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A Psychological Flexibility Perspective on Well-Being: Emotional Reactivity, Adaptive Choices, and Daily Experiences

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According to psychological flexibility theory, fully experiencing one's emotions, even when they involve negative reactions, can enhance psychological well-being. In pursuit of this possibility, procedures capable of disentangling reaction intensities from reaction durations, in response to affective images, were developed and variations of this paradigm were applied in understanding variations in happiness and adaptive behavior. Consistent with psychological flexibility theory, three studies showed that more intense emotional reactions, irrespective of valence, were associated with higher levels of well-being. Two additional studies showed that happy individuals, relative to less happy individuals, exhibited more functional approach/avoidance behavior in behavior-focused tasks. Together, the results are consistent with the idea that adaptive emotion generation systems are those that flexibly adapt emotion output to concurrent emotion-related stimulation. The program of research adds to our understanding of the relationship between emotion reactivity and well-being while highlighting specific processes through which emotion and well-being interact.

Keywords: affective dynamics, emotion, psychological flexibility, reactivity, well-being

A body of work has concluded that more intense reactions to unpleasant events can serve as markers of psychopathology or ill-being (Heller et al., 2018; Nock et al., 2008). For example, more intense reactions to unpleasant events are often observed at higher levels of the personality trait of neuroticism (Gross et al., 1998; Suls & Martin, 2005), which is pathogenic (Lahey, 2009). Perhaps relatedly, studies have linked lower levels of happiness to greater reaction intensities to daily life events, even when they are pleasant ones (Grosse Rueschkamp et al., 2020; Oishi et al., 2007).

There are, however, other lines of research suggesting that psychologically healthy individuals exhibit higher, rather than lower, levels of emotional reactivity, at least under some circumstances (Bylsma, 2021). As an example, blunted (or attenuated) levels of stress reactivity have been observed among individuals with eating disorders (Carroll et al., 2017), schizophrenia (Grigoriou & Upthegrove, 2020), and as a function of lifetime adversity (Lovallo et al., 2012). Relatedly, major depressive disorder has repeatedly been linked to attenuated emotional reactivity to a wide variety of eliciting events (Bylsma, 2021; Bylsma et al., 2008; Carroll et al., 2017). Conversely, higher levels of reactivity, even to unpleasant events, have been observed as a function of eudaimonic well-being (Schaefer et al., 2013) and resilience (Waugh et al., 2011), which is linked to well-being (Alessandri et al., 2012).

Importantly, too, there are theoretical perspectives suggesting that healthy emotional systems should produce robust emotional reactions to normatively pleasant or unpleasant stimuli (Mayer et al., 2016). Emotions serve important functions in motivating individuals to respond to the threats and rewards that they encounter (Frijda, 2004). Hence, people who tend to experience more intense, but context-appropriate (Rottenberg & Hindash, 2015), reactions should be better able to cope with difficulties by behaving adaptively as a function of their feelings (Damasio & Carvalho, 2013; Waugh et al., 2011). Such context-dependent reactions are a key indicator of *Psychological Flexibility*, which can be defined in terms of capacities to respond to situational demands, flexibly shift mindsets or behavior, and a willingness to experience reality as it is (Kashdan & Rottenberg, 2010). Whether defined as an individual difference or a process of relating to the environment, psychological flexibility is thought to be a key determinant of health and well-being (Kashdan & Rottenberg, 2010; Steenhaut et al., 2019).

A critical point concerning psychological flexibility as well as the present studies is that the peak intensity of a reaction need not reflect the overall (time-aggregated) magnitude of the response. Indeed, a moderate but elongated unpleasant emotional reaction could easily involve more overall negative affect than an intense but brief reaction (Fredrickson & Kahneman, 1993). Thus, a healthy, flexible emotional response to a stressor or aversive event could—and perhaps typically does—involve a more intense reaction that is shorter-lived (Burke et al., 2005; Schaefer et al., 2013; Taubitz et al., 2013). Theoretically, such tradeoffs would occur

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because intense reactions would lead the person to mobilize coping or behavioral resources to restore homeostasis more quickly, resulting in lesser tendencies toward prolonged levels of negative affectivity (Teper et al., 2013).

