000), have the potential to benefit employees (Scott, 1914). Researchers even theorize that short-term recovery opportunities “are important in maintaining attention and improving future performance” (Dalal et al., 2014, p. 1427), but scholarly research about recovery has primarily focused on formal non-work periods such as evenings and weekends (e.g., Etzion, Eden, & Lapidot, 1998; Lounsbury & Hoopes, 1986; Totterdell, Spelten, Smith, Barton, & Folkard, 1995). Thus, organizational research on work breaks is sparse. What is known is that employees use between 5-15% of their formal, "on-the-clock" work time on non-work tasks (e.g., Esteves, 2013; McGehee & Owen, 1940). It is also known that employees in jobs that deplete cognitive resources report taking a break (i.e., engaging in a non-work task) because they feel that they need respite from work (D'Abate, 2005). In addition, some states have labor laws requiring specific break durations for employees (e.g., California Industrial Welfare Commission, 2001). Because of this, scholars have recently called for organizational researchers to examine non-formal breaks during the workday (Sonnentag, Niessen, & Neff, 2011), break durations shorter than one hour (Trougakos et al., 2014), and how both break durations and what an employee does during that break time impacts individual variations in energy and performance (Tucker, 2003). In conclusion, scholars a) have theorized that breaks are beneficial, b) know that people need breaks and take "unauthorized" breaks, and c) understand that some states require break periods for employees. Nonetheless, the organizational sciences have not yet rigorously examined how these short breaks impact employees.

Additionally, organizational scholars are rarely explicit about time durations of recovery periods. By not explicitly measuring durations of recovery, there are potential confounding explanations for why some employees have improved outcomes while others do not. It is possible that conflicting results in the literature might be caused by differences in break durations. For example, one study found that employees engaging in work-related activities during a break had decreased energy (Trougakos et al., 2014), whereas another study has found that employees increased energy after engaging in work-related activities during a break (Hunter

& Wu, 2014). The Trougakos et al. study examined only one-hour lunch breaks, whereas the study by Hunter and Wu did not track break durations. Thus, to provide a better causal understanding of the recovery process, organizational researchers should heed the call from other scholars in the field and explicitly examine durations and the impact time can have on outcomes (George & Jones, 2000). Using a temporal lens to conduct research puts time duration and time intervals as a primary focus, and allows scholars the potential to discover patterns of phenomenon (Ancona, Goodman, & Lawrence, 2001).

Fortunately, scientific fields like ergonomics and industrial engineering have examined durations and explicitly focused on work breaks. Henning, Sauter, Salvendy, and Kreig (1989) instructed employees to take microbreaks after every 40 minutes of work, and found that individuals who took longer breaks had improved job performance (e.g., reduced typing errors) following the break. Break durations were at the employee's discretion, and ranged from eight seconds to more than three minutes. One limitation of this and similar studies (e.g., Henning, Kissel, & Maynard, 1994) is that individuals are instructed to take a break, but what employees do during this time is not measured. Other studies in ergonomics have focused on well-being outcomes rather than performance. For example, Galinsky, Swanson, Sauter, Hurrell, and Schleifer (2000) found that when data-entry employees take 5-minute breaks at work they report less muscular discomfort and eye strain. While studies like this improve our understanding of the relationship between breaks and well-being, they focus on the depletion of physical resources (impacting physical well-being) rather than cognitive resources.

In sum, research in the organizational sciences has focused on recovery activities and appraisals, yet not explicitly examined recovery durations. Engineering and ergonomics research has focused on durations, but does not examine what people do during the break and rarely focuses on the depletion and recovery of cognitive resources. While the interdisciplinary nature of organizational research has been well-established in the areas of work task and job design (Grant & Parker, 2009), the research focused on recovery from knowledge work rarely integrates with industrial engineering and ergonomics. This study blends these literatures to gain a better understanding of work breaks in knowledge work environments.

The purpose of this study is to examine if momentary changes in energy and performance stem from different microbreak durations, engaging in different microbreak activities, or experiencing (i.e., appraising) microbreaks differently. My study answers these questions using an experimental design with randomized controlled trials. By integrating disparate research streams and manipulating break durations and break activities, this study provides an improved causal understanding of work recovery that studies using daily diary and cross-sectional survey designs are not able to do. By including objective outcome measures (e.g., accuracy on task), this study improves our understanding beyond self-report subjective measures that have been used in most organizational research.

This chapter is organized as follows. First, I provide an overview of the Effort-Recovery Model (Meijman & Mulder, 1998), the main framework within which this study is grounded. Second, I define the individual resources examined in this study: energy and attention. Finally, I describe the recovery process, accentuating and differentiating recovery activities, recovery appraisals, and durations of recovery. The recovery section also includes hypotheses and research questions for my experiment.

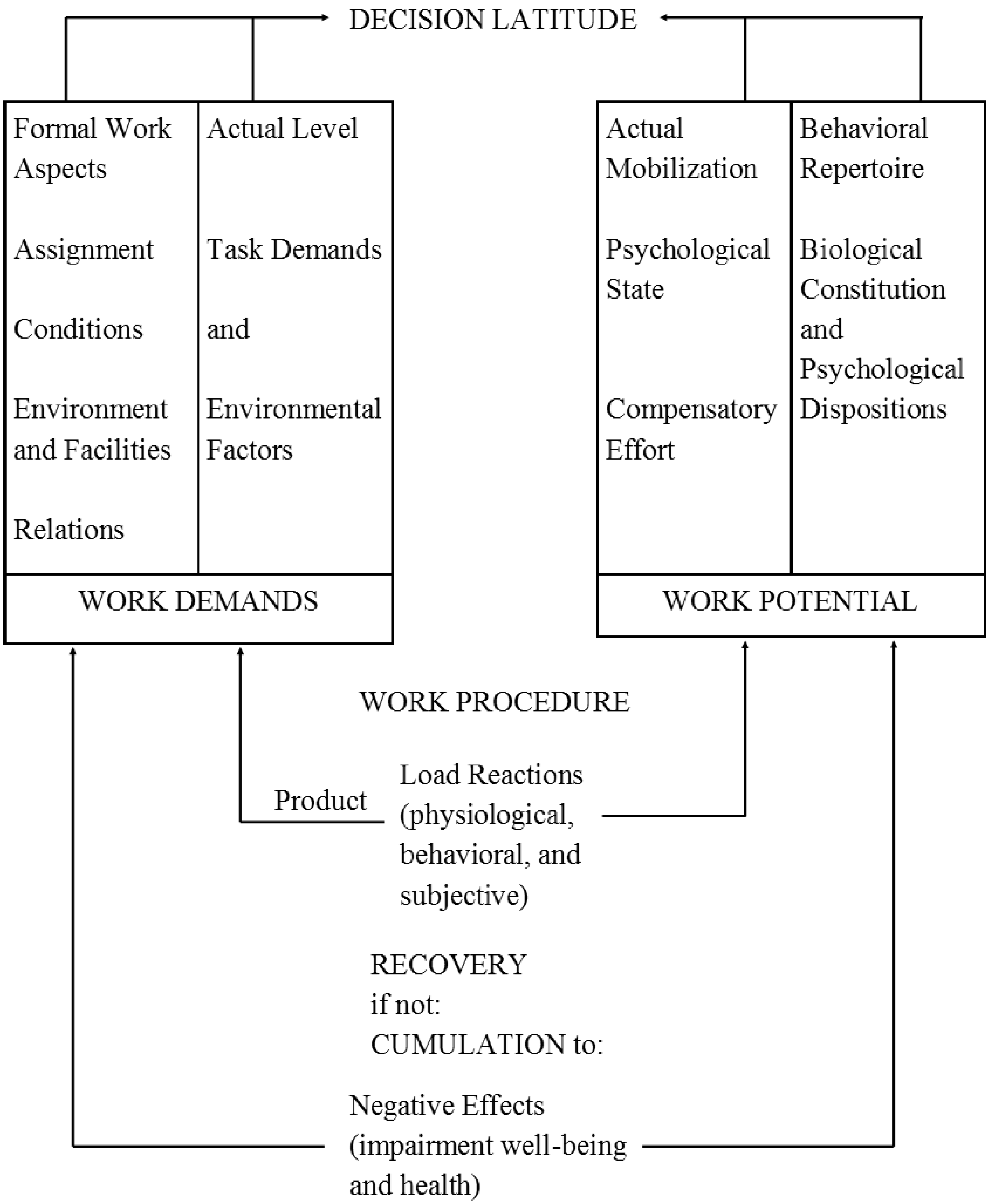
Theoretical foundations

In 1998, Meijman and Mulder summarized research about the impact of depletion of mental resources in the workplace. They then drew from exercise physiology research that showed how physical resources deplete and can be replenished. Combing these two streams, they proposed the Effort-Recovery Model (ERM; Meijman & Mulder, 1998), which explained that cognitive resources can also be replenished and how recovery impacts employee task performance, energy, and well-being. Figure 1 shows their model in its entirety.

As shown, work potential, work demands, and decision latitude all impact an individual's work procedure. This work procedure has two outcomes: task performance ("product" in their model), and load reactions. The current recovery literature (e.g., Fritz & Sonnentag, 2006; Trougakos et al., 2014) and remainder of my study calls these load reactions *resource depletion*. As shown in the bottom of the figure, these resource depletion outcomes are reversible, meaning that depletion of cognitive resources can be stopped and can also be replenished. This is the recovery process. If the recovery process does not occur, this can lead to the accumulation of additional resource loss, an increase in negative psychological outcomes, and a decrease in task performance (Fritz & Sonnentag, 2006; Lilius, 2012; Totterdell et al., 1995; Trougakos et al., 2014).

Figure 1

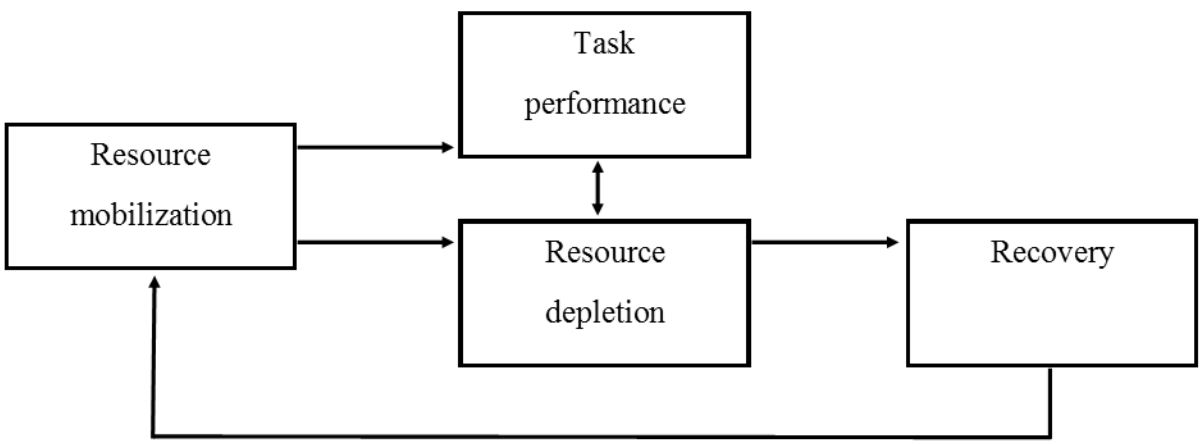
The Effort-Recovery Model (Meijman & Mulder, 1998, p. 9)



For jobs at a power company or air traffic control tower, employees might have little decision latitude or changes in task demands. Thus, this study focuses only on the work potential aspect of ERM. By using an experimental design, I hold constant the work demands and decision latitude aspects of this model, meaning these components do not change during any portion of the experiment. In doing so, I measure how recovery during microbreaks impacts variations in individual resources (called “actual mobilization” in Figure 1), as well as how this recovery of resources impacts task performance. Figure 2 shows a simplified version of ERM that only includes the components related to this study.

Figure 2

Simplified Effort-Recovery Model



Note: If no recovery, negative effects accumulate

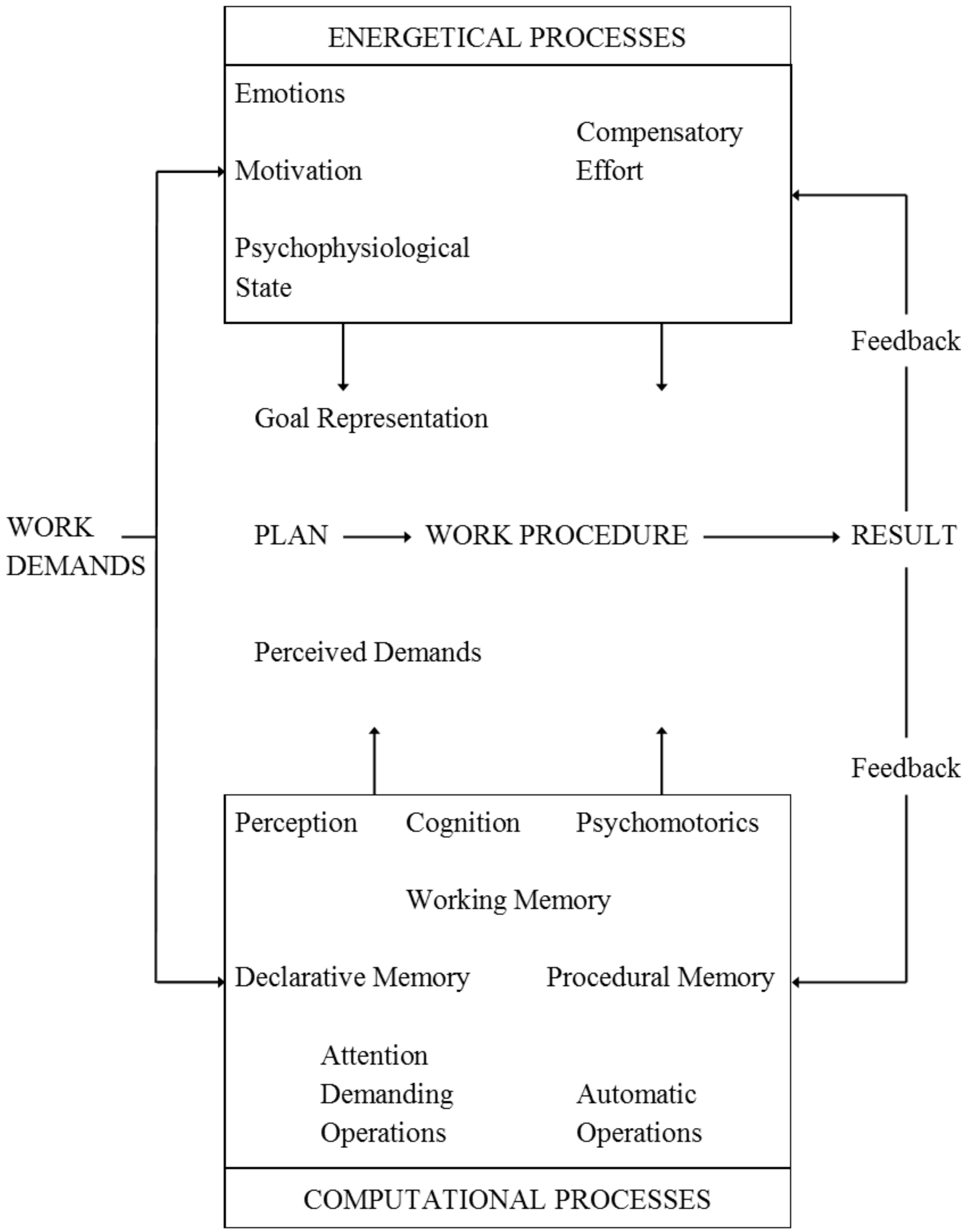
To understand the recovery process better, consider again the employee whose job task includes monitoring changes on computer screens. In order to maintain attention and performance in a task like this, individuals must increase the amount of energy they use (Kahneman, 1973). Using attention and energy is *resource mobilization*. The *task performance* component is watching a screen and making adjustments to what is viewed. If an individual feels that they are using more energy (or increasing their effort) as the work shift continues throughout the day, this leads to that person feeling more fatigued (Meijman, 1997). Depleting attentional resources and energy is *resource depletion*. As mentioned earlier, employees have a limited supply of attentional and energetic resources. By the end of a work shift, one individual might still feel energized and maintain a high level of job performance, while another might feel exhausted and not perform as well on job tasks. The difference is that one employee has had adequate *recovery*. Thus, the focus of this study is examining how a brief respite from work tasks (Scott, 1914) impacts the recovery process and helps individuals both stop resource loss and replenish resources.

Resource definitions

Meijman and Mulder drew from their previous work (Van Ouwerkerk, Meijman, & Mulder, 1994) and modeled how individual resources impacted work potential. They realized that individual work potential, which I call resource mobilization, uses both cognitive processes and energetic processes. Figure 3 is the figure used by Meijman and Mulder showing how cognitive and energetic resources are integrated into ERM.

Figure 3

Integration of Resources Into ERM (Meijman & Mulder, 1998, p. 19)



In this figure and throughout their work, Meijman and Mulder use the term *process*. Recent organizational research on this topic typically uses the term *resource* instead (Westman et al., 2004). However, there is a slight difference in these two terms. Process is the action, or the ongoing activity, that draws from a resource pool. Individual resources are defined as “objects, personal characteristics, conditions, or energies that are valued by the individual or that serve as a means for attainment of these objects, personal characteristics, conditions, or energies” (Hobfoll, 1989, p.516). Recent work refines this definition and emphasizes that resources are unique within individuals and are what an individual perceives can help with goal achievement (Halbesleben et al., 2014). This clearly aligns with Meijman and Mulder’s model of computational and energetical processes leading to goals (“plan”) and then a work procedure. As shown in Figure 3, and as discussed by other scholars (Hobfoll, 1989; Quinn et al., 2012), resources can help an individual engage in a work procedure and achieve a goal.

Energy. The study of human energy has been of interest to organizational scholars for many years (e.g., Baker & Burney, 1928), including differences in energy usage for work and non-work activities (Passmore & Durnin, 1955) and how motivation impacts an individual’s energy and effort towards work tasks (Vroom, 1964). Energy has received increased attention recently as being a key component to making organizations more sustainable (Pfeffer, 2010). This is because “energy benefits both individuals and employer organizations” (Dutton, 2003, p. 7) and is considered the “fuel that helps organizations run successfully” (Fritz, Lam, & Spreitzer, 2011, p. 28). An increasing awareness of the role of human energy as an individual resource has led scholars to emphasize that "future research could focus more on the role of energy, and explicitly research the effects on human energy level" (Schippers & Hogenes, 2011, p. 200).

Human energy is categorized in two ways: physical energy and energetic activation (Quinn et al., 2012). Physical energy is the action or capacity to engage in action, and can be measured using chemical changes such as calories needed to complete a work task. Of greater importance to occupations requiring mental work, energetic activation is the feeling of being energized and is measured with subjective scales such as assessing if one feels "bursting with energy" (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001) or feels "depleted" and "tired" (Michielsen, De Vries, & Van Heck, 2003). Energy is a limited resource and is dynamic in nature, meaning that it fluctuates within an individual (ten Brummelhuis & Bakker, 2012a). The subjective feeling of energy has two components: high energy or activation, and low energy or the lack of activation (Thayer, 1986). There is ongoing scholarly debate concerning the nature of the energy construct (Cole, Walter, Bedeian, & O'Boyle, 2012). However, recent studies have shown that high energy and low energy are related but distinct components of the energy construct and have unique antecedents, fluctuations, and outcomes (Fritz et al., 2011; Halbesleben, 2010; Mäkikangas, Feldt, Kinnunen, & Tolvanen, 2012). For example, evening psychological detachment from work predicted increased vigor at bedtime but did not predict reduced exhaustion at bedtime (Demerouti, Bakker, Sonnentag, & Fullagar, 2012).

In the social sciences, high energy is measured as vitality (e.g., Ryan & Deci, 2000), vigor (e.g., Shirom, 2004), positive activation (e.g., Watson & Clark, 1999), arousal (e.g., Thayer, 1986), and being alert (e.g., McNair, Lorr, & Droppleman, 1971). Typically these measures are adjective checklists with an individual using a Likert-type scale to assess how they feel, such as how alert they feel at that moment or in general each day at work (McNair et al., 1971). Other measures have individuals rate how they feel using a Likert-type scale to items such as "I feel bursting with energy" (Demerouti et al., 2001). These feelings of high energy are proposed to be part of an overall approach-oriented behavior system, meaning it is used to direct individuals towards the procurement of resources (Shirom, 2004). Studies have shown that individuals with higher levels of energy are rated as being better performers by their supervisors (Carmeli, Ben-Hador, Waldman, & Rupp, 2009), and a recent meta-analysis reported that energy outcomes have a moderate to strong relationship with all ratings of individual job performance (Ford, Cerasoli, Higgins, & Decesare, 2011). In addition to examining performance, a longitudinal study over three years found that individual feelings of high energy is related to better health outcomes (Armon, Melamed, & Vinokur, in press).

The study of low energy has been examined more frequently in the social sciences (Sonnentag et al., 2011), in part because the majority of research in the stress and well-being literature views energy as a scare rather than abundant resource (Quinn et al., 2012). Low energy is most frequently described as feeling fatigued (e.g., McNair, Lorr, & Droppleman, 1971), exhausted (e.g., Demerouti, Bakker, Nachreiner, & Schaufeli, 2001), tired (e.g., Watson & Clark, 1999), or used up (e.g., Maslach, Schaufeli, & Leiter, 2001). Unlike high energy, which can be used to direct or engage in future behaviors, low energy is considered an antecedent of withdraw-oriented behaviors (Shirom, 2004). It has been proposed that "feeling[s] of fatigue may result from the subconscious analyses of cost and benefits to expend energy, or to conserve energy" (Boksem & Tops, 2008, p. 131). Longitudinal studies have found that feelings of low energy predict reduced self-rated task performance and citizenship behaviors (Halbesleben & Bowler, 2007), as well as lower supervisor-rated job performance (Wright & Cropanzano, 1998).

Scholarly research has also found that feelings of low energy (e.g., exhaustion) but not positive affect or negative affect are predictive of employee performance (Wright & Cropanzano, 1998). Thus, there is a distinction between feelings of energy or activation and feelings of affect, although some models also differentiate affective states as having high or low activation components (Cropanzano, Weiss, Hale, & Reb, 2003). Collectively, this research stream provides convincing evidence that an individual's energy level is important for employee well-being, individual performance, and the entire organization. One contribution of this study is the simultaneous examination of both the expansion and scarcity viewpoints of energy are missing from most organizational research (Quinn et al., 2012). That is, I examine both high and low energy levels at the same time in this experiment. I do this by investigating how microbreaks influence both the replenishment and depletion of energy (Marks, 1977).

Attention. Attention is the cognitive process that "filters and prioritizes information" (Steinman & Steinman, 1998, p. 147) and is a distinct component of working memory in the Effort-Recovery Model (Meijman & Mulder, 1998). There are two metaphors to illustrate the human attention system: attention as a search light and attention as a resource. With attention as a search light or flash light, everything within the beam of light is processed and everything outside that beam of light is not processed, and one can widen or narrow his or her attentional focus to process more or less information (Cowan, 1988). However, these attention-demanding processes consume resources, and there is a limited capacity of these attentional resources (Wickens, 1984). There are two attention mechanisms. One is stimulus-induced attention, or an involuntary response to a change in the environment such as a change in one's field of vision. Second is voluntary or sustained attention, which is a controlled cognitive process (Kahneman, 2003).

Current neuroscientific and behavioral studies use a framework that distinguishes three attention networks: alerting, orienting, and executive control (Posner & Petersen, 1990; Posner & Rothbart, 2007). The alerting network allows one to maintain a constant vigilant state, the orienting network allows one to alter attentional focus to different spaces and sensory information, and the executive control network allows one to monitor attentional focus and resolve conflicts between expectations, stimuli, and responses (MacLeod et al., 2010). Within this human attention system, the alerting and orienting networks fluctuate on a momentary basis, whereas executive control is more stable and fluctuates between individuals (Fan, Wu, Fossella, & Posner, 2001). In the larger scope of how the human attention system impacts task performance, the momentary fluctuations of the alerting and orienting networks impact short-term fluctuations in performance. Executive control is more closely related to working memory capacity (Engle, 2002; Kane, Conway, Hambrick, & Engle, 2007), and this individual difference impacts self-regulation of behaviors (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008). In sum, attention is the vital link between the employee's goals and performance (Dijksterhuis & Aarts, 2010).

