EXAMINING POSITIVE DISTRACTION AS A COPING STRATEGY FOR
CHRONIC STRESS

BY

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Dedication

This dissertation is dedicated to my parents, Jim and Karen, and my sister, Jaimie, who have made countless sacrifices over the years to encourage my success and happiness.
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Chapter 2: An Ecological Study of Positive Distraction

abcs completely standardized indirect effect
CA cognitive avoidance
CESD Center for Epidemiologic Studies Depression Scale
CRI Coping Responses Inventory
df degrees of freedom
M mean
N sample size
ND neutral distraction
n.s. non-significant
PD positive distraction
$r_sp$ semi-partial correlation
Sample P parent sample
Samples U1, U2, U3 undergraduate samples
SD/SE standard deviation/standard error
SPC Situational Positive Coping measure
SWLS Satisfaction with Life Scale
95% CI 95% confidence interval

Chapter 3: Experimental Studies Comparing Positive and Neutral Distraction

ANCOVA analysis of covariance
bpm beats per minute
CL center line
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CO</td>
<td>cardiac output</td>
</tr>
<tr>
<td>ECG</td>
<td>electrocardiography</td>
</tr>
<tr>
<td>HR</td>
<td>heart rate</td>
</tr>
<tr>
<td>HRV</td>
<td>heart rate variability</td>
</tr>
<tr>
<td>ICG</td>
<td>impedance cardiography</td>
</tr>
<tr>
<td>L/min</td>
<td>liters/min</td>
</tr>
<tr>
<td>LCL</td>
<td>lower confidence limit</td>
</tr>
<tr>
<td>MAΔ</td>
<td>change scores, difference between two means</td>
</tr>
<tr>
<td>MAP</td>
<td>mean arterial pressure</td>
</tr>
<tr>
<td>mmHg</td>
<td>millimeters of mercury</td>
</tr>
<tr>
<td>msec</td>
<td>milliseconds</td>
</tr>
<tr>
<td>msec(^2)</td>
<td>milliseconds squared</td>
</tr>
<tr>
<td>NE</td>
<td>negative emotions</td>
</tr>
<tr>
<td>PEP</td>
<td>pre-ejection period</td>
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<tr>
<td>PNS</td>
<td>parasympathetic nervous system</td>
</tr>
<tr>
<td>RM-ANOVA</td>
<td>repeated measures analysis of variance</td>
</tr>
<tr>
<td>RSA</td>
<td>respiratory sinus arrhythmia</td>
</tr>
<tr>
<td>SBP</td>
<td>systolic blood pressure</td>
</tr>
<tr>
<td>SEM</td>
<td>standard error of the mean</td>
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<tr>
<td>SNS</td>
<td>sympathetic nervous system</td>
</tr>
<tr>
<td>TPR</td>
<td>total peripheral resistance</td>
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<tr>
<td>UCL</td>
<td>upper confidence limit</td>
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Abstract

Positive distraction involves distracting oneself from a stressor by thinking about or engaging in activities that induce positive emotion. It blends elements of disengagement coping (historically maladaptive) with elements of positive emotional coping (historically adaptive) and has been relatively understudied in the context of chronic stressors. This dissertation represents one of the first attempts to characterize the ecological implications and underlying mechanisms of positive distraction use. In one set of studies, I examined the real-world implications of using positive distraction across four samples, comparing it to both avoidance and neutral distraction and investigating some potential mediators of its efficacy. This first chapter demonstrated that both positive and neutral distraction are adaptive strategies for coping with chronic stress, while avoidance is maladaptive. However, positive distraction was still more predictive than neutral distraction of increased life satisfaction and decreased depression levels. In a second set of studies simulating chronic stress, I experimentally compared positive and neutral distraction as emotion regulation strategies for repeated laboratory stressors. I found that positive, but not neutral, distraction both replenishes energy levels lost during an initial stressor and buffers from the negative emotional and fatiguing consequences of a second stressor. Collectively, these studies provide a better understanding of how positive distraction is distinct from other more commonly studied coping strategies and suggest that it has an important role in helping people cope with chronic stress in daily life. Ultimately, I posit that it can and should be employed strategically to prevent burnout and mental health decline as chronic stress levels continue to rise in the modern world.
Chapter 1: General Introduction
Very intense and/or unresolved stress can have a multitude of detrimental effects on the psychological and physical health of an individual. Despite this risk, people actually exhibit a spectrum of responses to stressors. Some are resilient, only showing mild-moderate stress responses at the outset (Bonanno, 2004), while others succumb to the effects of the stressor and develop subsequent psychopathology or health problems. It was once thought that a majority of people are naturally quite resilient (Bonanno, 2004), but recent studies suggest that this may not be the case (Hobfoll et al., 2011; Infurna & Luthar, 2016). These more recent findings encourage a renewed effort to understand natural resilience in order to promote it in those who may be inherently susceptible to stress. The factors determining personal resilience are numerous and range from the molecular to the sociological/environmental (Feder et al., 2009). An important contribution to resilience are the strategies that people use to cope with their stress. Researchers have spent several decades elucidating the psychological and some of the physiological/neural mechanisms underlying the efficacy (or lack thereof) of a wide variety of coping strategies. Yet, one ecologically important strategy, positive distraction [turning toward pleasant stimuli to distract from a stressor; Webb et al. (2012)], has been somewhat neglected in many bodies of literature, either lumped together with other forms of emotional distancing like avoidance, or set aside in favor of emotionally neutral forms of distraction. That is not to say that positive distraction has been entirely absent from the stress and coping literature; it often appears under a different moniker (e.g. 'leisure coping'; Iwasaki & Mannell, 2000, or even just 'distraction' itself, referring to turning towards pleasant activities for distraction; Skinner et al., 2003). While these studies do not examine positive distraction in its entirety, they do point to the possibility that
positive distraction may be a useful coping strategy for helping people to be more resilient. In the following review, I build a case for the utility, adaptiveness, and even necessity of positive distraction coping, gathering evidence from several individual bodies of literature. I begin with a discussion on stress and why it is so paramount that we find ways to reduce it when it is very intense and/or chronic and follow with a general discussion of coping strategies, touching on the historical perspectives that have shaped coping dogma today. Next, I present evidence distinguishing positive distraction from its siblings, avoidance and neutral distraction, and discuss some possible mechanisms that make positive distraction a unique disengagement strategy. Finally, I identify future avenues for research as we aim to understand better how, why, and for whom (or for what) positive distraction is effective, with the ultimate goal of incorporating it into recommended coping interventions for health, stress-reduction, and well-being.

Stress and Why We Care: The Balance Between Susceptibility and Resilience

Stress has always been a ubiquitous aspect of the human condition, for which our ancestors evolved a well-defined set of physiological and psychological responses to cope. These responses, termed "allostasis" (Sterling & Eyer, 1988), are especially suited to help people deal with acute life stressors. For instance, an acute stressor like being chased by an animal predator or sitting for a difficult exam causes a normal release of catecholamines and glucocorticoids (Sapolsky, 2015). These molecules have a number of downstream effects, including increasing heart rate and diverting blood from the internal organs to the skeletal muscles (which facilitates running away from the predator) and improving executive function and working memory through glucocorticoid receptors in
the prefrontal cortex of the brain (which could help performance on the exam) (McEwen, 2007; McEwen et al., 2016). However, the adaptiveness of this stress response is tenuous and dose-dependent. Researchers have determined that the relationship between stress and its resultant effects can best be described by a U-shaped curve (McEwen, 2007; Sapolsky, 2015; Seery, Holman, & Silver, 2010). Both too little and too much stress are linked to unhealthy responses across a range of outcomes, whereas moderate stress levels actually seem to be adaptive. Seery et al. (2010) showed in a large longitudinal study that people who experienced some degree of adverse events in their lifetimes had higher levels of life satisfaction and lower levels of global distress, post-traumatic stress, and functional impairment than people who experienced either no events or high degrees of adverse lifetime events. This U-shaped response curve can also be observed in hippocampal synaptic plasticity, whereby a moderate amount of stress and its associated glucocorticoid levels facilitates synaptic potentiation and, thus, memory-encoding, while too little or too much impairs potentiation (Diamond et al., 1992; Okuda et al., 2004; Sapolsky, 2015; see McEwen, 2007 for a review). So the goal for stress researchers is not so much to eliminate people's responses to stress, but rather to optimize these experiences in order to enhance well-being and appropriate human development.

For most people, it is unlikely that they will experience no stress at all in a lifetime. Therefore, our efforts to optimize the stress experience will most likely be focused on preventing allostasis from exceeding the moderate range (i.e. from reaching "allostatic overload", a state in which the body's normal response to stress becomes exaggerated or prolonged; McEwen, 2007) or on preventing the development of long-term mental health disorders by bringing excessive stress levels back to a healthy range.
This goal requires us to appropriately identify the types of stressors that can contribute to allostatic overload or negative psychological sequelae. Both can be caused by very intense acute stressors, which may leave a lasting traumatic impression on an individual (e.g. disasters, abuse, loss of a loved one), or by chronic stressors, which arise when themed acute life stressors become chained together without proper coping and psychophysiological resolution (McEwen, 2007; Waugh, 2013). When individuals experience these traumatic or chronic stressors, the previously healthy stress responses begin to exert detrimental effects, putting people at a greater risk of developing poor physical and mental health outcomes. Chronically elevated catecholamines and glucocorticoids can lead to chronically elevated blood pressure and disrupted inflammatory responses (Karatsoreos & McEwen, 2011; Sorrells & Sapolsky, 2007). These physical outcomes may then contribute to the development of cardiovascular disease and diabetes (Fenton & Stover, 2006), metabolic syndrome (Juster et al., 2010; Rasmusson et al., 2010), adverse pregnancy outcomes (Hobel et al., 2008), reduced ability to fend off HIV/AIDS (Cohen et al., 2007), and tumor progression (Powell et al., 2013). Unresolved chronic stress may also lead to the development of a number of psychopathologies, including post-traumatic stress disorder (McEwen, 2007), anxiety (Charles et al., 2013; Davidson & Baum, 1986; Friedman & Pavlovsky, 2009; Lawrence & Fauerbach, 2003), and major depressive disorder (Charles et al., 2013; Dantzler et al., 2008; Fullerton et al., 2004; Goshen et al., 2008; Hammen et al., 2009; Zatzick et al., 2008).

Importantly, not everyone who experiences stress will develop poor outcomes. People may respond to traumatic and/or chronic stressors in a number of ways. Some are
resilient, responding appropriately to stress at the outset, then successfully recovering to pre-stress levels. These individuals may first show markers of elevated distress, which then disappear with recovery (Bonanno, 2004; Infurna & Luthar, 2016). Other people may experience posttraumatic growth, in which their psychological functioning improves relative to pre-stress levels through coping and other transformation efforts (Jayawickreme & Blackie, 2014; Tedeschi & Calhoun, 2004), and still others, a much larger proportion than was previously thought (Infurna & Luthar, 2016), do not cope successfully over time and develop subsequent mental and physical health problems.

What determines one's trajectory seems to be an interaction between biological constitution and environmental factors, including the amount of resources at one's disposal and the coping choices one makes. Researchers are now beginning to understand the many molecular individual differences that make one person more resilient vs. susceptible to stress (Alexander et al., 2009; Friedman & Pavlovsky, 2009; Gotlib et al., 2008; Hodes et al., 2015; Russo et al., 2012; Sapolsky, 2015). However, reducing the risk of developing poor outcomes via these biological mechanisms is still, largely, not at our disposal. On the other hand, facilitating effective coping, or helping people to make better coping choices and improving their coping resources, is one important, controllable way in which environmental susceptibility to stress can be reduced. Researchers have spent decades trying to elucidate the most effective methods for coping successfully with chronic stressors, and yet new insights are still being made. The rest of this work focuses on how coping strategies, specifically positive distraction, serve to decrease stress levels when necessary and help individuals recover from chronic, or repeated, life stressors, so that the risk of developing subsequent detrimental health problems is reduced.
History Shapes Modern Coping Dogma, but New Perspectives Emerge

People cope with life stressors using a wide variety of methods. To simplify constructs, researchers have historically painted in broad swaths when trying to characterize and understand these strategies. The most common groupings pit problem-focused strategies (those that aim to solve concrete problems associated with a stressor; Carver et al., 1989) against emotion-focused strategies (those that aim to deal with the emotions associated with a stressor; Carver et al., 1989) and approach oriented strategies (those directing energy and effort toward a stressor; Moos & Schaefer, 1993) against avoidant/disengagement strategies (those directing energy and effort away from a stressor; Moos & Schaefer, 1993).

The issue with dichotomizing coping mechanisms is that we begin valuing one category over another. People begin thinking of some broad groupings as adaptive and useful for relieving stress and others as maladaptive exacerbators of distress. Several decades of research support and drive these assumptions that problem-focused strategies are good, emotion-focused strategies are bad; approach-oriented strategies are good, and avoidant strategies are bad (Baker & Berenbaum, 2007; Bonanno & Burton, 2013; Stanton et al., 1994). This dogma has been internalized by the stress and coping literature enough that studies have investigated the effects of "maladaptive coping" on some outcome by measuring use of avoidant strategies (Johnson & Lynch, 2012; Zheng et al., 2012), or have hypothesized mechanistic links between maladaptive personality traits and use of emotion-focused strategies (Chang, 2012) - in other words, making a priori assumptions of the connection between these categories and undesirable outcomes.
But relatively recently, there has been a growing movement to challenge these principles (Aldao, 2013; Bonanno & Burton, 2013; Cheng et al., 2014; Folkman & Moskowitz, 2004; Stanton & Revenson, 2006), particularly as evidence accumulates against the fallacy of uniform efficacy (subscribing to a belief that certain categories of strategies are consistently good for health outcomes or not; Bonanno & Burton, 2013). This new evidence primarily suggests that the traditionally maladaptive strategies are sometimes more predictive of favorable outcomes than the traditionally adaptive strategies. In certain contexts, managing one's emotions about a stressor is better than trying to problem-solve (Austenfeld & Stanton, 2004), suppressing overt emotional responses can be better than expressing them (Webb et al., 2012), and avoiding negative emotions is not necessarily predictive of prolonged grief and psychological distress (Bonanno et al., 1995). So it is quite possible that old perspectives of cataloguing coping mechanisms are inadequate, and with this call to upend old adages comes the opportunity to reevaluate, or even more closely evaluate for the first time, coping strategies that we thought we already knew. Positive distraction is one such strategy that deserves more specialized attention.

**Redefining 'Disengagement'**

Distraction is notoriously difficult to characterize, having once been relegated to the maladaptive group along with avoidance and other traditional forms of disengagement (e.g. wishful thinking, denial; Friedman & Silver, 2006), but is more and more frequently recognized as predictive of successful coping. There are several possible reasons for the empirical ambiguity observed with the efficacy of using distraction to
cope with stress. The first are the reasons discussed briefly above - that coping efficacy is probably a more complex issue than we once thought, with distraction being effective in some contexts, but less so in others. However, distraction coping also lacks a consistent definition specific enough to capture its nuances. The broadest description defines distraction as a means to cope with stress by disengaging, or diverting one's attention and efforts away, from a stressful stimulus (Traeger, 2013), a definition that effectively yokes distraction with avoidance. Studies employing this perspective often utilize measures that confound disengagement cognitions and behaviors with unfavorable outcomes (e.g. "I drink alcohol or take drugs, in order to think about it less" or "I sleep more than usual"; COPE Inventory; Carver, Scheier, & Weintraub, 1989) or use language with a negative tone (e.g. "I admit to myself that I can't deal with it, and quit trying"; Carver, Scheier, & Weintraub, 1989). Not surprisingly, these studies often find that using distraction is linked with worse psychological and physical outcomes, including anxiety, depression, prolonged stress, and more feelings of hopelessness (Dunkel-Schetter et al., 1992; Higgins & Endler, 1995; Landis et al., 2007; Simpson et al., 2012). Other definitions of distraction provide an additional clause, that it is an act of disengaging from a stressor, but by "redirecting attention toward an alternative target and [reflects] awareness and acknowledgement of the stressor" (pg. 92, Compas et al., 2001). Another definition even specifies the nature of the alternative target as "alternative pleasurable activities" (pg. 242, Skinner et al., 2003). Studies adopting these definitions tend to report a positive association between distraction coping and psychological adjustment (Bushman, 2002; Kohl et al., 2013; Stone et al., 1995).
These discrepant findings are possibly due to a differential qualification of the act of disengaging, with the latter depiction of distraction as an adaptive coping strategy being more ecologically valid. When individuals distract themselves from a stressor, it is with a particular intention to somehow cope with that stressor. This intentionality leads them to engage with another target, whether it be a pleasant thought or activity, or some other emotionally neutral task. Because of this subsequent engagement process, distraction has sometimes been characterized as an approach-oriented (Hamilton & Ingram, 2001; Patry et al., 2007; Snyder & Pulvers, 2001) or engagement (Skinner et al., 2003) coping strategy. In contrast, avoidance reflects a disengagement process without the intention of coping. Indeed, Snyder and Pulvers (2001) present a model in which people avoid a stressor after making the appraisal that they do not have the resources to try and cope with it. Avoidance then becomes a reactive fall-back to active coping, employed when an individual has no other way to deal with the stressor or its emotional consequences. I summarize this distinction with the assertion that distraction occurs when individuals engage with coping by disengaging from a stressor, while avoidance occurs when individuals disengage from coping and the stressor altogether.

Patry et al. (2007) provide empirical evidence for the differences in motivational drive between distraction and avoidance. Interestingly, they were able to show that similar disengagement behaviors (leisure coping, or engaging in pleasurable leisure activities) could be used with two very distinct intentions and had opposing effects on outcomes. Individuals used distraction as "planned breathers," or temporary productive distractions, when they wanted to cope with a stressor in order to promote self-important goals (intrinsic motivation in Self-Determination Theory; Ryan & Deci, 2002). Using
distraction with this intention was positively associated with positive emotions felt about a stressful experience. In contrast, people used distraction in an avoidant manner when they wanted to deny that the stressor existed. Avoidant distraction was negatively correlated with positive emotions felt about a stressor and positively associated with stress, negative emotions felt about a stressor, and physical exhaustion. Tsaur and Tang (2012) showed further that using distraction as a planned breather buffered individuals from the detrimental effects of stress and promoted well-being, whereas using distraction as an avoidance strategy enhanced the detrimental effects of stress and reduced subsequent well-being. Therefore, it seems that there are really two shades of disengagement, which can be either adaptive or maladaptive, depending on whether it is used with the intention of actively coping with a stressor (distraction) or avoiding its existence (avoidance).

"Take a Break and Come Back to It Later"

Clearly an important function of distraction coping is allowing for temporary, planned breaks from stressful experiences (Iwasaki & Mannell, 2000; Patry et al., 2007; Perez-Sales et al., 2005). These moments of respite then serve at least three important coping functions that ultimately help people to feel refreshed and better able to cope with their stressors after a reprieve (the key being that one returns to cope with the stressor or its related emotions after a time; Iwasaki, 2001; Shimazu & Schaufeli, 2007). The first function is self-protection. Diverting attention away from a stressor pauses the tide of negative emotions associated with the stressful experience, thereby disrupting the harmful processes that link chronic or traumatic stress to poor outcomes (Kleiber et al.,
Indeed, Sheppes and Gross (2011) have found that distraction is most useful for people and more preferred than other emotion regulation strategies when it is employed early during a negative experience because it stops the processing of negative emotions before they become too prominent or cognitively salient.

A second function of temporary breaks is self-restoration (Kleiber et al., 2002). Stress and its negative emotional consequences can be mentally, emotionally, and physically exhausting, often involving some kind of resource loss. Hobfoll’s (2011) Conservation of Resources theory of stress posits that people are driven to protect and preserve resources that they hold to be important (e.g. physical health, social bonds, mental energy, self-esteem, etc). The subjective experience of stress occurs when these resources are lost, while the stockpiling of, or even just the motivation to gain (or regain) these resources contributes to successful coping. A wealth of evidence supports this resource gain vs. loss model of resilience and stress (see Hobfoll, 2011 for a review), strongly suggesting that personal resources play an important role in helping individuals to cope successfully with life stressors. Distraction allows people to step away from their stressors temporarily in order to replenish these resources that were lost during the stressful experience (Hamilton & Ingram, 2001). This self-restoration process builds on itself in a self-perpetuating way, such that the more one breaks away from the negative and often narrowed perspective of stress in order to restore lost resources, the easier it will be to cope with the stressor later, and the more time and energy one will have to devote to further cultivation of personal resources. In essence, maladaptive downward spirals of negativity and loss encountered during traumatic or chronic stress often bring an individual from the point of an initiating stressful experience to the depths of long-
term psychological and/or physiological distress; distraction allows people to counter these downward spirals by initiating upward spirals resource "gain cycles" (Hobfoll, 2011).

Preparation is the third important function of planned breathers from stress. Aside from the opportunity to stockpile resources, a number of researchers have proposed that distraction stimulates new ways of thinking about a negative situation, which in turn may facilitate future coping efforts through accommodation, or fit-focused secondary control (bringing one's personal goals, beliefs, and motivations more in line with the situation in question; Morling & Evered, 2006) to the stressor if it is not controllable, or problem-solving if it is controllable (Iwasaki et al., 2005; Shimazu & Schaufeli, 2007; Skinner et al., 2003). Specifically, Iwasaki et al. (2005) found from qualitative reports that people used distraction to gain new perspectives of their stressors and to reappraise them as less stressful than initially perceived, and Shimazu & Schaufeli (2007) found that distraction and problem-solving worked synergistically to improve the subjective well-being and job performances of people experiencing high levels of job stress. Together, this evidence suggests that distraction coping is adaptive because it allows people to take a break from their stressors, either to protect from becoming overly taxed or to prepare for more adequate re-engagement with the stressor at another time.

Distraction Coping Can Be Either Neutral or Emotionally-Valenced

I have argued thus far that distraction coping is distinct from avoidance in that it is an adaptive disengagement strategy, while avoidance is maladaptive. Distraction itself can be further qualified as involving positively-valenced or emotionally neutral
alternative targets (positive distraction or neutral distraction, respectively). As an aside, I posit that it is unlikely for distraction coping, as I have defined it here, to be negatively-valenced. Turning away from a stressor and towards a target that induces negative emotions perhaps implies an extreme desire to disengage from a stressor, in which case it is not likely that one intends to cope with the stressor at all and, therefore, is more consistent with my definition of avoidance coping. That is, I propose that if and when people are driven to engage in "negative distraction," their underlying intention is to avoid the stressor and not to take a temporary, planned break from it. This note is distinct from the idea that distraction can be employed through engaging in physically unhealthy behaviors (e.g. smoking) as planned breaks, which may then promote improved mental health and adaptive psychological outcomes. Likewise, engaging in physically healthy behaviors (e.g. exercise) may be wholly unenjoyable to an individual and, therefore, an additional source of mental burden. Thus, I also posit that the physical healthiness of a distraction strategy does not necessarily correlate with its mental healthiness.

From a coping perspective, a key distinction between positive and neutral distraction may be the difference between helping someone to feel less badly about a stressor (i.e. fewer negative emotions, less stress, etc.) and helping someone to feel better about a stressor (i.e. still reducing stress levels, but also increasing positive emotions in the process). Indeed, Van Dillen & Koole (2007) describe neutral distraction as "[activities] that draw the person's attention away from his or her mood, so that the person's mood becomes more neutral" (pg. 715), whereas positive distraction involves turning to positive stimuli to enhance positive mood (McCuskey Shepley, 2006; Skinner et al., 2003; Webb et al., 2012).
Quantitatively, a greater number of experimental studies have been devoted to neutral distraction (Webb et al., 2012), but there is good evidence to suggest that both are effective at helping people to respond less negatively to acute negative stimuli (Dalebroux et al., 2008; Fredrickson & Levenson, 1998; Joorman et al., 2007; Kalisch et al., 2005; Kuehner et al., 2009; Langens & Morth, 2003; Sheppes & Gross, 2011; Smolarski et al., 2015; Van Dillen & Koole, 2007; Van Dillen & Koole, 2009). For instance, Sheppes et al. (2014) have shown that people prefer to use neutral distraction over other regulation strategies when acute stimuli are intense, an effect that is increased as the distraction task becomes more mentally taxing. Smolarski et al. (2015) asked participants to think about three stressors in their life at the moment, then had them draw pictures of something happy (positive distraction) or trace a series of lines (neutral distraction). Both improved mood over time. At times, positive and neutral distraction have been found to be effective in different contexts. Joorman et al. (2007) found that both a neutral word construction task and recall of positive memories helped reduce negative mood in never-depressed individuals, but only the neutral distraction task was beneficial for depressed individuals. And Langens and Morth (2003) showed that people prefer to utilize neutral distraction for low-intensity threatening stimuli, but actively switch to using positive distraction when presented with high-intensity negative stimuli. Interestingly, the two strategies do not seem to differ significantly in how well they help people deal with acute negative stimuli (see Webb et al., 2012\(^1\) for a meta-analysis), a similarity that may be attributable to overlapping neural circuitry. Both positive and neutral distraction increase activation in brain regions associated with successful emotion

\(^1\) One explanation for the lack of significant difference in efficacy may have been that the number of studies included for positive distraction was much less than that for neutral distraction, possibly skewing the overall findings.
regulation (e.g. the lateral prefrontal cortex; Delgado et al., 2008; Gyurak & Etkin, 2014; Kanske et al., 2011; McRae et al., 2009) and decrease activation in brain regions associated with fear, stress, and negative emotion processing (e.g. the amygdala; Delgado et al., 2008; Kanske et al., 2011; McRae et al., 2009; Ressler, 2010).

Even so, the two forms of distraction are not identical, as they may be qualitatively different in the context of chronic or repeated stressors. The few studies directly comparing the two as coping strategies for chronic stressors have found that while both provide benefits to coping with chronic stressors, positive distraction is used more often and with better subjective psychological outcomes. Iwasaki (2001) found that engaging in leisure activities as a means of distraction coping (i.e. "leisure coping") predicted improved coping efficacy (a belief that one is coping well; Iwasaki, 2001) and well-being even when accounting for the predictive effects of other commonly studied coping strategies including avoidance and other forms of disengagement. Similar findings have been reported in response to natural disasters. Perez-Sales et al. (2005) found that survivors of the 2001 earthquakes in El Salvador relied on both incorporating daily routine into their lives and engaging in positive activities to cope with their stress. However, the humorous theatrical plays organized by the disaster shelters were the most effective at reducing stress levels compared to all other coping resources. Survivors of the 2004 tsunami in Sri Lanka exhibited similar coping preferences, reporting that they relied heavily on positive distraction (e.g. “sports activities, drawing sessions, and dramas”; Ekanayake et al., 2013, pg. 72) to cope after the disaster.

These differences in efficacy may stem from distinct neural mechanisms for processing emotional vs. non-emotional information (Bryant, Chadwick, & Kluwe, 2011;
Dolcos & McCarthy, 2006; Oei et al., 2012). For instance, emotionally-valenced distracters shown after an acute stressor increased activation in ventral "affective processing" brain regions while neutral distracters decreased this activation (Oei et al., 2012). Moreover, positive stimuli have been shown to evoke both this distinct "affective" pattern of neural activity, as well as activation of brain regions that are involved in the processing and persistence of positive emotions (e.g. ventromedial prefrontal cortex; Matsunaga et al., 2009; Monosov & Hikosaka, 2012; Wager et al., 2008; Waugh, Shing, et al., under review). This activation in the ventromedial prefrontal cortex does not occur in response to neutrally valenced stimuli and is positively correlated with subjective pleasantness while watching positive emotion-inducing videos (Matsunaga et al., 2009).

A comparison of findings from McRae et al. (2010) and Kanske et al. (2011) vs. Delgado et al. (2008) extends these findings beyond the processing of positive stimuli to show that positive *distracters* as emotion regulation agents also recruit brain regions that process positive emotions as part of the mechanism underlying positive distraction efficacy. Specifically, McRae et al. (2009) and Kanske et al. (2011) tested a neutral distraction paradigm, finding that neutral distraction successfully reduced negative affect, accompanied by decreased activation in the amygdala and increased activation in the lateral prefrontal cortex. Delgado et al. (2008) tested a *positive* distraction paradigm, finding similar reductions in negative affect and amygdalar activity with increased lateral prefrontal cortex activations but also an additional relative activation in the ventromedial prefrontal cortex.

Until now, I have presented a case for the benefits of both positive and neutral distraction as coping strategies that allow people to take a break from stressful
experiences. While the two seem to be equally effective for recovering from acute negative stimuli, there seems to be a relative advantage of positive distraction over neutral for coping with chronic stressors. I posit that, as these neural studies suggest, an important underlying mechanistic distinction between the two could be that positive distraction may capitalize on the presence and cultivation of positive emotions, which is reflected in its recruitment of neural regions implicated in the processing of positive emotional stimuli. Positive emotions provide a wide-ranging set of benefits to individuals both in daily life and during times of stress. In the following sections, I discuss these benefits, then follow with how the incorporation of positive emotions may make positive distraction more effective than neutral for coping with chronic stressors.

How Could Positive Emotions Help Positive Distraction Be an Adaptive Coping Mechanism?

Positive Emotions Promote Health and Resilience

Contrary to popular belief, positive and negative emotion levels are not orthogonal to each other (Cacioppo & Berntson, 1994). That is, people can experience elevated levels of both positive and negative emotions, but it is the presence of positive emotions experienced during a stressor that predicts how resilient one is to developing post-stress distress. Trauma and grief victims co-experience positive and negative emotions felt about their respective stressors (Bonanno & Keltner, 1997; Folkman & Moskowitz, 2000; Fredrickson et al., 2003; Ong & Bergeman, 2004; Ong et al., 2006), a phenomenon that has also been shown in lay populations regarding daily stressors (Ong et al., 2006). The individuals most resistant to poor post-stress outcomes in each of these
studies reported experiencing relatively higher levels of positive emotions compared to those who were less resilient, and the highly resilient people used increases in positive emotions to reduce the depressive impact of a traumatic stressor (Fredrickson et al., 2003). Ong et al. (2006) also found that if low-resilient individuals were able to experience higher levels of positive emotions in the midst of a stressor, they also tended to report having lower levels of negative emotions, suggesting that positive emotions could even protect less resilient people from the negative consequences of stress.

Positive emotions also have the capacity to dampen the physiological stress response (see Dockray & Steptoe, 2010 for a review). They have been linked to lower daily cortisol levels (Hoyt et al., 2015; Steptoe et al., 2005), morning cortisol levels (Brummett et al., 2009; Steptoe et al., 2007), daily average heart rate (Steptoe et al., 2005), pro-inflammatory cytokines (Stellar et al., 2015), and fewer sleep disturbances (Steptoe et al., 2008). Moreover, positive emotions predict lower inflammatory (Bostock et al., 2011; Ditzen et al., 2008; Steptoe et al., 2005) and blood pressure (Brummett et al., 2009; Steptoe et al., 2007) responses to stressors, and people at risk of depression who are able to maintain their positive emotion levels in the midst of a stressor also exhibit less cortisol reactivity (Waugh et al., 2012).

The stress-protective effects of positive emotionality can also be observed on a neural level from studies involving the ventromedial prefrontal cortex. Increased ventromedial prefrontal cortex activity is associated with reduced amygdalar reactivity to threat (Somerville et al., 2013), negative stimuli (Johnstone et al., 2007), and social stress (Kern et al., 2008) in both humans and rats (Milad & Quirk, 2002; Quirk et al., 2003). Reduced ventromedial prefrontal cortex activity after stress is linked to larger heart rate
stress reactivity, and damage to the ventromedial prefrontal cortex is associated with greater subjective stress responses (Buchanan et al., 2010). Kern et al. (2008) also reported that stress-concurrent glucose metabolism in the ventromedial prefrontal cortex was associated with lower perceived stress, higher perceived control, and smaller cortisol reactivity to a social stressor. Lataster et al. (2011) found similarly that stress induced dopamine release in the ventromedial prefrontal cortex, but posited that this release may actually be important for attenuating the stress experience, as ventromedial prefrontal cortex-specific dopamine depletion in rats results in a heightened mesolimbic stress-related activation (Scornaiencki et al., 2009). Finally, ventromedial prefrontal cortex activity is also linked with real-world psychological outcomes, such as the persistence of daily positive emotional states (Waugh, Shing, et al., under review), less anxiety (Somerville et al., 2013), and better response to transcranial magnetic stimulation treatment for depression (Kito et al., 2012).

How Do Positive Emotions Promote Health and Resilience?

Researchers have proposed a number of mechanisms linking positive emotions to good outcomes. Primarily, positive emotions help people build resources and expand their cognitive/behavioral repertoires for coping with stressors, aid in recovering from the negative consequences of a stressful experience, and may serve as safety signals in the midst of a stressor to encourage continued coping efforts. I present these mechanisms in further detail below.

The Broaden-and-Build theory of positive emotions. Fredrickson (1998) pioneered a new era of positive psychology with the Broaden-and-Build theory of
positive emotions, which posits that positive emotions serve at least two important functions. The first, proximal function, is to broaden the possible cognitive and behavioral responses an individual has within a given moment (i.e. thought-action repertoires; Fredrickson, 1998). These enhanced thought-action repertoires provide individuals with greater possibilities for interacting with the environment and for coping with stressors in a unique way. Whereas negative emotions tend to narrow one's focus in response to a stimulus (purportedly to provide rapid, evolutionarily-conserved responses to stress or threat), positive emotions (specifically those like gratitude and amusement that are also characterized by low motivational drive; Harmon-Jones et al., 2013; Huntsinger, 2013; Huntsinger et al., 2014) do the opposite. A series of seminal studies showed that positive emotion inductions helped people make more abundant and more creative word associations (Isen et al., 1985) and more creative problem-solving choices when faced with a difficult task (Isen et al., 1987) compared to people who received neutral emotion inductions. Derryberry and Tucker (1994) also proposed that positive emotions can widen the scope of attentional foci. Since then, a plethora of research has accumulated (Isen, 2008 for review) to show that positive emotions do tend to broaden attention (Biss et al., 2010; Fredrickson & Branigan, 2005; Grol et al., 2013; Johnson, Waugh, & Fredrickson, 2010; Rowe, Hirsh, & Anderson, 2007), aid executive functioning (Yang et al., 2013), and enhance cognitive flexibility (Biss et al., 2010; Johnson, Waugh, & Fredrickson, 2010). For instance, Schmitz et al. (2009) reported that negative affect increased filtering of peripheral, unattended stimuli from the primary visual cortex to higher-order visual processing regions; in contrast, positive affect decreased filtering of these peripheral stimuli such that individuals neurally encoded a
broader spectrum of attentional foci after being induced to experience positive emotions. These studies suggest that positive emotions promote a more open encoding of and interaction with an individual's external environment.

