The Interplay of Mindfulness and Effortful Control with the Emotional Dynamics of Everyday Life

by

Saul A. Castro

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Graduate Supervisory Committee:

Frank Infurna, Chair
Leah Doane
Mary Davis

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ABSTRACT

Research on self-regulatory variables like mindfulness and effortful control proposes strong links with physical and mental health outcomes across the lifespan, from childhood and adolescence to adulthood and old age. One pathway by which self-regulation may confer health benefits is through individual differences in reports of and emotional responses to daily negative and positive events. Mindfulness is broadly defined as non-reactivity to inner experiences, while effortful control is broadly defined as attentional and behavioral regulation. Mindfulness and effortful control have both been conceptualized to exert their beneficial effects on development through their influence on exposure/engagement and emotional reactivity/responsiveness to both negative and positive events, yet few empirical studies have tested this claim using daily-diary designs, a research methodology that permits for examining this process. With a sample of community-dwelling adults (n=191), this thesis examined whether dispositional mindfulness (i.e., non-reactivity of inner experience) and effortful control (i.e., attention and behavioral regulation) modulate reports of and affective reactivity/responsiveness to daily negative and positive events across 30 days. Results showed that mindfulness and effortful control were each associated with reduced exposure to daily stressors but not positive events. They also showed that mindfulness and effortful control, respectively, predicted smaller decreases in negative affect and smaller increases in positive affect on days that positive events occurred. Overall, these findings offer insight into how these self-regulatory factors operate in the context of middle-aged adults' everyday life.

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INTRODUCTION

Broadly defined as the set of abilities and processes that regulate cognition, affect, and behavior in pursuit of personal and situational goals (Karoly, 1993), self-regulation is considered to underlie a range of both adaptive and maladaptive outcomes across the lifespan, from childhood and adolescence to adulthood and old age. In childhood and adolescence, markers of self-regulation have been associated with fewer psychological symptoms and emotion-regulation difficulties, and better social competence and relationships (e.g., Eisenberg et al., 1997; Busch & Hoffer, 2012; Baer et al., 2006). In adulthood and old age, better self-regulation is consistently associated with fewer symptoms of stress, depression, and anxiety, as well as better vitality and physical health (e.g., Kabat-Zinn et al., 1985; Quinn & Kim, 2010; Jain, Shapiro, Swanick, Roesch, Mills, Bell, et al., 2007).

A unifying theme across the numerous concepts used to define self-regulation is emerging evidence that suggests self-regulation is biologically-based and partially heritable, and continually shaped over time through a combination of contextual and family influences and maturational processes (Posner & Rothbart, 2006; Eisenberg, Smith, Sadovsky, & Spinrad, 2004). According to recent theoretical and conceptual integrations from the social, developmental, clinical, and neurobiological literatures, self-regulation can be differentiated into two components: “top-down” regulation that reflects more effortful/executive control processes, and “bottom-up” regulation that reflects more reactive, automatic processes (for review, see Bridgett, Burt, Edwards, & Deater-

Deckard, 2015). These two components are considered distinct, yet interacting components of the self-regulatory system (Kelley, Wagner, & Heatherton, 2015).

Based on this framework, I plan to examine how two indicators of “top-down” self-regulatory processes, mindfulness and effortful control, are associated with behavioral and emotional functioning in everyday life. Utilizing daily diaries from a sample of individuals in midlife (ages 40 to 65), this thesis proposal is guided by methodological frameworks that examine how personal characteristics impact differential exposure and reactivity to daily stressors (Bolger & Zuckerman, 1995), as well as differential engagement with and responsiveness to daily positive events (Zautra, Affleck, Tennen, Reich, & Davis, 2005). Based on a two-dimensional framework of well-being that differentiates between negatively and positively valanced emotions (Zautra, 2003; Folkman, 2008), this thesis will assess how between-person differences in “top-down” self-regulation shape exposure to/engagement with daily events and emotional reactivity/responsiveness to those events.

BACKGROUND LITERATURE

Self-Regulation as a Driver of Development across the Lifespan

Considerable evidence posits that self-regulation factors, such as mindfulness and effortful control play a key role in health, well-being, and overall development across the lifespan (Zoogman, Goldberg, Hoyt, & Miller, 2015; Khoury, Lecomte, Fortin, Masse, Therien, Bouchard, & Hofmann, 2013; Eisenberg et al., 2004). One pathway by which these self-regulatory features potentially influence these pertinent outcomes is through daily stress processes (Chung, Flook, & Fuligni, 2011; Zautra, 2003). Specifically, mindfulness and effortful control may underlie exposure to stressful experiences, and shape emotional reactions to those stressors. Although self-regulation has been robustly implicated in stress and emotion outcomes, mindfulness and effortful control have not been simultaneously examined, largely because they stem from sub-disciplines within psychology. For example, clinical researchers frequently study self-regulation through a mindfulness framework (Kabat-Zinn et al., 1985), whereas developmental researchers often study self-regulation from a temperament framework with measures of effortful control (Rothbart, Derryberry, & Posner, 1994). Considering the conceptual and theoretical overlap between mindfulness and effortful control, each have been implicated in emotional reactivity to stress (Rothbart, 2007; Donald, Atkins, Parker, Christie, & Ryan, 2016). However, research has yet to simultaneously examine both self-regulatory facets in the context of daily life. My goal is to illuminate the overlap between mindfulness and effortful control in midlife and their distinct influence on exposure to daily stressors, engagement with positive events, and emotional reactivity/responsiveness to each.

Mindfulness. Mindfulness is a multidimensional construct that is defined as both a disposition (Creswell, Way, Eisenberger, & Lieberman, 2007) and momentary experience (Geschwind, Nicole, Peeters, Frenk, Drukker, van Os, Kim, Wicher, Marieke, 2011). The multidimensional facets of mindfulness include several components: sustained attention on the present moment, acceptance of emotional experiences as they occur, and non-reactivity to events (Jankowski & Holas, 2014). Despite the various definitions of mindfulness, there is general agreement that the concept originated from meditative practices common to Buddhism. Kabat-Zinn and colleagues (1985) introduced the construct to clinical science as the key mechanism underlying their mindfulness-based stress reduction (MBSR) program, finding significant reductions in anxiety and depression, along with increases in physical activity and resilience to pain, in their initial clinical trial. Subsequent research has continued to show the benefits of MBSR in clinical and population samples (c.f., Creswell, 2017). As a result, mindfulness has gained considerable interest.

Researchers have defined mindfulness as an attentive, non-reactive awareness of the present moment (Brown & Ryan, 2003; Kabat-Zinn, 2003). A separate line of inquiry by Bishop and colleagues (2004) defined mindfulness as self-regulation of attention *and* a curious orientation to experiences. Shapiro and colleagues (2006) extended this definition to include the degree of “intention” behind mindful practices.

Across the numerous definitions of mindfulness, a common theme is its multidimensional nature. Mindfulness is considered a multidimensional disposition towards responses in life; these dimensions include *observing, describing, acting with awareness, non-judgment of inner experience, and non-reactivity to inner experiences* (Baer et al., 2006). In this thesis and consistent with prior studies showing the predictive value of the non-reactivity facet (Soysa, & Wilcomb, 2015; Eisenlohr-Moul, Walsh, Charnigo Jr, Lynam, & Baer, 2012), mindfulness is conceptualized as a disposition (or orientation) towards non-reactivity of inner experiences that naturally varies across individuals (Neff, 2003; Pepping & Duvenage, 2016).

Mindfulness-based programs were originally designed to improve self-regulation of individuals with chronic pain (Kabat-Zinn et al., 1985), and a disposition towards mindful responding and mindful states of mind have been uniquely linked to more autonomous self-regulation in daily life (Brown & Ryan, 2003). This self-regulatory facet is associated with both negative and positive dimensions of psychological health. Cross-sectional, longitudinal, and within-person (e.g., Weinstein, Brown, and Ryan, 2009) evidence strongly links mindfulness to both enhanced well-being and lower perceived stress. Furthermore, the practice of mindfulness via behavioral programs is associated with reduced stress and increased positive states of mind when enduring significant adversity such as cancer (e.g., Bränström, Kvillemo, Brandberg, & Moskowitz, 2010) and chronic pain conditions like fibromyalgia and rheumatoid arthritis (Davis & Zautra, 2013; Davis, Zautra, Wolf, Tennen, & Yeung, 2015).

Dispositional mindfulness reflects a tendency for sustained, non-reactive processing of external and internal information (Jankowski & Holas, 2014). In contrast to relatively automatic responses to stressful events like reappraisal or thought suppression (John & Gross, 2003; Nezlek & Kuppens, 2008), which may undermine well-being with repeated use (Hayes, Luoma, Bond, Masuda, & Lillis, 2006), mindfulness has been proposed as an alternative strategy that facilitates adaptive responses to stressors. For example, mindfulness is associated with the ability to sustain well-being by dampening emotional reactivity to stressful experiences in daily life (Donald, Atkins, Parker, Christie, & Ryan, 2016). One theorized mechanism is that by consistently focusing on the present moment, individuals who report higher levels of mindfulness broaden the range of interpretations and responses to stressors, leading to a more adaptive profile of affective reactivity that fuels healthy aging (e.g., Feldman, Lavallee, Gildawie, & Greeson, 2016; Mroczek, Stawski, Turiano, Chan, Almeida, Neupert, & Spiro, 2013).

Recent studies with adolescents and young adults suggest that mindfulness modulates affective reactivity to stressors. For example, Dixon and Overall (2016) conducted a 10-day diary study of dispositional mindfulness and stressor-related fluctuations in depressed mood in a sample of young adults and found that greater daily stress was associated with increases in depressed affect, but the negative influence of stress was buffered for people reporting greater mindfulness. Importantly, the effect of mindfulness was independent of neuroticism, depressive symptoms, and emotion-regulation strategies like suppression and reappraisal (Dixon & Overall, 2016). Feldman and colleagues (2016) found evidence to suggest that mindfulness buffers dysphoric emotional responses to daily lapses in executive functioning in young adults, and another study with adolescents showed that mindfulness buffered the effects of daily stress on dysphoric mood (Ciesla, Reilly, Dickson, Emanuel, and Updegraff, 2012). There is growing empirical evidence that indicates a mindful disposition strongly attenuates affective reactivity to daily stressors, independently of prior-day affect and relevant covariates.

There is a relative absence of research on mindfulness in community-dwelling middle-aged adults. Moreover, differences in measurement of the construct make it difficult to properly compare mindfulness in younger adults with middle-aged or older adults. Preliminary cross-sectional studies indicate that older adults report higher levels of dispositional mindfulness relative to young adults (c.f., Fountain-Zaragoza, Londeree, Whitmoyer, & Prakash, 2016), and that older adults with mindfulness meditation experience exhibit better inhibitory control and working memory than age-matched non-meditators (Prakash, Heo, Voss, Patterson, & Kramer, 2012). Despite the limited examinations of mindfulness in samples of adults in midlife and old age, researchers have encouraged future exploration, citing potential benefits of mindfulness on attention, well-being, and inflammation for middle-aged and older adults (Fountain-Zaragoza & Prakash, 2017).

Effortful Control. In contrast to mindfulness, developmental approaches to the study of self-regulation have used temperament-based measures of effortful control. Effortful control encompasses the ability to focus and shift attention, and activate and inhibit behavioral responses when necessary (Rothbart, Derryberry, & Posner, 1994). These psychobiological models of temperament are based on the notion that the disposition towards effortful self-regulation stems from genetic and biological factors, and is strongly shaped by a child's socialization and cultural experiences (Zhou, Lengua, & Wang, 2009). One of the main tenants in temperament-based theories of self-regulation is that effortful control protects against heightened physiological and affective reactivity (for review, see Eisenberg et al., 2004). Three aspects of effortful control may account for this protective effect: attention control, inhibitory control, and activation control. The ability to maintain and shift attentional focus contributes to the processing of information, and the ability to disengage from affect-eliciting events (e.g., distracting oneself from an event that elicits frustration). Alternatively, inhibitory control could mitigate reactivity by inhibiting dominant behavioral response in situations that call for it (e.g., preventing oneself from responding aggressively when angered). Activation control may underlie affective regulation by allowing individuals to behave in ways that dampen reactivity directly (e.g., going for a walk to reduce stress from an event; Rothbart, 2007).

