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## Move Your body, Change Your Mind: Physical Activity in the Morning and its Implications for Work

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MOVE YOUR BODY, CHANGE YOUR MIND: PHYSICAL ACTIVITY IN THE MORNING  
AND ITS IMPLICATIONS FOR WORK

by

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B.A. University of South Florida, 2015

A thesis submitted in partial fulfillment of the requirements  
for the degree of Master of Science  
in the Department of Psychology  
in the College of Sciences  
at the University of Central Florida  
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## **ABSTRACT**

Drawing upon the broaden-and-build theory of positive emotions (Fredrickson, 2001), this study examines the links between morning physical activity, subsequent positive emotions, broadened thinking, and psychological resource accumulation at work. Fifty-two participants who worked full-time completed a daily diary for 10 workdays that included measures of their emotions and physical activity each morning and measures of broadened thinking each afternoon.

Psychological resources were assessed at the beginning and end of the 10-day period. Data were analyzed using multilevel structural equation modeling (MSEM) with Mplus. Results did not support the mediating role of positive emotions and broadened thinking between morning physical activity and psychological resources, as would be predicted by the broaden-and-build theory. However, results did indicate that participants experienced more positive emotions on the days they engaged in morning physical activity. Additionally, participants who more frequently engaged in morning physical activity experienced positive emotions more often during the study period. There was also evidence to suggest that positive emotions promoted planning and active coping in response to workplace problems. In sum, these findings indicate morning physical activity may boost employees' emotional states and experiences of positive emotions may result in the use of broad-minded coping strategies at work. Implications for research and practice are discussed.

*Keywords:* physical activity, positive emotions, broadened thinking, well-being

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## INTRODUCTION

Research has shown that physical activity reduces depressive symptoms (Barbour, Edenfield, & Blumenthal, 2007; DiLorenzon et al., 1999; Mead et al., 2009), improves attention and information processing (Angevaren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008; Colcombe & Kramer, 2003), promotes positive mood (Annesi, 2005; Biddle, 2000; Reed & Ones, 2006; Walter et al., 2013), and increases energy levels (Loehr & Schwartz, 2005; Thayer, 1987). In a more recent study, physical activity was examined as a way for employees to psychologically detach from work (Feuerhahn et al., 2014). More specifically, Feuerhahn et al. (2014) studied daily physical activity in the evening as an after-work recovery tool. They found that physical activity provides individuals with an opportunity to psychologically detach from their work. This detachment allows for the recovery of psychological resources which may be drawn on during the following workday and facilitate improved well-being.

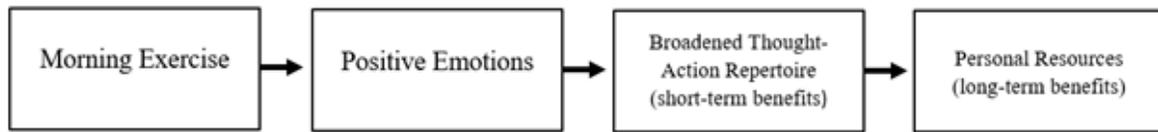
Given the observed benefits associated with physical activity in the evening (Feuerhahn et al., 2014), it may also be beneficial to consider the impact of morning engagement in physical activity on an employee's workday. Both anecdotal and empirical evidence suggest that instances of physical activity are often associated with subsequent experiences of positive emotions (Annesi, 2005; Biddle, 2000; Reed & Ones, 2006). In general, people who more frequently experience positive emotions tend to be more productive (Graziotin, Wang, & Abrahamsson, 2014), creative (Madrid, Patterson, Birdi, Leiva, & Kausel, 2013), and more satisfied with their job (Illies & Judge, 2004). At work, these positive feelings are also linked to increases in helping behavior towards coworkers and customers (George, 1991) and reductions in emotional labor associated with the expression of positive mood towards customers (Morris & Feldman, 1996). A potential way for employees reap these benefits is to more frequently

experience positive emotions through physical activity. However, the mechanisms through which these benefits are manifested are not yet well understood. Thus, research is necessary to examine the possible benefits for employees who engage in morning physical activity.

One theory that may lend support to the idea that physical activity has benefits that extend beyond its role as a recovery tool is Fredrickson's (2001) Broaden-and-Build Theory of Positive Emotions. Fredrickson's (2001) theory entails two key propositions. First, the theory posits that positive emotions broaden thinking. Second, this broadened state leads individuals to think more creatively and, in turn, build personal resources. More frequent experiences of positive emotions are expected to be associated with more instances of broadened thinking and, therefore, more resources are expected to accumulate. Over time, this resource accumulation is expected to provide benefits for an individual's well-being.

When applied to physical activity before work, the broaden-and-build theory may provide a tenable explanation for the impact that the positive emotions resulting from this activity may have on an individual's experiences and well-being at work. Given the strong empirical support of a link between physical activity and positive emotions (Biddle & Mutrie, 2001; Daley & Welch, 2004; Reed & Ones, 2006), it is possible that employees who exercise in the morning before work will experience positive emotions that last into the beginning of the workday. Thus, the present study seeks to determine whether these positive emotions resulting from morning physical activity predict broadened thinking and subsequent resource gains as Fredrickson's (2001) broaden-and-build theory would suggest (see Figure 1). More specifically, daily engagement in morning physical activity is expected to be associated with daily experiences of

positive emotions which broaden an employee's thinking at work. Additionally, resource gains are expected to be associated with more frequent experiences of broadened thinking.



*Figure 1.* Morning Exercise in the Context of the Broaden-and-Build Theory.

### **Affect: Mood vs. Emotions**

According to Fredrickson (2001), the process of broadened thinking and resource accumulation begins with an experience of positive emotions. Thus, the present study deals primarily with positive emotions following physical activity in the morning before work and, therefore, it is important to clearly communicate a definition of emotions in the context of the broaden-and-build theory. The most widely accepted definition of emotions states that they are fleeting affective experiences with a clear cause and are strong enough to interrupt thought processes (Brief & Weiss, 2002). These feelings can have a positive or negative valence. Examples of positive emotions include feeling happy, excited, or pride. Conversely, examples of negative emotions include feeling sad, angry, or scared.

Emotions are distinct from both mood and affect. According to their definitions, mood and emotion are both affective states (Brief & Weiss, 2002). Unlike emotions, mood is generally defined as an affective state with a more obscure cause and does not have the strength to interrupt an individual's thought processes. Feeling irritable or optimistic for no obvious reason is an example of a mood state, whereas feeling angry at a rude coworker or joy after solving a problem is an emotional state. Additionally, moods can last for as long as a few months, whereas emotions are much shorter in duration (Oatley & Jenkins, 1996).

In the literature, affect tends to serve as an umbrella term that encompasses both mood and emotion; it includes an individual's in-the-moment feeling states, long-lasting feeling traits, and tendencies to generally feel negatively or positively about one's experiences (Barsade & Gibson, 2007; Watson & Clark, 1984). To determine whether an author is examining mood or emotion when they use the term 'affect', attention must be paid to the specific definitions and measures they employ.

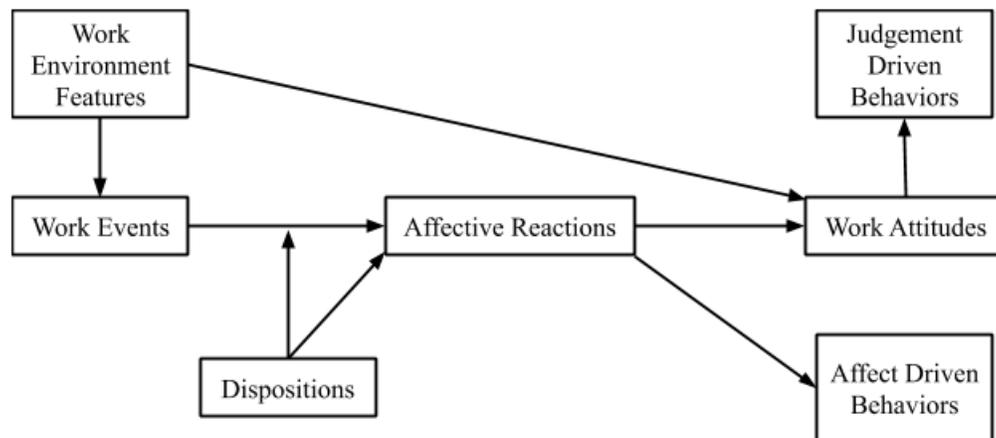
### **Emotions at Work**

The literature on emotion at work indicates that positive emotions may be associated with many benefits in work contexts. For example, employees who experience positive emotions more often tend to be more productive (Graziotin, Wang, & Abrahamsson, 2014), creative (Madrid, Patterson, Birdi, Leiva, & Kausel, 2013), and more satisfied with their job (Illies & Judge, 2004). Moreover, positive emotions are also related to reduced risk taking (Mittal & Ross, 1993), improved information processing (Staw & Barsade, 1993), fewer counter productive work behaviors (Spector & Fox, 2002), reduced feelings of fatigue (Zohar, Tzischinski, & Epstein, 2003), and increased well-being (Harris, Daniels, & Briner, 2003).

Much of this research on emotion at work is consistent with Weiss and Cropanzano's (1996) Affective Events Theory (AET). AET provides a useful framework for understanding how emotions may influence employees' job performance and job attitudes (see Figure 2). This theory was initially presented alongside the argument that job satisfaction should not be thought of as an affective reaction, but rather as a job attitude.

According to AET, when employees encounter a work event, this event elicits an immediate, emotional reaction. For example, an employee who is denied time off by his supervisor might feel disappointed or frustrated. As time passes after an event, this employee

may engage in more cognitive processing. This processing allows the initial emotional reaction to impact job attitudes. Here, the employee might begin to feel dissatisfied with the lack of flexibility of his or her job. However, the Weiss and Cropanzano (1996) acknowledge that features of the work environment and employees' dispositions also play a key role. For instance, an employee with few job constraints and high trait positive affect may be more likely to form positive job attitudes and more frequently experience positive emotions. Thus, AET helps elucidate how the emotional and cognitive processing of work events may ultimately shape job performance and job attitudes.



*Figure 2.* Affective Events Theory Framework.

Since AET was first introduced, the theory has received empirical support (e.g., Thoreson, Kaplan, Barksy, Warren & de Chermont, 2003) for the role of affective events in relation to key workplace outcomes. Thoreson et al.'s (2003) meta-analysis ( $k = 305$ ,  $n = 64,527$ ) showed that state affect was related to the following job attitudes: job satisfaction, organizational commitment, turnover intentions, and job burnout. Additionally, AET has found support in the following contexts: leadership (Bono, Foldes, Vinson, & Muros, 2007), workplace bullying

(Glasø, Vie, Holmdal, & Einarsen, 2011), work-family enrichment (Carlson, Kacmar, Zivnuska, Ferguson, & Whitten, 2011), and teams (Cole, Walter, & Bruch, 2008).

Although AET provides a useful framework for understanding the role of emotions at work, it may also be worthwhile to consider a theory of emotion that has not been frequently applied to work contexts; the Broaden-and-Build Theory of Positive Emotions (Fredrickson, 2001). In the following sections, I will describe this theory in greater detail, review some of the empirical support, and explain why this theory is best suited to explain the possible effects of engagement in physical activity before work.

### **The Broaden-and-Build Theory of Positive Emotions**

The broaden-and-build theory may provide a plausible explanation for the impact that the positive emotions resulting from morning physical activity may have on an individual's experiences and well-being at work. This theory posits that positive emotions, including joy, interest, contentment and love, "broaden an individual's momentary thought-action repertoire" (Fredrickson, 2004, p. 1367). Put simply, a momentary thought-action repertoire is the breadth of actions that occur to an individual at a specific point in time in the face of a challenge or problem to solve. Additionally, the broaden-and-build theory postulates this broadening of an individual's thought-action repertoire leads him or her to think more creatively and, in turn, build personal resources. These resources can be psychological (e.g., mindfulness), social (e.g., social support), or physical (e.g., decreased resting heart rate) in nature and become part of a reservoir that the individual can draw from to aid coping during times of hardship. Importantly, these resources are enduring and outlast the fleeting emotional states that allow them to accumulate. Thus, the broaden-and-build theory provides a tenable explanation for the impact of positive emotions on an individual's short- and long-term well-being.