Attention resources and task performance. At this point, it is necessary to consider an alternative point of view. Some scholars might contend that the loss of attention regulation resources and the use of microbreaks to restore these resources might not have substantial value. This has some merit, especially considering recent research showing that individuals can adapt to tasks that require self-regulation (Converse & DeShon, 2009). Their results from three experimental studies show that when repeating the same work tasks over multiple work periods, individuals used less self-regulatory resources during subsequent trials. This was based on initial theorizing that with increased duration on a task, skills used during the task becomes proceduralized and resource-allocation decreases (Norman & Bobrow, 1975). However, in all three studies, Converse and DeShon (2009) used persistence in behavior "as the index of effortful self-regulation" (p. 1320). As they acknowledge, maintaining attention and persistence on a difficult task are different components of self-regulation. It is likely that behavioral persistence on a difficult task is a better indicator of impulse control (e.g., controlling the impulse to stop the task) than attention regulation (Hofmann, Friese, & Roefs, 2009). In addition, there is evidence that attentional resources do not adapt after multiple trials or rounds of the same task, like what was found with persistence tasks. Rather, attentional resources adapt over time within one performance episode and start again with each task performance trial after a rest (Jung, Makeig, Stensmo, & Sejnowski, 1997; Van Orden, Jung, & Makeig, 2000).

In sum, we know that employees in attention-critical settings use attentional cognitive processes and deplete attention regulation resources over a period of time on the same task. Research has shown that as attentional resources deplete, an employee is more prone to attentional failure, which is correlated with decreased safety ratings, days missed from work, and injuries on the job (Wallace & Chen, 2005). However, these attentional resources can be replenished. Thus, an employee that engages in adequate recovery processes during microbreaks has an opportunity to enhance well-being and performance. The next section provides an overview of such a recovery process, and sets up the proposed experimental study of microbreak durations, activities, and appraisals.

Recovery

The process of ending depletion and replenishing individual resources is called recovery (Meijman & Mulder, 1998). The recovery process occurs during periods of non-work or respite. There are three main streams in work recovery research. The organizational and psychological sciences have focused on two similar areas: participation in specific tasks during non-work periods, called recovery activities, and the appraisal of time spent during non-work periods, called recovery experiences. These two streams place little emphasis on time duration. Industrial engineering and ergonomics focused more on the duration of time for non-work periods, but has not examined what an individual does or feels during that time.

Within all recovery literatures, there are four time distinctions: macrorecovery, metarecovery, mesorecovery, and microrecovery (Sluiter et al., 2000). Macrorecovery involves respite periods longer than two days. Changes in energetic resources have been studied during periods such as weekends (e.g., Fritz, Sonnentag, Spector, & McInroe, 2010), vacations (e.g., Fritz & Sonnentag, 2006), or sabbaticals (e.g., Davidson et al., 2010). Metarecovery periods range from one hour to two days. Studies examining metarecovery of energetic resources often assess non-work time during evenings (e.g., Sonnentag et al., 2008) and two-hour work breaks (e.g., Trougakos et al., 2008). Mesorecovery ranges from ten minutes to one hour, with studies focused on changes in energetic resources after lunch breaks (e.g., Trougakos, Hideg, Cheng, & Beal, 2014). Microrecovery periods, or microbreaks, are short non-work periods lasting ten minutes or less, and are the focus of this study. The study of microbreaks is rare in the organizational sciences literature (Trougakos et al., 2014). Yet, it is vital to understand what employees can do during brief, informal breaks such as the time occurring in between work tasks (Sonnentag et al., 2011). Understanding within-person fluctuations in energy and performance, rather than only focusing on between-person differences, is vital to helping organizational performance (Dalal et al., 2014). The remainder of this section highlights previous research on recovery activities, recovery appraisals, and durations of recovery.

Recovery activities. Recovery activities became a focus in the organizational sciences after publication of an influential five-day dairy study of Dutch teachers (Sonnentag, 2001). This study focused on the total amount of time spent each day for the period between leaving the workplace and before bed in five categories: work-related activities, such as preparing for the next day; household activities, such as cooking or child care; low-effort activities, such as taking a bath or watching television; social activities, such as a phone call or meeting friends; and physical activities, such as participating in sports or dancing. Results indicated that work-related activities had a negative effect on situational well-being before bed, and that low-effort, social, and physical activities had a positive effect on situational well-being before bed.

Following this study, additional research was conducted used similar measurement methods of asking individuals to report time spent in specific activity categories. Rook and Zijlstra (2006) replicated Sonnentag (2001) and added to the study by examining sleep quality, but found some different results from the original study. These different results could have occurred because their measure of energy focused on subjective fatigue rather than physical fatigue. Neither work-related activities nor household activities had any statistically significant impact on energy, compared to the negative effect found previously. Low-effort and social activities also did not have a statistically significant impact, contrary to the beneficial results found in 2001. In this study, physical activities actually increased feelings of fatigue. Other replications have found inconsistent findings as well, such as time spent on low-effort and physical activities having no statistically significant relationship with fatigue (Sonnentag & Jelden, 2009). These studies with low energy measures of fatigue or exhaustion are better at understanding if recovery activities can stop the depletion of energy, as low energy is conceptualized as the absence of energy (Quinn et al., 2012). Changes in low energy can indicate either that an individual's energy continues to be reduced or that this depletion period has ended.

Rather than focus on energy depletion, some studies have focused on replenishment of energy by measuring if evening activities led to increases in high energy measures such as feelings of vigor or vitality. Feelings of high energy are more indicative of an abundance of energy and not just reduced depletion of energy (Binnewies et al., 2010). Sonnentag and Niessen (2008) discovered that spending evening time on work-related activities decreased vigor each day, and this decreased vigor accumulated each day during the week, meaning an individual's high energy decreased more rapidly each day that one worked at home during the evening. This study also showed that the combined time spent on low-effort, social, and physical activities each day had no impact on replenishing energy each day, but there was an accumulated benefit over time, meaning time spent on consecutive days added up to increase feelings of high energy later. Bakker, Demerouti, Oerlemans, and Sonnentag (2013) also found that work-related activities in the evening decreased feelings of vigor at bedtime. Their investigation found that both physical and social activities were statistically significant predictors of vigor at bedtime each day, but did not investigate accumulation effects. The relationship between vigor and specific activities seem to hold true when measured at several intervals (e.g. after work, before bed, or the next morning). Work-related activities reduced vigor and social, physical, and low-effort activities increased vigor when subjective vigor was measured the next morning rather than before bedtime (ten Brummelhuis & Bakker, 2012b). Using Likert-type measures of time spent on activities, Fritz and Sonnentag (2005) found that social activities during the weekend was not a statistically significant predictor of reduced fatigue at the beginning of the work week. However, social activities did predict increases in self-reported task performance at work.

In 2008, a shift in the organizational literature occurred and scholars began to also examine what individuals do during the work day. This began with Trougakos et al. (2008), when they examined employees engaging in work chores (e.g., errands, preparing for work, working with customers) or respite (e.g., napping, relaxing, socializing) activities during two-hour breaks. Focusing on affective states and subsequent affective displays of instructors at a cheerleading camp, the results showed that employees who reported engaging in more respite activities during their break was correlated with higher employee-reported positive emotions and lesser degrees of negative emotions, as well as more other-rated positive affective displays during their instructional sessions. Employees engaging in more chores reported increased negative emotions after the break period but did not show a statistically significant change in job performance (i.e., affective displays). Following up on this study, Trougakos and colleagues examined the interplay of recovery activities and recovery appraisals during formal lunch breaks. Similar to research on longer respites like evenings and weekends, employees who reported engaging in work-related activities during their lunch break were observed by others to have higher fatigue at end of workday (Trougakos et al., 2014).

In sum, there have been a wide range of recovery activities researched for over a decade. Table 1 provides a definition and outcomes examined from previous studies of work recovery activities. Based on the framework from Sonnentag and Fritz (2007) that grouped recovery processes into psychological detachment, relaxation, mastery, and control, I focus on three recovery activities that can induce these processes and are most likely to occur during a microbreak: psychological detachment, relaxation, and task change activities. Psychological detachment activities are those in which one can mentally disengage from the work task, such as by watching a funny video (Rzeszotarski, Chi, Paritosh, & Dai, 2013). The detachment activity in this experiment is intended to induce a mental disconnect from the work task, and is similar to previous studies using detachment activities. Relaxation activities are those that provide a respite from work tasks, such as napping or relaxing (Trougakos et al., 2008). The relaxation activity in this experiment is an activity intended to induce a relaxation response, and is similar to previous work examining low-effort, respite, and passive activities. Task change activities are those in which one continues to complete work-related tasks (Sonnentag, 2001). The work-related activity in this experiment is a break manipulation during which individuals change work tasks rather than continuing with the same work task. This extends earlier studies by differentiating that the work task completed during non-work time is different from the previous work task completed. I did not include physical activities in the break manipulations because it is more likely that individuals participate in these activities during breaks longer than ten minutes (e.g., 15-minute walk; Ryan et al., 2010). I did not include social activities during a microbreak because this would be difficult to control within the confines of an experiment. I did not include household activities because this study is focused on individuals in a work location that is physically distinct from the home environment, and thus would not be able to complete these tasks. Inducing mastery experiences, by its nature of using longer periods of time as to tackle a positive challenge, is not appropriate for the study of short microbreak time periods. I did not induce control experiences through an activity as this experiment requires that participants engage in a specific activity.

Table 1

List of Recovery Activities

Recovery activity	**Description / Sample item**	**Source**
Physical activities	“Sports, cycling, or dancing”	(Sonnentag, 2001)
Social activities	“Meeting with others or making a phone call to chat”	(Sonnentag, 2001)
Low-effort activities	“Watching television or taking a bath”	(Sonnentag, 2001)
Household activities	“Cooking, doing the dishes, shopping, and taking care of the children”	(Sonnentag, 2001)
Work-related activities	“Finishing or preparing for work duties”	(Sonnentag, 2001)
Detachment activities	“Cognitive-focused” story break with an “eye-catching comic to read” “While performing this activity, I could ‘switch off’ completely”	(Rzeszotarski et al., 2013) (Sonnentag & Bayer, 2005)
Passive activities	“Reading a novel or watching television”	(de Bloom et al., 2011)
Chore activities	“Working with customers, running errands, practicing material, and preparing for upcoming sessions”	(Trougakos et al., 2008)
Respite activities	“Napping, relaxing, and socializing”	(Trougakos et al., 2008)
Volunteer activities	“How much time did you spend on volunteer work activities today, for example, in church, political activities?”	(Mojza, Lorenz, Sonnentag, & Binnewies, 2010)
Chance-related gambling activities	Game where one chooses “to risk earned money for a fair chance of more payout” Playing slot machines, bingo, or other chance-related games	(Rzeszotarski et al., 2013) (Bourgeois, 2011)
Skill-related gambling activities	Playing card games or skill-games for money	(Bourgeois, 2011)

Psychological detachment activities. The Effort-Recovery Model (Meijman & Mulder, 1998) proposed that time away from work tasks allows for the psychobiological load to cease, reducing resource loss and allowing resources to replenish. This time away from work tasks creates psychological distance or detachment, and the nature of being away is beneficial because resources are no longer being drained as a result of work tasks (Etzion et al., 1998). Evidence from previous studies support that that detachment can induce a recovery process leading to resource replenishment, and some scholars have even proposed that psychological detachment is "the most powerful recovery experience" (Siltaloppi, Kinnunen, & Feldt, 2009, p. 344). High levels of detachment after work have been found to reduce energy depletion (Demerouti et al., 2012; Sonnentag & Bayer, 2005). Conversely, low levels of detachment after work predict higher feelings of energy depletion the next day (Sonnentag, Binnewies, et al., 2008; Sonnentag, Kuttler, & Fritz, 2010). Ten Brummelhuis and Bakker (2012b) found that individuals participating in evening activities that lead to increased psychological detachment reported subsequently higher levels of energy the next day. Missing from these previous studies are an examination of shorter recovery periods. However, in a study of 30- second microbreaks, individuals engaging in activities that induced detachment by reading a story or short comic saw increased subsequent performance in two of three types of work tasks (Rzeszotarski et al., 2013).

In summary, ERM proposes that resource mobilization leads to both task performance but also depletes resources, and that recovery processes can replenish resources, ultimately leading to improvements in subsequent task performance. ERM also proposes that detachment from the work task can induce the recovery process. Previous studies have found that individuals engaging in detachment activities predicts increased feelings of high energy and reduced feelings of low energy, but these results have only been examined for metarecovery periods (e.g., evenings). Based on these findings, I propose that there will be the same relationship between detachment activities and energy for microbreaks. Although to my knowledge there are no previous studies examining the relationship between detachment activities with attention regulation resources, ERM proposes that this resource can be replenished during microrecovery periods just like other resources (e.g. energy; see Figure 3). Lastly, a previous study of microrecovery periods found that individuals engaging in detachment activities resulted in improved task performance, which aligns with ERM. In this current study, I use different measures of task performance and a different detachment task, but I expect to confirm this positive relationship between microbreak detachment activities and task performance. Based on ERM and results from previous studies showing that detachment activities can induce the recovery process, and this recovery process can impact subsequent resources and performance, I propose the following about the detachment microbreak condition:

> *Hypothesis 1:* Individuals in the detachment microbreak condition will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no work break (control) condition.

Relaxation activities. Relaxation activities are defined as those that require little effort (e.g. watching television; Sonnentag, 2001) and induce feelings of calmness and decreased wakefulness (Sommer, Stürmer, Shmuilovich, Martin-Loeches, & Schacht, 2013). Ten Brummelhuis and Bakker (2012b) confirmed that non-work activities in the evening requiring only small amounts of effort were experienced as relaxation. Relaxation has been found to have multiple benefits for employee well-being (e.g. Siltaloppi et al., 2009; Sonnentag & Fritz, 2007). For example, in a randomized-control trial with a workplace intervention, seven individuals participated in a 20-minute relaxation exercise during their lunch break each day while the control group engaged in normal social activities in the break room (Krajewski, Sauerland, & Wieland, 2011). Results from the study showed that levels of cortisol (used as a stress indicator) were only reduced in the relaxation group after lunch, and the benefit of relaxation continued when measured at bedtime and next morning.

Results from previous studies with different recovery lengths (e.g., metarecovery, mesorecovery, microrecovery) support the notion that relaxation induces recovery, which impacts energy resources. Several studies have found that relaxation in the evening predicts increased employee feelings of high energy (e.g., Sonnentag, Mojza, Binnewies, & Scholl, 2008; ten Brummelhuis & Bakker, 2012b) and decreased feelings of low energy (e.g., Derks & Bakker, in press; Feldt et al., 2013). For mesorecovery periods, one study discovered that individuals who reported engaging in relaxing activities during an hour-long lunch break were rated by co-workers as being less fatigued at the end of the work day (Trougakos et al., 2014). This negative relationship between relaxation and fatigue was a direct effect in the study, but the study also found that if an individual felt that he or she had little control over their lunch break activity, then that person actually felt more fatigue rather than decreased fatigue. Based on these findings, I expect that this negative relationship between relaxation activities and feelings of low energy will be the same for microbreaks as well. Previous microrecovery studies have found that mediation activities during a microbreak were correlated with increased employee vitality (Fritz et al., 2011). I expect to confirm this relationship in the current study.

Some scholars have proposed that when individuals engage in relaxing activities like meditation, attentional resources will be restored (Kaplan, 2001). This aligns with the Effort-Recovery Model, which proposes that relaxing or low-effort activities will be beneficial because involving minimal amounts of activation of one's psychobiological systems will halt resource loss and replenish resources (Stone, Kennedy-Moore, & Neale, 1995). To my knowledge, there are no direct tests of microbreak relaxation activities with attention or performance. Nonetheless, ERM details that low-effort activities induce the recovery process, and should thus replenish attention regulation resources and subsequent task performance (see Figure 3). Therefore I propose that the following about the relaxation break condition:

> *Hypothesis 2:* Individuals in the relaxation microbreak condition will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition.

Task change activities. Although less frequently studied than recovery activities in the organizational sciences, scholars recognize that individuals switch tasks and have multiple work performance episodes during a workday (Beal, Weiss, Barros, & MacDermid, 2005). It has been proposed that the very nature of changing tasks may facilitate recovery (Trougakos & Hideg, 2009). As discussed in the Relaxation Activities section, Krajewski et al.'s study in 2011 was an excellent study design with a lunch break relaxation intervention over multiple days. However, one limitation is that it is possible that the change in lunch routine created a Hawthorne effect (Roethlisberger & Dickson, 1939), or that changing routines and not the relaxation induction impacted employee experiences and subsequent outcomes. This study examines task change explicitly to help tease out this potential confounding explanation.

Regarding energy resources, Horsman (2011) studied individuals who spent one weekend each month as a Canadian Armed Forces Army Reservist. Results showed that this change in work tasks and work environment for a weekend predicted reduced feelings of fatigue. Using an experimental design, Lorist et al. (2000) found that changing tasks during a work period decreased feelings of high energy (e.g., vigor) but had no statistically significant effect on low energy (e.g., fatigue). Based on these findings, I expect that individuals changing tasks during a microbreak will have reduced feelings of low energy and reduced feelings of high energy.

Regarding attentional processing and attentional regulation resources, Hunter and Wu (2013) used an event-contingent experience sampling methodology to examine work breaks (but not necessarily microbreaks, as duration of break was not reported). Although not termed “task change” in their study, employees responded to survey items each time after they believed they had engaged a break. Employees would not have responded if they were continuing with the same work task, but rather if they felt that they were taking a break and engaging in work-related activities. Results showed that employees who reported engaging in work-related activities during the break predicted increased feelings of concentration directly after the break. Based on these findings, I expect that changing work tasks during a microbreak can improve attention regulation resources.

Regarding task performance, Longman, Lavric, and Monsell (2013) found that perceptual change tasks (tasks that change visual attention) creates a delay in full access to visual attentional processes and prolongs visual response time to a stimulus for one-half to two-thirds of a second. After this brief delay there is a reorientation of attention, and this reorientation actually increases performance on the task at hand over a longer period of time. The underlying mechanisms for why changing tasks can improve performance are likely due to goal reactivation. For example, results from one study in an educational setting found that students had improved learning outcomes if they took a break and changed tasks when feeling either bored or frustrated, and this was proposed to be because task switching allowed one to pause and then subsequently renew learning goals (Sabourin, Rowe, Mott, & Lester, 2011). Subsequent studies have since confirmed that when task change activities have different goals, meaning an individual deactivates the original work goal and later reactivates the original work goal, task performance improves (e.g., Ariga & Lleras, 2011; Weaver & Arrington, 2013). Based on these results, I expect that individuals in the microbreak task change condition will have improved subsequent task performance in comparison to individuals in the control (no break) condition. Collectively, I propose that:

> *Hypothesis 3:* Individuals in the task change condition will have (a) decreased levels of low energy, (b) decreased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition.

Recovery appraisals. While the focus on recovery activities in the evening and weekend was an appropriate way to begin the examination of the recovery process in employees, there are some limitations to these studies as well. One limitation of these studies is the assumption that all individuals have the same amount of time available to engage in recovery activities during the evening. Studies often ask for individuals to report the number of minutes spent on a recovery activity each evening and assess subjective well-being before bed (e.g., Bakker et al., 2013), drawing conclusions from time use. The concerns with this approach are that causality cannot be determined without multiple assessments over time and that individuals may differ in the amount of time available for recovery each evening. For example, study results could find that detachment activities are "best", yet the individuals who engaged in the highest amount of detachment activities also engaged in more recovery activities than others, thus skewing the results. During the time that these concerns were being raised, new information was emerging regarding how individuals perceived their time on these activities. Sonnentag and Bayer (2005) used a daily diary design to assess how much individuals experienced psychological detachment, or "switching off", when engaging in after-work recovery activities. Individuals who reported experiencing more psychological detachment after work also reported higher positive mood and lower fatigue before bed than those who did not report high levels of detachment. This finding was important because individual reports of time spent on recovery activities (i.e., work-related, household, low-effort, physical, and social) were not statistically significant predictors of positive mood or fatigue at bedtime. Thus, recovery experiences are related, but not identical to, leisure or recovery activities (Sonnentag & Fritz, 2015).

Previous work in the stress and well-being literature found that appraisals of stress impact employees, including that stress appraisals can increase attention to tasks (Chajut & Algom, 2003). An experimental study then found that the way individuals appraised a situation predicted their emotional response more than the situation itself, even when the situation was the same for all participants (Siemer, Mauss, & Gross, 2007). For this reason, it has been proposed that "it is not a specific activity per se that helps to recover from job stress but its underlying attributes such as relaxation or psychological distance from job-related issues" (Sonnentag & Fritz, 2007, p. 204). This seminal work by Sonnentag and Fritz in 2007 found that there were four distinct recovery experiences: psychological detachment, relaxation, mastery, and control. *Psychological detachment* is when one is cognitively removed from work. *Relaxation* is when an individual feels that he or she is only required to use small amounts physical or psychological effort. *Mastery* experiences are challenging and provide personal growth or learning opportunities not related to one's work. *Control* is an appraisal when one feels able to choose how he or she uses their non-work time. These four recovery experiences are assessed with sixteen items (the four most construct valid items of each appraisal) in the Recovery Experience Questionnaire (REQ; Sonnentag & Fritz, 2007). There is increasing evidence that these items from the REQ assess recovery appraisals and are valid predictors of various aspects of employee well-being. In addition to initial validation in Germany, the REQ has been validated in Spain (Sanz-Vergel et al., 2010), Japan (Shimazu, Sonnentag, Kunota, & Kawakai, 2012), and Finland (Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011). More recently, a state-level version of REQ was validated in the Netherlands (Bakker, Sanz-Vergel, Rodríguez-Muñoz, & Oerlemans, 2014). In addition, the REQ has been used to investigate the relationship between recovery appraisals and individual resources in more than 50 studies, providing overall support that these four recovery appraisals are distinct predictors of individual resource changes (Bennett, 2013).

For this study of microbreaks, I focus only on detachment and relaxation appraisals as these are also direct manipulations of recovery activities. I chose not to induce mastery activities or assess mastery appraisals because mastery experiences, by definition, require sufficient time for learning and growth, which is extremely difficult to do during respite periods less than ten minutes in duration. I chose not to assess control appraisals for two reasons. One is because allowing for participant control over break time would interfere with the experimental microbreak time manipulations. I decided to explicitly test different time intervals rather than allow for an individual to have control over break time because research has shown that individuals have poor conceptualizations of short amounts of time such as taking a microbreak (Sonnenberg, Riediger, Wrzus, & Wagner, 2012). Second, previous research has shown that when individuals have control over their own time during a break, they either fail to spend an adequate amount of time to recover (Henning et al., 1989) or choose break activities that hinder rather than aid in recovery (Fritz et al., 2011).

Unique effect of recovery appraisals. Many studies have found that that recovery appraisals impact resource and performance outcomes. Psychological detachment appraisals during the evening predict decreased feelings of fatigue after work and at bedtime (Sonnentag & Bayer, 2005) and increased feelings of vigor after work and at bedtime (Sanz-Vergel, Demerouti, Bakker, & Moreno-Jimenez, 2011). Detachment appraisals of lunch breaks has been shown to predict a decrease in subjective attentiveness (Lin, 2009). Evening detachment appraisals have a small positive relationship with self-reported job performance (Shimazu et al., 2012), although this relationship is likely curvilinear such that high or low detachment predicts lower other-rated task performance and a medium level of detachment predicts higher other-rated task performance (Fritz, Yankelevich, et al., 2010). Relaxation appraisals of evening time predicts decreased levels of exhaustion (Sonnentag & Fritz, 2007) and fatigue in the morning (Sonnentag, Binnewies, et al., 2008), as well as increased vigor the next morning (ten Brummelhuis & Bakker, 2012b). Relaxation appraisals of lunch break activities have been shown to predict increased feelings of attentiveness (Lin & Fritz, 2014). Evening relaxation appraisals also predict self-reported job performance (Shimazu et al., 2012). In addition to appraisals of detachment and relaxation, the appraisal of enjoyment, pleasure, or preference for an activity might matter as well. Van Hooff, Geurts, Beckers, and Kompier (2011) found that fatigue was reduced and vigor was increased if an individual felt that off-job time was spent on a pleasurable activity. Related to this, a recent study has found that the best predictor of resource replenishment occurred if an individual appraised that they engaged in a preferred activity during a work break (Hunter & Wu, 2013). The appraisal of enjoyment of non-work activities has been mentioned as a specific area for future research in the recovery literature (ten Brummelhuis & Bakker, 2012b).

