TEMPORAL MECHANISMS UNDERLYING SYSTEMATIC MOOD FLUCTUATION:

RE-EVALUATING TIME AND DAY

By

Ihno A. Lee

Submitted to the graduate degree program in Psychology and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

____
Chairperson: Todd D. Little, Ph.D.

____
Kristopher J. Preacher, Ph.D.

____
Pascal R. Deboeck, Ph.D.

____
Wei Wu, Ph.D.

____
Paul E. Johnson, Ph.D.

Date Defended: June 11, 2011

The Dissertation Committee for Ihno A. Lee

certifies that this is the approved version of the following dissertation:

TEMPORAL MECHANISMS UNDERLYING SYSTEMATIC MOOD FLUCTUATION:

RE-EVALUATING TIME AND DAY

Chairperson: Todd D. Little, Ph.D.

Date approved: June 15, 2011

Abstract

Positive and negative moods fluctuate systematically during our waking hours and throughout the course of a week; however, the mechanisms underlying these changes have not been fully explored. These systematic changes may be due to temporal influences, such as time of day and day of the week, as well as intertwined situational factors, such as daily routines, hassles, and stressors. Their collective influence on daily mood patterns has been examined, but previous research has not attempted to isolate and examine the unique effects. This study re-evaluated the influences of time and day over a 7-day period and examined the extent to which systematic daily mood patterns are driven by temporal versus situational influences. Results from nonlinear latent curve analyses indicated that temporal influences exerted differential effects on valence and arousal dimensions of mood, as well as positive and negative arousal components. Daily energy (i.e., arousal), but not affect, was entrained to the time of day, with only positive energy being additionally influenced by daily events. Day-to-day changes in weekday affect and positive energy were primarily driven by day of the week. Sunday, representing a transition to the new week, induced abrupt shifts in mood; however, the magnitude of these shifts was also determined by daily events.

Table of Contents

Our affective lives are always in flux, changing in accordance with the ups and downs of daily life. Countless influences, from minor irritants (e.g., waiting in line) to major events (e.g., losing a job), account for these shifts in momentary and daily moods; the effects of situational factors are well-documented in numerous studies utilizing daily diaries or experience-sampling methodologies (Clark & Watson, 1988; Marco & Suls, 1993; Stone, Neale & Shiffman, 1993). However, in spite of these situational influences, our moods also change in a systematic and predictable fashion. For instance, we feel happier on weekends and more sluggish on Mondays (Larsen & Kasimatis, 1990; Reid, Towell, & Golding, 2000). We tend to feel least energetic in the early morning and most upbeat around mid-day (Egloff, Tausch, Kohlmann, & Krohne, 1995). In other words, time matters.

Time of day and day of the week are crucial in structuring our daily routines, and as a result, are intertwined with the type and number of events that we experience. This overlap is reflected in terms such as ‘happy hour’, which in current usage, refers to the late afternoon during which bars and restaurants offer discounted drinks to coincide with the end of the work day. Other expressions such as ‘blue Monday’ and ‘thank god it’s Friday’ indicate the extent to which our concept of time (i.e., day of the week) is influenced by our daily routines. Collectively, these temporal and situational influences account for systematic changes in our day-to-day moods. But is time, in itself, a regulating factor? To what extent do time and day dictate our moods, above and beyond daily events and hassles? To date, previous research has not isolated and examined these unique temporal influences. The present study addresses this gap in affective science literature and re-evaluates the role and significance of time and day on daily mood change. As stated by Davidson (2003), understanding the processes and mechanisms underlying affective change remains one of the most important challenges in the study of mood and emotion.

Emotion, Mood and Affect

In our vernacular, emotion and mood are often used interchangeably in reference to our general feelings or states. From a psychological perspective, emotion and mood are distinct concepts and differ with regard to their origins, duration and various response characteristics. Emotions are short, intense affective responses, or "fluctuating changes in emotional 'weather'" (APA, 1994, p. 763), that typically interrupt our thought processes (Weiss & Cropanzano, 1996). Mood, by contrast, is more diffuse, longer in duration and represents the "pervasive and sustained 'emotional climate,'" (APA, 1994, p. 763). As a broader state of being, mood is not tied to a specific object or event and tends to bias cognition more than behavior (Davidson, 1994; Fiedler, 1988). Mood and affect may be viewed as synonymous terms, in that they both refer to the broader, more persistent states of being.

Emotion and mood are often represented hierarchically, where emotions are lower order components subsumed within superordinate valenced mood categories (Diener, Smith, & Fujita, 1995; Watson & Clark, 1992). For instance, *happy, interested,* and *amused*, are distinct emotions that fall under a global 'positive mood' category, whereas *sad, lonely*, and *depressed* are subsumed within a general 'negative mood' category. As expected, emotions are highly intercorrelated within these larger categories (Russell & Carroll, 1999; Watson, Wiese, Vaidya, & Tellegen, 1999); for instance, individuals often report feeling a specific positive emotion in the context of other positive emotions (Watson & Clark, 1992). These intercorrelations are addressed by dimensional models of affect, which regard affective experiences as a continuum of interrelated states.

Though the mapping of affective space is still a matter of debate, a two-dimensional structure of affective experience has consistently emerged. According to the circumplex model, these dimensions have been identified as valence and arousal (Russell, 1980); the valence dimension is represented by a pleasant-unpleasant continuum, and the arousal (or activation) dimension is depicted by a high-low arousal continuum. Each emotion may be conceptualized as having varying degrees of valence and arousal, and can be mapped to a coordinate within this two-dimensional space. These dimensions have also been interpreted as tension and energy (Thayer, 1989), approach and withdrawal (Lang, Bradley, & Cuthbert, 1998), and positive and negative affect (Watson et al., 1999); currently, any of these interpretations are deemed acceptable, and the use of one or the other is viewed as a matter of choice. In the present study, I adopt the valence and arousal conceptualization of affect, in which valence (i.e., pure affect) and arousal (i.e., energy) are conceptualized as orthogonal dimensions.

To date, no consensus exists regarding the bipolarity of valence; positive and negative affect have been considered bipolar opposites of a single valence continuum, as well as two orthogonal unipolar components. Following the recommendation of Rafaeli and Revelle (2006), I adopt the view that positive and negative affect are two separable, inversely related components, where the strength of association depends on the items selected (Watson, 1988), the response format (e.g., unipolar, bipolar) and scaling of items (Russell & Carroll, 1999), and controlling for measurement error (Green, Goldman, & Salovey, 1993).

Daily Mood Fluctuation

According to state-trait theory (Cattell, 1963; Mischel & Shoda, 1995), mood variation has dispositional (i.e., trait) and temporal (i.e., state) features, both of which characterize our affective experience. Persistent, trait-dependent states of being account for general mood stability, whereas state-dependent affect fluctuates over time and in response to immediate events. This study focuses on the state-dependent component of affect, which varies as a function of time (e.g., time of day, day of the week) and other contextual factors.

The average person's mood is mildly positive and relatively consistent (Diener & Diener, 1996; Parkinson, Totterdell, Briner, & Reynolds, 1996). Variations in baseline mood and intensity of experience are generally attributed to individual differences, such as gender (Fujita, Diener, & Sandvik, 1991), personality (David, Green, Martin & Suls, 1997), and age (Larson, Csikszentmihalyi, & Graef, 1980; Rocke, Li, & Smith, 2009). Barring these individual differences, mood fluctuation generally exhibits stable and reliable patterns (Penner, Shiffman, Paty, & Fritzsche, 1994). Two broad influences, homeostasis and entrainment, largely account for this systematic fluctuation.

Homeostasis. From a homeostatic perspective, all living systems strive to maintain internal equilibrium or stability; when this equilibrium is disturbed, an adaptive mechanism functions to return the system to ‘normal’ levels (Helson, 1948). In this context, mood is a homeostatic system that self-regulates when affect levels deviate from baseline (Headey & Wearing, 1989). This baseline affect corresponds to a set point or core affect (Russell, 2003), which is determined in part by dispositional characteristics and hereditary factors, and not linked to any specific cause. According to homeostatic theory (Cummins, 1995), life events (ranging in impact severity) can cause deviations from this set point, but effects are transient, and affect returns to its set point over time. Homeostatic theory has been referred to by numerous labels; for instance, adaptation level theory (Brickman & Campbell, 1971), dynamic equilibrium theory (Headey & Wearing, 1989), and set-point theory (Lykken & Tellegen, 1996), among others.

This theory, though often used to characterize long-term mood patterns, can also be applied to short-term, daily mood change. Kuppens and colleagues (2010) recently introduced the DynAffect model, which draws from dynamical systems theory to depict the processes underlying momentary shifts in mood. The DynAffect model proposes that the affective system is characterized by core affect (i.e., a fixed-point attractor in two-dimensional affect space), which represents baseline mood, or an affective home base. This core affect is continuously influenced by internal and external events, resulting in some amount of variability. When events cause an individual’s state to deviate from its affective home base, a regulatory mechanism (i.e., attractor strength) is activated to return affect levels back to a ‘normal’ range of functioning. These DynAffect components, affective home base, affective variability, and attractor strength, account for systematic mood change in the short-term.

Entrainment. Entrainment, another process underlying systematic mood fluctuation, is the synchronization of two or more autonomous cyclic processes. Synchronization does not imply that these processes occur simultaneously in time, but that they are in a fixed temporal relation to one another; in other words, a systematic relationship exists between the periods of the cycles (i.e., number of complete cycles) and between the phases (i.e., time of onset).

Entrainment among physiological processes is common; for instance, body temperature and arousal, metabolic rates and REM sleep, all of which are subsumed within one larger system (i.e., the human body). McGrath and Kelly apply this concept of entrainment to the psychological domain in their social entrainment model (1986), which proposes that human behavior is temporal in nature and regulated by endogenous cyclic processes. Behavior patterns may also become synchronized between individuals in various contexts; for instance, while engaged in conversation, gaze and body movements are entrained (Chapple, 1970), as well as conversational turn-taking (speaking and listening) and breathing patterns (Warner, Waggener, & Kronauer, 1983). These types of synchronization represent mutual entrainment, in which the timing of one cycle (i.e., speaking) induces or modifies the timing of other cycles (i.e., listening), and vice versa.

According to McGrath and Kelly's social entrainment model (1986), behavior may also become entrained to external pacer events or rhythms. External entrainment is the synchronization of behavior to an exogenous stimulus, such as time or the light-dark cycle; however, this entrainment occurs in only one direction, which distinguishes it from mutual entrainment. For instance, temporal markers, such as deadlines, were found to influence the rate of productivity and patterns of interaction among team members (Kelly, Futoran, & McGrath, 1990). Other temporal influences such as diurnal rhythms (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004), monthly rhythms (MacFarlane, Martin, & Williams, 1998), and seasonal rhythms (Rosen & Rosenthal, 1991), have been shown to influence mood.

The Influence of Time and Day

Diurnal (i.e., daily) variation in mood is linked to the light-dark cycle and represents a segment of the 24-hour circadian rhythm (Clark, Watson, & Leeka, 1989; Watson et al., 1999), which follows a sinusoidal pattern (Murray, 2007). Positive mood exhibits a consistent trend; positive mood levels are generally lowest in the morning and evening, and peak at mid-day (Clark et al., 1989; Thayer, Takahashi, & Pauli, 1988; Watson et al, 1999). However, valence and arousal dimensions may exhibit different patterns; Egloff and colleagues (1995) showed that energy levels (i.e., arousal) peaked in the afternoon, whereas feelings of pleasantness (i.e., valence) increased from morning to evening.

Negative mood follows a mirrored pattern, with negative affect peaking in the morning and declining throughout the day. Fatigue exhibited a V-shaped quadratic pattern, dropping in the early afternoon and increasing thereafter (Kahneman et al., 2004). This experience of worse mood in the morning is also well documented in studies of depressed individuals (Hallonquist, Goldberg, & Brandes, 1986); higher levels of morning negative affect may be due to disturbances in circadian rhythms (Murray, 2007).

Day of the week has also been found to exert a strong influence on mood. The week, as another temporal pattern, is a unique component of time. Unlike days, months, or years, the week is unassociated with any astronomical event and remains strangely independent of other temporal units and general calendrical principles (Zerubavel, 1985). Nevertheless, the weekly calendar represents a temporal and social zeitgeber, functioning as a time-keeping unit and social structure with which we organize our daily routines. As expected, research has shown that mood is entrained to the weekly calendar (Almagor & Ehrlich, 1990; Larsen & Kasimatis, 1990; MacFarlane, Martin, & Williams, 1990).

Weekly mood fluctuation follows a sinusoidal pattern; Larsen and Kasimatis (1990) found that a seven-day sine wave accounts for 40% of the variance in daily mood. This oscillation is in accordance with the weekly calendar, where positive mood increases as the weekend approaches and subsequently decreases as a new week begins. However, this increase may differ by mood dimension, with the valence, but not arousal, component shown to exhibit this trend (Egloff et al., 1995). With regard to the affect dimension, this weekend effect is well-established (Larsen & Kasimatis, 1990; Reid, Towell, & Golding, 2000; Stone, Hedges, Neale, & Satin, 1985) and likely due to our associations of weekdays as paid work time and weekends as free time (Zerubavel, 1985).

These trends, however, are often exaggerated when people are asked to recall or predict their moods on a particular day of the week. For instance, the ‘blue Monday’ phenomenon is not supported by momentary mood ratings, but is evidenced in retrospective ratings and mood predictions (Areni & Burger, 2008; Stone et al., 1985; Totterdell, Parkinson, Briner, & Reynolds, 1997), both of which are influenced by day-of-the-week stereotypes.

Analyses of momentary mood trends show that the weekend effect differs for adults and college students. For adults, positive mood was highest on Saturday and Sunday, relative to the weekdays, including Friday (Kennedy-Moore, Greenberg, Newman, & Stone, 1992; Stone et al., 1985). College students experienced their most positive moods on Friday and Saturday, compared to the rest of the week (MacFarlane et al., 1988; Rossi & Rossi, 1977). Conflicting evidence is found for Sunday moods; some studies reported that positive mood is lowest on Sunday for students and adults (Gregory, 1994; Watson, 2000), where others showed an increase in positive mood (Kennedy-Moore, 1992; Stone et al., 1985). Regardless, these results illustrate that the weekend is experienced subjectively; mood changes in accordance with the timing and cycle of our daily work/school routines.

Dispositional and Situational Influences

Mood rhythms are also affected, to greater or lesser degrees, by countless factors spanning the biological, dispositional, behavioral, and situational domains. For instance, hormone levels (Susman, Dorn, & Chrousos, 1991), substance abuse (Nesse & Berridge, 1997), physical activity (Ekkekakis, 2009), and the subjective appraisal of events (Scherer, Dan, & Flykt, 2006), have been shown to influence mood. Affective regulation represents another class of influences, which involves conscious, effortful attempts to change mood for the purpose of achieving hedonistic goals (e.g., down-regulate negative mood) or satisfying instrumental motives (Tamir, Chiu, & Gross, 2007). Cognitive reappraisal, or reconstruing an emotional situation to diminish its emotional impact, is an effective strategy used to regulate emotions at no cognitive cost when initiated prior to an emotional situation (Gross, 2002; Richards, 2004).

This study focuses on dispositional and situational influences on mood, as these categories reflect the more prominent, influential, and frequently examined causes underlying short-term changes in affect and energy. Dispositional influences tend to influence baseline mood (or core affect) as well as long-term mood (i.e., trait-dependent emotional states), whereas situational factors have a greater impact on momentary, day-to-day mood (Diener et al., 1995).