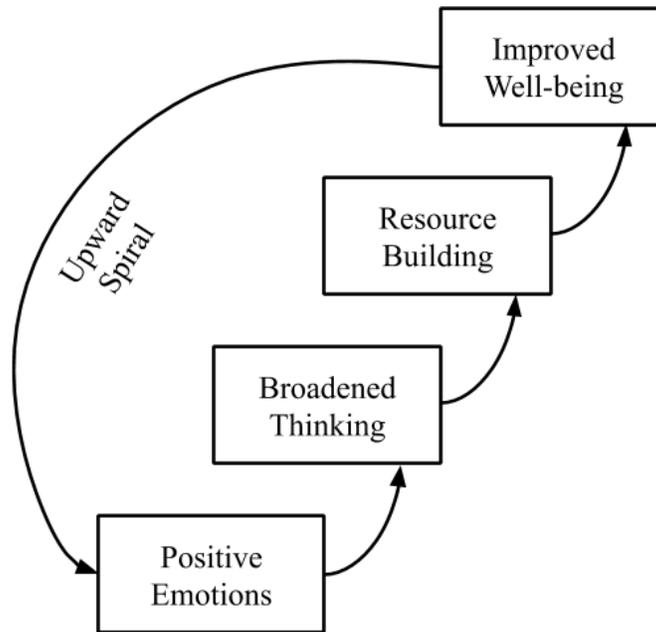
## **The Undo Hypothesis**

The broaden-and-build theory has implications for the strategies an individual can employ cope with situations that provoke negative emotions, such as anxiety. If negative emotions demonstrate a narrowing of an individual's thought action repertoire and positive emotions broaden it, positive emotions, according to the theory, should reverse the effects of negative emotions. Fredrickson and Levenson (1998) labeled this neutralizing effect the 'undo hypothesis' and there is some empirical evidence to support the existence of this effect. Research has shown that participants who experienced positive emotions immediately following an anxiety-producing task exhibited the fastest cardiovascular recovery (Tugade & Fredrickson, 2004). Thus, the mere experience of positive emotions is enough to help an individual recover and 'undo' the effect of negative emotional arousal. Fredrickson (2004) argues that the observed "broadening at the cognitive level mediates undoing at the cardiovascular level" (p. 1371). In other words, positive emotions may help individuals consider distressing experiences within the larger context of their lives and, consequently, lessen the impact of any discrete negative event.

## **Upward Spiral Dynamics**

In another extension of the broaden-and-build theory, Fredrickson (2013) explains that successful resource building increases the likelihood of subsequent experiences of positive emotions. In effect, experiences of increases in personal resources are expected to predict future experiences positive emotions, just as experiences of positive emotions predict increases in personal resources. This reciprocal relationship between the experience of positive emotions and resource building leads an individual into an upward spiral that brings about dramatic improvements in his or her well-being. Fredrickson (2013) refers to this process as "upward spiral dynamics" (p. 25; see Figure 2). Yet, resources cannot increase indefinitely. After enough

experiences of positive emotions over time, resource gains are expected to reach a ‘plateau’ stage in which individuals maximize their stores of resources and reach optimal well-being.



*Figure 3.* Upward Spiral Dynamics within the Context of Broaden-and-Build Theory.

### **Why Broaden-and-Build Theory?**

Fredrickson’s (2001) broaden-and-build theory is best suited to explain many of the benefits of positive emotions resulting physical activity for two reasons. First, the broaden-and-build theory only aims to explain the impact of individuals’ experiences of positive emotions. As discussed later in this review of the literature, research indicates individuals who engage in physical activity appear to report experiences of positive emotions, rather than negative or neutral emotions (Reed & Ones, 2006). Thus, the broaden-and-build theory is more suited to explaining the impact of positive emotions resulting from physical activity on employees’ experiences at work. Second, the broaden-and-build theory maps onto the some of the hypothesized relationships under AET. The broadened thinking hypothesis may provide an alternative explanation for AET’s hypothesized relationship between emotional reactions and job

performance driven by affect. In other words, broadened thinking may be observed through increases in employee performance resulting from positive emotions. Similarly, the build hypothesis mirrors the relationship between emotional reactions and work attitudes, however, it adds broaden thinking and resource building as a mediators of this relationship. Thus, the broaden-and-build theory goes a step further to explain the benefits of positive emotions for well-being. Support for these mechanisms are provided in the following section.

### **Empirical Support for the Broaden-and-Build Theory**

The broaden-and-build theory is composed of multiple parts and each of these components warrant further explanation. In the following sections, I discuss empirical research studies that examine both the broaden and build portions of Fredrickson's (2001) broaden-and-build theory. Then, I provide a brief overview of some boundary conditions that research on the broaden-and-build theory has uncovered to show the known limitation of the theory.

#### **The Broaden Hypothesis**

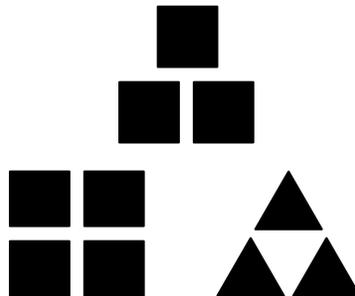
The first key proposition of Fredrickson's (2004) broaden-and-build theory is that positive emotions broaden an individual's thought-action repertoire. A broadened thought-action repertoire refers to an increase in the number of options that occur to individuals when they are faced with a problem. This boost to problem solving may be beneficial in work contexts. For example, employees who experience positive emotions may be better equipped to deal with problems in the workplace that require deeper, more creative thinking. Broadened thinking can also be thought of as a broadening of an individual's scope of attention or an increase in the amount of attention paid to the 'big picture' instead of smaller details.

Fredrickson's (2001) broaden hypothesis specifically refers to this relationship between the experience of positive emotions and a subsequent increase in the breath of thoughts, action urges, and perceptions that come to an individual's mind (Fredrickson, 2001). Fredrickson based

this hypothesis on the work of Alice Isen (Fredrickson, 2013). In her large body of work, Isen found evidence that positive emotions alter an individual's thinking in ways that support Fredrickson's broaden hypothesis. For example, Isen reports that individuals who experience positive emotions think more creatively (Isen, Daubman, & Nowicki, 1987), are likely to accept new information (Estrada, Isen, & Young, 1997), tend to demonstrate flexibility and inclusivity in their thinking (Isen & Daubman, 1984), and have a greater number of action urges come to mind than those who are not experiencing positive emotions (Isen, Rosenzweig, & Young, 1991). Fredrickson (2013) theorized all of these effects were attributable to a slight cognitive shift at a more basic level. More specifically, she argued "the boundaries of awareness stretch open a bit further during positive emotional experiences" (2013, p. 18).

Upon the formation of the broaden hypothesis, Fredrickson and her colleagues tested the hypothesis in a pair of studies with varying methodologies. In a preliminary study, Fredrickson and Branigan (2005) compared two distinct positive emotion conditions to two negative emotion conditions and a neutral condition. The researchers randomly assigned participants to view one of five short films designed to induce a particular emotion (i.e., amusement, contentment, neutrality, anger, or anxiety). To measure the broadening of participants' awareness, the researchers administered an 8-item global-local visual processing task (Kimchi & Palmer, 1982) immediately after the participants finished viewing the film. This measure is has a figure on top that is comprised of three of four shapes (e.g., three squares in a triangle configuration) with two comparison options below it (see Figure 3). The local option depicts a different number of the same shape in a different configuration (e.g., four squares in a square configuration) and the global option depicts the same number of a different shape in a similar configuration (e.g., three triangles in a triangular configuration). In short, it is designed to measure whether participants

attended to the image as a whole or focus on the smaller details within it. The former indicates global processing and the latter suggests local processing.



*Figure 4.* Example global-local visual processing task item.

Responses indicating a preference for the global option are tallied to compute a score ranging from 0 to 8 for each participant. Scores on this measure have been linked to scope of attention; higher scores were associated broadened attention and lower scores associated with narrowed attention (Derryberry & Tucker, 1994). Differences in the responses of participants between the positive emotion and neutral conditions indicated those who experienced the amusement or contentment conditions were more likely to choose the global option than the local option on the task. Thus, these results lend support to the broaden hypothesis.

In a second experiment using the same sample and film conditions, Fredrickson and Branigan (2005) examined whether positive emotions widened the array of action urges that come to an individual's mind. This time, participants completed a modified version of the Twenty Statements Test (TST; Kuhn & McPartland, 1954). More specifically, participants listed out all of the actions they could think of by completing the phrase "I would like to \_\_\_\_\_" twenty times. The results indicated that participants assigned to experience positive emotions listed significantly more actions than those who experienced either the neutral or the negative emotion conditions. Moreover, participants randomly assigned to experience negative emotions listed

fewer actions. Thus, negative emotions appeared to reduce the breadth of actions that occurred to the participants (Fredrickson & Branigan, 2005).

Other studies have more directly tested the broaden hypothesis. For example, one study found evidence to support the broaden hypothesis using functional magnetic resonance imaging (fMRI; Schmitz, De Rosa, & Anderson, 2009). Schmitz et al. (2009) examined whether positive and negative emotions differentially impact perceptual encoding in the areas of the brain associated with vision. More specifically, the researchers hypothesized positive emotions would broaden the visual field of view (FOV) and negative emotions would cause it to narrow. Positive, negative, and neutral emotional conditions were manipulated using the International Affective Picture System (IAPS). This system showed participants a series of 10 images for 2000ms each. Researchers assessed the breadth of participants' FOV by instructing participants' to observe faces in the center of a group of images and measuring the extent to which they attended to the images of houses that surrounded each face. More specifically, participants indicated whether each face that was presented belonged to a man or woman. When experiencing negative emotions, results indicated that participants' brains demonstrated decreased blood flow in the areas of the brain associated with visual perception. However, when experiencing positive emotions, results showed participants had increased blood flow in these areas and they were more likely to perceive the images of houses surrounding each face than participants in both the neutral or negative emotion conditions. Thus, these results are consistent with Fredrickson's (2001) broaden hypothesis and lend support from the cognitive neuroscience literature.

Another study by Trick, Brandigampola, and Enns (2012) examined the broaden hypothesis within the context of driving and provided further support for the broaden hypothesis. Specifically, these researchers tested the idea that broadened visual awareness resulting from

positive emotions would contribute to participants' driving performance. The researchers put participants in a driving simulator and displayed images on a screen within the vehicle. The study proposed three factors that would impact safe driving behaviors: valence, arousal, and time delay. These factors informed two hypotheses. First, the researchers anticipated an interaction between arousal and time delay such that participants' response times would be better when hazard events occurred 250 ms after the image and worse when these hazards occurred 500 ms after the image. Second, the researchers also anticipated that the valence of the image would impact participants' steering performance, such that positive images would be associated with improved steering and negative images would be associated with decreased performance. Not surprisingly, responding to images negatively impacted participants' driving performance in all conditions. However, positively valence images had a smaller impact on steering than negatively valenced images. Trick et al. (2012) argue this result provides supports the broaden hypothesis, but they note that the effect only emerged for low arousal images. The researchers attribute this inconsistency to the possibility that the activation of a body's autonomic system may narrow attentional focus and counterbalance the broadening effect of positive emotions.

### **The Build Hypothesis**

The second proposition of the broaden-and-build theory is that the broadening of an individual's thought-action repertoire allows him or her to build resources over time. Fredrickson's (2001) build hypothesis specifically refers to how the broadening of an individual's thinking spurs gains in personal resources. Research on this build hypothesis necessitates methodologies that evoke repeated experiences of positive emotions over a long enough period of time to permit resources to accumulate (Fredrickson, 2013). The fact that these methodologies are more challenging to implement and do not lend themselves easily to a

laboratory settings means that fewer researchers conduct tests of this hypothesis. Thus, a smaller number of studies provide support for this portion of Fredrickson's (2001) theory than the broaden hypothesis. Among the most methodologically rigorous of these few studies was a longitudinal field experiment that examined the effects of loving-kindness meditation (LKM; Salzberg, 2002) on an individual's experience of positive emotions and resource accumulation (Fredrickson, Cohn, Coffey, Pek & Finkel, 2008).

LKM is a mind-training technique used to increase warm feelings, self-care, and care for others (Salzberg, 2002). Fredrickson et al. (2008) randomly assigned a sample of employees (n = 139) to begin a 7-week LKM program or to wait on a waitlist (control group). In the LKM program, participants instructed to quietly contemplate people in their lives in a "open-hearted way". They were then instructed to project these warm feelings onto themselves and gradually apply these feelings to an increasing number of others. Six 60-minute group LKM sessions were held over the 7 weeks.

Over the course of 9 weeks, starting when the LKM program was first implemented, participants reported their emotional experiences daily. The researchers measured participants' cognitive, psychological, social, and physical resources after orientation to the LKM program (T1) and again when the daily reporting phase had concluded (T2). Results indicated that participants in the LKM program experienced more positive emotions as they progressed through the program when compared to those on the waitlist. Importantly, however, the researchers also showed recurrent experiences of positive emotions through LKM lead to gains in cognitive, psychological, social, and physical resources. More specifically, Fredrickson et al. (2008) observed benefits in "mindfulness, pathways thinking, savoring the future, social support received, positive relations with others, and illness symptoms" (p. 1054). Thus, this study

produced preliminary experimental data that support Fredrickson's (2001) build hypothesis through the use of the LKM program.