Individual differences in effortful control (specifically attention regulation) are found early on in life (i.e., in one-year-old infants; Rothbart, 2007). Effortful control is theorized to dramatically increase in preschool ages, continues to grow during middle childhood, substantially develops in adolescence, and becomes relatively stable in adulthood (e.g., Eisenberg et al., 2004; Kochanska, Murray, & Harlan, 2000; Lengua, 2006), with researchers comparing its stability to IQ (Kochanska & Knaack, 2003). Despite the abundance of research on effortful control in childhood and adolescence, there is a dearth of studies that have explored the construct in adulthood and old age. There are several possible reasons for this, including (1) an emphasis on other self-regulatory constructs like self-control and executive functioning (Bridgett, Burt, Edwards, & Deater-Deckard, 2015) in adults, and (2) the premise that temperamental self-regulation (i.e., effortful control) is subsumed under personality facets of neuroticism and conscientiousness (Muris, 2006; Eisenberg, Duckworth, Spinrad, & Valiente, 2014). Thus, neuroticism and conscientiousness will be included as covariates in all analyses.

Consistent evidence has shown that effortful control plays an important role in the regulation of social and affective processes across the lifespan. Greater effortful control has been linked to enhanced social competence and relationships in children (e.g., Eisenberg et al., 1997; Busch & Hoffer, 2012), and poorer effortful control has shown associations with depression, anxiety, and substance abuse in children (e.g., Muris et al., 2008; Gulley et al., 2016). Importantly, effortful control has shown strong relations to negative affect and stressful events (Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013). For example, results from a laboratory stressor study showed that those reporting greater effortful control exhibited stronger vagal control (via heart-rate variability) at rest and after the stressor and reported lower negative affect during the stressor (Spangler & Friedman, 2015).

Despite the abundance of research studies on effortful control, few studies have examined effortful control processes in the context of daily life. The only study to date examined whether self-control (that included effortful control in the composite) predicted adolescents' exposure and reactivity to daily stress across 14 days (Galla & Wood, 2015). These researchers found that adolescents with greater self-control reported less exposure to daily stressors, but no effect of self-control on emotional reactivity to stressors. Still, accumulated empirical evidence from the childhood and adolescence literature links effortful control to adaptive functioning in several domains (Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003), suggesting effortful control may exert its influence on development through exposure/engagement with and emotional reactivity/responsiveness to daily negative and positive events, respectively.

Similarities and Differences between Mindfulness and Effortful Control

Mindfulness and effortful control overlap in various ways. At the neurobiological level, both self-regulatory factors have been associated with activity and functional connectivity in the dorsal Anterior cingulate cortex (dACC) and the dorsolateral prefrontal cortex (dlPFC; Posner, 2012; Tomasino & Fabbro, 2016). Both factors have also been linked to overlapping facets of executive functioning such as attentional control (Lyvers, Makin, Toms, Thorberg, & Samios, 2014; Bridgett et al., 2013). Overall, mindfulness and effortful control are associated with less antisocial and aggressive behaviors (Wang, Chassin, Eisenberg, & Spinrad, 2015; Heppner, Kernis, Lakey, Campbell, Goldman, Davis, & Cascio, 2008), as well as dampened emotional reactions to negative stimuli and stressful events (Bridgett et al., 2013; Feldman et al., 2016).

The differences between effortful control and mindfulness is most evident when considering the focus of each self-regulatory facet. Effortful control is outwardly directed, whereas mindfulness is inwardly directed. For example, effortful control emphasizes the inhibition of dominant behavioral responses and promotion of subdominant behavioral responses in contextually appropriate ways (Rothbart, 2007; Eisenberg et al., 2004). Mindfulness does not focus on altering behavioral responses in context, insomuch as it denotes a capacity to maintain balance in nervous system activity, cognition, and affect when exposed to aversive contexts (Creswell & Lindsay, 2014). Effortful control may therefore be more relevant for exposure/engagement with everyday events, whereas mindfulness may play a greater role in buffering against stressor-related changes in emotion.

Daily Exposure to/Engagement with Negative and Positive Events, Affect, Reactivity, and Responsiveness

Daily stressors such as conflict with friends or family, or receiving negative results at the doctor's office may seem benign. However, considerable evidence shows that the regularity and cumulative effect of stressful daily experiences may negatively impact psychological well-being and distress as much as major life events (for review, see Zautra, 2003). Unexpected everyday occurrences, like getting a flat tire on your way home from work, as well as chronic stressors like divorce or unemployment, can also impact physical health. Exposure to minor stressors can contribute to poorer health via bodily inflammation when such events are frequent enough, or when stress responses are strong enough (e.g., Smyth, Zawadzki, & Gerin, 2013). For example, middle-aged adults and adolescents who reported fewer daily hassles (compared to those reporting more frequent stressors) showed lower levels of inflammation (e.g., interleukin [IL]-6; Gouin et al., 2012; Fuligni et al., 2009). In one study, middle-aged adults who reported more daily stressors than others (at the between-person level) showed a steeper diurnal cortisol slope, and experiencing a stressor during a day (compared to stressor-free days) was linked to greater total cortisol output, independent of negative affect (Stawski et al., 2013). Daily stressors are therefore an important unit of analysis when examining factors that contribute to healthy aging.

The strength of daily diary studies and other intensive repeated-measures methods is their utility when investigating within-person relations of events and affect across time. Affect broadly refers to numerous states, including emotions, feelings, and mood, that include both negative and positive dimensions of physiological and psychological responses (Gyurak, Gross, & Etkin, 2011). In contrast to negative and positive affect being considered opposite ends of a single continuum, a two-dimensional model has become widely accepted (Watson & Tellegan, 1985). Positive and negative affect are both experienced in stressful situations (Folkman & Moskowitz, 2000), and it has been theorized that the capacity to experience both independently underlies wellbeing and health (Zautra, 2003). In this thesis, I refer to affect and emotion, affective and emotional reactivity interchangeably.

As Bolger and Zuckerman (1995) pointed out in their seminal work, it is valuable to examine how person-level variables (like neuroticism) contribute to differences in exposure (i.e., frequency) and reactivity to stressors in daily life. Numerous factors, ranging from personality and social support to socioeconomic status are associated with affective reactivity (Almeida, 2005), which is defined as "…the magnitude of a person's change in affect on days when stressors occurred, compared with his or her stressor-free days. (Sin, Graham-Engeland, Ong & Almeida, p. 1155, 2015)". Other researchers who have included positive events in the study of daily life have similarly defined emotional reactivity as event-related changes in emotion from non-event days to event-days (Infurna, Rivers, Zautra, & Reich, 2015). Overall, greater emotional reactivity to stressors has been associated with mental health disorders (Charles et al., 2013), sleep disturbances (O'Leary, Small, Panaite, Bylsma, & Rottenberg, 2017), inflammation (Sin et al., 2015), onset of chronic illness (Piazza et al., 2013), and increased mortality risk (Mroczek et al., 2013), especially for individuals with chronic illness (Chiang et al., 2018).

It is equally important to examine how person-level variables contribute to differences in reported and responsiveness to daily positive events. Researchers have begun to infuse diary process methods to include positive events and affect, highlighting considerable implications for theory and research (Zautra, Affleck, Tennen, Reich, & Davis, 2005). Conceptually, this framework differentiates between *exposure to* stressors and *engagement with* positive events, as well as affective *reactivity to* stressors and *responsiveness to* positive events. Daily positive events are considered favorable or desirable events, like spending time in nature or sharing a meal with a friend, that reflect a person's transactions with their external environment (Zautra et al., 2005). Broadly, those who report a higher frequency of daily positive events also report more positive affect (Zautra et al., 2005), better sleep quality (Sin, Almeida, Crain, Kossek, Berkman, & Buxton, 2017), better health behaviors and less inflammation (Bajaj et al., 2016; Sin et al., 2015). In a recent study, middle-aged adults who reported more daily positive events than others showed a steeper diurnal cortisol slope, and experiencing a positive event in the morning (but not the prior afternoon/evening/night) was linked to steeper diurnal cortisol slope across that day, independent of positive affect (Sin, Ong, Stawski, & Almeida, 2017). Daily positive events are therefore an important unit of analysis when examining factors that contribute to healthy aging.

This dynamic, two-dimensional approach to the study of emotions, events, and wellbeing in everyday life lends itself to the study of the self-regulation factors of interest in this study. Intervention studies indicate that mindfulness training may promote wellbeing through increases in daily positive affective experiences (e.g., Garland, Geschwind, Peeters, & Wichers, 2015), and diary studies suggest that more mindful individuals report higher daily positive affect (Brockman, Ciarrochi, Parker, & Kashdan, 2016). Therefore, in addition to preserving positive affect when stressors occur, a mindful disposition may contribute to daily well-being through more frequent engagement with positive events. Furthermore, theoretical reasoning (e.g., Evans & Rothbart, 2007; Eisenberg et al., 2004) proposes that individual differences in effortful control may relate to reports of and responsiveness to positive events.

In summary, emerging research and theory posits that mindfulness and effortful control uniquely influence regulation of emotion and events in daily life (Donald et al., 2016; Dixon & Overall, 2016; Evans & Rothbart, 2007; Spangler & Friedman, 2015). Mindfulness has shown cross-sectional, longitudinal, and within-person associations with greater positive affect and lower perceived stress, while participation in mindfulness programs is associated with increases in positive states of mind and reductions in stress (Weinstein et al., 2009; Bränström et al, 2010). Similarly, effortful control is associated with reduced negative affect and less exposure to stressful events (Bridgett et al., 2013; Galla & Wood, 2015), and is theorized to underlie deliberate behavioral engagement with positive events (Hopko, Ryba, McIndoo, & File, 2015). Nonetheless, the associations of these self-regulatory with daily stressors and positive events and emotional reactivity/ responsiveness to those events has yet to be examined. Moreover, these emotional dynamics have not been studied in healthy middle-aged adults. This study addresses these limitations using a daily-diary design, a research methodology that permits for examining these processes, to advance understanding of how mindfulness and effortful control influence daily well-being and emotion regulation to everyday events in adulthood. This study goes a step further by also exploring whether the pattern of results varies across interpersonal and non-interpersonal events. Few studies examining reactivity and responsiveness to daily events have incorporated this comparison. It is possible that individuals emotionally respond to an event with friends, family, or a spouse differently than events with work, finances, and health (Machell, Kashdan, Short, & Nezlek, 2014).

Current Study

Despite the conceptual overlap, implications, and potential role of mindfulness and effortful control in exposure and affective reactivity to daily stressors and engagement and responsiveness to positive events, few studies have simultaneously examined whether and how these facets of self-regulation shape the course of daily life. Empirical research that examines the interplay among mindfulness and effortful control will promote better understanding of how self-regulatory variables have the potential to differentially impact exposure/engagement and emotional reactivity/responsiveness to both stressful and positive experiences. Effortful control is thought to arise in situations when individuals must resolve conflict, correct errors, and plan and execute new actions (Rothbart, 2007). This self-regulatory facet describes an attentive, non-reactive awareness of one's own behavior in the moment that is differentiated from less voluntary, reactive control-based processes (e.g., Eisenberg et al., 2004), which resembles mindfulness' description as an attentive, nonreactive awareness of one's own thoughts and emotions in the moment (see above). Both constructs are, thus, relevant in the study of exposure/engagement to events and subsequent emotional reactions/responses.