The Hunter and Wu (2013) study also discovered that the type of activity employees engaged in (e.g., work-related, social, effortful, outside the office) during a work break did not impact employee energy, but the appraisal of the activity (e.g., preferred) did statistically predict reduced employee fatigue. Other studies have examined both recovery activities and recovery appraisals before as well, each with different findings. A study of vacation periods found that the statistically significant predictors of post-vacation outcomes were both time spent on activities (non-work activities) and appraisals (psychological detachment and relaxation; de Bloom, Geurts, & Kompier, 2012). The study by Van Hooff, Geurts, Beckers, and Kompier (2011) not only found that appraisals of pleasurable evening activities decreased feelings of fatigue and increased feelings of vigor, but that that time spent on physical and social activities increased feelings of fatigue at bedtime as well. In sum, there is some evidence that both the non-work activity and the appraisal of the activity can impact energy and performance outcomes.

Having discovered that that appraisals of activities were important predictors of employee well-being (Sonnentag & Fritz, 2007), scholars have proposed that recovery appraisals could be a mediator between recovery activities and outcomes. That is, time spent on an activity impacts an individual's appraisal of that experience, which in turn impacts an individual's momentary energy assessment and thus the allocation of future effort (Sonnentag et al., 2011). This mediation model has since been confirmed in an empirical test, showing that evening activities impacted recovery appraisals, and these recovery appraisals then predicted next-day energy and subsequent engagement during the work day (ten Brummelhuis & Bakker, 2012b). Additional models have tested and found support for appraisals as a mediator in the recovery process. For example, Kinnunen, Feldt, Siltaloppi, and Sonnentag (2011) found support for recovery appraisals as a partial mediator between both job demands and job resources with outcomes. This testing of a mediation model was a significant contribution to the field because it builds off of the work showing that appraisals are a necessary component to predicting affective outcomes (ten Brummelhuis & Bakker, 2012b). Missing from these studies are comparisons of similar activities and appraisals. In other words, a limitation of the recovery research is that studies focus on time spent in broad categories like physical activities and then assessing appraisals (Mojza, Sonnentag, & Bornemann, 2011), rather than explicitly asking individuals to engage in an activity that will induce feelings of detachment or relaxation. Two studies that have examined recovery appraisals following specific activities are van Hooff and Baas (2013) who found that a 15-minute meditation activity reduced stress and increased serenity mediated through relaxation and mastery but not psychological detachment, and Eschleman, Madsen, Alarcon, and Barelka (2014) who found that a creative activity had both direct and indirect effects on performance as mediated by all recovery experiences except psychological detachment. Just as recovery appraisals have been found to mediate the relationship between broader recovery activities and outcomes, I propose that:

Hypothesis 4: Recovery appraisals of (a) detachment, (b) relaxation, and (c) enjoyment partially mediate the relationship between break activity conditions and energy, attention, and performance outcomes.

Time duration of recovery. Individuals are more likely to need a rest from mental tasks rather than physical tasks (Strongman & Burt, 2000). In a knowledge work environment, employees have reported that they engage in work breaks (e.g., coffee break, surfing the internet) because they are bored or require a respite (D'Abate, 2005). But, how long of a break is necessary to recover? McGehee and Owen (1940) studied clerical workers and found that individuals took unauthorized rest pauses for an average of three minutes for every hour at work.

These were considered unauthorized because the pauses were not within a formal work break period and occurred during paid work time. Even after altering formal work and break schedules, employees still took over one minute of unauthorized work pauses each hour. Doerr, Mitchell, Klastorin, and Brown (1996) conducted similar research at a fish processing plant. They manipulated work flow conditions in multiple ways, and found that when individuals had more idle time between work episodes (i.e., a longer break duration), individuals had subsequent increased task performance. Esteves (2013) recently studied employees at a technology company who had complete control over their time spent at work. These employees were observed spending an average of 58 minutes of every eight hour work day on non-work tasks. Individuals reported spending this time, roughly 12% of their working day, on non-work tasks because they desired a respite or wanted to engage in activities of personal convenience (e.g. checking e-mail). This study did not examine the impact of these break durations on well-being or performance, but does show that employees take breaks often.

Overall, there is “little hard evidence concerning the optimum length of rest breaks,” especially in relation to reducing fatigue, increasing alertness, and increasing performance (Tucker, 2003, p. 123). In this study, I experimentally manipulate durations of breaks to address this issue. For example, Trougakos et al. (2008) had individuals indicate (yes or no) if they had respite time during a work break, but it is possible that one individual might have a work respite of five minutes whereas another individual could have a respire of thirty minutes. Being explicit with different durations allows for the measurement of a dose-response to manipulations. Similar to testing the effectiveness of different dosages in medical interventions, time has been used to test the dose-response in industrial and organizational psychology as well (e.g., Toker & Biron, 2012). To conduct a dose-response examination, I tested microbreaks of shorter, medium, and longer durations with evenly-spaced interventions of 1-minute, 5-minute, and 9-minute microbreaks.

Longer microbreak durations. Longer microbreaks are interesting from a legal perspective because California requires that personal service employees have a paid 10 minute break for every four hour working period (California Industrial Welfare Commission, 2001). Multiple scientific studies focus on these longer breaks as well. In an experimental design, Kanfer and Ackerman (1989) included 10-minute breaks after participants completed 30 minutes on tasks depleting attentional resources. They reported that these breaks were included to minimize practice effects, but there was no assessment during or after recovery periods. A study by Dababneh, Swanson, and Shell (2001) increased the duration and frequency of work breaks. Employees underwent two weeks each in a control group that their regular daily break schedule (one 30-minute lunch break, two 15-minute breaks), one manipulation that added 12 3-minute breaks into the work day, and a second manipulation added four 9-minute breaks. Neither break manipulation helped or hindered overall productivity, but the productivity rate increased in both break conditions, meaning individuals were more productive during their time on task even though they had less time to accomplish these tasks due to the added microbreaks. The 9-minute breaks were preferred over the 3-minute breaks by employees, and also led to a reduction in physical discomfort at the end of the work day. This study also only analyzed the second week of data from each manipulation, as this helped reduce any impact in the results occurring because of change (Hawthorne effects). Based on the above, I propose the following about individuals in the longer (9-minute) break condition:

Hypothesis 5: Individuals in the 9-minute break condition will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition.

Medium microbreak durations. A study by Galinsky et al. (2000) found in their field study that adding four 5-minute microbreaks into the work day improved employee well-being (decreased discomfort and decreased visual problems), but no statistically significant performance differences were found. This study also used exemplary methodology, as the participants were randomly placed into different groups (added breaks vs. no break manipulations) and only data from the third and fourth week of the manipulation were analyzed to reduce the potential impact of Hawthorne effects. During a visual attention task of an air traffic controller simulation, Kanfer et al. (1994) provided some participants with two 4-minute breaks during which they were instructed to sit in their chair and not talk with anyone. Individuals in this break condition (versus no breaks between trials) saw improved performance as measured by fewer flight errors (rule violations).

Three-minute breaks have also been studied. As discussed earlier, a 9-minute break was preferred over a 3-minute break, but there was no statistically significant difference between the no-break and 3-minute break conditions in performance or well-being (Dababneh et al., 2001). Another study focused on employees at two different work sites who performed both data entry tasks and customer service (Henning, Jacques, Kissel, Sullivan, & Alteras-Webb, 1997). Participants were prompted with a visual cue to take three 30-second breaks and one 3-minute break each hour. Some individuals were asked to perform stretching exercises at their desk, while the control group was allowed to do as they pleased during the breaks. Overall, employees preferred the 3-minute break, and the majority of the time did not comply with the cue to take a 30-second break. Employees from both sites who were in the stretching condition reported less discomfort at the end of the day. No other statistically significant results were found overall at the work site with more employees. However, at the work site with fewer employees, employee well-being (i.e. mood) and productivity improved in the break condition versus the control group with no additional break. In addition, productivity was further improved when breaks included stretching exercises. Thus, I propose the following about individuals in the medium (5-minute) break condition:

> *Hypothesis 6*: Individuals in the 5-minute break condition will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition.

Shorter microbreak durations. Shorter microbreaks have also been examined from various perspectives, with several studies drawing on the seminal work of Henning et al. (1989). This study found that when data entry operators were allowed to control the length of their break, they often did not allow adequate time for recovery. The average break duration was 37 seconds. However, the standard deviation was 33 seconds, and individuals with longer breaks had improved outcomes. Another significant result from this study was that the degree of recovery, measured with subjective mood and heart rate, was linked to the duration of the break, such that individuals who had longer break durations were more recovered and individuals who had the shortest breaks did not have adequate recovery. A second study focusing on 30-second breaks manipulated the frequency of breaks, where the control group could decide when to take a break, the first experimental group were provided a 30-second break every 20 minutes, and the second experimental group was provided a 30-second break every 40 minutes (Mclean, Tingley, Scott, & Rickards, 2001). The results from this study were rather minimal, only noting that individuals who were provided a break reported better well-being (less discomfort), with no positive or negative impact on productivity. The results from these studies begin to indicate that employees at least a 1-minute break might be necessary for effective recovery of well-being outcomes.

Short microbreaks have also been examined in the examination of cognitive resources. Henning, Bopp, Tucker, Knoph, and Ahlgren (1997) examined 1-minute breaks every 10 minutes for dyads completing work tasks. Although the main manipulation was the amount of feedback the group received about the break (when to take a break), dyads who were provided a cue to take a break and complied by taking the 1-minute break had improved productivity and less mood irritability (impatience) versus those groups that had less feedback or did not take a break. In educational setting, Rosen, Cheever, and Carrier (2012) found that a 1-minute technology break after a 15-minute lesson improves individual attentional focus.

There is some support for short microbreaks having a positive impact on task performance as well. Rzeszotarski et al. (2013) found that individuals engaging in 30-second psychological detachment activities between work trials had improved performance compared to individuals in the no-break control group. Based on these findings regarding the impact of short microbreaks on employee well-being, cognitive resources, and performance, I propose that:

Hypothesis 7: Individuals in the 1-minute break condition will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition.

Time duration and nonlinear outcomes. Results from previous studies examining the duration of microbreaks all have some evidence of positive outcomes, but there are potentially conflicting or unclear results. For example, one study showed that individuals preferred 3-minute breaks over 30-second breaks (Henning, Jacques, et al., 1997). Another study showed that individuals preferred 9-minute breaks over 3-minute breaks (Dababneh et al., 2001). So it might appear that a longer break is better or more preferred, yet studies have also found that individuals were given control over the duration of their break, they often spent an inadequate amount of time on the break to fully recover (Henning et al., 1989). In addition, the relationship between break duration and performance, energy, and well-being is inconsistent. For example, performance increased in one study of 30-second breaks (Rzeszotarski et al., 2013) but not another (Mclean et al., 2001). A three-minute break improved employee mood and performance at one work site but not another (Henning, Jacques, et al., 1997). Performance increased in a study with 4-minute breaks (Kanfer et al., 1994) but not in a study with 5-minute breaks (Galinsky et al., 2000). The study with a 9-minute break showed improved employee well-being but not productivity (Dababneh et al., 2001). These conflicting results are potentially caused by different work tasks in each

Combined, these studies show that there might be a “sweet spot”, or optimal break duration for recovery based on the task demands. Increased break duration should increase alertness and decrease fatigue, and these changes in energy levels mediate the relationship between the temporal components of breaks and performance improvements (Ong, 1984). Previous organizational scholars have proposed that the relationship between duration and outcomes is nonlinear (Blount & Janicik, 2001). Studies of recovery have recently used sinuous transformations to account for the nonlinear nature of time and recovery (e.g., Trougakos et al., 2014). Sine and cosine transformations are used when there is a pattern of cyclical variance (Beal & Weiss, 2003), indicating that in these studies there is a nonlinear relationship between time and recovery outcomes.

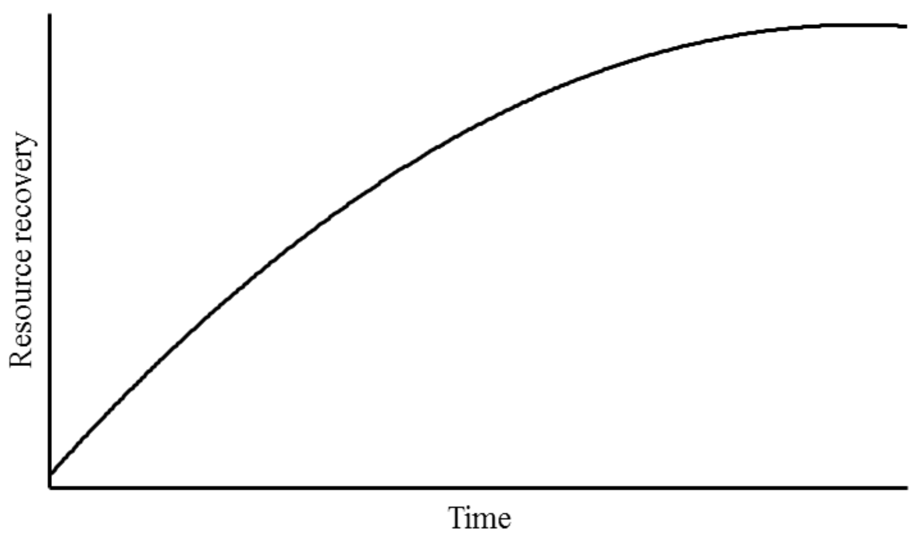
Drawing from industrial engineering provides better evidence that more rapid recovery occurs earlier in time. With respect to physical resource recovery, the *Rohmert curve* predicted that recovery from physical fatigue should be reduced in a non-linear manner, such that first half (50%) of recovery time should reduce fatigue by 75% (Rohmert, 1973). Multiple studies have modeled and confirmed a nonlinear pattern of physical resource recovery (e.g., El ahrache, Imbeau, & Farbos, 2006; Ma, Chablat, Bennis, Zhang, & Guillaume, 2010; Xia & Law, 2008). This work supports a nonlinear trend between rest break durations with performance and fatigue outcomes from tasks depleting physical resources. However, there have been no causal examinations of this recovery process for mental resources. There is initial evidence that longer breaks (15 minutes) might not be as effective as shorter breaks (7.5 minutes) to reduce subjective and objective measures of fatigue (Boucsein & Thum, 1997). In addition, prior research has found that employees recover faster in the first few minutes of a break than in the later stages of a break (Konz & Johnson, 2000). The Effort-Recovery Model (Meijman & Mulder, 1998) proposes that mental resource recovery behaves in a similar way as theories and models of physical resource recovery, I expect that there will be a nonlinear relationship for time and mental resource recovery. Figure 4 is a visual representation of this expected nonlinear relationship between time and resource recovery. Because this study has individuals participate in 10-minute work episodes, I expect that the optimal microbreak duration will occur for the 5-minute condition, stated as:

Hypothesis 8: Individuals in the 5-minute and 9-minute break conditions will have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the 1-minute break condition.

Hypothesis 9: Individuals who have a 9-minute break will see no statistically significant difference in (a) levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the 5-minute break period.

Figure 4

Expected Non-linear Relationship between Time and Recovery



Optimal microbreak durations and activities. The hypotheses of this study propose that all types of activities and durations will have beneficial outcomes in comparison to a control group. The hypotheses also explicate that some breaks durations could yield improved outcomes over others durations. While there is no known theoretical or empirical study contrasting combinations of time durations and recovery activities, this could have a tremendous practical impact on individuals in the workplace. For example, it could be that a 1-minute detachment activity is best to decrease feelings of low energy, but a 9-minute relaxation activity is best for increasing feelings of high energy and subsequent performance. Several studies provide evidence that this could occur. An unpublished meta-analysis has found that appraisals of psychological detachment and relaxation during the evening were better predictors for reducing feelings of low energy, with no statistically significant impact on increasing feelings of high energy (Bennett, Bakker, & Field, 2014). Previous research finding that changing tasks for a short time period increases feelings of high energy (Ariga & Lleras, 2011) might show that resource replenishment occurs more strongly for this recovery activity. Recent studies have also found that when relaxation is induced through mindfulness mediation practice, mental alertness increases but there is not an increase on a subsequent cognitive task (Amihai & Kozhevnikov, 2014). In addition, individuals who engaged in a relaxation activity during a 3-minute break replenished their self-regulation resources as well as those in 10-minute break (Tyler & Burns, 2008). In sum, there is tentative evidence that specific activities, appraisals, and durations could yield varying outcomes. However there is not enough information to support a hypothesized relationship that one combination of break activity and duration is better than another. Thus, I ask:

Research question 1: Are there optimal interactions between break activity conditions and duration conditions to (a) decrease feelings of low energy, (b) increase feelings of high energy, (c) increase attention, and (d) improve subsequent performance after a break?

Chapter 3: Methods

This study examined the impact of microbreak duration, activities, and appraisals on subjective energy, attention regulation resources, attentional cognitive processes, and task performance using an experimental design. The benefit of using an experiment is that it reduces other plausible explanations for the findings, strengthening causal inference (Schwab, 2005).

Population and procedure

Participants in the study were students at a large southeastern university enrolled in Management or Accounting courses, receiving extra credit in exchange for participation. Students were recruited during class time and with e-mails sent by instructors. An *a priori* power analysis was conducted to determine a suitable number of participants required. Following statistical conventions, I set the probability of making a Type I error at 5% (α=0.05) and the probability of making a Type II error at 20% (β=0.80). I examined effect sizes from previous research with energy and performance outcomes, and the smallest effect size was f=0.30 (based on group mean differences in reaction time of orienting network after experimental manipulation; Berman, Jonides, & Kaplan, 2008). With a 3x3+1 factorial design and multiple outcomes, I anticipated 10 groups, 9 predictors, 6 response variables (dependent variables), and 4 covariates (control variables). Using G*Power 3.14 (Faul, Erdfelder, Lang, & Buchner, 2007), there is no direct power analysis for a MANCOVA. However, I ran *a priori* power analyses separately with this information for ANCOVA and MANOVA tests, with the total sample size required to find an effect being 183 and 30, respectively.

All students participated on a voluntary basis and registered for an experiment session that best fit their schedule using an online system (www.signupgenius.com). There were 71 experiment sessions conducted in a computer laboratory, and all sessions were randomly assigned to an experimental condition. In total, 270 students began the experiment. Due to technical difficulties (e.g., experimental program shutting down unexpectedly during sessions; video manipulations not loading), and one individual failing all quality control checks, 65 participants were removed. Thus, the final sample comprised of 205 participants (75.9% retained), and was largely female (56.1%) and white (45.4%; 23.4% Asian American, 18.5% black, 6.3% Hispanic/Latino, 0.5% Native American, 5.9% other/preferred not to answer.). Participants were 24.2 years old on average and worked 17.8 hours on average per week.

Procedure. An overview of the study design is as follows. First, students were provided instructions about the experiment (see Appendix A). These instructions were read aloud and displayed on the computer screen. Next, participants engaged in a 10-minute work episode that utilized attentional resources. This trial length was chosen because attentional resources deplete in a monotonic pattern for the first 10 minutes on attentional tasks, and then plateau (Jung et al., 1997; Van Orden et al., 2000). Thus, the 10-minute trial was a sufficient time to induce maximum resource depletion. All non-control group participants were then prompted to engage in specific recovery or work activities (i.e., detachment, relaxation, task change) for a variable duration (i.e., 1 minute, 5 minutes, 9 minutes). This was followed by a second 10-minute period of work requiring attentional resources. The control group did not receive a period of time between the first and second work periods. The overall study design is shown in Figure 5. The entire experiment was run using E-Prime 2.0 Professional (Psychology Software Tools, 2014).

Figure 5

Overall Study Procedure

Time 1 measures	Time 2 Work task	Time 3 measures	Time 4 Break / No-break	Time 5 measures	Time 6 Work task	Time 7 measures

Measured during Time 1 were baseline subjective energy resources and attention regulation resources. Measured during Time 2 (the first 10-minute work period) was task performance. Measured during Time 3 (after the first work period) were subjective levels of energy and attention resources. There were no measures during Time 4 (break conditions, when applicable). Subjective levels of energy and attention and recovery appraisals of the break activity were measured at Time 5 after the break condition. Measured during Time 6 (the second 10-minute work period) was task performance. Time 7 (after the second work period) measured subjective energy and attention resources, as well as control variables and demographic data.

For the nine break manipulation groups, there were measures during Times 1, 2, 3, 5, 6, and 7. For the control group with no break period, measures were only at Time 1, Time 2, Time 3, Time 6, and Time 7. In other words, individuals in the control group completed baseline measures (Time 1), a 10-minute work period (Time 2), subjective resource measures after the first work period (Time 3), a second 10-minute work period (Time 6), and subjective resource measures after the second work period (Time 7). Details of each experiment scenario are shown in Table 2.

Table 2

Detailed Experimental Design

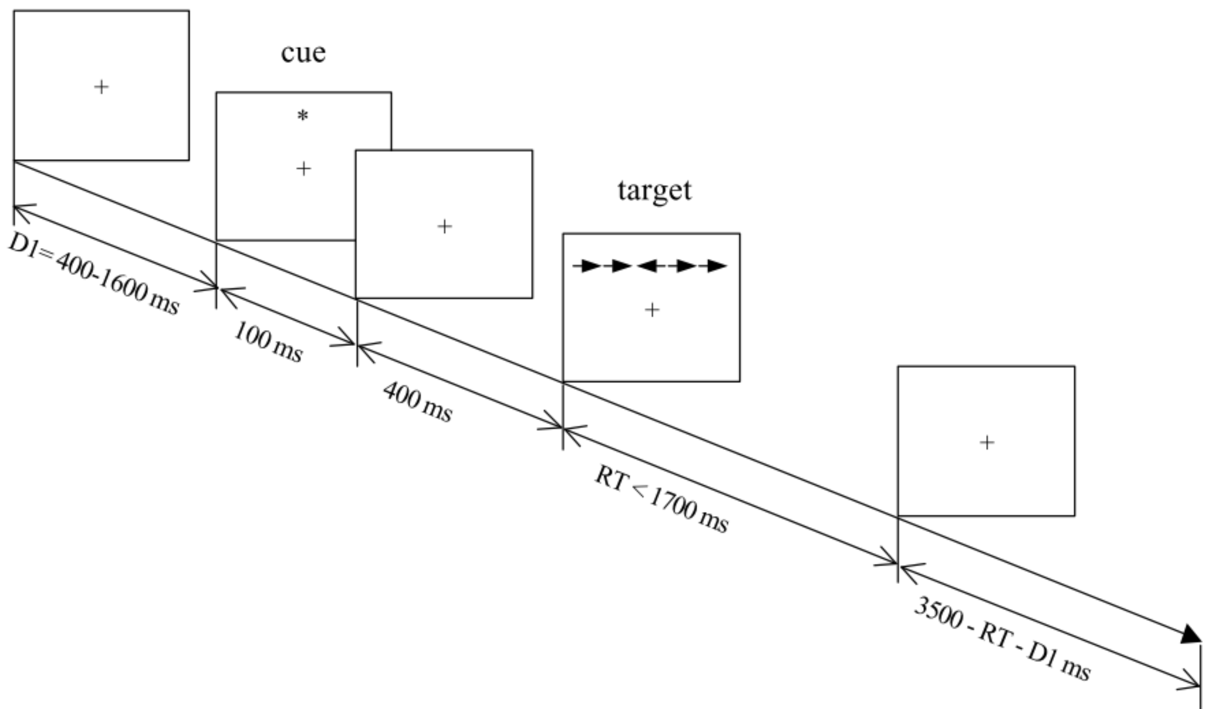
Time period	**Task**	**Length of time**	**Measures**
Time 1	Baseline measures		Energy resources Attention regulation resources
Time 2	Attentional Network Test	10 minutes	Task performance
Time 3	Resource measures		Energy resources Attention regulation resources
Time 4	Microbreak manipulations	Variable: 1-, 5-, or 9-minutes	
Time 5	Resources measures		Energy resources Attention regulation resources
Time 6	Attentional Network Test	10 minutes	Task performance
Time 7	Resource measures, controls, & demographics		Energy resources Attention regulation resources Caffeine intake Sleep quality Personality Attention trait characteristics Age Gender Race

Work Tasks

There are many different types of attention tasks that have been used in past research. A complex attention task uses both attentional focus (attention processing) and retrieval of information from storage (working memory capacity). Simple attention tasks provide an assessment of just attentional processing, and do not require high amounts of working memory capacity to complete the task. For job tasks like monitoring computer screens, a simple attention task is appropriate. To simulate this work task, I used the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002) which combines a flanker task with a cuing paradigm and has been found in multiple studies to assess three distinct attentional networks of alerting, orienting, and executive control (e.g., Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Wang, Fan, & Johnson, 2004). The ANT has been used in research to be highly correlated with task performance on work-related performance measures requiring attention (e.g., driving performance of an automobile; B. Weaver, Bédard, McAuliffe, & Parkkari, 2009). Figure 6 is a screen shot of what is viewed by participants in the ANT.