This broadening of possibilities for interacting with the environment then promotes the second, ultimate, function of positive emotions as posited by the Broaden-and-Build theory - to build resources for future use (Fredrickson, 1998). Joy and interest, for instance, encourage individuals to play and explore in their surroundings (Fredrickson, 1998), while feelings of love encourage individuals to approach loved ones and forge stronger interpersonal connections (Fredrickson, 1998; Waugh & Fredrickson, 2006). The ultimate function of these positive emotion-derived actions is to build personal resources (e.g. improved creativity/knowledge stores, greater social networks; Fredrickson et al., 2003) that help buffer from psychological distress in subsequent stressful situations. Even positive emotions cultivated internally, but that do not result in or from interactions with the environment, can increase perceived personal resources. Kok et al. (2013) found that people who practiced loving-kindness meditation (a type of meditation that focuses on generating positivity and feelings of love towards self and others; Salzberg, 1997) reported higher positive emotion levels than people who did not practice this form of meditation, and these positive emotions predicted perceptions of greater social connections and resources. Having more resources can then predict better health such as higher vagal tone, which has been linked to better gastrointestinal health (Bonaz et al., 2016) and reduced risk of heart disease (Abboud et al., 2012; Kok et al., 2013), more satisfaction with life (Fredrickson et al., 2008), less depression (Fredrickson et al., 2008), and very low levels of post-traumatic stress after a traumatic event.
(Bonanno et al., 2007). Importantly, the stockpiling of resources takes time, which is perhaps one reason why the relative benefit of positive distraction over neutral distraction has been difficult to observe in the setting of acute laboratory stimuli. The resource-building functions of positive emotions should be observed over a longer period of time, or at least in the context of repeated laboratory stressors.

**Positive emotions undo the effects of negative emotions.** Positive emotions have also been found to help undo the negative effects of stress once experienced across a range of outcomes. When people were shown positive, neutral, and negative emotion-inducing videos after first receiving a uniform fear induction, the participants who viewed the positive videos experienced more rapid cardiovascular reactivity compared to participants who viewed neutral and negative videos (Fredrickson & Levenson, 1998). Tugade and Fredrickson (2004) and Brown et al. (2013) reported similar findings, but in response to a laboratory social stressor, rather than to negative videos. Similarly, Tice et al. (2007) first exhausted people's self-control abilities by exposing them to a stressor, then gave them a positive, neutral, or negative emotion induction. Only the participants receiving the positive emotion induction were able to conduct a second self-control task as well as those who had never been exhausted in the first place. People who experience lower naturally-occurring levels of positive affect after a stressor also exhibit less complete heart rate recovery from stress (Waugh et al., 2012). Importantly, this restoration effect is not isolated to acute, or state, elevations in positive emotion levels.

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2 Although beyond the scope of this work, there is plentiful evidence for the role of neural plasticity in the ventromedial prefrontal cortex in resilience and reversing the effects of stress (Franklin et al., 2012 provide a review). For instance, Covington et al. (2010) showed that certain genes were down-regulated in the ventromedial prefrontal cortex of mice after exposure to a social defeat stressor to induce depressive behavior (i.e. reduced social interaction with other mice and decreased preference for sugar). Subsequent optogenetic stimulation of the ventromedial prefrontal cortex reversed these behavioral reductions and up-regulated the previously down-regulated genes.
but can extend to more ecologically relevant circumstances as well. People with higher daily positive emotional states exhibit faster and more complete recovery of diastolic blood pressure (Bostock et al., 2011; Papousek et al., 2010; Steptoe et al., 2007), sympathetically-influenced heart rate variability (Papousek et al., 2010), and subjective stress levels (Papousek et al., 2010) in response to stressors.

**Positive emotions serve as a safety signal.** Positive emotions may also serve as a signal of general safety in the midst of a stressful experience. Positive social emotions may have developed evolutionarily to signal times when our hominid ancestors were not in any immediate danger and could engage in play or foraging exploration of the environment (Gervais & Wilson, 2005), a signal that has persisted through time and allows people to form closer social bonds (Kurtz & Algoe, 2015). Because of the lasting symbolism of this safety signal, positive social emotions may not be useful just during times of actual safety, but also during times of stress, as laughter has the power to diffuse tense situations when employed during conflict (Butzer & Kuiper, 2008) and contributes to higher pain thresholds (Dunbar et al., 2012).

Extrapolating beyond positive social emotions, it may be that generating any sort of positive emotions (i.e. of either a social or a non-social nature) could function to signal an individual's safety or well-being in the midst of a stressor. A number of studies have shown that the ventromedial prefrontal cortex plays a central role in threat removal (see Diekhof et al., 2011 for meta-analysis) via passive fear extinction (i.e. abolishing a conditioned fear response by removing the co-presentation of a benign stimulus and a threatening stimulus), placebo, and more complex cognitive emotion regulation strategies like positive distraction (Delgado et al., 2008). The fact that the ventromedial prefrontal
cortex is also involved in processing positive emotions offers the possibility that positive emotional experiences are connected to fear extinction, thereby providing additional support for the theory that even non-social positive emotions could serve as evolutionarily-conserved safety signals from threat.

**Positive Emotions as Boosts to Coping with Chronic Stress: A Case for Positive Emotional Coping Strategies**

It is clear that positive emotional states serve an adaptive function for a wide range of stressful or negative emotion-inducing situations. From a stress and coping perspective, this psychological and physiological adaptiveness can be harnessed to promote successful coping, and subsequently, improve long-term outcomes and resilience, especially to chronic stress. Folkman and Moskowitz (2000) produced a seminal article detailing some ways in which positive emotions can be useful in the coping process. This paper effectively created a new family of coping strategies - the positive emotional coping strategies - that are "related to the occurrence and maintenance of positive affect" (pg. 650). These strategies included positive reappraisal (the cognitive reframing of a situation to be seen more positively), goal-focused problem-focused coping (finding controllable situations with which to engage, even while simultaneously experiencing uncontrollable stressors), and infusing ordinary life events with positive meaning (intentionally creating or specially noting positive life experiences). These positive emotional coping strategies, as well as other more recent additions (e.g. mindfulness meditation, gratitude, positive expressive writing, acceptance, benefit-finding; Quoidbach et al., 2015), have been linked to improved life satisfaction and well-
being, less depression and anxiety, better physical health, and more tempered physiological stress responses (Aspinwall & Tedeschi, 2010; Bower et al., 2008; Folkman, 2008; Garland et al., 2010; Sin & Lyubomirsky, 2009 for reviews). Impressively, Sin & Lyubomirsky (2009) found medium effect sizes in a large meta-analysis for the effect of positive psychology interventions on heightened well-being and lower depressive symptoms, suggesting that positive emotional coping strategies are quite effective at helping people cope with stress.

**Positive Distraction is a Positive Emotional Coping Strategy**

Although not currently recognized as such, I believe that positive distraction should be the newest to fall into the fold of positive emotional coping strategies\(^3\). The leisure coping literature provides good evidence to suggest that positive distraction reliably increases positive emotionality (Hood & Carruthers, 2013; Iwasaki & Mannell, 2000; Kim & McKenzie, 2014; Newman et al., 2013; Patry et al., 2007; Qian et al., 2014; Zawadzki et al., 2015), and there is also some evidence to support the role of positive distraction in stress regulation via activity in the ventromedial prefrontal cortex (Delgado et al., 2008). As such, positive distraction has the potential to bestow on a stressed individual all of the immediate and more long-term psychological and physiological benefits of positive emotionality that characterize these other positive emotional coping strategies and ultimately promote resilience to stress. Accordingly, there is already some

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\(^3\) Most studies on positive distraction have been conducted in the context of momentary, or acute, emotion-regulation to laboratory stressors or stimuli. In fact, Sin and Lyubomirsky (2009) do not report any studies utilizing positive distraction as a coping strategy or psychological intervention in their meta-analysis. In a review connecting positive coping interventions with emotion-regulation concepts, Quoidbach et al. (2015) also did not cite any studies investigating positive distraction as an established positive coping technique. This lack of recognition suggests that positive distraction is not yet a well-recognized positivity-based coping mechanism. Greatest support for positive distraction as an adaptive coping strategy comes from the leisure coping literature that has been periodically referenced throughout this paper.
evidence to suggest that positive distraction may be a stress-protective strategy in daily life. Zawadzki et al. (2015) conducted a study utilizing frequent assessments over the course of several days and found that people reported higher levels of positive affect, lower levels of negative affect and stress, and exhibited decreased heart rates when they were engaging in leisure vs. not. Notably, this group did not examine the effects of using positive distraction as a strategy to intentionally cope with life stressors, but Kim & McKenzie (2014) concluded through qualitative interviews that people do use leisure activities to increase their positive emotion levels and reduce stress levels. Qian et al. (2014) also found that leisure coping is more effective under conditions of high vs. low daily stress, in part because its value increases when people are busier and do not get to experience leisure very often. Although these studies point to some ways in which positive distraction can be adaptive, they do not assess its impact on general or long-term psychological and physiological health. This exploration should be a focus for future studies on positive distraction coping.

Another reason why I believe positive distraction to be a positive emotional coping strategy is that it theoretically combines elements of at least three already established positive emotional coping strategies. By providing people with temporary breaks from stressful situations, it may allow for: 1) the creation and savoring of positive life experiences unrelated to a stressor (infusing ordinary life events with positive meaning), 2) the redirection of attention to engage in controllable situations even while faced with uncontrollable stressors (goal-focused problem-focused coping), and 3) a distancing or separation from people's self-focused negative attention induced by stressful experiences (similar to a well-established mechanism for mindfulness
meditation; Garland et al., 2010; Hamilton & Ingram, 2001). So not only may positive distraction serve as an adaptive coping strategy because it directly increases positive emotion levels, but also because it can create opportunities for people to engage in other forms of positive emotional coping during moments of respite from the stressor. In these ways, positive distraction can both mitigate stress and negativity in the short-term and promote resilience and well-being for chronic, or repeated, life stressors.

**Future Questions**

I have presented what I hope is a clear proposal for the utility of positive distraction as an adaptive coping strategy and some possible mechanisms by which it may promote resilience above and beyond neutral distraction (see Figure 1 for a mechanistic summary).

![Figure 1. Summary of mechanisms linking positive and neutral distraction to adaptive coping outcomes in the current literature. Positive distraction may be relatively more beneficial than neutral distraction because it increases positive emotions and allows for temporary breaks from stress. Neutral distraction only facilitates planned breaks.](image-url)
When people are stressed, they tend to experience a narrowed and often harmful mindset of negativity. Positive distraction allows them a momentary respite from this stress, which, along with the positive emotions it elicits, can be used to recover from or prevent further harm, replenish resources, and reinterpret stressful situations, all to facilitate future coping efforts, promote well-being, and possibly prevent long-term distress. There are, however, a number of questions that remain as few of these theorized mechanisms have been tested directly, in the context of real-world stressors (vs. in the acute, laboratory setting), and for a range of psychological and physiological outcomes. Moreover, the intricacies and nuances of positive distraction efficacy have yet to be elucidated, presenting another set of questions to be addressed by future research. In the following sections, I discuss these questions and introduce three studies enclosed in this dissertation to initiate this research.

1) What are the Ecological Effects of Positive Distraction Coping?

While it seems clear that positive distraction elevates positive emotions, and there are good reasons to believe that it is an adaptive coping strategy, the fact remains that it has been grossly understudied compared to the other positive emotional coping strategies. Furthermore, there is a general lack of studies examining its efficacy in an ecological context. Researchers have either focused on its functions in an acute, laboratory setting, or have only examined the real-world effects of leisure as a coping strategy. Leisure is only one way in which positive distraction may manifest, so these studies are still limited in scope. An important question to address, then, is whether and how positive distraction influences real-world psychological and physical outcomes when used as a coping
strategy for chronic life stressors. Is there a consistent relationship between using positive distraction and exhibiting improved outcomes? If positive distraction is adaptive, why? Does it facilitate the efficacy of other adaptive coping strategies or engender reinterpretations of the stressor? If positive distraction is not adaptive, why? Does it share functional elements with avoidance? And how does it compare to neutral distraction as a coping strategy for life stressors?

The second chapter of this dissertation is devoted to beginning to answer some of these questions. I present results from four independent samples linking positive distraction use with scores on depression and well-being scales. I also examine the interplay of positive distraction with avoidance in predicting depression and well-being and compare positive distraction efficacy with that of neutral distraction. Finally, I measure the effects of several possible mediators of positive distraction efficacy to elucidate some mechanisms by which positive distraction might work. This study represents the first comprehensive investigation of positive distraction coping in an ecological context, specifically for coping with chronic life stressors.

2) Is There a Difference in Cognitive vs. Behavioral Positive Distraction?

Until now, I have discussed positive distraction as a primarily behavioral endeavor (largely because leisure coping is inherently behavioral). However, positive distraction can also be cognitive, with people using daydreaming, imagining, or fantasizing as some ways to experience brief mental breaks. An interesting theoretical point is that cognitive distraction can be employed even in the midst of experiencing a stressor, while behavioral distraction requires one to physically stop engaging with it in
order to take up another activity. We know that both can be effective in down-regulating negative emotions. Laboratory studies instructing people to think about pleasurable things to distract themselves from negative stimuli demonstrate that cognitive distraction can be adaptive (e.g. Delgado et al., 2008), and the leisure coping literature provides good evidence for the benefits of behavioral distraction (e.g. Freire, 2013; Hutchinson et al., 2003; Hutchinson et al., 2006; Iwasaki et al., 2005; Kim & McKenzie, 2014; Newman et al., 2014; Qian et al., 2014; Zawadzki et al., 2015). However, there are no studies comparing the two as real-world coping strategies and the specific mechanisms by which each may contribute to improved outcomes.

The second chapter also addresses these questions. By examining separately possible mediating variables of both cognitive and behavioral positive distraction, I hope to gain a better understanding of how each influences positive/negative perceptions of chronic life stressors and ultimately how people interact with their stressors to cope.

3) Do Positive and Neutral Distraction Differ in Efficacy for Repeated Stressors in the Laboratory?

Although the second chapter addresses whether positive and neutral distraction differ in efficacy for chronic life stressors, it does not provide insight into the causal relationships between these coping strategies and outcomes. The third chapter aims to address this question. To simulate chronic stress in the laboratory, I employ an experimental paradigm with repeated stressors in which participants are exposed to a stressful experience more than once. A positive or neutral distraction manipulation is set in-between each stressor to measure any causal links between using positive or neutral
distraction and a variety of psychological (subjective positive and negative mood) and physiological (cardiovascular activity) outcomes.

I include physiological outcome measures in this chapter because understanding the physiological implications of using positive distraction is just as important as understanding its psychological effects. First, it helps clarify the potential long-term health benefits of regularly employing positive distraction as a coping strategy for life stressors. If it is found that positive distraction reduces heart rate and improves parasympathetic functioning in times of stress and during recovery, it would be fruitful to investigate if and how positive distraction coping reduces the risk of cardiovascular disease in chronically or traumatically stressed individuals.

Understanding the physiological effects of positive distraction may also provide a biologically-rooted window into stress appraisal processes and the mechanisms by which positive distraction promotes resilience. People can perceive a particular stimulus as being either challenging (i.e. manageable) or threatening (i.e. not manageable) (Blascovich, 2008), and certain patterns of physiological responses have been reliably shown to indicate when people are in one state vs. the other (Seery, 2011; Tomaka et al., 1997). Importantly, people who view a stimulus as challenging are less likely to feel stressed, while those who appraise it as threatening are more likely to report feeling stressed (Harvey et al., 2010). Moreover, these appraisals can influence how resilient one is, with people who are higher on trait levels of resilience finding negative experiences less threatening than low-resilient people (Tugade & Fredrickson, 2004).

In summary, chapter 3 is devoted in part to investigating and comparing the causal links between use of positive vs. neutral distraction and a variety of outcome
measures. I present findings for subjective positive and negative mood, as well as continuous measurements of cardiovascular activity throughout each experiment. My goal is to understand more fully how distraction efforts influence psychological and physiological responses to stress and, by proxy, any cognitive appraisals of challenge vs. threat when attempting to cope with a stressor.

4) When is Positive Distraction Most Useful?

Positive distraction is not likely to be a panacea for stress, and we should not think of it as such at the risk of falling into the trap of Bonanno and Burton's (2013) fallacy of uniform efficacy. Indeed, positive emotions in general do not seem to always be adaptive. Papousek et al. (2010) reported that happier people exhibited better recovery from an academic stressor, but people who felt more positive emotions when anticipating the stressor actually exhibited worse recovery afterwards. The key for future researchers will be to uncover situational characteristics for which positive distraction is optimally effective and then to incorporate positive distraction into coping regimens for these situations only. The premise here is to help people maximize their coping flexibility, or the degree to which they can effectively match selected coping strategies to the characteristics of the stressor at hand (i.e. strategy-situation fit; Cheng et al., 2014), because coping flexibility predicts adaptive psychological outcomes (Bonanno & Burton, 2013; Cheng et al., 2014).

A promising avenue of research for positive distraction is how its efficacy changes in times of high vs. low stress, or high vs. low resource depletion as a function of stress. If positive distraction does serve as a safety signal in times of stress and if it does
replenish resources to aid future coping efforts, it could be more powerful for intensely overwhelming (i.e. more depleting) stressors than for more manageable stressors. Taking a temporary break to experience something pleasant might serve as a comforting safety reminder, but only when this reminder is actually needed; likewise, the ability for a coping strategy to replenish resources may be highly adaptive, but only if there is initial resource depletion. Some evidence already exists to support this theory. Tsaur and Tang (2012) reported exactly this moderating effect when examining the utility of leisure coping during times of high vs. low stress. Employees undergoing high levels of job stress benefited more from using positive distraction than those experiencing low levels of job stress, and Qian et al. (2014) reported similarly that people benefited more from leisure coping when they were busier and experiencing more frequent bouts of stress in daily life. Iwasaki (2006) also found in a large urban sample that leisure coping use was positively related to health outcomes for people reporting high vs. low stress levels and only for those in lower social classes (presumably who were under greater amounts of life stress). Even so, these studies do not show a causal connection between positive distraction and good outcomes as moderated by perceived stressfulness/resource depletion. The final study in Chapter 3 represents an attempt to establish this causal link. I employ another repeated stressor paradigm and manipulate the length (and depletion by proxy) of the stressors. The purpose is to understand if positive distraction is particularly effective for coping with stressors that are perceived to be more depleting and to compare this efficacy to that of neutral distraction.
Conclusion

There are many more questions to address regarding positive distraction coping. However, because it has been relatively understudied in a detailed, mechanistic manner, the present work is just one of the first to investigate the nuances of its use and, therefore, only touches on the questions posed above. This work, then, is by no means an exhaustive endeavor, but I believe that the studies presented in the following two chapters are a good starting point to expand our knowledge about the usefulness of positive emotions and distraction coping for chronic stress.
Chapter 2: An Ecological Study on Positive Distraction
Introduction

Stress has always been a ubiquitous aspect of the human condition, for which our ancestors evolved a well-defined set of physiological and psychological responses to cope. These responses are especially suited to help people deal with acute life stressors (e.g. running away from an animal predator in the past, or sitting for a difficult exam in present day). Acutely experienced life stress is not necessarily bad, and is in fact, likely adaptive in many circumstances, particularly if it engenders learning and development (Sapolsky, 2004). However, it is when related acute life stressors are chained together without proper coping and psychological resolution that chronic stressors arise (Waugh, 2013). Inadequate coping with these chronic stressors can result in impaired psychological and physiological functioning, such as anxiety (Charles et al., 2013), depression (Charles et al., 2013), cardiovascular disease (Vitaliano et al., 2002), and immune system dysregulation (Cacioppo et al., 2000). These effects, coupled with the prevalence of chronic stress (an estimated 44% of the American population has experienced increased levels of life stress in the last 5 years; Clay, 2011) in the modern world, necessitates the development of improved stress-reduction programs.

People can use a wide range of coping strategies to cope with their chronic stressors. But research suggests that some may be more effective than others. For instance, problem-solving strategies (those that people use to directly change aspects of the stressor; Carver et al., 1989) and active, approach-oriented strategies (those that direct coping efforts towards a stressor or its resultant emotions; Carver et al., 1989) are thought to produce better psychological and physiological outcomes than passive, avoidance-oriented strategies (those that direct coping efforts away from a stressor or its resultant
emotions; Carver et al., 1989). One set of adaptive strategies incorporates the benefits of increasing positive emotions felt about a chronic stressor. These are the positive emotional coping strategies (Folkman & Moskowitz, 2000; Quoidbach, Mikolacjzak, & Gross, 2015), which include, but are not limited to, positive distraction, positive reappraisal, expressing gratitude, acceptance, and finding positive meaning in stressful situations (Lyubomirsky & Layous, 2013; Parks & Biswas-Diener, 2013; Quoidbach et al., 2015; Schueller, Kashdan, & Parks, 2014). Although several of these positive emotional coping strategies have been studied extensively (e.g. positive reappraisal, positive meaning-making), positive distraction has been largely understudied in comparison. Unlike the others, the efficacy of positive distraction as a coping strategy for chronic stressors is unclear, as are the mechanisms that might underlie its possible efficacy. Moreover, positive distraction is sometimes affiliated with the generally maladaptive avoidant coping strategies, and so its utility as a coping strategy is further obscured. In the present study, we aim to elucidate the efficacy and nature of positive distraction as a coping strategy for chronic stressors. Because the hypotheses for the present work were informed by several different bodies of literature, we have organized the following introduction into subsections. We begin by defining positive distraction as a positive emotional coping strategy and follow with a discussion of how it relates to other forms of disengagement coping strategies. We then provide a brief introduction to possible mediating mechanisms driving the efficacy of positive distraction coping and conclude with a detailed description of the present study.
Why Positive Distraction is a Different Kind of Positive Emotional Coping Strategy

Positive emotional coping strategies are those that people use to intentionally enhance their positive emotion in order to promote well-being and potentially decrease negative feelings and depression. These strategies can help people experience better career success (Boehm & Lyubomirsky, 2008), physical health (Boehm & Kubzansky, 2012), social relationships (Lyubomirsky, King, & Diener, 2005), and coping self-efficacy (Lyubomirsky, King, & Diener, 2005) in addition to reducing stress levels. In particular, one specific form of positive distraction (leisure coping, or engaging in leisure activities in response to stressors; Iwasaki & Mannell, 2000; Iwasaki et al., 2005; Kleiber, Hutchinson, & Williams, 2002) has been shown to predict improved life satisfaction and coping self-efficacy (Iwasaki, 2001) and may also promote personal transformation in the face of a stressor (Kleiber, Hutchinson, & Williams, 2002). There is also evidence to suggest that positive distraction can be highly useful for intense stress experiences. Indeed, disaster survivors often report using positive distraction and leisure to cope with the early stages (often the most intense) of the disaster aftermath (Ekanayake et al., 2013; Perez-Sales et al., 2005).

The repertoire of positive emotional coping generally falls into a single category: accommodative (emotion-focused engagement) strategies, which individuals voluntarily employ to actively engage and cope with their stressor-related emotions. The result of this process is usually shown to be adaptive as people bring their own goals and beliefs more in line with environmental circumstances (Carver & Connor-Smith, 2010; Compas et al., 2001; Skinner et al., 2003). However, while most of the well-studied positive emotional coping strategies (positive reappraisal, expressing gratitude, finding
acceptance, and positive meaning-making) fit neatly and clearly into this classification scheme, positive distraction is more ambiguous (Skinner et al., 2003). Some studies indicate that it operates through similar accommodative mechanisms as the other positive emotional coping strategies (Skinner et al., 2003). That is, something (yet to be elucidated) about positive distraction helps individuals accommodate to a stressful experience. Other studies describe positive distraction as a disengagement strategy similar to avoidance and withdrawal, through which individuals direct their attention away from a stressor in a way that promotes poor long-term psychological outcomes (Kaminsky, Robertson, & Dewey, 2006; Zimmer-Gembeck & Skinner, 2016 for a discussion). Still other studies have found positive distraction to form its own category, not associating with either avoidance or positive cognitive/emotional restructuring on factor analyses (Ayers et al., 1996).

These mixed findings are likely due to the fact that positive distraction involves increasing positive emotions that are *not about* the stressor. It requires one to disengage from the stressor in order to engage with some other positive thought or experience. Thus, while the engagement aspect of positive distraction may establish it as a positive emotional coping strategy, the disengagement aspect inevitably connects it to the family of avoidance coping strategies as well, an idiosyncrasy of positive distraction that sets it slightly apart from the other positive emotional coping strategies.

**Why Positive Distraction is a Different Kind of Disengagement Strategy**

Although positive distraction and avoidance coping are related, the two are likely not synonymous. Avoidant strategies are those that involve disengagement, or diverting
one's attention away from a stressor, and include, but are not limited to, denial that the stress exists and distancing oneself from goals being threatened by the stressor (e.g. no longer striving to be the best student in the class if one is particularly stressed about an upcoming test; Friedman & Silver, 2006). Moreover, while distraction certainly does require one to disengage, the quality of this disengagement is notably different from that of avoidance. Emotional avoidance seems to occur as a passive reaction to a stressor, often employed if an individual feels that they do not have enough coping resources to engage with the stressor in a more productive way (Skinner et al., 2003; Snyder & Pulvers, 2001). In contrast, distraction occurs when an individual makes an intentional or conscious effort to disengage from the stressor and its emotional consequences, often to prepare for better engagement later (Hamilton & Ingram, 2001; Skinner et al., 2003). Indeed, Compas et al. (2001) note that the very act of redirecting attention from the stressor to something else reflects a level of awareness about the stressor's existence that is not often present during avoidance coping. Therefore, a possible distinction between these two strategies is that positive distraction occurs when individuals engage with coping by disengaging from a stressor, while avoidance occurs when individuals disengage from coping and the stressor altogether.

Positive distraction and avoidance may also be fundamentally different based on the primary motivations driving their use. People may use avoidance when they primarily want to avoid negative outcomes or aspects of a stressor, but without a clear notion of what other gains they want to make in the process of disengaging. In contrast, people may use positive distraction when they want to experience fewer negative aspects of a stressor, but primarily by approaching or engaging with positive experiences to gain
better outcomes. This distinction draws from regulatory focus theory (Higgins, 1997), which describes two motivational drives - promotion (seeking to maximize gains) and prevention (seeking to minimize losses) - that people typically exhibit. Though neither motivational drive is better than the other along many dimensions in life (Scholer & Higgins, 2012), it is possible that having a promotion-focused coping motivation is more adaptive than having a prevention-focused coping motivation. In any case, there are reasons to believe that positive distraction both overlaps with and is distinct from emotional avoidance.

**Comparing Positive and Neutral Distraction**

While positive distraction has been found to be useful, the possibility remains that other forms of distraction, like neutral distraction, may be just as effective. Neutral distraction has been conceptualized as intentionally directing one's attention and focus away from a stressor and its associated emotions, but with thoughts or behaviors that do not carry much emotional valence (Yanos, West, & Smith, 2010). Some research indicates that neutral distraction can be effective for minimizing negative emotional responses to acute negative stimuli. Specifically, these studies often ask individuals to distract themselves in a laboratory setting by thinking of nonemotional objects or doing serial subtraction (Kanske et al., 2011; McRae et al., 2010; Sheppes et al., 2014), showing that neutral distraction is effective at reducing negative emotions when it is employed early after stimulus presentation and if the stimuli are of high vs. low intensity (Sheppes & Gross, 2011).
Despite evidence of efficacy for helping people cope with acute laboratory stressors, it is not clear how neutral distraction compares to positive distraction for coping with chronic life stressors. Positive distraction may be more effective than neutral distraction for coping with chronic stressors, because it necessarily incorporates an elevation in positive emotion levels. The positive psychology literature has found that cultivating and experiencing positive emotions produces an abundance of psychological and physiological benefits (Chida & Hamer, 2008; Fredrickson & Levenson, 1998; Fredrickson et al., 2003; Steptoe et al., 2005; Tugade & Fredrickson, 2004; Vernon et al., 2009) and that increasing positive emotion in daily life is directly associated with improved coping with chronic stressors (Folkman & Moskowitz, 2000; Lyubomirsky et al., 2011; Ong et al., 2006). A probable mechanism for these benefits of positive emotions is described in Fredrickson's Broaden-and-Build theory of positive emotions (Fredrickson, 2001). This theory posits that positive emotions broaden the scope of how individuals respond to present stimuli (thought-action repertoires; Fredrickson, 2001) and facilitate the building of emotional, social, and physical resources to cope with future stressors. Indeed, studies have found that individuals with higher positive emotion levels report having greater levels of perceived resources and therefore exhibit better psychological outcomes when coping with chronic stressors (Fredrickson et al., 2003; Folkman, 2008). Positive distraction could therefore be more useful than neutral distraction for coping with chronic stressors because of the benefits associated with increasing positive emotion levels.

Few studies have directly assessed the differences between positive and neutral distraction thus far. Most have investigated the benefits of one or the other, with the
number of studies on neutral distraction prevailing, at least for acute laboratory stressors (Webb et al., 2012). However, in the context of chronic stressors, one study on leisure coping has demonstrated that it predicts improved well-being and coping self-efficacy above and beyond other coping strategies, including typical disengagement/avoidance-based strategies (Iwasaki, 2001). Further providing evidence for a possible differentiation between positive and neutral distraction, leisure coping has also been shown to consist of three major dimensions - palliative coping (i.e. taking a breather from a stressor and directing oneself away from the emotional stress response), companionship (i.e. having social support), and mood enhancement (i.e. increasing positive emotion levels; Iwasaki & Mannell, 2000) - only one or two of which (palliative coping and social support if the neutral activity involves other people) are shared with neutral distraction. So while the attention-diversion component of neutral distraction may allow individuals to take a cognitive/emotional break from experiencing a stressor (Sheppes & Gross, 2011), positive distraction may have an additional advantage due to the added benefits of increasing positive emotion levels, allowing individuals to broaden their momentary thought-action repertoires for coping with present chronic stressors and to build psychological and physical resources to cope with future stressors (Fredrickson, 2001).

**Distinguishing Between Cognitive and Behavioral Distraction**

Cognitive and behavioral distraction likely represent two different strategies from both an emotion-regulation and a stress and coping perspective. Gross’ process model of emotion-regulation (Gross, 2015) categorizes cognitive distraction as an attention-deployment emotion-regulation strategy (Webb et al., 2012; Sheppes & Gross, 2011) and
behavioral distraction as a situation-selection or situation-modification emotion-regulation strategy (Gross, 1998). This distinction indicates that while both strategies function to distract individuals from negative stimuli, the points at which they are deployed in the emotion-regulation process are different. Similarly, stress and coping researchers have identified through factor analyses that cognitive and behavioral distraction strategies are indeed two related, but distinct, forms of distraction coping (Moos & Schaefer, 1993; Ottenbreit & Dobson, 2004; Skinner et al., 2003). From the stress and coping perspective, cognitive distraction involves attempting to cognitively minimize or distract from the stressor whereas behavioral distraction involves attempting to behaviorally engage in other activities to avoid stressor-related situations.

Few studies have directly compared behavioral vs. cognitive positive distraction, especially in the context of coping with chronic stressors. Most studies that do have been conducted in child and young adolescent samples as assessments of how cognitive/behavioral coping patterns change with age (Skinner & Zimmer-Gembeck, 2007). From these studies, it is apparent that people are able to utilize behavioral positive distraction at a much earlier age than cognitive positive distraction, but that once both coping strategies are developed fully, they seem to be effective and used frequently, especially for uncontrollable stressors. Moreover, young adolescents are readily able to switch between the two forms of distraction. To extrapolate from these findings and draw from emotion-regulation theory, it is possible that neither one is more effective than the other in general, but that the utility of each depends on the characteristics of the stressor and other life circumstances. It may be that behavioral positive distraction is more effective when the situation can be modified, and cognitive positive distraction is more
effective when one does not have the capacity to leave a stressful situation. Both, however, may not differ in the overall degree to which they help to elevate positive emotions and improve psychological outcomes.

**Understanding Mechanisms of Positive Distraction Efficacy**

The mechanisms underlying the efficacy of positive distraction are somewhat unclear given that positive distraction has been relatively understudied compared to other positive emotional and disengagement coping strategies and because it simultaneously features functional elements of the two. The most obvious possible mediator is positive emotion, which should increase during the coping process as individuals expose themselves to pleasant thoughts and experiences. Given the clear benefits of increasing positive emotions in daily life (Ong et al., 2006; Folkman, 2008), these positive emotions should then drive the development of improved psychological outcomes (decreased depression and higher overall life satisfaction). Importantly, we postulate that positive distraction should increase positive emotions felt directly about a stressor (in addition to feeling more positive emotions in general) if it is being used effectively as a coping strategy and not just as a means to distract from or forget about the fact that a stressor exists. If positive distraction does work to help individuals accommodate to a stressful experience as the other positive emotional coping strategies do (Skinner et al., 2003; Folkman & Moskowitz, 2000), then it should help people feel better (i.e. experience more positive emotions) about a specific stressor.