Research Questions:

R1: Are mindfulness and effortful control associated with mean levels of and variability in daily positive and negative affect?

R2: Are mindfulness and effortful control associated with the likelihood of reporting a positive event or stressor on any given day?

R3: Are mindfulness and effortful control associated with changes in affect as a function of daily negative (i.e., stressful) and positive (i.e., enjoyable) events?

Hypotheses.

H1: Correlations will indicate that higher scores on mindfulness and effortful control will be uniquely associated with lower levels of negative affect and higher levels of positive affect, along with lower variability (i.e., standard deviation) in well-being (positive and negative affect).

H2: Estimating the likelihood of experiencing each type of event, mindfulness will be associated with a decreased likelihood of reporting a daily negative event, but not an increased likelihood of reporting a daily positive event. Alternatively, effortful control will be associated with both a decreased likelihood of reporting a negative event and an increased likelihood of reporting a positive event.

H3: Mindfulness will significantly predict within-person daily negative event affect, such that reporting higher scores on mindfulness will be associated with weaker decreases in positive affect on stressful-event days compared to no-event days, and weaker increases in negative affect on stressful-event days compared to no-event days. Effortful control will significantly predict within-person daily negative event affect, such that reporting higher scores on effortful control will be associated with weaker increases in negative affect on stressful-event days compared to no-event days.

H4: Both mindfulness and effortful control will significantly predict within-person daily positive event affect, such that reporting higher scores on mindfulness and effortful control, respectively, will be associated with weaker increases in positive affect on positive-event days compared to no-event days.

METHODS

Participants and Procedures

This thesis used data from the ASU Live Project, a large study of middle-aged residents (ages 40-65) in the Phoenix metropolitan area (n=800) that focused on identifying individual, familial, and community factors associated with mental and physical health and resilience (Resilience Processes in Individuals and Communities: R01 AG26006). Of the 800 participants who were recruited through purposive sampling strategies, 782 completed the initial component of the study that involved self-report questionnaires related to family history, personality, traumatic and stressful events, as well as physical and mental health. The study was multi-modal, with a randomly selected quarter of the sample completing a laboratory-stressor task, and another randomly selected quarter completing daily diaries across 30 days (for description of daily diary procedures, see Infurna et al., 2015).

The specific data used for this examination is based on a subsample (n=191) of participants that completed daily diaries (*M* = 26) and provided self-report questionnaire data on the variables of interest (Mindfulness, Effortful Control, Daily Events, & Daily Positive and Negative Affect). Diary reports were meant to collect accounts of participants' daily life events near in time to events as they occurred, and were collected through PC tablets given to participants that were pre-loaded with questions related to affect and the days' most negative and positive event. They were instructed to complete a diary entry each evening 30 minutes before going to sleep. Participants averaged 54 years of age (SD=7.45), 54% were women, and 75% attended some college.

Measures: One-time questionnaire at baseline

Mindfulness. Mindfulness was measured using the Non-Reactivity subscale from the Self-Compassion Questionnaire (Neff, 2003), which has shown to be a unique predictor of psychological well-being (Muris & Petrocchi, 2017). Items consisted of 4 statements: participants indicated how often he or she participated in the activity (e.g., "When something upsets me I try to keep my emotions in balance") on a 5-point Likert scale (1=almost never; 5=almost always; *M* = 3.80, *SD* = 0.81; α=.85).

Effortful Control (EC). Scores on the attentional control, inhibitory control, and activation control subscales from the Adult Temperament Questionnaire (Evans & Rothbart, 2007) were averaged to calculate EC. The scale consisted of 19 items:

participants indicated how true the statement was of him or her on a 7-point Likert scale (1=extremely false; 7=extremely true). Necessary items were recoded to reflect greater effortful control with higher scores (M = 4.96, SD = 0.78; α=.80).

Personality. Conscientiousness and Neuroticism were measured with subscales from a Big Five questionnaire developed for use with English and Spanish-speaking populations (Benet-Martinez & John, 1998). Conscientiousness consisted of 9 items (e.g., "Does a thorough job?") and neuroticism consisted of 8 items (e.g., "Can be tense?"), which were re-coded when necessary. Participants indicated the extent to which they agreed the statement reflected themselves on a 5-point Likert scale (1=disagree strongly; 5=agree strongly). Internal consistency for conscientiousness (α=.78) and neuroticism (α=.80) were both good.

Measures: Daily Diary

Positive and Negative Affect. Each day, participants completed the positive and negative affect schedule (PANAS), which totaled 32 items (Watson and Tellegen, 1988). The Positive Affect scale consisted of 16 items that measured a general dimension of positive affective states like feeling happy, relaxed, cheerful, and calm. The Negative Affect scale included 16 items that assessed a general dimension of negative affective states such as feeling sad, hostile, and distressed. Participants reported how often they had felt this way during the past 24 hours on a 5-point scale that ranged from 1 (*very slightly/not at all*) to 5 (*extremely*). As with prior daily diary literature (Gunaydin et al., 2016; Leger et al., 2016), well-being is defined as levels of positive or negative affect on days when no positive or negative event was reported, while emotional reactivity/responsiveness is defined as changes in positive or negative affect on days when positive or negative events were reported.

Positive and Negative Daily Events. Each night, prior to going to sleep, participants responded on tablets to questions regarding daily positive and negative events. The specific wording for daily positive events was, "*Think of the <u>most positive</u> event that occurred today, even if it may not have been too positive. Which category was this event in?*" The wording for negative events was, "*Think of the <u>most stressful</u> event that occurred today, even if it may not have been too stressful. Which category was this event in?*" The categories for both type of events were spouse/partner, family, friends, work, finances, health, other, and positive/stressful event. Two dichotomous variables were created from these items, one for positive events and one for negative events, to indicate whether participants reported a negative/positive event during the given day. If participants indicated a positive or negative event in the domains of spouse/partner, family, friends, work, finances, health, or other, then the positive/negative dichotomous variable was coded as 1, with a 0 for days indicative of no positive/negative event. A negative event was reported on 60% of days and a positive event was reported on 80% of the days. Table 1 provides descriptive information on the frequency of negative and positive daily events by event domain. Individuals, on average, reported a negative event on 16.71 of the diary days (SD = 10.74) and, on average, reported a positive event on 21.67 of the diary days (SD = 11.41).

Analytic Plan

In a first step, data from the 30-day daily diaries will be used to create two aggregate measures of both positive and negative affect, namely a mean and standard deviation. Mean scores represent one's overall levels of positive and negative affect across the 30 days of assessments, whereas standard deviation scores represent one's fluctuations in negative affect and positive affect across the 30 days. Pearson Correlations will be utilized to assess relations between each self-regulatory factor and mean levels of and variability in daily positive and negative affect.

The second set of analyses focus on the extent to which each self-regulatory factor was associated with differences in reports of daily positive and negative events. That is, the goal was to determine whether effortful control or mindfulness increases or decreases one's likelihood of experiencing a positive or negative event on any given day. To do this, I utilized a multilevel binomial logistic regression models so that the log odds of the probability of reporting a negative or positive event were modeled as the outcome and self-regulatory variables were separately included as person-level predictors, while accounting for average negative event exposure or positive event engagement, respectively. Models were estimated using SAS (Version 9.4) PROC GLIMMIX following procedures by Ene, Leighton, Blue, and Bell (2015).

In the third set of analyses, I used multilevel linear regression models to assess whether self-regulatory variables moderated emotional reactivity/responsiveness to daily negative and positive events, respectively. All models were estimated using SAS

(Version 9.4) PROC MIXED, which accommodates for incomplete data using missing at random assumptions at the within- and between-person levels. Consistent with multilevel modeling procedures, individual-specific intercepts and slopes (βs from the Level 1 model) were modeled at Level 2 with between-person differences estimated (i.e., variance parameters) assuming normal distributions, correlations with each other, and uncorrelated residual errors, e_{ti}. Full information likelihood estimation (FIML) was used to estimate regression coefficients (i.e., fixed) and variance (i.e., random) parameters for two reasons: (1) the current sample was large and (2) FIML is necessary to compare fixed and random parameter estimates across nested models using log likelihood tests (Peugh, 2010). All multilevel models were computed with denominator degrees of freedom set at between-within and an autoregressive (1) covariance structure to account for autocorrelated residuals from equally spaced observations inherent in daily diary designs. Simulation studies have shown that in intensive longitudinal data with 20-40 observations per cluster (as with the current sample data), autoregressive (1) structures are preferable (i.e., provides less biased random intercept estimates and fixed effect standard error estimates) to unstructured covariance structures (Jahng & Wood, 2017). Intercepts and both daily event slopes were set to vary randomly across clusters (i.e., individuals) for two reasons: (1) increase generalizability of results and (2) convergence criteria could not be met without these random effects.

Before proceeding with multilevel models, interclass correlations (ICCs) were computed to assess the degree of within-person (i.e., Level 1) and between-person (i.e., Level 2) variation in each outcome. Results indicated 67% of the variance in positive affect and 57% of the variance in negative affect occurred at Level 2, suggesting that multilevel analyses of this nested data (i.e., daily observations nested within individuals) was appropriate. Based on prior work (e.g., Gunaydin et al., 2016; Leger et al., 2016), the following two-level model was used to estimate daily negative affect:

Level 1: $\text{Negative Affect}_{ti} = \beta_{0i} + \beta_{1i}(\text{Negative Event}_{ti}) + \beta_{2i}(\text{Positive Event}_{ti}) + e_{ti}$

Level 2: $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Average Negative Events}_{i}) + \gamma_{02}(\text{Average Positive Events}_{i}) + r_{0i}$

$$\beta_{1i} = \gamma_{10} + r_{1i}$$

$$\beta_{2i} = \gamma_{20} + r_{2i}$$

At Level 1, β_{0i} is the intercept and reflects negative affect (NA) experienced on a day when a participant reported no negative or positive event. Negative Event was a dichotomously coded as 0 (when no negative event was experienced) or 1 (when at least one negative event was experienced). Thus, β_{1i} is a within-person affective reactivity slope reflecting the difference in a participant's NA on days when at least one negative event was experienced to days when no negative event was experienced. Positive Event was also dichotomously coded, so its coefficient, β_{2i}, is a within-person affective responsiveness slope reflecting the difference in a participant's NA on days when at least one positive event was experienced to days when no positive event was experienced. The residual error term, e_{ti}, reflects a participant's deviation from his/her average NA. At Level 2, γ_{00}, γ_{10}, and γ_{20}, reflect the sample average of NA on no-negative event days, NA reactivity to negative events, and NA responsiveness to positive events, respectively. Moreover, γ_{01}, reflects the association between person-sum frequency of negative event exposure and NA, and γ_{02}, reflects the association between person-sum frequency of positive event engagement and NA. These terms were included to control for between-person differences in negative and positive event exposure/engagement. The error terms, r_{0i}, r_{1i}, and r_{2i} reflect deviations from the sample's average NA, average NA reactivity slopes, and average NA responsiveness slopes, respectively. Daily positive affect (PA) reactivity and responsiveness were estimated in the exact same way except the outcome variable was PA.

To assess whether self-regulatory factors (mindfulness or effortful control) were associated with affective reactivity/responsiveness, I entered each separately into the model as a predictor of β_{0i} (estimating the main association of self-regulation variable with daily affect), β_{1i}, (estimating the interaction of negative event exposure and self-regulation variable), and β_{2i}, (estimating the interaction of positive event engagement and self-regulation variable). The Level 1 equation was the same as above and the Level 2 equation were:

Level 2: $\beta_{0i} = \gamma_{00} + \gamma_{01}$ (Average Negative Events$_i$) + γ_{02} (Average Positive Events$_i$) + r_{0i}

$$\beta_{1i} = \gamma_{10} + \gamma_{11} \text{ (Self-Regulation Factor)} + r_{1i}$$

$$\beta_{2i} = \gamma_{20} + \gamma_{21} \text{ (Self-Regulation Factor)} + r_{2i}$$

In the above model, γ_{11} and γ_{21} reflect change in affective reactivity to negative events and affective responsiveness to positive events, respectively, associated with a one unit increase in a self-regulatory factor.