Under the build hypothesis, Fredrickson (2013) also argues for the existence of upward spirals that allow resources to accumulate more quickly over time. Specifically, she argues that the repeated experience of positive emotions allows resources to accumulate that, in turn, allow for more frequent experiences of positive emotions and additional resource gains. In an initial exploration of upward spiral dynamics, Fredrickson and Joiner (2002) found evidence for the existence of a reciprocal relationship between experiences of positive emotions and gains in broad-minded coping. Two subsequent studies have built on this finding by testing upward spiral dynamics within the context of work (Salanova, Bakker, & Llorens, 2006) and exploring a possible underlying mechanism (Kok & Fredrickson, 2010).

The first of these two studies examined whether personal and organizational resources facilitate flow at work and whether this relationship was reciprocal. Salanova et al. (2006) operationalized personal resources as self-efficacy beliefs. Meanwhile, organizational resources were conceptualized as social support and clear goals. In this context of this study, a state of work-related flow occurs when an individual experiences complete immersion, intrinsic motivation, and enjoyment in his or her work. The researchers used a two-wave design and recruited 258 secondary school teachers. A series of structural equation modeling analyses produced results that supported both hypotheses. Not only did an individual's experience of flow at work predict resource gains, but also, resource gains predicted flow at work. However, flow more strongly predicted self-efficacy than self-efficacy predicted flow. The researchers explain that positive emotions are a core component in the experience flow at work and argue that their findings lend additional support to Fredrickson's (2002) upward spiral hypothesis.

The second study aimed to investigate a driving mechanism of upward spiral dynamics. Specifically, Kok and Fredrickson (2010) examined the relationship of vagal tone (VT) with social and psychosocial well-being. Vagal tone refers to a type of arrhythmia that manifests as a relative decrease in heart rate when an individual exhales (Grossman, 1983). The researchers argue for the importance of VT as a component of upward spiral dynamics due to its ties with autonomic flexibility, or the ability of the parasympathetic nervous system to react to situational changes by sending signals to modify arousal, heart rate, respiration, and attention (Friedman & Thayer, 1998). Previous research shows, individuals with high VT demonstrate improved performance on measures of cognitive flexibility (e.g., working memory and directed attention; Hansen, Johnsen, & Thayer, 2003; Suess, Porges, & Plude, 1994). Additionally, they show improved resilience (El-Sheikh, Harger, & Whitson, 2001) and improved ability to self-regulate (Seegerstrom & Nes, 2007).

To test the relationship of VT with social and psychosocial well-being, the researchers recruited 73 participants from a university and measured their baseline VT. Over a period of 63 days, participants reported the three longest social interactions they had experienced each day. Participants also completed the Russell's UCLA Loneliness scale (1996) and the modified Differential Emotions Scale (mDES; Fredrickson et al., 2003). At the end of the 63-day period, participants' VT was assessed a second time. Interestingly, results indicated that adults who possessed higher levels of baseline VT demonstrated greater improvements in connectedness and positive emotions than their lower level counterparts. Additionally, increases in connectedness and positive emotions predicted improvements in VT. The authors argue that this finding provides further support for the existence of an upward spiral. More specifically, they argue that

VT serves as a key component through which improvements in other personal resources lead to increased experiences of positive emotions.

### **A Limitation of the Broaden-and-Build Theory**

Until this point, I have presented empirical support for Fredrickson's (2001) broaden-and-build theory. However, it is also important to explore the circumstances where researchers fail to find support for this theory. Notably, research has uncovered one boundary condition of the broaden hypothesis pertaining to the method used to induce positive emotions. Gable and Harmon-Jones (2008) asked participants to view either neutral images or images of desserts to manipulate their emotional experiences. The neutral images were expected to have little impact on participants' emotions whereas the images of desserts were expected to produce positive emotional reactions. The researchers assessed the breadth of participants' thought-action repertoires by measuring their reaction times on a global-local visual processing task (Kimchi & Palmer, 1982). When participants viewed desserts, their attentional focus was narrower when compared to participants who viewed neutral images. In one interpretation this result, Gabel and Harmon-Jones (2008) state the possibility that positive emotions associated with approach motivations reduce participants' breadth of attention because they tend to focus only on the object that attracts them. Although these findings may seem counter to the broaden-and-build theory, Fredrickson (2013) argues that the feelings participants experienced in this study are physical pleasures rather than positive emotions. She explains that physical pleasures are different from positive emotions and that only positive emotions are capable of broadening an individual's thought-action repertoire. Additionally, physical pleasures are unlikely to lead to the accumulation of personal and social resources over time.

## **Summary of Broaden-and-Build theory Research**

In sum, the past two decades have produced a variety of studies that support Fredrickson's (2001) broadened-and-build theory. A growing body of research supports both the build (Fredrickson & Branigan, 2005; Schmitz et al., 2009; Trick et al., 2012) and the broaden hypotheses (Fredrickson et al., 2008; Fredrickson & Joiner, 2002). Moreover, these researchers have found evidence to suggest the existence of upward spirals that lead the experience of positive emotions to have an even greater impact on an individual's overall well-being (Kok & Fredrickson, 2010; Salanova et al., 2006). Importantly, this research has already begun to be applied to the positive emotions that result from physical activity and the proposed study seeks to expand upon it. In the following sections, I will discuss the research on physical activity, positive emotions, broadened thinking, and resource building.

### **Harnessing the Power of Positive Emotions with Physical Activity**

Given the empirical evidence for the benefits of positive emotions, how organizations help their employees reap these rewards? There are several methods worth consideration. Some examples of techniques used to generate positive feelings include the following: expressing gratitude or optimism (Lyubomirsky, Dickerhoof, Boehm & Sheldon, 2011), sharing positive events (i.e., capitalization; Langston, 1994), and benefit finding (Affleck & Tennen, 1996). However, I argue physical activity should also be considered, for the following reasons. First, physical activity leads to a number of other benefits for a person's physical (Friedenreich, 2002; Thompson et al., 2003; Warburton et al., 2006) and psychological health (Biddle & Mutrie, 2001; DiLorenzon et al., 1999; Scully, Kremer, Meade, Graham, & Dudgeon, 1998). Second, physical activity is easily accessible for most individuals and remarkably inexpensive to implement. Employers do not need to invest a large amount of money to encourage their employees to adopt a physical activity routine. Many organizations already partner with a local

gym to offer employees memberships at a discounted rate (Gebhardt & Crump, 1990) or offer flexible schedules to employees who exercise before work (Dishman, Sallis, & Orenstein, 1985). Third, a growing body of research links physical activity to individuals' experiences of positive emotions and may help explain how physical activity may fit within Fredrickson's (2001) theory.

### **Physical Activity and Positive Emotions**

In the present study, I explore physical activity as an event that appears to lead to experience of positive emotions in the morning before work. A large number of studies provide support for the link between physical activity and enhanced affect, mood, and emotions (Biddle & Mutrie, 2001; Daley & Welch, 2004; Reed & Ones, 2006). I will provide a brief overview of this literature and discuss immediacy and duration of the positive emotional states that appear to follow engagement in physical activity.

Interestingly, the affective effect of physical activity has been observed mere minutes after engagement in physical activity. Reed and Ones (2006) conducted a meta-analysis to explore the effects of acute bouts of aerobic physical activity on self-reported positive-activated affect. A total of 158 studies between 1979 and 2005 provided data. The researchers coded exercise duration in minutes and coded exercise intensity by calculating the percentage of oxygen uptake reserve (% VO<sub>2</sub>R). This percentage provided a uniform expression of exercise intensity that could be derived from heart rate, perceived exertion, and percent oxygen uptake data. Exercise dose was defined as a combination of exercise intensity and duration. Among several hypotheses, Reed and Ones (2006) predicted an inverse relationship between exercise dose and post-exercise improvement in positive-activated affect, such that low and moderate physical activity would be followed by an increase in positive-activated affect, but more extreme doses would be followed by a decrease. Additionally, they hypothesized that there would not be

a differential effect of exercise duration on positive-activated affect for typical exercise periods (e.g., 14 - 40 minutes).

The results provided support for both hypotheses. Reed and Ones (2006) also observed that increases in positive-activated affect were present regardless of participants' personal and situational settings and this change could be observed immediately after physical activity occurred. Thus, this meta-analytic study provides some compelling evidence that individuals' experiences of positive emotions may be measured immediately following engagement in physical activity. Additionally, the amount, or dose, of physical activity does not appear to substantially impact the subsequent emotional states, so long as individuals do not overexert themselves.

One noteworthy article that Reed and Ones (2006) included in their meta-analysis was a lab study conducted by Daley and Welch (2004). The purpose of this study was to explore the effects of acute bouts of exercise on participants' affect during and after 15- and 30-minute bouts of physical activity on a cycle ergometer. Participants were 23 physically active students from a large university in England. All participants participated in both the 15- and 30-minute exercise conditions. If they were randomly assigned to experience the 15-minute condition first, they completed the 30-minute condition the following week. Researchers had participants complete the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994) to report their positive well-being, psychological distress, and fatigue. Participants completed the SEES while halfway through each condition and then 5 min, 30 min, 1 hour and 2 hours after each condition. After waiting 5 minutes and completing the SEES, participants left the laboratory. Researchers called participants at the 30 min, 1 hour and 2-hour marks and asked participants to verbally complete the SEES at these timepoints. The data indicated participants experienced

improvements in positive well-being and reductions in both distress and fatigue. Importantly, there was no difference between the 15- and 30-minute conditions. The authors also argue that the improved scores on the SEES after exercise indicate an improvement in participants' affect. Moreover, this improvement was observable two hours after the cessation of physical activity.

In sum, the results of both Read and Ones' (2006) meta-analysis and Daley and Welch's lab study suggest that a variety of types and durations of physical activity result in the experience of positive emotions. Additionally, Daley and Welch (2004) found that the positive emotions resulting from physical activity may last up to two hours following an individual's engagement in physical activity. Thus, the literature on the link between physical activity and positive emotions indicates that the affective effects of physical activity are immediate. Moreover, if employees engage in physical activity prior to the start of the workday, Daley and Welch's (2004) findings suggest that their experience of positive emotions may still be ongoing as they begin work.

### **Physical Activity, Broadening, and Building**

Given the empirical evidence of an association between physical activity and positive emotions, the potential exists for physical activity to lead to broadened thinking and resource accumulation through positive emotions as stated by the broaden-and-build theory. In this section, I will discuss research that indirectly links physical activity to broadened thinking. Then, I will discuss how the short-term benefits of positive emotions due to physical activity may lead to longer-term benefits, such as resource accumulation and improved well-being. Lastly, I will discuss a study that has already examined physical activity within the context of the broaden-and-build theory.

Positive emotions resulting from physical activity may function similarly to positive emotions in other contexts where research already indicates a link to broadened thinking. As stated previously, the broaden hypothesis states that positive emotions broaden an individual's thought-action repertoire (Fredrickson, 2001). Although, the relationship between physical activity and broadened thinking has not yet been directly studied, a large body of research has provided evidence for a link between physical activity and increases in cognitive performance. The following studies on improvements in cognitive performance from physical activity may provide preliminary support for a link between physical activity and broadened thinking.

Two prominent meta-analyses examined the effects of physical activity on cognitive performance. The first was a conducted by Etnier, Salazar, Landers, Petruzzello, Han, and Nowell (1997) who collected data from 134 studies which examined the effects of acute and long-term bouts of physical activity on cognitive functioning at a biological level (i.e., an increase in neurotransmitters). Of the 852 effect sizes included in their analyses, some pertained to the moderating the effects of acute bouts of physical activity on cognition ( $n = 371$ ), others looked at the effects of long-term training programs ( $n = 358$ ), others used correlational or cross-sectional method ( $n = 117$ ), and the remaining used a combination ( $n = 6$ ). As a whole, the data showed that physical activity has a positive effect on cognitive performance ( $d = .25$ ). Additionally, acute physical activity significantly affected cognitive performance with a small positive effect size ( $d = .16$ ). In studies where participants completed a training program (instead of exercising on their own schedule at their own pace), the effect size was larger ( $d = .33$ ). Lastly, studies that employed cross-sectional or correlational methods produced a medium effect size ( $d = .53$ ). The researchers concluded that studies with more rigorous experimental designs,

produced smaller effect sizes for the link between physical activity and improved cognitive conditioning.