Positive distraction efficacy may also be mediated by the negative emotions that people feel about a stressor and the perceived control they have. Even though positive
and negative emotions experienced during a stressor are not directly orthogonal to each other and can co-occur in any given moment (Folkman & Moskowitz, 2000), a strategy that effectively improves long-term psychological outcomes likely does so by eventually reducing stress and negative emotion levels throughout the coping process. People may also experience greater perceptions of control over their chronic stressors, if positive distraction helps them accommodate (i.e. increase secondary control) to a stressful situation. Positive distraction may help provide the momentary respite that helps people build resources and ready themselves to engage with a stressor, thereby increasing their levels of perceived control over the stressor.

Finally, we examined two additional potential mediators - amount of time people spend in stressor-related situations and how overwhelmed they felt about a stressor - to test the theory that positive distraction provides these moments of respite, or palliation in the leisure coping literature. Positive distraction, especially behavioral, could remove an individual from the midst of a stressful experience, again allowing them to recover from stress and to prepare for the next stressful situation. In doing so, people may also feel less overwhelmed. Both of these mechanisms may help to explain why using positive distraction in the context of chronic stressors can help individuals cope and escape maladaptive long-term psychological outcomes.

The Present Study

The purpose of the present work is to characterize the efficacy and nature of positive distraction in an ecologically meaningful way (i.e. to characterize the efficacy and mechanisms of positive distraction coping in the context of chronic life stressors).
We present data from four samples (one sample of parents and three samples of undergraduates) in which we investigated the mechanisms by which positive distraction may be effective for coping with chronic stressors in daily life. We first assessed how frequently people utilize positive distraction vs. neutral distraction and positive reappraisal (our chosen representative of positive emotional coping strategies) to cope with chronic stressors. We selected positive reappraisal as a comparison positive emotional coping strategy for positive distraction because it is a well-documented adaptive coping strategy from the 'positive emotional engagement' category. Thus, positive reappraisal likely possesses enough conceptual similarities with positive distraction and yet is distinct enough to draw meaningful comparisons and contrasts between their efficacies as coping strategies for chronic life stressors. In two of the undergraduate samples, we further specified how frequently people use cognitive positive (i.e. thinking about pleasant or fun experiences to distract from a stressful experience) vs. cognitive neutral distraction (thinking about daily tasks or activities to distract) and behavioral positive (i.e. engaging in pleasant or fun behaviors to distract from a stressful experience) vs. behavioral neutral distraction (engaging in daily tasks or activities to distract). We hypothesized that both forms of positive distraction would be used more frequently than both forms of neutral distraction. We also hypothesized that positive distraction would be used at least as frequently as positive reappraisal because people might find both useful as positive emotional coping strategies but not so similar that

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4 We drew direct distinctions between behavioral positive and neutral distraction in two undergraduate samples. However, we did assess use of behavioral positive distraction in the parent sample and first undergraduate sample using a corollary measure that will be further defined and discussed in the methods section. We did not measure behavioral neutral distraction in the parent sample and first undergraduate sample.
using one renders the other redundant (i.e. positive reappraisal involves engaging directly with the stressor, whereas positive distraction involves disengaging from the stressor).

Second, we examined and compared the efficacies of positive distraction, neutral distraction, and positive reappraisal in predicting long-term psychological outcomes (depression and well-being) in each sample.

We also investigated the possible overlap between distraction and avoidance by testing cognitive avoidance as a suppressor of positive distraction. We hypothesized that cognitive avoidance would be associated with poor psychological outcomes and that both positive and neutral distraction would be associated with good outcomes. We further hypothesized that positive distraction would be a stronger predictor of these good outcomes than would neutral distraction and that the adaptive effects of positive distraction would manifest the strongest when controlling for the maladaptive effects of cognitive avoidance. This hypothesis was based on prior research suggesting that there is a considerable mechanistic overlap between distraction and avoidance coping (i.e. disengagement) and our theory that the quality of this disengagement differs between positive distraction and avoidance. We also hypothesized that positive distraction would be at least as effective as positive reappraisal in predicting psychological outcomes.

Finally, we tested some a priori predictions of the mechanisms of positive distraction efficacy. Based on prior research of how other positive emotional and distraction coping strategies work, we tested positive/negative emotion levels felt about the stressor (Fredrickson et al., 2003, 2008) and level of perceived control over the stressor (Lazarus & Folkman, 1984) as possible mediators explaining how positive distraction aids coping with chronic stress. We also tested whether amount of time spent
in stressor-related situations and feelings of being overwhelmed might also mediate the relationship between positive distraction and psychological outcomes. We added these variables based on the leisure coping research suggesting that positive distraction may help people cope in part because of its palliative functions (i.e. allowing people to step away and gather respite from a stressor). We hypothesized that the efficacy of positive distraction would be mediated by higher levels of positive emotions and perceived control and by lower levels of negative emotions, amount of time spent in stressor-related situations, and feelings of being overwhelmed.

In summary, the present study seeks to characterize positive distraction as a possibly effective coping strategy for chronic life stressors across a range of individuals. We present results from four samples, one comprised of parents recruited in general pediatric clinics and pediatric cancer clinics, who experience chronic stress related to parenting and caring for a family unit especially when a child they are caring for has cancer, and three samples of undergraduate students, who experience chronic stress related to school and managing interpersonal relationships (Ross et al., 1999). Because we honed our assessments across the different samples, each sample received slightly different questions. We note these differences in the sections below. However, we chose to present all the samples together, and utilized internal meta-analyses when appropriate so that readers may more easily evaluate our evidence on its generalizability and replicability.
**Method**

**Participants**

**Sample P - Parents.** Participants in the parents sample were comprised of two separate caregiver samples, recruited for another study, then collapsed into one sample to increase the statistical power of the analyses in the present study. Childhood cancer caregivers were recruited from the inpatient oncology unit and outpatient oncology clinic of a large teaching hospital. Caregivers of healthy children (non-cancer caregivers) were recruited from two general pediatric clinics in the surrounding community. Both recruitment procedures were conducted in accordance with a protocol approved by the Institutional Review Board. Eligible parents were a) aged 18 and over, b) had the ability to read and speak English, and c) were a self-reported primary caregiver of the patient. The patient in clinic also needed to be less than 18 years of age. Only one caregiver per family was allowed to participate in the study. A majority of caregivers were parents of the patient. However, five caregivers identified themselves as grandparents. This resulted in a sample size of n = 138 (83.3% female) with an average age of 37.47 years (SD = 8.66).

Healthcare providers helped identify potentially eligible participants based on the inclusion/exclusion criteria described previously. Study team members then approached patients and their families either in inpatient rooms or in clinic rooms while waiting to be seen by healthcare providers. After determining eligibility and obtaining informed consent, participants were given two options for study completion - they could fill out the survey at home or while in the hospital/clinic. In both cases, the survey was administered
online. Participants were compensated for their time and efforts after survey completion with a $10 retail gift card.

Notably, the two separate subsamples comprising sample P did not differ significantly on scores of our two primary psychological outcome measures - depression: \( t(136) = .828, \text{ns} \) (mean cancer caregiver score = 12.333, SD = 8.728; mean non-cancer caregiver score = 11.109, SD = 7.331) and well-being: \( t(136) = -1.92, \text{ns} \) (mean cancer caregiver score = 4.853, SD = 1.315; mean non-cancer caregiver score = 5.271, SD = 1.011). However, because the two caregiver subsamples were recruited from separate locations and may differ on other variables not assessed here, we included a mean-centered dummy code variable as a regressor of non-interest for all sample P analyses.

**Sample U1 - Undergraduate Students.** Participants in sample U1 were undergraduate students enrolled in the spring semester of an Introductory Psychology course (n = 276, 53.4% female). Participants were invited to complete the study at the beginning of the semester. All students enrolled in Introductory Psychology at the time were eligible to participate in the study. Undergraduate participants were invited to complete the measures as part of a mass testing procedure that included several other psychological measures not relevant to the present study. Students voluntarily completed the surveys online and were compensated with class credit for their time.

**Sample U2 - Undergraduate Students.** Participants in sample U2 were undergraduate students enrolled in the fall semester of an Introductory Psychology course (n = 381, 56.4% female). Recruitment and procedure were the same as with sample U1.

**Sample U3 - Undergraduate Students.** Participants in sample U3 were undergraduate students enrolled in the spring semester of an Introductory Psychology
course (n = 295, 52.2% female). Recruitment and procedure were the same as with sample U1.

Measures

Situational Positive Coping (SPC). We created a measure to assess individuals’ use of distraction to cope with chronic stressors, as well as several factors that might mediate the efficacy of positive distraction. We first had participants in each sample think of a chronic stressor in their life. Specifically, cancer caregivers were asked to think about the chronic stressors associated with caring for a child with cancer. Undergraduates and caregivers of healthy children were asked to identify and describe a chronic stressor in their life at the moment. We provided the undergraduates and caregivers of healthy children with some examples to give them an idea of what could constitute a "chronic stressor" (e.g. dealing with roommate issues, having difficulty in school, workplace/financial stress, experiencing relationship problems, etc). Next, we oriented participants in all samples to the situations they experienced in the last week that were related to their chronic stressor ("Please think about the times when you were in situations related to your chronic stressor in the last week.") and asked them to respond to the SPC questions with these situations in mind. Participants were then asked to report 1) how frequently they experienced positive and negative emotions (1 = Not at all in the last week, 2 = Once or Twice, 3 = Sometimes, 4 = Fairly often in the last week mirroring the 1-4 scale used in the Coping Responses Inventory, see below) with regard to these chronic stressors and 2) how frequently they experienced high levels of perceived control
over their stressors. These items were included as measures of potential mediators of positive distraction coping efficacy.

Next, participants reported how frequently they used positive/neutral distraction and positive reappraisal in the last week to cope with the situations related to their chronic stressors using the same 1-4 Likert-like scale described above (Each sample received a slightly different version of the SPC to investigate additional hypotheses about distraction coping. These differences are detailed in the following sub-sections and are summarized in Table 1).

Finally, participants were asked to report how frequently in the last week they were exposed to stressor-related situations (i.e. amount of time spent in stressor-related situations). Only the cancer caregivers and the undergraduates were asked to report on this variable, as the caregivers of healthy children received an older version of the SPC than is discussed in the present study. Participants reported frequency of exposure to stressor-related situations as percentage of time in the last week.

**SPC – Parents version.** Parents received the SPC version described in the section above. Only cognitive positive distraction was assessed in this version (behavioral positive distraction was assessed in this sample using the Coping Responses Inventory - see below). Parents were asked to report how frequently they used cognitive positive distraction by "thinking about other positive things/situations not related to the stressor" and how frequently they used positive reappraisal by "thinking about the stressor more positively (finding positive meaning or focusing on what is good)."

**SPC – U1 version - Separating positive vs. neutral distraction.** In the second major iteration of the SPC (administered to participants in sample U1), we added
questions to distinguish cognitive positive and cognitive neutral distraction. To separate these two types of distraction, we first asked participants to report the frequency with which they used general distraction by "thinking about other things/situations not related to the stressor." Participants then reported how frequently they distracted themselves by "thinking of pleasant/fun things" (cognitive positive distraction) or by "thinking of everyday tasks and activities" (cognitive neutral distraction). Items about positive/negative emotions, perceived control, and time spent in stressor-related situations remained unchanged.

**SPC – U2 and U3 version - Separating cognitive vs. behavioral distraction.** In the third major iteration of the SPC (administered to participants in samples U2 and U3), we added questions to separate cognitive and behavioral forms of positive and neutral distraction. In this third version of the SPC, participants were asked to report the frequencies with which they thought about vs. engaged in distracting activities. They reported these frequencies for both positive and neutral distraction strategies (e.g. "When you distracted yourself from the stressor, how often did you do it by THINKING of pleasant or fun things/activities?"; "When you distracted yourself from the stressor, how often did you do it by ENGAGING in everyday tasks/activities?").

Items about positive/negative emotions, perceived control, and time spent in stressor-related situations remained unchanged from previous SPC versions. However, to test additional mediating pathways of positive distraction efficacy, we also asked the undergraduates in sample U2 & U3 to report how frequently they felt overwhelmed by their chronic stressor in the last week.
Table 1. Summary of variables assessed in each iteration of the Situational Positive Coping measure.

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*Behavioral positive distraction was assessed as the Seeking Alternative Rewards subscale from the Coping Responses Inventory in samples P and U1.


**Coping Responses Inventory (CRI).** Participants completed a modified version of the CRI (Moos, 1995), which consists of 8 subscales measuring various types of coping strategies. Typically, individuals are asked to relate the CRI items to the most important stressor they faced in the last year. Participants in the present study were asked to report how frequently they employed each strategy to cope with the chronic stressor described in the SPC. All responses were rated on a 1-4 Likert-like scale (1 = Not at all in the last week, 2 = Once or Twice, 3 = Sometimes, 4 = Fairly often in the last week).

For the present study, we focused on the subscales "Seeking Alternative Rewards" and “Cognitive Avoidance.” We were interested in participants’ scores on the “Cognitive Avoidance” subscale to assess how avoidance relates to psychological outcomes and to control for its effects in models assessing how positive and neutral distraction relate to outcomes. Reliability for the 6 items in the "Cognitive Avoidance" subscale was good for all four samples (P: α = .870; U1: α = .800; U2: α = .766; U3: α = .744).

We were interested in using scores on "Seeking Alternative Rewards" as a well-validated corollary measure of our SPC measures of behavioral positive distraction. These scores were included in analyses for samples P and U1, before the SPC version including behavioral distraction was created. Reliability for the 6 items in the "Seeking Alternative Rewards" subscale was good for sample P (α = .855) and fair for sample U1 (α = .695). Of note, the Seeking Alternative Rewards subscale does not map perfectly onto our conceptualization of behavioral positive distraction. Some items ("Turn to work or other activities to help you manage things") fit better into our conceptualization of behavioral neutral distraction than others ("Try to help others deal with a similar problem"). Nevertheless, most of the items on the subscale reflect engaging in positive
distraction (e.g. "Get involved in new activities," "Try to make new friends," etc.), and we thus use it in the first two samples as a validated corollary to our conceptualization of behavioral positive distraction\(^5\). To confirm that the Seeking Alternative Rewards subscale measures similar constructs as our SPC measure of behavioral positive distraction, we correlated Seeking Alternative Rewards scores with SPC behavioral positive distraction scores in samples U2 and U3 (U2: r(365) = .334, p < .001; U3: r(278) = .262, p < .001). Finally, although the Seeking Alternative Rewards subscale was positively correlated with our SPC measure of behavioral distraction, we did not conduct analyses using scores on it for Samples U2 and U3. Scores on the subscale did not contribute a significant amount of predictive power above and beyond SPC behavioral positive distraction in predicting our psychological outcomes for Sample U2 or in predicting well-being for Sample U3\(^6\).

**Center for Epidemiologic Studies-Depression Scale (CES-D).** All participants completed the CES-D (Radloff, 1977), a commonly used measure of depressive symptoms. The CESD was included as the primary outcome measure of psychological distress. Reliability for the 20 items on the CESD was high for all four samples (P: α = .893; U1: α = .912; U2: α = .893; U3: α = .904).

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\(^5\) Hereafter, we refer to Seeking Alternative Rewards as "behavioral positive distraction" in the results and discussion sections in order to minimize changes in terminology.

\(^6\) We conducted multiple regression analyses testing SPC behavioral positive distraction, Seeking Alternative Rewards, cognitive avoidance, and sex (a covariate of non-interest) as predictors of our primary psychological outcomes in both samples U2 and U3. In sample U2, Seeking Alternative Rewards did not predict depression or well-being (CESD: B = -.693, SE = .913, ns; SWLS: B = .202, SE = .119, ns) above and beyond our SPC measure of behavioral positive distraction (CESD: B = -1.443, SE = .613, p = .019; SWLS: B = .199, SE = .080, p = .013). In sample U3, Seeking Alternative Rewards did not predict well-being (B = .229, SE = .133, ns) above and beyond our SPC measure of behavioral positive distraction (B = .193, SE = .093, p = .044). Because Seeking Alternative Rewards generally does not contribute additional predictive variance compared to the SPC measure, we do not include it as a predictor of outcomes in samples U2 or U3. It is only included as a corollary measure of behavioral positive distraction in samples P and U1.
Satisfaction with Life Scale (SWLS). All participants completed the SWLS (Diener et al., 1985) as a measure of global life satisfaction. The SWLS was included as the primary outcome measure of psychological well-being. Reliability for the 5 items on the SWLS was high for all four samples (P: $\alpha = .870$; U1: $\alpha = .860$; U2: $\alpha = .847$; U3: $\alpha = .872$).

Data Analyses

We first conducted analyses in each sample individually, then conducted a set of internal-meta-analyses to synthesize results across the four samples and to clarify our findings of the relationship between distraction and depression/well-being. Mean difference, zero-order, and regression analyses were conducted for each individual sample using IBM SPSS Statistics (version 23). Further details of these analyses are presented in the results section.

After conducting the regression analyses, we examined the effects of possible mediators of positive and neutral distraction efficacy (positive/negative emotions felt about a stressor, perceived control, time spent in stressor-related situations, and feelings of being overwhelmed) for each sample individually. Mediation analyses were conducted using PROCESS for SPSS version 2.13 (Hayes, 2013). Indirect effects in each model were tested by generating bias-corrected 95% confidence intervals from 10,000 bootstrap samples (Hayes, 2013). In each analysis, either positive or neutral distraction served as the predictor variable, depression or well-being as the outcome variable, and cognitive avoidance as a covariate of interest. Additionally, caregiver type and age were included as covariates of non-interest for Sample P; sex was included as a covariate of non-interest.
for samples U1, U2, and U3. These covariates did not change the overall mediation findings.

To synthesize findings across the four samples, we conducted internal meta-analyses using Metafor (Viechtbauer, 2010) for R. We conducted meta-analyses on three types of effect sizes - 1) Pearson r correlation to examine zero-order relationships between our distraction variables and depression/well-being, 2) semi-partial correlations \( r_{sp} \) (Aloe & Becker, 2012) to examine the overall unique predictive effects of each distraction variable on depression/well-being while controlling for avoidance and the other-valenced distraction variable (For example, we calculated a semi-partial correlation for positive behavioral distraction and depression while controlling for avoidance and neutral behavioral distraction.), and 3) completely standardized indirect effects \( ab_{cs} \) (Hayes, 2016, Preacher & Kelley, 2011) to examine the effects of our mediator variables. We used the meta-analyses to examine the effects of distraction overall, positive and negative distraction collapsed across cognitive and behavioral versions, as well as the individual cognitive and behavioral versions of positive and neutral distraction.

For all meta-analyses, we specified random effects models using the Hunter-Schmidt method (Hunter & Schmidt, 1991) and employed a Knapp and Hartung adjustment of the standard error estimate to account for a possible inaccurate estimate of \( \tau^2 \) due to having a sample size of less than 100 studies in the analysis (Knapp & Hartung, 2003). All Q-statistics measuring heterogeneity of results across samples were non-significant unless otherwise noted in the results section (significant Q-statistics represent substantial differences in results among samples included in the meta-analysis).
Finally, we present the meta-analysis findings in the text below, with data from individual samples presented in tabular form for reference. We do, however, describe results from individual samples when they provide a possible clarification of the meta-analysis findings.

**Results**

**Positive Distraction is Preferred Over Positive Reappraisal by Young Adults but Not Parents**

To assess how much individuals prefer using positive distraction rather than positive reappraisal to cope with chronic stressors, we conducted paired samples t-tests for each sample to compare the frequency of positive distraction vs. positive reappraisal use (Table 2). For all four samples, we used cognitive positive distraction rather than behavioral distraction because it provides a more conservative test of whether distraction and reappraisal are different given that they both involve changes in one’s thoughts. In the meta-analysis, we tested the proposed effect that people use positive distraction more frequently than positive reappraisal to cope with chronic stressors. The meta-analytic effect was not significant ($d_+ = 0.029; 95\% \text{ CI: } -0.45; 0.50, \text{ n.s.}$)\(^7\). However, examination of effects in each individual sample revealed that the parent sample used positive reappraisal more frequently than positive distraction, whereas the undergraduates used positive distraction more frequently than positive reappraisal (Table 2). Collectively, these results indicate that cognitive positive distraction is generally preferred over positive reappraisal as a coping strategy for chronic life stressors by college students, but is less preferred than positive reappraisal by parents. It is interesting to note, however, that despite this decreased preference, parents still report using positive distraction

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\(^7\) The Q statistic was significant for this test ($Q = 44.06, p < .001$).
between "Once or Twice" and "Sometimes" to deal with chronic stressors in any given one week period ($M_{\text{distract}} = 2.69$, $SD = 1.102$).

Table 2. Paired samples t-tests comparing Positive Distraction – Positive Reappraisal frequency in parents and three undergraduate samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>N</th>
<th>df</th>
<th>t</th>
<th>Sig.</th>
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<td>P</td>
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<td>1.10</td>
<td>3.16</td>
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<td>136</td>
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<tr>
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<td>.96</td>
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<td>.96</td>
<td>248</td>
<td>247</td>
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<td>.273</td>
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Positive Distraction is Preferred Over Neutral Distraction by Young Adults

We conducted paired samples t-tests in samples U1, U2, and U3 to compare the frequency of positive distraction vs. neutral distraction use as coping strategies for chronic life stressors (Table 3). Frequency of neutral distraction use was not assessed in sample P, which was therefore excluded from the analysis. The meta-analysis revealed that positive cognitive distraction was used more frequently than neutral cognitive distraction ($d_+ = 0.291; 95\% \text{ CI: } 0.078, 0.504; p = .028)$, and positive behavioral distraction was used more frequently than neutral behavioral distraction ($d_+ = 0.182; 95\% \text{ CI: } 0.165, 0.199; p = .005$). These results collectively suggest that positive distraction is preferred over neutral distraction by college students for coping with chronic life stressors.

Table 3. Paired samples t-tests comparing Positive Distraction – Neutral Distraction frequency in three undergraduate samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Positive Distraction</th>
<th>Neutral Distraction</th>
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<tr>
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<td>SD</td>
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<td>U2 (Behavioral)</td>
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<td>.816</td>
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<td>U3 (Cognitive)</td>
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<td>.951</td>
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<td>U3 (Behavioral)</td>
<td>3.25</td>
<td>.832</td>
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</table>
Zero-order Associations

Before conducting regression analyses with multiple predictors, we conducted zero-order correlations to examine basic relationships between our variables of interest in each sample (Tables 4-7) and in the meta-analysis.

Distraction is associated with good outcomes. Distraction was related to both higher well-being and lower depression, but was more consistently associated with well-being. Specifically, the composite distraction variable was significantly positively correlated with well-being ($r = .135; SE = .029; 95\% \text{ CI}: 0.0715, 0.198; p = .0005)^8$ and negatively correlated with depression ($r = -0.045; SE = .017; 95\% \text{ CI}: -0.082, -0.009; p = 0.019$). Within this composite distraction variable, neither positive nor neutral distraction was associated with depression$^9$. However, both positive and neutral distraction were each correlated positively with well-being (Composite Positive: $r = .137; SE = .049; 95\% \text{ CI}: 0.0218, 0.251; p = .026^{10}$; Composite Neutral: $r = .135; SE = .020; 95\% \text{ CI}: 0.077, 0.191; p = .003$). Then, within positive distraction, positive cognitive distraction was positively associated with well-being ($r = .122; SE = .022; 95\% \text{ CI}: 0.051, 0.192; p = .012$), whereas positive behavioral distraction was not. Within neutral distraction, neutral behavioral distraction was positively related to well-being ($r = .131; SE = .007; 95\% \text{ CI}: 0.101, 0.161; p = .003$), while neutral cognitive distraction was not. Collectively, these results indicate that the use of both positive and neutral distraction coping strategies were related to better psychological outcomes on a zero-order level.

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$^8$ The Q-statistic was significant for this test ($Q = 32.05, p < .001$).

$^9$ This phenomenon by which a composite variable may exhibit a significant effect, while its individual components do not, can occur when pooling the individual variables together substantially decreases sampling error in a meta-analysis.

$^{10}$ The Q-statistic was significant for this test ($Q = 29.37, p < .001$).
**Positive distraction is associated with greater positive emotions.** Positive distraction use was related to higher levels of positive emotions felt about a stressor (r = 0.106; SE = 0.042; 95% CI: 0.007, 0.204; p = .039.) Neutral distraction was not significantly associated with positive emotions on a zero-order level (r = 0.111; SE = 0.050; 95% CI: -0.028, 0.249; p = .090).

**Positive reappraisal is associated with good outcomes.** Positive reappraisal was also related to good outcomes. Use of positive reappraisal predicted lower depression (r = -0.147; 95% CI: -0.179, -0.115; p < .001) and higher well-being (r = 0.151; 95% CI: 0.077, 0.224; p = .007).

**Avoidance is associated with poor outcomes but also with positive distraction.** Cognitive avoidance exhibited maladaptive associations with both depression and well-being. Cognitive avoidance use was associated with higher levels of depression (r = 0.338; 95% CI: 0.242, 0.434; p < .001) and lower well-being (r = -0.166; 95% CI: -0.235, -0.097; p = .004) on a zero-order level. Cognitive avoidance was marginally associated with more frequent use of both positive cognitive and positive behavioral distraction (Positive Cognitive: r = 0.215; 95% CI: -0.062, 0.492; p = 0.09; Positive Behavioral: r = 0.292; 95% CI: -0.074, 0.659; p = 0.08).

**Relationships involving covariates of non-interest.** To conclude our analyses of zero-order associations, we examined the associations between covariates of non-interest (caregiver type and age for Sample P and sex for Samples U1, U2, and U3) and our psychological outcomes for each sample. We conducted a correlation analysis to examine associations of age with outcomes (included in Table 4 for Sample P) and t-tests to examine associations of caregiver type and sex with outcomes (Table 8). Caregiver type
and age were not significantly associated with depression or well-being in Sample P. Sex was not significantly associated with depression or well-being in Samples U1, U2, or U3.
Table 4. Zero-order correlations among variables of interest for Sample P.

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<th></th>
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<th>SWLS</th>
<th>Caregiver Type</th>
<th>Age</th>
<th>Cognitive Avoidance</th>
<th>Cognitive Positive Distraction</th>
<th>Behavioral Positive Distraction</th>
<th>Positive Reappraisal</th>
<th>Positive Emotions</th>
<th>Negative Emotions</th>
<th>Perceived Control</th>
<th>Time in Stressor</th>
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* p < .05, ** p < .01
Table 5. Zero-order correlations among variables of interest for Sample U1.

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*p < .05, **p < .01
Table 6. Zero-order correlations among variables of interest for Sample U2.

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* p < .05, ** p < .01
Table 7. Zero-order correlations among variables of interest for Sample U3.

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* p < .05, ** p < .01
Table 8. Independent samples t-tests comparing effects of caregiver type (sample P) and sex (samples U1, U2, U3) on depression and well-being.

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Positive Distraction is Distinct from Emotional Avoidance

Because distraction has traditionally been associated with avoidance, we wanted to probe further the unique relationship between positive distraction and psychological outcomes when controlling for cognitive avoidance. We created a regression models for each measure of positive distraction (cognitive and behavioral), testing it as a predictor of our primary psychological outcomes of interest (CESD and SWLS). In each model, we entered the positive distraction variable and cognitive avoidance as predictors of interest with either age/caregiver type (sample P) or sex (samples U1, U2, and U3) as covariates of non-interest. Results for individual samples are summarized in Tables 9-10. The covariates of non-interest did not significantly predict outcomes or significantly change the predictive power of positive distraction and cognitive avoidance.

The meta-analysis showed that, compared with zero-order associations, positive distraction became a stronger predictor of well-being ($r_{sp} = 0.157; SE = .004; 95\% \text{ CI}: 0.145, 0.169; p < .0001$) and became a significant predictor of depression ($r_{sp} = -0.125; SE = .019; 95\% \text{ CI}: -0.177, -0.071; p = .003$) when controlling for avoidance. Within positive distraction, the unique predictive effect of positive cognitive distraction on well-being also increased compared to on a zero-order level ($r_{sp} = 0.156; SE = .007; 95\% \text{ CI}: 0.126, 0.187; p = .002$), and positive behavioral distraction became a significant predictor of well-being when controlling for avoidance ($r_{sp} = 0.157; SE = .006; 95\% \text{ CI}: 0.076, 0.239; p = .026$). Overall, the fact that the predictive power of positive distraction becomes more consistent when controlling for avoidance suggests that avoidance may act as a suppressor of positive distraction. Although the two share some functional overlap,
they are distinct in that avoidance seems to be maladaptive, while positive distraction seems to be adaptive.

**Positive Distraction is a Better Unique Predictor of Outcomes Than is Neutral Distraction**

After determining that use of positive distraction predicts adaptive psychological outcomes when controlling for avoidance, we tested whether this effect is a unique property of positive distraction or is a function of distraction in general. We reasoned that if the effect of positive distraction was just due to it being a distraction strategy, then controlling for neutral distraction would eliminate its unique predictive power. To test this hypothesis, we created multiple regression models for samples U1, U2, and U3 that included positive distraction, cognitive avoidance, and neutral distraction as predictors of both depression and well-being. Sample P was excluded from this analysis because neutral distraction use was not assessed for this group. Results for individual samples are summarized in Tables 9-10.

In the meta-analysis, adding neutral distraction as another predictor to the model did not generally detract from the predictive power of positive distraction. For well-being, the composite positive distraction variable remained a significant predictor above and beyond neutral distraction ($r_{sp} = 0.125; SE = .005; 95\% CI: 0.111, 0.138; p < .0001$). This was also the case within the composite positive distraction variable for both positive cognitive and behavioral distraction (Cognitive: $r_{sp} = 0.129; SE = .007; 95\% CI: 0.099, 0.159; p = .003$; Behavioral: $r_{sp} = 0.118; SE = .003; 95\% CI: 0.074, 0.162; p = .018$). For depression, the composite positive distraction variable also remained a significant unique...
predictor ($r_{sp} = -0.109; SE = .023; 95\% CI: -0.172, -0.045; p = .009$), and within this variable, positive behavioral distraction actually became a significant unique predictor after adding neutral behavioral distraction to the model ($r_{sp} = -0.114; SE = .003; 95\% CI: -0.158, -0.070; p = .019$). Positive cognitive distraction remained a non-significant predictor of depression in this model.

In contrast, neutral distraction was not as powerful a unique predictor of outcomes as positive distraction. The composite neutral distraction variable and neutral cognitive distraction did uniquely predict well-being, but not as strongly as positive distraction in either case (Composite Neutral: $r_{sp} = 0.106; SE = .015; 95\% CI: 0.064, 0.148; p = .002$; Cognitive: $r_{sp} = 0.084; SE = .003; 95\% CI: 0.068, 0.101; p = .002$). Moreover, neutral behavioral distraction, which was initially related to higher well-being on a zero-order level, was no longer a significant predictor when controlling for the effects of avoidance and positive behavioral distraction ($r_{sp} = 0.134; SE = .026; 95\% CI: -0.199, 0.466; n.s.$).

The differential in predictive power between positive and neutral distraction was even more apparent for depression, as no neutral distraction variables were significant predictors above and beyond avoidance and positive distraction.

In sum, these results suggest that both positive and neutral distraction predict good outcomes independent of each other, but positive distraction is the more effective coping strategy of the two. It was the only unique predictor of depression, was a significant unique predictor of well-being in 3 out of 3 models tested against neutral distraction (vs. 2 out 3 for neutral distraction), and exhibited stronger effect sizes than neutral distraction in the regression models for which both variables were significant predictors.
Table 9. Regression models predicting depression scores from Positive Distraction (PD) controlling for Cognitive Avoidance (CA; Model 1) vs. from Neutral Distraction (ND) controlling for PD and CA (Model 2).

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# p < .10, * p < .05, ** p < .01, *** p < .001
Table 10. Regression models predicting well-being scores from Positive Distraction (PD) controlling for Cognitive Avoidance (CA; Model 1) vs. from Neutral Distraction (ND) controlling for PD and CA (Model 2).

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# p < .10, * p < .05, ** p < .01, *** p < .001
Positive Distraction and Positive Reappraisal Uniquely Predict Good Outcomes

We compared the efficacies of positive distraction and positive reappraisal in a set of analyses similar to the ones conducted comparing positive vs. neutral distraction. We created multiple regression models for each sample that included positive cognitive distraction, cognitive avoidance, and positive reappraisal as predictors of both depression and well-being. We did not compare the effects of positive behavioral distraction with positive reappraisal, as any observed effects might have been confounded with the fact that positive behavioral distraction is a behavioral strategy, while positive reappraisal is a cognitive strategy. Results for separate samples are presented in Tables 11-12.

Both positive cognitive distraction and positive reappraisal use uniquely predicted higher well-being (Positive Cognitive Distraction: \( r_{sp} = 0.094; SE = .029; 95\% CI: 0.002, 0.187; p = .047 \); Positive Reappraisal: \( r_{sp} = 0.103; SE = .027; 95\% CI: 0.018, 0.189; p = .031 \)). However, only positive reappraisal uniquely predicted depression (\( r_{sp} = -0.091; SE = .019; 95\% CI: -0.153, -0.031; p = .017 \)). Overall, the results suggest that both positive distraction and positive reappraisal are adaptive coping mechanisms in improving well-being during chronic life stressors, although positive reappraisal may be somewhat better at predicting lower depression levels.
Table 11. Regression models predicting effect of Positive Cognitive Distraction vs. Positive Reappraisal (controlling for Cognitive Avoidance) on depression scores.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Predictors: Positive Distraction, Positive Reappraisal, and Cognitive Avoidance</th>
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<tbody>
<tr>
<td></td>
<td>Depression (CESD) Scores</td>
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<td>Caregiver Type (mean-centered)</td>
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<tr>
<td>Sample P</td>
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<td>Cognitive Avoidance</td>
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<td>Cognitive Positive Distraction</td>
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<td>Positive Reappraisal</td>
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<tr>
<td>Sample U2</td>
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<td>Cognitive Avoidance</td>
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<tr>
<td></td>
<td>Cognitive Positive Distraction</td>
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<tr>
<td></td>
<td>Positive Reappraisal</td>
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<tr>
<td>Sample U3</td>
<td>Sex</td>
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<td></td>
<td>Cognitive Avoidance</td>
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<td></td>
<td>Cognitive Positive Distraction</td>
</tr>
<tr>
<td></td>
<td>Positive Reappraisal</td>
</tr>
</tbody>
</table>

*p < .10, ** p < .05, *** p < .001
Table 12. Regression models predicting effect of Positive Cognitive Distraction vs. Positive Reappraisal (controlling for Cognitive Avoidance) on well-being scores.