Next, I assessed whether the association between each self-regulation factor and affective reactivity/responsiveness holds after controlling for other individual difference factors associated with daily affect. Consistent with previous work (Leger et al., 2016; Gunaydin et al., 2016), in separate analyses I replaced self-regulation factors in the above Level 2 equations with each of the other individual difference variables (age, gender, education, income, neuroticism, and conscientiousness) to test whether they predicted affective reactivity/responsiveness slopes. Then, I computed four final models, one for daily NA and one for daily PA, for each self-regulatory factor. The final models included all significant Level 1, Level 2, and cross-level interactions from previous models. In all multilevel models, Level 2 (person-level) variables were grand-mean centered and robust standard errors were employed to estimate confidence intervals for coefficients. Log likelihood tests were conducted to compare nested models when possible (i.e., when models differed in parameters estimated).

Post-hoc Analyses. In post-hoc analyses, I explored the extent to which each self-regulatory factor was associated with differences in reports of interpersonal and non-interpersonal daily events. That is, the goal was to determine whether effortful control or mindfulness increases or decreases one's likelihood of experiencing an interpersonal or non-interpersonal positive or negative event on any given day. To do this, I utilized a multilevel multinomial logistic regression model so that the log odds of the probability of reporting an interpersonal or non-interpersonal positive or negative event, respectively, were modeled as the outcome. Self-regulatory variables were separately included as person-level predictors. Models were estimated using SAS PROC GLIMMIX. The Daily

Negative Event variable was transformed into one dummy variable coded as 0 (when no negative event was experienced) or 1 (when at least one negative event with spouse/partner friends, and/or family was experienced) or 2 (when at least one negative event with work, finances, health or other was experienced). Daily Positive Event was identically transformed into one dummy variable reflecting no event, interpersonal event, or non-interpersonal event.

In another set of post-hoc analyses, I used multilevel linear regression models to explore whether self-regulatory variable's moderation of affective reactivity/responsiveness to daily negative and positive events differed across interpersonal and non-interpersonal domains. All models were estimated using SAS (Version 9.4) PROC MIXED, with the same model specifications and model-building procedures described above. The Daily Negative Event variable was transformed into two dummy variables: an interpersonal negative event variable dichotomously coded as 0 (when no negative event was experienced) or 1 (when at least one negative event with spouse/partner friends, and/or family was experienced); and, a non-interpersonal negative event variable dichotomously coded as 0 (when no negative event was experienced) or 1 (when at least one negative event with work, finances, health or other was experienced). Daily Positive Event was identically transformed into two dummy variables reflecting interpersonal and non-interpersonal positive events.

Accounting for Skewness. It should be noted that PROC MIXED was employed for all models testing changes in affect as a function of negative or positive events. However, in this data, negative affect (NA) was skewed substantially (M = 1.35; SD =

.49; Skewness = 2.62; Kurtosis = 9.18), suggesting that a gamma response distribution was necessary to account for the non-normality. Thus, all models testing differences in affective reactivity/responsiveness for NA were re-done using PROC GLIMMIX with a gamma distribution (for discussion, see Schilling & Diehl, 2014). Given that the direction and magnitude of effects and probability values across these models were comparable, I present findings from the PROC MIXED models. Positive affect (PA) showed no pronounced non-normality (M = 3.12; SD = .93; Skewness = - 0.14; Kurtosis = - 0.38).

Effect Size Estimation. Effect sizes for daily outcome measures were computed using a proportional reduction of variance measure (PRV). Due to the hierarchical structure of daily diaries, no single effect size measure exists, as changes may not be consistent at Level 1 (i.e., daily) and Level 2 (i.e., individual clusters). PRV measures have been suggested as a suitable representation of effect size (Raudenbush and Bryk, 2002). In the current study, these measures were computed by subtracting the Level 2 variances in an unconditional model (i.e., no predictors specified) for a given outcome variable, and these respective variances in a fully-specified model (Model 1, 2, or 3), then dividing this difference score by the unconditional model variance at Level 2 (Raudenbush and Bryk, 2002). See Tables 3-10 for PRV estimates.

RESULTS

As a first step, I used the 30-day daily diary to create two aggregate measures of both positive affect and negative affect, namely an inter-individual mean (*iMean*) and standard deviation (*iSD*). The *iMean* scores reflects one's overall levels of positive and negative affect and the *iSD* scores represent one's fluctuations in each affect over the course of the daily observations. Table 1 shows descriptive statistics for the variables included in the present study. Correlational analysis suggests that reporting more effortful control was associated with higher overall levels of positive affect ($r = .30$, $p < .01$) and lower levels of daily negative affect ($r = -.30$, $p < .01$), and less variability in positive affect ($r = -.15$, $p < .05$) and negative affect ($r = -.20$, $p < .01$). They also indicated that higher levels of mindfulness were associated with higher overall levels of positive affect ($r = .33$, $p < .01$), lower levels of daily negative affect ($r = -.27$, $p < .01$), and less variability in negative affect ($r = -.22$, $p < .01$). Importantly, correlations revealed that effortful control and mindfulness were positively associated ($r = .38$, p < .01). Regarding demographics, those who were more educated reported greater effortful control ($r = .17$, $p < .05$) and older individuals reported higher levels of positive affect ($r = .20$, $p < .01$). These preliminary results indicate that both self-regulatory variables were generally associated with higher overall levels of and less fluctuations in daily well-being.

Table 1

Descriptive Statistics and Correlations for Key Study Variables

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Effortful Control	4.96	.78	--											
2. Mindfulness	3.80	.81	.38**	--										
3. PA iMean	3.13	.78	.30**	.33**	--									
4. PA iSD	.47	.22	-.15*	-.08	-.17*	_								
5. NA iMean	1.48	.34	-.30**	-.27**	-.25**	.20**	_							
6. NA iSD	.24	.14	-.20**	-.22**	-38**	.49**	.66**	_						
7. Age	53.4	7.43	.11	-.06	.20**	-.05	-.00	-.13.	_					
8. Gender⁺	.46	.5	.04	-.00	.11	-.11	.05	.00	.07	_				
9. Education	6.37	1.87	.17*	-.06	.05	-.12	.04	.03	.15*	-.10	_			
10. Income	6.22	2.91	.13	-.04	.08	-.05	-.13	-.09	-.07	.04	.32**	_		
11. Conscientiousness	35.5	6.17	.58**	.32**	.20**	-.04	-.29**	-.21**	.05	-.05	-.01	.06	_	
12. Neuroticism	21.8	6.43	-.49**	-.42**	-.28**	.15*	.26**	.22**	-.13	-.24**	.06	-.15*	-.28**	_

Note: Scores are based on data diary reports from 184-190 participants.

**: $p < .01$, *: $p < .05$, (2-tailed)

⁺0= Female, 1 = Male

Effortful Control, Mindfulness, and Daily Negative and Positive Events

Table 2 shows the frequency of negative and positive events by specific domains. Table 3 shows results from a set of multilevel binomial analyses examining whether each self-regulatory was separately associated with the likelihood of experiencing a negative or positive event on a given day. Regarding daily negative events, effortful control was associated with a decreased likelihood of reporting a negative daily event (Odds ratio = 0.52, 95%, CI= [0.35, 0.68]), such that a one unit increase in effortful control was associated with a 38% decreased likelihood of reporting a daily negative event on a given day. Similarly, mindfulness was associated with a decreased likelihood of reporting a negative daily event (Odds ratio = 0.56, 95%, CI= [0.41, 0.77]), such that a one unit increase in effortful control was associated with a 34% decreased likelihood of reporting a daily negative event on a given day. Both effortful control and mindfulness, respectively, were not associated with an increased likelihood of reporting a positive event on a given day (see Table 3).

Table 2

Frequency of Negative and Positive Daily Events

	Negative Events		Positive Events	
Event Domain	Observations	%	Observations	%
None	2,011	40	1,074	20
Spouse/partner	390	8	720	14
Family	540	11	1,132	23
Friend	198	4	802	16
Work	777	15	528	11
Finances	311	6	136	3
Health	374	7	199	4
Other	450	9	451	9
Interpersonal Domain				
Interpersonal	1128	23	2654	53
Non-Interpersonal	1912	37	1314	27

Note. N = 189. Total number of observations from diaries was 4977.

Table 3

Self-Regulatory Factors Associated with Likelihood of Reporting a Daily Negative and Positive Event

	Negative Events		Positive Events	
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Fixed effects				
Effortful Control	0.52** [0.35, 0.68]	0.83* [0.72, 0.97]	1.39 [0.88, 2.19]	1.11 [0.86, 1.4]
Average Negative Events	--	1.15** [1.1, 1.2]	--	--
Average Positive Events	--	--	--	0.86** [0.85, 0.88]
Mindfulness	0.56** [0.41, 0.77]	0.83** [0.7, 0.96]	1.01 [0.65, 1.54]	1.07 [0.80, 1.4]
Average Negative Events	--	1.15** [1.1, 1.2]	--	--
Average Positive Events	--	--	--	0.86** [0.85, 0.88]

Note. $^{*}p < .05$, $^{**}p < .01$, $^{+} < .10$

Self-Regulatory Factors, Negative Affect Reactivity and Responsiveness to Daily Events

Table 4 and 5 show results from a series of multilevel linear regression models that examined whether each self-regulatory factor moderated NA reactivity to daily stressors and NA responsiveness to daily positive events. Model 1 revealed that experiencing a negative event was associated with an increase in NA ($\gamma_{10} = 0.15$, $p < 0.01$, 95% CI = [0.13, 0.20]) and experiencing a positive event was associated with a decrease in NA ($\gamma_{20} = -0.10$, $p < 0.01$, 95% CI = [-0.15, -0.06]). At Level 2, average negative event exposure was positively associated with NA ($\gamma_{01} = 0.01$, $p < 0.01$, 95% CI = [0.01, 0.02]) and average positive event engagement was negatively associated with NA ($\gamma_{02} = -0.01$, $p < 0.01$, 95% CI = [-0.01, -0.003]), suggesting that individuals who experienced a greater number of stressors and few number of positive events experienced higher levels of NA.