Dispositional influences, such as personality, have a substantial impact on daily mood, as traits and affect are believed to be associated on a theoretical level (Eysenck, 1967; Watson, 2000). Extraversion is positively correlated with positive affect, and neuroticism is positively associated with negative affect (Costa & McCrae, 1980; David, Green, Martin, & Suls, 1997; Eaton & Funder, 2001; Larsen & Diener, 1992). Extraverted, autonomous individuals are less entrained to the weekly calendar, as they are more inclined to pursue social activities and experiences that alleviate negative mood (Larsen & Kasimatis, 1990; Reis, Seldon, Gable, Roscoe, & Ryan, 2000). Those high in neuroticism show average levels of entrainment, with more variability in negative mood within and between days (Bolger & Schilling, 1991; Marco & Suls, 1993). Furthermore, individuals higher in neuroticism, anxiety, and depression are shown to experience more intense negative mood in the evening (Rusting & Larsen, 1998); evenings are typically less structured, allowing more free time and opportunity to focus on negative moods. In addition, individuals high in trait reappraisal experience greater positive emotion and less negative emotion (Gross & John, 2003).

Situational influences include a range of exogenous and endogenous events of varying impact, from routine daily hassles to life-altering events. As expected, major events significantly impact mood. Immediately following the September 11th terrorist attacks, negative affect increased by eight standard deviations from baseline (Perrine, Schroder, Forester, McGonagle-Moulton, Huessy, 2004). Extreme mood levels (positive or negative) generally do not last; lottery winners or those having suffered severe injuries reported mood levels regressing to baseline within relatively short periods (Brickman, Coates, & Janoff-Bulman, 1978; Costa, McCrae & Zonderman, 1987). In support of this claim, Suh, Diener, and Fujita (1996) reported that the impact of major life events (positive or negative) on happiness was significantly diminished after 2 months. However, recent studies suggest that major events do have the power to alter an individual's core affect (i.e., well being) or set point over the long term (Headey, 2010; Wagner et al., 2007).

Daily hassles and other minor events influence mood to greater or lesser degrees, depending on the nature of the event. Sleep quality and daily activities influence the diurnal variation of positive affect (Kahneman et al., 2004). Interpersonal conflicts are more upsetting than routine stressors and concerns (e.g., commuting to work) and affect mood over longer periods (Bolger, DeLongis, Kessler, & Schilling, 1989; Cranford, 2004), whereas effects of routine stressors are temporary and rarely persist for more than one day (Marco & Suls, 1993; Stone & Neale, 1984). Chronic stress, however, has a lingering effect on mood. Individuals coping with chronic stress did not experience the usual decline in negative mood on weekends (Cranford et al., 2006). Other external factors such as peer and family support (Weinstein, Mermelstein, Hedeker, Hankin, & Flay, 2006), increased social activity and exercise (Watson, 1988), and various weather-related factors, such as sunshine, temperature and other phenomena (Cunningham, 1979; Denissen, Butalid, Penke, & van Aken, 2008; Thayer, 1989), are found to influence mood.

The Present Study

Time of day and day of the week have been generally regarded as occupying a peripheral role in shaping our daily moods. More attention has been paid to the daily events, hassles, and stressors that elicit deviations in mood rather than the mechanisms underlying the regularity of momentary and day-to-day mood change. This study isolates and examines time and day as external pacers, or entraining factors, that regulate short-term mood change, above and beyond dispositional and situational influences.

Approach. Systematic mood change (i.e., exhibiting linear and nonlinear patterns) was examined in a series of nonlinear structured latent curve models. First, baseline models of positive and negative affect and energy were constructed to represent the typical within- and between-day change patterns over a 7-day period. Next, dispositional and situational factors were added as predictors of baseline mood. Dispositional and situational influences were evaluated via the strength and significance of their fixed effects. In contrast, temporal influences were evaluated via the *non-significance* of all situational effects.

The absence of any significant (situational) effect on mood trajectories implies that this change is primarily due to time of day or day of the week, as external pacers. Finally, results were compared across the affect and energy mood dimensions, as well as between positive and negative components.

Significance. Affect research is starting to focus on the mechanisms underlying the patterns and regularities of affective experience, above and beyond its causes and consequences. This research represents another step in that direction and, in the spirit of Kuppens et al. (2010), provides another perspective on momentary and day-to-day mood change. In addition, this study also addresses the bipolarity issue in the ongoing debate on the structure of affect. If different mechanisms are found to underlie positive and negative mood change, this result would provide further evidence of positive and negative components as separate unipolar factors, rather than representing opposite ends of a single valence continuum.

This study also has implications for the future of affective research. If time and day are shown to be strong external pacers (and resistant to the influence of daily events experienced), we can conclude that our moods are strongly dictated by biological factors, as well as temporal cognition. Circadian rhythms, as a biological influence, would appear to regulate our diurnal mood rhythms and are immune to various internal and external influences. In addition, our day-of-the-week associations would be the defining factor underlying day-to-day mood change; this result suggests that our perceptions of time (i.e., day) are more important in predicting our moods than what we actually experience on a daily basis.

Hypotheses. Hypotheses 1a and 1b address the patterns of affect and energy change within and between days.

> *Hypothesis 1a:* Affect does not oscillate during the day, but changes in accordance with the day of the week. The direction of day-to-day change depends on valence. Positive affect increases throughout the week but declines on Sunday. Negative affect decreases throughout the week but increases on Sunday.

> *Hypothesis 1b:* Energy fluctuates in accordance with time of day and day of the week. The pattern and direction of change depends on valence. Within-day positive energy is highest in the early afternoon, and within-day negative energy is highest in the morning. From day to day, positive energy increases throughout the week but declines on Sunday. Negative energy decreases throughout the week but increases on Sunday.

Hypothesis 2 addresses the factors influencing within-day changes in energy.

> *Hypothesis 2:* Controlling for covariate effects, daily academic and interpersonal events influence within-day positive and negative energy change.

Hypotheses 3a and 3b address the factors influencing day-to-day changes in affect and energy.

> *Hypothesis 3a:* Controlling for covariate effects, changes in positive and negative affect are due to day-of-the-week associations and are not influenced by daily academic and interpersonal events.

> *Hypothesis 3b:* Controlling for covariate effects, changes in positive and negative energy are due to daily academic and interpersonal events, above and beyond day-of-the-week associations.

Method

Participants

The initial sample consisted of 137 undergraduates from the University of Kansas. Participants were recruited over an 11-month period and received course credit for participation. All were in good health; none reported taking antidepressants or any prescribed mood-altering medication prior to study onset.

Participants began the study on various days of the week; for instance, day 1 fell on a Monday for some individuals, while falling on a Thursday for others. Since the weekend transition period is the focal point at which to capture mood change, only participants who rated their mood from Thursday to Sunday (in temporal sequence) were retained; this retention strategy was necessary in order to model the full, unbroken change patterns through the weekend. To maximize the number of participants retained, Thursday was selected as day 1. As a result, 110 participants who began the study on Monday, Tuesday, Wednesday, or Thursday, were retained. However, a total of 27 participants began rating their mood on a Friday, Saturday, or Sunday, and were excluded due to their Thursday to Sunday ratings being split between 2 weeks. In addition, 1 participant was dropped because of non-adherence to study guidelines. After excluding these 28 participants, the total sample size was 109 (76 female, 33 male). A majority (98.1%) were between the ages of 17 and 23.

Procedure

Participants provided ratings of positive and negative affect and energy, as well as reported their routine lifestyle habits (e.g., hours of sleep the night before) and daily events experienced via paper-and-pencil diaries, every 3 hours upon waking, for a seven-day period. Ratings were timed according to each person's schedule, where time 1 represents an individual's first rating of the day (which may be at 8:00 AM or 10:30 AM), rather than a fixed time of day. In other words, ratings were 'standardized' by each person's subjective experience of morning. This procedure was implemented to avoid disturbing the natural sleep-wake rhythms and mood patterns that could result from specifying a fixed time of day to begin rating; furthermore, having participants rate their mood at 9:00 AM every day, for example, would likely affect mood levels (e.g., asking someone who rises at 10:30 AM to rate their mood at 9:00 AM would negatively influence mood) and could result in fabrication of ratings at time 1. Participants noted the actual time of rating on each form.

Participants were instructed to use personal electronic devices, such as cell phones, PDAs, or wristwatches, to prompt them at each 3-hour interval. Baseline measures of personality and emotion regulation were completed online before day 1 of the study.

Measures

Affect. Affect measures were taken from the Inventory of Felt Emotion and Energy in Life (IFEEL; Little, Ryan, & Wanner, 1997), which assesses the affect, energy and self-evaluation components of positive and negative affect. Six composite items targeted each construct of interest, with individual items given as an example (e.g., "Rate the extent to which your affect has been positive (e.g., happy, glad)"). Example items of "happy" and "glad" were given with the positive affect (PA) composites, and "down" and "unhappy" were included with the negative affect (NA) composites. Similarly, "full of energy" and "lively" items, as well as "bored" and "tired", were presented with the positive energy (PE) and negative energy (NE) composites, respectively. For the purposes of this study, only the affect and energy composite items are utilized.

Event variables. Self-reporting of current events included positive and negative events of an academic and interpersonal nature. Participants indicated at each rating interval if any positive or negative events had influenced their mood in the past 3 hours. They indicated whether the event was of an academic or interpersonal nature. Example events were given for each category. Events such as 'receiving a high grade' or 'completing homework assignments' were shown as examples of positive and negative academic events, respectively; similarly, events such as 'spending time with friends or significant others' or 'fighting or arguing' were given as examples of positive and negative interpersonal events.

Covariates. Demographic information (i.e., gender and age) and dispositional factors (i.e., personality and emotion regulation) were included. Personality measures were taken from the Big Five Inventory (BFI; John, Donahue, & Kentle; 1991), and emotion regulation trait tendencies were taken from the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). Situational influences were also included; participants reported the occurrence of any atypical, impactful negative events within the past month (e.g., death of a relative, end of a romantic relationship), as well as the number of hours slept during the previous night.

Analysis

Nonlinear latent curve models. Latent curve models (McArdle, 1988; Meredith & Tisak, 1990) represent change in the response variables as some (linear or nonlinear) function of time. The shape of response trajectories may be freely estimated, particularly when conventional structures do not adequately summarize the growth pattern. Though in many cases, response trajectories follow a specified polynomial growth function (e.g., linear or quadratic functions); polynomial growth functions are characterized by a property known as dynamic consistency (Keats, 1983; Singer & Willett, 2003). Dynamic consistency has 2 defining characteristics: 1) The "curve of the averages" is equivalent to the "average of the curves"; in other words, a curve drawn from the average raw scores across all time points is identical to one that is plotted using the average of all individual growth parameters. This equivalency holds when a model is linear in its parameters. 2) Individual trajectories follow the same functional form (or shape) as the average trajectory.

Polynomial functions, however, are not always well suited to capturing all forms of change. For instance, reading ability in young children follows an exponential growth pattern; performance improves rapidly at first, and then levels off over time (Blozis, Conger, & Harring, 2007). Crime rates follow a cyclical trend and fluctuate in accordance with the changing seasons (Hipp, Bauer, Curran, & Bollen, 2004). These trends are best represented by complex nonlinear functions (e.g., exponential, sine/cosine functions), not characterized by dynamic consistency. These dynamically inconsistent functions may be specified within latent curve models by constraining the growth trajectory to follow a particular functional form. Model specification is similar to that of traditional latent curve models, in that the latent factors (i.e., random components) continue to enter the model in a linear fashion; however, parameters denoting fixed effects may enter the model nonlinearly via complex equality constraints specified in the factor loading matrix. This nonlinear latent curve modeling (NLCM) approach[1] was used to represent within- and between-day mood change, which follows sinusoidal and linear trends, respectively. Next, model specification is explained in more detail.

In matrix form, a NLCM is expressed as

$$\boldsymbol{y} = \boldsymbol{\Lambda\eta} + \boldsymbol{\varepsilon}$$

where $\boldsymbol{y}$ is a t x 1 vector of mood ratings (i.e., affect or energy) for individuals at each time point (t), $\boldsymbol{\eta}$ is an m x 1 vector for the m latent factors measuring the overall mood level and its change over time, $\boldsymbol{\Lambda}$ is a t x m matrix that specifies the functional relationship between the latent factors and observed mood ratings, and $\boldsymbol{\varepsilon}$ is a t x 1 vector of disturbance terms for each observation at each time point. My model included an $\boldsymbol{\eta}$ vector consisting of intercept, oscillation, slope, and event factors; the intercept represents the average mood level, the oscillation represents within-day mood fluctuation, the slope represents between-day

[1] NLCMs are not to be confused with nonlinear *structured* latent curve models (Blozis, 2004; Browne, 1993; Browne & du Toit, 1991), in which each component of the target function is constrained to equal the first derivative of the corresponding growth parameter; this specification allows individuals to vary with regard to specific parameters within the target function. In contrast, NLCMs represent variation in the target function as a whole rather than in each parameter.

changes in mood, and the event factor represents discontinuous change. Next, I discuss how each factor was defined in the $\mathbf{\Lambda}$ matrix.

The intercept factor (η_1) was defined by setting the first column of $\mathbf{\Lambda}$ to

$$\lambda_{t1} = 1$$

where *t* represents time; time points were scaled such that zero corresponds to the first rating on Thursday morning (i.e., day 1 of the study).

The oscillation factor (η_2) was defined by constraining the second column of $\mathbf{\Lambda}$ to:

$$\lambda_{t2} = amp * \sin(2\pi * freq * (t + phase))$$

or

$$\lambda_{t2} = amp * \cos(2\pi * freq * (t + phase))$$

where each constraint specifies the functional form of a sine and cosine wave (Sit & Poulin-Costello, 1994). The sine function and its phase characteristic (description to follow) best represent positive mood fluctuation, and the cosine function and characteristics represent negative mood fluctuation.[2] The loadings for the oscillation factor, which represents the height of the wave series (i.e., amount of oscillation), were expressed as a function of time (*t*) and 3 additional parameters, amplitude (*amp*), frequency (*freq*), and phase.

As mentioned, *t* represents each time point (or rating). The *amp* parameter represents the peak wave height (as measured from its center position) and was freely estimated to allow waves to peak at different estimated magnitudes. The *freq* parameter represents the wave frequency, defined as the number of complete wave cycles per unit of time. Wave frequency may be estimated, particularly if the rate of cycling is unknown or inconsistent; however, given a strong expectation that the number of cycles correspond with a specific interval length (e.g., the 24-hour light-dark period), the *freq* parameter was fixed at a particular value. The phase parameter represents the starting point of the wave (or the amount of

[2] Sine and cosine functions represent identical wave forms that differ only by their location on the X axis. See Appendix A for a description of the basic sine/cosine wave components. Though either function could be used to model both positive and negative mood, specifying that which corresponded most closely to the observed positive/negative mood pattern resulted in higher convergence rates and fewer out-of-bounds estimates.

shift from the zero point on the X-axis). With a zero starting point, sine waves peak at the quarter-point of the interval (or $\pi / 2$, given a standard wavelength of 2π), and cosine waves peak at the zero point. The phase was estimated to allow each complete wave series (over the 7 days) to begin at a different starting point (i.e., have a different amount of shift).[3]

The linear slope factor (η_3) was defined by setting the third column of $\mathbf{\Lambda}$ to

$$\lambda_{t3} = d$$

where *d* corresponds to day of the week and represents 7 blocks of consecutive time points. However, I did not expect a consistent linear increase from Thursday (day 1) to Wednesday (day 7); Sunday, which represents a transition point to the new week, coincides with an abrupt shift in mood. Given this discontinuity, the values of *d* were adjusted accordingly.

The Sunday event factor (η_4) was defined by setting the fourth column of $\mathbf{\Lambda}$ to

$$\lambda_{t4} = 1$$

only where values of *t* represent time points from Sunday through Wednesday (i.e., the new week). Factor loadings were fixed to 0 for values of *t* that correspond to Thursday, Friday, and Saturday ratings.

In sum, each factor represents one aspect of mood change: the baseline mood level (on Thursday), systematic within-day oscillation, between-day growth, and discontinuous change. These latent factors are treated as outcomes, which in turn are predicted by a set of explanatory variables (i.e., covariates and focal predictors). This capability is crucial in evaluating the mechanisms underlying daily mood change.