<table>
<thead>
<tr>
<th>Sample P</th>
<th>Well-being (SWLS) Scores</th>
<th>Predictors: Positive Distraction, Positive Reappraisal, and Cognitive Avoidance</th>
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</thead>
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<td>SE (B)</td>
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<td>Caregiver Type (mean-centered)</td>
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<td>Cognitive Avoidance</td>
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<td>.158</td>
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<tr>
<td>Cognitive Positive Distraction</td>
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<td>.115</td>
</tr>
<tr>
<td>Positive Reappraisal</td>
<td>.290</td>
<td>.117</td>
</tr>
</tbody>
</table>

| Sample U1 | Sex | -.061 | .160 | -.026 | -.385 |
| Cognitive Avoidance | -.369 | .111 | -.228 | -3.320** |
| Cognitive Positive Distraction | .185 | .103 | .126 | 1.790* |
| Positive Reappraisal | .113  | .084 | .093  | 1.345 |

| Sample U2 | Sex | -.098 | .130 | -.041 | -.754 |
| Cognitive Avoidance | -.283 | .092 | -.168 | -3.093** |
| Cognitive Positive Distraction | .202 | .077 | .151 | 2.639** |
| Positive Reappraisal | .081  | .066 | .070  | 1.221 |

| Sample U3 | Sex | -.042 | .162 | -.016 | -.260 |
| Cognitive Avoidance | -.211 | .117 | -.115 | -1.800* |
| Cognitive Positive Distraction | .089 | .091 | .065 | .979 |
| Positive Reappraisal | .147  | .087 | .112  | 1.701* |

# p < .10, * p < .05, ** p < .01, *** p < .001
Mediation Analyses

To elucidate possible pathways through which the adaptive component of positive and neutral distraction (i.e. "non-avoidant positive distraction"; "non-avoidant neutral distraction") predict good psychological outcomes, we conducted a series of mediation analyses for the significant predictor-outcome relationships. Specifically, we tested mediators of the following relationships: 1. composite positive distraction, positive cognitive distraction, and positive behavioral distraction with well-being; 2. composite positive distraction and positive behavioral distraction with depression; 3. composite neutral distraction and neutral cognitive distraction with well-being. Tables 13-14 display completely standardized indirect effects and 95% confidence intervals for the separate samples.

Overall, positive emotions felt about a stressor most consistently mediated the effects of distraction on outcomes. It was a significant mediator of both the composite positive and neutral distraction effects on well-being (Positive: abcs = 0.034; SE = .006; 95% CI: 0.181, 0.049; p = .001; Neutral: abcs = 0.042; SE = .004; 95% CI: 0.029, 0.054; p < .001) and of the composite positive distraction effect on depression (abcs = -0.046; SE = .009; 95% CI: -0.068, -0.023; p = .002). Within positive and neutral distraction, positive emotions also significantly mediated the effects of cognitive distraction on well-being (Positive Cognitive: abcs = 0.044; SE = .009; 95% CI: 0.14, 0.073; p = .018; Neutral Cognitive: abcs = 0.040; SE = .006; 95% CI: 0.012, 0.069; p = .026) and marginally mediated the effects of positive behavioral distraction on well-being (abcs = 0.028; SE = .009; 95% CI: -0.0002, 0.055; p = .051) and depression (abcs = -0.036; SE = .012; 95% CI: -0.074, 0.002; p = .058). Collectively these results suggest that positive emotions felt
about a stressor tend to increase with distraction coping regardless of the emotional valence of the distraction strategy, and this increase in positive emotions predicts better psychological outcomes.

Because positive distraction, but not neutral distraction, was associated with higher levels of positive emotions on a zero-order level, we probed whether there were any differences in how well each form of distraction predicted positive emotions in the mediation models. We reasoned that one form of distraction might be more effective at predicting positive emotions even while positive emotion levels mediate distraction-outcome relationships for both forms of distraction. We analyzed semipartial correlations to determine relationships between the distraction variables and positive emotions while controlling for avoidance and covariates of non-interest. Positive and neutral distraction both significantly predicted positive emotion levels (Positive Distraction: \( r_{sp} = 0.204; \ SE = .032; \ 95\% \ CI: 0.128, 0.280; \ p < .001 \); Neutral Distraction: \( r_{sp} = 0.217; \ SE = .016; \ 95\% \ CI: 0.173, 0.262; \ p < .001 \)).

The effects of other mediators were more mixed. Perceived control mediated the effects of positive distraction on well-being (\( ab_{cs} = 0.025; \ SE = .006; \ 95\% \ CI: 0.010, 0.040; \ p = .006 \)) and depression (\( ab_{cs} = -0.037; \ SE = .008; \ 95\% \ CI: -0.055, -0.018; \ p = .002 \)), but was not a mediator for neutral distraction on well-being (\( ab_{cs} = 0.015; \ SE = .008; \ 95\% \ CI: -0.008, 0.039; \ p = .147 \)). Negative emotions felt about a stressor mediated the effect of neutral distraction on well-being (\( ab_{cs} = 0.016; \ SE = .005; \ 95\% \ CI: 0.003, 0.030; \ p = .028 \)) and marginally mediated the effect of positive distraction on well-being (\( ab_{cs} = 0.012; \ SE = .006; \ 95\% \ CI: -0.0003, 0.026; \ p = .055 \), but not on depression (\( ab_{cs} = -0.026; \ SE = .012; \ 95\% \ CI: -0.054, 0.003; \ p = .068 \)). Finally, time spent in stressor
related situations mediated the effects of positive behavioral distraction on well-being
(ab_{cs} = 0.018; SE = .006; 95% CI: 0.0002, 0.036; p = .037) and depression (ab_{cs} = -0.044;
SE = .012; 95% CI: -0.082, -0.007; p = .033). Time did not mediate the effects of either
positive or neutral cognitive depression on well-being. Feelings of being overwhelmed
did not successfully mediate any models tested.

Together these results suggest that positive emotions are the most ubiquitous
mediator of both positive and neutral distraction efficacy. Also, positive distraction
efficacy may be uniquely mediated by increased perceived control over a stressor
compared to neutral distraction. Both positive and neutral distraction may be mediated by
decreasing negative emotions felt about a stressor, although the evidence for its
mediation of neutral distraction efficacy may be better. Behavioral distraction efficacy,
compared to cognitive distraction efficacy, seems to be mediated by the amount of time
people spend in stressor-related situations.
Table 13. Completely standardized indirect effects and 95% confidence intervals for mediation analyses with depression (CESD) scores as the outcome.

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<tr>
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<tr>
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<tr>
<td>Time</td>
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<tr>
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* p < .05
Table 14. Completely standardized indirect effects and 95% confidence intervals for mediation analyses with well-being (SWLS) scores as the outcome.

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<td>0.028</td>
<td>0.010</td>
<td>-0.019</td>
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*Neutral distraction was not assessed in sample P.

* p < .05
Discussion

In the present study, we sought to characterize positive distraction coping as a potentially useful method for coping with chronic life stressors. Drawing from previous literature on leisure coping, distraction, and positive emotionality, we proposed that positive distraction would not function like a typical "avoidant/disengagement" coping strategy with maladaptive outcomes. However, because positive distraction still requires one to disengage, or divert attention away, from a stressor, it shares some conceptual elements with traditional avoidant coping. Therefore, we predicted that cognitive avoidance would serve as a suppressor of positive distraction, such that the adaptive component (i.e. predicting decreased depression and increased well-being levels) would be most clear when controlling for cognitive avoidance. Our results supported this hypothesis. In the meta-analysis, positive distraction was significantly related to well-being but not depression on a zero-order level, but when controlling for avoidance, positive distraction became a stronger predictor of well-being and significantly predicted decreased depression. These results suggest that positive distraction and avoidance do, in fact, share some conceptual and functional overlap as coping strategies, but that they have unique and opposing effects on mental health outcomes: Avoidance is a maladaptive coping strategy (Carver et al., 1989), predicting higher depression and lower well-being scores in the present study, whereas positive distraction in its purest form is an adaptive strategy (predicting lower depression and higher well-being scores).

Future stress and coping researchers will need to identify the mechanisms that distinguish distraction, especially positive distraction, from avoidance. One potential difference may be the intentionality guiding the use of one versus the other. More
specifically, avoidance coping has at times been considered a reactive form of disengagement from a stressor and its related negative emotions (Patry, Blanchard, & Mask, 2007; Snyder & Pulvers, 2001; Tsaur & Tang, 2012), while distraction has been conceptualized as an intentional form of disengagement (Hamilton & Ingram, 2001; Patry, Blanchard, & Mask, 2007; Tsaur & Tang, 2012). Avoidance is thought to be employed when an individual becomes emotionally overwhelmed, but is unaware that they have other coping resources at their disposal or is incapable of mobilizing these other resources (Snyder & Pulvers, 2001). Distraction may also be a response to feeling emotionally taxed, but is chosen actively at opportune times in order for individuals to adjust their cognitive perceptions of the stressor (i.e. to accommodate or increase secondary control; Skinner et al., 2003) or to prepare and build resources to actively cope with chronic stressors at a later time (Hamilton & Ingram, 2001). Therefore, one characteristic making distraction an adaptive coping strategy may be an awareness of stress levels that drives the choice to disengage from a stressor coupled with the awareness that this disengagement is only a temporary reprieve and not a sustainable solution. As a reactive strategy, avoidance coping may not share these same aspects of awareness.

Positive distraction and avoidance may also differ along the motivational foci driving their use. Specifically, people may use positive distraction if they are primarily focused on approaching positive experiences/rewards (a promotion regulatory focus), and/or they may use avoidance if they are primarily focused on avoiding negative experiences/losses (a prevention regulatory focus). According to Higgins' regulatory focus theory (Higgins, 1997), promotion and prevention motivation orientations do not
tend to be better than the other (Scholer & Higgins, 2012), but act as separate
time ago, there is a way in which these motivational drives interact with other
intrapersonal characteristics to manifest as coping strategies. Scholer & Higgins (2012)
point out that certain people are more inclined towards action than inaction (i.e.
"locomoters"), and these people will exhibit greater well-being if they are also focused on
attaining positive gains. A locomoter who uses avoidant coping strategies may develop
worse psychological outcomes than a locomoter who uses positive distraction. More
subtly, but just as important, motivational drives also tend to interact with the dominant
drive of a particular sociocultural environment. Fulmer et al. (2010) have shown that
people experience better self-esteem and well-being if their promotion vs. prevention
tendencies match the tendencies of their home country. We can theorize similarly that
cultures valuing promotion (typically individualistic cultures; Lockwood et al., 2005) will
also value coping strategies like positive distraction that have the potential for gain.
Using avoidant strategies within these cultural contexts might hinder successful coping
and long-term well-being. Future studies might investigate these theories as potential
determinants of the adaptive/maladaptive distinction between positive distraction and
avoidance.

The present study comprises an initial effort to identify the exact mechanisms by
which positive distraction serves as an adaptive coping strategy in daily life. Our results
suggest that the efficacy of positive distraction is very likely mediated by helping
individuals increase their positive emotions experienced about a chronic stressor. Less
consistently, we found that it may also be mediated by helping people decrease their
negative emotion levels experienced about a chronic stressor and by increasing the amount of control they perceive having over a chronic stressor. This latter finding could support the broadening and resource-building functions of positive emotions, which are able to help individuals prepare to cope with future stressors (Fredrickson, 1998; Hobfoll, 2011) and therefore to experience higher levels of perceived control over chronic or repeated stressful situations. Positive distraction, when behavioral in form, may also be mediated by reducing the amount of time people spend in stressor-related situations. Positive distraction efficacy was not mediated in this study by how overwhelming the stressor was, but future studies should continue investigating the possible mediating or moderating effect of overwhelmingness, as some studies have indicated that positive distraction is more useful for situations of high vs. low stress (Iwasaki et al., 2005; Qian et al., 2014; Tsaur & Tang, 2015).

Positive emotions, in particular, have previously been shown to mediate the effects of other positive emotional coping strategies (Lyubomirsky & Layous, 2013), so it is not surprising that it is also a mediator of positive distraction efficacy. More interestingly, the positive emotions that we measured in the present study reflected how people felt about their stressors, not just how they felt in general. Other studies investigating the mediating mechanisms of positive emotional coping strategies often measure overall positive emotion levels (e.g. Fredrickson et al., 2008). Our findings add to this literature by showing that positive emotional coping strategies, at least in the form of positive distraction, help increase how positively people perceive a stressor, which is then predictive of reduced depression and increased well-being. Moreover, the fact that we demonstrate this mechanism in positive distraction, a coping strategy that involves
disengaging from the stressor and deriving positive emotions from another source, makes the connection between using positive distraction as a coping strategy and increasing positive emotions felt about a stressor much more impactful. Of note, though, is the fact that positive emotions felt about a stressor also mediated the efficacy of neutral distraction. This finding was surprising given that positive distraction definitionally enhances positive emotions, while neutral distraction does not. It is possible that simply distracting yourself at all allows people an opportunity to experience and generate more positive emotions, which can then influence how positively one feels about a stressor.

Our study found important differences between positive and neutral distraction. Participants reported using positive distraction more frequently than neutral distraction to cope with chronic life stressors, suggesting that people (at least young adults) prefer positive distraction over neutral distraction. Positive distraction was also a relatively more efficacious strategy. Neutral distraction showed some efficacy as a coping strategy, as it was positively correlated with well-being on a zero-order level and predicted higher well-being above and beyond the effects of positive distraction. But compared with the predictive effects of positive distraction, it was less consistent and exhibited weaker predictive effects. Neutral distraction did not predict depression above and beyond positive distraction, whereas positive distraction did when controlling for neutral distraction, and the previously significant zero-order association between neutral behavioral distraction and well-being went away once we controlled for positive behavioral distraction. In contrast, both composite positive distraction and its specific cognitive/behavioral subtypes remained significant unique predictors of outcomes even after controlling for neutral distraction. This differential set of findings suggests that
while distraction is generally an adaptive coping strategy for chronic stressors, the emotional valence of the alternate target of attention may be important. It is not that neutral distraction is a maladaptive or ineffective coping strategy, but rather that positive distraction may be relatively more useful. It would be interesting, however, to determine how effective neutral distraction is for older adults, as this measure was not assessed in the present sample of parents.

We also compared positive distraction to positive reappraisal, which served as a representative of other positive emotional coping strategies. We did not find many differences in efficacy between positive distraction and positive reappraisal. Overall, both predicted well-being (but not depression) when controlling for the other, suggesting that they may independently help people cope with chronic stressors. We did, however, find differences in frequency of use between the two. Two of the three undergraduate samples reported using positive distraction more frequently than positive reappraisal, while the parent sample reported using positive reappraisal more frequently. One potential explanation for this finding could be that coping tendencies shift as individuals develop greater capacities for conscious awareness, self-identity, and cognitive emotion regulation across the lifespan. Indeed, young children use behavioral distraction much more frequently than cognitive distraction, but as they enter young adulthood in their late teens, they begin to incorporate and shift readily between behavioral and cognitive distraction strategies (Skinner & Zimmer-Gembeck, 2007). It is possible, then, that as young adults develop further into adults, they might begin to rely on even more elaborate cognitive emotion regulation strategies like positive reappraisal and positive meaning-making.
Another goal of this study was to begin addressing potential differences between cognitive and behavioral positive distraction. Many researchers have previously suggested that cognitive distraction is a separate construct from behavioral distraction, positing that they work through distinct mechanisms (Gross, 2015; Moos & Schaefer, 1993; Skinner et al., 2003) and may be more or less useful for different stressor situations (Ottenbreit & Dobson, 2004). However, to our knowledge, few studies directly compare the mediating mechanisms of cognitive and behavioral positive distraction, especially in the context of chronic stressors. We found that time spent in stressor related situations only successfully mediated the efficacy of positive behavioral distraction. These results make sense in that engaging in distracting activities would necessarily decrease the amount of time one has to spend in stressor-related situations, a characteristic that does not necessarily exist for positive cognitive distraction, which can be employed even while a stressful experience is ongoing. Moreover, it could potentially be maladaptive to use positive behavioral distraction if the stressor is solvable or controllable, because reducing the amount of time spent in stressor-related situations might also detract from the amount of time one devotes to resolving the stressor. In this case, taking a brief moment to mentally disengage from the stressor with positive cognitive distraction would allow an individual to continue any efforts dedicated to solving or managing the stressor and its effects while still providing some respite from the stress itself.

Finally, future researchers should investigate the contextual elements that make positive distraction more or less useful. This idea of coping flexibility, or strategy-situation fit, posits that no coping strategy serves as a panacea, but that most strategies will be more or less useful given the contextual parameters of the situation (e.g.
personality characteristics, stressor characteristics, individual goals and expectations, etc.; Cheng et al., 2014). For instance, the amount of time that one may allot to positive behavioral distraction may also moderate its efficacy. Qian et al. (2014) reported that busier people actually benefited more from using positive behavioral distraction, possibly because those opportunities were rare and could be more savored. Future studies investigating more complex mediation and moderation (e.g. moderated mediation) models could provide further insight into the mechanisms of positive distraction efficacy and the conditions in which it is most useful with the goal of helping people become more adaptive, or flexible, in their coping efforts.

**Study Limitations**

Our study has several potential limitations. First, our adult sample was created by combining responses from two subsamples of caregivers in order to increase the power of the study. Although we did not find any significant differences in our outcomes of interest between the two subsamples, the possibility that they were experiencing different levels and types of chronic stress could have influenced our findings from the larger sample. For instance, non-cancer caregivers coping with "typical" chronic life stressors might benefit from cognitive positive distraction in a similar way as the undergraduates, whereas the cancer caregivers might actually experience poorer outcomes when utilizing cognitive positive distraction. These opposing effects would have negated each other in the analyses for the larger adult sample. Larger sample sizes for each caregiver subsample would have given us enough statistical power to assess the efficacy of positive
distraction coping in each sample separately, perhaps then giving us a better idea of how positive distraction works for different types of chronic life stressors.

Our study was also limited by the fact that our assessment of distraction in the Situational Positive Coping measure relied on single-item responses. With single-item measures, there is a risk that the question does not reliably assess the intended underlying construct. If this were the case in our study, then our conclusions would not be a good reflection of the characteristics of positive or neutral distraction coping. The potential effects of this limitation are somewhat mitigated by the fact that we include four separate samples in the study and that our measures of distraction are correlated with another validated measure of distraction from the Coping Responses Inventory (Moos, 1995). Aggregating results across four samples with the internal meta-analysis also bolsters the soundness of our findings. We can therefore make relatively sound conclusions about the validity and reliability of our own distraction measures, but the possibility remains that the Situational Positive Coping measure does not adequately assess the whole constructs of positive or neutral distraction. Future directions include using psychometric analyses and replication efforts to develop further a reliable and valid measure of positive distraction coping.

Summary & Conclusion

The present study represents an initial effort to characterize positive distraction for coping with chronic life stressors. We presented results from separate samples comparing positive distraction with cognitive avoidance and neutral distraction. Overall, we found that positive distraction coping shares some features with both neutral
distraction and cognitive avoidance. But where avoidance is a clearly maladaptive strategy associated with increased depression and decreased well-being levels, positive distraction seems to be adaptive, specifically when controlling for any overlapping characteristics with avoidance. Neutral distraction is not as preferred as positive distraction, nor is it as effective at helping people cope with life stressors. The distinctions among these three coping strategies are important given that distraction has traditionally been linked with avoidance in the coping literature as a maladaptive coping strategy. The results from this study, showing that avoidance is a suppressor of positive distraction, suggest that distraction should not be viewed as a maladaptive like avoidance. Future works should seek to build upon the findings presented here in order to create a more complex and well-understood idea of how and under what circumstances positive distraction helps people cope with their life stressors.
Chapter 3: Experimental Studies Comparing Positive and Neutral Distraction
**Introduction**

*Positive distraction* is a form of distraction coping or emotion regulation that involves redirecting attention towards a positive stimulus. Theoretically, this redirection not only reduces negative mood, but also enhances positive mood (Shepley et al., 2006; Skinner et al., 2003; Webb et al., 2012). This attentional shift differs from that of *neutral distraction*, which involves redirecting one's attention towards a non-emotional target to simply neutralize a negative mood (Van Dillen & Koole, 2009). As emotion regulation strategies for acute stressors and/or negative mood inductions on a short time scale, both forms of distraction have proven similarly effective (Webb et al., 2012). Evidence also suggests that both positive and neutral distraction can successfully reduce amygdala activation (Delgado et al., 2008; Kanske et al., 2011; McRae et al., 2010) and negative mood responses (Kanske et al., 2011; McRae et al., 2010; Smolarski et al., 2015; Strick et al., 2009; Van Dillen & Koole, 2007) when viewing negatively-valenced images. Positive distraction also improves cardiovascular recovery from fear inductions (Fredrickson & Levenson, 1998) and reduces skin conductance responding to fear-conditioned stimuli (Delgado et al., 2008).

Although positive and neutral distraction seem to be similarly effective for coping with acute stressors, they may be more distinct in the context of chronic stressors. Qualitative studies indicate that both are used to cope with chronic stress (e.g. Ekanayake et al., 2013; Perez-Sales et al., 2005), but that positive distraction may be more preferred than neutral. Perez-Sales et al. (2005) reported that in comparison to using daily tasks (e.g. cooking and cleaning), earthquake survivors relied more heavily on pleasant activities (e.g. humorous plays) to cope with the stress of post-disaster displacement. We
found corroborating evidence in Chapter 2 empirically comparing positive and neutral
distraction for coping with chronic stress. Both positive ("thinking of or engaging in
pleasant things or activities") and neutral ("thinking of or engaging in daily tasks or
activities") distraction use predicted higher subjective well-being levels, but positive
distraction did so more strongly and across more types of distraction coping (both
cognitive and behavioral distraction vs. just cognitive for neutral distraction). Moreover,
when controlling for neutral distraction, positive distraction predicted both increased
well-being and decreased depression, whereas neutral distraction only predicted well-
being when controlling for positive distraction (Shing, McLean, & Waugh, in prep).

One possible explanation as to why positive distraction could be more effective
than neutral distraction for coping with chronic stressors is its promotion of positive
emotions. Our previous study (Chapter 2) showed that both positive and neutral
distraction were mediated by positive emotion levels when controlling for avoidance.
However, only positive distraction was significantly associated with increased positive
emotion levels on a zero-order level. One important function of positive emotions is to
replenish resources (e.g. cognitive, emotional, physical, social) that are lost during stress
(Fredrickson, 1998; Hobfoll, 2011). Indeed, after first being depleted of psychological
resources, people who are subsequently exposed to a positive emotion-inducing stimulus
are more prepared to re-engage with a cognitively demanding task than those who are
given a neutral stimulus (Tice et al., 2007). Presumably, the positive emotions helped
restore some psychological resources, which in turn aided participants in tackling the
second task. This replenishing effect has also been observed physiologically. When given
a positive-emotion induction, people exhibit faster cardiovascular recovery from acute
laboratory stressors (Bostock et al., 2011; Brown et al., 2013; Fredrickson & Levenson, 1998), and people who experience more positive emotions on a daily basis exhibit faster cardiovascular recovery from life stressors (Papousek et al., 2010). These findings suggest that positive emotions also aid in the restoration of physical resources, which then theoretically help people cope with the next physiologically stressful event.

Despite the ecological evidence that positive distraction may be more adaptive than neutral for coping with chronic stressors, no studies have directly compared the two in a laboratory setting. Experimental designs are a necessary component of the literature on distraction coping, as ecological studies lack the ability to imply causality. Studies employing direct manipulations of distraction use are needed for this purpose. Notably, the existing experimental literature focuses heavily on the benefits of positive distraction for single-hit, acute stimuli and has yet to assess its effectiveness for chronic stress. One reason for this relative scarcity may be that it can be challenging to model chronic stress in the laboratory due to time and feasibility constraints. Still, one way in which chronic stress researchers have simulated chronic stress is through repeated stressor paradigms, used particularly commonly in animal models (Sutanto & de Kloet, 1994). These paradigms are based on the theory that one mechanism underlying the development of chronic stress is the cumulative effect of experiencing shorter repeated stressors (Gouin et al., 2013; McEwen, 2007; Oken et al., 2015; Sapolsky, 2004). These paradigms are also imperfect as there is still a relative paucity of research linking findings from studies using repeated stressor models in humans to ecological psychosocial outcomes (Kudeilka & Wust, 2010), but they still provide important information regarding the way in which people's stress responses change over time (Kudeilka & Wust, 2010).
The timeline of repeated stressor studies can range from hours to weeks, but the common characteristic among them is that subjects are exposed to more than one stressor, with the goal of examining how psychological and physiological functioning changes dynamically over time (Oken et al., 2015). The present work describes two experimental studies directly comparing the effects of positive vs. neutral distraction on repeated laboratory stressors, which may serve as an empirical corollary to chronic life stress.

Study 1

The purpose of the first study was to directly test our hypothesis that positive distraction is more adaptive than neutral distraction for coping with repeated stressors and that this relative adaptiveness would be due to replenishment of psychological and physical resources, which may facilitate coping with subsequent stressors. To simulate exposure to chronic stress, we employed a repeated stressor paradigm in which participants experienced two social evaluative stress tasks (doing serial subtractions in front of an evaluator). They were randomly assigned to complete a positive or neutral distraction task in between the two stressors. Psychological resources were tracked as 1) subjective measures of pleasantness and unpleasantness at distinct time points during the experiment as well as about the experiment as a whole (overall pleasantness/unpleasantness), 2) behavioral measures of performance on the stress tasks, and 3) specific profiles (described below) of physiological measures obtained throughout the experiment (heart rate, heart rate variability, cardiac output, pre-ejection period, systolic blood pressure, and total peripheral resistance). Physical resources were tracked directly as changes in each physiological measure. We also included behavioral measures
of attempts on the stress tasks (how many times they attempted to make a subtraction) to control for the possibility that differences in affect and physiological reactivity were due to differential task engagement.

Cardiovascular measures were included in the experimental design for two reasons. The first was to investigate the possibility that positive distraction restores physical resources more effectively than neutral distraction. The second was to probe the effect of positive vs. neutral distraction on physiological correlates of psychological processes. The physiological stress response is generally thought to involve a decrease in parasympathetic nervous system (PNS) activity, mediating decreases in heart rate variability (HRV; the degree to which heart rate varies over time), and an increase in sympathetic nervous system (SNS) activity, mediating increases in heart rate (HR), myocardial contractility (evidenced by decreased pre-ejection period; PEP), and systolic blood pressure (SBP) among other physiological outcomes (Blascovich et al., 2011; Seery, 2011). However, a wealth of prior work suggests that activation differences in these outcomes are actually nuanced enough to reflect differences in complex orientations to stress (Blascovich et al., 2011; Kelsey, 2004; Seery, 2011). For instance, people who perceive a stressor to be threatening vs. challenging (i.e. evaluate the stressor to be more demanding than their resources can manage; Blascovich & Mendes, 2010) typically report worse psychological outcomes (e.g. higher subjective stress levels) and exhibit a cardiovascular activation profile mediated by both the sympathetic-adrenomedullary system and the hypothalamic-pituitary axis (Seery, 2011). This 'threat' profile includes increased total peripheral resistance (TPR) and decreased or unchanged cardiac output (CO) relative to baseline levels (Blascovich & Mendes, 2010; Seery,
In the present study, we anticipated the first stressor to deplete participants' resources. If the distraction period was unsuccessful in replenishing these resources, we expected that participants would evaluate the second stressor as being more demanding than their resources could manage and therefore exhibit a physiological 'threat' profile (↑ TPR, ↓ or unchanged CO from baseline). Conversely, people who perceive a stressor to be challenging vs. threatening (i.e. evaluate their resources to be greater than stressor demands; Blascovich & Mendes, 2010) typically exhibit better psychological outcomes (e.g. lower subjective stress levels) and a cardiovascular activation profile mediated by just the sympathetic-adrenomedullary system (Seery, 2011). This 'challenge' profile includes increased CO and decreased TPR relative to baseline levels (Seery, 2011). If the distraction tasks did help to replenish resources, we expected that participants would evaluate the second stressor to be less demanding than their resources could manage and therefore exhibit a physiological 'challenge' profile (↓ TPR, ↑CO from baseline). Based on our proposition that positive distraction is more replenishing than neutral distraction because it capitalizes on positive emotions, we expected that the positive distraction task would be more likely than neutral distraction to elicit a 'challenge' profile during the second stressor. Interestingly, increases in HR, myocardial contractility, and SBP relative to baseline are less reflective of resource/demand evaluations and more indicative of active engagement with a task/stressor - a pre-requisite for adopting either orientation to stress (Seery, 2011; Mendes, 2009). No or little increase from baseline is often reflective of disengagement or not caring about a task, which can occur when a task or stressor is impossible to complete (Richter et al., 2008). We did not expect participants in either distraction condition to find the second stressor impossible. Therefore, we expected
participants in both groups to exhibit similarly elevated HR, myocardial contractility, and SBP (relative to baseline) during the second stressor.

The dynamic role of the parasympathetic nervous system during stress is somewhat less straightforward. When people are not stressed, the parasympathetic nervous system acts via the vagus nerve to tonically control resting-state bodily functions. When a person experiences a stressor, this vagal/parasympathetic tone typically decreases, allowing for the sympathetic nervous system to engage the body in an active stress response. This reduction in vagal tone is considered an appropriate vagal response to stress. Then when the stressor is removed, the PNS resumes its tonic influence on the heart (Blascovich & Mendes, 2010). According to Porges' Polyvagal Theory (Porges, 1995; 2007), the quality of PNS functioning can be indexed by changes in HRV between times of rest and stress. High HRV at rest indicates good vagal tone and vice versa, while greater reductions in HRV during stress and greater increases in HRV during recovery indicate good vagal responsiveness. Poor vagal tone and/or responsiveness can be an indicator of physical disease or poor health (Porges, 2007), but because our participants consisted of healthy young adults, we expected to find an appropriate decrease in vagal tone/HRV during both stressors and an increase during distraction and recovery. Both vagal tone and vagal responsiveness have also been linked to a number of psychological processes. High vagal tone is associated with improved emotion regulation (Fabes & Eisenberg, 1997) and engagement in social situations (Porges, 2007) as well as positive mood (Kok et al., 2013; Oveis et al., 2009; Wang, Lu, & Qin, 2013), while greater vagal responsiveness to negative stimuli has been associated with decreased depression (Rottenberg et al., 2005). Because of this link between
increased vagal responsiveness (decreased HRV) and decreased negative emotional arousal, we expected the positive distraction group to exhibit greater decreases in HRV (less negative emotional arousal) during the second stressor compared to the neutral distraction group. Finally, Blascovich and Mendes (2010) also note that people who have a 'challenge' orientation towards stress may exhibit faster and greater increases in HRV during recovery, often to levels that exceed those at baseline ("vagal rebound"). Thus, we also expected to see, if positive distraction is better at replenishing resources than neutral distraction and facilitates a greater 'challenge' orientation to the second stressor, that people in the positive distraction condition would exhibit greater vagal rebound than people in the neutral distraction condition.

We made a number of hypotheses in this study, all related to the overarching proposition that positive distraction may be relatively more adaptive than neutral for coping with repeated stressors in part because it replenishes resources, thus protecting from the negative effects of subsequent stressors. If positive distraction replenishes resources after a stressor more so than neutral, then we expected that the positive distraction task would help restore outcomes displaced during stressor 1 better than the neutral distraction task. Specifically, we hypothesized that the positive distraction group would exhibit higher pleasantness ratings and lower unpleasantness ratings after the distraction task compared to the neutral distraction group, as well as greater increases in pleasantness ratings and greater decreases in unpleasantness ratings from stressor 1 to distraction compared to the neutral distraction group. We could not make specific predictions about direction of change for CO and TPR prior to knowing if participants would exhibit a "challenge" (↑HR, ↓PEP, ↑SBP, ↑CO, ↑TPR, ↓HRV) or "threat" (↑HR,
↓PEP, ↑SBP, ↓CO, ↑TPR, ↓HRV) profile to stressor 1, but similar to our affect predictions, we predicted that the positive distraction group would exhibit a greater trend in the direction of baseline for each measure during the distraction period compared to the neutral distraction group (e.g. if HR increased during stressor 1, it would decrease more during distraction in the positive distraction group than in the neutral distraction group). We did not necessarily expect measures to return to baseline levels during distraction given that the distraction task still required effortful cognitive engagement. We will refer to this set of hypotheses as our "replenishment hypotheses."

Next, we proposed that if positive distraction replenishes resources better than neutral distraction, participants in the positive distraction group would be more prepared to cope with, and therefore relatively less affected by, the stressor - buffered from its effects - compared to the neutral distraction group (we will refer to these hypotheses as our "buffering hypotheses"). Specifically, we hypothesized that the positive distraction group would report greater increases in pleasantness and greater decreases in unpleasantness from stressor 1 to stressor 2 compared to the neutral distraction group. We also hypothesized that because of greater resource replenishment, participants’ perceptions of the experiment as a whole would be buffered - the positive distraction group would report higher overall pleasantness and lower overall unpleasantness than the neutral distraction group.

Physiologically, we hypothesized that the positive distraction group would be buffered from the demands of the second stressor. At this point, there were two possibilities, based on how participants responded to the first stressor. If they responded with a threat orientation (↑HR, ↓PEP, ↑SBP, ↓CO, ↑TPR, ↓HRV relative to baseline) to
the first stressor, we expected the positive distraction task to facilitate a switch to a challenge orientation (↑HR, ↓PEP, ↑SBP, ↑CO, ↓TPR, ↓HRV relative to baseline) towards the second stressor. If they responded with a challenge orientation to the first stressor, we expected the positive distraction task to still facilitate a challenge orientation to the second stressor, but to a lesser degree compared to during stressor 1 as the second stressor would now be perceived as less demanding (relative to stressor 1) and therefore not as physiologically activating. In this second scenario, physiological stress activation would be decreased during stressor 2 compared to during stressor 1 (↓HR, ↑PEP, ↓SBP, ↓CO, ↓TPR, ↑HRV relative to stressor 1). We also expected the positive distraction group to exhibit a reintroduction of vagal tone during recovery with an increase in HRV exceeding baseline levels (vagal rebound).