Table 4

Multilevel Models predicting Mean Daily Negative Affect, Affective Reactivity to Negative Events and Affective Responsiveness to Positive Events: The Role of Effortful Control Across Interpersonal and Non-Interpersonal Domains

	Model 1	Model 2	Model 4	Model 5
Predictors	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept, γ_{00}	1.35** (0.03)	1.35** (0.03)	1.35** (0.03)	1.35** (0.03)
Average Negative Events (NE), γ_{01}	0.01** (0.01)	0.01* (0.01)	0.01* (0.01)	0.01* (0.01)
Average Positive Events (PE), γ_{02}	-0.01** (0.01)	-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)
Effortful Control, γ_{03}	--	-0.17** (0.04)	--	-0.17** (0.04)
General Events				
Daily NE, γ_{10}	0.15** (0.01)	0.15** (0.01)	--	--
X Effortful Control, γ_{11}	--	-0.02 (0.02)	--	--
Daily PE, γ_{20}	-0.10** (0.02)	-0.10** (0.02)	--	--
X Effortful Control, γ_{21}	--	0.06** (0.02)	--	--
Domain-Specific Events				
Interpersonal NE, γ_{10}	--	--	0.16** (0.02)	0.16** (0.02)
X Effortful Control, γ_{11}	--	--	--	-0.05* (0.02)
Non-Interpersonal NE, γ_{20}	--	--	0.14** (0.01)	0.14** (0.01)
X Effortful Control, γ_{21}	--	--	--	-0.01 (0.02)
Interpersonal PE, γ_{30}	--	--	-0.10** (0.02)	-0.10** (0.02)
X Effortful Control, γ_{31}	--	--	--	0.07** (0.02)
Non-Interpersonal PE, γ_{40}	--	--	-0.10** (0.02)	-0.10** (0.02)
X Effortful Control, γ_{41}	--	--	--	0.06* (0.02)
Random Effects				
Intercept	0.12** (0.01)	0.10** (0.01)	0.12** (0.01)	0.10** (0.01)
AR (1)	0.27** (0.08)	0.27** (0.08)	0.27** (0.05)	0.27** (0.05)
Residual	0.09** (0.01)	0.09** (0.01)	0.09** (0.01)	0.09** (0.01)
Model Fit & Effect Sizes (PRV L2 & L1)	73%	74%	78%	79%
-2LL	2570.3	2549.8 $^{\chi}$	2556.0	2539.3
BIC	2638.4	2633.6	2644.7	2644.2
Parameters estimated	13	16	15	20

Note. Intraclass correlation (ICC): Negative Affect = .578. $^{\chi}$ = significant log likelihood test, * $p < .05$, ** $p < .01$, $^{+} < .10$

For effortful control models (Table 4), a likelihood ratio test yielded a significant test statistic, χ^2 (3) = 20.5, $p < 0.001$, showing that predicting NA from Model 2 was a better fit to the data than predicting NA with Model 1 (Table 4). Model 2 (from Table 4) shows that effortful control was associated with lower NA ($\gamma_{03} = -0.17$, $p < 0.01$, 95% CI = [-0.20, -0.10]). It also predicted lower NA responsiveness to positive event engagement ($\gamma_{21} = 0.06$, $p < 0.05$, 95% CI = [0.002, 0.11]); individuals high in effortful control experienced smaller declines in NA from a no-positive event day to a day on which they experienced at least one positive event.

Table 5

Multilevel Models predicting Mean Daily Positive Affect, Affective Reactivity to Negative Events and Affective Responsiveness to Positive Events: The Role of Effortful Control Across Interpersonal and Non-Interpersonal Domains

	Model 1	Model 2	Model 4	Model 5
Predictors	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept, γ_{00}	2.98** (0.06)	2.97** (0.05)	2.98** (0.06)	2.97** (0.05)
Average Negative Events (NE), γ_{01}	-0.05** (0.01)	-0.03** (0.01)	-0.04** (0.01)	-0.03** (0.01)
Average Positive Events (PE), γ_{02}	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)
Effortful Control, γ_{03}	--	0.34** (.07)	--	0.34** (0.07)
General Events				
Daily NE, γ_{10}	-0.19** (0.03)	-0.18** (0.04)	--	--
X Effortful Control, γ_{11}	--	-0.01 (0.03)	--	--
Daily PE, γ_{20}	0.35** (0.03)	0.36** (0.03)	--	--
X Effortful Control, γ_{21}	--	-0.11** (0.04)	--	--
Domain-Specific Events				
Interpersonal NE, γ_{10}	--	--	-0.17** (0.03)	-0.16** (0.03)
X Effortful Control, γ_{11}	--	--	--	0.03 (0.04)
Non-Interpersonal NE, γ_{20}	--	--	-0.19** (0.03)	-0.19** (0.03)
X Effortful Control, γ_{21}	--	--	--	-0.04 (0.04)
Interpersonal PE, γ_{30}	--	--	0.35** (0.03)	0.35** (0.03)
X Effortful Control, γ_{31}	--	--	--	-0.15** (0.04)
Non-Interpersonal PE, γ_{40}	--	--	0.34** (0.04)	0.36** (0.03)
X Effortful Control, γ_{41}	--	--	--	-0.05 (0.04)
Random Effects				
Intercept	0.50** (0.02)	0.43** (0.02)	0.50** (0.01)	0.43** (0.01)
AR (1)	0.29* (0.08)	0.29* (0.08)	0.28** (0.05)	0.28** (0.05)
Residual	0.24** (0.01)	0.24** (0.01)	0.24** (0.01)	0.24** (0.01)
Model Fit & Effect Sizes (PRV L2 & L1)	62%	66%	74%	76%
-2LL	7537.6	7515.7 $^{\chi}$	7536.0	7490.7 $^{\chi}$
BIC	7605.8	7599.5	7614.6	7595.5
Parameters estimated	13	16	15	20

Note. Intraclass correlation (ICC): Positive Affect = .676. $^{\chi}$ = significant log likelihood test, * $p < .05$, ** $p < .01$

For mindfulness models (see Table 5), a likelihood ratio test yielded a significant test statistic, χ^2 (3) = 19.4, $p < 0.001$, showing that predicting NA from Model 2 was a better fit to the data than predicting NA with Model 1 (Table 6). Model 2 (from Table 6) shows that mindfulness was similarly associated with lower NA (γ_{03} = -0.16, $p < 0.01$, 95% CI = [-0.20, -0.10]), and also predicted lower NA responsiveness to positive event engagement (γ_{21} = 0.06, $p < 0.01$, 95% CI = [0.03, 0.13]), such that individuals high in mindfulness experienced smaller declines in NA from a no-positive event day to a day on which they experienced at least one positive event. Neither effortful control nor mindfulness predicted NA reactivity to daily stressors (all *ps* > 0.10).

Model 3 tested whether these results held after controlling for significant covariates. Likelihood ratio tests indicated that for effortful control models, Model 3 fit the data better than Model 2, χ^2 (3) = 44.3, $p < 0.001$. Regarding mindfulness models, Model 3 fit the data better than Model 2, χ^2 (3) = 49.4, $p < 0.001$. Model 3 (for effortful control and mindfulness, respectively) included average negative events, daily negative event, average positive events, daily positive event, neuroticism, and conscientiousness as predictors of the intercept (i.e., average NA); and effortful control (or mindfulness) as predictors of NA responsiveness to positive events, and gender as a predictor of NA reactivity to negative events. In these final models, both effortful control (γ_{21} = 0.06, $p < 0.05$, 95% CI = [0.01, 0.11]) and mindfulness (γ_{21} = 0.06, $p < 0.01$, 95% CI = [0.03, 0.13]), respectively, were still associated with lower NA responsiveness to positive events. These results are graphically illustrated in Figures 1 and 2. Simple slope analyses indicated that individuals with higher effortful control had smaller decreases in NA on days when positive events occurred (1-SD above mean: Est. -0.05, p <.05), compared to those with lower effortful control (1-SD below mean: Est. -0.15, p <.01), with slopes significant for 87% of the sample. Individuals with higher mindfulness had smaller decreases in NA on days when positive events occurred (1-SD above mean: Est. -0.05, p >.01), compared to those with lower mindfulness (1-SD below mean: Est. -0.15, p <.01), with slopes significant for 89% of the sample.

Figure 1: Negative Affective Responsiveness: Effortful Control

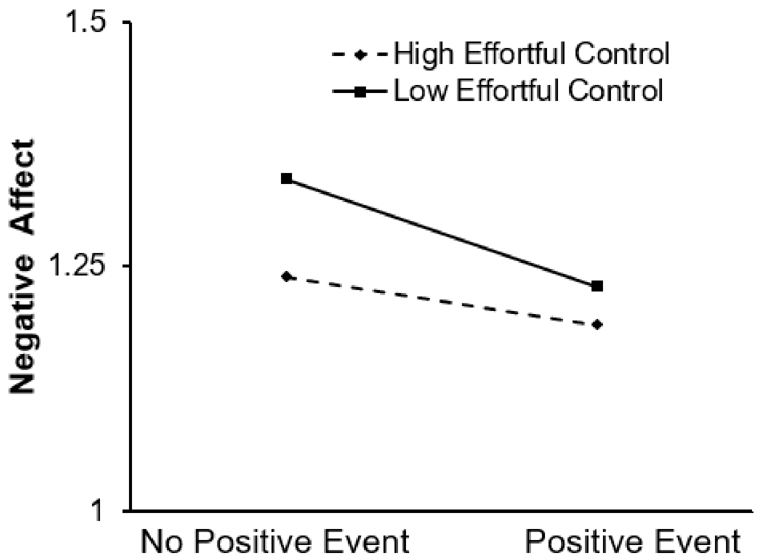
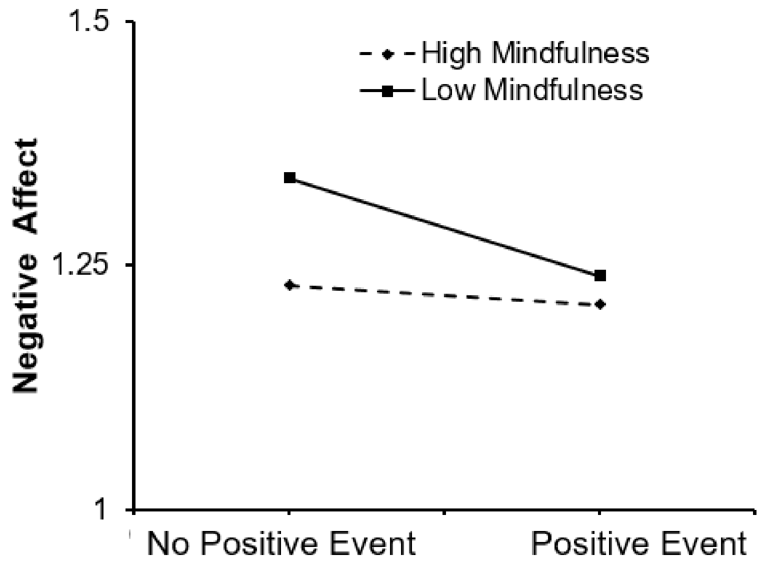


Figure 2: Negative Affective Responsiveness: Mindfulness



Self-Regulatory Factors, Positive Affect Reactivity and Responsiveness to Daily Events

Table 6 and 7 show results from a series of multilevel linear regression models that examined whether each self-regulatory factor moderated PA reactivity to daily stressors and PA responsiveness to daily positive events. Model 1 revealed that experiencing a negative event was associated with a decrease in PA (γ_{10} = -0.19, $p < 0.01$, 95% CI = [-0.28, -0.11]) and experiencing a positive event was associated with an increase in PA (γ_{20} = 0.35, $p < 0.01$, 95% CI = [0.35, 0.53]). At Level 2, average negative event exposure was negatively associated with PA (γ_{01} = -0.05, $p < 0.01$, 95% CI = [-0.06, -0.03]) and average positive event engagement was positively associated with PA (γ_{02} = 0.03, $p < 0.01$, 95% CI = [0.02, 0.04]), suggesting that individuals who experienced a fewer number of stressors and greater number of positive events experienced higher levels of PA.