Orthogonalization of focal event predictors. Daily events are associated, in part, with the day of the week in which they occurred; for instance, events of an academic nature are more likely to arise when classes are in session (i.e., Monday through Friday), and the frequency of interpersonal exchanges is likely to increase at the end of the week (i.e., Thursday, Friday, Saturday). To examine whether events influence mood above and beyond day of the week, event predictors must be uncorrelated from day of the

[3] Unique phase shifts can be estimated for each wave in the series; however, in the interest of simplicity, only 1 phase was estimated for the entire wave series.

week; this disentangling of components was achieved by removing the day influence from events via regression analyses, with the residuals to be output and retained as the focal event predictors.

First, to determine which regression analysis was most suitable, I examined the characteristics and distribution of event variables. Raw event variables represent counts of events that influenced mood in a positive or negative way since the last rating period (3 hours prior). Event counts of positive and negative academic and interpersonal events were summed within each day; four variables representing positive and negative academic and interpersonal event totals were created. These newly created event totals have 2 important characteristics: 1) Event totals follow a Poisson distribution, and 2) event totals are nested within person. Thus, a multilevel Poisson regression analysis (i.e., based on the generalized linear model) is most suitable, provided that any overdispersion[4] is accounted for. This analysis accounts for nonindependence of observations due to the nested data structure and can model non-normal outcomes via specification of an appropriate link function.

A multilevel Poisson regression was conducted in SAS (using PROC GLIMMIX); 6 dummy coded day-of-the-week predictors were used to predict each of the 4 event variables. Positive academic, positive interpersonal, and negative interpersonal event totals, did not exhibit any overdispersion, as indicated by the χ^2/df ratio.[5] Negative academic event totals, however, displayed a slight overdispersion ($\chi^2/df = 1.04$). To account for this tendency, the model was adjusted by a scaling factor (φ), which corrects the bias in standard errors.[6] See Appendix B for multilevel Poisson regression estimates and χ^2/df ratios from all 4 models.

Four variables containing Pearson residuals were output from these regression analyses; Pearson residual values are the standardized difference between observed and expected (i.e., model-predicted) counts. Adjusted residuals were calculated by dividing by the standard error of the residuals, which has

---

[4] Overdispersion is the tendency for the data to have greater variability than that predicted by the model's random component. A Poisson distribution has an identical mean and variance (i.e., 1 estimated parameter), though the variance is often greater than the mean.

[5] A χ^2/df ratio greater than 1.0 is an indication of overdispersion.

[6] The scaling factor, φ, is the ratio of χ^2/df. A model adjustment was made by multiplying the covariance matrix of parameter estimates by φ, which corrects the downward bias in standard errors and protects against Type I errors.

the desirable effect of increasing the range of residuals and making the definition of 'large' more clear. Finally, these adjusted residuals were averaged across days for each individual. Four variables containing average adjusted residuals for positive and negative academic and interpersonal events were used as the focal event predictors.

Model Building and Specification

Model building was accomplished in 5 steps. Steps 1-3 involve constructing a baseline model; that is, fitting intercept and slope factors to model average mood levels and change patterns. Steps 4-5 involve adding covariate and event variables as predictors of mood change. Each step is described in depth with regard to model specification.

Step 1. A Thursday intercept factor (η_1) was included to model the average mood level throughout the week. All items loaded onto the factor and were fixed at 1.0. Residual variance components were correlated from one time point to the next. Correlated residuals within each day were constrained to equality, such that 1 estimate was specified for all within-day residual covariances. The 6 correlated residuals between each day (e.g., Thursday night to Friday morning) were also equated.

Step 2. Oscillation (η_2) was added to represent the systematic within-day fluctuation of mood. The factor loadings were constrained to nonlinear sine and cosine functions, with each parameter specified as follows: The time (*t*) parameter was fixed to represent the time interval, where time 0 represented the first rating on Thursday morning. The frequency (*freq*) parameter was fixed to 1/8, which corresponds to one waveform for every 8 time points (or 24 hours, where 1 time point corresponds to a 3-hour interval). The phase parameter was freely estimated, with one parameter representing the same amount of shift for each wave series. Two amplitude (*amp*) parameters were estimated, one for the weekdays (Sunday-Thursday) and another for the weekends (Friday-Saturday).[7] A non-significant

[7] A model with 1 freely estimated *amp* parameter is nested within a model having 2 *amp* parameters. PA, PE, and NE models with 2 *amp* parameters had significantly better fit than those with 1 *amp* parameter, (PA $\Delta\chi^2(1)= 10.854$; PE $\Delta\chi^2(1) = 23.953$; NE $\Delta\chi^2(1) = 16.858$; all ps < .01). For NA, the improvement in model fit was approaching significance ($\Delta\chi^2(1)= 3.555$, p<.06).

oscillation mean and variance indicates that no within-day fluctuation is present (i.e., the oscillation is zero), and for purposes of simplification, may be removed from the baseline model.

Step 3. Linear slope (η_3) and Sunday event (η_4) factors were added to represent systematic day-to-day mood change, as well as discontinuous, abrupt shifts in mood. Linear slope factor loadings corresponding to each of 7 daily sets of indicators were fixed at 0, 1, 2, 0, 4, 5, and 6, to represent systematic growth throughout the 7-day period (specifically, from Thursday to Saturday, and from Sunday to Wednesday).[8] The Sunday event factor accounted for the abrupt change in mood on Sunday, occurring in anticipation of the coming week. Sunday event factor loadings for the sets of indicators from days 4-7 (i.e., Sunday, Monday, Tuesday, and Wednesday) were fixed at 1.0, with all others (from days 1-3, Thursday, Friday, and Saturday) fixed at zero. See Figure 1a for a diagram of the baseline model, incorporating intercept, oscillation, slope, and event factors.[9]

Step 4. Covariates, including demographics (gender, age), dispositional traits (extraversion, neuroticism, reappraisal), and a situational factor (experiencing any negative events of significance in the past month) were included as predicting the intercept, oscillation, linear slope, and event factors. Sleep (i.e., hours slept the night before) was included as another situational factor, which measured average sleep throughout the study period (from Thursday onward); however, due to issues of temporal precedence, sleep cannot predict the Thursday intercept and was specified to predict only the oscillation, linear slope, and Sunday event factors.

Step 5. Focal event variables (i.e., average adjusted residuals for positive and negative academic and interpersonal events), were included as predictors of the oscillation, linear slope, and event factors. Residual event totals reflect those occurring from Thursday onward and were not used to predict initial

---

[8] Comparison of separate Thursday-Saturday and Sunday-Wednesday slopes indicated equivalent rates of change (PA $\Delta\chi^2(1)= 2.741$; NA $\Delta\chi^2(1)= 2.026$; PE $\Delta\chi^2(1)= 0.364$; NE $\Delta\chi^2(1)= 1.482$; all ps>.05). One linear slope was sufficient to represent the systematic day-to-day change across weekdays.

[9] The path diagram depicts each daily subset as consisting of 5 indicators. Response categorization (into 5 time points) is addressed in the Results section.

Thursday mood levels. See Figure 1b for the full model with covariates and focal event predictors included.

Results

I begin by addressing preliminary analyses, which include participant response characteristics and temporal categorization of mood ratings. Next, I report descriptives of mood ratings, event variables, and covariates, followed by a report of model fit and evaluation. Finally, I address the results for the 3 hypotheses and conclude with a general summary.

Response Characteristics

On average, participants reported their affect and energy approximately 4 times per day (between the hours of 8:00 AM and 10:59 PM) over the 7-day period. The average number of daily ratings was relatively consistent, with averages ranging from a minimum of 3.57 ratings to a maximum of 4.40 ratings per day. See Table 1a for the mean number of ratings for positive and negative affect and energy by day.

With regard to rating consistency, most participants adhered to study guidelines and consistently rated their mood in 3-hour intervals. Approximately 84-92% of participants rated their mood at least 3 times per day for a majority of the week (i.e., 5 or more days). Though less than half of participants (33-34%) provided 3 or more daily affect ratings on all 7 days; a slightly higher percentage of 41% provided 3 or more energy ratings on all days. A minority of participants rated their mood infrequently; 7% of participants failed to rate their mood consistently, providing 3 or more ratings for less than half of the week (i.e., 0-3 days). See Table 1b for participant rating consistency by number of days rated.

Temporal Categorization of Mood Ratings

Mood ratings were reported at 3-hour intervals throughout the day, with participants completing the first rating within the first 15 minutes after they woke up. For analysis purposes, ratings needed to be re-categorized according to the actual time of day; this categorization was accomplished by assigning ratings into a series of bins, with each bin spanning a 3-hour interval (to coincide with the 3-hour interval rating instructions).[10] In order to identify the lower boundary (i.e., start time) for bin 1, two distributions were examined; the first distribution representing the frequency of morning ratings (i.e., the first rating of the day) by hour of day, and the second representing the frequency of all ratings (from morning to night) by hour of day.

Morning ratings were reported anywhere from 4:00 AM to 3:00 PM, with a majority of ratings (81%) occurring in the interval from 7:00-10:59 AM; this distribution is plotted in Figure 2a. Examination of rating frequency by time of day revealed 5 peak rating times; the first rating occurred at 10 AM (or within the hour, 10:00-10:59 AM), followed by ratings occurring around 1 PM, 4 PM, 7 PM, and 10 PM, as plotted in Figure 2b. These peak rating times served as the mid-point for each bin. The interval boundaries were selected with regard to minimizing the number of ratings on the cusp between successive intervals (i.e., minimizing the loss of information resulting from categorization). With these considerations in mind, five 3-hour bins were selected: Time 1 (i.e., bin 1) was from 8:00-10:59 AM, time 2 from 11:00 AM-1:59 PM, time 3 from 2:00-4:59 PM, time 4 from 5:00-7:59 PM, and time 5 from 8:00-10:59 PM.

Descriptives

Mood ratings. Mean affect and energy levels followed the expected patterns, with peak mood levels occurring in conjunction with a specific time of day and day of the week. Energy levels exhibited a within-day fluctuation consistent with light-dark cycles; positive energy increased until mid-day before tapering off, and negative energy followed a mirrored pattern, peaking in the morning and dropping as the day progressed. These within-day patterns were also observed in positive and negative affect, but to a lesser degree. See Figures 3a and 3b for a plot of affect and energy levels. Mood change from day-to-day also followed a marked trajectory which was aligned with the day of the week. Positive affect and energy peaked on Saturday (affect: M=5.17, SD=1.34; energy: M =4.95, SD =1.48), before dropping to their

[10] Categorization (i.e., polytomization, dichotomization) of continuous variables (e.g., time) is known to be problematic and can yield misleading results (MacCallum, Zhang, Preacher, & Rucker, 2002). Creating a series of 1-hour bins may circumvent this issue, but at the expense of model convergence and estimation. Under the circumstances, the current approach is deemed the most appropriate.

lowest levels on Sunday (energy: M = 4.41, SD =1.46) and Monday (affect: M = 3.34, SD =1.56), and then increasing steadily throughout the week. Negative affect and energy followed a complementary trajectory, dropping to their lowest levels on Friday (M =2.25, SD =1.28) and Saturday (M =2.93, SD =1.55), before spiking on Sunday (affect: M =2.70, SD =1.45; energy: M =3.37, SD =1.53). Means and standard deviations for each day are presented in Table 2.

Missing values accounted for 19.1% of the data; however, 13.6% were due to participants who began the study on a Monday, Tuesday, or Wednesday, and completed their week's ratings before the following Wednesday. As a result, only 5.5% of missing values were due to missing a scheduled rating period. No other consistent missing data patterns were observed, so values were assumed to be missing at random. Missing values were handled via full-information maximum likelihood estimation procedures.

Event predictors. A majority of participants reported at least 1 event that influenced their mood throughout the study. Approximately 79% reported a positive academic event, 85% reported a negative academic event, 80% reported a positive interpersonal event, and 61% reported a negative interpersonal event. On a daily basis, however, experiencing an influential academic or interpersonal event occurred less than 50% of the time. Positive and negative academic events were reported on approximately 33% and 37% of days, respectively. Positive and negative interpersonal events were reported on approximately 39% and 21% of days, respectively. A maximum of 6 events per day were reported. See Tables 3a and 3b for the event reporting frequencies at the person and day levels. Means and standard deviations for the average adjusted residual event counts (from which day of the week effects are removed) are reported in Table 4. Overall, participant residual event scores were slightly below expected counts (ranging from -.31 to -.40).

Covariates. A majority of participants were female (69.7% female, 30.3% male), and on average, they were 19 years of age. Participants received approximately 7.4 hours of sleep per night, which included weekdays and weekends. Approximately 17.1% reported experiencing a negative event of significance (e.g., death of a relative, serious illness, parents' divorce) in the previous month. Means and standard deviations of age, extraversion, neuroticism, reappraisal, and sleep, are presented in Table 5.

Model Fit and Evaluation

Analyses were conducted using Mplus version 6.11 (Muthén & Muthén, 1998-2010). Model fit was evaluated via the chi-square statistic, the root mean square error of approximation (RMSEA; Browne & Cudeck, 1993; Steiger & Lind, 1980), the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis index (TLI; Tucker & Lewis, 1973), and the standardized root mean residual (SRMR). The CFI and TLI indices were recalculated using an appropriate longitudinal null model, which fixes all item covariances at zero and constrains the indicator means and variances to be equal over time (Widaman & Thompson, 2003).[11]

Overall, baseline affect and energy models had acceptable fit, though NA and NE had the least adequate fit. The PA model fit well, indicating that the intercept, oscillation, linear slope, and event factors were satisfactorily reproducing the observed day-to-day relationships. The NA model, however, had slightly worse fit as indicated by lower CFI and TLI values (CFI=.883, TLI=.873). The PE model was also acceptable in representing the within- and between-day change in energy. In comparison, the NE model had slightly worse fit, similar to that of NA. SRMR values were relatively consistent, ranging from .119 to .141. See Table 6 for model fit information. Model-implied trajectories are represented in Figures 4a and 4b.

Although most indices were just beyond the range of established model fit criteria (Browne & Cudeck, 1993; Hu & Bentler, 1999), I evaluated these results less stringently for the following reasons: 1) NLCMs represent a newer approach to analyzing mood data, and at present, no precedent of model fit can be found in existing mood literature. More latitude should be given when evaluating statistical applications in 'new' areas. 2) NSCLMs, as extensions of growth curve models, attempt to reproduce

[11] CFI and TLI values provided by Mplus are calculated using the standard independence null model as the baseline model. This calculation assumes that the worst-fitting model is one that has heterogeneous item variances and no item covariances, which is more appropriate for single group, single time point models. This specification is not appropriate for longitudinal models, given the null expectation that means and variances of an indicator do not change over time.

mean and covariance structures. Model misspecification may result from either or both structures, and the potential for misspecification is increased (Wu & West, 2010). 3) Finally, I expected some amount of model misspecification due to the impossibility of including all potential influences, particularly time-varying covariates, of daily mood change. By definition, models are imperfect approximations of real-world phenomena and are not expected to reproduce observed relationships to an exact degree (MacCallum, 2003). With these points in mind, I consider the baseline models as exhibiting acceptable levels of fit.

Hypotheses 1a, 1b: Patterns of Mood Change

Baseline model results are described with regard to within- and between-day change. Estimates are presented in Table 7.

> *Hypothesis 1a:* Affect does not oscillate during the day, but changes in accordance with the day of the week. The direction of day-to-day change depends on valence. Positive affect increases at a linear rate throughout the week but declines on Sunday. Negative affect decreases at a linear rate throughout the week but increases on Sunday.

Within-day change. The mean oscillation for both positive and negative affect was nonsignificant ($p>.05$), which indicates that affect does not oscillate according to the time of day. In addition, the variance of both factors was nonsignificant ($p>.05$). These results indicate that no within-day fluctuation was present (i.e., with oscillation not significantly different from zero), and the oscillation factor may be removed from each model.