The second, more recent meta-analysis by Lambourne and Tomporowski (2010) reviewed 40 studies that assessed the effects of physical activity on cognitive performance on specific tasks (e.g., response times, critical flicker fusion, and auditory addition tasks). Results indicated cognitive performance was hampered slightly during the first 20 minutes of physical activity with a small, negative effect size ( $d = -.14$ ). However, after physical activity had concluded, cognitive performance significantly increased ( $d = .20$ ). Interestingly, the type of physical activity performed also impacted cognitive performance. For example, cycling was associated with increases in cognitive performance both during and after physical activity. Conversely, running on a treadmill resulted in impaired performance during and improved performance after physical activity. The researchers attributed this difference to a difference in the concentration required by running compared to cycling. More specifically, running demands more attention to prevent a fall whereas cyclists can change their cadence while working on a task with no risk of injury. The most important finding was that, regardless of the type of physical activity performed, participants' cognitive performance on tasks improved 20 minutes following his or her engagement in physical activity. However, the authors conclude that the relationship between physical activity and improvements in cognition is complex and warrants further attention.

The present study draws upon these findings regarding the association between physical activity and increases in cognitive performance to propose a link between physical activity and broadened thinking. More specifically, I argue that it is possible that the increases in cognitive performance observed in these meta-analyses (Etneir et al., 1997; Lambourne & Tomporowski,

2010) are attributable to the broadening of participants' thought action repertoires brought about by the experience of positive emotions. Provided that this is the case, Fredrickson's (2001) theory would indicate there are longer-term benefits that stem from the broadening of individual's thought action repertoires. In the following section, I will explore the link between an individual's engagement in physical activity and an accumulation of resources.

In addition to short-term benefits of positive emotions and broadened thought-action repertoires, physical activity may have implications for employee well-being over the long term. The build hypothesis states that the broadening of an individual's thought-action repertoire leads individuals to think more creatively and, in turn, build personal resources. The literature suggests a number of other activities have been shown to help individuals accumulate resources, avoid burnout and increase trait resiliency that do not necessarily broaden thought-action repertoires. For example, periods of rest (i.e., breaks and vacations) appear to facilitate resource recovery (Lim, Teng, Wong, & Chee, 2016; Trougakos & Hideg, 2009) and decrease perceived stress and burnout (Etzion, Eden, & Lapidot, 1998; Westman & Eden, 1997). Importantly, the effects of this recovery appear to diminish rapidly when an employee returns to work (Westman et al., 1997). Physical activity has similarly been described as a recovery mechanism that allows for resource replenishment (Toker & Biron, 2012). Recent findings indicate physical activity facilitates recovery of resources after and during work (Coffeng, van Sluijs, Hendriksen, van Mechelen, & Boot, 2015; Feuerhahn, Sonnentag, & Woll, 2014).

For example, Feuerhahn et al. (2014) examined the relationship between physical activity and recovery from work during leisure time. According to their definition, an individual experiences recovery when "depleted resources can be restored or further resources can be gained" (p. 63). These researchers hypothesized that time spent on physical activity after work

would be related to improved affective states in the evening, which would facilitate recovery from stressors experienced at work. Feuerhahn et al. (2014) also expected detachment from work, sense of belonging, and physical self-perceptions to mediate this relationship. To test these hypotheses, they recruited 126 participants from a variety of fitness groups in Germany and had them complete a diary twice each day for one work week. The results supported the hypotheses and showed that physical activity after work predicted positive affect later in the evenings. Additionally, psychological detachment, sense of belonging, and physical self-perceptions mediated the relationship between physical activity after work and subsequent positive affect. The authors concluded that physical activity provides individuals with an opportunity to psychologically detach from their work. This detachment allows for the recovery of resources which may be drawn on during the following workday (Feuerhahn et al., 2014).

In one noteworthy article, Hogan, Catalino, Mata and Fredrickson (2015) examined physical activity through the lens of Broaden-and-Build theory (Fredrickson, 2001). The researchers conducted two studies to test whether engagement in physical activity was indirectly associated with gains in individuals' personal resources through the experience of positive emotions. More specifically, the researchers expected that time spent engaging in physical activity would predict positive emotions and psychosocial resources. Additionally, they anticipated that positive emotions would mediate the relationship between physical activity and psychosocial resources. Two separate studies were conducted to examine the hypothesized mediation. Study 1a employed a cross-sectional method and collected data from 624 individuals who were recruited through flyers, emails and internet ads and compensated \$20 dollars upon their completion of the online survey. The survey collected data regarding participants physical activity, sedentary behaviors, emotions and psychosocial resources (i.e., "self-acceptance,

environmental mastery, purpose in life, positive relations with others, autonomy, personal growth, social contribution, social actualization, social coherence, social acceptance and social integration”, p. 357). Analyses revealed that time spent physically active significantly predicted both positive emotions and psychosocial resources. Thus, these results of this first study were consistent with the researchers’ assertion that the positive emotions associated with physical activity provide a means to build psychosocial resources. Hogan et al. (2015) also tested alternative directionality models, but the data did not support their viability.

Building on the first study, study 1b addressed the limitations associated with cross sectional designs and utilized longitudinal data collection methods to provide more substantial support for a relationship between engagement in physical activity and resource gains. A subset of participants (N = 208) from the first study were asked to participate in an additional online study. A total of 142 participants completed follow up questionnaires three months later. Hogan et al. (2015) employed the day reconstruction method (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004) as a tool to examine a specific day in the lives of their participants. Specifically, the measure asked participants to describe experiences on a single Tuesday in a series of episodes during the following Wednesday morning. The findings from study 1b built upon the previous study by linking physical activity on a typical Tuesday to future resources gains. More specifically, the data indicated that physical activity during a typical day significantly predicted gains in psychosocial resources three months later. Thus, both studies provided evidence to suggest that emotions account for the relationship between physical activity and gains in psychosocial resources.

One limitation of Hogan et al.’s (2015) studies that the present study seeks to address is that they did not measure participants’ thought-action repertoires to determine whether

broadening occurred between their experience of positive emotions and the observed gains in psychosocial resources. If found, evidence of a broadening effect, following the experience of positive emotions that can be attributed to physical activity, would provide greater support for the broaden-and-build theory within the context of physical activity. Moreover, the broaden-and-build theory would become a possible explanatory mechanism for the improvements in cognitive performance that are observed following engagement in physical activity (Etnier et al., 1997; Lambourne & Tomporowski, 2010).

## **THE PRESENT STUDY**

The body of research on physical activity and positive emotions appears to indicate that physical activity may have benefits that extend beyond its ability to serve as an afterwork recovery tool (Feuerhahn et al., 2014). Given that emotional states are fleeting (Daley & Welch, 2004; Reed & Ones, 2006), it is possible that an employee's engagement in physical activity in the morning might have a larger impact on their thinking and resource accumulation during the workday than physical activity the evening before (Feuerhahn et al., 2014). The present study investigated the relationship of morning engagement in physical activity with broadened thinking and resource accumulation at work. More specifically, I aimed to demonstrate that the positive emotions associated with morning physical activity have an immediate, short-term effect that increases the breadth of thought-action repertoires at work that day. Additionally, I anticipated that broadened thinking at work would enable employees to build psychological resources that ultimately lead to increased improved well-being (see Figure 4). Thus, the present study examined Fredrickson's (2001) broaden-and-build theory within the context of morning physical activity and work by utilizing an experience sampling method to explore whether morning physical activity impacts employees' emotional experiences and thinking in response to workplace problems during the workday.

### **Hypotheses**

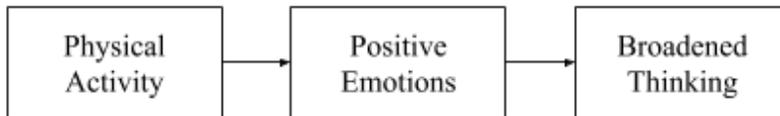
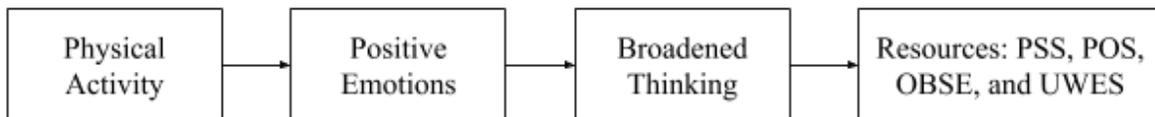
H1. Positive emotions (Level 1) are expected to mediate the relationship between morning physical activity (Level 1) and broadened thought-action repertoires (Level 1) at work.

H2. Broadened thought-action repertoires (Level 1) are expected to mediate the relationship between positive emotions (Level 1) and gains in psychosocial resources (Level 2).

H3. Positive emotions (Level 1) and broadened thought-action repertoires (Level 1) are expected to serially mediate the relationship between morning physical activity (Level 1) and psychosocial resources (Level 2).

H4. Psychosocial resource gains (Level 2) are expected to predict employee well-being (Level 2).

Between



Within

Figure 5. Hypothesized Model of The Relationship Between Physical Activity, Positive Emotions, Broadened Thinking, and Psychological Resources.

## Method

### Participants

I conducted an *a priori* power analysis based on the effect size of .27 reported by Reed and Ones (2006) for the effect of physical activity on positive-activated affect. G\*Power 3.1 (Faul, Erdfelder, Buchner, and Lang, 2009) estimated a total sample size of 32 with power  $(1 - \beta)$  set at .80 and  $\alpha$  at .05. Additionally, sample-size guidelines for multilevel designs specify that when sample sizes at the person level are less than 30, there is a potential for biased results (Ohly, Sonnetag, Niessen, & Zapf, 2010; Scherbaum & Ferreter, 2009). Thus, I attempted to oversample by approximately 20 participants for a minimum of 50 total participants.

Participants were recruited through the distribution of a flyer around central Florida and online. The following inclusion criteria were specified: First, participants must be at least 18 years of age and be full-time employees who work at least 30 hours each week. Second, participants must be able to take 5 to 10 minutes out of their workday to complete the daily questionnaires. Third, participants must already regularly exercise at least twice per week to be included in this study. Fourth, participants must work daytime jobs. Lastly, participants must either pass a pre-screener to assess whether they are healthy enough to participate in physical activity or obtain approval from their primary care physician. To motivate participation in this study, participants were offered the choice between a Fitbit Flex and a \$25 Target gift card.

A total of 81 individuals responded to the flyer by phone or email. Of these, 55 passed the prescreen survey, completed the baseline survey, and received the daily diary surveys. However, three of these participants were removed from the sample due to large amounts of incomplete data. The final sample contained 52 participants. This sample had a mean age of 34.13 ( $SD = 14.47$ ) and predominantly composed of women (63.46%). On average, participants worked 41.36 hours per week ( $SD = 10.18$ ).

## **Measures**

The *Revised Activity Readiness Questionnaire* (PAR-Q; Thomas, Reading, & Shephard, 1992) assessed whether participants are healthy enough for physical activity before the start of the study. Physical activity is a safe, health-promoting activity for most people. For some, however, physical activity can potentially be hazardous to their health. This measure is intended to identify those for whom physical exertion could be harmful. The following is an example item from this measure: “Have you developed chest pain in the past month?” If a participant answers

“yes” to any of the 7 items in this scale, he or she was asked whether they have the approval of a healthcare provider to engage in physical activity. If yes, participants were permitted to proceed.

This pre-screener also assessed participants’ eligibility to participate with questions regarding their age, exercise routine, and work schedules.

The *Short Questionnaire to Assess Health enhancing physical activity* (SQUASH; Wendel-Vos, Schuit, Saris, & Kromhout, 2003) was used to collect data on participants’ average activity levels at work as well as during leisure time and other daily activities. This measure consists of four subsections that measure physical activity during each of the following. Commuting activities, leisure time activities, household activities, and activity at work and school. Participants are asked to report the number of days per week they performed each activity, how much time they usually spent on the activities, and the amount of effort (slow/moderate/fast or light/moderate/intense) that each activity involves.

Additionally, participants reported the *frequency, intensity, time and type* (FITT; American College of Sports Medicine, 2013) of their morning physical activity on the days that they work out. More specifically, they reported the time they began exercising, duration (in minutes), intensity (on a 1-5 scale), and the type of physical activity (cardio, strength training, flexibility).

Participants completed the PANAS scale (Watson, Clark, & Tellegen, 1988) to measure positive and negative emotional states and trait positive and negative affect. This measure contains two 10-item subscales. One set of items specifically targets positive affectivity (PA) and the other measures negative affectivity (NA). These subscales ask participants to what extent they have felt specific emotions (e.g., excited, proud, nervous, and alert) within a specified time period (e.g., today or over the past few weeks). Participants indicate their response on a 5-point

likert scale ranging from “very slightly or not at all” to “extremely”. Scores on each of the two subscales range from 10 to 50. Higher scores indicate a larger presence of PA and NA respectively.