We had two competing hypotheses for the neutral distraction group. If the neutral distraction task failed to replenish resources, then participants in this group would not be buffered from the demands of the second stressor, and this lack of buffering could manifest in two possible ways. First, they could switch from a challenge state during stressor 1 to a threat state during stressor 2 or, alternatively, they could exhibit a threat state during stressor 1 and be as or even more threatened during stressor 2 (i.e. exhibit even greater physiological activation; ↑HR, ↓PEP, ↑SBP, ↓CO, ↑TPR, ↓HRV relative to stressor 1). Our competing hypothesis accounted for the possibility that neutral distraction might replenish some resources, but not as much as positive distraction. In this case, there were two possible outcomes relative to the positive distraction group. Participants might display an initial threat orientation to stressor 1, then switch to a challenged state but with more physiological activation than the positive distraction
group during stressor 2 (↑HR, ↓PEP, ↑SBP, ↑CO, ↑TPR, ↓HRV relative to the positive distraction group at stressor 2). Or participants might display a challenge orientation to both stressors 1 and 2, exhibiting less physiological activation during stressor 2 compared to stressor 1 (↓HR, ↑PEP, ↓SBP, ↓CO, ↓TPR, ↑HRV relative to stressor 1), but more physiological activation compared to the positive distraction group at stressor 2 (↑HR, ↓PEP, ↑SBP, ↑CO, ↑TPR, ↓HRV relative to the positive distraction group at stressor 2).

We also expected the return of vagal tone to be less pronounced during recovery compared to the positive distraction group - HRV levels would increase during recovery compared to stressor 2, but not to levels exceeding those at baseline.

For our behavioral measures, we expected that the positive distraction group would make more subtraction attempts and fewer errors than the neutral distraction group during stressor 2 as a result of perceiving it be less demanding/stressful. Prior studies have shown that people who find a motivated performance task (e.g. socially evaluated mental arithmetic) to be less demanding/stressful tend to make more attempts and fewer errors (Tomaka et al., 1993) and are less withdrawn/defeated behaviorally (Blascovich & Mendes, 2010). This prediction is further supported by prior evidence suggesting that positive mood states aid performance on a variety of cognitive tasks (Bryan & Bryan, 1991; Iordan & Dolcos, 2015; Kubzansky et al., 2012).

Method

Participants. Participants were 110 Introductory Psychology students at a southern university. Prior to participation, participants were randomly assigned to either a positive distraction or a neutral distraction condition. Students were recruited over the
course of two semesters via an online mechanism and received one hour of research credit as compensation for participating. Data from one participant in the neutral distraction condition was excluded because they did not complete the study. The Positive Distraction group included 55 students (65.5% Female), while the Neutral Distraction group included 54 students (59.3% Female). Prior to conducting this study, we calculated that this sample size would allow us to achieve 80% power to detect significant differences (alpha = .05) for a hypothesized effect size of $\eta^2 = .070$ for differences in subjective affect ratings after positive vs. neutral emotion induction (Monfort et al., 2015) and being distracted vs. not (Van Dillen & Koole, 2007)\textsuperscript{11}.

**Mental arithmetic stressor.** The repeated stressor in this study was a serial subtraction social evaluative stressor modified from the Trier Social Stress Test (Kirschbaum, 2010). Participants were asked to count backwards by either 17s or 13s from 4672 and 3412, respectively, while in front of an evaluator (Chida & Hamer, 2008). They were told to count as quickly and accurately as possible in the time given and were asked to start over if they made a mistake. The evaluator was trained to remain stoic and as neutral in their facial expressions and demeanor as possible. Evaluators were instructed to not give any facial feedback to the participants during the study. To enhance an attitude of professionalism, evaluators also wore a white lab coat, carried a clipboard and pen to record the number of mistakes and attempts made by each participant, and used a stopwatch to time the task. Not all participants were included in the analyses for

\textsuperscript{11} Note that this power calculation was originally conducted for a 2x2 factorial study of Positive vs. Neutral distraction and High vs. Low working memory load. Because we reduced the number of groups to 2 in the present study, we conducted a post-hoc power analysis, which revealed that our sample size allowed us to reach an achieved power of 88% to detect significant differences (alpha = .05) for an $\eta^2 = .017$ for differences in pleasantness ratings as a function of time*distraction condition.
attempts and mistakes due to recording errors that were corrected as the study progressed. We were able to record mistakes for 85 participants and attempts for 57 participants. Finally, each participant completed one serial 17s subtraction and one serial 13s subtraction, the order of which was randomly counterbalanced prior to participation.

**Distraction task.** The distraction task was programmed using ePrime Pro (version 2.0). Participants performed a 2-back short-term memory task (based on the n-back memory task; Kirchner, 1958), in which they viewed a series of faces and were asked to remember the genders of those faces. For each trial, participants were instructed to identify whether the gender was the "same" or "different" from the face they had seen two trials earlier. The n-back task has been used previously to distract people from emotional stimuli (Buratto et al., 2014). We used pictures of happy (positive distraction condition) and neutral (neutral distraction condition) facial expressions taken from a standardized database (NimStim Face Set; Tottenham et al., 2009; Levens and Gotlib, 2012), with equal numbers of male and female faces in each condition. The viewing of positive vs. neutral facial expressions in this task was based on a validated form of Cognitive Bias Modification (Wadlinger & Isaacowitz, 2011; Dandeneau et al., 2007), which has been shown to increase positive emotionality by first increasing attentional bias for positive stimuli. This distraction task constitutes a form of passive positive/neutral distraction (Webb et al., 2012), in which individuals were not told explicitly to distract themselves from thinking about their math performance while completely the memory task.
Self-report and behavioral measures.

Distraction success. At the end of the study, participants were asked to report how well the working memory task distracted them from thinking about their performance on the mental arithmetic tasks. They used a continuous rating scale on the computer screen (range: 0 - 1900 pixels; adapted from Waugh, Fredrickson, & Taylor, 2008) to provide their responses. Participants saw a bar with a continuous gray color gradient ranging from white (left) to very dark (right). The ends of the bar were labeled as being "Not at all" distracted (left) to "Very" distracted (right). They were asked to click anywhere along the bar to indicate their response. This measure was used to confirm that the positive and neutral distraction tasks did not differ in distraction efficacy, and thus that any differences observed between the two groups were due to other factors.

Pleasantness/Unpleasantness. Participants provided ratings of positive and negative affect using the continuous affect rating scale described above. Participants saw two scales during each emotion rating period, one for positive affect ('pleasant') and one for negative affect ('unpleasant'). Each scale ranged from neutral ("Not at all" pleasant/unpleasant) to high positive or high negative affect ("Very" pleasant/unpleasant). Participants were instructed to click along the shaded bar indicating how pleasant/unpleasant they were feeling "right now" (at the moment they saw the scales).

Overall pleasantness/unpleasantness. At the end of the study, participants were asked to report how pleasant and unpleasant they felt about the experiment as a whole.
using the continuous affect rating scale. These items were intended to measure if positive vs. neutral distraction has an effect on overall mood pertaining to a particular experience.

**Subtraction attempts and mistakes.** During the mental arithmetic stressors, the evaluator recorded the number of attempts made by each participant. An attempt was defined as any time a participant tried to make a subtraction, regardless of whether it was a correct response. The evaluator also recorded the number of mistakes made during the task. Mistakes were counted only as incorrect responses. During data analysis, we computed performance scores by calculating the ratio of mistakes to attempts (error rates) for each stressor, similar to the percentage correct method employed in prior studies (Callister et al., 1992; Kelsey et al., 2004). This method allowed us to account for the fact that some people might make fewer mistakes because they also made fewer attempts, and the mistake recordings for these individuals would not be comparable to those who made few mistakes but many attempts. Further analyses of mistakes were then conducted on these new error rates variables. Finally, as noted before, mistakes and attempts were not recorded for all participants due to recording errors that were corrected as the study progressed. We were able to record mistakes for 85 participants and attempts for 57 participants.

**Physiological measures.** All physiological activity was recorded at a rate of 1 kHz. Raw physiological signals were acquired with an integrated software system (Biopac MP150, AcqKnowledge; Biopac Systems, Goleta, CA). All signals were collected and scored in 180 second intervals (reflecting each distinct period in the
experimental paradigm) and processed in ANSLAB (Wilhelm & Peyk, 2005) with custom MATLAB scripts. Details of specific processing parameters are presented below for each physiological measure.

**Heart rate (HR).** Continuous heart rate monitoring was acquired with a modified lead II configuration electrocardiogram (ECG). Disposable all-purpose snap electrodes (EL-504 electrodes - purchased from Biopac Systems, Goleta, CA) were placed on the left and right lower ribs of each participant following a previously used protocol (Waugh et al., 2012). During signal processing, signals were resampled with custom scripts at a rate of 400 Hz. We inspected the ECG data for artifacts and missing R-peaks. Artifacts were removed and missing R-peaks were inserted half-way in between neighboring R-peaks. After correcting for artifacts and missing R-peaks, we calculated the average HR for each 180 second interval in beats per minute (bpm).

**Heart rate variability (HRV).** HRV was measured by applying a spectral analysis in ANSLAB to the ECG data after it was corrected for artifacts and missing R-peaks. Band filters were set as: Very low frequency (0.025 - 0.07 Hz), Low frequency (0.07 to 0.15 Hz), and High frequency (0.15 - 0.4 Hz). From the spectral analysis, we used the respiratory sinus arrhythmia (RSA) data as our measure of HRV because RSA is the spectral frequency of HRV that is most reflective of parasympathetic nervous system activity (Berntson et al. 1997; Thayer et al., 2012). We calculated the average RSA values (msec²) for each 180 second interval in the study.

**Cardiac output (CO) & Pre-ejection period (PEP).** In psychophysiological research, CO is used in combination with other measures (HR, TPR) as an index of
challenge vs. threat appraisals. PEP is used as an index of sympathetic nervous system activity (Sherwood et al., 1990). CO and PEP were both assessed in the present study using impedance cardiography (ICG; Sherwood et al., 1990). ICG provides a non-invasive measurement of stroke volume and other cardiovascular indices by inducing a constant alternating current along the thoracic space and measuring changes in voltage output. The change in voltage is indirectly proportional to the impedance, or resistance, of the thoracic tissue, which itself changes directly with changes in blood flow through the aorta. Thus, ICG can be used to detect stroke volume, or the volume of blood ejected by the left ventricle into the aorta with each contraction. Cardiac output is then calculated from the stroke volume and the heart rate. PEP can also be calculated from the ICG waveform, as a measurement of the amount of time between the onset of electrical signaling in the ventricles (Q point on the ECG waveform) to the opening of the aortic valve for left ventricular ejection of blood (B-point on the ICG waveform) (Sherwood et al., 1990).

To acquire raw ICG signals, we employed the most commonly used tetrapolar band electrode configuration (Sherwood et al., 1990). Two disposable band electrodes (EL-506 bioimpedance strips - purchased from Biopac Systems, Goleta, CA) were placed on the neck of each participant, and two were placed on the chest. All electrodes were placed at least 3 cm apart to ensure that there was a uniform distribution of current density across the voltage electrodes, an important assumption in the ICG calculation of stroke volume (Sherwood et al., 1990). We also recorded the distance (in cm) between the two inner (current) electrodes for each participant, which was later used to calculate CO.
During signal processing, signals were resampled with custom scripts at a rate of 1000 Hz. We inspected the ICG data for signal interference during acquisition and for missed B- and x- points by the ANSLAB algorithm. The B-point in ICG waveforms corresponds to the opening of the aortic valve, while the x-point corresponds to aortic valve closure. We manually inserted any misidentified B- and x-points according to guidelines presented by Sherwood et al. (1990) and set the blood resistivity constant, Rho, to 135 Ohm·cm for stroke volume/cardiac output calculations (Sherwood et al., 1990). Participants for whom there was a lot of signal interference in the ICG signal were removed from further CO and PEP analyses. After processing, we calculated the average CO (L/min) and PEP (msec) values for each 180 second interval.

**Systolic blood pressure (SBP).** To assess SBP, we continuously monitored blood pressure with the CNAP Monitor 500 (CNSystems, Austria), which non-invasively measures blood pressure in the fingers. A double-barrel finger sensor was placed over the first and second digits of the participant's left hand and the monitor pack was strapped over the dorsal aspect of the participant's left forearm. A standard blood pressure arm cuff was also placed around the participant's upper left arm. The arm cuff was used to calibrate the values obtained from the finger cuffs. Calibrations were set to occur every 25 minutes. Per the manufacturer's setting, only one finger cuff was inflated at a time. The cuff was set to switch sides every 25 minutes unless the participant asked us to manually switch it for comfort reasons.

To process the raw blood pressure signals, we inspected the data for spike/waveform outliers (those that distort the mean) and artifacts of calibration periods. As recommended by ANSLAB, we only removed calibration artifacts that occurred over
once per minute, or that lasted longer than 200 seconds. We also defined outliers as values greater than 3 standard deviations from the mean. Participants for whom there were any artifacts or outliers using these parameters were excluded from further analyses. After processing, we calculated the average SBP (mmHg) values for each 180 second interval.

**Total peripheral resistance (TPR).** To assess TPR, we first obtained both systolic and diastolic values using the processing parameters described above. We used these values to calculate mean arterial pressure (MAP) for each 180 second interval using the following equation:

\[
\text{MAP} = \frac{1}{3} \text{Systolic} + \frac{2}{3} \text{Diastolic}
\]

Finally, we calculated TPR for each 180 second interval using the following equation:

\[
\text{TPR} = \frac{\text{MAP}}{\text{CO}}
\]
Procedure. The procedure for this study is depicted in Figure 1.

Figure 1. Experimental paradigm for Study 1. Positive and negative affect were measured at five time points. Physiological measures were recorded continuously throughout the study. PE = Positive Emotions (Pleasantness), NE = Negative Emotions (Unpleasantness)

Pre-task. Upon arrival, participants were seated in a comfortable armchair and asked for informed consent according to an Institutional Review Board approved protocol. They were also informed that they would be monitored on a closed circuit camera for safety purposes. The experimenter then explained the continuous affect rating scale to the participant and obtained a baseline report of positive and negative affect. Then the experimenter placed the cardiovascular and blood pressure sensors described above on the participant. A respiration belt and skin conductance sensors were also attached, but neither respiration nor electrodermal activity were analyzed as we experienced substantial difficulties obtaining clear respiration signals and unexpected difficulties in calibrating the skin conductance signals properly (resulting in negative skin
conductance values). The skin conductance electrodes also served as an electrical ground for the ECG and ICG electrodes.

To facilitate clear signal acquisition, participants were asked to sit with both arms on the armrests, their backs off the back of the chair, and with legs uncrossed. After the sensors were fully attached, the experimenter explained the distraction task to the participant, saying only, "Now you are going to learn and practice a task that you will do later." The participant was then given 10 practice trials, but was allowed to repeat the trials until they felt comfortable with the task. No participant asked to repeat the practice trials more than two times. After confirming that they understood the distraction task, the participant was asked to sit and rest quietly for 3 minutes (acclimation period) while the experimenter left the room to check the signal acquisition. The acclimation period was also used for troubleshooting if the acquired physiological signals were unclear.

**During task.** After the acclimation period, the participant was asked to sit and rest quietly for another 3 minutes (baseline period), constituting the start of physiological data collection. The baseline period was followed by the first mental arithmetic stressor, which also lasted 3 minutes. When the first stressor was over, the evaluator left the room for the experimenter to enter and re-explain the distraction task. The participant was then left alone to complete the distraction task for 3 minutes. After the distraction task was over, the evaluator re-entered the room and had the participant complete the second 3-minute mental arithmetic stressor.

**Post-task.** After the second stressor, the participant was asked to sit and rest quietly for 3 minutes for the recovery period. At the end of the study, the experimenter removed all sensors from the participant and debriefed them about the protocol.
**Data analysis.** All analyses were conducted using IBM SPSS Statistics (version 23). Differences between groups for distraction success was assessed with an independent samples t-test. Differences between groups for the overall pleasantness/unpleasantness variables were assessed with univariate analyses of covariance (ANCOVAs) to account for baseline levels of pleasantness/unpleasantness as a covariate of non-interest. For pleasantness/unpleasantness at specific time points and each physiological measure described above, we conducted a 5x2x2 factorial repeated measures ANOVA (RM-ANOVA) investigating main effects of time (Baseline, Stress 1, Distraction, Stress 2, Recovery), math task order [subtracting by 17s first (17/13) vs. subtracting by 13s first (13/17)], and distraction condition (Positive vs. Neutral). For attempts and error rates, we conducted 2x2x2 factorial RM-ANOVAs investigating main effects of two time points (Stress1 and Stress 2), math task order, and distraction condition. For all outcomes, we also investigated interactions of time*math task order, time*distraction condition, math task order*distraction condition, and time*math task order*distraction condition. We applied a Greenhouse-Geisser correction to account for violations of sphericity. Because outcomes did not differ by gender, it was not included as a covariate in our analyses. Significant interactions were followed up with specific pair-wise comparisons described below.

**Results**

**Distraction success.** The positive and neutral distraction groups did not report significant differences in how successfully the memory task distracted them from
thinking about the stressors (Positive Distraction: M = 1169.24; SD = 362.12; Neutral Distraction: M = 1104.54; SD = 431.99; t(106) = -.843, p = .401, d = .162). These findings suggest that any further observed differences between the positive and neutral distraction groups were not just due to differences in distraction efficacy.

**Affect reports.**

**Pleasantness.** A significant within-subjects effect of time was found for pleasantness (Figure 2), F(3.011[4], 316.181[420]) = 9.067, p < .001, η² = .079. Participants decreased in pleasantness from Baseline to Stressor 1 (Baseline: M = 978.69 pixels, SD = 369.79 vs. Stressor 1: M = 886.25 pixels, SD = 337.12; t(108) = 2.093, p = .039, d = .201. Pleasantness levels then increased significantly relative to Stressor 1 after the distraction task (M = 1033.20 pixels, SD = 305.00); t(108) = 5.485, p < .001, d = .529, and returned to baseline levels; t(108) = 1.289, p = .200, d = .124. Pleasantness levels dropped again after Stressor 2 (M = 905.47 pixels, SD = 349.31) relative to post-distraction; t(108) = -3.846, p < .001, d = .371, but did not differ from those reported after Stressor 1; t(108) = -.659, p = .511, d = -.063. Finally, pleasantness levels increased after recovery (M = 1053.18 pixels, SD = 324.10) back to baseline levels; t(108) = 1.864, p = .065, d = .179. There was no significant between-subjects effect for distraction condition or math task order (13s first vs. 17s first) and no significant interactions.

Together, these results suggest that our stress manipulations were effective at reducing positive affect. However, our hypotheses were not supported. The distraction task replenished positive emotion levels, but not differentially for positive vs. neutral distraction, and our buffering hypothesis was not supported - we did not find that the
distraction task weakened the degree to which pleasantness levels dropped during stressor 2 as compared to stressor 1, nor was there a differential effect between the positive and neutral distraction groups.

Figure 2. Self-reported pleasantness ratings throughout Study 1 broken down by distraction condition. The 5 time points assessed are represented on the X-axis, with pleasantness ratings on the Y-axis. The blue line depicts ratings from the Neutral Distraction group, and the red line depicts ratings from the Positive Distraction group. Average raw values at each time point with standard error bars are shown.

**Unpleasantness.** A significant within-subjects effect of time was found for unpleasantness (Figure 3), F(2.992[4], 311.167[416]) = 2.770, p = .042, η² = .026. Participants increased in unpleasantness levels from Baseline to Stressor 1 (Baseline: M = 801.44, SD = 360.54 vs. Stressor 1: M = 928.54, SD = 326.57); t(108) = -3.279, p = .001, d = -.320. Unpleasantness levels decreased significantly relative to Stressor 1 after the distraction task (M = 741.61, SD = 284.69); t(108) = -6.447, p < .001, returning to baseline levels; t(108) = 1.577, p = .118, d = .153. Unpleasantness levels increased again after Stressor 2 (M = 921.17, SD = 367.11) relative to post-distraction; t(108) = 4.064, p < .001, d = .392, but did not differ from those reported after Stressor 1; t(108) = -.162, p
=.872, d = -.015. Finally, unpleasantness levels decreased during recovery (M = 770.41, SD = 338.58) back to baseline levels; t(108) = .630, p = .530, d = .060.

There was no significant between-subjects effect for distraction condition. However, as we hypothesized, there was a significant time*distraction condition interaction, F(2.992[4], 311.167[416]) = 3.225, p = .023, η² = .030. Follow-up analyses revealed that the Positive Distraction and Neutral Distraction conditions did not differ during Baseline (Positive: M = 827.53, SD = 370.61; Neutral: M = 774.87, SD = 351.46; t(107) = .761, p = .448, d = .146), Stressor 1 (Positive: M = 932.60, SD = 298.36; Neutral: 924.41, SD = 355.80; t(107) = .130, p = .897, d = .025), or Distraction (Positive: M = 776.84, SD = 275.89; Neutral: M = 705.74, SD = 291.57; t(107) = 1.308, p = .194, d = .25). We also calculated change scores (MΔ) reflecting how much unpleasantness decreased from stressor 1 to distraction (subtracted unpleasantness ratings during distraction from unpleasantness ratings during stressor 1) and compared these scores between the Positive and Neutral Distraction groups. Unpleasantness ratings did not decrease more in the Positive Distraction group (MΔ = 155.77 pixels, SD = 293.76) compared to in the Neutral Distraction group (MΔ = 218.49 pixels, SD = 308.18); t(107) = -1.093, p = .277, d = -.208, which was inconsistent with our replenishment hypothesis.

Consistent with our buffering hypothesis, however, the Positive Distraction group experienced significantly less unpleasantness during Stressor 2 compared to the Neutral Distraction group (Positive: M = 833.96, SD = 358.85; Neutral: M = 1009.98, SD = 357.06; t(107) = -2.567, p = .012, d = -.492). We also calculated change scores reflecting how much unpleasantness decreased from stressor 1 to stressor 2 (Stress 1 unpleasantness - Stress 2 unpleasantness; positive change scores reflect less unpleasantness at stressor 2.
relative to stressor 1) and compared these scores between the Positive and Neutral Distraction groups. The change scores between groups were significantly different from each other; $t(107) = 2.05, p = .043, d = .39$. The Positive Distraction group exhibited a positive change score ($M\Delta = 98.64$ pixels, $SD = 476.76$), while the Neutral Distraction group exhibited a negative change score ($M\Delta = 85.57$ pixels, $SD = 462.57$), suggesting that unpleasantness levels actually increased from stressor 1 to stressor 2 for the Neutral Distraction group. The Positive Distraction group also reported marginally significant lower levels of unpleasantness after recovery compared to the Neutral Distraction group (Positive: $M = 716.25$, $SD = 321.74$; Neutral: $M = 825.57$, $SD = 349.26$; $t(107) = -1.700$, $p = .092$, $d = -.326$). Finally, there was no significant between-subjects effect for math task order (13s first vs. 17s first) and no other significant interactions.

Together, these results supported our buffering hypothesis. Exposure to the Positive Distraction task protected against feelings of unpleasantness in response to a repeated social evaluative stressor. This effect was not shared by Neutral Distraction and lasted to recovery. Interestingly, our replenishment hypothesis was not supported. Although unpleasantness levels decreased during the distraction task, they did not do so differentially for positive vs. neutral distraction.
Figure 3. Self-reported unpleasantness ratings throughout Study 1 broken down by distraction condition. The 5 time points assessed are represented on the X-axis, with unpleasantness ratings on the Y-axis. The blue line depicts ratings from the Neutral Distraction group, and the red line depicts ratings from the Positive Distraction group. Average raw values at each time point with standard error bars are shown.

**Overall Pleasantness/Unpleasantness.** Ratings of how pleasant/unpleasant participants perceived the experiment to be as a whole did not differ between the positive (Overall Pleasantness: M = 940.13, SD = 276.50; Overall Unpleasantness: M = 883.91, SD = 319.95) and neutral distraction groups (Overall Pleasantness: M = 954.65, SD = 368.51; Overall Unpleasantness: M = 894.19, SD = 312.89) [Overall Pleasantness: F(1,106) = .682, p = .411, $\eta^2 = .006$; Overall Unpleasantness: F(1,106) = .024, p = .877, $\eta^2 < .001$]. Thus, our hypothesis that the positive distraction group would report higher overall pleasantness and lower overall unpleasantness than the neutral distraction group was not supported.

We found it intriguing that unpleasantness levels would be different between the two groups during stressor 2 and marginally so during recovery, and yet this difference
was not reflected in the overall unpleasantness ratings, which were measured at the same time as the recovery ratings. One possible explanation was that there was an indirect effect between distraction condition and overall unpleasantness ratings working through another variable. We posited that this variable could be the relative difference in unpleasantness between stressors 1 and 2 (i.e. whether one's perceptions of unpleasantness were buffered or not). To probe this possibility, we dummy coded the positive and neutral distraction conditions (Neutral = 1, Positive = 2) and conducted a mediation analysis testing indirect effects with 10,000 bootstrap samples to investigate whether the change scores in unpleasantness between stressors 1 and 2 (Stressor 1 Unpleasantness - Stressor 2 Unpleasantness; positive change scores represented lower unpleasantness levels during stressor 2 relative to stressor 1) might explain overall unpleasantness ratings between groups. This change score was negatively correlated with overall unpleasantness (r = -.241, p = .012), suggesting that the less unpleasant stressor 2 was compared to stressor 1, the less unpleasant the experiment was as a whole. We then found that the relative difference in unpleasantness between stressors 1 and 2 had an indirect effect on the relationship between distraction condition and overall unpleasantness (ab = -30.10, 95% CI: -87.48, -1.64; Figure 4). Specifically, being in the positive distraction group predicted having a greater positive difference score (i.e. reporting lower unpleasantness at stressor 2 relative to stressor 1; B = 184.21, SE = 89.99, p = .04), which in turn predicted reporting lower overall unpleasantness (B = - .163, SE = .064, p = .011).
Figure 4. Mediation model for the indirect effect of buffering unpleasantness on overall unpleasantness. The model showed that positive distraction was predictive of lower levels of unpleasantness during stressor 2 compared to stressor 1, which in turn predicted lower overall levels of unpleasantness.

**Physiological outcomes.** Results for physiological measures are presented separately below to discuss how findings pertain to our replenishment hypotheses. These sections are followed by a presentation of findings across the outcomes (i.e. profiling 'challenge' vs. 'threat' orientations) to discuss how the results pertain to our buffering hypotheses.

**Heart rate (HR).** We first examined the HR data for outliers and excluded one participant from the analysis due to having HR measurements that were below 40 beats per minute (bpm) and more than 3 interquartile range deviations from the mean. 8 other participants were excluded from this analysis due to unclear ECG signal acquisition (movement artifacts, unexplained signal interference). A total of 101 participants (Positive Distraction N = 49; Neutral Distraction N = 52) were included in the analysis.

A significant main effect of time was found, F(1.955[4], 189.622[384]) = 150.46, p < .001, η² = .608 (Figure 5). HR significantly increased during Stressor 1 compared to Baseline (Baseline: M = 72.48 bpm, SD = 10.55 vs. Stressor 1: M = 87.25 bpm, SD =
HR then decreased significantly during the distraction task (M = 79.83 bpm, SD = 12.55) compared to Stressor 1 [t(100) = -9.496, p < .001, d = -.950] but did not return to baseline levels [t(100) = 10.821, p < .001, d = 1.121]. HR increased significantly during Stressor 2 (Stressor 2: M = 85.99 bpm, SD = 12.18) compared to during distraction [t(100) = 10.402, p < .001, d = 1.036], but was still significantly lower than HR during Stressor 1; t(100) = 2.33, p = .022, d = .238. HR during Stressor 2 was significantly higher than at Baseline; t(100) = 15.79, p < .001, d = 1.595. Recovery then significantly reduced HR back to baseline levels (Recovery: M = 73.17 bpm, SD = 10.99); t(100) = 1.631, p = .106, d = .162. There were no significant between-subjects effects or interactions.

**Figure 5.** Average heart rate in beats per minute (bpm) throughout Study 1. The 5 time points assessed are represented on the X-axis, with heart rate on the Y-axis. The blue line depicts heart rates for the Neutral Distraction group, while the red line depicts heart rates for the Positive Distraction group. Average raw heart rate values at each time point with standard error bars are shown.
Overall, these results indicate that participants were expending more effort during the stressors than during baseline, distraction, and recovery. However, our replenishment hypothesis was not supported as HR did not decrease differentially during the distraction period for the positive vs. neutral distraction conditions, suggesting that positive distraction did not have a greater replenishing effect on HR compared to neutral distraction. Additionally, HR did not fully return to baseline levels, suggesting that participants were still expending some effort during the distraction task relative to baseline. These results likely reflect the fact that the distraction tasks required active cognitive engagement, and together with the lack of significant between-subjects effect of distraction condition, supports the assumption that participants in both conditions were similarly engaged in their respective distraction tasks.

*Heart rate variability (Respiratory sinus arrhythmia; RSA).* We examined and excluded data through the same process as for HR to produce a final total of 101 participants (Positive Distraction N = 49; Neutral Distraction N = 52).

A significant main effect of time was found, $F(2.181[4], 211.55[384]) = 17.41$, $p < .001$, $\eta^2 = .152$ (Figure 6). RSA decreased significantly during Stressor 1 compared to Baseline (Baseline: $M = 8.26 \text{ msec}^2$, $SD = 1.17$ vs. Stressor 1: $M = 7.82 \text{ msec}^2$, $SD = 1.11$; $t(100) = 4.093$, $p < .001$, $d = .408$) and stayed low during the distraction task ($M = 7.73 \text{ msec}^2$, $SD = 1.14$), at a level comparable to that during Stressor 1 [$t(100) = .883$, $p = .379$, $d = .088$] and Stressor 2 (Stressor 2: $M = 7.77 \text{ msec}^2$, $SD = .98$; $t(100) = .552$, $p = .582$, $d = .056$). RSA during Stressor 2 was significantly lower than at Baseline [$t(100) = -4.752$, $p < .001$, $d = -.476$]. Finally, RSA increased during recovery back to baseline.
levels (Recovery: $M = 8.26$ msec$^2$, $SD = 1.24$) [$t(100) = .018$, $p = .986$, $d = .002$]. There were no significant between-subjects effects or interactions.

**Figure 6.** Average respiratory sinus arrhythmia (msec$^2$) throughout Study 1. The 5 time points assessed are represented on the X-axis, with RSA on the Y-axis. The blue line depicts RSA for the Neutral Distraction group, while the red line depicts RSA for the Positive Distraction group. Average raw RSA values at each time point with standard error bars are shown.

Overall, our replenishment hypotheses for RSA were not supported. RSA did not increase during distraction, but rather remained at a similar level as during Stressor 1. This finding corroborates the HR results to suggest that participants were not able to reach a fully relaxed state in comparison to baseline levels. There was also no difference between distraction conditions in RSA levels during the distraction period.

**Cardiac output (CO).** Prior to analyses, we excluded 8 participants for outlier (greater than 3 interquartile range deviations from the mean) and nonsensical values (negative cardiac output) and 10 participants for poor signal acquisition (movement...
artifacts, signal interference). A total of 91 participants (Positive Distraction N = 46; Neutral Distraction N = 45) were included in the analysis.

We found a significant main effect of time, F(2.809[4], 244.38[348]) = 4.711, p = .004, \( \eta^2 = .051 \) (Figure 7). CO increased during Stressor 1 (M = 9.68 L/min, SD = 3.85) relative to Baseline (M = 8.84 L/min, SD = 2.65); t(90) = 3.038, p = .003, d = .351, then decreased significantly during the distraction task (M = 9.12 L/min, SD = 2.94) compared to Stressor 1 [t(90) = -2.563, p = .012, d = -.299] to Baseline levels [t(90) = 1.311, p = .193, d = .139]. CO increased again during Stressor 2 (M = 9.28 L/min, SD = 3.19) to a level that was not different from Distraction [t(90) = .884, p = .38, d = .093], but was marginally less than CO at Stressor 1 [t(90) = -1.939, p = .056, d = -.214] and marginally greater than CO at Baseline [t(90) = 1.961, p = .053, d = .213]. CO decreased during Recovery (M = 8.88 L/min, SD = 2.82) back to baseline [t(90) = .284, p = .777, d = .030]. There were no significant between-subjects effects or interactions.

Figure 7. Average cardiac output (L/min) throughout Study 1. The 5 time points assessed are represented on the X-axis, with cardiac output on the Y-axis. The blue line depicts
cardiac output for the Neutral Distraction group, while the red line depicts cardiac output for the Positive Distraction group. Average raw CO values at each time point with standard error bars are shown.

These results do not support our replenishment hypothesis that CO would decrease differentially for the positive vs. neutral distraction groups during the distraction period.

**Pre-ejection period (PEP).** We excluded 13 participants with extreme outlier values and/or for poor signal acquisition. A total of 96 participants (Positive Distraction N = 48; Neutral Distraction N = 48) were included in the analysis.