Between-day change. For PA, the day-to-day linear increase was significant ($\alpha=.044$, SE=.014, $p<.01$) as well as the drop in PA on Sunday ($\alpha= -.406$, SE=.080, $p<.01$). Though people did not vary in the linear rate of increase ($p>.05$), they varied in their decrease in PA on Sunday ($\psi=.325$, SE=.086, $p<.01$). These results indicate that the change in PA conforms to the expected patterns and directions as hypothesized. For NA, the day-to-day linear decrease was not significant ($p>.05$), though the rate of decrease varied across individuals ($\psi=.010$, SE=.004, $p<.01$). However, NA increased significantly on Sunday ($\alpha=.322$, SE=.081, $p<.07$), and this change in NA also varied from person to person ($\psi=.380$, SE=.097, $p<.01$).

Hypothesis 1b: Energy fluctuates in accordance with time of day and day of the week. The pattern and direction of change depends on valence. Within-day positive energy is highest in the early afternoon, and within-day negative energy is highest in the morning. From day to day, positive energy increases at a linear rate throughout the week but declines on Sunday. Negative energy decreases at a linear rate throughout the week but increases on Sunday.

Within-day change. The mean oscillation for PE was significant (α =.202, SE=.037, p<.01), with Friday and Saturday energy levels reaching a higher magnitude than those from Sunday through Thursday. In addition, PE had an estimated phase shift of -.642, which indicates that PE peaked during the interval between 3:56 PM–6:55 PM (i.e., .642 intervals or 116 minutes from the zero point, Time 1).[12] Oscillation varied across individuals (ψ=.051, SE=.003, p<.01), indicating that individual within-day mood patterns differed from the average trajectory implied by the wave series. The mean oscillation for NE was significant (α =.150, SE=.035, p<.01), with the peak on Friday and Saturday reaching higher levels than the Sunday-Thursday peak. NE had an estimated phase shift of 1.232, which indicates that NE peaked during the interval between 4:20 AM–7:19 AM (i.e., 1.232 intervals or 222 minutes before the zero point, Time 1).[13] As with PE, oscillation varied across individuals (ψ=.050, SE=.000, p<.01).

Between-day change. For PE, the day-to-day linear increase was significant (α=.035, SE=.014, p<.05) as well as the drop in PE on Sunday (α= -.347, SE=.078, p<.01). Though participants did not vary in the rate of increase (p>.05), they varied in their decrease in PE on Sunday (ψ=.249, SE=.082, p<.01). These results indicate that the change in PE was as hypothesized and followed the same patterns as PA. For NE, the day-to-day linear decrease was not significant (p>.05), though the rate of decrease varied across individuals (ψ=.008, SE=.004, p<.05). NE increased abruptly on Sunday (α=.343, SE=.084, p<.01), and this increase also varied from person to person (ψ=.303, SE=.101, p<.01).

[12] The phase parameter is negative, but the shift occurs in a positive direction. Subtracting a negative phase value from X (as indicated in the functional form) results in a forward shift. The estimated phase is -.642, which suggests a phase shift of .642 intervals beyond the zero point (i.e., Time 3, or the quarter-point of a 24-hour interval). One interval is equivalent to 3 hours (or 180 minutes), so 180 min * (-.642) = -116 minutes. Since Time 3 represents an interval from 2:00-4:59 PM, PE peaks at Time 3 + 116 minutes, or in the interval from 3:56 PM – 6:55 PM.

[13] A phase parameter with a positive sign indicates a reverse shift. The estimated phase of 1.232 suggests a phase shift backward in time, which corresponds to 222 minutes before the zero point (i.e., Time 1). Since Time1 represents an interval from 8-10:59 AM, NE peaks at Time1 - 222 minutes, or in the interval from 4:20 AM – 7:19 AM.

Hypothesis 2: Factors Influencing Within-day Change

> *Hypothesis 2:* Controlling for covariate effects, within-day changes in positive and negative energy are due to daily academic and interpersonal events, above and beyond the time of day.

Positive academic events influenced PE (β= .074, SE=.036, p<.05); for each 1-unit increase in residual PE, the oscillation increased by 9.1%.[14] The NE oscillation was not affected by any focal events. Significant covariate effects were observed for NE, but not PE. Reappraisal, or the tendency to regulate mood, influenced NE (β= -.134, SE=.054, p<.05), with each 1-unit increase in trait reappraisal associated with a 20.5% decrease in NE oscillation. Negative events experienced in the past month also had an effect on NE. Having recently experienced a negative event of significance increased the oscillation of NE by 11.6%. These predictors, in part, accounted for 23% of the variance in PE within-day fluctuation and 33% of the variance in within-day NE fluctuation. PE and NE estimates are presented in Tables 8a and 8b, respectively.

Hypothesis 3a, 3b: Factors Influencing Day-to-day Change

> *Hypothesis 3a:* Controlling for covariate effects, changes in positive and negative affect are due to day-of-the-week associations and are not influenced by daily academic and interpersonal events.

Positive Affect. Academic events influenced mood on Sunday, with negative academic events predicting lower PA levels (or a steeper drop in PA from Thursday; β= -.247, SE=.099, p<.05). Focal events did not influence day-to-day change in PA. Personality covariates influenced initial PA on Thursday; more extraverted individuals had higher levels of PA (β=.238, SE=.085, p<.01), whereas individuals with higher neuroticism had less PA (β= -.336, SE=.102, p<.01). These predictors, in part, accounted for 41% of the variance in initial Thursday PA levels, 13% of the variance in PA on Sunday, and 12% of variance in the day-to-day change. PA estimates are displayed in Table 9a.

Negative Affect. A similar pattern of results was observed for NA, though in the opposite expected direction. Academic events influenced the mood on Sunday, with positive academic events predicting lower NA levels (or less of a spike/jump in NA from Thursday; β= -.229, SE=.101, p<.05) and

---

[14] This percentage is calculated by dividing the covariate effect by the oscillation intercept. A 1-unit increase in residual PE increases the magnitude of oscillation by .074 / .817 = 9.1%.

negative academic events predicting greater NA levels (or a steeper increase in NA from Thursday; β= .222, SE=.097, p<.05). Focal events did not influence day-to-day change in NA. Personality covariates also accounted for initial NA levels on Thursday; more extraverted individuals had less NA (β= -.240, SE=.084, p<.01), whereas individuals with higher neuroticism had more NA (β= .372, SE=.101, p<.01). These predictors, in part, accounted for 47% of the variance in initial Thursday NA levels, 17% of the variance in NA on Sunday, and 7% of the variance in day-to-day change. NA estimates are displayed in Table 9b.

Hypothesis 3b: Controlling for covariate effects, changes in positive and negative energy are due to daily academic and interpersonal events, above and beyond day-of-the-week associations.

Positive Energy. Negative academic events influenced Sunday energy levels, with negative academic events predicting lower PE levels (or a steeper drop in PE from Thursday; β= -.280, SE=.079, p<.01). Focal events did not influence day-to-day change in PE. Personality covariates influenced initial PE on Thursday; more extraverted individuals had higher levels of PE (β=.310, SE=.104, p<.01), whereas individuals with higher neuroticism had less PE (β= -.376, SE=.125, p<.01). These predictors, in part, accounted for 38% of the variance in initial Thursday PE levels, 35% of the variance in PE on Sunday, and 65% of variance in the day-to-day change in PE. Estimates are displayed in Table 8a.

Negative Energy. Positive interpersonal events influenced day-to-day change in NE, with higher residual event counts predicting a sharper decrease in NE (β= .042, SE=.018, p<.05); in other words, positive exchanges resulted in feeling less tired or bored. Negative academic events influenced energy on Sunday (β= .256, SE=.087, p<.01), with higher residual event counts resulting in more NE; in other words, more negative academic events predicted low energy levels (or by extension, feeling bored and uninterested). Significant covariate effects were also observed. Neuroticism influenced NE levels on Thursday; individuals with higher neuroticism had higher levels of NE (β= .501, SE=.0=138, p<.01). Reappraisal influenced NE in an unexpected direction (β=.233, SE=.119, p<.06); individuals with a higher tendency to use reappraisal strategies had higher NE levels on Thursday. These predictors, in part, accounted for 35% of the variance in initial Thursday NE levels, 28% of the variance in NE on Sunday, and 52% of the variance in day-to-day change in NE. Estimates are displayed in Table 8b.

Summary

Mood change followed hypothesized patterns, with these patterns varying by dimension. Affect exhibited no within-day oscillation, whereas energy levels fluctuated throughout the day; positive energy peaked in the late afternoon, and negative energy (i.e., fatigue) peaked in the early morning. Furthermore, positive affect and energy displayed a steady increase from day to day, whereas negative affect and energy did not change systematically. All mood components, however, changed abruptly on Sunday. In addition, results showed that these patterns were influenced by different event factors; though regardless of mood dimension, personality consistently influenced initial mood levels, which is consistent with previous research.

Controlling for covariate effects, events influenced abrupt changes in affect (i.e., on Sunday) but not systematic, day-to-day changes. Positive academic events resulted in better Sunday mood (i.e., decreased NA), and negative academic events resulted in worse Sunday moods (i.e., decreased PA, increased NA). Day-to-day changes in affect were attributed to day of the week effects.

Similarly, events influenced abrupt changes in energy (i.e., on Sunday) but had differential effects on within- and between-day changes. Positive academic events resulted in increased within-day oscillations of positive energy, but not negative energy. Positive interpersonal events resulted in feeling less tired (i.e., decreased NE) from day to day but did not impact positive energy. Within-day oscillations of negative energy and systematic day-to-day changes in positive energy were attributed to time of day and day of the week, respectively. Negative academic events resulted in feeling less energized and active on Sunday (i.e., decreased PE), as well as more uninterested and bored (i.e., increased NE).

Discussion

These results suggest that time and day play a significant role in shaping our everyday moods. Previous studies have found evidence of similar diurnal rhythms and weekend effects; however, the extent to which mood rhythms were influenced by time and day, beyond the co-occurrence of daily events, was unknown. The main contribution of this study is in the partitioning of temporal and event components, which allow for evaluation of unique time and day influences. In addition, this study utilizes multiple mood ratings per day, which yield more reliable results (at the day level) than those based on once-per-day measurements. In the sections that follow, I address the implications for affect theory and research, acknowledge various limitations of this study, and propose directions for future research.

Implications for Affect Theory and Research

More researchers are beginning to view positive and negative mood as separable (unipolar) dimensions in the ongoing bipolarity debate (Cacioppo & Gardner, 1999; Carver, 2001; Rafaeli & Revelle, 2006; Watson et al., 1999). The current findings provide additional support for positive and negative mood components as belonging to unipolar dimensions; specifically, the patterns of and influences on mood change differed by valence. With regard to day-to-day trajectories, positive, but not negative, mood (i.e., affect and energy) showed a consistent rate of change throughout the week. Though each component showed an abrupt change on Sunday, negative affect was slightly more sensitive to academic events than positive affect; both positive and negative academic events influenced negative affect, whereas only negative academic events influenced positive affect. In addition, positive academic events increased within-day energy levels (i.e., positive energy) but had no effect on curbing fatigue (i.e., negative energy). These differences in trajectory and sensitivity suggest that positive and negative mood should be measured and assessed as separate (but not necessarily orthogonal) unipolar dimensions. As noted by many researchers, measuring affect with unipolar items minimizes the potential loss of information and is the least restrictive (Barrett & Russell, 1998; Rafaeli & Revelle, 2006).

Consistent with previous research (Egloff et al., 1995; Kahneman et al., 2004), mood (i.e., energy) levels fluctuate systematically from morning until night; positive energy peaked in the middle of the day, and negative energy exhibited an opposite V-shaped quadratic pattern. This fluctuation follows a sinusoidal pattern and coincides with a 15-hour segment (i.e., from 8:00 AM to 10:59 PM) within an individual’s circadian rhythm. This mapping of affective fluctuation to circadian rhythms indicates, by extension, that mood change has biological origins. Circadian rhythms (i.e., physical, mental and behavioral changes that follow a 24-hour cycle) are regulated by the suprachiasmatic nucleus (SCN); that is, a group of nerve cells located in the hypothalamus. The SCN controls production of melatonin, a hormone that responds to light-dark cycles, which is responsible for regulating sleep-wake patterns. This biological basis explains, in part, why focal events influenced mood rhythms to a lesser degree; by comparison, melatonin supplements have been shown to effectively treat sleep disorders and reduce jet lag by inducing phase shifts in daily rhythms (Arendt, Skene, Middleton, & Lockley, 1997; Cajochen, Kräuchi, & Wirz-Justice, 2003).

Implications for day-to-day mood change also extend to cognition, and how we perceive time (i.e., day of the week). Despite any (negative) events experienced, positive affect and energy continued to increase systematically as the weekend approached. This increase was not sensitive to other influences (internal and external), which implies that day-of-the-week perceptions predict mood more accurately than daily experiences. This finding is quite striking; our perceptions of day of the week appear to be dictating our daily moods[15].

Limitations and Directions for Future Research

Neither dispositional nor situational factors influenced day-to-day change in weekday affect and positive energy, which implies that weekday mood change is primarily due to day of the week. However, this result may be due to the treatment of time-varying (and other situational) predictors as time-invariant. Event counts, measured repeatedly within and between days, were averaged to conform to the structure of the NLCM. A NLCM, as a specialized latent curve model, resembles a single-level structural equation model. Multilevel data (involving repeated measurements) are incorporated by structuring the repeated measurements in ‘wide’ format within the data file, such that repeated measurements (i.e., affect ratings from time 1 to time 35) are included as separate variables, with each row of data corresponding to one

[15] Approximately 49% and 30% of participants reported that their moods were highest on Fridays and Saturdays, respectively.

individual. Including event predictors in their original time-varying form would likely increase their predictive power; however, this approach would require the creation of numerous time- and day-specific predictors for incorporation within the NLCM, and is usually not recommended.[16]

Another unexamined influence of weekday mood change could be the anticipation of future events, rather than immediate or recent experiences. The weekend, itself, can be viewed as an 'event', or an interval of time that we look forward to, regardless of how we choose to structure the time. In this light, our moods may change according to our expectations; thus, positive mood is likely to increase at the end of the week, followed by an increase in negative mood as the new week begins.

To test this theory, two variables reflecting the presence of anticipated events were included as predictors of the baseline mood factors (excluding the Thursday intercept).[17] One variable represented the number of days leading up to the weekend (i.e., from Thursday through Saturday) in which individuals anticipated one or more events to take place, and another represented the number of days from Sunday through Wednesday.[18] Results showed that the expectation of future events did not influence day-to-day changes in affect; however, anticipating events at the beginning of the week (Sunday through Wednesday) resulted in heightened positive energy oscillations ($p<.05$). See Appendix C for the anticipated event frequencies and parameter estimates for the affect and energy models.

Another explanation for the strong weekday influence (or non-significance of focal event predictors) may involve the specification of the linear slope factor as representing day-to-day mood change. The current approach assumes that pre-weekend change is conceptually similar to post-weekend change and is adequately represented by 1 linear slope factor. Given that the Thursday-to-Wednesday

---

[16] Including time-varying predictors requires transposing multilevel data to create person-level variables that contain specific time- or day-level information. While these procedures are easily done, including all relevant predictors would drastically increase the number of estimated parameters. Given the current sample size and general feasibility, this approach was avoided.

[17] Events could span numerous categories (i.e., academic, financial, personal, interpersonal, or other).

[18] Dummy coded event variables for each day (i.e., indicating the presence or absence of anticipated event(s) for that day) were summed across each interval. Anticipated event variables reflect the number of days in which (positive or negative) events of note were expected. A maximum of 3 days could be reported for the Thursday-Saturday period, and a maximum of 4 days for the Sunday-Wednesday period.

sequence is an equivalent representation of the Sunday-to-Saturday sequence, weekday change (from Monday to Friday) was expected to be qualitatively, as well as quantitatively, similar.[19] However, pre-weekend change could be substantively different from post-weekend change; in which case, each change segment should be represented by a separate linear slope. Future research could differentiate between these subsets of change by examining distinct pre- and post-weekend components.