Figure 6

S*creenshot of Attentional Network Test (ANT; from Posner & Fan, 2004, p. 30)*



In the ANT, participants are asked to notice when the middle arrow on the screen is pointing in the same or opposite direction as the other arrows in the same horizontal line. Each individual is instructed to complete this task as quickly and efficiently as possible. Once the participant has confirmed the direction of the middle arrow on the screen, a new trial begins. Although there could be some concern that attention is shifted with the use of a keyboard, previous research has found that cognitive resources and psychomotor resources draw from separate resources pools in similar tasks (Huddleston et al., 2013).

The use of 10-minute task trials is common in experiments focused on attention (e.g., Einöther, Martens, Rycroft, & De Bruin, 2010; Lorist et al., 2000; Sato et al., 1999), and the 10-minute version of the ANT has been found to be as valid as versions with longer durations (B. Weaver, Bédard, & McAuliffe, 2013). In previous experiments, the test-retest reliability of the ANT with 10-minute breaks between trials ranges from 0.52 to 0.77 (Fan et al., 2002). However, test-retest reliability may be an inappropriate reliability measure as the second test round scores are expected to show group mean differences caused by the experimental conditions. Taking this into consideration, I note that the original scoring method has low split-half reliability, and this could impact statistical power. MacLeod et al. (2010) found split-half reliability of reaction times to be 0.20 in the alerting network, 0.32 in the orienting network, and 0.65 for the executive control network. A new scoring method using median response times and difference scores that have less overlap in attentional networks reports higher split-half reliability than the older scoring method, with a value of 0.71 for the reaction time scores across all networks (Y. Wang et al., 2014). For this reason, the new scoring method was used.

Independent Variables

Microbreak Recovery Activity Manipulation Conditions. Three microbreak activity conditions were designed to simulate different types of work break activities that an employee uses to induce recovery processes. The three activities used in this experiment a psychological detachment activity, a relaxation activity, and a task change activity.

Psychological detachment microbreak condition. The detachment microbreak manipulation used a 1-minute, 5-minute, or 9-minute video that provided a brief story and humor. This activity was intended to help an individual think of something other than the work tasks. Drawing from previous studies (e.g., Muraven, Tice, & Baumeister, 1998), each video clip was from Saturday Night Live. The use of funny video clips has been in experiments examining cognitive resources (e.g., Schmeichel, Volokhov, & Demaree, 2008; Tsai, Levenson, & Carstensen, 2000), and experiments have used similar video clips with different durations (e.g., Fredrickson & Kahneman, 1993).Watching online (e.g. YouTube, www.break.com) video clips is in line with previous research showing that individuals surf the internet during short work breaks (D'Abate, 2005; Fritz et al., 2011; Lim & Chen, 2012), and this includes watching videos (Hunter & Wu, 2013). Videos are also shown to have improved affective inductions than other methods (Ferrer, Grenen, & Taber, 2015). A link to these videos is provided in Appendix B.

Relaxation microbreak condition. For the relaxation microbreak activity, I used guided mindfulness meditation activities. Just like the detachment break activities, these were YouTube videos watched by participants. I chose these videos specifically because this type of relaxation activity is available to the public and is used by individuals in the workplace. Mindfulness meditation has been shown to induce a relaxed state and to improve subsequent attentional resources (for a review, see Holzel et al., 2011). Previous studies have found that individuals use meditation as a recovery activity during work breaks (Fritz et al., 2011), and that mindfulness impacts both recovery processes (Hülsheger et al., in press) and energy outcomes (Hülsheger, Alberts, Feinholdt, & Lang, 2013). A link to these videos is provided in Appendix B.

Task change microbreak condition. Based on research showing that changing to a very different task can create interference and decrease performance (Kiesel et al., 2010), the microbreak task change activity needed to have a similar goal orientation (i.e., noticing a change on a screen) while still consisting of a different work task or work routine. Thus, individuals in the task change microbreak condition participated in a computerized version of the Stroop Color-Word Conflict Test (Stroop, 1935). The Stroop test requires attentional focus (Olk, 2013) and presents a series of words in congruent or incongruent colors (e.g., the word "green" written in green text [congruent], or the word "green" in red text [incongruent]). Participants were asked to select the color or written word in the center of the screen. The Stroop test and its variations have been widely used in psychological and organizational research (e.g., Converse & DeShon, 2009; Ganster, Schaubroeck, Sime, & Mayes, 1991), including studies focused on depleting and replenishment of resources (e.g., Gailliot et al., 2007). Previous studies (e.g., Fan et al., 2002) have used the Stroop test as a task change activity during trials of the Attention Network Test, with empirical evidence showing that these two tests assess the same cognitive constructs using different tasks (Breton et al., 2011; Lyche, Jonassen, Stiles, Ulleberg, & Landrø, 2011).

Microbreak Recovery Time Duration Manipulations. The microbreak experimental conditions included different durations of each recovery activity. Similar to research examining organizational interventions or medical trials, these time increments are considered a dosage manipulation (Toker & Biron, 2012). Each recovery activity (i.e., psychological detachment, relaxation, and task change) had a 1-minute, 5-minute, and 9-minute manipulation. In the psychological detachment and relaxation microbreak activity conditions, the video clips had similar content. The use of video clips with different durations but similar content has been used in previous research studies (e.g., Fredrickson & Kahneman, 1993). The task change conditions for each time manipulation used the same work task (Stroop), with the duration as the only change. The duration of each manipulation is included in Appendix B.

Microbreak Recovery Appraisals. All non-control group participants assessed how they appraised the break activity. Participants responded on a Likert-type scale from 1 (strongly disagree) to 5 (strongly agree) with how much they agree with the statements provided.

Detachment and relaxation appraisals. Recovery appraisal items were from the Recovery Experience Questionnaire (REQ; Sonnentag & Fritz, 2007). There are four psychological detachment appraisal items and four relaxation appraisal items. Versions of these items have been validated in multiple countries and cultures (Burke & El-Kot, 2009; Sanz-Vergel et al., 2010; Shimazu et al., 2012), and have been used to assess both the general level of recovery appraisal (e.g., Sonnentag & Fritz, 2007) and state-level, or more momentary, recovery appraisals (Bakker et al., 2014). Items from the Recovery Experience Questionnaire have been adapted to assess recovery appraisals of week-long (e.g., Flaxman, Ménard, Bond, & Kinman, 2012), weekend (e.g., Hahn, Binnewies, & Haun, 2012), evening (e.g., Fritz, Yankelevich, et al., 2010), and work break (e.g., Trougakos et al., 2014) time periods. In the current study, items were at the state-level (Bakker et al., 2014) and prompted individuals to evaluate their appraisal of the microbreak (e.g., Trougakos et al., 2014). At the state-level of assessment, the internal consistency (Cronbach's alpha) of these items typically ranges from 0.88 to 0.95 (Bakker et al., 2014). The items used in this study are included in Appendix C, and the internal consistency of psychological detachment (α= .90) and relaxation (α= .93) was within the typical range.

Enjoyment appraisals. To assess enjoyment of the break, I drew from studies examining enjoyment during recovery periods (e.g., Van Hooff et al., 2011) and preference of recovery activities (e.g., Hunter & Wu, 2013). I used four of the five items from an enjoyment scale for work break research (Reinecke, Klatt, & Kramer, 2011). A fifth item was removed because the wording was duplicative (i.e., "The break was enjoyable" was kept and "I enjoyed the break" was removed). Similar items have been used to assess enjoyment appraisals of work-related tasks (Brown, 2005). On a 7-point Likert-type scale, participants indicated how much they agreed with the items. All items are included in Appendix C. The internal consistency of this scale was adequate (α= .77).

Dependent variables

Energy resources. Individual assessments of energy levels were assessed with the Profile of Mood States (POMS; McNair et al., 1971). Participants responded on 5-point scale to each adjective with how they felt at the moment, ranging from "not to all" to "extremely". High energy was measured with eight items from the vigor-activity subscale. Low energy was assessed with seven items from the fatigue-inertia subscale. POMS has been used in previous recovery research (e.g., Fritz et al., 2011; Sonnentag, Binnewies, et al., 2008) and is ideal for this experiment because it assesses affective states of a short duration (Shirom, 2004) rather than longer-term moods or emotions (Elfenbein, 2007). These items are provided in Appendix D. The internal consistency at each time point was: vigor at Time 1 (α= .87), vigor at Time 3 (α= .91), vigor at Time 5 (α= .91), vigor at Time 7 (α= .89), fatigue at Time 1 (α= .89), fatigue at Time 3 (α= .90), fatigue at Time 5 (α= .92), and fatigue at Time 7 (α= .91).

Attentional resources. Attentional resources were assessed with the self-regulation component of attention often described as attention regulation resources (Hofmann et al., 2009). I assessed the attention regulation resources that an individual felt he or she had available by adapting an attention scale used in research in which participants assessed their attention during an ANT task (Davis & Yi, 2004). The measure was adapted by changing the wording from "during the video demonstration" to "during the previous task", and was chosen over measures in the organizational sciences like the Cognitive Failure Scale (Wallace & Chen, 2005) because measures assessing cognitive failure and cognitive liveliness are assessments of outcomes (i.e., failure) rather than direct assessments of attentional resources. These items are in Appendix E. The internal consistency of this scale was suitable at Time 1 (α= .87), Time 3 (α= .92), Time 5 (α= .91), and Time 7 (α= .96).

Task performance. Task performance was assessed using response time measures from the ANT. There are three attentional networks that impact performance: alerting, orienting, and executive control. The alerting network is used to achieve and maintain an alert state, the orienting network is used to select information from what is visually observed, and the executive control network is used to resolve conflict among responses and remain vigilant on the task over time (Fan et al., 2002). An individual uses all three attention networks in different but related ways. One workplace example is an air traffic controller. The employee uses the alerting network to respond to flashing points or changes in color of a shape on the monitor, uses the orienting network to move his/her visual attention to the appropriate location on the monitor, and uses the executive control network to remain on task and stay focused. Thus, task performance is a value in milliseconds assessing each attentional network rather than an overall response time.

In the ANT, individuals respond using a keyboard to indicate the direction (left or right) of the middle arrow in a row of five arrows. Trial conditions vary by having a random combination of a) presenting or not presenting a visual alerting cue before the flanker arrows, b) presenting or not presenting a visual spatial orienting cue before the flanker arrows, and c) having congruent or incongruent flanker arrows. Figure 6 is an example of a trial condition in which there is an alerting cue (the asterisk flashes on the screen before the arrows), a spatial cue (the alerting cue appears above the fixation cross rather than on the fixation cross), and incongruent flanker arrows (the middle arrow points left and the surrounding flanker arrows point right). There are six combinations of trial conditions used to score task performance. The no-cue congruent combination is when there is no alerting or orienting cue and the flanker arrows point the same direction as the center arrow. The center-cue congruent combination is when there is an alerting cue on the fixation cross and the flanker arrows point in the same direction as the center arrow. The spatial-cue congruent condition is when the alerting cue is above or below the fixation cross and the flanker arrows point the same direction as the center arrow. The center-cue congruent condition is when the alerting cue is displayed directly on the fixation cross and the flanker arrows point the same direction as the center arrow. The no-cue congruent condition is when there is no alerting cue displayed and the flanker arrows point the same direction as the center arrow. The no-cue incongruent condition is when there is no alerting cue and the flanker arrows point in the opposite direction as the center arrow.

Scoring for each attentional network is calculated using the equations in Wang et al. (2014). These equations are an improvement over the Fan et al. (2001) scoring method because the equations provide a more direct examination of each attentional network by utilizing fewer overlapping conditions in each equation (see MacLeod et al., 2010 for a thorough discussion of this problem) and uses the median response time (rather than mean) of each condition because response times do not have a normal distribution. *Alerting RT* is calculated by subtracting the median response time of the center-cue congruent trials from the median response time of the no-cue congruent trials. A positive *Alerting RT* value indicates that an individual was faster when there was a short cue before the flanker screen, and is a benefiting effect (B. Weaver et al., 2009). *Orienting RT* is calculated by subtracting the median response time of the spatial-cue congruent trials from the median response time of the center-cue congruent trials. A positive *Orienting RT* value is when an individual responded quicker (in milliseconds) from knowing both when and where the flanker would occur. Thus, a positive (rather than negative) value indicates improved performance. Executive Control RT is calculated by subtracting the median response time of no-cue congruent trials from the median response time of the no-cue incongruent trials. A positive value indicates a slower response time (in milliseconds) that it took an individual to respond when the center arrow was pointing in a different direction from the other arrows in the flanker portion, and this is a negative (or cost) effect (B. Weaver et al., 2009). Overall, when comparing performance values between groups, better performance occurs when an individual has a higher Alerting RT and Orienting RT value and a lower Executive Control RT value.

To assess performance differences caused by the experiment condition (different break activities), performance values were calculated using the response times on ANT trials after the manipulation (Time 6). To ensure that this was appropriate, I conducted one-way analysis of variance to test if the 10 experimental groups had different response times in the first round of the ANT (Time 2) before the experiment manipulations began. There were no statistically significant differences between experiment groups for Alerting RT in Round 1 ($F_{(9,195)} = .83$, *n.s.*) or Orienting RT at Time 2 ($F_{(9,195)} = .46$, *n.s.*). There was a statistically significant difference between groups for Executive Control RT at Time 2, ($F_{(9,189)} = 2.08$, $p = .03$), and a post-hoc test showed this only occurred between the Control group and the 9-minute Detachment group (mean difference = 99, $p = .05$). Given the random assignment of individuals to experiment conditions, and that Executive Control assesses more stable and trait-like differences (Redick & Engle, 2006), this difference was likely by chance.

Control variables and covariates

In addition to analyzing data without control variables, I provide supplementary analyses that control for several variables having an impact on energy, attention, and task performance outcomes. The inclusion of control variables helped provide better causal inference because I not only examined changes over time with an experiment, but I had the potential to determine the incremental impact of microbreaks to explain the within-person variance beyond trait-level variables. First, I controlled for extraversion (α=.73) and neuroticism (α=.63) using two items each from the Big Five Shortened Scale (Gosling, Rentfrow, & Swann, 2003). Controlling for these two traits is imperative given that extraversion and neuroticism have been found to affect perceptions of fatigue (Boksem & Tops, 2008), and extraversion has been correlated with the ANT Executive Control RT (Matthews & Zeidner, 2012). Second, I controlled for caffeine consumption with one item asking participants to indicate the number of cups (8oz) of caffeinated coffee, tea, and soda they have consumed in the past four hours. Caffeine consumption has been shown to impact feelings of energy (Lorist & Tops, 2003; Young & Benton, 2013). In addition, caffeine consumption up to 200mg improves Alerting RT and Executive Control RT on the ANT (Brunyé, Mahoney, Lieberman, & Taylor, 2010) and Stroop tests (Kenemans, Wieleman, Zeegers, & Verbaten, 1999). Lastly, I controlled for sleep quality with a single item ("How would you rate your sleep quality overall?"; 1 = very bad; 4 = very good) from the Pittsburg Sleep Quality Questionnaire (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), given the fact that sleep quality has been shown to impact individual resources and task performance (Querstret & Cropley, 2012; Takahashi et al., 2011; Tucker, Dahlgren, Akerstedt, & Waterhouse, 2008). All control variable and demographic items are provided in Appendix F.

Data Analysis

I used a 3x3+1 incomplete factorial design, meaning there is a fully-crossed 3x3 design with one additional cell for a control group condition. This design allowed for both absolute comparisons of each treatment condition against the control condition and relative comparisons of treatment groups. The hypotheses and research questions in this study examined between-group mean differences. Thus, the overall analysis plan examined the statistical significance of these mean differences using multivariate analysis of covariance (MANCOVA).

Hypotheses 1, 2, 3, 5, 6, and 7 proposed that each experimental condition (activity type and duration) would exhibit a statistically significant mean difference compared to the control group. To analyze these hypotheses, I conducted a one-way multivariate analysis of covariance (MANCOVA). The independent variables in these hypotheses are each microbreak condition (activity or duration). There are four related dependent variables: the change in high energy from after the work period to after break (change from Time 3 to Time 5), change in low energy from after the work period to after break (change from Time 3 to Time 5), change in attention regulation resources from after the work period to after break (change from Time 3 to Time 5), and task performance (response time) in the second work period (Time 6). The covariates were the control variables (i.e., extraversion, neuroticism, caffeine, sleep quality).

Hypothesis 4 predicted that recovery appraisals would partially mediate the relationship between microbreak recovery activities and outcomes. I used a bootstrapping technique to estimate the statistical significance of the total, direct, and indirect effects (Preacher & Hayes, 2004) using the PROCESS macro in SPSS (Hayes & Preacher, 2014).

Hypothesis 8 predicted that individuals in the 5-minute and 9-minute microbreak durations would have statistically significant changes in outcomes when compared to the 1-

minute microbreak condition. Hypothesis 9 predicted that individuals in the 9-minute microbreak duration would not have statistically significant differences in outcomes compared to the 5-minute microbreak condition. Similar to Hypotheses 1, 2, 3, 5, 6, and 7, I used one-way MANCOVA to test the mean differences between groups. However, for these hypotheses I compared the means of one microbreak duration condition against another microbreak duration condition.

Research Question 1 asked if there are any optimal microbreak conditions that impact subjective levels of energy resources, attention regulation resources, and task performance. Similar to previous hypotheses, I was interested if there were statistically significant mean differences in outcomes, and tested this using MANCOVA. To assess what combinations of duration and recovery activity had statistically significant mean differences in outcomes, I conducted a post hoc analysis. Levene's test for homogeneity was not significant for all outcome variables ($p > .05$), indicating that I could assume equal variances between groups. Therefore I used the Tukey / LSD post hoc test.

Chapter 4: Results

The means, standard deviations, and correlations between focal variables are presented in Table 3.

Table 3

Means, Standard Deviations, and Correlations of Focal Variables

	Mean	SD	1	2	3	4	5	6	7
1 Extraversion	4.07	1.59	-						
2 Neuroticism	3.21	1.35	-.01	-					
3 Caffeine	1.00	1.26	.05	.11	-				
4 SleepQuality	2.62	0.84	.00	-.03	.01	-			
5 BreakTime	4.37	3.44	.08	-.12	.16*	-.02	-		
6 BreakActivity	1.83	1.03	.07	-.02	.09	-.06	.32**	-	
7 PsychDetach	3.16	1.19	-.07	-.10	-.02	-.05	.01	-.48**	-
8 Relax	3.06	1.25	.00	-.06	.04	-.04	.05	-.60**	.74**
9 Enjoyment	3.34	1.01	.06	-.02	.08	-.03	-.10	-.43**	.52**
10 VigorAfterBreak	2.47	0.91	.10	-.05	.06	.07	.09	-.10	.24**
11 FatigueAfterBreak	2.31	1.03	.01	.14*	.06	-.20**	.10	.12	-.22**
12 AttentionAfterBreak	5.16	1.42	.00	-.09	-.02	.08	-.02	.07	.19**
13 AlertingRT	36.61	63.68	.09	.00	.01	-.07	-.09	-.02	-.05
14 OrientingRT	35.10	49.23	-.05	.00	.01	-.03	.20**	.11	-.05
15 ExecutiveControlRT	116.75	94.68	.02	.05	.06	.02	.07	-.03	.04

	8	9	10	11	12	13	14	15
8 Relax	-							
9 Enjoyment	.66**	-						
10 VigorAfterBreak	.30**	.27**	-					
11 FatigueAfterBreak	-.12	-.14	-.30**	-				
12 AttentionAfterBreak	.05	.19*	.35**	-.37**	-			
13 AlertingRT	.00	.06	.03	.01	-.05	-		
14 OrientingRT	-.01	-.12	-.07	.09	-.05	-.48**	-	
15 ExecutiveControlRT	.04	-.05	.05	.17*	-.06	-.45**	.15*	-

Note. N = 205 for all correlations except recovery appraisals after break (N = 180 for PsychDetach, Relax, & Enjoyment) as the control group did not complete these.
** $p < .05$. * $p < .01$.

All of the hypotheses tested between-group effects in outcomes. Overall results indicated that statistically significant between-group differences exist for fatigue after break ($F_{(9, 190)}$=2.62, p<.01, partial η^2=.11) and attention after break ($F_{(9, 190)}$=2.41, p=.013, partial η^2=.10). Between-groups differences were marginally statistically significant for Executive Control RT ($F_{(9, 190)}$=1.90, p=.054, partial η^2=.08) and Orienting RT ($F_{(9, 190)}$=1.67, p=.099, partial η^2=.07), and were not statistically significant for vigor after break ($F_{(9, 190)}$=1.23, *n.s.*, partial η^2=.06) and Alerting RT ($F_{(9, 190)}$=.69, *n.s.*, partial η^2=.03).

Partial eta-squared values provided are an effect size that explain the proportion of the variation in each outcome attributed to differences in break conditions partialling out (excluding) other factors, ranging from 0 to 1 (Pierce, Block, & Aguinis, 2004). For example, 11% of the variation in fatigue is caused from an individual being placed in one break condition versus another. For comparison, the effect size of η^2=.08 is the same as f=.30, the effect size I used when conducting my *a priori* power analysis. Statistical power is the likelihood that the hypothesis test will reject the null hypothesis when a relationship exists (Murphy, 2002). A post-hoc power analysis revealed that the statistical power of this experiment (α=.05) is .96 for fatigue, .63 for vigor, .94 for attention, .37 for Alerting RT, .79 for Orienting RT, and .86 for Executive Control RT.

For ease of interpretation and to better compare differences with unequal sample sizes, estimated marginal means (corrected for covariates) and standard errors of between-group outcomes are presented.

Hypothesis 1

Hypothesis 1 predicted that individuals in the detachment work break condition would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 4 presents the estimated marginal means and standard errors of these two groups. I conducted a multivariate analysis of covariance including all dependent variables to assess if differences exist in outcomes between the group that watched a funny video during a break to induce detachment and the control group. Results showed that individuals in the detachment break condition reported lower fatigue, higher vigor, increased attention, and had reduced delays in response times when completing incongruent flanker tasks. There was no statistically significant difference between groups in Alerting RT and Orienting RT. Thus, Hypotheses 1a, 1b, and 1c were supported, and Hypothesis 1d was partially supported.

Table 4

Statistical Results for Hypothesis 1

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
Detachment break condition	52	1.94*	0.14	2.80*	0.13	5.41*	0.19

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.92	22.02	9.93	151.82	18.82
Detachment break condition	52	40.73	8.96	29.76	6.89	98.64*	13.05

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 2

Hypothesis 2 predicted that individuals in the relaxation microbreak condition would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 5 presents the estimated marginal means and standard errors of these two groups. Following the same protocol in testing Hypothesis 1 for Hypothesis 2, results showed that there were no statistically significant differences between groups for any outcome variables. Thus, Hypotheses 2a, 2b, 2c, and 2d were not supported.

Table 5

Statistical Results for Hypothesis 2

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
Relaxation break condition	54	2.29	0.14	2.41	0.12	4.98	0.19

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.92	22.02	9.93	151.82	18.82
Relaxation break condition	54	31.02	8.79	42.74	6.76	113.70	12.80

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 3

Hypothesis 3 predicted that individuals in the task change condition would have (a) decreased levels of low energy, (b) decreased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 6 presents the estimated marginal means and standard errors of these two groups. Results showed that there were no statistically significant differences between groups for any outcome variables. Thus, Hypotheses 3 was not supported.

Table 6

Statistical Results for Hypothesis 3

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
Task change break condition	69	2.54	0.12	2.35	0.11	5.31	0.17

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.92	22.02	9.93	151.82	18.82
Task change break condition	69	38.37	7.78	38.35	5.98	120.06	11.33

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 4

Hypothesis 4 proposed that appraisals of a) psychological detachment, b) relaxation, and c) enjoyment of the work break would partially mediate the relation between the work break condition (detachment activity, relaxation activity, work activity) and outcomes. I used the boostrapping technique with the PROCESS macro to resample 10,000 samples and estimate the direct, indirect, and total effects from each break activity, as well as the direct and total effects from each appraisal (Hayes, 2009). If data was missing for an appraisal, I imputed data using the mean value for the entire sample. Table 7 provides these effect size estimates. I tested mediation by gauging the statistical significance of the indirect effects when the direct effect was also modeled (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Only vigor and attention after the break had statistically significant indirect effects (indicating mediation occurred). Thus, Hypothesis 4 was partially supported.