Table 6

Multilevel Models predicting Mean Daily Negative Affect, Affective Reactivity to Negative Events and Affective Responsiveness to Positive Events: The Role of Mindfulness Across Interpersonal and Non-Interpersonal Domains

	Model 1	Model 2	Model 4	Model 5
Predictors	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept, γ_{00}	1.35** (0.03)	1.34** (0.03)	1.35** (0.03)	1.34** (0.03)
Average Negative Events (NE), γ_{01}	0.01** (0.01)	0.01** (0.01)	0.01* (0.01)	0.01** (0.01)
Average Positive Events (PE), γ_{02}	-0.01** (0.01)	-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)
Mindfulness, γ_{03}	--	-0.16** (0.04)	--	-0.16** (0.04)
General Events				
Daily NE, γ_{10}	0.15** (0.01)	0.15** (0.01)	--	--
X Mindfulness, γ_{11}	--	-0.01 (0.02)	--	--
Daily PE, γ_{20}	-0.10** (0.02)	-0.10** (0.02)	--	--
X Mindfulness, γ_{21}	--	0.06** (0.02)	--	--
Domain-Specific Events				
Interpersonal NE, γ_{10}	--	--	0.16** (0.02)	0.16** (0.02)
X Mindfulness, γ_{11}	--	--	--	-0.04 (0.02)
Non-Interpersonal NE, γ_{20}	--	--	0.14** (0.01)	0.14** (0.01)
X Mindfulness, γ_{21}	--	--	--	0.01 (0.02)
Interpersonal PE, γ_{30}	--	--	-0.10** (0.02)	-0.10** (0.02)
X Mindfulness, γ_{31}	--	--	--	0.07** (0.02)
Non-Interpersonal PE, γ_{40}	--	--	-0.10** (0.02)	-0.10** (0.02)
X Mindfulness, γ_{41}	--	--	--	0.07** (0.02)
Random Effects				
Intercept	0.12** (0.01)	0.10** (0.01)	0.12** (0.01)	0.10** (0.01)
AR (1)	0.27** (0.08)	0.27** (0.08)	0.27** (0.05)	0.27** (0.05)
Residual	0.09** (0.01)	0.09** (0.01)	0.09** (0.01)	0.09** (0.01)
Model Fit & Effect Sizes (PRV L2 & L1)	73%	75%	78%	79%
-2LL	2570.3	2550.9 $^{\chi}$	2556.0	2535.7 $^{\chi}$
BIC	2638.4	2634.8	2644.7	2640.6
Parameters estimated	13	16	15	20

Note. Intraclass correlation (ICC): Negative Affect = .578. $^{\chi}$ = significant log likelihood test, * $p < .05$, ** $p < .01$, $^{+} < .10$

For effortful control models, a likelihood ratio test yielded a significant test statistic, χ^2 (3) = 21.9, $p < 0.001$, showing that predicting PA from Model 2 was a better fit to the data than predicting PA with Model 1 (Table 6). Model 2 (from Table 6) shows that effortful control was associated with higher PA ($\gamma_{03} = 0.34$, $p < 0.01$, 95% CI = [0.23, 0.46]). It also predicted lower PA responsiveness to positive event engagement ($\gamma_{21} = -0.11$, $p < 0.01$, 95% CI = [-0.23, -0.006]), such that individuals high in effortful control experienced smaller increases in PA from a no-positive event day to a day on which they experienced at least one positive event (Figure 3).

For mindfulness models, a likelihood ratio test yielded a significant test statistic, χ^2 (3) = 24.2, $p < 0.001$, showing that predicting PA from Model 2 was a better fit to the data than predicting PA with Model 1 (Table 7). Model 2 (from Table 7) shows that mindfulness was similarly associated with higher PA ($\gamma_{03} = 0.34$, $p < 0.01$, 95% CI = [0.24, 0.46]), and also predicted lower PA responsiveness to positive event engagement ($\gamma_{21} = -0.11$, $p < 0.01$, 95% CI = [-0.22, -0.01]); individuals high in mindfulness experienced smaller increases in PA from a no-positive event day to a day on which they experienced at least one positive event (Figure 4). Neither effortful control nor mindfulness predicted PA reactivity to daily stressors (all *ps* > 0.50).

Table 7

Multilevel Models predicting Mean Daily Positive Affect, Affective Reactivity to Negative Events and Affective Responsiveness to Positive Events: The Role of Mindfulness Across Interpersonal and Non-Interpersonal Domains

	Model 1	Model 2	Model 4	Model 5
Predictors	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept, γ_{00}	2.98** (0.06)	2.98** (0.05)	2.98** (0.06)	2.98** (0.05)
Average Negative Events (NE), γ_{01}	-0.05** (0.01)	-0.03** (0.01)	-0.04** (0.01)	-0.03** (0.01)
Average Positive Events (PE), γ_{02}	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)
Mindfulness, γ_{03}	--	0.34** (.07)	--	0.34** (0.07)
General Events				
Daily NE, γ_{10}	-0.19** (0.03)	-0.18** (0.04)	--	--
X Mindfulness, γ_{11}	--	-0.04 (0.03)	--	--
Daily PE, γ_{20}	0.35** (0.03)	0.35** (0.03)	--	--
X Mindfulness, γ_{21}	--	-0.10** (0.04)	--	--
Domain-Specific Events				
Interpersonal NE, γ_{10}	--	--	-0.17** (0.03)	-0.16** (0.03)
X Mindfulness, γ_{11}	--	--	--	0.02 (0.04)
Non-Interpersonal NE, γ_{20}	--	--	-0.19** (0.03)	-0.20** (0.03)
X Mindfulness, γ_{21}	--	--	--	-0.07* (0.03)
Interpersonal PE, γ_{30}	--	--	0.35** (0.03)	0.35** (0.03)
X Mindfulness, γ_{31}	--	--	--	-0.11** (0.04)
Non-Interpersonal PE, γ_{40}	--	--	0.34** (0.04)	0.35** (0.03)
X Mindfulness, γ_{41}	--	--	--	-0.07 (0.04)
Random Effects				
Intercept	0.50** (0.02)	0.43** (0.02)	0.50** (0.01)	0.14** (0.01)
AR (1)	0.29* (0.08)	0.28* (0.08)	0.28** (0.05)	0.28** (0.05)
Residual	0..24** (0.01)	0.24** (0.01)	0.24** (0.01)	0.24** (0.01)
Model Fit & Effect Sizes (PRV L2 & L1)	62%	66%	74%	76%
-2LL	7537.6	7513.4 $^{\chi}$	7536.0	7493.7
BIC	7605.8	7597.2	7614.6	7598.5
Parameters estimated	13	16	15	20

Note. Intraclass correlation (ICC): Positive Affect = .676. $^{\chi}$ = significant log likelihood test, * $p < .05$, ** $p < .01$

Model 3 tested whether these results held after controlling for significant covariates. Likelihood ratio tests indicated that for effortful control models, Model 3 fit the data better than Model 2, χ^2 (3) = 118.5, $p < 0.001$ (Table 6). Regarding mindfulness models, Model 3 fit the data better than Model 2, χ^2 (3) = 119.9, $p < 0.05$. Model 3 (for effortful control and mindfulness, respectively) included average negative events, daily negative event, average positive events, daily positive event, neuroticism, and conscientiousness as predictors of the intercept (i.e., average PA); and effortful control (or mindfulness) as predictors of PA responsiveness to positive events and gender as a predictor of PA reactivity to negative events. In these final models, both effortful control (γ_{21} = -0.12, $p < 0.01$, 95% CI = [-0.24, -0.02]) and mindfulness (γ_{21} = -0.12, $p < 0.01$, 95% CI = [-0.22, -0.02]), respectively, were still associated with lower PA responsiveness to positive events. These results are graphically illustrated in Figures 3 and 4. Simple slope analyses indicated that individuals with higher effortful control had smaller increases in PA on days when positive events occurred (1-SD above mean: Est. 0.26, p <.01), compared to those with lower effortful control (1-SD below mean: Est. 0.44, p <.01), with slopes significant for 98% of the sample. Individuals with higher mindfulness had smaller increases in PA on days when positive events occurred (1-SD above mean: Est. 0.25, p <.01), compared to those with lower mindfulness (1-SD below mean: Est. 0.45, p <.01), with slopes significant for 100% of the sample.

Figure 3: Positive Affective Responsiveness: Effortful Control

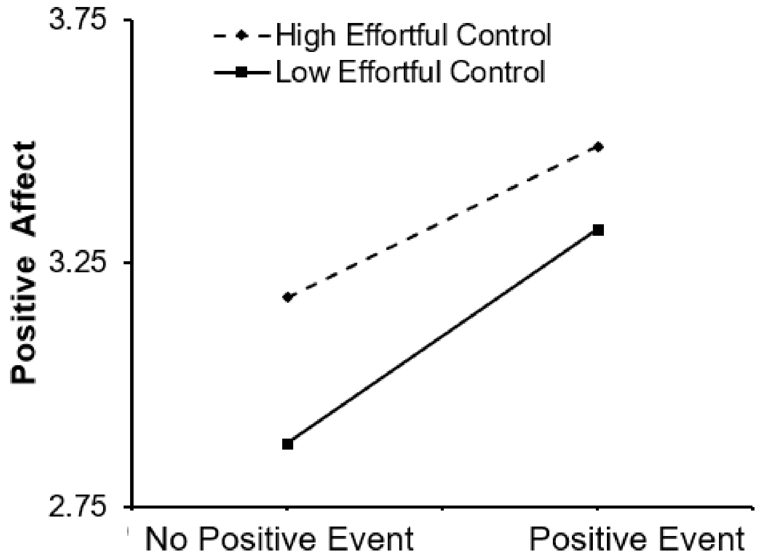
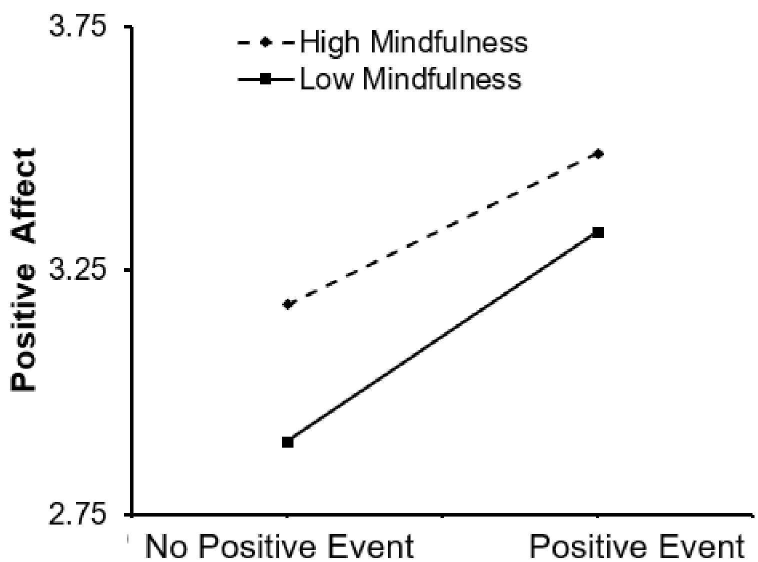


Figure 4: Positive Affective Responsiveness: Mindfulness



Daily Negative and Positive Events: Interpersonal versus Non-Interpersonal Domains

A post-hoc set of multilevel multinomial logistic regression analyses examined whether each self-regulatory factor was separately associated with differences in the likelihood of experiencing an interpersonal versus non-interpersonal event on a given day. Regarding negative events, analyses with effortful control as the Level 2 predictor produced two estimates for the intercept (i.e., one for interpersonal and one for non-interpersonal daily events) and one slope associated with effortful control. This indicates that the value of the effortful control estimate remains constant across logits/intercepts (Ene et al., 2015), suggesting that effortful control is associated with a similar reduced likelihood of experiencing a stressful daily event (Odds ratio = 0.59, CI = 0.46, 0.78, $p < .001$) regardless of domain. A one unit increase in effortful control was associated with a 41% decreased likelihood of reporting a daily negative event on a given day. Analyses with mindfulness as the Level 2 predictor similarly produced two estimates for the intercept and one slope associated with mindfulness, suggesting that mindfulness is associated with a similar reduced likelihood of experiencing a stressful daily event (Odds ratio = 0.69, CI = 0.54, 0.90, $p < .01$) regardless of domain. A one unit increase in effortful control was associated with a 31% decreased likelihood of reporting a daily negative event on a given day.