This study examined temporal influences in college students, whose schedules were structured according to the academic calendar. Other extensions might examine temporal influences in less structured time periods, such as during summer vacation or winter break (for student populations). The influence of time, and in particular, day of the week, may be somewhat diminished if individuals are evaluated during relatively unstructured periods (without the routine obligations of school, work, etc). In addition, special populations might be studied (e.g., retirees, night workers) to examine if these patterns still hold, and if so, to what extent. The mechanisms underlying systematic mood change are likely to differ across groups, particularly in those with markedly different schedules.

[19] As illustrated by $\Delta\chi^2$ tests, the rates of Thursday-Saturday and Sunday-Wednesday change were quantitatively similar and adequately represented by 1 linear slope.

References

Agresti, A. (2007). *An Introduction to Categorical Data Analysis*. Hoboken: John Wiley & Sons.

Almagor, M. & Ehrlich, S. (1990). Personality correlates and cyclicity in positive and negative affect. *Psychological Reports*, *66(3)*, 1159-1169.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Arendt, J., Skene, D.J., Middleton, B., & Lockley, S.W. (1997). Efficacy of melatonin treatment in jet lag, shift work, and blindness. *Journal of Biological Rhythms, 12,* 604-617.

Areni, C.S., & Burger, M. (2008). Memories of “bad” days are more biased than memories of “good” days: past Saturdays vary, but past Mondays are always blue. *Journal of Applied Social Psychology*, *38(6),* 1395–1415.

Barrett, L.F., & Russell. J.A. (1998). Independence and bipolarity in the structure of affect. *Journal of Personality and Social Psychology*, *74,* 967-984.

Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107,* 238-246.

Blozis, S.A. (2004). Structured latent curve models for the study of change in multivariate repeated measures. *Psychological Methods*, *9(3),* 334–353.

Blozis, S.A., Conger, K.J., & Harring, J.R. (2007). Nonlinear latent curve models for multivariate longitudinal data. *International Journal of Behavioral Development*, *31(4),* 340-346.

Bolger, N., & Schilling, E.A. (1991). Personality and the problems of everyday life: The role of neuroticism in exposure and reactivity to daily stressors. *Journal of Personality*, *59(3)*, 355-386.

Bolger, N., DeLongis, A., Kessler, R.C., & Schilling, E.A. (1989). Effects of daily stress on negative mood. *Journal of Personality and Social Psychology*, *57(5),* 808-818.

Brickman, P., & Campbell, D. T. (1971). Hedonic relativism and planning the good society. In M. H. Appley (Ed.), *Adaptation level theory: A symposium* (pp. 287–302). New York: Academic Press.

Brickman, P., Coates, D., & Janoff-Bulman, R. (1978). Lottery winners and accident victims: Is happiness relative? *Journal of Personality and Social Psychology, 36(8),* 917-927.

Browne, M.W. (1993). Structured latent curve models. In C.M. Cuadras & C.R. Rao (Eds.), *Multivariate analysis: Future directions 2* (pp. 171–198). Amsterdam: Elsevier Science.

Browne, M.W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen & J.S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage.

Browne, M.W., & Du Toit, S.H.C. (1999). Models for learning data. In L.M. Collins & J.L. Horn (Eds.), *Best methods for the analysis of change* (pp. 47–68). Washington, DC: American Psychological Association.

Cacioppo, J.T., & Gardner, W.L. (1999). *Emotion*. Annual Review of Psychology, 50, 191-214.

Cajochen, C., Kräuchi, K., & Wirz-Justice, A. (2003). Role of melatonin in the regulation of human circadian rhythms and sleep. *Journal of Neuroendocrinology*, *15(4),* 432-437.

Carver, C.S. (2001). Affect and the functional bases of behavior: On the dimensional structure of affective experience. *Personality and Social Psychology Review*, *5*, 345-356.

Cattell, R. B. (1963). The structuring of change by P-technique and Incremental R-technique. In C. W. Harris (Ed.), *Problems in measuring change* (pp. 167-198). Madison: University of Wisconsin Press.

Chapple, E.D. (1970). *Culture and Biological Man: Explorations in Behavioral Anthropology*. New York: Holt.

Clark, L.A., & Watson, D. (1988). Mood and the mundane: Relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology, 54,* 296-308.

Clark, L.A., Watson, D., & Leeka, J. (1989). Diurnal variation in the positive affects. *Motivation and Emotion*, *13,* 205-234.

Costa, P., & McCrae, R.R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology, 38(4),* 668-678.

Costa, P., McCrae, R.R., & Zonderman, A.B. (1987). Environmental and dispositional influences on well-being: Longitudinal follow-up of an American national sample. *British Journal of Psychology, 78(3),* 299-306.

Cranford, J.A. (2004). Stress-buffering or stress-exacerbation? Social support and social undermining as moderators of the relationship between perceived stress and depressive symptoms among married people. *Personal Relationships, 11,* 23-40.

Cranford, J., Shrout, P.E., Iida, M., Rafaeli, E., Yip, T., & Bolger, N. (2006). A procedure for evaluating sensitivity to within-person change: Can mood measures in diary studies detect change reliably? *Personality and Social Psychology Bulletin, 32(7),* 917-929.

Cummins, R. A. (1995). On the trail of the gold standard for life satisfaction. *Social Indicators Research, 35,* 179–200.

Cunningham, M.R. (1979). Weather, mood, and helping behavior: Quasi experiments with the sunshine samaritan. *Journal of Personality and Social Psychology, 37(11),* 1947-1956.

David, J.P., Green, P.J., Martin, R., & Suls, J. (1997). Differential roles of neuroticism, extraversion, and event desirability for mood in daily life: An integrative model of top-down and bottom-up influences. *Journal of Personality and Social Psychology, 73(1),* 149-159.

Davidson, R.J. (1994). On emotion, mood and related affective constructs. In P.Ekman & R.J. Davidson (Eds.), *The Nature of Emotion: Fundamental Questions* (pp. 51-55). New York, NY: Oxford University Press.

Davidson, R.J. (2003). Darwin and the neural bases of emotion and affective style. *Annals of the New York Academy of Sciences, 1000,* 316–336.

Denissen, J.J.A., Butalid, L., Penke, L., & van Aken, M.A.G. (2008). The effects of weather on daily mood: A multilevel approach. *Emotion, 8,* 662–667.

Diener, E., & Diener, C. (1996). Most people are happy. *Psychological Science, 7(3),* 181-184.

Diener, E., Smith, H., & Fujita, F. (1995). The personality structure of affect. *Journal of Personality and Social Psychology, 69(1),* 130-141.

Eaton, L.G., & Funder, D.C. (2001). Emotional experience in daily life: Valence, variability, and rate of change. *Emotion, 1(4),* 413-421.

Egloff, B., Tausch, A., Kohlmann, C., & Krohne, H.W. (1995). Relationships between time of day, day of the week, and positive mood: Exploring the role of the mood measure. Motivation and Emotion, 19(2), 99-110.

Ekkekakis, P. (2009). The dual-mode theory of affective responses to exercise in metatheoretical context: I. Initial impetus, basic postulates, and philosophical framework. *International Review of Sport and Exercise Psychology, 2,* 73–94.

Eysenck, H. (1967). *The biological basis of personality*. Springfield, IL: Charles C Thomas.

Fiedler, K. (1988). Emotional mood, cognitive style, and behavior regulation. In K. Fiedler & J.P. Forgas (Eds.), *Affect, Cognition and Social Behavior* (pp. 25-43). Toronto: Hogrefe.

Fujita, F., Diener, E., & Sandvik, E. (1991). Gender differences in negative affect and well-being: The case for emotional intensity. *Journal of Personality and Social Psychology, 61,* 427-434.

Green, D.P., Goldman, S.L., & Salovey, P. (1993). Measurement error masks bipolarity in affect ratings. *Journal of Personality and Social Psychology, 64(6),* 1029-1041.

Gregory, T. (1994, October 2). Monday blues are almost tolerable compared to the Sunday night blahs. *Chicago Tribune*, pp. 1-3.

Gross, J.J., 2002. Emotion regulation: affective, cognitive, and social consequences. *Psychophysiology, 39,* 281–291.

Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85(2),* 348–362.

Hallonquist, J.D., Goldberg, M.A., & Brandes, J.S. (1986). Affective disorders and circadian rhythms. *Canadian Journal of Psychiatry*, *31*, 259-272.

Headey, B. (2010). The set point theory of well-being has serious flaws: On the eve of a scientific revolution? *Social Indicators Research, 97(1),* 7-21.

Headey, B. & Wearing, A.J. (1989). Personality, life events, and subjective well-being: Toward a dynamic equilibrium model. *Journal of Personality and Social Psychology, 57(4),* 731-739.

Helson, H. (1948). Adaptation level as a basis for a quantitative theory of frames of reference. *Psychological Review*, *55*, 397-313.

Hipp, J.R., Bauer, D.J., Curran, P.J., & Bollen, K.A. (2004). Crimes of opportunity or crimes of emotion? Testing two explanations of seasonal change in crime. *Social Forces, 82(4),* 1333-1372.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6(1),* 1-55.

John, O.P., Donahue, E.M., & Kentle, R.L. (1991). *The Big Five Inventory--Versions 4a and 54.* Berkeley: University of California, Berkeley, Institute of Personality and Social Research.

Kahneman, D., Krueger, A.B., Schkade, D.A., Schwarz, N., & Stone, A.A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. *Science*, *306*, 1776-1780.

Keats, J.A. (1983). Ability measures and theories of cognitive development. In H. Wainer & S. Messick (Eds.), *Principles of modern psychological measurement: A festschrift for Frederick M. Lord.* Hillsdale, NJ: Erlbaum.

Kelly, J.R., Futoran, G.C., & McGrath, J.E. (1990). Capacity and capability: Seven studies of entrainment of task performance rates. *Small Group Research*, *21*, 283-314.

Kennedy-Moore, E., Greenberg, M., Newman, M., & Stone, A.A. (1992). The relationship between daily events and mood: The mood measure may matter. *Motivation and Emotion*, *16*, 143–155.

Kuppens, P., Oravecz, Z., & Tuerlinckx, F. (2010). Feelings change: Accounting for individual differences in the temporal dynamics of affect. *Journal of Personality and Social Psychology, 99(6),* 1042–1060.

Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (1998). Emotion, motivation, and anxiety: Brain mechanisms and psychophysiology. Biological Psychiatry, *44*, 1248-1263.

Larson, R., Csikszentmihalyi M., & Graef, R. (1980). Mood variability and the psychosocial adjustment of adolescents. *Journal of Youth and Adolescence, 9*, 469-490.

Larsen R.J, & Diener E. (1992). Promises and problems with the circumplex model of emotion. In M.S. Clark, (Ed.), *Review of personality and social psychology: Emotion* (Vol. 13, pp. 25–59) Newbury Park, CA: Sage.

Larsen, R.J. & Kasimatis, M. (1990). Individual differences in entrainment of mood to the weekly calendar. *Journal of Personality and Social Psychology*, *58(1)*, 164-171.

Little, T.D., Wanner, B., & Ryan, R. (1997). Development and initial validation of the Inventory of Felt Emotion and Energy in Life (I FEEL) (ACCD Technical Report No. 5). Berlin, Germany: Max Planck Institute for Human Development and Education.

Lykken, D., & Tellegen, A. (1996). Happiness is a stochastic phenomenon. *Psychological Science*, *7*, 186-189.

MacCallum, R.C. (2003). Working with imperfect models. *Multivariate Behavioral Research*, *38* (1), 113-139.

MacCallum, R.C., Zhang, S., Preacher, K.J., & Rucker, D.D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods*, *7*, 19-40.

MacFarlane, J.M., Martin, C.L., & Williams, T.M. (1988). Mood fluctuations: Women versus men and menstrual versus other cycles. *Psychology of Women Quarterly*, *12*, 201-223.

Marco, C.A., & Suls, J. (1993). Daily stress and the trajectory of mood: Spillover, response assimilation, contrast, and chronic negative affectivity. *Journal of Personality and Social Psychology, 64(6),* 1053-1063.

McArdle, J.J. (1988). Dynamic but structural equation modeling of repeated measures data. In J.R. Nesselroade & R.B. Cattell (Eds.), *Handbook of multivariate experimental psychology* (pp. 561-614). New York: Plenum Press.

Meredith, W., & Tisak, J. (1990). Latent curve analysis. *Psychometrika, 55,* 107-122.

Mischel, W., & Shoda, Y. (1995). A cognitive-affective system theory of personality: Reconceptualizing situations, dispositions, dynamics, and invariance in personality structure. *Psychological Review, 102,* 246-268.

McGrath, J. E., & Kelly, J. R. (1986). *Time and Human Interaction: Toward a Social Psychology of Time*. New York: Guilford.

Murray, G. (2007). Diurnal mood variation in depression: A signal of disturbed circadian function? *Journal of Affective Disorders, 102,* 47-53.

Muthén, L.K. and Muthén, B.O. (1998-2010). *Mplus User's Guide*. Sixth Edition. Los Angeles, CA: Muthén & Muthén.

Nesse, R. M., & Berridge, K. C. (1997, October 3). Psychoactive drug use in evolutionary perspective. *Science, 278*, 63– 66.

Parkinson, B., Totterdell, P., Briner, R.B., & Reynolds, S. (1996). *Changing Moods: The Psychology of Mood and Mood Regulation*. New York, NY: Addison Wesley Longman.

Penner, L.A., Shiffman, S., Paty, J.A., & Fritzsche, B.A. (1994). Individual differences in intraperson variability in mood. *Journal of Personality and Social Psychology, 66(4),* 712-721.

Perrine, M.W.B., Schroder, K.E.E., Forester, R., McGonagle-Moulton, P., & Huessy, F. (2004). The impact of the September 11, 2001, terrorist attacks on alcohol consumption and distress: Reactions to a national trauma 300 miles from Ground Zero. *Journal of Studies of Alcohol, 65,* 5-15.

Rafaeli, E., & Revelle, W. (2002). A premature consensus: Are happiness and sadness truly opposite affects? *Motivation and Emotion*, *30(1)*, 1-12.

Reid, S., Towell, A.D., & Golding, J. F. (2000). Seasonality, social zeitgebers and mood variability in entrainment of mood: Implications for seasonal affective disorder. *Journal of Affective Disorders*, *59(1)*, 47-54.

Reis, H.T., Seldon, K.M., Gable, S.L., Roscoe, J., & Ryan, R.M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin*, *26(4)*, 419-435.

Richards, J.M. (2004). The cognitive consequences of concealing feelings. *Current Directions in Psychological Science*, *13*, 131–134.

Rocke, C., Li, S., & Smith, J. (2009). Intraindividual variability in positive and negative affect over 45 days: Do older adults fluctuate less than young adults? *Psychology and Aging*, *24(4)*, 863-878.

Rosen, L.N., & Rosenthal, N.E. (1991). Seasonal variations in mood and behavior in the general population: A factor-analytic approach. *Psychiatry Research*, *38*, 271–283.

Rossi, A.S., & Rossi, P.E. (1977). Body time and social time: Mood patterns by menstrual cycle phase and day of the week. *Social Science Research*, *6(4)*, 273-308.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39(6)*, 1161-1178.

Russell, J.A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, *110(1)*, 145-172.

Russell, J.A., & Carroll, J.M. (1999). On the bipolarity of positive and negative affect. *Psychological Bulletin*, *125(1)*, 3-30.

Rusting, C.L., & Larsen, R.J. (1998). Diurnal patterns of unpleasant mood: Associations with neuroticism, depression, and anxiety. *Journal of Personality*, *66(1)*, 85-103.