Individuals had higher levels of vigor after the microbreak when engaging in a detachment or relaxation break activity. The indirect effect for these two activities was statistically significant, and the total effect was not statistically significant. The direct effect for relaxation appraisals was statistically significant. Thus, appraisals of relaxation fully mediated the relationship. In other words, individuals felt more vigorous in the relaxation or detachment break activity as a result of appraising the break as relaxing.

Individuals also reported higher levels of attention when changing work tasks for the break. The statistically significant indirect effect of this relationship, combined with the statistically significant direct effects for detachment and enjoyment appraisals, provide evidence that these appraisals mediate the relationship between changing tasks and the break. However, the direct and total effects for this relationship were also statistically significant. This indicates that detachment and enjoyment appraisals partially mediated the relationship. In other words, individuals felt more attentive both because of the task change activity and because they appraised the activity as either enjoyable of as experiencing psychological detachment from the original work task.

Table 7

Tests of Mediation

	Fatigue after break			Vigor after break		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Break activity						
Psychological detachment	-.36	.14	-.22	.07	.28*	.34
Relaxation	-.15	.08	-.07	-.10	.19*	.09
Working task	.23	-.01	.22	.09	-.10	-.01
Break appraisal						
Psychological detachment	-.13		-.13	-.08		-.08
Relaxation	.15		.15	.25**		.25**
Enjoyment	.06		.06	.03		.03

	Attention after break			AlertingRT		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Break activity						
Psychological detachment	.27	.01	.28	-10	4	-6
Relaxation	.28	-.13	.15	-10	4	-6
Working task	.79*	-.17*	.63*	1	0	1
Break appraisal						
Psychological detachment	.30*		.30*	-4		-4
Relaxation	-.26		-.26	6		6
Enjoyment	.27*		.27*	-1		-1

	OrientingRT			ExecutiveControlRT		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Break activity						
Psychological detachment	7	3	10	-53*	7	-46*
Relaxation	11	6	17	-46*	8	-37
Working task	13	2	15	-22	-6	-28
Break appraisal						
Psychological detachment	-4		-4	5		5
Relaxation	8		8	8		8
Enjoyment	-7		-7	-7		-7

Note. N = 200 (5 cases deleted for missing data). Fatigue, Vigor, and Attention values are regression weights. AlertingRT, OrientingRT, and ExecutiveControlRT values are milliseconds.
$^{*}p < .05$ and $^{**}p < .01$.

Hypothesis 5

Hypothesis 5 predicted that individuals in the 9-minute break condition would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 8 presents the estimated marginal means and standard errors of these two groups. Results showed that the only statistically significant difference between groups was that individuals in the 9-minute group had faster response times when an orienting cue was presented before the flanker task. Thus, Hypotheses 5a, 5b, and 5c were not supported, and Hypothesis 5d was partially supported.

Table 8

Statistical Results for Hypothesis 5

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
9-minute break condition	56	2.40	0.14	2.59	0.12	5.17	0.19

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.89	22.02	9.77	151.82	18.66
9-minute break condition	56	28.39	8.61	52.77**	6.53	133.22	12.47

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 6

Hypothesis 6 predicted that individuals in the 5-minute break condition would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 9 presents the estimated marginal means and standard errors of these two groups. Results showed that the only statistically significant difference between groups was that individuals in the 5-minute group had reduced delays in response time for incongruent flanker tasks. Thus, Hypotheses 6a, 6b, and 6c were not supported, and Hypothesis 6d was partially supported.

Table 9

Statistical Results for Hypothesis 6

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
5-minute break condition	61	2.42	0.13	2.52	0.12	4.96	0.18

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.89	22.02	9.77	151.82	18.66
5-minute break condition	61	37.59	8.25	31.23	6.26	107.48*	11.95

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 7

Hypothesis 7 predicted that individuals in the 1-minute break condition would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the no microbreak (control) condition. Table 10 presents the estimated marginal means and standard errors of these two groups. Results showed that individuals in the 1-minute microbreak groups reported statistically significant higher levels of attention, and had reduced delays in response time for incongruent flanker tasks. Thus, Hypotheses 7c were supported, 7d was partially supported, and 7a and 7b were rejected.

Table 10

Statistical Results for Hypothesis 7

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	2.50	0.20	2.31	0.18	4.67	0.28
1-minute break condition	58	2.03	0.13	2.40	0.12	5.59**	0.18

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
Control (no break) condition	25	39.70	12.89	22.02	9.77	151.82	18.66
1-minute break condition	58	44.09	8.46	28.30	6.42	95.46**	12.25

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 8

Hypothesis 8 predicted that individuals in the 5-minute and 9-minute break conditions would have (a) decreased levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) increased subsequent task performance after the break period than individuals in the 1-minute break condition. Table 11 presents the estimated marginal means and standard errors of these groups, comparing the 1-minute versus the 5-minute microbreak group, and then the 1-minute versus the 9-minute microbreak group. Results show that individuals in the 5-minute microbreak conditions reported higher levels of fatigue and lower levels of attention than individuals with a 1-minute microbreak. Individuals in the 9-minute microbreak versus the 1-minute condition also had increased response times when an orienting cue was present and had increased delays in response for incongruent flanker tasks. Collectively, these are almost entirely opposite of the hypothesized predictions. Thus, Hypotheses 8a, 8b, 8c, and 8d were rejected.

Table 11

Statistical Results for Hypothesis 8

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
1-minute break condition	58	2.03	0.13	2.40	0.12	5.59	0.18
5-minute break condition	61	2.42*	0.13	2.52	0.12	4.96*	0.18

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
1-minute break condition	58	44.09	8.46	28.30	6.42	95.46	12.25
5-minute break condition	61	37.59	8.25	31.23	6.26	107.48	11.95

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
1-minute break condition	58	2.03	0.13	2.40	0.12	5.59	0.18
9-minute break condition	56	2.40	0.14	2.59	0.12	5.17	0.19

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
1-minute break condition	58	44.09	8.46	28.30	6.42	95.46	12.25
9-minute break condition	56	28.39	8.61	52.77**	6.53	133.22**	12.47

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Hypothesis 9

Hypothesis 9 predicted that individuals in the 9-minute break conditions would not have a statistically significant difference in (a) levels of low energy, (b) increased levels of high energy, (c) increased attention, and (d) task performance after the break than individuals in the 5-minute break period. Table 12 presents the estimated marginal means and standard errors of these two groups. Results showed that the only statistical significant difference was that individuals in the 9-minute microbreak conditions had faster response times when an orienting cue was presented before the flanker tasks. Thus, Hypothesis 9a, 9b, and 9c was supported, and Hypothesis 9d was partially supported.

Table 12

Statistical Results for Hypothesis 9

		Fatigue		Vigor		Attention	
	n	M	SE	M	SE	M	SE
5-minute break condition	61	2.42	0.13	2.52	0.12	4.96	0.18
9-minute break condition	56	2.40	0.14	2.59	0.12	5.17	0.19

		AlertingRT		OrientingRT		ExecutiveControlRT	
	n	M	SE	M	SE	M	SE
5-minute break condition	61	37.59	8.25	31.23	6.26	107.48	11.95
9-minute break condition	56	28.39	8.61	52.77*	6.53	133.22	12.47

Note. Statistical significantly different means between groups indicated by ** at the $p < .01$ level and * at the $p < .05$ level.

Research Question 1

Research Question 1 asked if there were optimal interactions between break activity conditions and duration conditions to (a) decrease feelings of low energy, (b) increase feelings of high energy, (c) increase attention, and (d) improve subsequent performance after a break. Table 13 presents the mean outcomes for each of the 10 experiment conditions, and Figure 7 depicts these results in visual form. The statistical significance of the estimated marginal mean differences between each condition was assessed by running multiple analysis of covariance. Individuals in the 1-minute and 9-minute detachment conditions (watching a funny video) reported the lowest fatigue after the microbreak, and the means from these two conditions were statistically different from the control, 5-minute task change, and 9-minute task change conditions. Individuals in the 9-minute task change (Stroop task) reported the highest level of fatigue after the microbreak, and the mean of this group was statistically higher than all other break activities except the 5-minute relaxation group. The 5-minute and 9-minute detachment groups reported the highest levels of vigor after the microbreak, and the estimated marginal means from these two conditions were statistically different from the control, 1-minute task change, and 5-minute task change conditions. Interestingly, individuals in the 1-minute task change condition reported the highest level of attention after the microbreak, and the mean of this group was statistically higher than all other break activity conditions expect the 1-minute and 9-minute detachment groups. Regarding performance differences, none of the experiment groups had a statistically significant estimated marginal mean difference in response times when an alerting cue occurred before a flanker task. Individuals in the 9-minute task change condition had a statistically faster response time than the control, 1-minute detachment, 5-minute detachment, 1-minute task change, and 5-minute task change groups when an orienting cue was present before a flanker task. However, this 9-minute task change group also had much larger delays on incongruent flanker tasks, and the mean of the delay (in milliseconds) for this group is statistically different at the $p < .05$ level from 1-minute detachment, 5-minute detachment, 9-minute detachment, 1-minute relaxation, 1-minute task change, and 5-minute task change groups.

Table 13

Mean Outcome Variables for each Experiment Condition

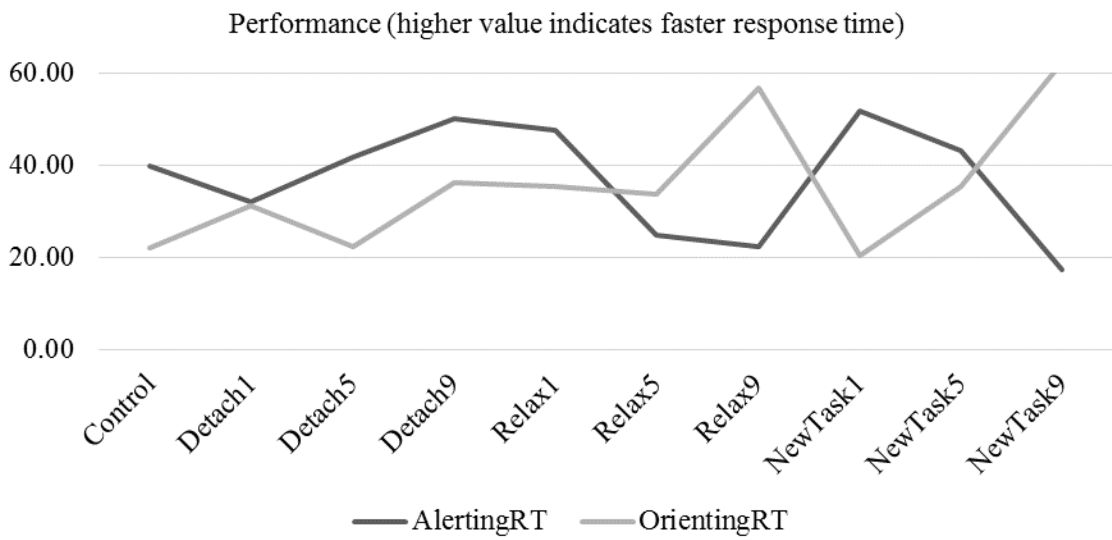
	Experiment group	Fatigue	Vigor	Attention
0	Control	2.50 ^{1,3}	2.31 ^{3}	4.67 ^{1,3,7}
1	Detach 1min	1.89 ^{0,8,9}	2.61	5.51 ^{0}
2	Detach 5min	2.16 ^{9}	2.86 ^{7}	4.87 ^{2,7}
3	Detach 9min	1.77 ^{0,8,9}	2.95 ^{0,7,8}	5.88 ^{0,3,5,6,9}
4	Relax 1min	2.21 ^{9}	2.39	5.04 ^{7}
5	Relax 5min	2.30 ^{9}	2.43	4.93 ^{3,7}
6	Relax 9pm	2.34 ^{9}	2.41	4.96 ^{3,7}
7	New task 1min	2.01 ^{8,9}	2.23 ^{2,3}	6.07 ^{0,2,4,5,6,8,9}
8	New task 5min	2.65 ^{1,3,7}	2.36 ^{3}	5.05 ^{7}
9	New task 9min	2.96 ^{1,2,3,4,5,6,7}	2.48	4.83 ^{3,7}

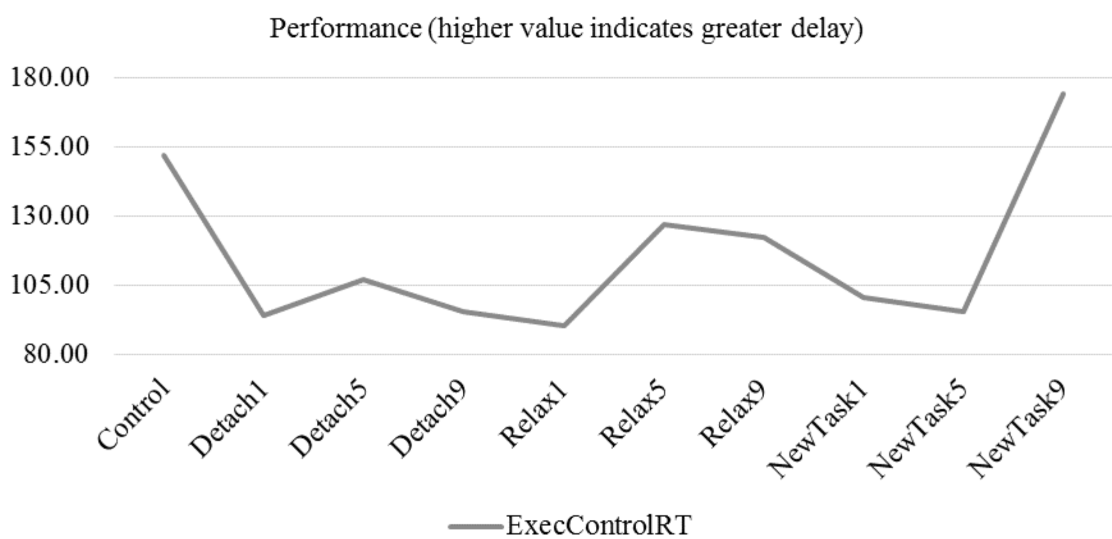
	Experiment group	AlertingRT	OrientingRT	ExecutiveControlRT
0	Control	39.70	22.02 ^{6,9}	151.82 ^{1,4,8}
1	Detach 1min	32.13	31.11 ^{9}	93.92 ^{0,9}
2	Detach 5min	41.68	22.26 ^{6,9}	106.85 ^{9}
3	Detach 9min	49.94	36.13	95.53 ^{9}
4	Relax 1min	47.65	35.38	90.32 ^{0,9}
5	Relax 5min	24.71	33.76	126.79
6	Relax 9pm	22.25	56.63 ^{0,2,7}	122.45
7	New task 1min	51.68	20.41 ^{6,9}	100.75 ^{9}
8	New task 5min	43.13	35.28	95.72 ^{0,9}
9	New task 9min	17.30	62.23 ^{0,1,2,7}	174.15 ^{1,2,3,4,7,8}

Note. Superscripts 0-9 indicate that the mean difference between the two experiment groups was statistically significant at the $p < .05$ level.

Figure 7

Mean Outcome Variables for each Experiment Condition


Performance (higher value indicates faster response time)
60.00
40.00
20.00
0.00
Control
Detach1
Detach5
Detach9
Relax1
Relax5
Relax9
NewTask1
NewTask5
NewTask9
AlertingRT
OrientingRT


Performance (higher value indicates greater delay)
180.00
155.00
130.00
105.00
80.00
Control
Detach1
Detach5
Detach9
Relax1
Relax5
Relax9
NewTask1
NewTask5
NewTask9
ExecControlRT

Summary of Study Findings

Table 14 provides a summary of this study's research findings, and compares the direction of the results with the hypothesized relationship and previous findings in the resource recovery literature. For this table, improved performance is when the Alerting RT and Orienting RT have a positive value (indicating a faster response) and when the ExecutiveControl RT value is lower (indicating a shorter delay). Table 15 provides a summary of all hypotheses. As shown in results and collectively in these tables, many of the findings from this experiment are in the hypothesized direction but not always statistically significant. This could be due to a lack of statistical power for some variables (i.e., Alerting RT). However, the statistical power was relatively high ($\beta \geq .79$) for Fatigue, Attention, Orienting RT, and Executive Control RT, indicating that at least with these variables the experiment was rigorous enough to find statistically significant differences if they existed. Nonetheless, some non-statistically significant findings could have practical significance. For example, results from Hypothesis 2 found that engaging in a relaxing activity during a break is better than not taking a break at all.

Table 14

Summary of Study Results

	Fatigue			Vigor		
	Previous research	Hypothesis direction	Study results	Previous research	Hypothesis direction	Study results
Break activity						
Detachment	-[b]	-	-*	+[b]	+	+*
Relaxation	-[a]	-	-	+[a]	+	+
Task change	-[a]	-	+	-[b]	-	+
Break appraisal						
Psychological detachment	-[b]		-*	+[b]		+*
Relaxation	-[b]		-	+[b]		+*
Enjoyment	---		-	---		+*
Break duration						
9-minute (long)	---	-	-	---	+	+
5-minute (medium)	---	-	-	---	+	+
1-minute (short)	---	-	-	---	+	+

	Attention			Performance		
	Previous research	Hypothesis direction	Study results	Previous research	Hypothesis direction	Study results
Break activity						
Detachment	---	+	+*	+[a]	+	+
Relaxation	---	+	+	---	+	+
Task change	+[a]	+	+	+[a]	+	+
Break appraisal						
Psychological detachment	---		+*	+[b]		
Relaxation	---		+*	+[b]		
Enjoyment	---		+*	---		
Break duration						
9-minute (long)	---	+	+	+[a]	+	+
5-minute (medium)	---	+	+	+[a]	+	+
1-minute (short)	+[a]	+	+*	+[a]	+	+

Note. Direction of relationship and statistical significance for break activities and break durations is based on hypothesis tests, and break appraisals is based on zero-order correlations. A plus sign (+) indicates a positive relationship, and a negative sign (-) indicates a negative relationship. --- indicates no previous research support. Superscript [a] indicates that the previous research finding was from a study of work breaks, superscript [b] indicates that the previous research finding was from a study of evening or weekend recovery. * $p < .05$.

Table 15

Summary of Hypotheses Results

Prediction	Result
Hypothesis 1: Detachment activity vs. control	
1a: Lower levels of fatigue	Supported
1b: Higher levels of vigor	Supported
1c: Higher levels of energy	Supported
1d: Better performance	Partially supported (only Executive Control RT had statistically significant difference)
Hypothesis 2: Relaxation activity vs. control	
2a: Lower levels of fatigue	Not supported (lower level, but mean difference not statistically significant)
2b: Higher levels of vigor	Not supported (higher level, but mean difference not statistically significant)
2c: Higher levels of attention	Not supported (higher level, but mean difference not statistically significant)
2d: Better performance	Not supported (Orienting RT and Executive Control RT were better, but mean difference not statistically significant)
Hypothesis 3: Task change activity vs. control	
3a: Lower levels of fatigue	Not supported (higher level)
3b: Lower levels of vigor	Not supported (lower level, but mean difference not statistically significant)
3c: Higher levels of attention	Not supported (higher level, but mean difference not statistically significant)
3d: Better performance	Not supported (Orienting RT and Executive Control RT were better, but mean difference not statistically significant)
Hypothesis 4: Recovery appraisals partially mediates between break activity and outcomes	
4a: Psychological detachment appraisal	Partially supported (only statistically significant direct effect for attention)
4b: Relaxation appraisal	Partially supported (only statistically significant direct effect for vigor)
4c: Enjoyment appraisal	Partially supported (only statistically significant direct effect for attention)
Hypothesis 5: 9-minute break vs. control	
5a: Lower levels of fatigue	Not supported (lower level, but mean difference not statistically significant)
5b: Higher levels of vigor	Not supported (higher level, but mean difference not statistically significant)
5c: Higher levels of attention	Not supported (higher level, but mean difference not statistically significant)
5d: Better performance	Partially supported (only Executive Control RT had statistically significant difference)

Table 15 (*continued*)

Prediction	Result
Hypothesis 6: 5-minute break vs. control	
6a: Lower levels of fatigue	Not supported (lower level, but mean difference not statistically significant)
6b: Higher levels of vigor	Not supported (higher level, but mean difference not statistically significant)
6c: Higher levels of attention	Not supported (higher level, but mean difference not statistically significant)
6d: Better performance	Partially supported (only Executive Control RT had statistically significant difference)
Hypothesis 7: 1-minute break vs. control	
7a: Lower levels of fatigue	Not supported (lower level, but mean difference not statistically significant)
7b: Higher levels of vigor	Not supported (higher level, but mean difference not statistically significant)
7c: Higher levels of attention	Supported
7d: Better performance	Partially supported (only Executive Control RT had statistically significant difference)
Hypothesis 8: 5-minute & 9-minute vs. 1-minute break	
8a: Lower levels of fatigue	Not supported (statistically significant in opposite direction - fatigue higher for 5-minute and 9-minute break groups)
8b: Higher levels of vigor	Not supported (higher level as predicted, but mean difference not statistically significant)
8c: Higher levels of attention	Not supported (statistically significant in opposite direction – attention lower for 5-minute and 9-minute break groups)
8d: Better performance	Not supported (only Orienting RT in predicted direction, but Executive Control RT was statistically significantly different in opposite direction of prediction)
Hypothesis 9: 9-minute vs. 5-minute break	
9a: No difference in fatigue	Supported
9b: No difference in vigor	Supported
9c: No difference in attention	Supported
9d: No difference in performance	Partially supported (9-minute break had statistically significant better Orienting RT)

Supplementary Analyses

With a randomized experimental design, between-person differences are considered negligible. However, I also collected theoretically-relevant individual-level data that could have altered the relations between constructs in previous research. Two of the four control variables (neuroticism and sleep quality) had statistically significant zero-order correlations with feelings of fatigue after the break. Two other control variables (extraversion and caffeine) did not have statistically significant relationships with outcome variables at the $p < .05$ level.

When including these four control variables as additional covariates in the model, Hypotheses 3c and 7a became supported (statistically significant between-group differences at the $p < .05$ level). Support for Hypothesis 3c indicates that individuals reported that they felt they were paying greater attention after changing tasks during a microbreak than those in the control condition. Support for Hypothesis 7a indicates that individuals in the 1-minute microbreak groups reported statistically significant lower levels of fatigue than individuals in the control condition.

There is also the potential concern that the detachment and relaxation break activities could be creating a mood boost (Thayer, Newman, & Mcclain, 1994) rather than inducing a specific recovery appraisal. Table 16 examines mean appraisal values (1-5 scale) for each break condition, with the detachment activity leading to the highest appraisals of detachment, relaxation, and enjoyment. Individuals engaging in a relaxation activity during the break reported on average higher appraisals of detachment, relaxation, and enjoyment than individuals in the task change break activity condition.

Table 16

Mean Appraisal Values for Each Break Activity Condition

Break group	Detachment	Relaxation	Enjoyment
1 Detachment activity	3.76 [3]	3.87 [2,3]	3.98 [2,3]
2 Relaxation activity	3.54 [3]	3.50 [1,3]	3.25 [1,3]
3 Task change activity	2.40 [1,2]	3.06 [1,2]	2.92 [1,2]

Note. Superscripts 1, 2, and 3 indicate that the mean difference between the two experiment groups was statistically significant at the $p < .05$ level.

Chapter 5: Discussion

This study began broadly as a way to examine microbreaks, or breaks between work tasks that are shorter than ten minutes in duration. As the nature of work has changed in developed nations to become knowledge-based economies (Machlup, 1962), scholars have found that, just like with physical resources, individuals use cognitive and psychological resources to complete work tasks and have a limited supply of these resources (Halbesleben et al., 2014). Drawing on Meijman and Mulder's (1998) Effort-Recovery Model, I explored how work tasks deplete individual resources and also how microbreaks can potentially aid in the replenishment of mental resources. Using an experimental design, I tested how microbreaks impacted individual resources like energy and attention as well as job performance outcomes with three main questions. First, I explored if the activity one engages in during the microbreak had an impact on outcomes. Individuals were randomly placed into an experiment condition that had no break activity (control group), watched a funny video during the break (psychological detachment condition), watched a mindfulness meditation video during the break (relaxation condition), or worked on a new task during the break (task change condition). Second, I questioned if an individual's appraisal of the break impacted outcomes in addition to, or potentially more than, engaging in a break activity. To examine this, I asked individuals in all nine break conditions to what extent the microbreak made one think about something other than the work task (psychological detachment appraisal), feel calm and relaxed (relaxation appraisal), or was perceived as fun and enjoyable (enjoyment appraisal). Third, I investigated how the time duration of the microbreak impacted outcomes. For each microbreak activity condition, individuals were randomly placed into a 1-minute, 5-minute, or 9-minute group. Collectively, I explored if there is an optimal combination of break time, break activity, or break appraisal for the "best" recovery of resources and subsequent performance in attention-demanding work tasks.