In sum, there are discrepant perspectives on reactivity within the literature that could, potentially, be resolved by recognizing that the concept of "emotion reactivity" is a multidimensional one (Davidson, 1998, 2000). Davidson (1998), for example, proposes distinctions among reaction threshold (whether a mild stimulus would be likely to trigger a reaction), peak intensity (how strong a reaction is when it peaks), and reaction duration (low long a reaction lasts, particularly when an eliciting stimulus is no longer present). Given this analysis (also see Verduyn et al., 2012), it is important to develop new technologies capable of isolating distinct components of emotional reactivity, which will almost certainly have different relationships with external variables such as well-being (Davidson, 1998, 2000; Schimmack et al., 2000; Watson, 2000).

In this context, negative associations between emotional reactivity and well-being have typically been obtained in daily diary or ecological momentary assessment designs (e.g., Bolger & Schilling, 1991; Grosse Rueschkamp et al., 2020). Research of this type is ecologically valid and clearly informs researchers about emotional reactivity processes. However, because such measurement procedures permit little control over the nature of eliciting events or their timing, the processes contributing to reactivity slopes are almost necessarily uncertain. Any particular observation could reflect a peak reaction if it happens to occur in close proximity to an event or it could reflect a lack of recovery following an event that occurred minutes or hours previously. In contrast, studies showing positive associations between reaction intensity and well-being have tended to use laboratory methods that allow for increased experimental control over the intensity of the eliciting stimulus (i.e., stimuli are specially selected because they typically elicit robust emotional responses: Lang et al., 2005) as well as the precise timing of both eliciting stimuli and state assessments of affect (Bylsma, 2021; Schaefer et al., 2013; Waugh et al., 2011).

The Present Studies

The present program of research consists of five studies, all of which assessed global well-being in terms of a composite of eudaimonic and positive emotional components (Kashdan et al., 2008). Studies 1 and 2 then sought to link global well-being to tendencies exhibited in a recently created task termed the Dynamic Affective Reactivity Task (DART: Robinson, Irvin, et al., 2021), which assesses subjective emotional reactions, continuously over time, in response to images known to elicit pleasant versus unpleasant reactions (Lang et al., 2005). Under these highly controlled conditions, it was hypothesized that happier people would display larger peak displacements from neutrality when rating how pleasant versus unpleasant their momentary feelings were. Such results would be consistent with flexibility-linked theories, which contend that context-appropriate emotional reactions of higher intensity contribute to, as well as follow from, higher levels of well-being (Kashdan & Rottenberg, 2010; Waugh et al., 2011).

Studies 3 and 4 were designed to investigate behavioral phenomena that could link higher levels of emotional flexibility to higher levels of well-being, with predictions rooted in the idea that emotional reactions exist because they motivate solutions to problems consistently present in our evolutionary past (Nesse & Ellsworth, 2009). One such problem is that environments are constantly changing (Nesse & Ellsworth, 2009)—for example, some environments contain a threat that should be avoided and others contain a reward that should be pursued. To survive in such a heterogeneous space, humans must approach reward while also avoiding threats, and to accomplish such situation-specific behavior, people must possess the requisite motivations, which are strongly linked to emotional states (Carver & White, 1994; Miller, 1944). To the extent that one's emotion generation system produces robust positive and negative emotions in response to perceived reward and threats, we theorized, one should be better able to flexibly adjust behavior to match environmental contingencies (Kashdan & Rottenberg, 2010). In the context of these behavioral paradigms, it was hypothesized that happy individuals, relative to individuals with lower levels of happiness, would make behavioral decisions that are more aligned with the nature of the eliciting stimuli. For example, the feeling ratings of individuals with higher levels of happiness should more strongly predict their willingness to review stimuli that had induced pleasant or unpleasant reactions (Study 4).

To further contribute to the literature, Study 5 sought to prospectively link lab-based DART performance to states of well-being in a daily diary protocol. We predicted that individuals displaying more intense peak laboratory reactivity would also experience higher levels of well-being up to 4 weeks later, as assessed in the daily diary protocol.

Study 1

Method

Transparency and Openness

No experiments were preregistered, but each experiment was replicated during the course of the investigation. Data sets for the project, as well as a materials file, are available at https://osf.io/w4xt8/?view_only=49d9d2c1678743a48dda7cf6af0f9af7 (Klein & Robinson, 2022). Data were analyzed with SAS, primarily using the PROC MIXED procedure (Singer, 1998).

Participants and General Procedures

All studies used a multilevel modeling strategy, which should provide the best estimates of key parameters (Nezlek, 2012). Sample size decisions, for all studies, were made on the basis of general recommendations in the literature (Nezlek, 2012; Scherbaum & Ferreter, 2009), which suggest that sample sizes of 100 participants with at least 10 observations per person should provide good power for our multilevel hypotheses (Ohly et al., 2010). To obtain samples sizes in this range, we conducted the laboratory portion of each study for two weeks, as procedures of this type have resulted in sample sizes of 100+ in previous studies within the lab. Of note, all studies were approved by North Dakota State University's Institutional Review Board, consent was obtained, and all participants were informed of their ability to terminate an experiment at any time, for any reason.