We found a significant main effect of time, F(2.3.115[4], 286.56[368]) = 4.515, p = .004, η² = .047 (Figure 8). PEP decreased significantly during Stressor 1 (M = 89.65 msec, SD = 25.15) compared to Baseline (M = 96.31 msec, SD = 21.07); t(95) = -3.47, p = .001, d = -.36. Then, PEP values proceeded to increase throughout Distraction (M = 91.26 msec, SD = 25.13) and Stressor 2 (M = 91.89 msec, SD = 24.42), but values during Stressor 1, Distraction, and Stressor 2 did not differ significantly from each other (all t-values < 1.00, all p-values > .15). PEP values did not return to baseline levels during the distraction period [t(95) = -2.374, p = .020, d = -.246], and PEP values during Stressor 2 were significantly lower than those at Baseline; t(95) = -2.037, p = .044, d = -.21. Finally, PEP increased significantly during Recovery (M = 95.15 msec, SD = 21.14) in comparison to Stressor 2 [t(95) = 2.063, p = .042, d = .215] back to baseline levels; t(95) = -.765, p = .446, d = .078. There were no significant between-subjects effects or interactions.
**Figure 8.** Average pre-ejection period (msec) throughout Study 1. The 5 time points assessed are represented on the X-axis, with PEP on the Y-axis. The blue line depicts PEP for the Neutral Distraction group, while the red line depicts PEP for the Positive Distraction group. Average raw PEP values at each time point with standard error bars are shown.

In sum, Stressor 1 seemed to have the biggest impact on decreasing pre-ejection period, which then slowly increased back to baseline levels by the end of the experiment (all other t-values < 2.50, p-values n.s). These findings do not support our replenishment hypothesis that PEP values would increase more in the positive distraction group vs. the neutral distraction group. Moreover, the fact that PEP does not increase significantly during distraction compared to during stressor 1 corroborates the HR and RSA findings to suggest that participants were expending effort during the distraction task.

**Systolic blood pressure (SBP).** Data from 10 participants were excluded for movement artifacts, systolic outside our pre-defined parameters, and calibration periods
longer than our pre-defined parameters. A total of 99 participants were included in the analysis (Positive Distraction N = 49; Neutral Distraction N = 50).

Again, we found a significant main effect of time, $F(3.14[4], 297.84[380]) = 4.434, p = .004, \eta^2 = .045$ (Figure 9). SBP increased during Stressor 1 compared to Baseline (Baseline: $M = 146.53$ mmHg, $SD = 14.40$ vs. Stressor 1: $M = 150.42$ mmHg, $SD = 14.73$; $t(98) = 4.035, p < .001, d = .404$). SBP decreased significantly during Distraction ($M = 146.30$ mmHg, $SD = 16.71$) compared to Stressor 1 [$t(98) = -3.79, p < .001, d = .386$) and returned to baseline levels [$t(98) = .213, p = .831, d = .023$]. SBP increased significantly during Stressor 2 ($M = 149.25$ mmHg, $SD = 17.33$) compared to Distraction [$t(98) = 2.333, p = .022, d = .235$] and Baseline [$t(98) = 1.991, p = .049, d = .204$], but did not differ from Stressor 1 [$t(98) = .859, p = .244, d = .088$]. Finally, SBP decreased during Recovery ($M = 147.85$ mmHg, $SD = 17.18$) to baseline levels [$t(98) = 1.173, p = .244, d = .121$]. There were no significant between-subjects effects or interactions.
Our replenishment hypothesis that SBP in the positive distraction group would show a greater decrease during distraction relative to stressor 1 than in the neutral distraction group was not supported. Rather we found that SBP was significantly lower during distraction than stressor 1 regardless of task condition.

**Total peripheral resistance (TPR).** Because TPR is calculated from CO and MAP, only participants for whom both values were valid for the time points assessed were included in the analysis. We also excluded 8 participants for having extreme outlier values or negative values after data processing. A total of 80 participants were included in the analysis (Positive Distraction N = 38; Neutral Distraction N = 42).

We found a significant main effect of time, $F(2.474[4], 188.036[304]) = 12.105, p < .001, \eta^2 = .137$ (Figure 10). TPR decreased during Stressor 1 (M = 1085.97 dynes, SD = 415.96) relative to Baseline (M = 1211.79 dynes, SD = 424.92) [$t(79) = -3.911, p < .001, d = -.437$]. Although TPR increased slightly during Distraction (M = 1102.88 dynes, SD = 406.62) relative to Stressor 1, this difference was not significant [$t(79) = .880, p = .382, d = .099$]. Moreover, Distraction TPR values did not reach Baseline levels; $t(79) = -3.57, p = .001, d = -.40$. Next, TPR levels decreased during Stressor 2 (M = 1046.23 dynes, SD = 385.94) relative to Distraction [$t(79) = -2.53, p = .013, d = .283$] and were much lower than Baseline levels; $t(79) = -4.572, p < .001, d = -.513$. Finally, TPR increased during Recovery (M = 1178.67 dynes, SD = 415.59) to Baseline levels;
\[ t(79) = 1.488, \ p = .141, \ d = .167. \] There were no significant between-subjects effects or interactions.

![Figure 10](image.png)

*Figure 10.* Average total peripheral resistance (dynes) throughout Study 1. The 5 time points assessed are represented on the X-axis, with TPR on the Y-axis. The blue line depicts TPR for the Neutral Distraction group, while the red line depicts TPR for the Positive Distraction group. Average raw TPR values at each time point with standard error bars are shown.

Our replenishment hypothesis was not supported. TPR increased slightly during distraction compared to during stressor 1, but not significantly. Moreover, there was no difference in how much TPR increased between the positive and neutral distraction groups.

**Summary of physiological profiles.**

**Stressor 1.** Consistent with a physiological profile supporting a challenge orientation towards stressor 1, we found that HR, myocardial contractility, SBP, and CO
increased relative to baseline, while TPR and RSA decreased. This was the case for participants in both distraction conditions.

**Distraction.** The physiological profile during distraction reflected a mix of recovery and a challenge orientation to the distraction task. HR and myocardial contractility were both increased relative to baseline, while TPR and RSA were decreased, all of which are suggestive of active engagement in a challenge orientation. However, CO and SBP both decreased back to baseline levels during distraction, which is suggestive of physiological recovery. Changes in these outcomes during the distraction period did not differ between the positive and neutral distraction groups.

**Stressor 2.** The physiological profile during stressor 2 reflected a challenge orientation. HR, myocardial contractility, SBP, and CO were increased relative to baseline, and TPR and RSA were decreased. However, reactivity in these outcomes relative to reactivity during stressor 1 did not differ between the positive and neutral distraction groups.

**Recovery.** In support of the challenge profile observed during stressor 2, RSA increased during recovery back to baseline levels, indicating an appropriate return of vagal tone after stressor termination. However, RSA during recovery did not exceed baseline levels, so we did not see evidence of vagal rebound. There was also no effect of distraction condition on RSA recovery.

Overall, our buffering hypothesis was not supported by these results. We did not find a difference between the positive and neutral distraction groups in orientation to stressor 2 relative to stressor 1, suggesting that positive distraction was not better than neutral distraction at buffering from physiological reactivity to stress.
Behavioral results.

Attempts. For the analysis of attempts, no significant main effects were found. Only the time*math task order interaction was found to be significant, \( F(1[1], 52[52]) = 53.418, p < .001, \eta^2 = .507 \). Participants in the 17/13 condition (\( n = 17 \)) made fewer attempts at Stressor 1 (doing serial 17 subtractions; \( M = 16.59, SD = 8.10 \)) than participants in the 13/17 condition (\( n = 40 \)) (doing serial 13 subtractions; \( M = 27.52, SD = 9.91 \)); \( t(55) = 4.01, p < .001, d = 1.21 \). At Stressor 2, the number of attempts for each condition was reversed, but not significantly - participants in the 17/13 condition (doing serial 13 subtractions; \( M = 25.06, SD = 9.37 \)) made more subtraction attempts than participants in the 13/17 condition (doing serial 17 subtractions; \( M = 20.83, SD = 9.82 \)); \( t(55) = -1.51, p = .137, d = .44 \). These results suggest that the serial 17 subtraction task was possibly more difficult than the serial 13 subtraction task, confirming our decision to counterbalance the tasks across stressors. However, these results do not support our hypothesis that the positive distraction group would make more attempts than the neutral distraction group during stressor 2 as a function of perceiving it to be less stressful. We can infer, instead, that both groups were similarly engaged with the stress tasks, so the finding that positive distraction reduced unpleasantness ratings during stressor 2 more than neutral distraction was likely not due to variability in active engagement with the second math task.

Error rates (Mistake:Attempt ratio). We found a significant 3-way interaction of time*math task order*distraction condition, \( F(1[1], 52[52]) = 6.115, p = .017, \eta^2 = .105 \). Follow-up analyses indicated that this interaction was driven by a significant math task order*distraction condition interaction during Stressor 1, \( F(1, 55) = 4.217, p = .045, \eta^2 = \)
.071, such that participants in the Positive Distraction condition had higher error rates when subtracting by 17s (M = .405, SD = .283) than by 13s (M = .1711, SD = .139); t(28) = 3.053, p = .005, d = 1.047. Participants subtracting by 17s vs. 13s in the Neutral Distraction condition did not differ in error rates during Stressor 1 (17s: M = .219, SD = .170; 13s: M = .154, SD = .178, p = .366, d = .375).

We also found a significant 2-way interaction of time*math task order, F(1[1], 52[52]) = 12.386, p = .001, η² = .192. Follow-up contrasts revealed that participants subtracting 17s (M = .307, SD = .242) had higher error rates than participants subtracting 13s (M = .163, SD = .158) during the first stressor; t(55) = 2.444, p = .018, d = .644. No main effects of time, distraction condition, or math task order were found.

Although we found that participants in the positive distraction group made more errors during stressor 1 compared to the neutral distraction group, this effect was prior to the distraction manipulation and therefore is not relevant to our hypotheses. Our hypothesis that the positive distraction group would have lower error rates during stressor 2 compared to the neutral distraction group was not supported.

Study 1 Discussion

In Study 1, we aimed to directly compare the efficacies of positive and neutral distraction in a laboratory simulation of chronic stress. Specifically, we hypothesized that positive distraction would be more effective than neutral at replenishing resources lost after an initial stressor (replenishment hypothesis), and that this relatively greater replenishment would help buffer from the harmful effects of a subsequent stressor (buffering hypothesis). We did not find direct evidence that positive distraction is more
effective than neutral at replenishing these resources. We did, however, find support for our buffering hypothesis with subjective unpleasantness ratings. As predicted, the positive distraction group reported significantly lower levels of unpleasantness during the second stressor compared to the neutral distraction group. The difference in unpleasantness ratings between stressor 1 and stressor 2 was also significantly different between the distraction conditions; unpleasantness decreased from stressor 1 to stressor 2 in the positive distraction group, but increased from stressor 1 to stressor 2 in the neutral distraction group. We concluded that this relative reduction in perceived unpleasantness represents a buffering effect of positive distraction on repeated stress that is not available with neutral distraction. These buffering findings are consistent with prior studies showing that positive emotion inductions can protect individuals from the negative emotional consequences of stress (Folkman & Moskowitz, 2000; Fredrickson et al., 2003; Ong et al., 2006).

We did not find a buffering effect of positive distraction on cardiovascular reactivity to the second stressor. By some accounts, this result is surprising, as previous studies have shown that positive emotions facilitate cardiovascular recovery from stress/negative emotion inductions (Tugade et al., 2004; Tugade & Fredrickson, 2004) in comparison to neutral (Fredrickson & Levenson, 1998). But other studies have also failed to show a clear buffering effect of cardiovascular reactivity from stress by a preceding positive emotion induction (Gramer & Supp, 2014; Purdum, 2010). As Fredrickson et al. (2000) noted, there may be a difference in how positive emotions influence cardiovascular reactivity to stress vs. cardiovascular recovery from stress. Dockray & Steptoe (2010) further note in a review of the literature that there really is no clear
association between positive emotions and cardiovascular activity in mood induction studies, possibly because experimenters have not really attempted to tease apart the effects of positive emotions on cardiovascular recovery vs. reactivity. Our findings, then, are not entirely inconsistent with the literature on the point that positive emotions may not buffer from cardiovascular reactivity to negative emotional states.

Our study also differs from past investigations, which have typically utilized passive film or picture viewing to induce negative emotional states and elicit cardiovascular reactivity (Dockray & Steptoe, 2010). We employed an active, motivated performance task as our stress induction, which invites evaluations of resource to demand ratios, in turn adding a layer of complexity to possible patterns of cardiovascular activation (Seery, 2011). Moreover, these evaluations can change even throughout a single task as people continuously reappraise and compare the level of resources they have to the degree of demands presented (Seery, 2011). Therefore, it is possible that our statistical methodology of averaging physiological values for each 180 second time period was not sensitive enough to identify changes in resource-demand appraisals from stressor 1 to stressor 2, particularly if these appraisals changed within stressor. For instance, participants could have started stressor 1 with a strong challenge orientation (resources >> demand), but as the stressor progressed, may have become relatively more depleted in resources to exhibit a weaker challenge orientation (resources > demand) or even a weak threat orientation (resources < demand). The distraction task would theoretically have replenished resources relative to this resource-demand state at the end of stressor 1, just as a potential buffering effect would be observed relative to this ending state. Additionally, a buffering effect would theoretically be observed most strongly right
after the distraction task (near the *beginning* of stressor 2) when resource levels are the greatest (i.e. before resources start to become depleted again during stressor 2).

Averaging across the full time period for each phase of the study might have obscured these subtle changes in resource-demand evaluations, thus also masking any potential buffering effects of positive vs. neutral distraction on cardiovascular reactivity to stress.

One goal of Study 2 was to re-evaluate our buffering hypothesis by analyzing smaller increments of time in order to compare people's psychophysiological states at the end of stressor 1 to those at the beginning of stressor 2.

Quite notably, we also found no evidence that positive distraction was better at replenishing resources than neutral distraction. This lack of replenishment was particularly curious for unpleasantness levels, for which we found a buffering effect of positive, but not neutral, distraction. One possible explanation to reconcile these findings is simply that the ability for positive vs. neutral distraction to buffer from the negative emotional consequences of stress may not be a function of differential resource replenishment. Alternatively, positive and neutral distraction might differentially replenish resources in an ecological context, but our specific positive and neutral distraction tasks in the experiment may not have simulated this distinction. More specifically, our distraction tasks were still somewhat physiologically effortful, suggesting that they required some active engagement from the participant (not surprising since the task was designed to be cognitively demanding based on well-established distraction paradigms used by previous researchers; Buratto et al., 2014; Sheppes et al., 2014; Van Dillen & Koole, 2007). This type of distraction task may not have adequately represented the kinds of positive and neutral distraction that people utilize in daily life.
(i.e. leisure coping or other forms of planned positive mental/physical breathers vs. engaging in daily tasks or activities), and therefore potentially did not replenish participants in a way that positive vs. neutral distraction would in daily life.

A third explanation for why we did not observe differences in resource replenishment between groups is the possibility that our experimental paradigm did not accurately capture the resources that were being replenished. It may be that positive distraction buffers from negative emotions associated with a repeated stressor, not by restoring affective states better than neutral distraction does, but through some other mechanism not measured in the present study. Indeed, other researchers have found that motivation and fatigue may be stronger indicators of resource depletion/replenishment than negative affect (Hagger & Chatzisarantis, 2010). Another goal in Study 2 was to incorporate motivation and fatigue as additional markers of resource replenishment and to investigate if positive distraction is better than neutral distraction at replenishing these resources lost during stress.

We were also surprised to find that our positive distraction task did not increase subjective pleasantness ratings more so than the neutral distraction task, suggesting that positive emotions are similarly increased by positive and neutral distraction. However, this finding is inconsistent with our previous report that positive emotions in daily life are more highly correlated with positive distraction than with neutral distraction (Chapter 2). We posit that our measure of subjective pleasantness did not adequately capture participants' positive emotion levels as we intended, but perhaps a more salient sense of relief that the stressor was finished. This explanation would suggest that participants in both distraction groups felt a similar strong sense of relief to be done with the stressor.
that may have masked more subtle differences in positive affect induced by the
distraction tasks. Likewise, our positive distraction manipulation in this study may have
been too subtle to elicit substantial differences in self-reported pleasantness levels
compared to the neutral distraction task. While viewing positive emotional expressions
has previously been shown to sufficiently enhance subjective positive emotional states
(e.g. Cognitive Bias Modification to increase positive mood; Wadlinger & Isaacowitz,
2011; Dandeneau et al., 2007), our participants were not asked to focus on the emotional
expressions of the faces, but on gender, a non-emotional characteristic. This effort
expended on a non-emotional cognitive task could have diminished the effect of viewing
positive facial expressions on increasing positive emotion ratings. We acknowledge that
one interpretation of not finding differences in pleasantness ratings between the positive
and neutral distraction groups is that the buffering effect we did observe for
unpleasantness in the positive distraction group may not be due to differences in
distraction valence, per se. Therefore, we wanted to retest our replenishment and
buffering hypotheses in Study 2 after changing the emotional salience of the distraction
paradigms to elicit a more robust positive emotion induction from the positive distraction
task.

Finally, we also probed if positive distraction would have a greater buffering
effect on emotional overall ratings than neutral distraction, but we did not find direct
evidence for this hypothesis. At first glance, the positive distraction group did not
experience greater overall pleasantness and lower overall unpleasantness than the neutral
distraction group. However, the results of our follow-up mediation analysis for overall
unpleasantness suggest otherwise - positive distraction use (vs. neutral distraction) may
actually be related to decreased feelings of overall unpleasantness, and this relationship can be explained in part by how unpleasant one perceives repeated stressors to be relative to each other. The many statistical explanations for how we could find a significant indirect effect (ab) with a non-significant total effect (c) is beyond the scope of this discussion, but one possibility is that the apparent lack of a total effect is driven by having multiple explanatory mediators (perhaps unmeasured in this study) with opposing indirect effects (Rucker et al., 2011). For instance, relative to neutral distraction, positive distraction may make a second stressor less unpleasant compared to the first, which is related to lower overall unpleasantness, but positive distraction may also make the second stressor more unpleasant through some other pathway related to higher overall unpleasantness. These two combined effects would be negated in the total relationship between positive distraction and overall unpleasantness.

In summary, we found in Study 1 that positive distraction buffers from negative emotions experienced during a repeated stressor, while neutral distraction does not. We could not conclude that this buffering effect was due to positive distraction replenishing more resources than neutral distraction since our replenishment hypotheses were not supported. We identified a number of limitations that may have influenced our ability to fully test the replenishment proposition, and Study 2 builds on Study 1 to address the limitations discussed. Specifically, we included two additional subjective measures (fatigue and motivation) to assess resource change more directly. We looked at changes in outcomes from minute to minute to capture more sensitive measures of psychophysiological states at distinct time points. We also made the distraction tasks more emotionally salient to increase the positive emotion induction by the positive
distraction task relative to the neutral distraction task. Further additions to Study 2 are detailed below.

**Study 2**

The purpose of Study 2 was two-fold. First, we wanted to retest our hypotheses from Study 1 using additional subjective measures of depletion, a set of distraction tasks that might elicit greater differences in positive emotionality, and smaller increments of time for data analysis. Additionally, we wanted to probe whether the relative advantage of positive distraction over neutral for reducing negative emotions (observed in Chapter 2 and Study 1) is contingent on depletion level.

Strategy-situation fit (Cheng et al., 2014) posits that no strategy serves as a panacea, but that most will be more or less useful given the contextual parameters of the situation (e.g. personality characteristics, stressor characteristics, individual goals and expectations, etc.). Individuals who have a large repertoire of strategies and are good at matching them to optimally fit contextual parameters tend to be more successful at coping with stress than people who are either limited or rigid in strategy selection (Cheng et al., 2014). One challenge for stress and coping researchers has been to delineate for which parameters various coping strategies are best suited to work.

Based on prior research and our hypothesis that positive distraction more effectively replenishes resources than neutral distraction, we tested the possibility that positive distraction efficacy is moderated by how depleting, or overwhelming, a stressor is. Indeed, stressors are experienced as overwhelming when one perceives the demands of the stressor to exceed the resources with which one has to cope (Lazarus & Launier,
Prior work suggests that some corollaries of depletion level may moderate distraction efficacy. Distraction is a more effective emotion regulation technique for high vs. low intensity stressors in comparison to cognitive reappraisal (Sheppes & Meiran, 2007), and the efficacy of leisure coping is moderated by the amount of time people spend in stressor-related situations (Qian et al., 2014). Iwasaki (2006) also reported that people may benefit more from leisure coping when under conditions of high vs. low daily stress. Notably, these studies provide evidence for both neutral (Sheppes & Meiran, 2007) and positive distraction (Iwasaki, 2006; Qian et al., 2014), but none have directly tested a potential difference in moderating effect between the two. We posit that if positive distraction is better at replenishing resources than neutral distraction, then its relative adaptiveness as a coping strategy for repeated stressors should be more apparent for more depleting stressors. We aimed to test this hypothesis in Study 2.

Study 2 is divided into two parts - a and b. Study 2a was a pilot study to determine two stressor lengths, which served as experimental proxies for low vs. high levels of depletion. We aimed to identify two stressor lengths (one short, one long) for which the social evaluative stressor described in Study 1 produced relatively equal levels of perceived unpleasantness (to ensure that both stressor lengths were perceived as similarly stressful and unpleasant), but different levels of motivation/fatigue. This operationalization of depletion was based on the literatures for self-regulatory resource depletion and burnout. Specifically, Hagger and Chatzisarantis (2010) found in a meta-analysis that depletion of resources related to self-control is strongly related to self-reported fatigue and motivation, only moderately associated with negative affect, and not associated with positive affect. The burnout literature also defines burnout as a state of
prolonged/high stress levels leading to physical or emotional exhaustion (i.e. fatigue; Ptacek et al., 2013).

In Study 2b, we randomly assigned participants to receive either the short (low depletion) or long (high depletion) social evaluative stressor (mental arithmetic performed in front of an evaluator) and either a positive or neutral distraction task (expressive or neutral writing; Quoidbach et al., 2015). Like in Study 1, participants were exposed to the social stressor twice with the distraction task in between to simulate chronic stress. Outcomes again included subjective pleasantness/unpleasantness, number of attempts and mistakes on the math tasks, and cardiovascular activity. We also included subjective ratings of motivation and fatigue. We tested the same replenishment and buffering hypotheses outlined in Study 1, but included an additional set of hypotheses to test the moderating effect of resource depletion on positive vs. neutral distraction efficacy. We hypothesized that the ability for positive distraction to buffer from the negative consequences of a repeated stressor would become more prominent if they were more depleted by an initial stressor. For instance, we predicted that participants in the positive distraction group would report a greater reduction in levels of fatigue and unpleasantness (as a replication of what we found in Study 1) from stressor 1 to stressor 2 compared to the neutral distraction group, but that this difference in buffering effect would be more pronounced for participants in the long vs. short stressor condition. Finally, because we found through follow-up analyses in Study 1 that the difference in unpleasantness between stressors 1 and 2 had an indirect effect on the relationship between distraction condition and overall perceived unpleasantness, we wanted to test this relationship in Study 2 and hypothesized that it would be replicated. We tested
similar indirect effects for the other three overall affect measures, but made no a priori hypotheses for these analyses.

**Study 2a – Pilot Study**

**Method**

**Participants.** Participants were 22 Introductory Psychology students at a southern university (50% Female). Students were recruited in one semester via an online mechanism and received 0.5 hours of research credit as compensation.

**Mental arithmetic stressor.** The general format of the stressor for this study was similar to that of the previous study. Participants were asked to complete serial subtractions in front of a stoic evaluator. However, participants only completed one set of subtractions (either by 17s or by 13s), and they did so for 10 minutes. They were not made aware of how long the math task would take. Participants were randomly assigned to subtract by 17s (N = 11) or by 13s (N = 11) prior to participation in the study.

**Self report & behavioral measures.**

**Pleasantness/Unpleasantness.** Measures of pleasantness/unpleasantness were assessed in the same way as described in Study 1.

**Motivation/Fatigue.** Participants also provided ratings of motivation ("motivated") and fatigue ("tired") levels using the continuous affect rating scale described in Study 1.
Subtraction attempts and error rates. Attempts and mistakes were recorded as described in Study 1, but scored for each minute of the 10 minute stressor. Error rates were calculated from mistake:attempt ratios. These measures were included in the study to test for practice effects (error rates) and behavioral indicators of fatigue/motivation (attempts) throughout the stressor.

Procedure. The procedure for this study is depicted in Figure 1.

Figure 1. Experimental paradigm for Study 2. Participants were randomly assigned to subtract by either 13s or 17s. Affect ratings were collected after each minute of the stressor.

Pre-task. The pre-task procedure was similar to that described in Study 1, but no impedance cardiography sensors were placed on participants due to experimental time constraints. All other sensors were attached to more closely match the experience participants would have in Study 2b, but the acquired data will not be reported here as it did not impact our decisions derived from the pilot study.

During task. After the acclimation period, participants were asked to sit and rest quietly for another 3 minutes (baseline period), which was followed by another set of
affect ratings (Baseline 2). Next, the evaluator entered the room and explained the mental arithmetic task. Participants were told that they would be stopped periodically to provide more affect ratings. However, they did not know how long the stressor was to last (10 minutes) and how frequently they were to provide affect ratings (once every 60 seconds). To reduce practice effects, participants were not asked to start at the very first number at the beginning of each minute. Rather, the evaluator told them the number they ended on during the previous minute (their last correct response) and asked participants to begin subtracting from this number. Participants, therefore, also did not need to hold in memory what this number was during the affect rating breaks.

**Post-task.** There was no measured recovery period in this experiment. After the math task, the experimenter removed all sensors and debriefed participants about the study.

**Data analysis.** All analyses were conducted using IBM SPSS Statistics (version 23). We conducted a set of repeated measures ANOVAs (RM-ANOVA) with 12 time points (2 baseline and 10 stressor time points) to determine if motivation and fatigue changed over time. We initially conducted each RM-ANOVA with math condition (serial subtraction by 13s vs. 17s) as a between-subjects factor, but there was no significant effect of math condition on outcomes (all p-values > .05). Therefore, we removed math condition as a between-subjects variable in further analyses. We included gender as a covariate of non-interest and applied a Greenhouse-Geisser correction to account for violations of sphericity. Significant interactions were followed up with specific pair-wise comparisons using a Bonferroni correction to account for multiple comparisons.
In addition to conducting RM-ANOVAs to assess change in motivation and fatigue over time, we also plotted control charts to identify the time points at which each outcome was "unstable" relative to the other time points. Control charts are typically used in quality control investigations to monitor for poor production quality (Reynolds & Stoumbos, 2001). Many "stability criterion" have been developed, but all provide statistical rules to help analysts determine if a measurement at a certain time point is meaningfully different from the other time points (i.e. unstable). Our stability criterion was set at ±3 sigma (σ; population standard deviation) values away from the mean, which is the traditional method (Reynolds & Stoumbos, 2001). We used the control chart analyses as an additional statistical method to identify the time points at which motivation and fatigue began to deviate meaningfully throughout the stressor.

After conducting the RM-ANOVAs and control chart analyses, we identified two time points to represent the short and long stressor lengths, then conducted follow-up paired t-tests comparing ratings between these time points for unpleasantness, motivation and fatigue to confirm that unpleasantness ratings were similar, but fatigue/motivation ratings were significantly different, for these stressor lengths.

Results

Self-report measures.

Pleasantness: A significant within-subjects effect of time was found for pleasantness ratings, F(5.023, 105.474) = 4.446, p = .001 (Figure 12 for control chart). Positive affect steadily decreased throughout the study with the sharpest declines occurring after the first minute of the stressor and again after the 8th minute of the
stressor.

Figure 12. Control chart for pleasantness ratings throughout Study 2a. Upper and lower confidence limits (UCL and LCL) were calculated as 3 standard deviation values from the mean (center line, CL). Red diamonds represent time points for which pleasantness values violated a control rule, suggesting that these values are substantially different from the others.

Unpleasantness: A significant within-subjects effect of time was found for unpleasantness ratings, \( F(5.59, 117.394) = 13.302, p < .001 \) (Figure 13 for control chart). Negative affect rapidly increased after the first minute of the stressor, then climbed much more slowly throughout the rest of the study.
Motivation. A significant within-subjects effect of time was found for motivation ratings, $F(5.053[11], 101.055[220]) = 7.929, p < .001, \eta^2 = .284$ (Figure 14 for control chart). According to the control chart analysis, motivation steadily decreased throughout the study with two sharp declines - one after the first minute of the stressor and one again after the ninth minute of the stressor. Motivation at the first and second time points (baseline) was more than 3 standard deviations higher than the mean. Motivation was more than 3 standard deviations lower than the mean during the 9th and 10th minutes of the stressor.
Figure 14. Control chart for motivation ratings throughout Study 2a. Upper and lower confidence limits (UCL and LCL) were calculated as 3 standard deviation values from the mean (center line, CL). Red diamonds represent time points for which motivation values violated a control rule, suggesting that these values are substantially different from the others.

**Fatigue.** A significant within-subjects effect of time was found for fatigue ratings, \( F(3.355[11], 67.107[220]) = 3.595, p = .015, \eta^2 = .152 \) (Figure 15 for control chart).

Unlike motivation, fatigue levels did not change substantially until the end of the stressor. The 9th and 10th minutes of the stressor were the only two to fall outside 3 standard deviations from the mean.
Summary of initial affect findings. Motivation decreased rapidly at stressor onset, then again during the last two minutes. Fatigue remained similar to baseline values throughout the stressor until the last two minutes. Taken as a whole, these results suggest that last two minutes of the stressor (minutes 9-10) seemed to be more emotionally depleting for participants compared to minutes 1-8. From these results, we made an initial determination to set the short and long stressor lengths at 5 and 10 minutes, respectively. We chose 10 minutes for the long condition because Fatigue and Motivation levels were maximally different from the mean at this time point. We chose 5 minutes for the short condition primarily for ease of conducting the experimental procedure and for processing/analyzing the in Study 2b (since it is half of 10 minutes).
Follow-up analyses. Results from the follow-up analyses supported our decision to set the stressor lengths at 5 vs. 10 minutes. Neither pleasantness nor unpleasantness levels differed significantly between the 5th (Pleasantness: M = 644.00 pixels, SD = 554.59; Unpleasantness: M = 1227.95 pixels, SD = 523.91) and 10th minutes (Pleasantness: M = 511.18 pixels, SD = 483.93; Unpleasantness: M = 1384.91 pixels, SD = 518.84), [Pleasantness: t(21) = 1.153, p = .262, d = .47; Unpleasantness: t(21) = -1.653, p = .113, d = -.35]. However, motivation and fatigue levels were both significantly lower and higher, respectively, at the 10th minute (Motivation: M = 368.41 pixels, SD = 305.89; Fatigue: M = 1272.59 pixels, SD = 630.03) compared to the 5th (Motivation: M = 662.00, SD = 496.13; Fatigue: M = 929.55, SD = 531.36); [Motivation: t(21) = 3.300, p = .003, d = .768; Fatigue: t(21) = -3.233, p = .004, d = -.701].

Attempts and mistakes. Due to errors in recording attempts and mistakes, 3 participants were excluded from this analysis.

Attempts. No significant main effects of time were found for the number of attempts participants made throughout the task, F(5.818[9], 98.901[153]) = .975, p = .445, η² = .054, suggesting that participants were not behaviorally fatigued/unmotivated despite their affect reports. The control chart analysis did suggest that participants made fewer attempts during the 1st minute of the stressor compared to the rest (Figure 16). Overall, however, these results suggest that participants' effort level remained consistent throughout the stressor even though their emotions were changing.
Figure 16. Control chart for subtraction attempts throughout the stressor in Study 2a. Upper and lower confidence limits (UCL and LCL) were calculated as 3 standard deviation values from the mean (center line, CL). We did not find a significant main effect of time in the RM-ANOVA. However, the attempts at the first time point (red diamond) fell outside 3 standard deviations of the mean value.

Error rates (Mistake:Attempt ratio). A significant main effect of time was found for the ratio of mistakes to attempts that participants made throughout the task, $F(5.493[9], 93.374[153]) = 5.493, p < .001, \eta^2 = .254$ (Figure 17 for control chart). In general, participants made fewer mistakes per attempt as the stressor progressed, indicating possible practice effects. However, our control chart analysis did not reveal any substantial violations of control rules, showing that mistakes made at all time points were within ±3 standard deviations from the mean.
**Figure 17.** Control chart for error rates throughout the stressor in Study 2a. No values fell outside 3 standard deviation values of the mean.

**Study 2a Discussion**

The aim of this pilot study was to identify two stressor lengths that would likely produce different levels of resource depletion. Based on prior work from the burnout and self-regulatory resource depletion literature, we posited that these two stressor lengths would be defined by eliciting similar levels of unpleasantness, but different levels of fatigue/motivation. We found that fatigue and motivation were significantly higher and lower, respectively, at the 10th minute of the stressor than the 5th minute, while unpleasantness was not. Thus, we determined that the two math task lengths would be 5 minutes (Short) vs. 10 minutes (Long) to simulate low vs. high levels of resource depletion.

Finally, the fact that we saw no behavioral evidence of depletion can be interpreted in two ways. The first is that our depletion manipulation may not be strong
enough to elicit behavioral changes. Alternatively, these findings can serve as a control to suggest that any differences between groups observed later in Study 2b are not just due to differential task engagement.

**Study 2b**

**Method**

**Participants.** Participants were 154 undergraduate students enrolled in an Introductory Psychology course at a southern university. Students were recruited via an online mechanism over the course of two semesters and were given 1 hour of research credit as compensation for participating. 5 participants were removed from all analyses due to voluntary attrition and/or time constraints preventing study completion (final n = 149, 56.4% female). Other exclusions are noted in the results section. There were four conditions in the study, which followed a 2x2 factorial design. Participants were randomly assigned prior to participation to a high depleting (long stressor) or a low depleting (short stressor) condition as well as to a positive distraction or a neutral distraction condition. We will refer to these groups as LongPositive (n = 39), ShortPositive (n = 35), LongNeutral (n = 29) and ShortNeutral (n = 43).

Prior to conducting this study, we calculated that we would need a total sample size of n = 164 to achieve 80% power to detect significant differences (alpha = .05) of an effect size $\eta^2 = .017$ for a time*distraction condition interaction on pleasantness ratings (determined in Study 1). A total sample size of n = 116 would allow us to achieve 80% power to detect significant differences (alpha = .05) of an effect size $\eta^2 = .033$ for a time*distraction condition interaction effect on unpleasantness ratings (determined in
Study 1). Therefore, our final sample size may have been slightly underpowered to detect significant effects for pleasantness.