Theoretical Contributions

This study makes several contributions to the work recovery literature. Scholars of work recovery have primarily focused on evening, weekend, or longer respite time such as vacations, even though past research has shown that individuals spend approximately 5-15% of their time at work doing non-work-related activities (Esteves, 2013; McGehee & Owen, 1940) in an attempt to replenish resources (D'Abate, 2005; Fritz et al., 2011). The exceptions to this research have focused on formal break periods such as a 2-hour break between work sessions (Trougakos et al., 2008) or a 1-hour lunch break (Trougakos et al., 2014). Thus, one major contribution is that I extended recovery research to microbreaks, or non-work time less than ten minutes in duration (Sluiter et al., 2000), responding to the call to focus on recovery during actual work time (Sonnentag & Fritz, 2015). Many of the results from this study align with previous findings about recovery activities. The statistically significant findings from this study that are new to the work recovery literature or examined in a work break context for the first time are that, in comparison to a control group with no work break, individuals engaging in detachment break activities reported lower levels of fatigue, higher levels of vigor, and increased levels of attention. New findings regarding recovery appraisals for work breaks are that psychological detachment appraisals are negatively related to fatigue, positively related to vigor, and positively related to attention. Both relaxation appraisals and enjoyment appraisals had a statistically significant positive correlation with vigor and attention as well.

However, not all results of this study are the same as those found from studies of longer recovery periods like evenings or weekends, potentially indicating that shorter recovery periods may have different outcomes, or that the precision of my experiment ruled out confounding variables affecting prior results. Previous research findings and my hypotheses predicted that changing work tasks would reduce fatigue and vigor. In this sample, the changing tasks break condition had increased fatigue and increased vigor from the control group, although neither of these increases were significantly higher from the control group. Previous research also found that detachment and relaxation appraisals had a positive relationship with performance, but in this sample there were very mixed findings regarding recovery appraisals and performance, which may be due to the performance measure being a more objective measure of response time rather than self-reported performance (e.g., Binnewies et al., 2010).

These differential findings also highlight the importance of considering the impact of time in organizational research. The second major contribution of the study is that it responds to the call from other scholars to include time in theory building (George & Jones, 2000) and to explicitly include time and the temporal ordering of variables to establish causality in resource recovery (Sonnentag & Fritz, 2015). Drawing from physical resource replenishment literature, I used the Rohmert curve (Rohmert, 1973) to develop and test new theory that microbreak durations have differential outcomes on mental resources and work tasks that utilize these resources. The only statistically significant finding from this research that had not been tested before was that a short, 1-minute break reduced fatigue in comparison to individuals who did not take a break. Contrary to what was expected, individuals in the longer 5-minute and 9-minute breaks had consistently worse outcomes than individuals in the 1-minute break condition. However, there were very few changes in outcomes for individuals in the 5-minute and 9-minute break conditions. The lack of new statistically significant findings and findings that were opposite of the hypotheses could be because all break conditions were grouped together. For example, the hypotheses that tested break time versus a control group included detachment, relaxation, and work change activities during the break, and combining all groups for the hypothesis test may have muddled the results. Research Question 1 helped clarify these initial findings and parse out what actually occurred between break groups. There were no statistically significant differences between 1-minute and 5-minute break activities. However, individuals in the 9-minute detachment and 9-minute relaxation group reported much lower feelings of fatigue than individuals in the 9-minute break that changed work tasks.

The third major contribution from this study is that I explicitly tested if combinations of break durations, activities, and appraisals have a systematic difference in outcomes. This is a complex question that other scholars have asked before (e.g., Trougakos et al., 2014), and is especially interesting considering the conflicting results regarding microbreak durations. By using an experimental design with multiple break conditions, this study was able to tease apart the differences occurring from break activities and durations and compare the outcomes from each group. There are several general trends from this analysis. The 9-minute detachment condition was the only group that was consistently better than the control group regarding subjective measures, as these individuals reported lower fatigue, higher vigor, and higher attention, highlighting that this could be one of the best microbreak recovery strategies. In addition, the outcomes from the 1-minute work change condition was surprising in that this group reported lower fatigue than the control group and individuals also reported paying more attention after this break than in almost all other break and control conditions. If only a short amount of time is available, it may be best to complete another small task and then return to the previous task. Another trend is that, in general, all of the relaxation conditions had almost no statistically different outcomes than other groups or the control group. It could be that the benefits of mindfulness mediation found in other research studies did not occur because this may have been the first time an individual was experiencing mindfulness meditation. In other words, mindfulness meditation or any other form of meditation may require practice or a willingness to engage in meditation to reap the potential benefits of meditating during work breaks. It is also possible that a shorter duration of mindfulness mediation may not have a direct impact on recovery processes. In this way, the findings from this experiment align with recent findings from a mindfulness meditation intervention study showing that individuals participating in a short (average of 10.5 minutes) mindfulness activity in the morning for 10 consecutive workdays had improved sleep, but no changes in psychological detachment experiences compared to a control group (Hülsheger, Feinholdt, & Nübold, 2015).

Research Question 1 also helped explore general trends occurring with the performance variables. The group that changed work tasks for 9-minutes had the highest Orienting RT but also the highest Executive Control RT. This likely occurred because the individuals who worked on another attention-demanding task (Stroop) for a long period had faster responses when an orienting cue appeared when compared to when one did not because they were already more fatigued or paying less attention. The Executive Control RT value seems to indicate that this was happening, as these individuals had the largest delay in response when an incongruent arrow was present in the flanker task. These performance findings require additional explanation to make sense in the context of a work environment. As described earlier, occupations such as truck drivers, lifeguards, nurse anesthetists, and air traffic controllers all require use of attentional resources to successfully complete work tasks. Using a task like the ANT in a computer lab is not exactly like the job tasks that individuals experience in these occupations. However, all three attentional networks assessed by the ANT are vital components of these jobs, and response time on the ANT can translate to the use of attentional resources on the job. For example, an air traffic controller uses executive control to stay vigilant and continuously watch the computer monitors, utilizes the alerting component to notice when a change has occurred such as a signal flashing, and uses the orienting component to place where in space on the monitor the change occurred. Faster responses when an alerting cue and orienting cue occur are beneficial in this environment, and fewer delays in the Executive Control RT variable (a lower value) indicate that an individual was more vigilant during the trials, which is also beneficial in this type of job.

Research Contributions. Components of this experimental research contribute more to how scholars conduct research than contributing to theory or improved knowledge of resource recovery from work breaks. In cognitive and developmental psychology, there are ongoing debates about the ability and usefulness of training to improve attention and working memory (e.g., Rapport, Orban, Kofler, & Friedman, 2013). Results from the performance outcomes of this study indicate that training effects could appear based on the design of the training assessments. For example, when examining group differences with the ANT, participants frequently have several 5-minute rounds of the ANT with a break in between (e.g., Matthews & Zeidner, 2012). This research suggests that what an individual does during that break period could impact outcomes, and standardizing break activities as well as times could potentially clarify the inconsistencies within the literature. An additional benefit of this research design is that I separated the constructs of low energy (fatigue) and high energy (vigor). One debate in the employee stress and well-being literature is whether these are two distinct but related constructs (Demerouti et al., 2012) or if they opposite poles of the same construct (Cole et al., 2012).

Including both measures and graphing both at the same points in time in Figure 7 show that specific break activities may be better at reducing fatigue and others may be better at increasing vigor. Lastly, this study used multiple, related yet distinct dependent variables. For example, higher levels of fatigue or slower responses times may indicate that attentional resources have been depleted. The bivariate relationships between outcome variables are statistically significant in many instances, but are not too highly correlated, indicating that these are similar yet unique constructs.

Practical Implications

There are multiple practical implications stemming from this study, although all must be interpreted with caution as the experimental design, while enhancing control and allowing for more causal claims, may limit the generalizability of the findings to individuals in the workplace. One general finding from this study was that individuals who engaged in a detachment activity (watching a funny video) reported lower fatigue, higher vigor, and increased attention than the individuals who did not have a break, whereas individuals who changed work activities only reported higher levels of attention, and individuals who engaged in a relaxation activity saw no statistical changes versus individuals in the control (no break) condition. Thus, when one does take a break, doing something that helps one briefly mentally disengage such as watching a video, playing a game, or reading a story or news article could help.

An additional practical implication is more time-related. If an individuals is provided a 10-minute break period, such as what occurs by law in some industries, the results from this study would recommend mentally detaching from work, perhaps by watching a funny video or engaging in something else that one finds enjoyable. However, there many individuals that may feel they do not have time to take a 10-minute break at work. For example, lawyers typically track billable hours in 6-minute increments, and taking a 10-minute break is a financially significant amount of time to not work during a work period. In these instances, it still appears that a shorter, 1-minute break can be helpful. The results from this study found that changing work tasks for a 1-minute period is actually as good as taking a 1-minute detachment break in terms of increasing attention and reducing fatigue. Thus, if an individual feels exhausted by a current attentionally-demanding task, a short 1-minute break or just changing tasks (and perhaps, still billing the same client) will still be beneficial. For these individuals, building into one's schedule an intentional 1-minute activity every hour could help reduce overall exhaustion at the end of the day.

Individuals in some workplaces may not have a formal work break period, or may feel like they cannot take a work break because of the perception that the break is a counterproductive work behavior (Robinson & Bennett, 1995; Rodell & Judge, 2009). The results of this study highlight that managers should consider short breaks beneficial and allow for minor periods when an employee may take personal phone calls or e-mails. In a workplace in which an individual still feels he or she cannot take a break by detaching from the work task, these results show that changing tasks could also be beneficial. In other words, a beneficial break does not have to be viewed as something that is considered counterproductive, but rather it can be something such as doing paperwork or responding to an e-mail for a few minutes before returning to an attentionally demanding task.

The results from the ANT also provide practical implications. In the context of one workplace, a nurse anesthetist assess the patient's physical cues as well as visual changes on a monitor that reports patient medial information. The monitor has text that flashes or blinks when a value changes (e.g., heart rate increasing or decreasing), which is both an alerting and orienting cue. In this way, higher ANT alerting and orienting scores indicate that the employee responded quicker when the cue was present. Comparing group mean scores in this study, experiment groups with higher mean values for Alerting RT and Orienting RT indicates that these individuals responded faster from their experimental condition than the comparison group. A nurse anesthetist will also have to notice if the value on the monitor is within an acceptable range (a congruent condition) or not within an acceptable range (an incongruent condition). The Executive Control RT value indicates that the length of delay in an incongruent condition, and thus a lower value is better (the delay is shorter). Comparing group mean scores, the group with the lower value performs better because the delay is shorter when an incongruent condition exists. From a practical standpoint, these performance values matter, as faster time-critical responses could have a significant impact on health outcomes.

Limitations

This study is not without limitations. As highlighted when discussing practical implications, the use of an experiment provides a great amount of control and helps rule out other factors that could impact the results, allowing for greater causal inference by the nature of the design. Nonetheless, this limits the external validity of the findings, meaning that I cannot claim that the findings of this study are directly useful in a workplace without these controlled conditions. The use of the ANT also helped gain a better understanding of the use of attentional processing and attentional resources with each specific attention network, but this task is not exactly the same as what individuals do at work. Thus, caution must be used when examining task performance. Using the ANT as a work task also means that the results from this study are more applicable to individuals who have high visual attention demands at their job. For occupations that require other resources like physical strength, emotion regulation, or verbal working memory, the breaks that were helpful in this study may not have the same benefit.

The use of students rather than employees can also be considered by some to be a limitation. However, because I was studying the basic human processes of resource depletion and recovery, the sample itself was less important as long as all individuals are expected to undergo this process. In other words, examining human behaviors and processes would be the same in a student or nonstudent sample, making this less of a concern (Dobbins, Lane, & Steiner, 1988). In addition, a meta-analysis by Podsakoff, LePine, and LePine (2007)examining stress appraisals and outcomes found no statistically significant difference in the results utilizing an employee sample or a student sample, providing evidence that college students are not different from other working adults in how they appraise and handle work stress. This potential limitation is further minimized when considering that 66.3% of the sample worked on average 25.2 hours each week.

Regarding research design, this experiment controlled what break activity each individual engaged in and also focused only on the effects of one break period. This limits the generalizability of the findings because in most instances, employees will be able to decide what they do during the break. Feelings of control during non-work time longer than breaks have been linked to a multitude of improved well-being outcomes (e.g., Davidson et al., 2010; Hahn, Binnewies, Sonnentag, & Mojza, 2011; Sonnentag & Fritz, 2007). Thus, allowing individuals a choice in break activities is an avenue for future research. In addition, employees may have multiple breaks during a work period, leading to a cumulative effect of multiple recovery processes. Initial research has found that individuals utilize multiple break strategies each day (Fritz et al., 2011). This study was useful to disentangle the effects of recovery activities and appraisals over one time period, but future research should consider multiple breaks during a work period. An additional research limitation was the use of a general fatigue measure. Only recently has a scale been validated that separates physical, mental, and emotional fatigue at work (Frone & Tidwell, 2015), and including these conceptualizations would provide a stronger understanding how attention-demanding tasks impact employee energy.

Future Directions

Given these limitations, there are many avenues available for future research. One main aspect that should be considered is to examine how each microbreak impacted individuals over time. Analyzing the variance in outcomes within each person would provide a much better causal understanding of how microbreak activities and appraisals of these activities help individuals replenish resources. Examining resources after the final round of tasks could also show if resources were recovered after the break, but once again were depleted at the same rate as individuals who had no break. Could it be that individuals in the control (no break) condition actually have higher levels of resources at the end of the experiment because they finished all of their work trials faster? Overall, a more nuanced examination of the experimental results would allow for increased causal inferences about changes over time within each person.

Future research should also explore the interaction of emotions, social interactions, and attention (for more information, see: Federico, Marotta, Adriani, Maccari, & Casagrande, 2013; Morillas-Romero, Tortella-Feliu, Balle, & Bornas, 2014; Pessoa, 2009). It would be interesting to examine how social interactions during breaks impact individuals, as well as how having control over a break activity impacts resource recovery. Expanding the study of breaks to an environment that requires emotion regulation and attentional processes, such as a customer service job, is an area that also should be explored.

Lastly, future research should take these findings and attempt to directly replicate them (Kepes & McDaniel, 2013), as well as utilize a quasi-experimental design to enhance the generalizability of the findings. In a recent study, not only did individuals with greater executive control have improved task performance, this effect was stronger in an organizational setting with employees than a similar study with a student sample (Bosco, Allen, & Singh, 2015). Replicating this experiment could be practically significant to organizations too. For example, the visual attention of truck and car drivers has been a major topic of interest (e.g., Charlton & Starkey, 2011), especially since some vehicle manufacturers are considering adding ways to assess driver fatigue and attentiveness and have the vehicle automatically adapt (Doheny, 2012). Understanding how breaks can improve attention and reduce fatigue has great practical importance in this context, and future studies should continue to explore this area.

Conclusion

With increasing interest in how employees recover cognitive and psychological resources during non-work time, this study focused on microbreaks. Although employees report spending approximately 10% of their time on non-work activities, there has been relatively little research about how work breaks impact individuals in jobs that require more cognitive resources rather than physical resources. Overall, taking a break between work tasks allowed individuals to feel less fatigued, more energized, and more attentive. Although some of these findings may make sense to general public, it is important to test if and when our notions about breaks at work are actually true. In some instances, conducting these tests also help us recognize when common knowledge might be untrue. For example, this study found that taking a longer break of 5 or 9 minutes might not be any more helpful than taking a 1-minute break. In other words, the notion that “more is better” when it comes to short breaks during work time may not be true. Another surprising finding was that working on a different task for a short period rather than disengaging from work was the best at improving attention. This study also found that to increase feelings of energy at work, it may be best to change one's appraisal of the situation (finding something enjoyable) rather than take a break. In other words, changing tasks could even be helpful if one finds enjoyment in a different work task.

References

Adler, P. S. (2001). Market, hierarchy, and trust: The knowledge economy and the future of capitalism. *Organization Science*, *12*, 215–234.

Amihai, I., & Kozhevnikov, M. (2014). Arousal vs. relaxation: A comparison of the neurophysiological and cognitive correlates of Vajrayana and Theravada meditative practices. *PloS One*, *9*(7), e102990. doi:10.1371/journal.pone.0102990

Ancona, D. G., Goodman, P. S., & Lawrence, B. S. (2001). Time: A new research lens. *Academy of Management Review*, *26*, 645–663.

Ariga, A., & Lleras, A. (2011). Brief and rare mental "breaks" keep you focused: Deactivation and reactivation of task goals preempt vigilance decrements. *Cognition*, *118*, 439–443. doi:10.1016/j.cognition.2010.12.007

Armon, G., Melamed, S., & Vinokur, A. (2014). The reciprocal relationship between vigor and insomnia: A three-wave prospective study of employed adults. *Journal of Behavioral Medicine*, *37*, 664–674. doi:10.1007/s10865-013-9517-6

Baker, F. R., & Burney. (1928). Summaries of business research: The point plan for industrial control. *Harvard Business Review*, (January), 219–230.

Bakker, A. B., Demerouti, E., Oerlemans, W., & Sonnentag, S. (2013). Workaholism and daily recovery: A day reconstruction study of leisure activities. *Journal of Organizational Behavior*, *34*, 87–107. doi:10.1002/job

Bakker, A. B., Sanz-Vergel, A. I., Rodríguez-Muñoz, A., & Oerlemans, W. G. M. (2014). The state version of the recovery experience questionnaire: A multilevel confirmatory factor analysis. *European Journal of Work and Organizational Psychology*, 1–10. doi:10.1080/1359432X.2014.903242

Beal, D. J., & Weiss, H. M. (2003). Methods of ecological momentary assessment in organizational research. *Organizational Research Methods*, *6*, 440–464. doi:10.1177/1094428103257361

Beal, D. J., Weiss, H. M., Barros, E., & MacDermid, S. M. (2005). An episodic process model of affective influences on performance. *Journal of Applied Psychology*, *90*, 1054–1068. doi:10.1037/0021-9010.90.6.1054

Bennett, A. A. (2013). Recovering resources during evenings and weekends: A quantitative review of what works. In *Academy of Management Annual Meeting*. Orlando, Florida.

Bennett, A. A., Bakker, A. B., & Field, J. G. (2014). *Replenishing energy or reducing energy depletion? A meta-analytic investigation of recovery experiences*.

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*, 1207–1213.

Binnewies, C., Sonnentag, S., & Mojza, E. J. (2010). Recovery during the weekend and fluctuations in weekly job performance: A week-level study examining intra-individual relationships. *Journal of Occupational and Organizational Psychology*, *83*, 419–441.

Blount, S., & Janicik, G. A. (2001). When plans change: Examining how people evaluate timing changes in work organizations. *Academy of Management Review*, *26*, 566–585.

Boksem, M. A. S., & Tops, M. (2008). Mental fatigue: Costs and benefits. *Brain Research Reviews*, *59*, 125–139. doi:10.1016/j.brainresrev.2008.07.001

Bosco, F., Allen, D. G., & Singh, J. (2015). Executive attention: An alternative perspective on general mental ability, performance, and subgroup differences. *Personnel Psychology*. doi:10.1111/peps.12099.This

Boucsein, W., & Thum, M. (1997). Design of work/rest schedules for computer work based on psychophysiological recovery measures. *International Journal of Industrial Ergonomics*, *20*, 51–57.

Bourgeois, L. R. (2011). *Gambling as stress recovery? A new perspective on the stress - gambling relationship*. Saint Mary's University, Halifax, Nova Scotia.

Breton, F., Planté, A., Legauffre, C., Morel, N., Adès, J., Gorwood, P., … Dubertret, C. (2011). The executive control of attention differentiates patients with schizophrenia, their first-degree relatives and healthy controls. *Neuropsychologia*, *49*, 203–208. doi:10.1016/j.neuropsychologia.2010.11.019

Brown, K. G. (2005). An examination of the structure and nomological network of trainee reactions: A closer look at "smile sheets." *Journal of Applied Psychology*, *90*, 991–1001. doi:10.1037/0021-9010.90.5.991

Brunyé, T. T., Mahoney, C. R., Lieberman, H. R., & Taylor, H. A. (2010). Caffeine modulates attention network function. *Brain and Cognition*, *72*, 181–188. doi:10.1016/j.bandc.2009.07.013

Burke, R. J., & El-Kot, G. (2009). Benefits of recovery after work among Egyptian managers. *Journal of Transnational Management*, *14*, 309–331. doi:10.1080/15475770903334151

Buysse, D. J., Reynolds, C. F. I., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Journal of Psychiatric Research*, *28*, 193–213.

California Industrial Welfare Commission. Industrial Welfare Commission Order 2-2011 regulating wages, hours and working conditions in the personal service industry (2001).

Carmeli, A., Ben-Hador, B., Waldman, D. A., & Rupp, D. E. (2009). How leaders cultivate social capital and nurture employee vigor: Implications for job performance. *Journal of Applied Psychology*, *94*, 1553–1561. doi:10.1037/a0016429

Chaffin, D. B. (1973). Localized muscle fatigue-definition and measurement. *Journal of Occupational and Environmental Medicine*, *15*, 346–354.

Chajut, E., & Algom, D. (2003). Selective attention improves under stress: Implications for theories of social cognition. *Journal of Personality and Social Psychology*, *85*(2), 231–248. doi:10.1037/0022-3514.85.2.231

Charlton, S. G., & Starkey, N. J. (2011). Driving without awareness: The effects of practice and automaticity on attention and driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, *14*, 456–471. doi:10.1016/j.trf.2011.04.010

Clark, W. I. (1916). Efficiency in the worker, and its maintenance. *American Journal of Public Health*, *6*, 870–871.

Cole, M. S., Walter, F., Bedeian, A. G., & O'Boyle, E. H. (2012). Job burnout and employee engagement: A meta-analytic examination of construct proliferation. *Journal of Management*, *38*, 1550–1581. doi:10.1177/0149206311415252

Converse, P. D., & DeShon, R. P. (2009). A tale of two tasks: Reversing the self-regulatory resource depletion effect. *Journal of Applied Psychology*, *94*, 1318–1324. doi:10.1037/a0014604

Cooke, M. L. (1913). The spirit and social significance of scientific management. *Journal of Political Economy*, *21*, 481–493.

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information-processing system. *Psychological Bulletin*, *104*, 163–191.

Cropanzano, R., Weiss, H. M., Hale, J. M. S., & Reb, J. (2003). The structure of affect: Reconsidering the relationship between negative and positive affectivity. *Journal of Management*, *29*, 831–857. doi:10.1016/S0149-2063

D'Abate, C. P. (2005). Working hard or hardly working: A study of individuals engaging in personal business on the job. *Human Relations*, *58*, 1009–1032.

Dababneh, A. J., Swanson, N., & Shell, R. L. (2001). Impact of added rest breaks on the productivity and well-being of workers. *Ergonomics*, *44*, 164–174.