Scherer, K.R., Dan, E.S., & Flykt, A. (2006). What determines a feeling's position in affective space? A case for appraisal. *Cognition & Emotion*, *20*, 92–113.

Singer, J.D., & Willett, J.B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York: Oxford University Press.

Sit, V., & Poulin-Costello, M. (1994). Catalog of curves for curve fitting. In Bergerud, W. & Sit, V. (eds), *Biometrics Information Handbook Series Number 4*. Victoria: Ministry of Forests.

Steiger, J. H. & Lind, J. M. (1980, May). *Statistically-based tests for the number of common factors*. Paper presented at Psychometric Society Meeting, Iowa City, Iowa.

Stone, A.A., Hedges, S.M., Neale, J.M., & Satin, M.S. (1985). Prospective and cross-sectional mood reports offer no evidence of a "blue Monday" phenomenon. *Journal of Personality and Social Psychology, 49(1),* 129-134.

Stone, A.A., & Neale, J.M. (1984). Effects of severe daily events on mood. *Journal of Personality and Social Psychology, 46(1),* 137-144.

Stone, A.A., Neale, J.M., & Shiffman, S. (1993). Daily assessments of stress and coping and their association with mood. *Annals of Behavioral Medicine*, *15*, 8-16.

Suh, E., Diener, E., & Fujita, F. (1996). Events and subjective well-being: Only recent events matter. *Journal of Personality and Social Psychology*, *70*, 1091–1102.

Susman, E.J., Dorn, L.D., & Chrousos, G.P. (1991). Negative affect and hormone levels in young adolescents: Concurrent and predictive perspectives. *Journal of Youth and Adolescence*, *20*, 167–190.

Tamir, M., Chiu, C., Gross, J.J. (2007). Business or pleasure? Utilitarian versus hedonic considerations in emotion regulation. *Emotion*, *7(3),* 546–554.

Thayer, R.E. (1989). *The biopsychology of mood and arousal*. New York, NY: Oxford University Press.

Thayer, R. E., Takahashi, P. J., & Pauli, J. A. (1988). Multidimensional arousal states, diurnal rhythms, cognitive and social processes, and extraversion. *Personality and Individual Differences*, *9*, 15-24.

Totterdell, P., Parkinson, B., Briner, R. B., & Reynolds, S. (1997). Forecasting feelings: The accuracy and effects of self-predictions of mood. *Journal of Social Behavior and Personality*, 1*2*, 631–650.

Tucker, L.R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*, 1-10.

Wagner, G.G., Frick, J.R., & Schupp, J. (2007). Enhancing the power of the German socio-economic panel study (SOEP)—Evolution, scope and enhancements. *Schmoeller's Jahrbuch*, *127*, 139–169.

Warner, R.M., & Waggener, T.R., & Kronauer, R.E. (1983). Synchronized cycles in ventilation and vocal activity during spontaneous conversational speech. *Applied Physiology: Respiratory, Environmental, and Exercise Physiology*, *34*, 1324-1334.

Watson, D. (1988). The vicissitudes of mood measurement: Effects of varying descriptors, time frames, and response formats on measures of positive and negative affect. *Journal of Personality and Social Psychology,55*, 128-141.

Watson, D. (2000). *Mood and Temperament*. New York, NY: Guilford Press.

Watson, D., & Clark, L.A. (1992). Affects separable and inseparable: On the hierarchical arrangement of the negative affects. *Journal of Personality and Social Psychology, 62(3)*, 489-505.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology*, *76(5)*, 820-838.

Weinstein, S.M., Mermelstein, R.J., Hedeker, D., Hankin, B.L., & Flay, B.R. (2006). The time-varying influences of peer and family support on adolescent daily positive and negative affect. *Journal of Clinical Child and Adolescent Psychology, 35(3),* 420-430.

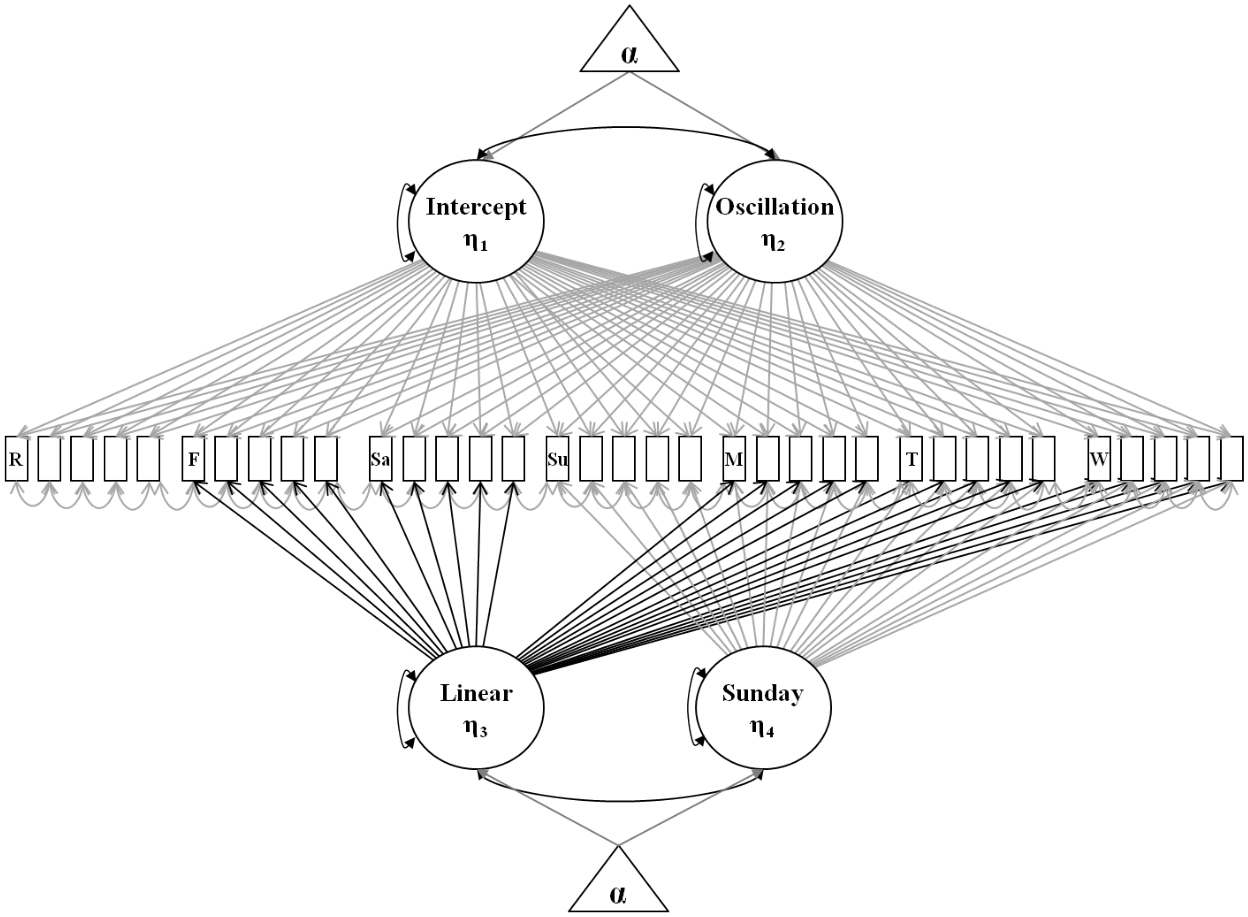
Widaman, K. & Thompson, J.S. (2003). On specifying the null model for incremental fit indices in structural equation modeling. *Psychological Methods, 8(1),* 16–37.

Wu, W., & West, S.G. (2010) Sensitivity of fit indices to misspecification in growth curve models. *Multivariate Behavioral Research, 45(3),* 420-452.

Zerubavel, E. (1985). *The seven day circle: The history and meaning of the week*. New York, NY: The Free Press.

Figures

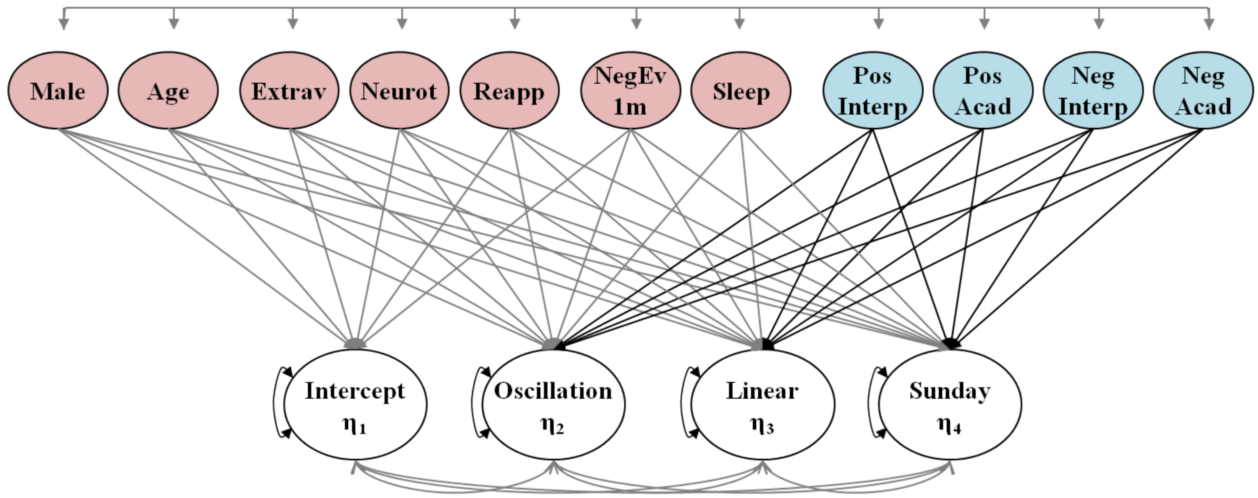
Figure 1a. *Path diagram of the Baseline NLCM*



Note: R=Thursday, F=Friday, Sa=Saturday, Su=Sunday, M=Monday, T=Tuesday, W=Wednesday.

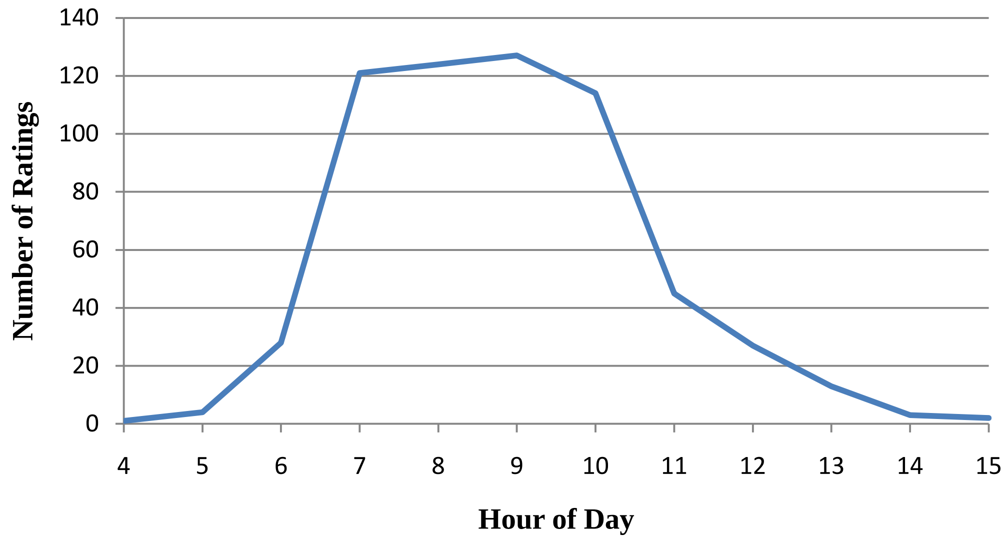
Covariances between all latent factors are estimated, though not represented in the diagram. Intercept and Sunday factor loadings are fixed at 1.0. Linear slope factor loadings are fixed to 1, 2, 4, 5, and 6, for the Friday, Saturday, Monday, Tuesday, and Wednesday subsets, respectively. Oscillation factor loadings are constrained to nonlinear sine/cosine functions. Indicator residual variances are correlated between consecutive time points. Correlated residuals within day are equated, and those between days (night-morning) are equated.

Figure 1b. *Path Diagram of the Full NLCM with Covariates and Event Predictors*



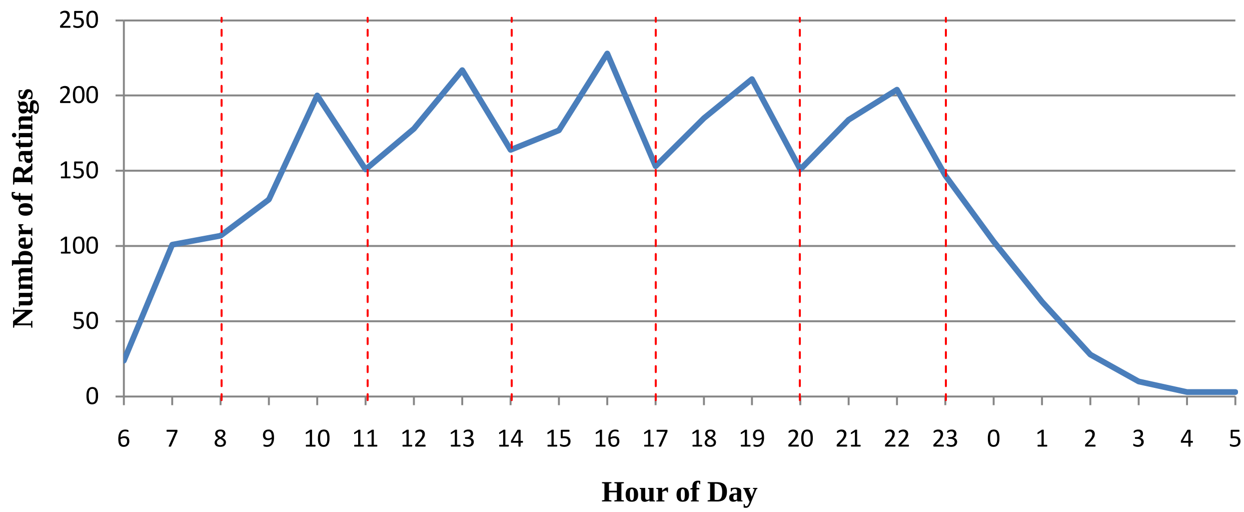
Note: Covariances between all covariates and event predictors are estimated. Event predictors do not predict the intercept.

Figure 2a. *Number of Morning Ratings Reported by Hour of Day*



Note: Hour of day is reported in military time.

Figure 2b. *Number of Ratings Reported by Hour of Day*



Note: The dotted vertical lines indicate the cutoffs for each 3-hour time interval. Time 1 represents the interval from 8:00-10:59 AM. Time 2 is from 11:00 AM-1:59 PM. Time 3 is from 2:00-4:59 PM. Time 4 is from 5:00-7:59 PM. Time 5 is from 8:00-10:59 PM. Hour of day is reported in military time.