Regarding positive events, analyses with effortful control as the Level 2 predictor produced two estimates for the intercept (i.e., one for interpersonal and one for non-interpersonal daily events) and one slope associated with effortful control, suggesting that effortful control is associated with a similar reduced likelihood of experiencing a day without a positive event (Odds ratio = 0.77, CI = 0.59, 1.01, $p = .062$) regardless of domain. Specifically, a one unit increase in effortful control was associated with 23% reduced likelihood of reporting a day without a positive event (i.e., associated with a 23% increased likelihood of reporting a positive event). Analyses with mindfulness as the Level 2 predictor also produced two estimates for the intercept and one slope associated with mindfulness. However, mindfulness was not associated with differences in the likelihood of experiencing a positive event across domains (Odds ratio = 0.91, CI = 0.70, 1.17, $p > .50$).

Daily Reactivity and Responsiveness: Interpersonal versus Non-Interpersonal Domains

A post-hoc set of multilevel linear regression analyses examined whether each self-regulatory factor separately moderated reactivity/responsiveness to interpersonal and non-interpersonal stressors and positive events for both NA and PA.

NA Reactivity and Responsiveness. Model 4 (Table 4 and 6) revealed that experiencing an interpersonal ($\gamma_{10} = 0.16$, $p < 0.001$, 95% CI = [0.14, 0.22]) and non-interpersonal negative event ($\gamma_{20} = 0.14$, $p < 0.001$, 95% CI = [0.13, 0.20]) was associated with increases in NA, and experiencing an interpersonal ($\gamma_{30} = -0.10$, $p < 0.001$, 95% CI = [-0.14, -0.06]) and non-interpersonal positive event ($\gamma_{40} = -0.10$, $p < 0.001$, 95% CI = [-0.15, -0.06]) was associated with decreases in NA. At Level 2, average negative event exposure was positively associated with NA ($\gamma_{01} = 0.01$, $p < 0.05$, 95% CI = [0.01, 0.02]) and average positive event engagement was negatively associated with NA (γ_{02} = -0.01, p < 0.05, 95% CI = [-0.01, -0.003]), suggesting that individuals who experienced a greater number of stressors and few number of positive events experienced higher levels of NA.

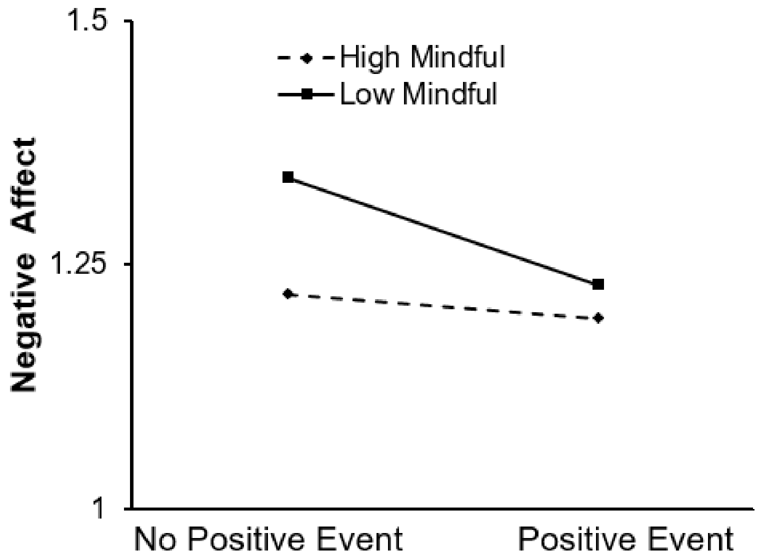
For effortful control models, a likelihood ratio test yielded a significant test statistic, χ^2 (5) = 16.7, $p < 0.01$, showing that predicting NA from Model 5 was a better fit to the data than predicting NA with Model 4 (Table 4). Model 5 (from Table 4) shows that effortful control predicted lower NA reactivity to daily negative interpersonal events (γ_{11} = -0.05, $p < 0.05$, 95% CI = [-0.01, -0.09]); individuals high in effortful control experienced smaller increases in NA from a no-stressor day to a day on which they experienced at least one interpersonal stressor. Effortful control also predicted lower NA responsiveness to daily positive interpersonal (γ_{31} = 0.07, $p < 0.01$, 95% CI = [0.01, 0.11]) and non-interpersonal (γ_{31} = 0.06, $p < 0.05$, 95% CI = [0.01, 0.11]) events; individuals high in effortful control experienced smaller declines in NA from a no-positive event day to a day on which they experienced at least one positive event.

For mindfulness models, a likelihood ratio test yielded a significant test statistic, χ^2 (5) = 20.3, $p < 0.01$, showing that predicting NA from Model 5 was a better fit to the data than predicting NA with Model 4 (Table 7). Model 5 (from Table 6) shows that mindfulness similarly predicted lower NA responsiveness to positive interpersonal (γ_{31} = 0.07, $p < 0.01$, 95% CI = [0.03, 0.12]) and non-interpersonal (γ_{41} = 0.07, $p < 0.01$, 95% CI = [0.03, 0.12]) events; individuals high in mindfulness experienced smaller declines in NA from a no-positive event day to a day on which they experienced at least one positive event. Mindfulness did not predict NA reactivity to daily stressors (p > .07).

For effortful control models, a likelihood ratio test yielded a significant test statistic, χ^2 (4) = 51.5, $p < 0.001$, showing that predicting NA from Model 6 (not shown in tables) was a better fit to the data than predicting NA with Model 5. Model 6 tested whether these results held after controlling for significant covariates in previous models. Model 6 for effortful control included average negative events (NE), daily interpersonal NE, daily non-interpersonal NE, average positive events (PE), daily interpersonal PE, daily non-interpersonal PE, neuroticism, and conscientiousness as predictors of the intercept (i.e., average NA); and effortful control as a predictor of NA responsiveness to interpersonal and non-interpersonal positive events and NA reactivity to interpersonal negative events, as well as gender and neuroticism as predictors of NA reactivity to interpersonal negative events. In this model, effortful control was still associated with lower NA responsiveness to positive interpersonal (γ_{31} = 0.07, $p < 0.01$, 95% CI = [0.0003, 0.07]0 and non-interpersonal (γ_{41} = 0.05, $p < 0.05$, 95% CI = [0.0003, 0.07]) events. Simple slope analyses indicated that individuals with higher effortful control had smaller decreases in NA on days when positive interpersonal events occurred (1-SD above mean: Est. -0.05, p <.05), compared to those with lower effortful control (1-SD below mean: Est. -0.15, p <.01), with slopes significant for 85% of the sample. Individuals with higher effortful control had smaller decreases in NA on days when positive non-interpersonal events occurred (1-SD above mean: Est. -0.06, p <.01), compared to those with lower effortful control (1-SD below mean: Est. -0.14, p <.01), with slopes significant for 90% of the sample.

Regarding mindfulness models, Model 3 fit better than Model 2, χ^2 (4) = 52.7, $p <$ 0.001. Model 6 for mindfulness (not shown in tables) included average negative events (NE), daily interpersonal NE, daily non-interpersonal NE, average positive events (PE), daily interpersonal PE, daily non-interpersonal PE, neuroticism, and conscientiousness as predictors of the intercept (i.e., average NA); and mindfulness as a predictor of NA responsiveness to interpersonal and non-interpersonal positive events, and gender and neuroticism as predictors of NA reactivity to interpersonal negative events. In this model, mindfulness was still associated with lower NA responsiveness to interpersonal (γ_{31} = 0.07, p < 0.01, 95% CI = [0.04, 0.12]) and non-interpersonal (γ_{41} = 0.07, p < 0.01, 95% CI = [0.04, 0.14]) positive events (Figure 5). Simple slope analyses indicated that individuals with higher mindfulness had smaller decreases in NA on days when positive interpersonal events occurred (1-SD above mean: Est. -0.05, p <.05), compared to those with lower mindfulness (1-SD below mean: Est. -0.15, p <.01), with slopes significant for 84% of the sample. Individuals with higher mindfulness had smaller decreases in NA on days when positive non-interpersonal events occurred (1-SD above mean: Est. -0.06, p <.01), compared to those with lower mindfulness (1-SD below mean: Est. -0.14, p <.01), with slopes significant for 89% of the sample.

Figure 5: Negative Affective Responsiveness to Interpersonal & Non-Interpersonal Domains: Mindfulness

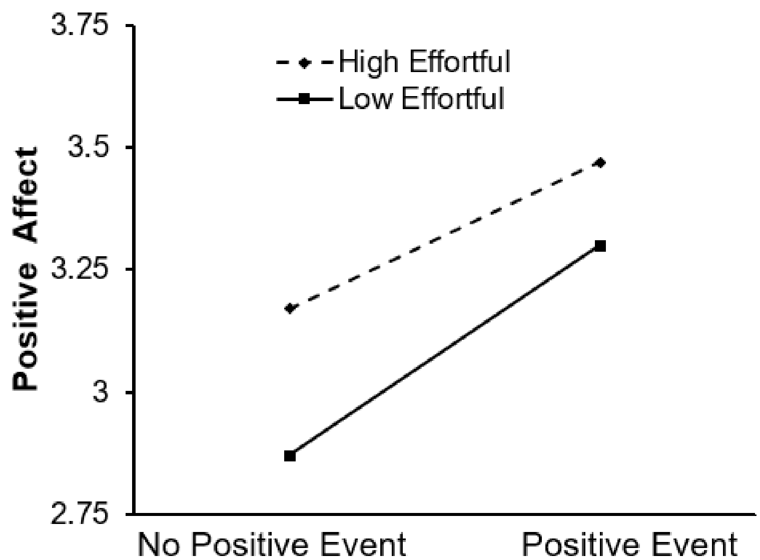


PA Reactivity and Responsiveness. Model 4 (Tables 5 and 7) revealed that experiencing an interpersonal (γ_{10} = -0.17, $p < 0.01$, 95% CI = [-0.20, -0.05]) and non-interpersonal negative event (γ_{20} = -0.19, $p < 0.001$, 95% CI = [-0.25, -0.11]) was associated with decreases in PA, and experiencing an interpersonal (γ_{30} = 0.35, $p < 0.001$, 95% CI = [0.35, 0.50]) and non-interpersonal positive event (γ_{40} = 0.34, $p < 0.001$, 95% CI = [0.34, 0.51]) was associated with increases in PA. At Level 2, average negative event exposure was negatively associated with PA (γ_{01} = -0.04, $p < 0.001$, 95% CI = [-0.06, -0.04]) and average positive event engagement was positively associated with PA (γ_{02} = 0.03, $p < 0.01$, 95% CI = [0.02, 0.04]), suggesting that individuals who experienced a fewer number of stressors and greater number of positive events experienced higher levels of PA.

For effortful control models, a likelihood ratio test yielded a significant test statistic, χ^2 (5) = 45.3, $p < 0.001$, showing that predicting PA from Model 5 was a better fit to the data than predicting PA with Model 4 (Table 5). For mindfulness models, a likelihood ratio test yielded a significant test statistic, χ^2 (5) = 50.0, $p < 0.001$, showing that predicting PA from Model 5 was a better fit to the data than predicting PA with Model 4. Model 5 (from Table 5) shows that effortful control predicted lower PA responsiveness to daily positive interpersonal events (γ_{31} = -0.15, $p < 0.01$, 95% CI = [0.01, 0.11]); individuals high in effortful control experienced smaller increases in PA from a no-positive event day to a day on which they experienced at least one positive interpersonal event. Model 5 (from Table 7) shows that mindfulness similarly predicted lower PA responsiveness to interpersonal positive events (γ_{31} = -0.11, $p < 0.01$, 95% CI = [-0.21, -0.03]); individuals high in mindfulness experienced smaller increases in PA from a no-positive event day to a day on which they experienced at least one interpersonal positive event. Effortful control did not predict PA reactivity to daily stressors ($p > .10$). However, mindfulness predicted PA reactivity to non-interpersonal negative events (γ_{21} = -0.07, $p < 0.05$, 95% CI = [-0.14, -0.01]), such that individuals high in mindfulness experienced larger decreases in PA from a no-negative event day to a day on which they experienced at least one non-interpersonal stressor.