Dalal, R. S., Bhave, D. P., & Fiset, J. (2014). Within-person variability in job performance: A theoretical review and research agenda. *Journal of Management*, *40*, 1396–1436. doi:10.1177/0149206314532691

Davidson, O. B., Eden, D., Westman, M., Cohen-Charash, Y., Hammer, L. B., Kluger, A. N., … Spector, P. E. (2010). Sabbatical leave: Who gains and how much? *Journal of Applied Psychology*, *95*, 953–964. doi:10.1037/a0020068

Davis, F. D., & Yi, M. Y. (2004). Improving computer skill training: Behavior modeling, symbolic mental rehearsal, and the role of knowledge structures. *Journal of Applied Psychology*, *89*, 509–523. doi:10.1037/0021-9010.89.3.509

De Bloom, J., Geurts, S. A. E., & Kompier, M. A. J. (2012). Effects of short vacations, vacation activities and experiences on employee health and well-being. *Stress and Health*, *28*, 305–318. doi:10.1002/smi.1434

De Bloom, J., Geurts, S. A. E., Sonnentag, S., Taris, T., de Weerth, C., & Kompier, M. A. J. (2011). How does a vacation from work affect employee health and well-being? *Psychology & Health*, *26*, 1606–1622. doi:10.1080/08870446.2010.546860

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology*, *86*, 499–512. doi:10.1037//0021-9010.86.3.499

Demerouti, E., Bakker, A. B., Sonnentag, S., & Fullagar, C. J. (2012). Work related flow and energy at work and at home: A study on the role of daily recovery. *Journal of Organizational Behavior, 33*, 276–295. doi:10.1002/job

Derks, D., & Bakker, A. B. (2014). Smartphone use, work-home interference, and burnout: A diary study on the role of recovery. *Applied Psychology: An International Review*, *63*, 411–440. doi:10.1111/j.1464-0597.2012.00530.x

Diamond, M. L. (2011). More employers setting up nap rooms for weary workers. *USA Today*. Retrieved from http://www.usatoday.com/story/money/business/2013/03/11/more-work-nap-rooms/1977603/

Dijksterhuis, A., & Aarts, H. (2010). Goals, attention, and (un)consciousness. *Annual Review of Psychology*, *61*, 467–90. doi:10.1146/annurev.psych.093008.100445

Dobbins, G. H., Lane, I. M., & Steiner, D. D. (1988). A note on the role of laboratory methodologies in applied behavioural research: Don't throw out the baby with the bath water. *Journal of Organizational Behavior*, *9*, 281–286. doi:10.1002/job.4030090308

Dodge, R. (1913). Mental work: A study in psychodynamics. *Psychological Review*, *20*, 214–229.

Doerr, K. H., Mitchell, T. R., Klastorin, T. D., & Brown, K. A. (1996). Impact of material flow policies and goals on job outcomes. *Journal of Applied Psychology, 81*, 142–152.

Doheny, K. (2012). Technology aimed at helping drowsy drivers stay awake. *Edmunds.com*. Retrieved from http://www.edmunds.com/car-safety/technology-aimed-at-helping-drowsy-drivers-stay-awake.html

Durkin, D. (2014). Refuel, recharge and reenergize your employees. *HR.com*. Retrieved from http://www.hr.com/en/magazines/all_articles/refuel-recharge-and-reenergize-your-employees_hqpd05t1.html

Dutton, J. E. (2003). Breathing life into organizational studies. *Journal of Management Inquiry*, *12*, 5–19.

Edelhauser, K. (2007). Video games at work? *Entrepreneur*. Retrieved from http://www.entrepreneur.com/article/179274

Einöther, S. J. L., Martens, V. E. G., Rycroft, J. A., & De Bruin, E. A. (2010). L-theanine and caffeine improve task switching but not intersensory attention or subjective alertness. *Appetite*, *54*, 406–409. doi:10.1016/j.appet.2010.01.003

El ahrache, K., Imbeau, D., & Farbos, B. (2006). Percentile values for determining maximum endurance times for static muscular work. *International Journal of Industrial Ergonomics*, *36*, 99–108. doi:10.1016/j.ergon.2005.08.003

Elfenbein, H. A. (2007). Emotion in organizations: A review and theoretical integration. *Academy of Management Annals*, *1*, 315–386.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science*, *11*, 19–23.

Eschleman, K. J., Madsen, J., Alarcon, G., & Barelka, A. (2014). Benefiting from creative activity: The positive relationships between creative activity, recovery experiences, and performance-related outcomes. *Journal of Occupational and Organizational Psychology*, *87*, 579–598. doi:10.1111/joop.12064

Esteves, J. N. D. (2013). “All work and no play makes Jack a dull boy”: What people do when they are not working at work. In *Academy of Management Annual Meeting*.

Etzion, D., Eden, D., & Lapidot, Y. (1998). Relief from job stressors and burnout: Reserve service as a respite. *Journal of Applied Psychology*, *83*(4), 577–85. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9729927

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *NeuroImage*, *26*, 471–479. doi:10.1016/j.neuroimage.2005.02.004

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, *14*, 340–347. doi:10.1162/089892902317361886

Fan, J., Wu, Y., Fossella, J. A., & Posner, M. I. (2001). Assessing the heritability of attentional networks. *BMC Neuroscience*, *2*(1), 14. doi:10.1186/1471-2202-2-14

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17695343

Federico, F., Marotta, A., Adriani, T., Maccari, L., & Casagrande, M. (2013). Attention network test--the impact of social information on executive control, alerting and orienting. *Acta Psychologica*, *143*, 65–70. doi:10.1016/j.actpsy.2013.02.006

Feldt, T., Huhtala, M., Kinnunen, U., Hyvönen, K., Mäkikangas, A., & Sonnentag, S. (2013). Long-term patterns of effort-reward imbalance and over-commitment: Investigating occupational well-being and recovery experiences as outcomes. *Work & Stress*, *27*, 64–87. doi:10.1080/02678373.2013.765670

Fenner, P., Leahy, S., Buhk, A., & Dawes, P. (1999). Prevention of drowning: Visual scanning and attention span in lifeguards. *Journal of Occupational Health and Safety - Australia and New Zealand*, *15*, 61–66.

Ferrer, R. A., Grenen, E. G., & Taber, J. M. (2015). Effectiveness of internet-based affect induction procedures: A systematic review and meta-analysis. *Emotion*.

Flaxman, P. E., Ménard, J., Bond, F. W., & Kinman, G. (2012). Academics’ experiences of a respite from work: Effects of self-critical perfectionism and perseverative cognition on postrespite well-being. *Journal of Applied Psychology*, *97*, 854–865. doi:10.1037/a0028055

Ford, M. T., Cerasoli, C. P., Higgins, J. A., & Decesare, A. L. (2011). Relationships between psychological, physical, and behavioral health and work performance - A review and meta-analysis. *Work & Stress*, *25*, 185–204.

Fredrickson, B. L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of Personality and Social Psychology*, *65*(1), 45–55. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8355141

Fritz, C., Lam, C. F., & Spreitzer, G. M. (2011). It’s the little things that matter: An examination of knowledge workers' energy management. *Academy of Management Perspectives*, *24*, 28–39.

Fritz, C., & Sonnentag, S. (2005). Recovery, health, and job performance: Effects of weekend experiences. *Journal of Occupational Health Psychology*, *10*, 187–199. doi:10.1037/1076-8998.10.3.187

Fritz, C., & Sonnentag, S. (2006). Recovery, well-being, and performance-related outcomes: The role of workload and vacation experiences. *Journal of Applied Psychology*, *91*, 936–945. doi:10.1037/0021-9010.91.4.936

Fritz, C., Sonnentag, S., Spector, P. E., & McInroe, J. A. (2010). The weekend matters: Relationships between stress recovery and affective experiences. *Journal of Organizational Behavior*, *31*, 1137–1162. doi:10.1002/job

Fritz, C., Yankelevich, M., Zarubin, A., & Barger, P. (2010). Happy, healthy, and productive: The role of detachment from work during nonwork time. *Journal of Applied Psychology*, *95*, 977–83. doi:10.1037/a0019462

Frone, M. R., & Tidwell, M.-C. O. (2015). The meaning and measurement of work fatigue: Development and evaluation of the Three-Dimensional Work Fatigue Inventory (3D-WFI). *Journal of Occupational Health Psychology*.

Gailliot, M. T., Baumeister, R. F., DeWall, C. N., Maner, J. K., Plant, E. A., Tice, D. M., … Schmeichel, B. J. (2007). Self-control relies on glucose as a limited energy source: Willpower is more than a metaphor. *Journal of Personality and Social Psychology*, *92*, 325–336. doi:10.1037/0022-3514.92.2.325

Galinsky, T. L., Swanson, N. G., Sauter, S. L., Hurrell, J. L., & Schleifer, L. M. (2000). A field study of supplementary rest breaks for data entry operators. *Ergonomics*, *43*, 622–638.

Ganster, D. C., Schaubroeck, J., Sime, W. E., & Mayes, B. T. (1991). The nomological validity of the Type A personality among employed adults. *Journal of Applied Psychology*, *76*, 143–68. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/2016215

George, J. M., & Jones, G. R. (2000). The role of time in theory and theory building. *Journal of Management*, *26*, 657–684. doi:10.1177/014920630002600404

Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, *37*(6), 504–528. doi:10.1016/S0092-6566(03)00046-1

Grant, A. M., & Parker, S. K. (2009). Redesigning work design theories: The rise of relational and proactive perspectives. *The Academy of Management Annals*, *3*, 317–375. doi:10.1080/19416520903047327

Hahn, V. C., Binnewies, C., & Haun, S. (2012). The role of partners for employees’ recovery during the weekend. *Journal of Vocational Behavior*, *80*, 288–298. doi:10.1016/j.jvb.2011.12.004

Hahn, V. C., Binnewies, C., Sonnentag, S., & Mojza, E. J. (2011). Learning how to recover from job stress: Effects of a recovery training program on recovery, recovery-related selfefficacy, and well-being. *Journal of Occupational Health Psychology*, *16*, 202–16. doi:10.1037/a0022169

Halbesleben, J. R. B. (2010). A meta-analysis of work engagement: Relationships with burnout, demands, resources, and consequences. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 102–117). New York, NY: Psychology Press.

Halbesleben, J. R. B., & Bowler, W. M. (2007). Emotional exhaustion and job performance: The mediating role of motivation. *Journal of Applied Psychology*, *92*, 93–106. doi:10.1037/0021-9010.92.1.93

Halbesleben, J. R. B., Neveu, J.-P., Paustian-Underdahl, S. C., & Westman, M. (2014). Getting to the "COR": Understanding the role of resources in Conservation of Resources Theory. *Journal of Management*. doi:10.1177/0149206314527130

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, *76*(4), 408–420. doi:10.1080/03637750903310360

Hayes, A. F., & Preacher, K. J. (2014). Statistical mediation analysis with a multicategorical independent variable. *British Journal of Mathematical and Statistical Psychology*, *67*, 451–470. doi:10.1111/bmsp.12028

Henning, R. A., Bopp, M. I., Tucker, K. M., Knoph, R. D., & Ahlgren, J. (1997). Team-managed rest breaks during computer-supported cooperative work. *International Journal of Industrial Ergonomics*, *20*(1), 19–29. doi:10.1016/S0169-8141(96)00028-5

Henning, R. A., Jacques, P., Kissel, G. V., Sullivan, A. B., & Alteras-Webb, S. M. (1997). Frequent short rest breaks from computer work: Effects on productivity and well-being in two field studies. *Ergonomics*, *40*, 78–91.

Henning, R. A., Kissel, G. V., & Maynard, D. C. (1994). Compensatory rest breaks for VDT operators. *International Journal of Industrial Ergonomics*, *14*, 243–249. doi:10.1016/0169-8141(94)90100-7

Henning, R. A., Sauter, S. L., Salvendy, G., & Kreig, E. F. (1989). Microbreak length, performance, and stress in data entry task. *Ergonomics*, *32*, 855–864.

Hitt, M. A. (1998). Presidential Address: Twenty-first century organizations: Business firms, business schools, and the Academy. *Academy of Management Review*, *23*, 218–224.

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, *44*, 513–524.

Hofmann, W., Friese, M., & Roefs, A. (2009). Three ways to resist temptation: The independent contributions of executive attention, inhibitory control, and affect regulation to the impulse control of eating behavior. *Journal of Experimental Social Psychology*, *45*, 431–435. doi:10.1016/j.jesp.2008.09.013

Hofmann, W., Gschwendner, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008). Working memory capacity and self-regulatory behavior: Toward an individual differences perspective on behavior determination by automatic versus controlled processes. *Personality Processes and Individual Differences*, *95*, 962–977. doi:10.1037/a0012705

Holzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, *6*, 537–559. doi:10.1177/1745691611419671

Horsman, P. A. (2011). *Is a change as good as a rest? Investigating part-time reserve service as a method of stress recovery*.

Huddleston, W. E., Aleksandrowicz, M. S., Yufa, A., Knurr, C. R., Lytle, J. R., & Puissant, M. M. (2013). Attentional resource allocation during a cued saccade task. *Acta Psychologica*, *144*, 112–120. doi:10.1016/j.actpsy.2013.05.006

Hülsheger, U. R., Alberts, H. J. E. M., Feinholdt, A., & Lang, J. W. B. (2013). Benefits of mindfulness at work: The role of mindfulness in emotion regulation, emotional exhaustion, and job satisfaction. *Journal of Applied Psychology*, *98*, 310–25. doi:10.1037/a0031313

Hülsheger, U. R., Feinholdt, A., & Nübold, A. (2015). A low-dose mindfulness intervention and recovery from work: Effects on psychological detachment, sleep quality, and sleep duration. *Journal of Occupational and Organizational Psychology*. doi:10.1111/joop.12115

Hülsheger, U. R., Lang, J. W. B., Depenbrock, F., Fehrmann, C., Zijlstra, F. R. H., & Alberts, H. J. E. M. (2014). The power of presence: The role of mindfulness at work for daily levels and change trajectories of psychological detachment and sleep quality. *Journal of Applied Psychology*. doi:10.1037/a0037702

Hunter, E. M., & Wu, C. (2013). Give me a better break: Choosing workday break activities to maximize resource recovery. In *Academy of Management Annual Meeting*.

Hunter, E. M., & Wu, C. (2014). *Give me a better break: Choosing workday break activities to maximize resource recovery*.

Jung, T.-P., Makeig, S., Stensmo, M., & Sejnowski, T. J. (1997). Estimating alterness from the EEG power spectrum. *IEEE Transactions on Biomedical Engineering*, *44*, 60–69.

Kahneman, D. (1973). *Attention and Effort*. *The American Journal of Psychology* (Vol. 88). Englewood Cliffs, New Jersey: Prentice Hall. doi:10.2307/1421603

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *The American Psychologist*, *58*(9), 697–720. doi:10.1037/0003-066X.58.9.697

Kane, M. J., Conway, A. R. A., Hambrick, D. Z., & Engle, R. W. (2007). Variation in working memory capacity as variation in executive attention and control. In A. R. A. Conway, C. Jarrold, M. J. Kane, A. Miyake, & J. N. Towse (Eds.), *Variation in working memory* (pp. 21–46). New York, NY: Oxford University Press.

Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative / aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology*, *74*, 657–690.

Kanfer, R., Ackerman, P. L., Murtha, T. C., Dugdale, B., & Nelson, L. (1994). Goal setting, condiditions of practice, and task performance: A resource allocation perspective. *Journal of Applied Psychology*, *79*, 826–835.

Kaplan, S. (2001). Meditation, restoration, and the management of mental fatigue. *Environment and Behavior*, *33*, 480–506. doi:10.1177/00139160121973106

Kenemans, J. L., Wieleman, J. S. T., Zeegers, M., & Verbaten, M. N. (1999). Caffeine and Stroop interference. *Pharmacology, Biochemistry, and Behavior*, *63*, 589–598. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10462187

Kepes, S., & McDaniel, M. A. (2013). How trustworthy is the scientific literature in I-O psychology? *Industrial and Organizational Psychology: Perspectives on Science and Practice*, *6*(3).

Kiesel, A., Steinhauser, M., Wendt, M., Falkenstein, M., Jost, K., Philipp, A. M., & Koch, I. (2010). Control and interference in task switching - A review. *Psychological Bulletin*, *136*, 849–874. doi:10.1037/a0019842

Kim, S. D., Bologna, D. A., Furst-holloway, S., Hollensbe, E. C., Masterson, S. S., & Sprinkle, T. (2014). Taking a break via technology? Triggers, nature, and effects of “online” work breaks. In *Academy of Management Annual Meeting*. Philadelphia, PA.

Kinnunen, U., Feldt, T., Siltaloppi, M., & Sonnentag, S. (2011). Job demands – resources model in the context of recovery: Testing recovery experiences as mediators. *European Journal of Work and Organizational Psychology*, *20*, 805–832.

Konz, S. A., & Johnson, S. (2000). *Work design: Industrial ergonomics*. Holcomb Hathaway Pubs.

Krajewski, J., Sauerland, M., & Wieland, R. (2011). Relaxation-induced cortisol changes within lunch breaks - an experimental longitudinal worksite field study. *Journal of Occupational and Organizational Psychology*, *84*, 382–394. doi:10.1348/096317910X485458

Lilius, J. M. (2012). Recovery at work: Understanding the restorative side of “depleting” client interactions. *Academy of Management Review, 37*, 569–588. doi:10.5465/amr.2010.0458

Lim, V. K. G., & Chen, D. J. Q. (2012). Cyberloafing at the workplace: Gain or drain on work? *Behaviour & Information Technology, 31*, 343–353. doi:10.1080/01449290903353054

Lin, B. C. (2009). *Do recovery experiences during lunch breaks impact worker well-being?*

Lin, B. C., & Fritz, C. (2014). *Give me a break! The effects of lunch break unwinding on employee well-being*.

Longman, C. S., Lavric, A., & Monsell, S. (2013). More attention to attention? An eye-tracking investigation of selection of perceptual attributes during a task switch. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*, 1142–1151. doi:10.1037/a0030409

Lord, R. G., Diefendorff, J. M., Schmidt, A. M., & Hall, R. J. (2010). Self-regulation at work. *Annual Review of Psychology*, *61,* 543–68. doi:10.1146/annurev.psych.093008.100314

Lorist, M. M., Klein, M., Nieuwenhuis, S., de Jong, R., Mulder, G., & Meijman, T. F. (2000). Mental fatigue and task control: Planning and preparation. *Psychophysiology*, *37,* 614–625.

Lorist, M. M., & Tops, M. (2003). Caffeine, fatigue, and cognition. *Brain and Cognition*, *53,* 82–94. doi:10.1016/S0278-2626(03)00206-9

Lounsbury, J. W., & Hoopes, L. L. (1986). A vacation from work: Changes in work and nonwork outcomes. *Journal of Applied Psychology*, *71*, 392–401. doi:10.1037//0021-9010.71.3.392

Lyche, P., Jonassen, R., Stiles, T. C., Ulleberg, P., & Landrø, N. I. (2011). Attentional functions in major depressive disorders with and without comorbid anxiety. *Archives of Clicnical Neuropsychology*, *26*, 38–47. doi:10.1093/arclin/acq095

Ma, L., Chablat, D., Bennis, F., Zhang, W., & Guillaume, F. (2010). A new muscle fatigue and recovery model and its ergonomics application in human simulation. *Virtual and Physical Prototyping*, *5*(3), 123–137. doi:10.1080/17452759.2010.504056

Machlup, F. (1962). *The Production and Distribution of Knowledge in the United States*. Princeton, NJ: Princeton University Press.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7,* 83–104. doi:10.1037/1082-989X.7.1.83

MacLeod, J. W., Lawrence, M. A., McConnell, M. M., Eskes, G. A., Klein, R. M., & Shore, D. I. (2010). Appraising the ANT: Psychometric and theoretical considerations of the Attention Network Tes. *Neuropsychology*, *24*, 637–651. doi:10.1037/a0019803

Mäkikangas, A., Feldt, T., Kinnunen, U., & Tolvanen, A. (2012). Do low burnout and high work engagement always go hand in hand? Investigation of the energy and identification dimensions in longitudinal data. *Anxiety, Stress, & Coping*, *25*, 93–116. doi:10.1080/10615806.2011.565411

Marks, S. R. (1977). Multiple roles and role strain: Some notes on human energy, time and commitment. *American Sociological Review*, *42*, 921–936.

Maslach, C., Schaufeli, W. B., & Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology*, *52*, 397–422.

Matthews, G., & Zeidner, M. (2012). Individual differences in attentional networks: Trait and state correlates of the ANT. *Personality and Individual Differences*, *53*, 574–579. doi:10.1016/j.paid.2012.04.034

McGehee, W., & Owen, E. B. (1940). Authorized and unauthorized rest pauses in clerical work. *Journal of Applied Psychology*, *24*, 605–614.

Mclean, L., Tingley, M., Scott, R. N., & Rickards, J. (2001). Computer terminal work and the benefit of microbreaks. *Applied Ergonomics*, *32*, 225–237.

McNair, D., Lorr, M., & Droppleman, L. (1971). *Manual for the profile of mood states*. San Diego, CA: Educational and Industrial Testing Service.

Meijman, T. F. (1997). Mental fatigue and the efficiency of information processing in relation to work times. *International Journal of Industr*, *20*, 31–38.

Meijman, T. F., & Mulder, G. (1998). Psychological aspects of workload. In P. J. D. Drenth & C. J. de Wolff (Eds.), *Handbook of Work and Organizational Psychology: Volume 2: Work Psychology* (pp. 5–33). Hove, England: Psychology Press.

Michielsen, H. J., De Vries, J., & Van Heck, G. L. (2003). Psychometric qualities of a brief self-rated fatigue measure. *Journal of Psychosomatic Research*, *54*, 345–352. doi:10.1016/S0022-3999(02)00392-6

Mojza, E. J., Lorenz, C., Sonnentag, S., & Binnewies, C. (2010). Daily recovery experiences: The role of volunteer work during leisure time. *Journal of Occupational Health Psychology*, *15*, 60–74. doi:10.1037/a0017983

Mojza, E. J., Sonnentag, S., & Bornemann, C. (2011). Volunteer work as a valuable leisure-time activity: A day-level study on volunteer work, non-work experiences, and well-being at work. *Journal of Occupational and Organizational Psychology*, *84*, 123–152. doi:10.1348/096317910X485737

Morillas-Romero, A., Tortella-Feliu, M., Balle, M., & Bornas, X. (2014). Spontaneous emotion regulation and attentional control. *Emotion*.

Muraven, M., Tice, D. M., & Baumeister, R. F. (1998). Self-control as limited resource: Regulatory depletion patterns. *Journal of Personality and Social Pschology*, *74*, 774–89. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9523419

Murphy, K. (2002). Using power analysis to evaluate and improve research. In *Handbook of research methods in industrial and organizational psychology* (pp. 119–137).

Norman, D. A., & Bobrow, D. G. (1975). On data-limited and resource-limited processes. *Cognitive Psychology*, *7*, 44–64.

O'Connor, C. (2012). The mystery monk making billions with 5-Hour Energy. *Forbes*. Retrieved from http://www.forbes.com/sites/clareoconnor/2012/02/08/manoj-bhargava-the-mystery-monk-making-billions-with-5-hour-energy/

Olguin, M. A. (2013). Worn-out employees? 5 ways to crank up the energy. *Inc.* Retrieved from http://www.inc.com/michael-olguin/5-ways-to-stay-motivated-in-a-fast-paced-environment.html

Olk, B. (2013). Measuring the allocation of attention in the Stroop task: Evidence from eye movement patterns. *Psychological Research*, *77*, 106–115. doi:10.1007/s00426-011-0405-9

Ong, C. N. (1984). VDT workplace design and physical fatigue–a case study in Singapore. In E. Grandjean (Ed.), *Ergonomics and Health in Modern Offices* (pp. 484–493). London, UK: Taylor & Francis.

Passmore, R., & Durnin, J. V. G. A. (1955). Human energy expenditure. *Physiological Reviews*, *35*, 801–840.

Pessoa, L. (2009). How do emotion and motivation direct executive control? *Trends in Cognitive Sciences*, *13*, 160–166. doi:10.1016/j.tics.2009.01.006

Pfeffer, J. (2010). Building sustainable organizations: The human factor. *Academy of Management Perspectives*, 34–46.

Pierce, C. A., Block, R. A., & Aguinis, H. (2004). Cautionary note on reporting eta-squared values from multifactor ANOVA designs. *Educational and Psychological Measurement*, *64*, 916–924. doi:10.1177/0013164404264848

Podsakoff, N. P., LePine, J. A., & LePine, M. A. (2007). Differential challenge stressor-hindrance stressor relationships with job attitudes, turnover intentions, turnover, and withdrawal behavior: A meta-analysis. *Journal of Applied Psychology, 92*, 438–54. doi:10.1037/0021-9010.92.2.438

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, *13*, 25–42.

Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annual Review of Psychology*, *58*, 1–23. doi:10.1146/annurev.psych.58.110405.085516

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36*, 717–731.

Psychology Software Tools. (2014). E-Prime 2.0 Professional. Pittsburgh, PA.