**Mental arithmetic stressor.** The repeated stressor in this study utilized the same general format as in Study 1, but participants were randomly assigned to experience either the 5 minute or 10 minute long stressor. Participants were not made aware of how long the math tasks would last. In addition to being randomly assigned to a short vs. long stressor length group, participants were also randomly counterbalanced to complete one serial 17s subtraction and one serial 13s subtraction across the two stressors.

**Distraction task.** The distraction task was programmed using ePrime Pro (version 2.0). In the positive distraction condition, participants were asked to recall the most pleasant experience they had in the last week and to write about it in as much detail as possible. In the neutral distraction condition, participants were asked to recall their daily Tuesday routine and to write about it in as much detail as possible. This task design was based on evidence suggesting that writing about positive experiences can enhance positive affect (Burton & King, 2004) and life satisfaction (Wing et al., 2006) much more than writing about neutral topics (see Quoidbach et al., 2015 for review). The distraction task lasted for 3 minutes. They were also not explicitly told that the writing task was to serve as a distraction from their performance on the math tasks.
**Self report & behavioral measures.**

*Distraction success.* After the writing/distraction task, participants were asked to report how well the writing task distracted them from thinking about their performance on the first mental arithmetic task. They used the continuous affect rating scale to provide their responses. This measure was used to confirm that the positive and neutral distraction tasks did not differ in distraction efficacy, and thus that any differences observed between the two groups were more likely due to differences in their abilities to replenish resources.

*Depletion level.* At the very end of the study, participants were asked to think back to how they felt after each math task and to report how overwhelmed each math task made them feel (as an emotional proxy to depletion level, Lazarus & Launier, 1978). They used the continuous affect rating scale to provide their responses. This measure was used as a manipulation check to confirm that the two stressor lengths elicited different degrees of resource depletion.

*Pleasantness, Unpleasantness, Motivation, Fatigue.* Participants provided the same subjective affect ratings during this study as in study 2a.

*Overall affect ratings.* At the end of the study, participants rated how pleasant, unpleasant, motivated, and tired they felt when thinking about the study as a whole. These measures were intended to assess if distraction condition and/or stressor length had an effect on overall affect reports.

*Subtraction attempts and error rates.* Attempts and mistakes were recorded as described in study 2a.
Physiological measures. Study 2b assessed all physiological measures described thus far (heart rate, heart rate variability, cardiac output, pre-ejection period, systolic blood pressure, and total peripheral resistance). However, all signals were scored in 60 second intervals. Signal acquisition and processing parameters were identical to those described in studies 1 and 2a. Of note, we encountered technical difficulties with our acquisition equipment throughout the study, which substantially reduced the number of participants for whom we have viable physiological data. We ran out of appropriate/non-expired ECG sensors, one of our impedance cardiography wires broke, and our blood pressure cuff and wire broke at separate times. To try and meet our goal sample size to achieve power for detecting differences in affect reports, we continued to run participants while troubleshooting these obstacles (e.g. waiting for new sensors/cuff to arrive, repairing the wire, etc.). We continued to place sensors on participants even if not actively collecting data in order to preserve consistency in the experimental environment across participants.

Procedure. The protocol for this study is depicted in Figure 18. The procedure was a combination of those described in studies 1 and 2a. This study employed a double-blind procedure prior to its start. The experimenter did not know the stressor length or distraction condition until the first stressor ended and the distraction task began, respectively. The evaluator knew the stressor length, but never learned the distraction condition even after the experiment ended.
Figure 18. Experimental paradigm for Study 2b. Participants were randomly assigned to a Short vs. Long stressor and a Positive vs. Neutral distraction task. Affect measures were collected after baseline, distraction, and recovery, and every minute during the stress tasks. Physiological measures were collected continuously throughout the experiment.

**Pre-task.** The pre-task procedure was identical to the one described in Study 1.

**During task.** The procedure for the first stressor was similar to that described in Study 2a. However, the stressor lasted either 5 or 10 minutes depending on the condition. After Stressor 1, the experimenter entered the room and explained the writing task. Participants were told to continue writing until the screen changed (a total of 3 minutes). They provided another set of affect ratings after the distraction task (Post-Distraction). Afterwards, the evaluator entered the room again and explained the next subtraction task (counterbalanced from stressor 1).

**Post-task.** A 3 minute Recovery period followed Stressor 2, after which participants provided a final set of affect ratings. Following recovery, the experimenter removed all sensors and debriefed participants about the study.
**Data analysis.** All analyses were conducted using IBM SPSS Statistics (version 23). Differences between groups for distraction success were assessed with independent samples t-tests. Differences between groups for the overall affect variables were assessed with univariate ANCOVAs including 2 factors (Positive vs. Neutral distraction and Short vs. Long stressor length) and Baseline affect measures as a covariate of non-interest. Significant interactions were evaluated with appropriate follow-up analyses. We also conducted indirect effects analyses with 10,000 bootstrap samples to probe if relative differences in perceived affect between stressors 1 and 2 had indirect effects on the relationship between distraction condition and overall affect ratings.

To evaluate our replenishment and buffering hypotheses for all other outcomes, we first created new variables for each outcome averaging the last two minutes of the first stress task for each participant regardless of stressor length. We specifically chose to use the last two minutes of stressor 1 for subsequent analyses, reasoning that it would be a more valid depiction of resource states by the end of a stressful experience than an average score including all time points in stressor 1. Also, we included the penultimate minute, rather than just using the last minute, to add estimate stability to each outcome measure. Next, we calculated an average of the 1st and 2nd minutes of the second stressor. We included two time points in stressor 2 for estimate stability and to match the number of time points analyzed in stressor 1. We also chose to assess the 1st and 2nd minutes of stressor 2 rather than other time points, reasoning that the former would provide a better depiction of how participants' psychophysiological and emotional states were affected by the distraction task. As the most proximal measure of outcomes after the distraction period, it should be the least influenced by non-distraction factors (e.g. time,
depletion by stressor 2, etc.). We then conducted an initial set of 4x2x2x2 RM-ANOVAs with 4 time points, 2 distraction conditions, 2 stressor length conditions, and 2 math task order conditions [subtracting by 17s first (17/13) vs. subtracting by 13s first (13/17)]. For the self-report variables, these time points consisted of the proximal (2nd) baseline measure (Baseline), the last two minutes of the first stress task (Stressor 1), the post-distraction measure (Post-Distraction), and the 1st and 2nd minutes of the second stress task (Stressor 2). For the physiological variables, these time points consisted of an average over the three baseline minutes (Baseline), the last two minutes of the first stress task (Stressor 1), an average over the three distraction minutes (Distraction), and the 1st and 2nd minutes of the second stress task (Stressor 2). For each outcome variable (pleasantness, unpleasantness, motivation, fatigue, attempts, error rate, and each physiological measure described above), we investigated interactions of time*distraction condition, time*stressor length, and time*distraction condition*stressor length. We also investigated main effects of time, distraction condition (Positive vs. Neutral), and stressor length (Short vs. Long). Although we included math task order as a between-subjects factor in all analyses, we only investigated its effects for attempts and error rates based on our findings from Study 1. We also included an average of the 1st and 2nd minutes of stressor 1 as a covariate to control for the fact that we were not comparing equivalent time points between stressors 1 and 2. That is, we wanted to account for the possibility that any differences observed between the two stressors with the RM-ANOVAs might only be due to an effect of people responding differently to a stressor at the beginning vs. at the end of it. Finally, only a few outcomes were significantly different by gender, so we did not include gender as a covariate in analyses unless noted. We applied a
Greenhouse-Geisser correction in all RM-ANOVAs to account for violations of sphericity, and significant effects were followed up with specific pair-wise comparisons.

**Results**

**Manipulation check.**

*Depletion level.* To determine if our stressor length manipulations were successful in producing differing levels of subjective depletion, we conducted independent samples t-tests comparing post-task ratings of feeling overwhelmed (depleted) by stressor 1 and stressor 2 between the Short and Long stressor length groups. Contrary to what we expected, the Short and Long groups did not report significantly different feelings of being depleted during stressor 1 (Short: M = 1247.24 pixels, SD = 463.78, n = 77; Long: M = 1150.00 pixels, SD = 521.20, n = 65; t(140) = 1.176, p = .242, d = .197) or stressor 2 (Short: M = 1037.94 pixels, SD = 501.81, n = 77; Long: M = 1096.54 pixels, SD = 568.03, n = 65; t(140) = -.653, p = .515, d = -.109), suggesting that manipulating stressor length was not a good experimental proxy in this study for altering subjective reports of resource depletion.

*Distraction success.* The positive and neutral distraction tasks did not differ in how well they kept participants from thinking about the first stressor (Positive Distraction: M = 473.61 pixels, SD = 505.05, n = 74; Neutral Distraction: M = 508.61, SD = 540.00, n = 71; t(143) = -.403, p = .687, d = -.067). These findings suggest that any further observed differences between the positive and neutral distraction conditions were not just due to differences in distraction efficacy between the writing tasks.
Affect reports.

Pleasantness. 14 participants were excluded from the analyses for pleasantness due to missing data points (final n = 135).

A significant within-subjects effect of time was found for pleasantness (Figure 19), F(2.647[3], 333.551[381]) = 46.874, p < .001, η² = .271. Pleasantness ratings were significantly lower at the end of Stressor 1 relative to Baseline (Baseline: M = 956.67 pixels, SD = 437.35 vs. Stressor 1: M = 685.69 pixels, SD = 469.33); t(134) = -6.975, p < .001, d = -.601. Pleasantness levels then increased significantly relative to Stressor 1 after the distraction task (Post-Distraction: M = 1051.03 pixels, SD = 424.69) [t(134) = 8.184, p < .001, d = -.706], and exceeded baseline levels [t(134) = 2.164, p = .032, d = .186]. Pleasantness dropped again at the beginning of Stressor 2 (Stressor 2: M = 681.26 pixels, SD = 444.07) relative to after the distraction task [t(134) = -9.354, p < .001, d = -.806], but did not differ from those reported at the end of Stressor 1; t(134) = -.161, p = .873, d = -.014. There were no significant interactions or between-subjects effects.

Figure 19. Average raw pleasantness ratings throughout Study 2b. Error bars represent standard error of the mean (SEM).
As in Study 1, our replenishment hypothesis was not supported by these results. Although the pleasantness levels increased from stressor 1 to distraction, this replenishment did not differ by distraction condition. Our buffering hypothesis was also not supported. Pleasantness levels were not higher at the beginning of stressor 2 compared with at the end of stressor 1 and did not differ by distraction condition.

**Unpleasantness.** 5 participants were excluded from the analyses for unpleasantness due to missing data points (final n = 144).

A significant within-subjects effect of time was found for unpleasantness (Figure 20), F(2.609[3], 352.213[405]) = 88.93, p < .001, \( \eta^2 = .397 \). Unpleasantness levels increased significantly by the end of Stressor 1 relative to Baseline (Baseline: M = 629.22 pixels, SD = 401.08 vs. Stressor 1: M = 1093.89 pixels, SD = 537.62); t(143) = 10.938, p < .001, d = .936. Unpleasantness levels decreased significantly relative to Stressor 1 after the distraction task (Post-Distraction: M = 635.57 pixels, SD = 448.96) [t(143) = -10.958, p < .001, d = -.924], and returned to baseline levels; t(143) = .169, p = .866, d = .014. Unpleasantness increased again at the beginning of Stressor 2 (Stressor 2: M = 1021.15 pixels, SD = 509.38) relative to after distraction [t(143) = 10.178, p < .001, d = .854], but was still significantly lower than those reported at the end of Stressor 1; t(143) = -2.632, p = .009, d = -.22. There were no significant interactions or between-subjects effects.
Our replenishment hypothesis was again not supported. Unpleasantness decreased significantly during the distraction task relative to stressor 1, but not differentially so for the positive vs. neutral distraction conditions. Surprisingly, our buffering hypothesis was also not supported. Unpleasantness levels at the beginning of stressor 2 were lower than levels at the end of stressor 1, suggesting that the distraction task in general did buffer from negative emotions associated with the onset of a repeated stressor. However, this effect was not stronger for the positive distraction group than the neutral distraction group, as we expected it to be.

**Subjective resource reports.**

**Motivation.** 5 participants were excluded from the analyses for unpleasantness due to missing data points (final n = 144).
A significant within-subjects effect of time was found for motivation ratings, $F(2.283[3], 308.143[405]) = 17.335, p < .001, \eta^2 = .114$ (Figure 21). There was also a significant between-subjects effect of stressor length, $F(1, 135) = 5.297, p = .023, \eta^2 = .038$.

![Figure 21. Average raw motivation ratings throughout Study 2b. Error bars represent standard error of the mean (SEM).](image)

These main effects were qualified by a marginally significant 3-way interaction of time*distraction condition*stressor length, $F(2.283[3], 308.143[405]) = 2.319, p = .092, \eta^2 = .017$. Follow-up analyses showed that the neutral distraction group reported lower motivation levels than participants in the positive distraction group at the end of stressor 1 [Positive Distraction: $M = 888.09$ pixels, $SD = 488.67$ vs. Neutral Distraction: $M = 720.29$ pixels, $SD = 488.83$; $F(1,74) = 8.013, p = .006, \eta^2 = .098$] and at the beginning of stressor 2 [Positive Distraction: $M = 926.96$ pixels, $SD = 460.15$ vs. Neutral Distraction: $M = 756.70$ pixels, $SD = 457.28$; $F(1,74) = 7.02, p = .010, \eta^2 = .087$], but only for participants in the Short stressor condition.
Since the ShortNeutral condition reported lower motivation levels than the ShortPositive condition at both stressor time points of interest, but motivation levels for both groups increased in stressor 2, we conducted another follow-up independent samples t-test to probe if these increases in motivation were larger for the ShortPositive group (dependent variable was the difference in motivation between stressor 1 and stressor 2). This analysis did not show a significant difference in motivation change scores between the ShortPositive (MΔ = -38.90 pixels, SD = 334.29) and ShortNeutral (MΔ = -36.41 pixels, SD = 303.58) groups; t(76) = -0.034, p = .973, d = -.008.

There were no other significant main effects or interactions.

Our replenishment hypothesis was not supported again. Motivation levels were not significantly different between the positive and neutral distraction groups during the distraction task. Although we found a significant time*distraction condition*stressor length interaction, this effect was already apparent before the distraction manipulation and not in the direction that supported our buffering hypothesis. More specifically, the positive distraction task was not better at increasing motivation levels than the neutral distraction task from stressor 1 to stressor 2, and we did not find evidence that the Long stressor condition potentiated a difference in motivation increases between distraction conditions.

**Fatigue.** 4 participants were excluded from the analyses for unpleasantness due to missing data points (final n = 145).

A significant within-subjects effect of time was found for fatigue, F(1.855[3], 252.32[408]) = 4.336, p = .016, η² = .031. There was also a between-subjects effect of stressor length, F(1, 136) = 5.435, p = .021, η² = .038. Follow-up analyses for the
between-subjects effect showed that participants in the Long stressor condition (M = 959.96 pixels, SEM = 32.53) were more fatigued than participants in the Short stressor condition (M = 856.90 pixels, SEM = 29.94).

The within-subjects effect of time was qualified by a significant time*distraction condition interaction, F(1.85[3], 252.32[408]) = 3.162, p = .048, \( \eta^2 = .023 \) (Figure 22).

Follow-up analyses indicated that fatigue levels did not differ between groups during Baseline (Positive Distraction: M = 910.99 pixels, SD = 449.10 vs. Neutral Distraction: M = 945.25 pixels, SD = 429.33; t(143) = -.469, p = .640, d = -.078) or Stressor 1 (Positive Distraction: M = 941.09 pixels, SD = 536.84 vs. Neutral Distraction: M = 966.79 pixels, SD = 548.46; t(143) = -.285, p = .776, d = -.047). However, participants in the Positive Distraction group reported being less fatigued than the Neutral

Figure 22. Changes in raw fatigue scores throughout Study 2b. Error bars represent standard error of the mean (SEM).
Distraction group during Distraction (Positive Distraction: M = 749.08 pixels, SD = 497.63 vs. Neutral Distraction: M = 947.24 pixels; SD = 449.38; t(143) = -2.513, p = .013, d = -.42) and at the beginning of Stressor 2 (Positive Distraction: M = 844.48 pixels, SD = 363.45 vs. Neutral Distraction: M = 971.32 pixels, SD = 402.99; t(143) = -1.992, p = .048, d = -.33). Supporting our replenishment hypothesis, the Positive Distraction group also reported a greater reduction in fatigue during distraction compared to during stressor 1 (MΔ = 192.01 pixels, SD = 311.50) than the Neutral Distraction group did (MΔ = 19.55 pixels, SD = 339.49); t(143) = 3.189, p = .002, d = .53.

Supporting our buffering hypothesis, the Positive Distraction group reported a greater reduction in fatigue during stressor 2 compared to during stressor 1 (MΔ = 96.61 pixels, SD = 257.23) than the Neutral Distraction group did (MΔ = -4.53 pixels, SD = 247.66); t(143) = 2.41, p = .017, d = .40.

We did not find any other significant main effects or interactions.

Collectively, our replenishment and buffering hypotheses were supported. The first stressor significantly increased fatigue levels, suggesting that mental energy levels were depleted during stressor 1. Then, the positive distraction task was better able to decrease fatigue levels than the neutral distraction task, providing evidence for the replenishment of mental energy levels that had been depleted in stressor 1. The positive distraction task was also better at protecting from new-onset fatigue during a repeated stressor experience. Indeed, fatigue levels decreased in stressor 2 compared to stressor 1 for the positive distraction group (positive change score for Stressor 1-Stressor 2), whereas they stayed about the same from stressor 1 to stressor 2 for the neutral
distraction group. Our moderator hypothesis was not supported, as we did not find that this differential replenishment/buffering efficacy was moderated by stressor length.

**Overall pleasantness.** We found a significant main effect of stressor length \([F(1, 136) = 3.992, p = .048, \eta^2 = .029]\). Participants in the Short stressor (\(M = 743.68\) pixels, \(SD = 231.21\)) reported higher overall pleasantness than participants in the Long stressor (\(M = 625.51\) pixels, \(SD = 216.51\)). We did not find a significant main effect of distraction condition or a significant distraction condition*stressor length interaction \([F(1, 138) = .238, p = .627, \eta^2 = .002]\). Thus, our buffering hypothesis that the positive distraction group would report higher ratings of overall pleasantness compared to the neutral distraction group at the end of the experiment was not supported. We also did not run an indirect effects analysis for overall pleasantness, because the distraction groups did not differ in their change scores for pleasantness between stressor 1 and stressor 2 (demonstrated previously in the results presented for subjective pleasantness).

**Overall unpleasantness.** We found a significant main effect of stressor length \([F(1, 136) = 5.98, p = .016, \eta^2 = .042]\). Participants in the Short stressor (\(M = 920.30\) pixels, \(SD = 242.26\)) reported lower overall unpleasantness than participants in the Long stressor (\(M = 1070.98\) pixels, \(SD = 231.21\)). We did not find a significant main effect of distraction condition or a significant distraction condition*stressor length interaction \([F(1, 138) = .037, p = .848, \eta^2 < .001]\). As we expected and consistent with Study 1 findings, distraction condition did not have a significant effect on overall unpleasantness ratings. Because there was no difference in buffering effect of distraction condition on stressor 2 unpleasantness ratings, we did not run an indirect effects analysis for overall unpleasantness using the change scores in unpleasantness between stressors 1 and 2.
However, it was still possible that the differential buffering effect on fatigue of positive vs. neutral distraction could have had a significant indirect effect on the relationship between distraction condition and overall unpleasantness, especially if fatigue was a better measure of resource depletion/replenishment than unpleasantness. Unfortunately, this hypothesis for an indirect effect was not supported by our analysis (ab = -9.30, SE = 18.83, 95% CI: -58.10, 19.25).

**Overall motivation.** We only found a significant main effect of stressor length, F(1, 136) = 5.326, p = .023, η² = .037. Participants in the Long stressor condition (M = 703.86 pixels, SD = 210.20) reported lower overall feelings of motivation than participants in the Short stressor condition (M = 883.74 pixels, SD = 230.69). Still, our buffering hypothesis that the positive distraction group would report higher ratings of overall motivation compared to the neutral distraction group and that this effect would be moderated by stressor length was not supported. We also did not run an indirect effects analysis for overall motivation, because the distraction groups did not differ in their change scores for motivation between stressor 1 and stressor 2 (demonstrated previously in the results presented for subjective motivation).

**Overall fatigue.** We did not find a significant main effect of distraction condition [F(1, 137) = 2.581, p = .110, η² = .018] or stressor length [F(1, 137) = 2.716, p = .102, η² = .019], or an interaction of distraction condition*stressor length [F(1, 137) = .154, p = .695, η² = .001]. Our buffering hypothesis that the positive distraction group would report lower ratings of overall fatigue compared to the neutral distraction group and that this effect would be moderated by stressor length was not supported. Our indirect effects analysis was also not significant, suggesting that the differential buffering effect of
positive vs. neutral distraction on fatigue did not help to clarify a relationship between
distraction condition and overall perceptions of fatigue (ab = 6.77, SE = 8.68, 95% CI: -
5.85, 30.44).

**Physiological outcomes.** Results for physiological measures are presented
separately below to discuss how findings pertain to our replenishment hypotheses. These
sections are followed by a presentation of findings across the outcomes (i.e. profiling
'challenge' vs. 'threat' orientations) to discuss how the results pertain to our buffering
hypotheses. Additionally, we encountered substantially greater problems collecting and
processing the physiological data for this study relative to Study 1, resulting in much
smaller sample sizes. The results presented below should therefore be interpreted with
cautions.

**Heart rate (HR).** 49 participants were removed from analysis due to equipment
malfunctions, and 12 others were removed due to excessive signal interference during
acquisition (N = 88 in final analysis; ShortPos: n = 23; LongPos: n = 24; ShortNeut: n =
27; LongNeut: n = 14). Gender was included as a covariate for these analyses as it had an
effect on HR at baseline.

A significant main effect of time was found, F(2.32[3], 180.91[234]) = 5.79, p =
.003, η² = .066 (Figure 23). HR significantly increased during Stressor 1 compared to
Baseline (Baseline: M = 72.74 bpm, SD = 10.01 vs. Stressor 1: M = 81.82 bpm, SD =
12.72; t(87) = 9.879, p < .001, d = 1.102), then decreased significantly during the
distraction task (Distraction: M = 79.16 bpm, SD = 10.64) compared to at the end of
Stressor 1[t(87) = -3.984, p < .001, d = -.448]. However, it did not return to baseline
levels; \( t(87) = 9.185, p < .001, d = .985 \). HR increased significantly at the onset of Stressor 2 (Stressor 2: \( M = 81.06 \) bpm, \( SD = 11.86 \)) compared to distraction [\( t(87) = 3.34, p = .001, d = .364 \)], but did not differ from HR at the end of Stressor 1; \( t(87) = -1.615, p = .110, d = -.176 \). There were no significant between-subjects effects or interactions.

![Figure 23. Average HR throughout Study 2b. Error bars represent standard error of the mean (SEM).](image)

Together, these results suggest that our replenishment hypothesis was not supported for HR. Although distraction in general seemed to partially restore HR, this effect did not differ by distraction condition. Moreover, HR did not return to baseline levels during distraction, suggesting that the writing task was still eliciting effort and engagement. The fact that HR during the distraction period did not differ across conditions also suggests that participants were similarly engaged in the two writing tasks.

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**Heart rate variability (Respiratory sinus arrhythmia; RSA).** Participants were excluded from analysis using the same parameters as for HR (N = 88 in final analysis; ShortPos: n = 23; LongPos: n = 24; ShortNeut: n = 27; LongNeut: n = 14).

There was a significant within-subjects effect of time, $F(2.560[3], 202.22[237]) = 41.345$, $p < .001$, $\eta^2 = .344$ (Figure 24). RSA decreased from Baseline to Stressor 1 (Baseline: $M = 8.32$ msec$^2$, SD = 1.28 vs. Stressor 1: $M = 7.87$ msec$^2$, SD = 1.18; $t(87) = 4.093$, $p < .001$, $d = .507$), then continued to decrease during distraction ($M = 7.14$ msec$^2$, SD = 1.32) compared to at the end of Stressor 1; $t(87) = -7.99$, $p < .001$, $d = -0.875$. RSA increased relative to distraction during the first two minutes of Stressor 2 ($M = 7.78$ msec$^2$, SD = 1.09) [$t(87) = 6.398$, $p < .001$, $d = .708$] to a level that did not differ from the end of Stressor 1; $t(87) = -1.288$, $p = .201$, $d = -.103$. There were no other significant main effects or interactions.
Our replenishment hypothesis was not supported. Contrary to what we expected, but consistent with Study 1, RSA continued to decrease during the distraction period, then increased at the onset of stressor 2.

**Cardiac output (CO).** Prior to analyses, we excluded 6 participants due to impedance cardiography equipment malfunctions. 45 participants were excluded for poor signal acquisition due to electrocardiogram equipment malfunctioning. 37 participants were excluded due to excessive impedance cardiography/electrocardiography interference during acquisition. 1 participant was excluded for having incomplete data. A total of 60 participants were included in the analysis (ShortPos: n = 16; LongPos: n = 17; ShortNeut: n = 21; LongNeut: n = 6).

Only a significant main effect of time was found, F(1.8831[3], 96.05[153]) = 3.835, p = .027, $\eta^2 = .070$ (Figure 25). CO increased, but not significantly, from Baseline (M = 9.21 L/min, SD = 3.00) to Stressor 1 (M = 9.47 L/min, SD = 3.77); t(59) = .746, p = .458, d = .107. CO then decreased during distraction (M = 8.63 L/min, SD = 2.94) relative to stressor 1 [$t(59) = -3.801; p < .001, d = -.554$] and was significantly lower than baseline levels; t(59) = -2.06, p = .044, d = -.262. Finally, CO increased at the onset of Stressor 2 (M = 9.46 L/min, SD = 3.80) relative to distraction [$t(59) = 3.436, p = .001, d = .489$], but did not differ from Stressor 1; t(59) = .020, p = .984, d = .008.
Figure 2. Average CO throughout Study 2b. Error bars represent standard error of the mean (SEM).

Our replenishment hypothesis was not supported. CO did decrease during the distraction period relative to Stressor 1, but not differentially for the positive and neutral distraction conditions.

Pre-ejection period (PEP). Pre-analysis exclusions were the same as for cardiac output. A total of 60 participants were included in the analysis (ShortPos: n = 16; LongPos: n = 17; ShortNeut: n = 21; LongNeut: n = 6).

We did not find any significant main effects or interactions for PEP with the RM-ANOVA. However, because we may not have achieved adequate power to detect significant effects with such a small sample size, we collapsed across all groups and conducted a set of paired t-tests to examine differences among the 4 time points in the RM-ANOVA (only to assess change patterns over time; Figure 26). This analysis revealed that PEP decreased, but not significantly, from Baseline to Stressor 1 (Baseline:
M = 94.56 msec, SD = 17.54 vs. Stressor 1: M = 92.94 msec, SD = 21.29); t(59) = .770, p = .453, d = .102. Then PEP increased significantly during Distraction (M = 95.91 msec, SD = 18.30) relative to stressor 1 [t(59) = 2.155, p = .035, d = .290] and reached baseline levels; t(59) = .720, p = .474, d = .093. PEP then stayed high at the onset of Stressor 2 (M = 95.41 msec, SD = 20.66), differing significantly from Stressor 1 [t(59) = 2.252, p = .028, d = .293] but not distraction [t(59) = .373, p = .711, d = .050].

Figure 26. Average PEP throughout Study 2b. Error bars represent standard error of the mean (SEM).

Again, our replenishment hypothesis was not supported. PEP did increase during the distraction period relative to Stressor 1, but not differentially for the positive vs. neutral distraction groups.

**Systolic blood pressure (SBP).** Data from 35 participants were excluded prior to processing due to equipment malfunctions during acquisition. 26 others were excluded
for having excessive movement artifacts, systolic values outside our pre-defined
parameters and calibration periods longer than our pre-defined parameters. A total of 88
participants were included in the analysis (ShortPos: n = 27; LongPos: n = 21; ShortNeut:
n = 28; LongNeut: n = 12).

There was no significant within-subjects effect of time. We only found a
significant time*stressor length interaction, $F(2.680[3], 211.715[237]) = 3.138, p = .031,
$\eta^2 = .038$. Follow-up analyses revealed that the Short group exhibited significant changes
in SBP throughout the study, while the Long group did not (for all comparisons between
time points of interest, t-values < 1.50, p-values > .19). For the Short group, SBP
increased during Stressor 1 compared to Baseline (Baseline: $M = 152.94$ mmHg, $SD =
13.46$ vs. Stressor 1: $M = 156.36$ mmHg, $SD = 15.56$; $t(53) = 2.478, p = .016, d = .344$).
SBP decreased significantly during the distraction period ($M = 150.34$ mmHg, $SD =
15.94$) compared to Stressor 1 [$t(53) = -4.661, p < .001, d = -.635$), returning to baseline
levels; $t(53) = 1.824, p = .074, d = .255$. SBP stayed low during onset of Stressor 2 ($M =
151.58$ mmHg, $SD = 17.15$) compared to during distraction [$t(53) = .704, p = .484, d =
.096$] and was significantly different from SBP levels at the end of Stressor 1; $t(53) = -
2.595, p = .012, d = -.355$.

Because we did not find a significant time*distraction condition interaction, our
replenishment hypothesis was not supported for SBP.

**Total peripheral resistance.** Because total peripheral resistance is calculated from
cardiac output and mean arterial pressure, only participants for whom both values were
valid for the 4 time points assessed were included in the analysis. A total of 42
participants were included in the analysis (ShortPos: n = 13; LongPos: n = 11; ShortNeut: n = 15; LongNeut: n = 3).

We did not find any significant interactions or main effects for this analysis. As with PEP, we conducted a set of paired samples t-tests to assess how TPR changed from one time point to another. This analysis also did not show any significant differences in TPR among our time points of interest. Thus, our replenishment hypothesis was not supported for TPR.

**Physiological profiles.**

**Stressor 1.** At the end of stressor 1, participants across all groups were exhibiting increased HR and decreased RSA. There were no other significant changes from baseline to stressor 1, although CO increased and PEP decreased slightly from baseline. Thus, we can only conclude that participants were exerting effort and engaged at the end of the first stressor and cannot make conclusions about challenge or threat orientations.

**Distraction.** HR decreased relative to stressor 1 and was not different from baseline levels. RSA and CO decreased relative to stressor 1 and were significantly lower than at baseline. PEP increased (myocardial contractility decreased) relative to stressor 1, but was not different from baseline. Again, there was no clear challenge or threat orientation to be inferred from this physiological profile. However, these results suggest there might have been recovery of HR, CO, and PEP during the distraction task relative to stressor 1, as well as active engagement in the distraction task (decreased RSA and increased HR relative to baseline).
Stressor 2. HR increased relative to distraction and baseline, but did not differ from HR during stressor 1. CO increased relative to distraction, but did not differ from CO during stressor 1. CO was higher than baseline levels, but not significantly. PEP was not significantly different from distraction/baseline and was higher than stressor 1 (lower myocardial contractility compared to stressor 1). Finally, RSA increased compared to distraction, did not differ from stressor 1, and was still significantly lower than baseline levels. No clear pattern of challenge or threat orientation was evident from these physiological changes. Degree of engagement with stressor 2 is also unclear - increased HR and decreased RSA relative to baseline suggests participants were actively engaged with the stressor, but lack of increased SBP or myocardial contractility also suggests that participants were not fully engaged with the stressor.

Overall, our buffering hypothesis that participants in the positive distraction group would exhibit a greater challenge orientation to stressor 2 than to stressor 1 and that this effect would not be evident for the neutral distraction group was not supported. Moreover, the pattern of physiological changes from one experimental phase to the next, as well as in relation to baseline, do not provide a clear depiction of physiological states (i.e. balance in activity between parasympathetic and sympathetic nervous systems) or psychological states (i.e. engagement/disengagement vs. challenge vs. threat).

Behavioral results.

Attempts and mistakes. Due to errors in recording attempts and mistakes, 14 participants were excluded from these analyses (final n = 135; ShortPos = 34, LongPos = 38, ShortNeut = 34, LongNeut = 25). Also, gender was included as a covariate for these
analyses because it had a significant effect on the number of attempts participants made during the math tasks.

*Attempts*. There was a significant within-subjects effect of time \( F(1[1], 125[125]) = 5.261, p = .023, \eta^2 = .04 \) that was qualified by a significant three-way interaction of time*distraction condition*stressor length \( F(1[1], 125[125]) = 4.544, p = .035, \eta^2 = .035 \). Surprisingly, follow-up analyses revealed that the ShortNeutral group (M = 8.51 attempts, SD = 4.38) made more subtraction attempts than the ShortPositive group (M = 7.21 attempts, SD = 3.36) during the 1st and 2nd minutes of the second stressor, \( F(1, 68) = 4.361, p = .041, \eta^2 = .06 \). There were no other significant differences between conditions at either time point (all other \( F \)-values < 2.00, \( p \)-values > .15).

There was also a significant 2-way interaction of time*math task order consistent with our findings from Study 1, \( F(1[1], 125[125]) = 38.414, p < .001, \eta^2 = .235 \). Participants made more attempts when subtracting by 13s (M = 10.15 attempts, SD = 4.36) than when subtracting by 17s (M = 7.35 attempts, SD = 3.48) in stressor 1; \( t(133) = 4.063, p < .001, d = .709 \). However, there were no significant differences in attempts during stressor 2 (Serial 13s: M = 8.44 attempts, SD = 3.47 vs. Serial 17s: M = 7.41 attempts, SD = 4.09); \( t(133) = 1.55, p = .122, d = .269 \).