Figure 3a. *Observed Positive and Negative Affect Trajectories over the 7-Day Period*

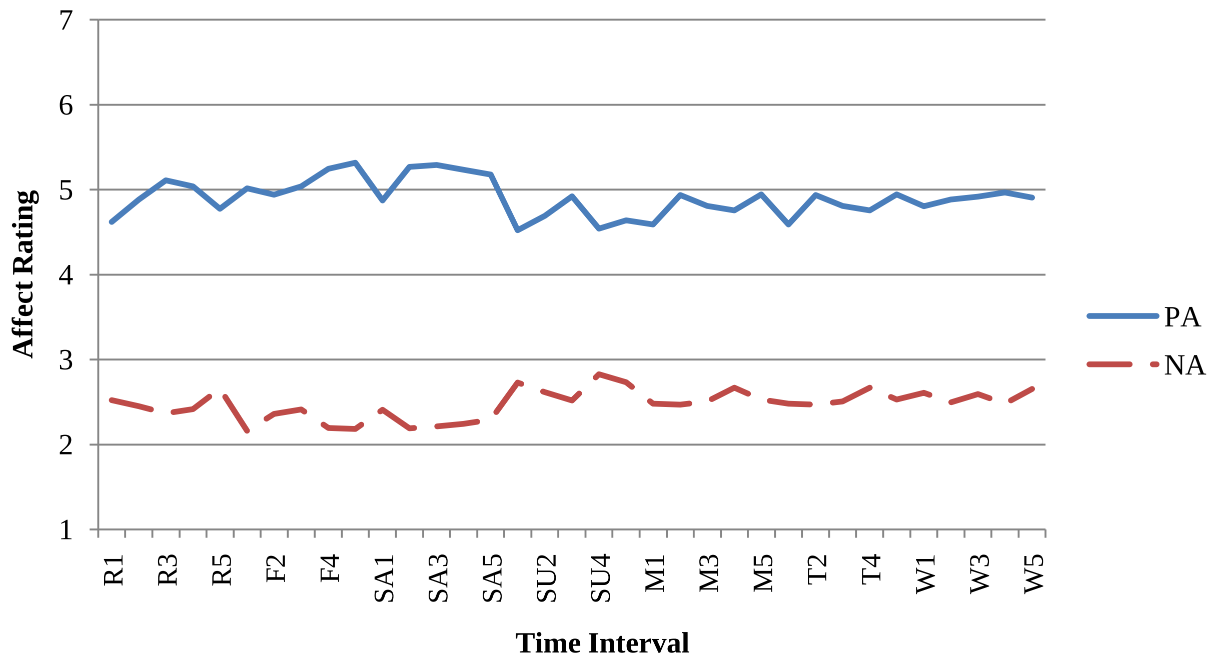
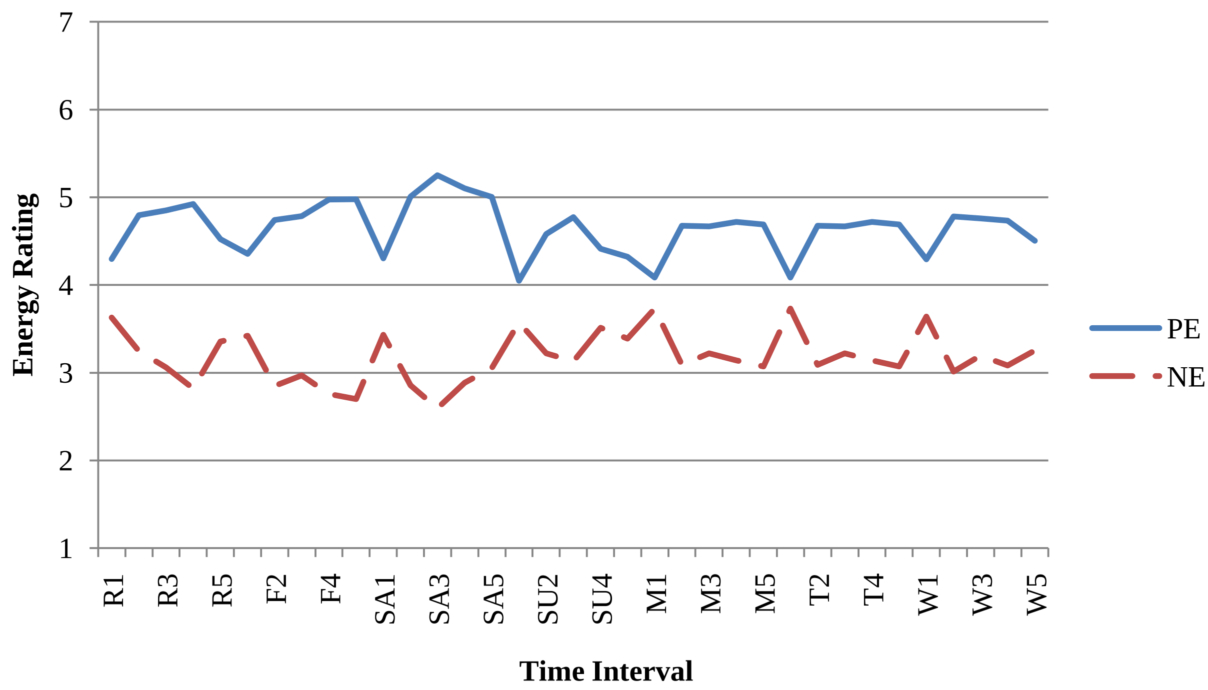


Figure 3b. *Observed Positive and Negative Energy Trajectories over the 7-Day Period*



Note: Each time point represents a 3-hour period, with 1 day containing 5 time points. Time 1 begins at 8 AM, and time 5 ends at 10:59 PM. The 7-day sequence begins on Thursday and ends on Wednesday.

Figure 4a. *Model-implied Positive and Negative Affect Trajectories over the 7-Day Period*

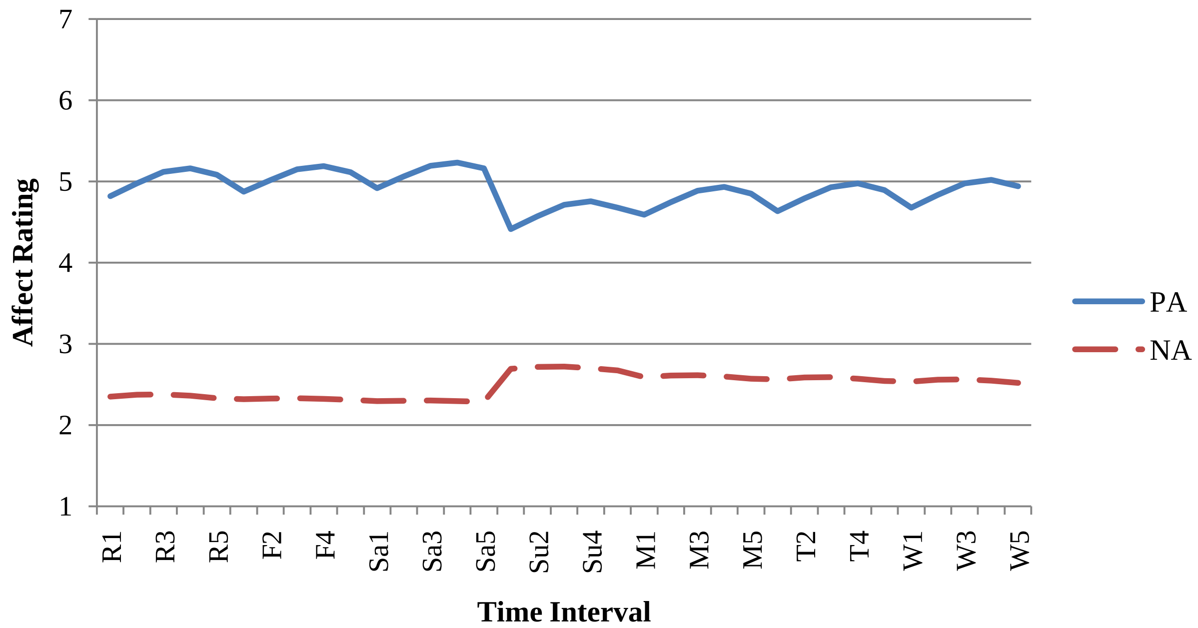
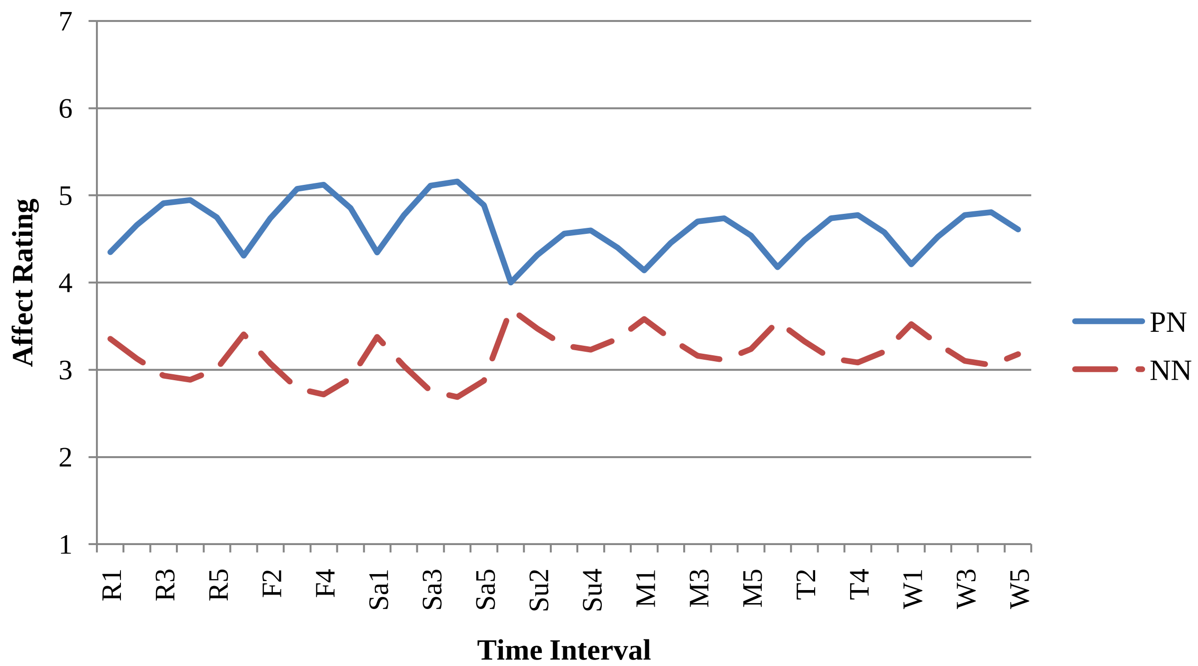


Figure 4b. *Model-implied Positive and Negative Energy Trajectories over the 7-Day Period*



Note: Each time point represents a 3-hour period, with 1 day containing 5 time points. Time 1 begins at 8 AM, and time 5 ends at 10:59 PM. The 7-day sequence begins on Thursday and ends on Wednesday.

Tables

Table 1a. *Means and Standard Deviations of Ratings Completed by Day and throughout the 7-day Period*

	Affect		Energy	
	Positive	Negative	Positive	Negative
Thursday	3.89 (1.74)	4.02 (1.41)	4.15 (1.25)	4.28 (1.34)
Friday	4.40 (1.15)	4.40 (1.15)	4.40 (1.33)	4.33 (1.35)
Saturday	4.18 (1.33)	4.11 (1.61)	4.06 (1.66)	4.09 (1.46)
Sunday	3.98 (1.52)	4.01 (1.60)	4.06 (1.25)	4.10 (1.12)
Monday	4.08 (1.55)	4.17 (1.55)	4.20 (1.31)	4.24 (1.26)
Tuesday	4.31 (1.40)	4.31 (1.20)	4.31 (1.20)	4.31 (1.40)
Wednesday	3.87 (1.41)	3.77 (1.40)	3.67 (1.55)	3.57 (1.82)
All 7 days	4.10 (0.79)	4.11 (0.77)	4.12 (0.77)	4.13 (0.78)

Table 1b. *Percentage of Participants Providing 3 or More Ratings per Day by Number of Days*

	Affect		Energy	
Days	Positive (%)	Negative (%)	Positive (%)	Negative (%)
7	33.94	33.03	41.28	41.26
6	33.03	29.36	24.77	30.26
5	17.43	22.94	25.69	18.35
4	9.17	9.17	4.59	6.42
3	4.59	3.67	2.75	1.83
2	1.83	1.83	0.00	0.92
1	0.00	0.00	0.00	0.92
0	0.00	0.00	0.92	0.00

Table 2. *Means and Standard Deviations of Affect and Energy Ratings by Day of the Week*

	Affect				Energy			
	Positive		Negative		Positive		Negative	
Thursday	4.86	(1.29)	2.45	(1.37)	4.62	(1.43)	2.94	(1.55)
Friday	5.08	(1.31)	2.25	(1.28)	4.72	(1.52)	2.98	(1.59)
Saturday	5.17	(1.34)	2.26	(1.32)	4.95	(1.48)	2.93	(1.55)
Sunday	4.65	(1.42)	2.70	(1.45)	4.41	(1.46)	3.37	(1.53)
Monday	3.34	(1.56)	2.54	(1.42)	4.72	(1.51)	2.97	(1.59)
Tuesday	4.76	(1.29)	2.53	(1.37)	4.43	(1.41)	3.32	(1.61)
Wednesday	4.88	(1.26)	2.59	(1.34)	4.54	(1.41)	3.29	(1.56)

Table 3a. *Percentage of Participants Reporting 0 or 1+ Events by Event Type*

	Academic Events		Interpersonal Events	
Number of Events	Positive (%)	Negative (%)	Positive (%)	Negative (%)
0	21.10	14.68	20.18	38.53
1+	78.90	85.32	79.82	61.47

Note: Percentages reflect all events throughout the 7-day period.

Table 3b. *Percentage of Days with 0-6 Events Reported by Event Type*

	Academic Events		Interpersonal Events	
Counts	Positive (%)	Negative (%)	Positive (%)	Negative (%)
0	67.02	63.00	60.93	79.31
1	20.79	16.71	19.47	12.33
2	8.61	11.14	10.33	4.38
3	2.38	5.31	5.70	2.52
4	0.53	2.12	2.12	1.06
5	0.26	1.06	1.06	0.40
6	0.40	0.66	0.40	0.00

Table 4. *Descriptive Statistics for Focal Event Predictors*

Variable	N	Mean	SD	Min	Max
Positive Academic Events	109	-0.33	0.91	-1.66	1.65
Negative Academic Events	109	-0.31	0.76	-1.57	1.31
Positive Interpersonal Events	109	-0.33	0.71	-1.42	1.14
Negative Interpersonal Events	109	-0.40	0.71	-1.19	0.85

Note: Event predictors represent the average adjusted residual event counts (with day-of-the-week effects removed)

Table 5. *Descriptive Statistics for Covariates*

Variable	N	Mean	SD	Min	Max
Age	107	19.22	2.18	17.00	37.00
Extraversion	107	26.50	5.58	13.00	39.00
Neuroticism	107	23.76	6.09	11.00	38.00
Reappraisal	107	4.59	0.91	2.00	6.83
Sleep	109	7.38	1.17	4.25	10.67

Table 6. *Model fit for the Baseline NLCMs*

	χ^2	*df*	RMSEA[1] (low, high)	CFI[2]	TLI[3]	SRMR[4]
Positive Affect	1325.409	611	.104 (.096, .121)	.932	.926	.136
Negative Affect	1419.104	611	.110 (.102, .117)	.883	.873	.119
Positive Energy	1535.202	611	.118 (.110, .125)	.905	.897	.141
Negative Energy	1390.593	611	.108 (.101, .116)	.888	.878	.120

[1] RMSEA = Root Mean Square Error of Approximation; low and high values correspond to a 90% confidence interval
[2] CFI = Comparative Fit Index
[3] TLI = Tucker-Lewis Index
[4] SRMR = Standardized Root Mean Residual

Note: Baseline models include Thursday intercept, oscillation, linear slope, and Sunday event factors. CFI and TLI were recalculated using the appropriate null model chi-square.