Participants in Study 1 (n = 134, M age = 18.99, 73.13% women, 88.81% Caucasian) were undergraduates who were recruited using SONA management software and compensated with course credit. These students arrived at the laboratory in groups of six or fewer and completed an affect dynamics task, which was programmed with E-Prime 2.0 software, as well as a psychological well-being assessment, which was programmed with MediaLab. All computers are equipped with 12.5″ × 16.5″ (1,280 × 1,024) monitors of an identical model (LG Flatron ME 20CR-BF).

Psychological Well-Being Assessment

Psychological well-being levels were assessed using the Flourishing scale and the positive component of the Scale of Positive and Negative Emotion (Diener et al., 2010). Collectively, these scales were designed to capture psychosocial prosperity across a broad range of affective, experiential, social, and eudaimonic aspects (Diener et al., 2010), which was deemed desirable in the present studies. The Flourishing Scale (FS) has exhibited high test–retest reliability (e.g., over 1 month, r = .71: Diener et al., 2010) and has robustly correlated with other global well-being measures (e.g., satisfaction with life scale, r = .62: Diener et al., 2010). The FS incorporates basic need satisfaction in terms of personal meaning and social support, as well as prosociality, optimism, engagement with one's life, and self-esteem. Participants rated the extent to which they agreed (1 = *strongly disagree*; 7 = *strongly agree*) with eight statements related to general success in key life domains such as "I lead a purposeful and meaningful life" and "my social relationships are supporting and rewarding" (M = 5.72, SD = .72, α = .87).

The Positive Emotionality (PE) component of the Scale of Positive and Negative Emotion (Diener et al., 2010) is a commonly used well-being instrument that has also shown adequate test-test reliability (one-month: r = .62) as well as convergent validity (e.g., correlation with PANAS Positive Affect items: r = .61). The scale asks participants to indicate how often (1 = *very rarely or never*; 5 = *very often or always*) they have experienced each of six broad, nonspecific positive feeling states (Positive, Happy, Contented, Pleasant, Good, Joyful) over the past 4 weeks (M = 3.86, SD = .50, α = .79). Hence, the overall measurement strategy was one in which we defined well-being in terms of the presence of positive indicators rather than the absence of negative indicators. Because we were principally interested in the relationship between emotion reactivity and overall well-being, we created a composite well-being score by standardizing and averaging the PE and FS scales (Newman et al., 2015: M = −.004, SD = .87), which were correlated at r = .58.

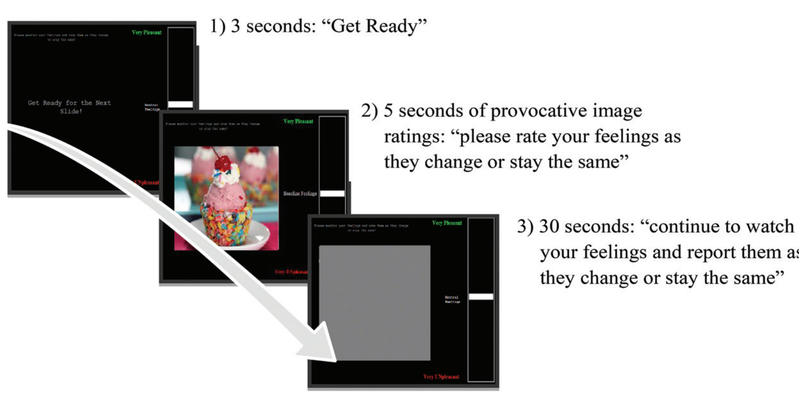
Dynamic Affective Reactivity Task

Procedure Synopsis. We designed the DART to present visual stimuli and record momentary changes in state affect over time. Within the Study 1 DART task, participants viewed 10 pleasant and 10 unpleasant images selected from the Nencki Affective Picture System (NAPS: Marchewka et al., 2014) that appeared at center screen (see below for a further description of the images). Images were presented for 5 seconds, after which they were replaced by a gray rectangle of the same dimensions for 30 seconds.