Together these results suggest, first, that the serial 13s task was likely easier than the serial 17s task, confirming our decision to counterbalance the math tasks. However, the fact that attempts for the 17s vs. 13s task during the second stressor were similar suggests that people who subtracted by 17s in the first stressor then made fewer attempts during the serial 13s task in the second stressor. More interestingly, we found that there was an effect on attempts by distraction condition and that this effect was moderated by
stressor length. Unfortunately, our exact buffering hypothesis that positive distraction
would elicit more attempts during the second stressor, especially for people in the long
stressor condition, was not supported. We found that the neutral distraction group made
more attempts during the second stressor compared to the positive distraction group, and
only for people in the short stressor condition. Other than this 1 difference, our findings
suggest that people exhibited similar behavioral engagement with the stressors at our time
points of interest.

*Error rates (Mistake:Attempt ratio).* We only found a significant interaction
between time and math task order for error rates throughout the task, F(1[1], 125[125]) =
10.346, p = .002, η² = .076. Participants made higher error rates in the serial 17s task
compared to the serial 13s task during both stressor 1 [Serial 17s: M = .12, SD = .11 vs.
Serial 13s: M = .07, SD = .08; t(133) = 2.662, p = .009, d = .48] and stressor 2 [Serial
17s: M = .16, SD = .15 vs. Serial 13s: M = .12, SD = .08; t(133) = 2.266, p = .025, d =
.33]. Participants collapsed across all groups also made more mistakes at the beginning of
the second stressor (M = .14, SD = .13) compared to at the end of stressor 1 (M = .09, SD
= .09); t(134) = 3.742, p < .001, d = .33.

These results again suggest that the serial 17s task was more difficult than the
serial 13s task. These results might also suggest that the distraction task actually caused
cognitive resource depletion as participants made more mistakes during stressor 2 than
stressor 1. However, a follow-up analysis comparing error rates in the first 2 minutes of
stressor 1 (M = .17, SD = .15) with those in the first 2 minutes of stressor 2 (M = .14, SD
= .13) indicated that people had marginally greater error rates at the beginning of stressor
1 than at the beginning of stressor 2; t(135) = 1.81, p = .07, d = .171. These follow-up
findings therefore suggest that people actually exhibited substantial practice effects by the end of stressor 1. When comparing time points at the beginning of both stressors (minutes 1 and 2 of each stressor), it actually appeared that the distraction task may have replenished some cognitive resources, helping participants make smaller error rates at the beginning of stressor 2 compared with at the beginning of stressor 1. Despite these findings, our hypothesis that people would make fewer mistakes in the positive distraction group than in the neutral distraction group was not supported.

**Study 2b Discussion**

Our aims in Study 2b were three-fold. We sought to 1) try and more adequately capture a measurement of the resources that positive distraction might be replenishing in order to have a buffering effect on unpleasantness in Study 1, 2) test stressor length (i.e. resource depletion level) as a moderator of the buffering effect that was identified for subjective unpleasantness in Study 1, and 3) retest our replenishment and buffering hypotheses from Study 1 after addressing some of its limitations. Our primary finding was that positive distraction both replenishes perceived energy levels (decreases fatigue) and buffers from ensuing fatigue experienced through repeated stress better than does neutral distraction. Our finding that positive distraction exerted a replenishing effect on fatigue levels is important because we could not confidently conclude at the end of Study 1 that the unique buffering effect of positive distraction (vs. neutral distraction) on unpleasantness was a function of better resource replenishment. Finding that fatigue was replenished by positive, but not neutral, distraction in the present study suggests that resource/energy replenishment is one mechanism through which positive distraction
buffers against the negative consequences of repeated stress. Our findings also contribute significantly to the literature, as previous studies have relied on demonstrating buffering effects to conclude or assume that positive emotions replenish resources better than neutral emotional states (Tice et al., 2007). We demonstrate that a single positive distraction task can first directly replenish fatigue accumulated during an initial stressor, then buffer from new-onset fatigue experienced at the beginning of a second stressor. Overall, our results substantiate our proposition that positive distraction is a better coping strategy for repeated stress than neutral distraction in part because it allows people to replenish resources, one of which is energy level, between stressors.

Surprisingly, our finding from Study 1 that positive distraction buffers from unpleasantness during a repeated stressor was not replicated in this study. A possible explanation may be that asking about both fatigue and unpleasantness in the present study allowed participants to separate these two emotions in their self-reports. Thus, the 'unpleasantness' reported in Study 1 may have been a blend of negative affect and of fatigue levels, which when measured individually revealed a stronger buffering effect on fatigue than on negative affect. This interpretation would suggest that positive distraction exerts an influence on good coping outcomes less because it reduces negative emotional experiences better than neutral distraction does, but more because it helps people feel less tired when in the midst of a stressor. This interpretation also coincides with our finding in Chapter 2 that negative emotions were not stronger mediators of positive distraction vs. neutral distraction efficacy. Individually assessing unpleasantness and fatigue in two separate studies with identical experimental paradigms would help to evaluate this explanation.
Another surprising finding in this study was that the difference in fatigue from stressor 1 to stressor 2 did not have an indirect effect on either overall fatigue or overall unpleasantness levels. The lack of replication in this study should be interpreted with caution since adding stressor length as a variable and juxtaposing unpleasantness ratings with fatigue ratings may have distinctly altered the indirect pathways between distraction condition and self-reported overall affect. However, it is possible that buffering from fatigue during a repeated stressor does not impact overall emotions, while buffering from unpleasantness does. We could not directly evaluate this comparison since we found no evidence of a buffering effect on unpleasantness in this study, but it is intriguing to postulate that feeling less tired in the midst of a stressor does not translate to feeling less tired or unpleasant in memory, while feeling less unpleasant in the midst of a stressor does. This proposition has implications for how we investigate mechanisms underlying positive distraction efficacy in the future. Currently, retrospective affect reports are used most commonly in the stress and coping literature, but these studies may only be providing a partial depiction of the mechanisms driving positive distraction efficacy. Experience sampling studies that assess momentary changes in emotion might elucidate what seems to be a complex interplay between resource replenishment and negative emotions associated with distinct stressful events in mediating the adaptiveness of positive distraction as a coping strategy for repeated stress.

There was also no effect of distraction condition on positive emotions again, despite the fact that we changed the distraction task to be more emotionally salient. Several explanations are possible. The first is that positive and neutral distraction actually do not have distinct influences on positive emotion levels. People may derive similar
levels of pleasantness from engaging in positive vs. neutral distraction thoughts or tasks. But this explanation is inconsistent with our findings in Chapter 2 that although positive emotions mediated the adaptive effects of both positive and neutral distraction coping in daily life, positive distraction still predicted positive emotion levels better than neutral distraction did. That is, positive distraction is more strongly associated with positive emotion levels in daily life and should, likewise, have been more strongly associated with positive emotions in the present study. An alternative explanation, then, is that assessing pleasantness in this study unintentionally measured a construct that is similarly affected by both positive and neutral distraction. As discussed in Study 1, this particular construct may be relief or pleasantness associated with the termination of an unpleasant experience, rather than pleasantness derived directly from the different distraction tasks. Another possibility is that positive and neutral distraction may not differentially increase explicit positive affect on a short time scale, but positive emotions on a more unconscious level (implicit positive affect; Quirin et al., 2009). For instance, Quirin et al. (2011) found that implicit positive affect was more influenced than explicit positive affect by both positive and negative mood inductions. Thus, while Chapter 2 indicates that positive and neutral distraction are differentially related to explicit positive emotions in daily life, this direct association may take time to manifest (i.e. on a longer time scale than is possible in a laboratory session), or perhaps may be a result of accumulating implicit positive emotions over time. Finally, a third explanation for our lack of evidence that positive distraction increases positive emotions more so than neutral distraction may be that our positive writing task was not as good at inducing explicit positive emotions as we intended. Lyubomirsky et al. (2006) have shown that writing about positive life
experiences may sometimes counterintuitively predict lower well-being in comparison to writing about negative life experiences, especially when analyzing the details of these events. Moreover, it is possible that the writing task was not an appropriate simulation of real-world distraction strategies and, therefore, did not differentially increase positive emotions as might occur in daily life. Future studies should evaluate the explanations proposed here by assessing implicit affect, utilizing more sensitive and valid measures of explicit positive emotions to distinguish relief from distraction-related positive emotions, and continuing to test different distraction paradigms that may be more closely aligned with distraction strategies that people employ in daily life.

We also did not find that manipulating stressor length successfully altered perceptions of resource depletion, as operationalized by overwhelmingness during each stressor. This conclusion is bolstered by the fact that stressor length also had no effect on overall fatigue ratings. Therefore, we could not properly assess our hypothesis that resource depletion moderates positive vs. neutral distraction, and will need to change our manipulation of resource depletion to reassess this proposition.

Finally, one limitation of this study was the lack of a no-distraction control group. Because we included a neutral distraction control group, we can conclude that our positive distraction task was better than neutral at replenishing mental energy levels and buffering from repeated stressor-related fatigue. However, it is unclear whether these replenishment/buffering effects are more prominent than the effects of simply resting or not engaging in any distraction strategies between stressors (i.e. if distraction coping is better than resting/doing nothing between stressors). Future studies should compare the effects of positive distraction coping to a no-distraction control period.
Another major limitation of this study was its probable lack of power to detect significant physiological effects (due to practical issues with data collection), making it more difficult to make meaningful conclusions about the observed patterns of physiological change from one time point to the next. For instance, because we did not find any significant changes in TPR throughout the study, we were unable to assess challenge vs. threat states throughout the study. Changes in HR were the most significant and clear, following a similar pattern as in Study 1. The fact that it decreased during distraction, but not back to baseline levels, likely indicates that distraction contributed to HR recovery, but was still a task requiring active engagement. Other markers of effort (myocardial contractility and SBP) did not show such clear changes, nor did they coincide completely with findings from Study 1. Specifically, there was no significant change in SBP throughout the experiment, and myocardial contractility increased (PEP decreased) during stressor 1, but not significantly, then decreased (PEP increased) during distraction and stayed low during stressor 2 at levels similar to those at baseline. Besides the conclusion that this study was underpowered, these changes in myocardial contractility could represent an incomplete sympathetic nervous system (SNS) response to stressor 1, a complete recovery during distraction, and a lack of SNS response to stressor 2. This lack of response to stressor 2 may be interpreted in two ways. The first suggests that distraction maladaptively facilitated a disengaged state, in which participants were no longer interested in or motivated by the math task. However, our findings that motivation levels, HR, and subtraction attempts did not decrease relative to stressor 1 weaken this conclusion. The other explanation is that the reduced response in myocardial contractility may reflect physiological habituation to a repeated stressor,
which is a well-documented phenomenon and typically considered to be adaptive when there are not simultaneous declines in subjective affect or behavior (Kelsey et al., 2004).

The pattern of change for RSA was also unexpected, but consistent with the findings in Study 1. RSA decreased in response to stressor 1, decreased further during distraction, then increased relative to distraction, but was still lower than baseline and recovery levels, during stressor 2 (making a U-shaped curve). This finding is surprising because we expected RSA to increase back to baseline levels during distraction, representing a return of vagal tone/parasympathetic influence on the heart. A fairly parsimonious explanation may be that vagal tone is typically increased in situations involving social engagement and decreased in comparison when opportunities for social interaction are absent (Mendes, 2009; Porges, 2007; Shahrestani et al., 2014; 2015). The low RSA during the distraction period relative to during the stressors may have reflected active engagement in a cognitively demanding task with no social component, while RSA levels during the stressors may have reflected active engagement in demanding tasks involving social evaluation and interaction. These findings corroborate recent reports that RSA changes in response to social stressors and cognitively demanding tasks are rather complex and not as readily interpretable as other cardiovascular markers of effort and/or sympathetic activity (Allen et al., 2014), which further encourages us to interpret our own physiological findings with caution.

**General Discussion**

Overall, we aimed to investigate whether positive distraction is better than neutral distraction at replenishing resources lost during stress. The studies presented here provide
support for this proposition as measured by unpleasantness and fatigue, but not by pleasantness, motivation, and cardiovascular indices of challenge vs. threat orientations to stress. We found that positive distraction is better than neutral at buffering against the negative emotions and new-onset fatigue associated with repeated stress. This buffering effect seems to be driven by a unique ability for positive distraction to replenish energy levels that were depleted during a prior stressful experience and has important implications for our understanding of how positive distraction works as an adaptive coping strategy for repeated stress. If energy resources that were depleted during one stressful event can be restored before the onset of a subsequent stressor, people can devote this energy reserve to building or replenishing additional coping resources that can be used in future coping efforts. Similarly, buffering from energy depletion by a second stressful event gives people an energy reserve from which to draw in the momentary experience of the stressor itself. Indeed, our second study showed that lower fatigue levels during the second stressor were concurrent with a relative improvement in cognitive performance at the beginning of the second stressor compared with at the beginning of the first stressor.

We initially proposed that this resource replenishment function was a consequence of the relative propensity for positive distraction to elevate positive emotions in comparison to neutral distraction. However, we were unable to demonstrate that positive distraction increased explicit positive emotions more than neutral distraction did. One conclusion is that positive distraction may uniquely replenish resources through some mechanism other than increasing explicit positive emotions (e.g. increasing self-efficacy, mastery, or autonomy), or perhaps through a more complicated mechanism than
could be inferred from these studies (e.g. through increasing implicit vs. explicit positive affect, or some ratio of the two). We discussed some possible explanations in the individual discussion sections for each study and identified potential avenues for future investigations. An additional possibility, however, may be that our particular distraction paradigms did not sufficiently simulate positive vs. neutral distraction strategies in daily life. If this were the case, then our distraction tasks would likely not have produced the positive emotional effects that might occur in daily life. In other words, it is possible that real-world positive distraction does increase positive emotions more than real-world neutral distraction, which in turn facilitates better resource replenishment and buffering from stress, but our distraction tasks were not appropriate to elicit differential increases in explicit positive emotions. As such, future studies employing more realistic distraction tasks, or at least calling to mind the explicit emotional states associated with positive distraction vs. neutral (e.g. "Imagine a time when you do something fun..." vs. "Imagine a time when you do chores to take your mind off a stressor), may produce more ecologically valid differences in positive emotion levels and allow us to more specifically evaluate our proposition that positive emotions mediate the resource replenishment observed in the present studies.

There was also an issue of uncertain effects on psychophysiological states. One way in which we attempted to frame resource loss and gain was as challenge vs. threat orientations to stress measured through physiological profiles. The first study, which produced the most interpretable pattern of physiological changes, indicated that participants were challenged by both stressor 1 and stressor 2. We initially presented two possible interpretations of these findings - that distraction had no effect on these
orientations or that it did have an effect that was not observable by the way in which we averaged values across a three minute time span. We aimed to investigate which of these two interpretations was more likely in Study 2, but our technical difficulties prevented us from collecting sufficient physiological data to make confident conclusions. In retrospect, there was also a third plausible conclusion of the psychophysiological findings from Study 1, namely that distraction may have actually caused participants to be less prepared to manage the second stressor. Decreased cardiovascular responses to repeated stressors (habituation) are a well-known and adaptive response when accompanied by unchanged behavioral responses and decreased or unchanged stress appraisals (Kelsey et al., 2004). The fact that we saw a clear cardiovascular response to the second stressor with unchanged behavioral responses suggests that our participants did not habituate physiologically to the repeated stressor. One interpretation of these findings, which we pursued in the discussion for Study 1 and influenced our methods for Study 2, is that the distraction task renewed participants’ resources enough for them to subsequently exhibit a strong, active engagement with the second stressor. An alternate conclusion, though, is that the lack of habituation to the second stressor represents a maladaptive overexertion of physical resources to meet the demands of a stressor that should no longer be perceived as so demanding. We posit that this latter explanation is less likely given that it is rather inconsistent with our affect findings as well as much of the coping literature indicating that temporary distraction is a healthy coping strategy. Nonetheless, we cannot determine which explanation is accurate without additional investigations. Perhaps positive distraction is linked to better temporary coping and mental health outcomes, but worse physical health outcomes. Future studies are warranted to address these questions.
We were unable to address whether positive vs. neutral distraction efficacy is moderated by degree of resource depletion because our depletion manipulation was unsuccessful. Based on findings from prior studies showing that positive distraction efficacy is moderated by stressor intensity (Iwasaki, 2006; Tsaur & Tang, 2012) and by how much time people must spend in stressful situations (Qian et al., 2014), we still posit that degree of resource depletion during one stressor may moderate how well positive distraction works to lessen the negative impacts of a subsequent stressor. Stressor length, however, may not be an appropriate laboratory proxy for degree of resource depletion as it did not create sufficient differences to be tested as a moderator variable. A future goal for us is to develop and test a repeated stressor paradigm that successfully produces differing levels of resource depletion in order to assess our moderator hypothesis.

Finally, these studies had at least two important limitations to our conclusions. First, we only measured the affect valence components of stress. Positive distraction may also beneficially influence other subjective characteristics of the stress response that were not measured here (e.g. perceived controllability over a stressor, arousal level). The second limitation of our studies is the degree to which our findings can be generalized to ecological outcomes. Few studies have sought to understand how the repeated stressor laboratory model relates to real-world psychosocial outcomes and/or coping responses to chronic life stress. Future studies in which findings from these repeated stressor models are linked to ecological assessments would strengthen our assumption that positive distraction is better than neutral and replenishing fatigue levels and buffering from future fatigue in the midst of experiencing chronic stress.
Conclusion

The studies presented in this work provide some additional insight into the mechanisms underlying positive and neutral distraction coping. Positive distraction does buffer from the negative emotional consequences of a repeated stressor better than neutral distraction, and this buffering effect seems to be attributed to a more effective replenishing of energy resources lost during an initial stressor. These studies make a significant contribution to the literature on positive distraction, as experimental studies have typically demonstrated no difference in efficacy between positive and neutral distraction (Webb et al., 2012). However, these previous studies have not employed repeated stressor paradigms, and therefore have not been able to advance conclusions about the effectiveness of positive vs. neutral distraction for chronic stressors. The present work represents the first, to our knowledge, to experimentally compare positive and neutral distraction as coping strategies for repeated stressors, which may serve as a corollary for chronic life stressors. Moreover, we were able to identify a potential distinguishing mechanism - resource replenishment - that sets positive distraction apart from neutral distraction and that may also explain why it has generally been found to be more adaptive than neutral in ecological studies.
Chapter 4: General Discussion
The purpose of this dissertation was to characterize positive distraction - a coping strategy for chronic stress that has largely been understudied in the past. At the outset, I proposed that positive distraction is a unique coping strategy combining elements of disengagement and positive emotional coping. I posited that, like other forms of distraction (i.e. neutral), it allows people to step away from a chronically stressful experience for some moments of respite. However, I also posited that positive distraction also offers additional benefits related to the cultivation and experiencing of positive emotional states, one of which is an increased ability to replenish emotional, physical, and social resources compared to neutral distraction. I also identified some questions to address in this dissertation that could provide a better characterization of positive distraction than has been previously understood. My findings helped clarify some of these questions and updated the mechanistic model that was proposed in the introduction, but as is often the case, presented even more questions to be answered in the future.

**Positive Distraction is an Adaptive Coping Strategy for Chronic Stress**

The primary finding in this dissertation was that positive distraction is a useful coping strategy for chronic stressors with beneficial impacts on self-reported mental health. It does not lead to unfavorable outcomes in the real world, and it is not as closely aligned with avoidance as has historically been portrayed. In Chapter 2, I showed across four samples that positive distraction predicted greater psychological well-being and less depression when used as a coping strategy for chronic stressors. This effect was statistically apparent when controlling for avoidance coping, which itself was predictive of lower well-being and higher depression, and suggests that positive distraction and
avoidance do share some overlapping characteristics, likely disengagement, or the act of distancing oneself from a stressor. However, these findings also suggest that positive distraction is uniquely adaptive, while avoidance is uniquely maladaptive in an ecological context. Indeed, the meta-analysis in Chapter 2 revealed that positive distraction predicts healthy psychological outcomes even when not controlling for avoidance, thus weakening even further the conceptual and functional overlap between the two. It is therefore paramount that coping theorists no longer continue mixing avoidance and positive distraction in assessments of 'healthy' vs. 'unhealthy' coping strategies.

**Positive Distraction is More Adaptive than Neutral Distraction**

In addition to being distinct from avoidance, positive distraction is also distinct from and more adaptive than neutral distraction. This finding was significant as it challenged prior reports that positive and neutral distraction are *equally* effective for helping people regulate their negative emotions (Webb et al., 2012) and substantiated qualitative findings from the trauma coping literature suggesting that people receive more benefit from positive than neutral distraction strategies in the real world (Perez-Sales et al., 2005). I posited in the introduction that a key distinction between these two literatures may have been their assessment of positive vs. neutral distraction as strategies for regulating acutely elevated negative emotions vs. for coping with chronic stress. I also noted that both ecological and experimental studies directly comparing positive and neutral distraction for coping with chronic stress were a necessary step forward in the coping literature. In Chapter 2, I reported that both positive and neutral distraction predicted increased well-being on a zero-order level. However, when comparing their
unique effects by controlling for the predictive power of the other, positive distraction was a more adaptive and more consistent predictor of psychological outcomes than neutral distraction. It predicted increased well-being and decreased depression symptoms when accounting for the predictive effects of neutral distraction, whereas the adaptive zero-order effects of neutral distraction on outcomes weakened when controlling for positive distraction. These findings emphasized several points. First, positive and neutral distraction are both adaptive for coping with chronic stress, especially if their effects are not compared with each other (i.e. zero-order). This conclusion is consistent with work from both Webb et al. (2012) and Perez-Sales et al. (2005) and implies that people can turn to both daily tasks/chores or pleasurable distractions when chronically stressed, and they will feel better. But the fact that positive distraction has a greater unique effect on healthy outcomes compared to neutral distraction also directly challenges findings from Webb et al. (2012) and suggests that people will receive a greater benefit from using pleasurable distractions than from turning to daily chores to cope with stress. Moreover, most of the benefits people derive from using non-emotional (neutral) distractions in daily life are driven by a mechanism shared by positive distraction (e.g. both forms of distraction allow for temporary respites from chronic stress), leaving few unique effects of neutral distraction on outcomes. What unique predictive effect neutral distraction does have on well-being can possibly be attributed to reducing negative emotions in daily life (shown in Chapter 2), but is much less impressive compared to the unique effect of positive distraction on both well-being and depression symptoms. In other words, neutral distraction seems to work primarily through a mechanism shared by positive distraction,
while positive distraction works through both this overlapping mechanism and others that are not shared with neutral distraction.

Positive Distraction Promotes Perceived Control, Positive Emotions, and Replenishment

Another objective of this dissertation was born out of the finding that positive distraction has a greater unique effect on outcomes than neutral distraction does. I subsequently set out to identify and compare the overlapping and unique mechanisms of positive and neutral distraction. In the beginning of this dissertation, I posited (Figure 1), based on prior work in the literature, that both positive and neutral distraction may work as planned breathers from stress, and these temporary breaks may facilitate 1) self-protection through pausing a chronically stressful experience, 2) time to prepare/brainstorm for coping with a chronic stressor, and 3) time to replenish resources.

I also posited that what may make positive distraction distinct from and more adaptive than neutral distraction is its promotion of positive emotional states, which in turn, can lead to better coping outcomes by 1) undoing the negative effects of a previously experienced stressor, 2) broadening repertoires for handling stressful situations, 3) serving as a safety signal to encourage further coping efforts, and 4) creating an impetus and opportunities to replenish/build resources (this function overlaps with that of taking planned breaks). I made significant discoveries in Chapters 2 and 3 that allowed me to update this initial model with more detail and to propose additional mechanistic pathways (Figure 2).
In Chapter 2, I found that positive distraction efficacy was mediated by the amount of control that people perceive to have over their chronic stressors. This effect was not shared by neutral distraction and constitutes a component of the unique predictive effect linking positive distraction to improved psychological outcomes. I also found that both positive and neutral distraction efficacies were mediated by increasing the positive emotions associated with a stressor, but these positive emotions were only related to positive distraction use on a zero-order level. These latter findings are important as they challenge my original assumption (and that of the literature) that positive distraction is definitionally distinct from neutral distraction because it alone is associated with positive emotions. In fact, both seem capable of helping people feel better about a stressful situation. Where they differ may be in magnitude as well as the

Figure 1. Originally proposed mechanistic model linking positive and neutral distraction to improved coping outcomes.
mechanisms underlying these increased positive emotions. For instance, people may derive more or stronger positive emotions from using positive distraction. Moreover, positive distraction seems to cultivate positive emotions directly, reflected in its unique relationship to positive emotions on a zero-order level, while neutral distraction may elevate positive emotions through an additional indirect pathway, as it was not directly correlated with positive emotions on a zero-order level. The nature of this indirect pathway is unclear and warrants further investigation, but I posit that it may involve taking planned breathers from stress (perhaps inviting relief, calm, etc.). It will be important in future assessments to delineate between these indirect positive emotions and the positive emotions that are derived directly from using distraction strategies to cope. Mixing the two may result in an inability to differentiate positive and neutral distraction based on positive emotion levels (as demonstrated in Chapter 3). Finally, I also question whether positive distraction is better at, or even unique in, elevating positive emotions that are not related to a distinct chronic stressor (i.e. general positive emotions in life) compared to neutral distraction. It is possible that positive distraction uniquely increases general positive emotions, which might then operate in a reinforcing loop to augment the positive emotions felt about a stressor. This process would be reminiscent of the upward spirals of positivity demonstrated by Fredrickson & Joiner (2002), such that general positive emotional states could reciprocally enhance the positive experience/perception of a specific stressor. If neutral distraction does not also promote general positive emotions, then the pathway proposed here could be yet another contributing to the unique adaptive effects of positive distraction.
Figure 2. Updated proposed mechanistic model comparing positive and neutral distraction based on findings presented in the present work.
In Chapter 3, I also assessed the proposition that positive distraction may be better at replenishing resources than neutral distraction is. This replenishment theory was supported, especially for perceived energy levels, as I found that positive, but not neutral, distraction was able to reduce fatigue that accumulated during an initial stressor. In fact, I did not find any evidence that neutral distraction was able to replenish resources, suggesting that this function may constitute a component of the unique adaptive effect of positive distraction on psychological outcomes.

The replenishment function of positive distraction also contributed to a unique buffering effect, which prevented people from feeling as unpleasant/fatigued during a second, repeated stressor as they had during the first stressor. This buffering effect was not evident for neutral distraction and may have important implications for disrupting negative emotional inertia and subsequently influencing how people construct overall impressions of their daily emotions. Emotional inertia is the tendency for negative emotional states to persist over time, from one life event to the next (Kuppens et al., 2010). A person with high negative emotional inertia, for instance, is more likely to experience negative emotions during a second life event if they were also in a negative emotional state during a first life event. This tendency for negative emotional inertia may be traced to an increased likelihood of activation in the amygdala from one negative event to the next (Pichon et al., 2015) and is influenced by activity in the lateral prefrontal cortex (Waugh, Shing, et al., under review). Rigid emotional inertia has also been linked to a variety of undesirable outcomes, including low self-esteem (Kuppens et al., 2010), high frequency of rumination (Koval et al., 2012), and depression (Koval et al., 2012; Kuppens et al., 2010). Importantly, degree of emotional inertia may be
influenced by one's use of specific coping strategies. Farmer & Kashdan (2012) reported that using cognitive reappraisal one day predicts a lower likelihood of experiencing negative emotions on the next day. The buffering effects I found in Chapter 3 advance this theory by showing that positive distraction may disrupt emotional inertia, not just from one day to the next, but from one stressful event to the next. Moreover, this disruption may also predict improved overall affect, as I found in one study in Chapter 3 that the buffering of unpleasantness from one stressor to the next explained an indirect effect between positive distraction and decreased overall unpleasantness. While this finding should be interpreted with some caution as it was not replicated in a second study, it does inspire the possibility that positive distraction may have an adaptive effect on mental health, not just through momentary shifts in positive emotions, perceived control, and resource levels, but also through the overall affective memories people make about a chain of experiences. The next step for future studies is to probe whether this influence on overall affect is predictive of better life outcomes. I posit that this will be the case and that another mechanism by which positive distraction, but not neutral distraction, improves coping outcomes is reducing negative emotional inertia through selective resource replenishment, which then reduces overall negative affect and improves overall mental health.

The Path Through Negative Emotions is Unclear

One uncertainty that arose across studies was the relative role of negative emotions in linking positive and neutral distraction to improved coping outcomes. In Chapter 2, I reported that reductions in negative emotions seemed to be a more consistent
mediator of neutral distraction efficacy than of positive distraction efficacy, but in Chapter 3, I found that they were equally effective at directly reducing negative emotions. Moreover, positive distraction was actually better at buffering from ensuing negative emotions than neutral distraction was. The collection of these findings across the studies in Chapters 2 and 3 indicates that it is still unclear how positive and neutral distraction impact negative emotion levels and how their effects on negative emotions are related to improved coping outcomes. It is possible that the conflicting evidence across these studies was a result of employing different research methods (e.g. experimental vs. not) and affect measures (e.g. asking about negative emotions, which is more general vs. unpleasantness, which is more specific). Even within Chapter 3, asking about unpleasantness without the juxtaposition of fatigue may have influenced participants' responses differently than when asking about both unpleasantness and fatigue in the same set of affect ratings. It is also possible that positive distraction efficacy may be mediated by more pathways than neutral distraction is, so the relative mediating influence of reducing negative emotions on coping outcomes is greater and more readily apparent for neutral distraction than for positive distraction. A goal for future research will be to clarify these relationships as we uncover more of the mechanisms driving the unique efficacies of positive and neutral distraction.

Time is a Key Difference between Cognitive and Behavioral Positive Distraction

Another aim of this dissertation was to identify mediating mechanisms that might distinguish positive cognitive from positive behavioral distraction. In Chapter 2, I tested five possible candidates - positive emotions, negative emotions, perceived control, time
spent in stressor related situations, and perceived overwhelmingness. Time spent in stressor related situations strongly distinguished the two forms of positive distraction, mediating the efficacy of positive behavioral distraction, but not positive cognitive distraction. Positive emotions mediated the efficacy of positive cognitive distraction, but they also marginally mediated the efficacy of positive behavioral distraction. The first finding supports my theory that positive cognitive distraction can be employed without removing oneself from a stressful situation. That is, one mechanism underlying the efficacy of positive behavioral distraction is stepping away from a stressor, or utilizing a planned break. Positive cognitive distraction does not require this exchange of time as it can be used to take temporary mental breaks while still in the midst of the stressor. It is, thus, also interesting that only positive cognitive distraction was associated with increased well-being on a zero-order level, suggesting that people do not need to actually take the time to engage in pleasurable activities to reap the benefits of positive distraction. Perhaps the mental reminder of a positive emotion is sufficient and even more powerful than going out and seeking positive experiences. This proposition is supported by the finding in Chapter 2 that positive emotions preferentially mediated the efficacy of positive cognitive distraction. Future studies should seek to evaluate more distinguishing mechanisms for positive cognitive vs. behavioral distraction and, especially, to probe whether one form of positive distraction is more beneficial than the other for coping with chronic life stressors.
Contextual Moderators Still Need to Be Identified

A final aim of this dissertation was to begin identifying contextual factors that might influence when and how positive distraction coping improves outcomes. I was unable to identify a meaningful moderator. However, I only tested one candidate for moderation out of an almost endless supply of possibilities. At least three types of contextual factors could potentially moderate the efficacy of positive distraction coping. First are the characteristics of positive distraction itself, as certain types of positive distraction may be more effective than others. Some potential moderators in this category include the length/duration and arousal level (i.e. highly arousing vs. calming) of the distracting thought or activity, as well as the social or non-social nature of the distraction. For instance, relaxation techniques might help reduce stress levels more than thinking about or engaging in activities that require a high amount of energy, or positive distraction techniques involving interactions with others could be more effective than those that involve solitary activities. Intrapersonal characteristics may also moderate the efficacy of positive distraction. These characteristics might include personality traits (e.g. hardiness, resilience, optimism, etc.), degree of other coping resources available (e.g. having many close friends with whom to engage with in positively distracting activities), and goals/motivations (e.g. how important the particular goal/motivation is that is being challenged by the stressor). Finally, stressor-specific characteristics may influence positive distraction efficacy. These characteristics include, but are not limited to, whether the stressor is social or non-social in nature (i.e. involving interactions with others or not) and the intensity or duration of the stressor (e.g. chronic vs. acute; length of time that one has been experiencing the chronic stressor). Systematically evaluating these possible
contextual determinants of positive distraction efficacy paves the way for many future research studies, especially as researchers and clinicians begin recognizing the need to tailor coping treatments to individuals and their unique life situations.

**Conclusion**

To conclude, there is a need to re-evaluate some coping strategies for chronic stress that may have been pushed aside in the past. Positive distraction is one such strategy. Although there were some identifiable limitations to the studies enclosed, this dissertation represents an initial effort to re-characterize positive distraction as an adaptive strategy with the ability to replenish resources to aid in future coping efforts and that is linked to improved life satisfaction and lower depression levels. The consistent finding that positive distraction can promote better mental health has important clinical and lifestyle implications, especially as chronic stress and burnout levels climb on a global scale (Michel, 2016; "2015 Stress in America Snapshot," 2016). Although burnout is now recognized as not being limited to occupational stress, one model posits that it develops when people experience high levels of job demand and low levels of job resources to cope with those demands (Demerouti et al., 2001). Indeed, Michel (2016) notes that "ultimately, burnout results when the balance of deadlines, demands, working hours, and other stressors outstrips rewards, recognition, and relaxation." Positive distraction could serve to correct these imbalances by promoting rest and relaxation. Importantly, there also seems to be a clear link between the types of maladaptive coping strategies people use and how much they burn out (Montero-Marin et al., 2014), leaving open the possibility that promoting healthier, adaptive coping styles like positive
distraction can effectively prevent or reverse burnout development. I hope that this work sparks a concerted interest in, and ultimately, a cultural paradigm shift to help people feel more comfortable with taking breaks (mental or physical) in order to cultivate and savor pleasant life experiences.
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