Watson et al. (1988) reports Cronbach’s alphas ranging from .86 to .90 for the PA subscale and .84 to .87 for the NA subscale and test-retest reliabilities of .79 and .81 respectively. The PANAS subscales also demonstrated convergent and discriminant validity with three measures of distress and psychopathology, specifically the Hopkins Symptom Checklist (HSCL; Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the State-Trait Anxiety Inventory State Anxiety Scale (A-State; Spielberger, Gorsuch, & Lushene, 1970). For NA, these correlations were .74, .56 and .51 when participants were asked about their experiences over the past few weeks. For PA, these correlations were -.19, -.35, and -.35 respectively. Alphas in the presents study were .91 and .72 for baseline PA and NA, respectively.

Breadth of thought-action repertoires. The breadth of participants’ thought-action repertoires were first assessed using a modified version of the *Twenty Statements Test* (TST; Fredrickson & Branigan, 2005; Kuhn & McPartland, 1954). Participants were asked to think about a stressful problem they experienced at work that day and describe their current feeling state in a few words. Then, participants received the following instructions: “Given this situation, please list all the things you could do to address it right now”. Twenty text boxes beginning with the phrase “I could...” were included for participants to provide their responses. Scores were coded based on the number of statements that participants completed, ranging from 0 to 20. Higher scores were expected to signify broader thought-action repertoires and engagement in broad-minded coping strategies. In an exploratory analysis, Fredrickson and Branigan (2005) had

two independent coders sort participants responses on this scale into several categories (e.g., sleep/rest, exercise, and be social). Interrater agreement was 94.4%.

Two subscales from the *COPE Scale* (Carver, Scheier, & Weintraub, 1989) were also administered to measure the extent to which participants engage in broad-minded coping. These two subscales measured active coping and planning strategies. Carver et al. (1989) presents a modified version of the COPE scale to measure coping in response to a specific event. For the purposes of the present study, we adapted this modified version of the COPE Scale to measure coping in response to a specific event that occurred at work each day. Participants were instructed to think about the stressful event that they recalled on the previous measure and indicate how much the situation mattered to them and whether it not it could be changed. Then, participants instructed to “think about the situation you have just described, and how you reacted to it. Then, indicate the extent to which you did whatever each of the following statements says” (Carver, Scheier, & Weintraub, 1989; p. 277). An example item from the active coping subscale is “I concentrated my efforts on doing something about it”. An example item from the planning subscale is “I tried to come up with a strategy about what to do”. Carver et al. (1989) reports alphas of .62 and .80 for the active coping and planning subscales, respectively. In the present study, the alphas were .84 and .91 for these scales.

Psychosocial resources. Multiple measures were administered to assess work-related psychological resources. These resources include perceived organizational support (Eisenberger, 1986), perceived supervisor Support (Eisenberger et al., 2002), organization-based self-esteem (Pierce et al. 1989), and work engagement (Schaufeli, Bakker, & Salanova, 2006).

Perceived organizational support (POS) was measured with Eisenberger’s (1986) *Survey of Perceived Organizational Support* (SPOS). The present study used the eight high-loading

items (items 4, 8, 9, 13, 20, 22, 23, and 25) selected by Eisenberger, Stinglhamber, Vandenberghe, Sucharski, & Rhoades (2002) to assess POS. An example item from this measure is: “Help is available from the organization when I have a problem”. Participants were instructed to indicate their level of agreement with each item on a 7-point Likert scale. Response options ranged from “strongly disagree” to “strongly agree. A meta-analytic report produced by Rhoades and Eisenberger (2002) showed high internal reliability, average  $\alpha = .90$ , for this measure with an average of 13 items used across the sample of studies. In the present study, Cronbach’s alpha for this measure of baseline POS was .94.

To assess perceived supervisor support (PSS), the present study used an adapted version of the SPOS proposed by Eisenberger et al. (2002). The eight, high-loading items was adapted by replacing the word *organization* with *supervisor* in each item. In the present study, Cronbach’s alpha for this measure of baseline POS was .94.

The *organization-based self-esteem* (OBSE) scale was assessed using Pierce, Gardner, Cummings, and Dunham’s (1989) measure. This scale instructed participants to indicate their level of agreement with 10 statements based on the messages they receive from their managers and supervisors. Participants indicated their response on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”. An example item indicated of this measure is “I am taken seriously”. Pierce et al. (1989) report an internal consistency of .91 and a test-retest reliability of .75 ( $p < .01$ ). In the present study, Cronbach’s alpha for this measure of baseline self-esteem was .92.

Lastly, work engagement was assessed using the Utrecht Work Engagement Scale (UWES; Schaufeli, Bakker, & Salanova, 2006). Participants indicated how often their jobs make them feel specific emotions by responding to 17 statements on a 7-point Likert scale that ranged

from “never” to “always”. The UWES contains the following three subscales that measure different dimensions of engagement: vigor, dedication, and absorption. An example item from the vigor subscale is “At my work, I feel bursting with energy”. An item from the dedication subscale is “I find the work I do full of meaning and purpose”. An item from the absorption subscale is “Time flies when I’m working”. Shaufeli and Bakker (2004) report internal consistencies of .86, .92, and .80 for the vigor, dedication, and absorption subscales, respectively. In the present study, Cronbach’s alpha for this measure of baseline engagement was .93.

The short version of the *Job-related Affective Well-being Scale* (JAWS; Van Katwyk, Fox, Spector, & Kelloway, 2000) measured employee’s emotional reactions to their work. This measure asked participants to indicate the frequency that they experience certain emotions (e.g., bored, excited, or content) at work. The following is an example item from this measure: “My job made me feel angry”. The response options occur on a five-point scale and range from “never” to “extremely often”. Van Katwyk et al. (2000) report a coefficient alpha of .95 for the 30-item version of the JAWS. For the purposes of the present study, the 20-item version was used and the instructions was modified to ask participants to report the frequency that they felt each emotion over the past two weeks rather than the past month. All items containing negative emotions was reverse scored and combined with positive emotion items to produce an overall score of job-related affective well-being. Spector, Fox, Goh & Bruursema (2003) report alphas of .88 and .80 for the negative and positive emotion subscales respectively. In the present study, Cronbach’s alpha for this measure of baseline well-being was .94.

## **Procedure**

During the recruitment phase, participants completed a pre-screen survey. The Revised Physical Activity Readiness Questionnaire (PAR-Q) assessed participants whether participants

are healthy enough for physical activity. Participants who either answered “no” to all seven items or had consent from their primary care physician to engage in physical activity were permitted to participate.

Participants who passed the pre-screen proceeded to the baseline survey. This survey collected data regarding participants’ demographics, trait affect, average level of physical activity, daily activity level, and psychosocial resources. I administered the SQUASH (Wendel-Vos et al., 2003), PANAS (Watson et al., 1988) and JAWS (Van Katwyk et al., 2000) in the baseline survey to assess participants’ physical health, trait affect, and well-being, respectively. I also collected information regarding participants’ baseline resources with measures of perceived organizational support (Eisenberger, 1986), perceived supervisor support (Eisenberger, 2002), organization-based self-esteem (Pierce et al. 1989), and work engagement (Schaufeli et al., 2006).

Then, participants completed a daily diary on a mobile device over the course of the next 10 workdays. Throughout the course of the study, I prompted participants twice a day, once in the morning before work and again after work via email. The morning questionnaire asked participants whether they exercised before work that day. If yes, participants reported the frequency, intensity, time and type (FITT) of their physical activity. Participants also completed the PANAS scale (Watson et al., 1988) to report their experience of positive and negative emotions, regardless of whether they exercised that morning or not.

Immediately following the conclusion of the workday, I administered two measures to assess the broadening of participants’ thought-action. Participants completed a revised version of the Twenty Statements Test (TST; Fredrickson & Branigan, 2005; Kuhn & McPartland, 1954)

followed by the active coping and planning subscales from COPE Inventory (Carver, Scheier, & Weintraub, 1989).

In addition to physical activity, emotions and broadened thought-action repertoires, the present study sought evidence of resource accumulation and improvements to well-being. Thus, I administered the resource measures and the well-being measure a second time on the 10th and final day of data collection in the late-morning survey.

## RESULTS

### Preliminary Analyses

Before running my main analyses, I generated descriptive statistics for each variable that would be included in my analyses and a correlation matrix (see Table 1). On average, participants engaged in physical activity on about 6 of the 10 days ( $M = .63, SD = .48$ ). Interestingly, physical activity was significantly related to positive emotions at both the within ( $r = .46, p < .01$ ) and between levels ( $r = .48, p < .01$ ). At the within level, physical activity was also related to active coping ( $r = .15, p < .01$ ), and planning ( $r = .20, p < .01$ ). Positive emotions were also related to active coping ( $r = .29, p < .01$ ) and planning ( $r = .38, p < .01$ ) at the within level. Unexpectedly, positive emotions were negatively associated with the number of solutions participants generated ( $r = -.14, p < .01$ ). Lastly, positive emotions were associated with all four psychological resources: PSS ( $r = .19, p < .01$ ), POS ( $r = .29, p < .01$ ), OBSE ( $r = .20, p < .01$ ), and engagement ( $r = .20, p < .01$ ).

Next, I conducted a multilevel CFA to confirm the expected factor structure of the level 1 (within-person) variables (i.e., daily positive emotions and broadened thinking). In the initial model, I expected the positive emotions and broaden thinking items to load onto two factors at both the within and between levels. This two-factor model demonstrated poor fit ( $X^2 = 789.45, df = 268, p < .001, CFI = .89, RMSEA = .061, SRMR_w = .053, SRMR_b = .060$ ).

In search of better fit, I divided the COPE scale items until their two component subscales (i.e., active coping and planning) and fitted a 3-factor model to the level 1 variables. This alternative model provided good fit to the data ( $X^2 = 616.32, df = 264, p < .001, CFI = .924, RMSEA = .051, SRMR_w = .046, SRMR_b = .055$ ). Thus, the COPE subscales were treated as two separate factors in the following analyses. All factor loadings for the within-person variables in this model were above .6. As a result, no items were removed at this step in the analyses.

Table 1. Descriptive Statistics and Correlations for Within and Between Level Variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Level 1 (within-person)																			
1. Physical Activity	.63	.48	-	.48**	.06	-.03	-.02	.08											
2. Positive Emotions	2.94	.98	.46**	-	.01	-.03	-.08	.42**											
3. # of Solutions	2.19	1.69	-.05	-.14**	-	-.11*	-.03	.04											
4. BT - active	3.09	.77	.15**	.29**	-.03	-	.56**	.05											
5. BT - planning	3.03	.86	.20**	.38**	-.14**	.73**	-	.00											
6. Sleep Quality	3.46	.96	.17**	.46**	.00	.16**	.17**	-											
Level 2 (between-person)																			
7. Age	34.13	14.47	.11*	.12**	-.06	.08	.16**	.02	-										
8. Gender	.37	.48	.04	-.02	-.15**	-.04	.01	-.18**	.21**	-									
9. Work Hours	41.26	10.18	.04	.09*	-.04	.01	-.05	.05	.35**	.34**	-								
10. Work Activity	1.45	2.41	.05	-.05	-.20**	-.09	-.11	.06	-.27**	-.35**	-.31**	-							
11. Trait PA	3.54	.68	.17**	.47**	-.29**	.17	.25**	.17**	.18**	-.02	.04	.13**	-						
12. Trait NA	1.45	.46	-.08	-.09*	-.06	-.04	-.09	-.16**	-.29**	.05	.15**	.12*	-.24**	-					
13. JAWS	3.52	.64	.14**	.33**	-.07	.02	.10*	.22**	.17**	-.20**	.02	.05	.64**	-.60**	-				
14. PSS	5.59	1.22	-.01	.19**	.16**	.06	.01	.16**	-.18**	-.12**	-.12**	-.31**	.09*	-.34**	.48**	-			
15. POS	4.90	1.30	.06	.29**	.03	.07	.15**	.11**	.03	-.13**	-.04	-.07	.44**	-.30**	.63**	.52**	-		
16. OBSE	4.26	.58	.06	.20**	.07	.06	.05	.17**	.06	-.25**	-.04	-.05	.37**	-.37**	.69**	.53**	.55**	-	
17. Engagement	5.31	1.157	.13**	.27**	.00	.00	.05	.19**	.35**	-.11*	.32**	-.14**	.52**	-.37**	.75**	.29**	.47**	.58**	-
18. Workload	2.77	.69	.07	.00	-.01	-.10*	-.02	-.08	.05	-.02	.22**	.27**	.04	.31**	-.02	-.11*	.12**	-.08	.27**

Note. Between-person correlations for Level 1 variables are presented above the diagonal; BT = Broadened Thinking; PA = Positive Affect; NA = Negative Affect; JAWS = Job-Related Affective Well-Being Scale; PSS = Perceived Supervisor Support; POS = Perceived Organizational Well-Being; OBSE = Organization Based Self-Esteem.