Table 7. *Fixed and Random Effect Estimates of Mood Change from Baseline NLCMs*

Variables	Affect Positive	Affect Negative	Energy Positive	Energy Negative
Fixed Effect Estimates				
Thursday intercept	4.950** (.0781)	2.353** (.083)	4.547** (.096)	3.183** (.104)
Oscillation	.055 (.071)	.053 (.085)	.202** (.037)	.150** (.035)
Linear slope	.044** (.014)	-.025 (.015)	.035* (.014)	-.029 (.016)
Sunday event	-.406** (.080)	.322** (.087)	-.347** (.078)	.343** (.084)
Additional Parameters				
Amp1	.201 (.328)	.058 (.314)	.205** (.026)	.201** (.030)
Amp2	.186 (.304)	.119 (.649)	.279** (.038)	.296** (.042)
Phase	-.848 (.244)	1.659+ (.862)	-.642** (.084)	1.232** (.117)
Random Effect Estimates				
Intercept	.498** (.091)	.505** (.089)	.753** (.132)	.874** (.153)
Oscillation	.464 (.586)	.030 (.202)	.051** (.003)	.050** (.000)
Linear slope	.005 (.003)	.010** (.004)	.003 (.003)	.008* (.004)
Sunday event	.325** (.086)	.380** (.097)	.249** (.082)	.303** (.101)

Note. + Significance of p <=.06, * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table 8a. *Fixed Effects of Event Predictors and Covariates on Positive Energy Factors*

Variables	Intercept[1]	Oscillation	Linear	Sunday
Event Predictors[2]				
Pos. Academic	----	.074* (.036)	-.008 (.015)	.153 (.081)
Neg. Academic	----	.037 (.032)	.018 (.015)	-.280** (.079)
Pos. Interpersonal	----	.064 (.038)	-.019 (.016)	-.001 (.086)
Neg. Interpersonal	----	-.022 (.041)	.024 (.018)	-.027 (.096)
Covariates				
Gender[3]	-.126 (.096)	.030 (.041)	.018 (.017)	-.097 (.090)
Age	.076 (.084)	-.034 (.033)	-.007 (.014)	.074 (.074)
Extraversion	.310** (.104)	.081 (.045)	-.018 (.018)	-.061 (.093)
Neuroticism	-.376** (.125)	.082 (.060)	-.021 (.024)	-.053 (.125)
Reappraisal	-.162 (.107)	.090 (.050)	.013 (.019)	-.112 (.101)
Past Negative Event	.005 (.084)	.039 (.033)	.005 (.013)	-.068 (071)
Sleep	----	.012 (.031)	.012 (.014)	-.074 (.072)
R^2	.38	.23	.65	.35

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts;
[3] Dummy-coded as Male=1

Note. [+] Significance of p <=.06. * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table 8b. *Fixed Effects of Event Predictors and Covariates on Negative Energy Factors*

Variables	Intercept[1]	Oscillation	Linear	Sunday
Event Predictors[2]				
Pos. Academic	----	-.071 (.039)	.007 (.017)	-.128 (.090)
Neg. Academic	----	.022 (.034)	-.017 (.016)	.256** (.087)
Pos. Interpersonal	----	.042 (.040)	.042* (.018)	-.071 (.096)
Neg. Interpersonal	----	-.043 (.044)	-.022 (.020)	.014 (.107)
Covariates				
Gender[3]	.138 (.106)	.028 (.042)	-.008 (.020)	.012 (.100)
Age	-.114 (.093)	-.044 (.035)	.011 (.016)	-.099 (.083)
Extraversion	-.196 (.113)	.048 (.044)	.019 (.020)	.051 (.103)
Neuroticism	.501** (.138)	.031 (.060)	.021 (.027)	-.016 (.140)
Reappraisal	.233+ (.119)	-.134* (.054)	-.022 (.022)	.114 (.114)
Past Negative Event	.041 (.094)	.076* (.036)	-.020 (.016)	.109 (.081)
Sleep	----	-.048 (.034)	-.025 (.015)	.066 (.081)
R^2	.35	.33	.52	.28

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts
[3] Dummy-coded as Male=1

Note. + Significance of p <=.06. * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table 9a. *Fixed Effects of Event Predictors and Covariates on Positive Affect Factors*

Variables	Intercept[1]	Linear	Sunday
Event Predictors[2]			
Pos. Academic	----	-.031 (.021)	.178 (.103)
Neg. Academic	----	.020 (.020)	-.247* (.099)
Pos. Interpersonal	----	-.029 (.023)	.109 (.112)
Neg. Interpersonal	----	.017 (.025)	-.080 (.122)
Covariates			
Gender[3]	-.140 (.078)	.009 (.023)	-.040 (.110)
Age	.004 (.071)	.002 (.019)	.020 (.090)
Extraversion	.238** (.085)	-.019 (.023)	.008 (.112)
Neuroticism	-.336** (.102)	-.027 (.029)	-.017 (.149)
Reappraisal	-.070 (.087)	.005 (.024)	-.069 (.119)
Past Negative Event	.054 (.070)	.012 (.019)	-.024 (.089)
Sleep	----	.017 (.019)	-.060 (.092)
R^2	.41	.12	.13

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts; [3] Dummy-coded as Male=1.

Note. [+] Significance of p <=.06, * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table 9b. *Fixed Effects of Event Predictors and Covariates on Negative Affect Factors*

Variables	Intercept[1]	Linear	Sunday
Event Predictors[2]			
Pos. Academic	----	.025 (.021)	-.229* (.101)
Neg. Academic	----	-.016 (.020)	.222* (.097)
Pos. Interpersonal	----	.001 (.022)	.106 (.107)
Neg. Interpersonal	----	-.003 (.024)	-.102 (.119)
Covariates			
Gender[3]	.116 (.078)	-.009 (.023)	.065 (.107)
Age	.038 (.069)	-.002 (.020)	-.105 (.088)
Extraversion	-.240** (.084)	.008 (.023)	.090 (.110)
Neuroticism	.372** (.101)	-.023 (.030)	.158 (.148)
Reappraisal	.002 (.086)	-.020 (.025)	.072 (.119)
Past Negative Event	.017 (.068)	-.018 (.019)	.064 (.086)
Sleep	----	-.009 (.019)	.021 (.090)
R^2	.47	.07	.17

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts; [3] Dummy-coded as Male=1.

Note. [+] Significance of p <=.06, * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

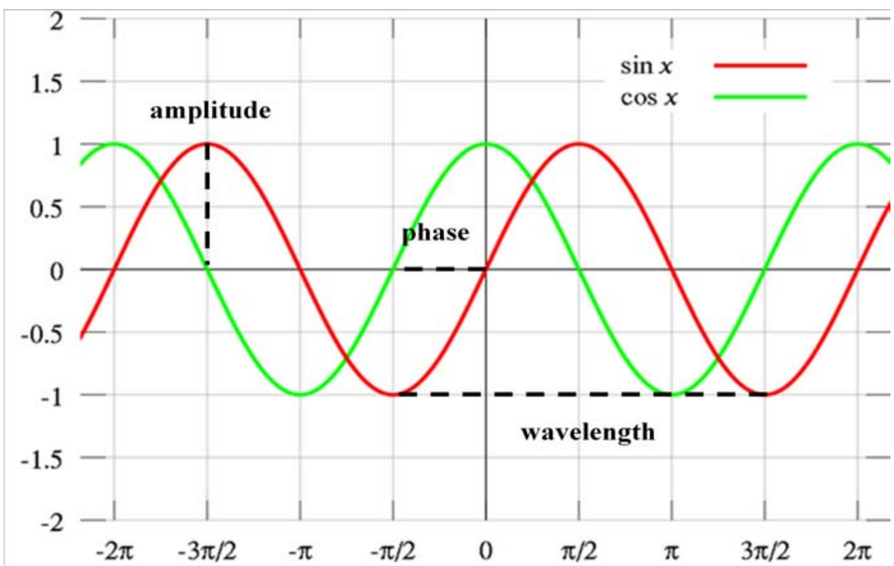
Appendix A

Sine and cosine are periodical functions, in which the shape of the curve repeats along the X-axis. The functions are identical, though their location on the X-axis differs by a lag of π / 2. The shape of the curve is determined by amplitude and wavelength, and its position on the X-axis is determined by phase.

Sine function: $$Y = a * \sin\left[\frac{2\pi}{b}(X - c)\right]$$

Cosine function: $$Y = a * \cos\left[\frac{2\pi}{b}(X - c)\right]$$

Amplitude (a) is the distance between the maximum Y-value from its center position (i.e., peak deviation)
Wavelength (b) is the length of each non-repeating pattern along the X-axis.
Phase (c) is the amount of shift along the X-axis.



Appendix B

Results from Multilevel Poisson Regression Analyses: Fixed Effects of Dummy-Coded Day of the Week Predictors on Event Totals

	Academic		Interpersonal	
Effect	Positive	Negative	Positive	Negative
Intercept	-.352** (.130)	-.132 (.128)	-.470** (.144)	-1.113** (.178)
Friday	-.291 (.157)	-.717** (.157)	.077 (.139)	-.517* (.217)
Saturday	-.859** (.189)	-.830** (.164)	-.045 (.143)	-.129* (.211)
Sunday	-1.335** (.225)	-1.053** (.177)	-.174 (.148)	-.642** (.226)
Monday	-.825** (.187)	-.493** (.147)	-.389* (.158)	-.388 (.210)
Tuesday	-.537** (.167)	-.320* (.139)	-.637** (.171)	-.505* (.217)
Wednesday	-.462** (.167)	-.373** (.144)	-.724** (.176)	-.531* (.219)
φ (or χ^2/df)	0.85	1.04	0.87	0.81

Note. * $p< .05$, ** $p< .01$. Standard errors of the negative academic event estimates are adjusted.

Negative academic event totals exhibit slight overdispersion, which is the tendency for the data to have greater variability than expected (i.e., predicted by the random component of the model). Common causes of overdispersion are heterogeneity among individuals, excessive variability in event counts, and positive correlations between responses (Agresti, 2007).

Appendix C

Table C.1. *Percentage of Participants Reporting 0-4 Days (Pre- and Post-Weekend) during which Events were Anticipated*

Number of Events	Pre-Weekend (%)	Post-Weekend (%)
0	14.68	13.76
1	27.52	28.44
2	38.53	32.11
3	19.27	19.27
4	0.00	6.42

Note: The pre-weekend interval includes Thursday, Friday and Saturday. The post-weekend interval includes Sunday through Wednesday.

Table C.2. *Fixed Effects of Event Predictors, Covariates, and Anticipated Events, on Positive Energy Factors*

Variables	Intercept[1]	Oscillation	Linear	Sunday
Event Predictors[2]				
Pos. Academic	----	.098* (.043)	-.015 (.016)	.184* (.090)
Neg. Academic	----	.031 (.037)	.018 (.016)	-.309** (.092)
Pos. Interpersonal	----	.063 (.046)	-.024 (.019)	-.002 (.101)
Neg. Interpersonal	----	-.027 (.044)	.023 (.019)	-.019 (.099)
Covariates				
Gender[3]	-.138 (.102)	.057 (.047)	.026 (.017)	-.122 (.098)
Age	.073 (.085)	-.039 (.034)	-.007 (.014)	.076 (.073)
Extraversion	.299** (.105)	.100* (.050)	-.014 (.018)	-.074 (.095)
Neuroticism	-.394** (.125)	.096 (.063)	-.018 (.024)	-.061 (.125)
Reappraisal	-.168 (.109)	.106* (.054)	.016 (.019)	-.123 (.103)
Past Negative Event	.010 (.086)	.037 (.035)	.004 (.013)	-.065 (072)
Sleep	----	.022 (.032)	.016 (.014)	-.088 (.073)
Pre-Weekend Events[4]	----	.061 (.061)	.001 (.026)	.033 (.141)
Post-Weekend Events[4]	----	.140 (.069)	.040 (.028)	-.140 (.151)
R^2	.38	.44	.86	.41

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts;
[3] Dummy-coded as Male=1; [4] Anticipated events

Note. + Significance of p <=.06. * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table C.3. *Fixed Effects of Event Predictors, Covariates, and Anticipated Events, on Negative Energy Factors*

Variables	Intercept[1]	Oscillation	Linear	Sunday
Event Predictors[2]				
Pos. Academic	----	-.089 (.044)	.011 (.018)	-.149 (.100)
Neg. Academic	----	.017 (.038)	-.018 (.018)	.291** (.101)
Pos. Interpersonal	----	.036 (.047)	.048* (.022)	-.065 (.114)
Neg. Interpersonal	----	-.048 (.046)	-.020 (.021)	-.026 (.111)
Covariates				
Gender[3]	.153 (.112)	.048 (.047)	-.013 (.021)	.013 (.110)
Age	-.114 (.094)	-.049 (.036)	.012 (.016)	-.101 (.084)
Extraversion	-.186 (.114)	.060 (.047)	.015 (.021)	.062 (.106)
Neuroticism	.522** (.138)	.041 (.062)	.018 (.027)	-.017 (.141)
Reappraisal	.245* (.121)	-.148* (.058)	-.025 (.023)	.119 (.117)
Past Negative Event	.035 (.097)	.076* (.037)	-.020 (.016)	.108 (.083)
Sleep	----	-.043 (.034)	-.028 (.016)	.076 (.083)
Pre-Weekend Events[4]	----	.048 (.063)	.015 (.030)	-.160 (.159)
Post-Weekend Events[4]	----	.102 (.069)	-.027 (.032)	.075 (.169)
R^2	.36	.41	.54	.31

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts;
[3] Dummy-coded as Male=1; [4] Anticipated events

Note. $^+$ Significance of $p <=.06$. * $p< .05$, ** $p< .01$. Unstandardized estimates are reported; standard errors are in parentheses.

Table C.4. *Fixed Effects of Event Predictors and Covariates on Positive Affect Factors*

Variables	Intercept[1]	Linear	Sunday
Event Predictors[2]			
Pos. Academic	----	-.034 (.023)	.192 (.114)
Neg. Academic	----	.020 (.023)	-.263* (.113)
Pos. Interpersonal	----	-.038 (.027)	.148 (.132)
Neg. Interpersonal	----	.030 (.026)	-.066 (.126)
Covariates			
Gender[3]	-.157 (.083)	.014 (.025)	-.063 (.121)
Age	.003 (.072)	.001 (.020)	.037 (.091)
Extraversion	.217* (.087)	-.014 (.024)	-.009 (.117)
Neuroticism	-.371** (.106)	-.021 (.030)	-.039 (.151)
Reappraisal	-.092 (.090)	.011 (.025)	-.094 (.122)
Past Negative Event	.064 (.074)	.012 (.020)	-.020 (.092)
Sleep	----	.008 (.020)	.007 (.098)
Pre-Weekend Events[4]	----	.008 (.038)	-.128 (.187)
Post-Weekend Events[4]	----	.028 (.041)	-.113 (.201)
R^2	.43	.12	.19

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts;
[3] Dummy-coded as Male=1; [4] Anticipated events

Note. $^+$ Significance of p <=.06. * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.

Table C.5. *Fixed Effects of Event Predictors and Covariates on Negative Affect Factors*

Variables	Intercept[1]	Linear	Sunday
Event Predictors[2]			
Pos. Academic	----	.029 (.023)	-.229* (.112)
Neg. Academic	----	-.016 (.022)	.246* (.111)
Pos. Interpersonal	----	.006 (.026)	.109 (.127)
Neg. Interpersonal	----	-.001 (.025)	-.100 (.123)
Covariates			
Gender[3]	.132 (.083)	-.015 (.025)	.069 (.119)
Age	.036 (.070)	-.001 (.020)	-.115 (.090)
Extraversion	-.224** (.085)	.005 (.025)	.094 (.117)
Neuroticism	.401** (.103)	-.027 (.031)	.166 (.150)
Reappraisal	.019 (.088)	-.024 (.025)	.077 (.122)
Past Negative Event	.013 (.071)	-.018 (.020)	.061 (.089)
Sleep	----	-.010 (.020)	-.021 (.096)
Pre-Weekend Events[4]	----	-.017 (.037)	.125 (.181)
Post-Weekend Events[4]	----	-.027 (.040)	-.049 (.195)
R^2	.48	.11	.19

[1] Intercept is defined at Thursday; [2] Event predictors are average adjusted residual event counts;
[3] Dummy-coded as Male=1; [4] Anticipated events

Note. [+] Significance of p <=.06. * p< .05, ** p< .01. Unstandardized estimates are reported; standard errors are in parentheses.