Continuously on-screen instructions asked participants to "please monitor your feelings and rate them as they change or stay the same." These ratings were made using the keyboard arrow keys, which controlled a sliding visual rating bar located on the right side of the computer screen (see Figure 1 for a trial schematic). The vertical rating bar was anchored with "Very Pleasant" on one side and "Very Unpleasant" on the other, with positions (e.g., pleasant on top and unpleasant on bottom) counterbalanced across participants. Rating bar locations were recorded every 100 milliseconds and ranged from −500 to +500, depending on momentary feelings. These general procedures are consistent with past research using continuous rating procedures (e.g., Mauss et al., 2005).

Affective Stimuli. Ten images of each valence were selected based on NAPS norm data for valence (1 = *very negative*, 9 = *very positive*) and arousal (1 = *relaxed*, 9 = *aroused*). Using the published norms of Marchewka et al. (2014), we first confirmed that the pleasant stimuli that were selected (M = 7.07) were more pleasant than the unpleasant images (M = 3.06), $F(1, 18) = 593.60$, $p < .001$, $\eta_p^2 = .97$. To match positive and negative images for valence extremity, we created extremity scores by calculating the absolute value of image valence norms minus 5 (M pleasant =

Figure 1
The Dynamic Affective Reactivity Task (DART) Environment



Note. See the online article for the color version of this figure.

2.07, *M* unpleasant = 1.94). Positive and negative image sets did not significantly differ with respect to their scores for valence extremity, $F(1, 18) = .64$, $p = .435$, $\eta_p^2 = .03$, or arousal, $F(1, 18) = .27$, $p = .610$, $\eta_p^2 = .01$. The content of these images varied and included faces, people, objects, animals, and landscapes.

DART Trial Procedure. The task consisted of 20 consecutive trials, each involving a distinct image. Each trial consisted of (a) a 3-second "Get Ready!" message, (b) 5 seconds of an affective image sized 10.5 in. × 9.25 in., and (c) 20 seconds during which the image had disappeared and a gray rectangle was present. Figure 2 displays rating data from a particular trial of the task.

Reaction Intensity Quantification

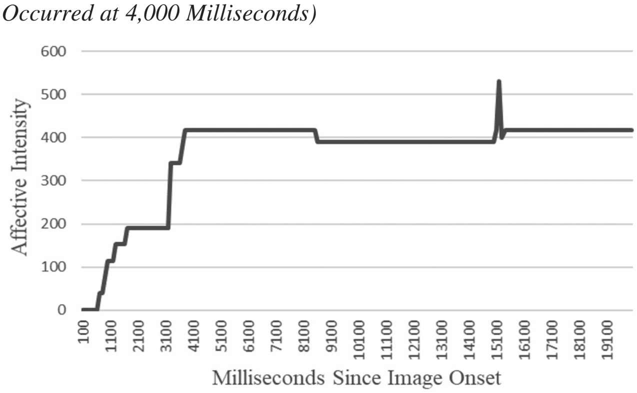
Each trial produced a stream of approximately 200 emotion intensities. To evaluate our hypotheses, each of the 2,680 trials (20 trials × 134 participants) needed to be objectively coded for a peak reaction intensity (as conceptualized by Reisenzein, 1994, and Rubin & Talarico, 2009; rather than more complex intensity models, such as that of Sonnemans & Frijda, 1994). To accomplish this coding process, two simple interlocking algorithms were developed. The algorithms were calibrated to determine the precise times at which: (a) increases in emotion intensity began (termed "React Start Time"), and (b) these increases ended (termed "Peak Time"). For each trial, the Peak Time point was associated with a corresponding emotion rating. The key outcome of these algorithms was this "Peak Intensity" value, or the rating bar position that corresponded with maximum amplitude displacement that was confirmed, by the algorithm, to be a peak reaction.

Algorithms. Before algorithms were applied to the data, difference scores were generated by subtracting each of the 200 emotion ratings from the subsequent rating. Each difference score was associated with a sample number corresponding to the first datum in the change score. To allow for direct comparisons between positive and negative emotion ratings, negative peak scores were reverse-scored. Thus, for both positive and negative images, a positive difference score indicates an emotion stream that is becoming more intense.

In the button-based paradigm used in Study 1, *Reaction Start Time* were simply defined as the first sample number following image onset that was associated with a positive change in affective intensity. *Peak Times* were more complex given that participants sometimes made arrow presses that seemed inadvertent or reported intensity increases following brief pauses in initial reactivity (see Figure 2). For this reason, a simple maximum value would not accurately quantify true peak intensity on many trials. The peak time algorithm was developed in an iterative fashion, with various iterations of the algorithm being tested and refined until outputs (e.g., peak time) matched manually coded peak reaction intensities on 100% of randomly sampled trials. This "ground truth" manual coding was based on consensus agreement between two experts who viewed the time/emotion plots of the raw data. The final peak time algorithm was defined as the first sample following reaction start time associated with 7.5 seconds without a consistent increase in affective intensity (i.e., the first point at which the emotion reaction showed a substantial plateau). This 7.5 rule allowed for the assessment of a meaningful peak time without coding inadvertent entries or brief plateaus that were followed by further increases in response intensity. *Peak Intensity* was defined as the emotion rating corresponding to the peak time sample number.