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

In a series of four additional multilevel CFAs, I checked the fit of a four-factor structure with positive emotions, active coping, planning and each of the four resource measures separately (see Table 2). I did not run a multilevel CFA with the solutions statements test because this measure consists of only one item.

The fit indices for the four factor models for PSS and POS suggested good fit. However, the OBSE ( $X^2 = 1098.825$ ,  $df = 476$ ,  $p < .001$ , CFI = .890, RMSEA = .050, SRMR<sub>w</sub> = .046, SRMR<sub>b</sub> = .110) and engagement ( $X^2 = 1728.976$ ,  $df = 686$ ,  $p < .001$ , CFI = .850, RMSEA = .054, SRMR<sub>w</sub> = .046, SRMR<sub>b</sub> = .095) models produced mixed results with RMSEA indicating good fit and CFI indicating poor fit for both models.

Table 2. MCFA Model Fit Indices

Model	$\chi^2$ , $df$	CFI	RMSEA	SRMR
PSS	987.106, 425	.901	.050	.046/.072
POS	989.917, 425	.900	.051	.047/.067
OBSE	1098.825, 476	.890	.050	.046/.110
Revised OBSE	853.775, 378	.910	.049	.046/.075
Engagement	1728.976, 686	.850	.054	.046/.095
Revised Engagement	1434.887, 590	.872	.052	.046/.085

Examination of the factor loadings revealed that both the OBSE and UWES measures had multiple items with factor loadings below .6. For OBSE, item 10 ( $\lambda = .18$ ), 8 ( $\lambda = .33$ ), 4 ( $\lambda = .38$ ), and 9 ( $\lambda = .38$ ) were sequentially removed until all loadings were above .6. After removing these items, the fit of the OBSE model improved substantially ( $X^2 = 853.775$ ,  $df = 378$ ,  $p < .001$ , CFI = .910, RMSEA = .049, SRMR<sub>w</sub> = .046, SRMR<sub>b</sub> = .075). This process was repeated for UWES. Item 17 ( $\lambda = .47$ ), 15 ( $\lambda = .52$ ), and 12 ( $\lambda = .58$ ) were sequentially removed until all loadings were above .6. After removing these items, the fit of the UWES model improved

slightly ( $\chi^2 = 1434.887$ ,  $df = 590$ ,  $p < .001$ , CFI = .872, RMSEA = .052, SRMR<sub>w</sub> = .046, SRMR<sub>b</sub> = .085).

### **Multilevel SEM**

I analyzed my data using multilevel structural equation modeling (MSEM) with Mplus. Prior to fitting the within model, I calculated intraclass correlations (ICC) for all day level items (i.e., physical activities, positive emotions, and both broadened thinking measures). Preacher, Zyphur, and Zhang (2010) warn that problems with convergence or biased estimates of the indirect effects are likely when ICCs fall below .05. Fortunately, all ICCs were above .05 and ranged from .195 to .521.

A series of chi-square difference tests revealed that the addition of sleep quality as a control variable on PE ( $\chi^2_{diff} = 57.29$ ,  $df_{diff} = 2$ ,  $p < .05$ ) and the Planning subscale ( $\chi^2_{diff} = 4.476$ ,  $df_{diff} = 1$ ,  $p < .05$ ) significantly improved fit. When sleep quality was regressed on the Active Coping subscale, there was no significant change in fit ( $\chi^2_{diff} = .329$ ,  $df_{diff} = 1$ , *n.s.*). The final within model included sleep quality as a control for PE, active coping, and planning at the within level and demonstrated good fit ( $\chi^2 = 470.820$ ,  $df = 164$ ,  $p < .001$ , CFI = .924, RMSEA = .061 [.055, .068], SRMR = .044).

At this stage of my analyses, I added positive affect and average activity at work as control variables at the between level. Trait positive affect and average activity were regressed on positive emotions. Fit indices for this multilevel SEM model showed good fit ( $\chi^2 = 776.878$ ,  $df = 363$ ,  $p < .001$ , CFI = .901, RMSEA = .056, SRMR<sub>w</sub> = .050, SRMR<sub>b</sub> = .065).

### **Hypotheses Testing**

In the following section, I present the results for hypotheses 1-4. The present study assessed broadened thinking using two COPE subscales and a modified version of the twenty tasks statement. I was unable to fit a model with a higher-order factor composed of the four

resources. Thus, each resource was entered into the within and between model separately to test the direct and indirect effects (see Tables 3 and 4).

Hypothesis 1 stated that positive emotions are expected to mediate the relationship between morning physical activity and broadened thought-action repertoires at work. To test this hypothesis, I computed the indirect effects of physical activity on each of the COPE subscales through positive emotions. The indirect path estimates for the active coping subscale ranged from  $-.006$  (*n.s.*) to  $-.003$  (*n.s.*) at the within level and from  $10.726$  (*n.s.*) to  $11.008$  (*n.s.*) at the between level. For the planning subscale, these indirect path estimates ranged from  $.065$  (*n.s.*) to  $.066$  (*n.s.*) at the within level and from  $10.381$  (*n.s.*) to  $10.687$  (*n.s.*) at the between level. The indirect effects for this path were also computed with the solutions statements test as the measure of broadened thinking. These indirect path estimates ranged from  $-.001$  (*n.s.*) to  $.003$  (*n.s.*) at the within level and from  $.103$  (*n.s.*) to  $.150$  (*n.s.*) at the between level. Across all of the models, positive emotions did not appear to mediate the relationship between physical activity and broadened thinking at either within or between levels. Thus, hypothesis 1 was not supported.

Hypothesis 2 stated that broadened thought-action repertoires are expected to mediate the relationship between positive emotions and gains in psychosocial resources. To test this hypothesis, I computed the indirect effects of positive emotions on each resource through both COPE subscales at the between level. The indirect path estimates for perceived supervisor support were  $3.998$  (*n.s.*) through active coping and  $-4.865$  (*n.s.*) through planning. For perceived organizational support, the indirect estimates were  $-1.836$  (*n.s.*) through active coping and  $.251$  (*n.s.*) through planning. For organization-based self-esteem, the indirect estimates were  $-1.437$  (*n.s.*) through active coping and  $.920$  (*n.s.*) through planning. For engagement, the indirect estimates were  $-2.275$  (*n.s.*) through active coping and  $1.045$  (*n.s.*) through planning. These

indirect effects were also calculated with the solutions statements test as the measure of broadened thinking. The estimates for the indirect of physical activity on solutions through positive emotions were .044 (*n.s.*) for perceived supervisor support, .022 (*n.s.*) for perceived organizational support, .019 (*n.s.*) for organization-based self-esteem, and .023 (*n.s.*) for engagement. Thus, hypotheses 2 was not supported.

Hypothesis 3 stated that positive emotions and broadened thought-action repertoires are expected to serially mediate the relationship between morning physical activity and psychological resources. To test this hypothesis, I computed the estimate of this indirect effect by computing the product of the paths from exercise to positive emotions, from positive emotions to broadened thinking, and from broadened thinking to each resource (Taylor, MacKinnon, & Tein, 2008).

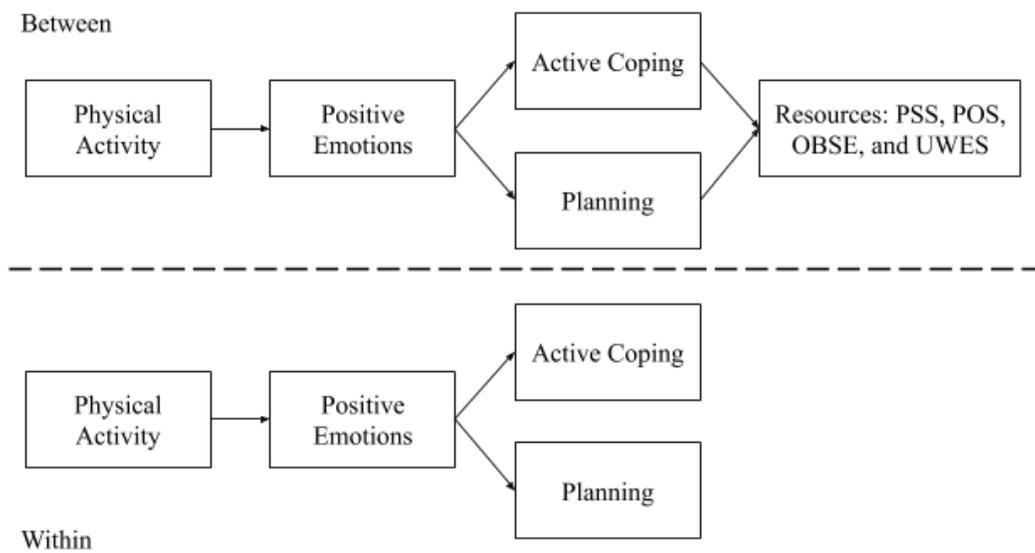
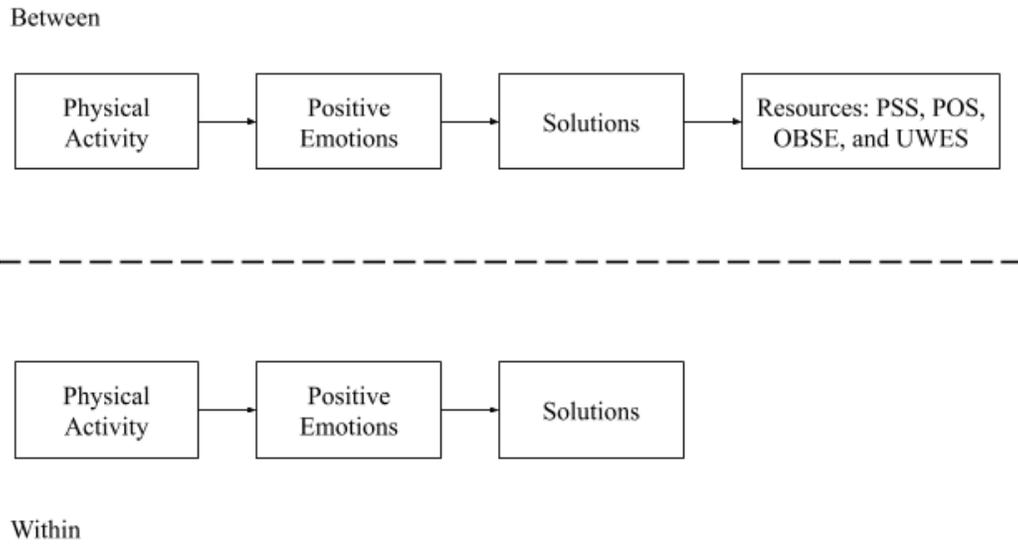


Figure 6. Model Test with the COPE Subscales

When the COPE subscales were used to assess broadened thinking (see Table 3 and Figure 5), the estimate for the serial mediation ranged from -9.20 (*n.s.*) to 16.527 (*n.s.*) for active coping and from -20.113 (*n.s.*) to 4.346 (*n.s.*). When broadened thinking was assessed with the

solutions statements test (see Figure 6), estimates ranged from .022 (*n.s.*) to .052 (*n.s.*). Thus, hypothesis 3 was not supported.