Model 6 tested whether these results held after controlling for significant covariates in previous models. This model fit better than Model 5, χ^2 (4) = 122.2, $p <$ 0.001. Model 6 for effortful control (not shown in tables) included average negative events (NE), daily interpersonal NE, daily non-interpersonal NE, average positive events (PE), daily interpersonal PE, daily non-interpersonal PE, neuroticism, and conscientiousness as predictors of the intercept (i.e., average PA); effortful control as a predictor of PA responsiveness to positive interpersonal events; conscientiousness as a predictor of PA reactivity to non-interpersonal stressors; and gender as a predictor of PA reactivity to interpersonal stressors . In this model, effortful control (γ_{31} = -0.11, $p < 0.01$, 95% CI = [-0.20, -0.05]) was still associated with lower PA responsiveness to positive interpersonal events (Figure 6). Simple slope analyses indicated that individuals with higher effortful control had smaller increases in PA on days when positive interpersonal events occurred (1-SD above mean: Est. 0.26, p <.01), compared to those with lower effortful control (1-SD below mean: Est. 0.43, p <.01), with slopes significant for 100% of the sample.

Figure 6: Positive Affective Responsiveness to Interpersonal Positive Events: Effortful Control



For mindfulness models, Model 6 fit better than Model 5, χ^2 (4) = 122.2, $p <$ 0.001. Model 6 for mindfulness included average negative events (NE), daily interpersonal NE, daily non-interpersonal NE, average positive events (PE), daily interpersonal PE, daily non-interpersonal PE, neuroticism, and conscientiousness as predictors of the intercept (i.e., average PA); and mindfulness as a predictor of PA responsiveness to interpersonal positive events; and mindfulness and conscientiousness as predictors of PA reactivity to non-interpersonal stressors; and gender as a predictors of PA reactivity to interpersonal stressors. In this model, mindfulness was still associated with lower PA responsiveness to interpersonal positive events (γ_{31} = -0.06, $p < 0.01$, 95% CI = [-0.16, -0.02]), and greater PA reactivity to non-interpersonal stressors (γ_{21} = -0.07, $p < 0.01$, 95% CI = [-0.16, -0.01]). Simple slope analyses indicated that individuals with higher mindfulness had smaller increases in PA on days when positive interpersonal events occurred (1-SD above mean: Est. 0.30, p <.01), compared to those with lower mindfulness (1-SD below mean: Est. 0.40, p <.01), with slopes significant for 100% of the sample. Individuals with higher mindfulness had larger decreases in PA on days when non-interpersonal stressors occurred (1-SD above mean: Est. -0.25, p <.01), compared to those with lower mindfulness (1-SD below mean: Est. -0.13, p <.01). However, region of significance testing indicated that slopes were significant for 0% of the current sample.

DISCUSSION

The current study examined whether self-regulatory factors of effortful control and mindfulness were differentially associated with exposure/engagement and emotional reactivity/responsiveness to daily stressors and positive events in a community sample of midlife adults. As expected, participants who reported a higher sense of effortful control tended to report more positive affect, less negative affect, and less variability in both affects. Similarly, those who reported higher mindfulness tended to report more positive affect, less negative affect, and less variability in negative affect. Individuals with higher levels of effortful control and mindfulness, respectively, were less likely to report stressors each day but their rate of reporting positive events did not differ. Moreover, consistent with hypotheses, those with higher effortful control and mindfulness, respectively, were less emotionally responsive to daily positive events, exhibited by smaller changes in well-being as a function of positive events. Surprisingly, individuals who reported higher effortful or mindfulness were not less emotionally reactive to daily stressors. These findings demonstrate how self-regulatory factors that broadly constitute temperament still impact daily life in midlife, and reveal considerable overlap in how effortful control and mindfulness operate in the context of everyday emotions and events.

Pathways Linking Self-Regulatory Factors to Health

Both effortful control and mindfulness were associated with higher levels of and less variability in daily well-being, each of which have been associated with key outcomes in adulthood and old age. For example, less consistency in daily well-being has been tied to higher concentrations of inflammatory markers (Steptoe, Demakakos, de Oliveira, & Wardle, 2012), sleep disturbances (Ong et al., 2013), and psychosis, depression, and future psychopathology (Wichers, Wigman, & Myin-Germeys, 2015). These self-regulatory factors likely operate through daily behaviors and health practices dynamically tied to physiological processes, such as heart-rate-variability and hypothalamic-pituitary-adrenal (HPA) functioning (Spangler & Friedman, 2015;

Creswell & Lindsay, 2014), that underlie the health effects of levels and variability in well-being (Pressman, 2005).

These results show that mindfulness was associated with lower daily negative affect and higher daily positive affect among middle-aged adults, which is consistent with previous work linking mindfulness to negative and positive dimensions of daily psychological health in young adults (Weinstein et al., 2009; Brockman et al., 2017). Previous work has revealed that effortful control is related to lower negative affect in general among young adults (Bridgett et al., 2013; Spangler & Friedman, 2015); my findings are the first to show that effortful control is associated with lower daily negative affect in midlife adults. Additionally, they are the first to show that effortful control is also associated with higher daily positive affect.

Individuals who reported higher effortful control and mindfulness, respectively, were also less likely to report daily stressful events but not positive experiences. These results extend previous work showing that effortful control is linked to lower frequency of stressful events in adolescents (Galla & Wood, 2015), while mindfulness has been linked to lower perceived stress in young adults (e.g., Weinstein et al., 2009). Thus, one pathway by which effortful control and mindfulness promote development is via reduced exposure to daily stressors that can have a cumulative effect on health and well-being in midlife (Almeida et al., 2010; Zautra, 2003). Given that daily positive events have been linked to more positive affect (Zautra et al., 2005), better sleep quality (Sin et al., 2017), better health behaviors and less inflammation (Bajaj et al., 2016; Sin et al., 2015, they are also an important unit of analysis to consider in daily diary studies. Results from the current study show that neither effortful control or mindfulness were associated with differential engagement with daily positive events among middle-aged adults.

Emotional Reactivity to Daily Negative Events. Findings showing that mindfulness was not associated with less emotional reactivity to daily stressors is at odds with previous research with young adults (Dixon & Overall, 2016; Ciesla et al., 2012). Researchers have theorized that mindfulness helps sustain well-being via non-reactive processing of information that broadens the range of interpretations and responses to stressful experiences in daily life (Dixon et al., 2016; Feldman et al., 2016). My results suggest that mindfulness may not make individuals susceptible to stressor-related changes in negative or positive affect, but instead alters the threshold at which an event is perceived as stressful. Alternatively, it is possible that mindfulness lessens reactivity to daily stressors only for specific types of affect, such as depressed or dysphoric mood (Dixon & Overall, 2016; Ciesla et al., 2012). Mindfulness in the current study was conceptualized as a between-person indicator; it is also possible that mindfulness, on average, is not associated with differential reactivity to stressors. Instead, it may be that an individual's mindfulness when stressors occur exerts a greater influence on emotional reactivity to daily stressful events (Donald et al, 2016).

Regarding effortful control, these findings offer initial evidence that a temperamental aspect of self-regulation is not associated with emotional reactivity to stressors among middle-aged adults. Effortful control, defined as one's ability to focus and shift attentions and activate and inhibit behavioral responses when necessary (Rothbart et al., 1994), has accumulated considerable evidence showing that it protects against heightened emotional reactivity from childhood to adolescence (Eisenberg et al., 2004). As previous research has noted (e.g., Eisenberg et al., 2014), it is likely that later in life effortful control is subsumed under personality facets more closely tied to reactivity to stressors, such as neuroticism (e.g., Bolger et al., 1995), which in the current study was associated with greater reactivity (i.e., pronounced increases in negative affect) to stressors involving friends, family, or spouse/partner in particular.

Emotional Responsiveness to Daily Positive Events. Individuals with higher effortful control and mindfulness, respectively, exhibited smaller changes in well-being on days that positive events occurred. These findings are novel in that positive-event-related changes in emotion have not been studied in the context of these self-regulatory factors. Those with higher effortful control and mindfulness, respectively, were better able to maintain low negative affect and high positive affect on days that positive events did not occur. This suggests that higher levels of these self-regulatory factors allow individuals to sustain well-being without relying on positive experiences. Recent work has highlighted how middle-aged adults with depression, or those who experienced childhood trauma (Infurna et al, 2015), rely on daily positive events to maintain well-being (Khazanov, Ruscio, & Swendsen, 2018). Thus, one pathway by which highly self-regulated individuals preserve health is by maintaining stable levels of well-being from day-to-day (e.g., Geschwind et al., 2010).

Differences Across Interpersonal and Non-Interpersonal Events. Findings from post-hoc analyses show that although effortful control and mindfulness were associated with a lower likelihood of reporting a daily stressor, there was no difference in the likelihood of reporting an interpersonal (i.e., family, friends, spouse) versus non-interpersonal (i.e., work, finances, health) stressor. These results are surprising given that effortful control and mindfulness have both been linked to better social competence and relationships (e.g., Eisenberg et al., 1997; Dixon & Overall, 2016).

When considering event-related changes in emotion, findings show that interpersonal positive events are important to consider. Individuals who reported higher effortful control (or mindfulness) were less responsive to positive-event-related changes in negative and positive affect regardless of whether the event was interpersonal or non-interpersonal in nature. However, effect size estimates indicated that the best-fitting models were those that partitioned daily events in two domains: interpersonal and non-interpersonal events. Future work examining event-related changes in daily emotion should consider partitioning events in a similar fashion. It is common for diary studies examining daily reactivity to stressors to dichotomize their stressor variable. Nonetheless, by exploring differences in interpersonal and non-interpersonal events it is possible to assess whether there are differences based on specific domains of daily events.

Limitations and Conclusions

The current study had several limitations. First, the measure of mindfulness used here indexed only one aspect of the construct—non-reactivity of inner experiences. It is possible that several of the findings reported here may differ when incorporating other aspects of mindfulness such as non-judgement or openness to experiences. Second, the sample used here was drawn from the Phoenix metropolitan area in Arizona. Despite it being representative of middle-aged residents in the southwestern United States, the generalizability of my results to middle-aged adults in other geographic locations is unknown. Future work should examine whether similar associations are found in other samples of middle-aged adults, or those in young adulthood and old age. Additionally, future research is warranted using ecological momentary assessment (EMA) research designs to further investigate “reactivity” or “responsiveness” more closely to the time period when a stressor or positive event occurred. Therefore, these findings should be considered alongside EMA paradigms to better understand associations found in the current study. It is likely that daily well-being, especially in the context of stressors and positive events, is dynamically tied to physiological processes (Pressman, 2005); thus, future research may benefit from exploring how physiological changes link daily events and emotions to later health.

The current study observed considerable overlap across effortful control and mindfulness in how they operated in middle-aged adults’ daily life. Both self-regulatory factors were similarly associated with daily well-being and reduced exposure to daily stressors (but not positive events). Furthermore, neither factors were linked to differences in emotional reactivity to daily stressors, yet both were associated with attenuated emotional responsiveness to daily positive events. Future work should examine whether these constructs similarly overlap in adolescence or young adulthood.

Self-regulatory factors have the potential to shape the course of development from childhood to midlife and older age. This study examined the extent to which effortful control and mindfulness were associated with multiple aspects of emotional regulation, with a 30-day daily diary that provided multiple indexes of functioning, including mean levels and variability in daily well-being, reports of daily stressors and positive events, and event-related changes in emotions. My findings suggest that differences in the patterns of everyday events and emotional responses to those events is one pathway potentially linking effortful control and mindfulness to better overall health in midlife and beyond.

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