Querstret, D., & Cropley, M. (2012). Exploring the relationship between work-related rumination, sleep quality, and work-related fatigue. *Journal of Occupational Health Psychology, 17*, 341–353. doi:10.1037/a0028552

Quinn, R. W., Spreitzer, G. M., & Lam, C. F. (2012). Building a sustainable model of human energy in organizations: Exploring the critical role of resources. *Academy of Management Annals*, *6*, 337–396. doi:10.1080/19416520.2012.676762

Rapport, M. D., Orban, S. A., Kofler, M. J., & Friedman, L. M. (2013). Do programs designed to train working memory, other executive functions, and attention benefit children with ADHD? A meta-analytic review of cognitive, academic, and behavioral outcomes. *Clinical Psychology Review, 33*, 1237–1252. doi:10.1016/j.cpr.2013.08.005

Reay, T., Berta, W., & Kohn, M. K. (2009). What’s the evidence on Evidence-Based Management? *Academy of Management Perspectives*, *23*(4), 5–18. doi:10.5465/AMP.2009.45590137

Redick, T. S., & Engle, R. W. (2006). Working memory capacity and Attention Network Test performance. *Applied Cognitive Psychology*, *20*, 713–721. doi:10.1002/acp.1224

Reinecke, L., Klatt, J., & Kramer, N. C. (2011). Entertaining media use and the satisfaction of recovery needs: Recovery outcomes associated with the use of interactive and noninteractive entertaining media. *Media Psychology, 14*.

Robinson, S. L., & Bennett, R. J. (1995). A typology of deviant workplace behaviors: A multidimensional scaling study. *Academy of Management Journal*, *38*, 555–572. doi:10.2307/256693

Rodell, J. B., & Judge, T. a. (2009). Can “good” stressors spark “bad” behaviors? The mediating role of emotions in links of challenge and hindrance stressors with citizenship and counterproductive behaviors. *Journal of Applied Psychology, 94*, 1438–51. doi:10.1037/a0016752

Roethlisberger, F. J., & Dickson, W. J. (1939). *Management and the worker: An account of a research program conducted by the Western Electric Company, Hawthorne Works, Chicago*. Cambridge, MA: Harvard University Press.

Rohmert, W. (1973). Problems of determination of rest allowances. *Applied Ergonomics*, *4*, 158–162.

Rook, J., & Zijlstra, F. (2006). The contribution of various types of activities to recovery. *European Journal of Work and Organizational Psychology*, *15*, 218–240. doi:10.1080/13594320500513962

Rosen, L. D., Cheever, N. A., & Carrier, L. M. (2012). *iDisorder: Understanding our obsession with technology and overcoming its hold on us*. New York, NY: Palgrave Macmillan.

Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the facilitation of intrinsic motivation, social development, and well-bein. *American Psychologist*, *555*, 68–78.

Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K. W., Mistretta, L., & Gagné, M. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology, 30*, 159–168. doi:10.1016/j.jenvp.2009.10.009

Rzeszotarski, J. M., Chi, E., Paritosh, P., & Dai, P. (2013). Inserting micro-breaks into crowdsourcing workflows. In *First AAAI Conference on Human Computation and Crowdsourcing* (pp. 62–63).

Sabourin, J., Rowe, J., Mott, B., & Lester, J. (2011). When off-task is on-task: The affective role of off-task behavior in narrative-centered learning environments. In G. Biswas, S. Bull, J. Kay, & A. Mitrovic (Eds.), *Artificial Intelligence in Education* (pp. 534–536). Springer Berlin Heidelberg. doi:10.1007/978-3-642-21869-9_93

Sanz-Vergel, A. I., Demerouti, E., Bakker, A. B., & Moreno-Jimenez, B. (2011). Daily detachment from work and home: The moderating effect of role salience. *Human Relations*, *64*, 775–799. doi:10.1177/0018726710393368

Sanz-Vergel, A. I., Sebastián, J., Rodríguez-Muñoz, A., Garrosa, E., Moreno-Jiménez, B., & Sonnentag, S. (2010). Adaptation of the Recovery Experience Questionnaire in a Spanish sample. *Psicothema*, *22*, 990–996.

Sato, N., Kamada, T., Miyake, S., Akatsu, J., Kumashiro, M., & Kume, Y. (1999). Subjective mental workload in Type A women. *International Journal of Industrial Ergonomics*, *24*, 331–336. doi:10.1016/S0169-8141(98)00060-2

Schippers, M. C., & Hogenes, R. (2011). Energy management of people in organizations: A review and research agenda. *Journal of Business and Psychology*, *26*, 193–203. doi:10.1007/s10869-011-9217-6

Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Pschology*, *95*, 1526–1540. doi:10.1037/a0013345

Schulz, C. M., Schneider, E., Fritz, L., Vockeroth, J., Hapfelmeier, A., Brandt, T., … Schneider, G. (2011). Visual attention of anaesthetists during simulated critical incidents. *British Journal of Anaesthesia*, *106*, 807–813. doi:10.1093/bja/aer087

Schwab, D. P. (2005). *Research methods for organizational studies* (2nd ed.). Psychology Press.

Scott, W. D. (1914). *Increasing Human Efficiency in Business: A Contribution to the Psychology of Business*. New York, NY: Macmillan.

Shimazu, A., Sonnentag, S., Kunota, K., & Kawakai, N. (2012). Validation of the Japenese version of the Recovery Experience Questionnaire. *Journal of Occupational Health*, *54*, 196–205.

Shirom, A. (2004). Feeling vigorous at work? The construct of vigor and the study of positive affect in organizations. In P. L. Perrewé & D. C. Ganster (Eds.), *Research in Occupational Stress and Well Being, Volume 3* (pp. 135–164). Emerald Group Publishing. doi:10.1016/S1479-3555(03)03004-X

Siemer, M., Mauss, I., & Gross, J. J. (2007). Same situation-different emotions: How appraisals shape our emotions. *Emotion*, *7*, 592–600. doi:10.1037/1528-3542.7.3.592

Siltaloppi, M., Kinnunen, U., & Feldt, T. (2009). Recovery experiences as moderators between psychosocial work characteristics and occupational well-being. *Work & Stress*, *23*, 330–348. doi:10.1080/02678370903415572

Sluiter, J. K., Frings-Dresen, M. H., Meijman, T. F., & van der Beek, A. J. (2000). Reactivity and recovery from different types of work measured by catecholamines and cortisol: A systematic literature overview. *Occupational and Environmental Medicine*, *57*, 298–315.

Sommer, W., Stürmer, B., Shmuilovich, O., Martin-Loeches, M., & Schacht, A. (2013). How about lunch? Consequences of the meal context on cognition and emotion. *PloS One*, *8*(7), e70314. doi:10.1371/journal.pone.0070314

Sonnenberg, B., Riediger, M., Wrzus, C., & Wagner, G. G. (2012). Measuring time use in surveys - Concordance of survey and experience sampling measures. *Social Science Research*, *41*, 1037–1052. doi:10.1016/j.ssresearch.2012.03.013

Sonnentag, S. (2001). Work, recovery activities, and individual well-being: A diary study. *Journal of Occupational Health Psychology*, *6*, 196–210. doi:10.10377/1076-8998.6.3.1

Sonnentag, S. (2012). Psychological detachment from work during leisure time: The benefits of mentally disengaging from work. *Current Directions in Psychological Science*, *21*, 114–118. doi:10.1177/0963721411434979

Sonnentag, S., & Bayer, U. (2005). Switching off mentally: Predictors and consequences of psychological detachment from work during off-job time. *Journal of Occupational Health Psychology*, *10*, 393–414. doi:10.1037/1076-8998.10.4.393

Sonnentag, S., Binnewies, C., & Mojza, E. J. (2008). "Did you have a nice evening?" A day-level study on recovery experiences, sleep, and affect. *Journal of Applied Psychology*, *93,* 674–84. doi:10.1037/0021-9010.93.3.674

Sonnentag, S., & Fritz, C. (2007). The Recovery Experience Questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology*, *12*, 204–221. doi:10.1037/1076-8998.12.3.204

Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior*, *36*, S72–S103. doi:10.1002/job

Sonnentag, S., & Jelden, S. (2009). Job stressors and the pursuit of sport activities: A day-level perspective. *Journal of Occupational Health Psychology*, *14*, 165–181. doi:10.1037/a0014953

Sonnentag, S., Kuttler, I., & Fritz, C. (2010). Job stressors, emotional exhaustion, and need for recovery: A multi-source study on the benefits of psychological detachment. *Journal of Vocational Behavior*, *76*, 355–365. doi:10.1016/j.jvb.2009.06.005

Sonnentag, S., Mojza, E., Binnewies, C., & Scholl, A. (2008). Being engaged at work and detached at home: A week-level study on work engagement, psychological detachment, and affect. *Work & Stress*, *22*, 257–276. doi:10.1080/02678370802379440

Sonnentag, S., & Niessen, C. (2008). Staying vigorous until work is over: The role of trait vigour, day-specific work experiences and recovery. *Journal of Occupational and Organizational Psychology*, *81*, 435–458. doi:10.1348/096317908X310256

Sonnentag, S., Niessen, C., & Neff, A. (2011). Recovery: Non-work experiences that promote positive states. In *Center for Positive Organizational Scholarship conference proceedings* (pp. 1–34).

Sonnentag, S., & Zijlstra, F. R. H. (2006). Job characteristics and off-job activities as predictors of need for recovery, well-being, and fatigue. *Journal of Applied Psychology*, *91*, 330–50. doi:10.1037/0021-9010.91.2.330

Spreng, R. N., Mar, R. a, & Kim, A. S. N. (2009). The common neural basis of autobiographical memory, prospection, navigation, theory of mind, and the default mode: A quantitative meta-analysis. *Journal of Cognitive Neuroscience*, *21*, 489–510. doi:10.1162/jocn.2008.21029

Steinman, S. B., & Steinman, B. A. (1998). Vision and attention. 1: Current models of visual attention. *Optometry and Vision Science*, *75*, 146–155.

Stone, A. A., Kennedy-Moore, E., & Neale, J. M. (1995). Association between daily coping and end-of-day mood. *Health Psychology*, *14*, 341–9. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7556038

Strongman, K. T., & Burt, C. D. B. (2000). Taking breaks from work: An exploratory inquiry. *The Journal of Psychology*, *134*, 229–242.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 643–662.

Takahashi, M., Iwasaki, K., Sasaki, T., Kubo, T., Mori, I., & Otsuka, Y. (2011). Worktime control-dependent reductions in fatigue, sleep problems, and depression. *Applied Ergonomics*, *42*(2), 244–50. doi:10.1016/j.apergo.2010.06.006

Tarkan, L. (2012). 5 ways to boost your energy at work. *Fox News*. Retrieved from http://www.foxnews.com/health/2012/02/29/5-ways-to-boost-your-energy-at-work/

Ten Brummelhuis, L. L., & Bakker, A. B. (2012a). A resource perspective on the work-home interface: The work-home resources model. *American Psychologist*, *67*, 545–56. doi:10.1037/a0027974

Ten Brummelhuis, L. L., & Bakker, A. B. (2012b). Staying engaged during the week: The effect of off-job activities on next day work engagement. *Journal of Occupational Health Psychology*, *17*, 445–55. doi:10.1037/a0029213

Thayer, R. E. (1986). Activation-deactivation adjective check list: Current overview and structural analysis. *Psychological Reports*, *58*, 607–614.

Thayer, R. E., Newman, J. R., & Mcclain, T. M. (1994). Self-regulation of mood: Strategies for changing a bad mood, raising energy, and reducing tension. *Journal of Personality and Social Psychology*, *67*, 910–925.

Toker, S., & Biron, M. (2012). Job burnout and depression: Unraveling their temporal relationship and considering the role of physical activity. *Journal of Applied Psychology*, *97*, 699–710. doi:10.1037/a0026914

Totterdell, P., Spelten, E., Smith, L., Barton, J., & Folkard, S. (1995). Recovery from work shifts: How long does it take? *Journal of Applied Psychology*, *80*, 43–57.

Trougakos, J. P., Beal, D. J., Green, S. G., & Weiss, H. M. (2008). Making the break count: An episodic examination of recovery activities, emotional experiences, and positive affective displays. *Academy of Management Journal*, *51*, 131–146.

Trougakos, J. P., & Hideg, I. (2009). Momentary work recovery: The role of within-day work breasks. In P. L. Perrewé & D. C. Ganster (Eds.), *Research in Occupational Stress and Well-being, Volume 7* (Vol. 7). Emerald Group Publishing. doi:10.1108/S1479-3555(2009)0000007005

Trougakos, J. P., Hideg, I., Cheng, B. H., & Beal, D. J. (2014). Lunch breaks unpacked: The role of autonomy as a moderator of recovery during lunch. *Academy of Management Journal*, *57*, 405–421.

Tsai, J. L., Levenson, R. W., & Carstensen, L. L. (2000). Autonomic, subjective, and expressive responses to emotional films in older and younger Chinese Americans and European Americans. *Psychology and Aging*, *15*, 684–693. doi:10.1037//0882-7974.15.4.684

Tucker, P. (2003). The impact of rest breaks upon accident risk, fatigue and performance: A review. *Work & Stress*, *17*, 123–137. doi:10.1080/0267837031000155949

Tucker, P., Dahlgren, A., Akerstedt, T., & Waterhouse, J. (2008). The impact of free-time activities on sleep, recovery and well-being. *Applied Ergonomics*, *39*, 653–662. doi:10.1016/j.apergo.2007.12.002

Tyler, J. M., & Burns, K. C. (2008). After depletion: The replenishment of the self's regulatory resources. *Self and Identity*, *7*, 305–321. doi:10.1080/15298860701799997

Van Dijk, H., van de Merwe, K., & Zon, R. (2011). A coherent impression of the pilots' situation awareness: Studying relevant human factors tools. *The International Journal of Aviation Psychology*, *21*, 343–356. doi:10.1080/10508414.2011.606747

Van Hooff, M. L. M., & Baas, M. (2013). Recovering by means of meditation: The role of recovery experiences and intrinsic motivation. *Applied Psychology*, *62*, 185–210. doi:10.1111/j.1464-0597.2011.00481.x

Van Hooff, M. L. M., Geurts, S. A. E., Beckers, D. G. J., & Kompier, M. A. J. (2011). Daily recovery from work: The role of activities, effort and pleasure. *Work & Stress*, *25*, 55–74. doi:10.1080/02678373.2011.570941

Van Orden, K. F., Jung, T.-P., & Makeig, S. (2000). Combined eye activity measures accurately estimate changes in sustained visual task performance. *Biological Psychology*, *52*, 221–240.

Van Ouwerkerk, R., Meijman, T. F., & Mulder, G. (1994). *De analyse van arbeidstaken op cognirieve en emotionele eisen (The analysis of tasks: Cognitive and emotional demands)*. Utrecht: Lemma.

Vroom, V. H. (1964). *Work and motivation*. New York: Wiley.

Wallace, J. C., & Chen, G. (2005). Development and validation of a work-specific measure of cognitive failure: Implications for occupational safety. *Journal of Occupational and Organizational Psychology*, *78*, 615–632. doi:10.1348/096317905X37442

Wang, H., Fan, J., & Johnson, T. R. (2004). A symbolic model of human attentional networks. *Cognitive Systems Research*, *5*, 119–134. doi:10.1016/j.cogsys.2004.01.001

Wang, Y., Cui, Q., Liu, F., Huo, Y.-J., Lu, F.-M., Chen, H., & Chen, H.-F. (2014). A new method for computing attention network scores and relationships between attention networks. *PloS One*, *9*(3), 1–8. doi:10.1371/journal.pone.0089733

Watson, D., & Clark, L. A. (1999). *The PANAS-X: Manual for the Positive and Negative Affect Schedule - Expanded Form*.

Weaver, B., Bédard, M., & McAuliffe, J. (2013). Evaluation of a 10-minute version of the Attention Network Test. *The Clinical Neuropsychologist*, *27*, 1281–1299. doi:10.1080/13854046.2013.851741

Weaver, B., Bédard, M., McAuliffe, J., & Parkkari, M. (2009). Using the Attention Network Test to predict driving test scores. *Accident Analysis and Prevention*, *41*, 76–83. doi:10.1016/j.aap.2008.09.006

Weaver, S. M., & Arrington, C. M. (2013). The effect of hierarchical task representations on task selection in voluntary task switching. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*, 1128–1141. doi:10.1037/a0031677

Weltman, A., Stamford, B. A., & Fulco, C. (1979). Recovery from maximal effort exercise: Lactate disappearance and subsequent performance. *Journal of Applied Physiology*, *47*, 677–682. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/511673

Westman, M., Hobfoll, S. E., Chen, S., Davidson, O. B., Davidson, B., & Laski, S. (2004). Organizational stress through the lens of Conservation of Resources (COR) Theory. In P. L. Perrewé & Daniel C. G (Eds.), *Interpersonal Dymanics (Research in Occupational Stress and Well-being, Volume 4)* (pp. 167–220). Emeral Group Publishing Limited. doi:10.1016/S1479-3555(04)04005-3

Wickens, C. D. (1984). Processing resources in attention. In R. Parasuraman & D. R. Davies (Eds.), *Varieties of Attention*. Orlando, Florida: Academic Press, Inc.

Wright, T. A., & Cropanzano, R. (1998). Emotional exhaustion as a predictor of job performance and voluntary turnover. *Journal of Applied Psychology*, *83*, 486–493.

Xia, T., & Law, L. A. F. (2008). A theoretical approach for modeling peripheral muscle fatigue and recovery. *Journal of Biomechanics*, *41*, 3046–3052. doi:10.1016/j.jbiomech.2008.07.013

Young, H. A., & Benton, D. (2013). Caffeine can decrease subjective energy depending on the vehicle with which it is consumed and when it is measured. *Psychopharmacology*, *228*, 243–254. doi:10.1007/s00213-013-3025-9

Appendix

Appendix A: Instructions to participants

This experiment studies work effectiveness. You will be placed into a working condition simulating a work task within a Fortune 500 company that involves monitoring changes to a computer screen. During this time, the instructions on the screen will tell you what to observe and how to use your mouse and keyboard. You will be asked to work as quickly as possible while maintaining accurate responses.

During the work period, you may be provided instructions to take a break or change tasks. These instructions may be different for each participant. Please follow the instructions provided only to you, and do not follow what individuals near you may be doing.

Following a set of work tasks, you will be asked questions to rate your appraisal of a situation or of yourself. At the end of the work period, you will also be asked questions about you in general, not about how you felt during the work period.

Participation in this experiment is completely voluntary. If you choose not to participate, your instructor will provide you with additional ways to receive course credit or extra credit.

If you have any questions, please raise your hand now.

Thank you for your participation!

Appendix B: Microbreak manipulation conditions

Recovery activity	Time	Details	Link
Psychological detachment			
1 minute	0:52	Saturday Night Live: Weekend Update	http://www.hulu.com/watch/544688
5 minutes	5:39	Saturday Night Live: Schweddy Balls	http://www.youtube.com/watch?v=z9t5AJNF0so
9 minutes	9:19	Saturday Night Live: Celebrity Jeopardy	http://screen.yahoo.com/darrell-hammond-snl-skits/celebrity-jeopardy-000000149.html
Relaxation			
1 minute	1:00	Guided Mindfulness Meditation	http://www.youtube.com/watch?v=0fcdv0kFVMs
5 minutes	5:19	Guided Mindfulness Meditation	http://www.youtube.com/watch?v=dEzbdLn2bJc
9 minutes	8:57	Guided Mindfulness Meditation	http://www.youtube.com/watch?v=YW-TDOgstSE
Task change			
1 minute	0:56	Stroop task	
5 minutes	5:29	Stroop task	
9 minutes	9:08	Stroop task	

Appendix C: Microbreak recovery appraisal items

Instructions: Below are several statements about you with which you may agree or disagree. Using the response scale below, indicate your agreement or disagreement with each item about the previous task (video).

Please use the following scale to record your responses. (1 = "strongly disagree;" 2; 3 = "neutral;" 4; 5 = "strongly agree").

Psychological detachment. Items adapted from Recovery Experience Questionnaire (Sonnentag & Fritz, 2007) with item wording changed for momentary, state-level assessments (Bakker, Sanz-Vergel, Rodríguez-Muñoz, & Oerlemans, 2014) and context wording for use with breaks (Trougakos, Hideg, Cheng, & Beal, 2014).

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

Relaxation. Items adapted from Recovery Experience Questionnaire (Sonnentag & Fritz, 2007) with item wording changed for momentary, state-level assessments (Bakker, Sanz-Vergel, Rodríguez-Muñoz, & Oerlemans, 2014) and context wording for use with breaks (Trougakos, Hideg, Cheng, & Beal, 2014).

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

Enjoyment. Items from Reinecke, Klatt, and Kramer (2011).

1. The break was enjoyable
2. I am glad the break did not last longer (R)
3. The break was fun
4. I liked the break

Appendix D: Energy items

Instructions: Please indicate the extent to which you feel the following right now. (1 = "not at all;", 2 = "a little"; 3 = "moderately;"; 4 = "quite a bit;" 5 = "extremely").

High energy. Items are the vigor-activity subscale from Profile of Mood States (POMS; McNair et al., 1971).

1. Lively
2. Active
3. Energetic
4. Cheerful
5. Alert
6. Full of pep
7. Carefree
8. Vigorous

Low energy. Items are the fatigue-inertia subscale from Profile of Mood States (POMS; McNair et al., 1971).

1. Worn out
2. Listless
3. Fatigued
4. Exhausted
5. Sluggish
6. Weary
7. Bushed

Appendix E: Attentional resource items

Instructions: Please rate the extent to which you agree with the following. (1 = "strongly disagree;" 2 = "disagree;" 3 = "slightly disagree;" 4 = "neutral;" 5 = "slightly agree;" 6 = "agree;" 7 = "strongly agree").

Attentional resources. Items adapted from self-assessed attention during a training video (Davis, 2004). The wording was changed from "during the video demonstration" or "during the previous task".

1. I paid close attention during the previous task
2. I was able to concentrate during the previous task
3. The previous task held my attention
4. During the previous task, I was absorbed in the work

Appendix F: Control variables and demographic items

Sleep quality. Item from the Pittsburg Sleep Quality Index (Buysse et al., 1989).

Instructions: Please rate your sleep quality last night with the following scale. (1 = "very bad", 2 = "fairly bad", 3 = "fairly good", 4 = "very good")

1. How would you rate your sleep quality overall?

Caffeine intake.

Instructions: Please indicate the number of caffeinated beverages you have consumed in the past four hours. (sliding scale of whole numbers from 0 to 10).

1. Coffee beverage (e.g., 8oz of caffeinated coffee; 12oz of iced coffee beverage)
2. Tea beverage (e.g., 8oz of black or green tea)
3. Highly caffeinated soda (e.g., one can / 12 oz of Mountain Dew)
4. Other caffeinated soda (e.g. one can / 12 oz of Coke, Pepsi)

Personality. Items from the Big Five Shortened Scale (Gosling, Rentfrow, & Swann, 2003).

Instructions: Please rate the extent to which you agree with the following words about yourself. (1 = "strongly disagree;" 2 = "disagree;" 3 = "slightly disagree;" 4 = "neutral;" 5 = "slightly agree;" 6 = "agree;" 7 = "strongly agree").

I see myself as:
1. Extraverted, enthusiastic
2. Reserved, quiet (reversed)
3. Critical, quarrelsome (reversed)
4. Sympathetic, warm
5. Dependable, self-disciplined
6. Disorganized, careless (reversed)
7. Anxious, easily upset
8. Calm, emotionally stable (reversed)
9. Open to new experiences, complex
10. Conventional, uncreative (reversed)

Attentional focusing. Items from the focusing subscale of the Attentional Control Scale (Derryberry & Reed, 2002).

Instructions: Please rate the extent to which the following describes you. (1 = "almost never;" 2 = "sometimes;" 3 = "often;" 4 = "always"). (R) signifies a reverse-scored item.

1. It's very hard for me to concentrate on a difficult task when there are noises around. (R)

2. When I need to concentrate and solve a problem, I have trouble focusing my attention. (R)
3. When I am working hard on something, I still get distracted by events around me. (R)
4. My concentration is good even if there is music in the room around me.
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.
6. When I am reading or studying, I am easily distracted if there are people talking in the same room. (R)
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts. (R)
8. I have a hard time concentrating when I'm excited about something. (R)

Demographic characteristics.

Instructions: Please indicate the following about yourself.

1. Female / Male / Prefer not to answer
2. Black / Native American / Hispanic or Latino / White / Asian / Other or prefer not to answer
3. Age (enter number using keyboard)
4. Major (enter string using keyboard)
5. GPA (enter number using keyboard)
6. Average number of hours worked per week (if employed)
7. Job title (if employed)

Vita

Andrew Alan Bennett was born May 11, 1982 in Henrico County, Virginia and is an American citizen. He graduated from Douglas Freeman High School, Richmond, Virginia in 2000. He received his Bachelor of Science in Mechanical Engineering from Clemson University, Clemson, South Carolina in 2004 and his Master of Arts in Organizational Leadership from Gonzaga University, Spokane, Washington in 2008.