*Figure 7. Model Test with the Solution Statements Test*

Table 3. Direct, Indirect, and Serial Mediation Effects using the COPE Subscales

Resource	$\chi^2$ , df	CFI	RMSEA	SRMR	Level	Direct Effects					Indirect Effects				Serial Mediation	
						Exercise → Positive Emotions	Positive Emotions → Active Coping	Positive Emotions → Planning	Active Coping → Resource	Planning → Resource	Exercise → Active Coping thru Positive Emotions	Exercise → Planning thru Positive Emotions	Positive Emotions → Resource thru Active Coping	Positive Emotions → Active Coping thru Active Coping	Thru Active Coping	Thru Planning
Within model	470.81 9, 164	.924	.061	.045	W	.560*** [.475, .646]	-.005 [-.123, .113]	-.096 [-.205, .013]	-	-	-.003 [-.069, .063]	-.054 [-.115, .007]	-	-	-	-
Within+ Between Model	776.87 8, 362	.901	.056	.050/.065	W	.625***[.478, .771]	-.007 [-.141, .126]	.120 [-.049, .289]	-	-	-.005 [-.088, .079]	-.075[-.036, .186]	-	-	-	-
					B	1.096** [.145, 2.048]	.519 [-.025, 1.063]	.515* [.030, 1.000]	-	-	.569 [-.311, 1.449]	.565 [-.196, 1.325]	-	-	-	-
PSS	1368.2 23, 556	.848	.063	.050/.178	W	.596*** [.455, .736]	-.009 [-.136, .119]	.111 [-.054, .276]	-	-	-.005 [-.081, .071]	.066 [-.037, .169]	-	-	-	-
					B	4.134*** [2.444, 5.824]	2.621** [.625, 4.617]	2.532** [.503, 4.562]	1.525 [-2.431, 5.481]	-1.921 [-5.311, 1.469]	10.837 [-.770, 22.444]	10.469 [-1.440, 22.378]	3.998 [-7.364, 15.360]	-4.865 [-13.932, 4.202]	16.527 [-31.783, 64.836]	-20.113 [-60.613, 20.388]
POS	1359.8 18, 556	.851	.063	.051/.187	W	.594*** [.454, .735]	-.010 [-.139, .119]	.109 [-.056, .274]	-	-	-.006 [-.083, .070]	.065 [-.038, .167]	-	-	-	-
					B	4.103*** [2.304, 5.901]	2.614**[.548, 4.680]	2.530* [.363, 4.697]	-.702 [-2.747, 1.342]	.099 [-1.699, 2.047]	10.726 [-1.51, 22.961]	10.381 [-2.346, 23.107]	-1.836 [-6.786, 3.113]	.251 [-4.336, 4.839]	-7.535 [-27.822, 12.753]	1.032 [-17.767, 19.830]
OBSE	1219.0 05, 528	.862	.060	.050/.191	W	.595*** [.455, .736]	-.008 [-.137, .120]	.110 [-.055, .275]	-	-	-.005 [-.081, .072]	.066 [-.037, .169]	-	-	-	-
					B	4.156*** [2.364, 5.949]	2.639**[.570, 4.707]	2.552* [.359, 4.745]	-.545 [1.731, .641]	.360 [-.719, 1.439]	10.967 [-1.381, 23.314]	10.608 [-2.357, 23.574]	-1.437 [-4.458, 1.584]	.920 [-1.867, 3.706]	-5.974 [-19.081, 7.133]	3.823 [-8.179, 15.825]
Engagement	2125.0 89, 745	.791	.071	.050/.192	W	.595*** [.445, .735]	-.009 [-.138, .120]	.110 [-.055, .275]	-	-	-.005 [-.082, .071]	.065 [-.038, .168]	-	-	-	-
					B	4.159***[2.206, 6.111]	2.647* [.402, 4.892]	2.570* [.134, 5.006]	-.859 [-2.959, 1.240]	.407 [-1.280, 2.093]	11.008 [-2.577, 24.594]	10.687 [-2.577, 25.127]	-2.275 [-7.399, 2.850]	1.045 [-3.269, 5.359]	-9.459 [-31.493, 12.575]	4.346 [-13.973, 22.665]

Note. Preacher et al. (2010) recommend the use of a 90% CI; PSS = Perceived Supervisor Support; POS = Perceived Organizational Support; OBSE = Organization-Based Self-Esteem. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

Table 4. Direct, Indirect, and Serial Mediation Effects using the Solutions Statements Test

# of Solutions						Direct Effects			Indirect Effects			Serial Mediation
Resource	$\chi^2$ , df	CFI	RMSEA	SRMR (w/b)	Level	Exercise → Positive Emotions	Positive Emotions → Solutions	Solutions → Resource	Exercise → Solutions thru Positive Emotions	Positive Emotions → Resource thru Solutions	Exercise → Positive Emotions → Solutions → Resource	
Within model	261.138, 62	.929	.080	.042	W	.560*** [.475, .645]	-.157 [-.418, .104]	-	-.088 [-.235, .059]	-	-	
Within + Between	384.595, 146	.908	.067	.047/.073	W	.629*** [.483, .776]	-.002 [-.225, .229]	-	-.001 [-.142, .144]	-	-	
					B	1.186* [.065, 2.307]	.124 [-.719, .967]	-	.147 [-.944, 1.238]	-	-	
PSS	748.282, 284	.863	.067	.047/.096	W	.629*** [.483, .776]	.005 [-.223, .232]	-	.003 [-.140, .146]	-	-	
					B	1.186* [.056, 2.316]	.127 [-.714, .968]	.344** [.074, .614]	.150 [-.943, 1.243]	.044 [-.251, .338]	.052 [-.331, .435]	
POS	752.896, 284	.865	.067	.047/.098	W	.629*** [.483, .776]	-.002 [-.225, .229]	-	-.001 [-.142, .144]	-	-	
					B	1.150* [.052, 2.247]	.103 [-.730, .937]	.214 [-.159, .587]	.119 [-.912, 1.150]	.022 [-.148, .191]	.025 [-.187, .238]	
OBSE	634.363, 263	.880	.062	.046/.119	W	.629*** [.483, .776]	.003 [-.221, .467]	-	.002 [-.141, .145]	-	-	
					B	1.159* [.063, 2.255]	.098 [-.735, .932]	.196* [.022, .369]	.114 [-.922, 1.150]	.019 [-.141, .179]	.022 [-.177, .222]	
Engagement	1244.053, 431	.807	.072	.047/.119	W	.629*** [.483, .776]	.002 [-.225, .229]	-	.001 [-.141, .144]	-	-	
					B	1.116 [-.004, 2.237]	.093 [-.737, .922]	.251 [-.016, .518]	.103 [-.888, 1.095]	.023 [-.180, .226]	.026 [-.218, .270]	

Note. Preacher et al. (2010) recommend the use of a 90% CI; PSS = Perceived Supervisor Support; POS = Perceived Organizational Support; OBSE = Organization-Based Self-Esteem. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

Hypothesis 4 stated that psychosocial resource gains (Level 2) are expected to predict employee well-being (Level 2). To test this, I ran a polynomial regression using to explore whether differences between participants' baseline and final scores on PSS, POS, OBSE, and engagement predict well-being (see Table 5). A positive slope along the line of incongruence was expected to indicate support for hypothesis 4. Unfortunately, the slope along the line of incongruence was not significant for PSS ( $a_3=.30, n.s.$ ), POS, ( $a_3=.05, n.s.$ ), OBSE ( $a_3=.77, n.s.$ ), or engagement ( $a_3=-.0,1 n.s.$ ). Thus, hypothesis 4 was not supported.

Table 5. Results of the Polynomial Regression for Hypothesis 4

Variable regressed onto well-being		<i>b</i> (se)
<b>Perceived Supervisor Support (PSS)</b>		
Polynomial regression analysis	Constant	3.552***
	PSS: Baseline	0.253 (.145)
	PSS: Final	-0.042 (.156)
	PSS: Baseline <sup>2</sup>	-0.132 (.108)
	PSS: Baseline x Final	0.238 (.152)
	PSS: Final <sup>2</sup>	-0.075 (.045)
	<i>R</i> <sup>2</sup>	.298
Response surface tests	<i>a</i> <sub>1</sub>	0.21 (.10)
	<i>a</i> <sub>2</sub>	0.03 (.03)
	<i>a</i> <sub>3</sub>	0.30 (.30)
	<i>a</i> <sub>4</sub>	-0.45 (-.45)
<b>Perceived Organizational Support (POS)</b>		
Polynomial regression analysis	Constant	3.535 (.100)***
	POS: Baseline	.201 (.084)*
	POS: Final	.156 (.099)
	POS: Baseline <sup>2</sup>	.051 (.078)
	POS: Baseline x Final	-.095 (.1)
	POS: Final <sup>2</sup>	.003 (.03)
	<i>R</i> <sup>2</sup>	.521

Response surface tests	$a_1$	.36 (.07)***
	$a_2$	-.04 (.05)
	$a_3$	.05 (.17)
	$a_4$	.15 (.16)
<hr/>		
<b>Organization-based Self-esteem (OBSE)</b>		
<hr/>		
Polynomial regression analysis	Constant	3.543 (.096)***
	OBSE: Baseline	0.763 (.232)**
	OBSE: Final	-0.007 (.246)
	OBSE: Baseline <sup>2</sup>	0.015 (.774)
	OBSE: Baseline x Final	-1.029 (.367)
	OBSE: Final <sup>2</sup>	0.766 (.530)
	$R^2$	.537
Response surface tests	$a_1$	0.76 (.14)***
	$a_2$	-0.25 (.20)
	$a_3$	0.77 (.46)
	$a_4$	1.81 (.71)**
<hr/>		
<b>Engagement (UWES)</b>		
<hr/>		
Polynomial regression analysis	Constant	3.603***
	Engagement: Baseline	0.24 (.109)*
	Engagement: Final	0.154 (.116)
	Engagement: Baseline <sup>2</sup>	-0.208 (.113)
	Engagement: Baseline x Final	0.392 (.199)
	Engagement: Final <sup>2</sup>	-0.194 (.093)*
$R^2$	.640	
Response surface tests	$a_1$	0.39 (.07)***
	$a_2$	-0.01 (.05)
	$a_3$	0.09 (.21)
	$a_4$	-0.79 (.24)***

*Note.*  $a_1$  = slope along  $x=y$ ;  $a_2$  = curvature on  $x=y$ ;  $a_3$  = slope along  $x=-y$ ;  $a_4$  = curvature along  $x=-y$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

### Supplementary Findings

Although none of the hypothesized indirect effects were significant, some significant direct effects emerged. Across all models for both the COPE subscales and solutions statements measure, physical activity significantly predicted positive emotions at both the within and between levels. Path estimates for this relationship ranged from .560 ( $p < .001$ ) to .596 ( $p < .001$ ) at the within level and from 1.200 ( $p < .05$ ) to 4.101 ( $p < .001$ ) at the between level. At the within level, this significant relationship indicates that on the days that participants engaged in physical activity, they were more likely to experience positive emotions than on the days that they did not engage in physical activity. At the between level, this relationship indicates that participants who exercised more frequently during the 10-day period, more frequently experienced positive emotions than individuals who engaged in physical activity less frequently.

When broadened thinking was assessed using the COPE subscales, positive emotions predicted active coping and planning at the between level in most models. However, the direct effect positive emotions to active coping was not significant in the within and between model. Path estimates across all models for the direct effect of positive emotions on active coping ranged from .519 (*n.s.*) to 2.647 ( $p < .05$ ). Similarly, path estimates for planning ranged from .515 ( $p < .05$ ) to 2.570 ( $p < .05$ ). At the between level, this result indicates that participants who experienced positive emotions more frequently, more frequently reported engagement in active coping and planning strategies. No significance at the within level indicates that the data do not suggest a relationship between experiences of positive emotions and engagement in active coping and planning strategies at the day level.

None of the direct effects from either active coping or planning to each of the resources were significant. However, when broadened thinking was assessed using the solutions statements

test, significant paths emerged from solutions to PSS and OBSE at the between level. Path estimates for these effects were .344 ( $p < .01$ ) and .196 ( $p < .05$ ), respectively. Additionally, the direct effects between positive emotions and solutions were not significant for neither the within nor the between models. Thus, experiences of positive emotions did not predict the number of solutions participants generated at either the day or person level.

*Table 6.* Change in Resources of 10-days

Resource	Baseline	Final	$\Delta$
PSS	5.63 (1.23)	5.68 (1.27)	.04
POS	4.91 (1.32)	5.28 (1.23)	.37**
OBSE	4.26 (.59)	4.24 (.53)	-.02
Engagement	5.32 (1.18)	5.37 (1.48)	.06

*Note.* PSS = Perceived Supervisor Support; POS = Perceived Organizational Support; OBSE = Organization-Based Self-Esteem.

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

Lastly, I investigated whether participants' resources changed over the 10-day period with a series of repeated-measures t-tests. The results of these tests were nonsignificant for PSS, OBSE, and engagement (see Table 6). However, POS significantly increased across the two administrations ( $\Delta = .37, p < .01$ ). Although this result would be expected under the broaden-and-build theory, it provides insufficient evidence for resource accumulation across the 10-day period when considered alongside the other nonsignificant findings.

## DISCUSSION

Previous research has shown that positive emotions serve to broaden thinking (Fredrickson et al., 2005; Schmitz et al., 2009; Trick, Brandigampola et al., 2012) and subsequently lead to the accumulation of psychological resources (Fredrickson et al., 2008; Kok et al., 2002; Salanova et al., 2006) that ultimately improve well-being (Fredrickson et al., 2003; Fredrickson et al., 2002). Through the lens of Fredrickson's (2001) broaden-and-build theory of positive emotions, this study examined whether the positive emotions experienced as a result of physical activity in the morning have implications for employees' thought processes at work. More specifically, I expected positive emotions and broadened thinking to serially mediate the relationship between morning physical activity and resource gains.

My results did not provide evidence for the hypothesized model. This result is partially attributable to the absence of a direct effect between positive emotions and broadened thinking. The absence of this effect contradicts previous research that has demonstrated support for the broadened hypothesis with experimental designs using global-local processing tasks (Fredrickson et al., 2005), fMRI scans (Schmitz et al., 2009), and driving simulations (Trick et al., 2012). Furthermore, this finding should not be interpreted as a lack of support for the broaden-and-build theory in the context of morning physical activity because the measures of broadened thinking and the timing of their administration may have limited my ability to detect the effect of positive emotions on broadened thinking. This issue will be explained in greater detail in the following section.

Despite the disappointing results for the hypothesized model, this study did provide some insight into the potential benefits resulting from physical activity and experiences of positive emotions just before the start of the workday. More specifically, discrete

experiences of physical activity were associated with positive emotions. Additionally, employees who more frequently engaged in physical activity also reported more experiences of positive emotions during the 10-day period. In most cases, experiences of positive emotions were associated with active coping and planning strategies, indicating that employees who experienced positive emotions were more likely to engage in broad-minded coping strategies.

Previous literature provides strong support for a link between physical activity and positive emotions (Biddle & Mutrie, 2001; Reed & Ones, 2006). Lab studies have shown that positive emotions follow engagement in physical activity and may last up to two hours (Daley & Welch, 2004). Consistent with these previous findings, present study found physical activity was associated with increases in positive emotions at the day level of analysis. At the day level, the days that participants engage in physical activity were associated with increases in positive emotions that day. This effect at the day level also mirrors the findings of Reed and Ones' (2006) meta-analysis that indicated increases in positive affect immediately following bouts of physical activity in lab settings.

This study contributes to the literature by providing additional evidence of the relationship between physical activity and positive emotions at the individual level. More specifically, the results of this study indicate that participants who engaged in morning physical activity more frequently during the study period, reported more positive emotions more frequently than participants who engaged in less frequent physical activity. These findings suggest morning physical activity not only has implications for an employees' emotions on a particular workday, but also across longer periods of time. Furthermore, more frequent engagement in morning physical activity may increase the propensity of an individual to experience positive emotions.

Another finding of the present study was that positive emotions may predict broad-minded coping strategies at the individual level. Specifically, more frequent experiences of positive emotions were related to more frequent engagement in both active coping and planning strategies. Research indicates these strategies may be effective at mitigating the effects of stressors and can allow employees to feel they are working towards reducing stressors (Keoske, Kirk, & Keoske, 1993). Thus, this result suggests that employees who more frequently experience positive emotions at work may be better equipped to deal with problems at work and reduce the strain they experience with broad-minded coping.

In the models that used the solutions statements test to measure broadened thinking (Table 4), the number of solutions appeared to predict certain resources at the individual level. More specifically, participants who reported more solutions to their problems at work during the 10-day period, had more perceived supervisor support (PSS) and organization-based self-esteem (OBSE) than those who listed fewer solutions. However, these findings should be interpreted with caution. In the case of PSS, employees with more support from their supervisors may be more likely to list supervisor involvement a possible solution on the solutions statements test. Additionally, it is possible that an employee's ability to come up with many solutions to the problems they encounter may drive their self-esteem at work. This explanation would be consistent with previous research that demonstrates a reciprocal relationship between self-esteem and achievement (Baumeister, Campbell, Krueger, & Vohs, 2003). Despite these alternative explanations, these links between broadened thinking and certain resources provide some support for the resource accumulation portion of the broaden-and-build theory.

## **Limitations**

As stated previously, the present study was unable to find evidence of a serial mediation between morning physical activity and resource accumulation through positive emotions and broadened thinking. Thus, it is important to review some key limitations that may have contributed to these null findings. In the following section, I will present limitations related to the present study's measures, design, and recruitment methods.

The use of an experience sampling methodology provided enough power at the day or within-level (Level 1) of analysis with a sample size of 52 and 10 observations for each participant. However, a smaller sample size at the individual or between-level (Level 2), may have reduced power to detect between level effects. Thus, a type II error may have occurred at the between level, thereby limiting the ability to detect a between-level mediation from physical activity to broadened thinking through positive emotions when broadened thinking was assessed using the COPE subscales.

Although there was sufficient power at the within-level analysis (Level 1), positive emotions did not mediate the relationship between daily morning physical activity and broadened thinking. There were also no significant direct effects from positive emotions to all measures of broadened thinking (see tables 3 and 4). Given the notable absence of these direct effects, it is possible broadened thinking was not well captured due to the scheduling of the afternoon survey. This survey included both measures of broadened thinking (i.e., solutions statements test and COPE subscales) and was e-mailed to participants late in the workday for them to complete after work.

Both broadened thinking scales required participants to experience a problem at work to use as a referent for their questions. The twenty solutions statements test asked participants to

about a stressful problem they experienced at work, describe their feelings in a few words, and then list the actions they could take to address it. Similarly, the COPE subscales were modified to measure coping in response to a specific problem during the workday. Thus, an afternoon survey administration was necessary to allow time for participants to experience problems at work that could be used to generate solutions for the solutions statements test and indicate coping strategies towards on the COPE subscales.

The late survey administration may have allowed for other affective events to occur between physical activity and the assessment of broadened thinking. Given previous research on the relationship between affective events and emotions (Brief & Weiss, 2002), events that were closer to the time that participants took the afterwork survey were more likely to impact their responses. Moreover, research has only shown that the positive emotions following physical activity can last up to two hours (Daley & Welch, 2004). So, any effect of the positive emotions resulting from morning physical activity may have worn off by the time participants completed the measures of broadened thinking.

A different measure of broadened thinking would need to be appropriate for daily administration to participants. For example, a game or a test with multiple, equivalent forms could be administered closer to the start of the workday. There is not yet a measure of broadened thinking that fits this description and it would have been costly and difficult to develop for the present study. However, such a measure may have overcome the limitations of the solutions statements test and COPE subscales and been better suited to capture evidence of broadened thinking at work.

Another limitation associated with measurement was the use of self-report measures throughout the study. Due to this use of solely self-report methods, issues associated with

common method variance, or monomethod bias, may be present (Campbell & Fiske, 1959). If present in the current study, the significant direct effects found between physical activity, positive emotions, broadened thinking, and certain resources may have been systematically inflated. However, the Spector (2006) suggests that any inflation in the hypothesized relationships due to the use of only self-report methods is likely to be insignificant.

Lastly, the present study encountered potential limitations due to the recruitment methods and design of the study. Rather than implementing a morning exercise intervention with a group of participants who did not engage in an exercise routine, the present study recruited individuals who already exercised regularly in the morning before work. Given their history of engagement in an exercise routine prior to the start of the study, it is possible that these participants already reached the ‘plateau’ stage described in the upward spiral hypothesis. Thus, the participants in the present study could no longer continue accumulating resources and had reached optimal well-being.

Supplementary analyses indicated some evidence for this plateau stage occurring in the present study. The PSS, POS, and engagement measures used 7-point Likert scales and produced fairly high baseline means of 5.63, 4.91, and 5.32, respectively. The OBSE measure used a 5-point Likert scale and had a baseline mean of 4.26. Interestingly, the resource measure with the lowest mean relative to its range, POS, was the only one to exhibit an increase during the 10-day period ( $\Delta = .37, p < .01$ ). As a result of this small amount of variability across the two time points for PSS, OBSE, and engagement, the ability of the present study to provide evidence to show that resource accumulation predicted increased well-being would be limited

## **Future Directions**

The purpose of the present study was to investigate the potential benefits of a morning physical activity routine for employees work experiences in the context of the broaden-and-build theory (Fredrickson, 2001). Results did not provide support for this theory as an explanation for the effects of a morning physical activity routine on employees work experiences. However, the limitations of the present study indicate it may be too early to discount this theory as a potential explanatory mechanism. Future research should address the limitations of the present study by utilizing a large sample size to have the necessary power to detect between level effects and administering a more suitable measure of broadened thinking closer to the time participants' experience positive emotions. This research would also need to consider the possibility that individuals who already engage in a physical activity routine may have reached the 'plateau' stage posited by the upward spiral hypothesis and recruit participants who do not already have such a routine.

One finding of the present study was that participants engaged in more frequent morning physical activity experienced positive emotions more frequently than those who engaged in less frequent physical activity. A plausible interpretation of this finding is that morning physical activity increased these participants' propensities to experience positive emotions. Future research should look for additional evidence of this effect. Given the relationship between affective experiences and job attitudes (Illies & Judge, 2004; Weiss & Cropanzano, 1996), researchers should also explore whether morning physical activity influences the formation of certain job attitudes like job satisfaction.

Beyond the context of the present study, future research should endeavor to develop better tools for assessing broadened thinking that can be delivered more closely to participants'

experiences of positive emotions. As previously discussed, there are no measures of broadened thinking available that can be administered repeatedly to participants in a daily diary design. Research hoping to further investigate the broaden-and-build theory in longitudinal designs will require the development of such a measure. I suggest utilizing modern technology to develop a mobile game with visual search or matching tasks that participants can play as a measure of broadened thinking. The emergence of this measure would greatly help researchers gain better understand the relationship positive emotions and broadened thinking and subsequent resource gains.

### **Implications**

The null findings of the present study leave open the possibility for the existence of alternative mechanisms to explain the potential benefits reaped by employees who experience positive emotions as the result of physical activity before work. However, despite the absence of support for the present study's hypotheses, the results do contain some noteworthy findings. First, employees experience positive emotions on the days they engage in morning physical activity. Second, employees who tend to more frequently engage in morning physical activity experience positive emotions more frequently. Third, positive emotions predicted planning COPE strategies, with mixed support for active coping as well. Together, these findings suggest morning physical activity may provide boosts to employees' emotional states on the days they exercise and employees who exercise in the morning more frequently may experience positive emotions more frequently as well. Moreover, experiences of the positive emotions may be associated with the use of broad-minded coping strategies, such as planning, at work.

Outside of the scope of this study and the broaden-and-build theory (Fredrickson, 2001), positive emotions may have other potential benefits for employees at work. When compared to

negative emotions, research indicates positive emotions are related to more occupational citizenship behaviors, creativity, and job satisfaction as well as less turnover and improved job performance (Ashkanasy, Hartel, & Daus, 2002). Other studies suggest positive emotions are related to reduced risk taking (Mittal & Ross, 1993), improved information processing (Staw & Barsadem, 1993), fewer counter productive work behaviors (Spector & Fox, 2002), reduced feelings of fatigue (Zohar, Tzischinski, & Epstein, 2003), and increased well-being (Harris, Daniels, & Briner, 2003). Although these outcomes of positive emotions were not directly examined in the present study, these are benefits are associated with positive emotions and may be experienced by individuals who experience positive emotions after engaging in physical activity before work.

Provided the results of the present study can be replicated in future research, they may have implications for practice. More specifically, organizations may expect benefits to be associated with the promotion of physical activity. It is likely that when organizations make morning exercise more accessible to employees, their employees will more frequently start their day with positive emotional experiences. Moreover, these positive emotional experiences may help organizations when employees engage in planning as a coping strategy when faced with problems at work. Thus, although the main hypotheses of this study were not supported, morning exercise is may still produce beneficial effects for organizations and employees. Organizations may reasonably consider providing employees with more schedule flexibility to exercise before the start of their workday or implementing wellness programs that include a morning physical activity routine. These initiatives to promote morning physical activity may boost employees' emotional states and, potentially, help them engage in more broad-minded coping at work.

**APENDIX**  
**IRB APPROVAL**



University of Central Florida Institutional Review Board  
 Office of Research & Commercialization  
 12201 Research Parkway, Suite 501  
 Orlando, Florida 32826-3246  
 Telephone: 407-823-2901 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

## Approval of Human Research

**From: UCF Institutional Review Board #1  
 FWA00000351, IRB00001138**

**To: Charlotte R. Holden**

**Date: December 18, 2018**

Dear Researcher:

On 12/18/2018 the IRB approved the following human participant research until 12/17/2019 inclusive:

Type of Review: UCF Initial Review Submission Form  
 Expedited Review Category #7  
 Project Title: Move Your Body, Change Your Mind: Physical Activity in the  
 Morning and its Implications for Work  
 Investigator: Charlotte R. Holden  
 IRB Number: SBE-18-14555  
 Funding Agency: N/A  
 Grant Title: N/A  
 Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 12/17/2019, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the [Investigator Manual](#).

This letter is signed by:

Signature applied by Kamille Chaparro on 12/18/2018 02:46:06 PM EST

Designated Reviewer

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