Data Cleaning. Algorithms were not able to code both a reaction start time and a peak time on 8.5% of trials, and visual inspection of these trials indicated no meaningful or substantive reaction pattern (e.g., no movements at all, movements in the wrong direction, chaotic movements with reversals). Because emotion reactions were the theoretical focus of the present studies, we dropped these trials from the main analysis (of note, happier people tended to have fewer dropped trials, also suggesting more definitive emotional reactions, but these percentages were often 0 and not suitable for analysis).

Figure 2
Example DART Output From a Single Trial (Peak Intensity Occurred at 4,000 Milliseconds)



Note. DART = Dynamic Affective Reactivity Task.

Results

The DART output contained variables that were repeatedly measured, yielding a structure in which trials were nested within participants. Multilevel Modeling (MLM) procedures are well-suited to structures of this type (Nezlek, 2012). All intercepts and slopes were allowed to vary at random.

An MLM using SAS PROC MIXED (Singer, 1998) was performed to examine whether larger peak reaction intensities were linked to higher psychological well-being composite levels, as well as to investigate whether this relationship interacted with image valence. This model included Peak Intensity (dependent variable), psychological well-being composite scores (*z*-scored level 2 independent variable), valence (level 1 independent variable, coded −1 for negative images and +1 for positive images), and the valence by psychological well-being interaction term. To directly compare Peak Intensity scores across valence, all Peak Intensity scores associated with negative stimuli were multiplied by −1 (which was appropriate given that the neutral midpoint was 0, with 500 units on either side).

The intercept of this model was significantly nonzero, $b = 263$, $t = 38.8$, $p < .001$, 95% CI [250, 277], indicating a moderate to strong average Peak. There was also a significant effect of valence, $b = -53.25$, $t = -12.82$, $p < .001$, 95% CI [−61.27, −45.22], indicating that positive images were associated with a smaller average peak (*M* positive = 211) than negative images (*M* negative = 318). More importantly, this model revealed the hypothesized level 2 main effect of the psychological well-being composite on Peak Intensity scores. As expected, higher Peak Intensity scores were associated with higher psychological well-being levels,

b = 15.70, t = 2.30, p = .023, 95% CI [2.17, 29.23]. To further understand this effect, we computed estimated intensity means at low (−1 *SD*) versus high (+1 *SD*) levels of the psychological well-being continuum (Aiken & West, 1991). These estimated means revealed that a prototypical high psychological well-being individual experienced greater average Peak Intensities (M = 279) than a prototypical low (−1 *SD*) psychological well-being individual (M = 248). Important to our psychological flexibility-derived predictions, this main effect for psychological well-being did not interact with the manipulation of image valence, b = −2.47, t = −.59, p = .558, 95% CI [−10.73, 5.79]. Accordingly, individuals with higher psychological well-being levels reacted more intensely to *both* positive and negative stimuli within the most encompassing analysis that was conducted.

Although, in the key analysis, there was no interaction by valence, we further probed the data by considering each valence separately. Psychological well-being was linked to more intense reactions to negative stimuli, b = 18.28, t = 2.29, p = .024, 95% CI [2.63, 33.93], but not positive stimuli, b = 13.03, t = 1.61, p = .109, 95% CI [−2.80, 28.86]. That happier individuals displayed stronger peak intensities to negative stimuli is consistent with the idea that negative reactions can be linked to higher rather than lower levels of well-being when stimuli are extreme and when peak intensities are precisely quantified.

We then returned to the model that included valence but performed analyses in which the psychological well-being composite was replaced with a single well-being score, either pertaining to positive emotionality or flourishing. The model including Positive Emotionality (PE) revealed a significant effect of valence, b = −53.45, t = −12.75, $p < .001$, 95% CI [−61.67, −45.23], a nonsignificant effect of PE, b = 10.41, t = 1.49, p = .138, 95% CI [−3.38, 24.20], and a nonsignificant valence by PE interaction, b = 1.80, t = 1.42, p = .671, 95% CI [−6.52, 10.12]. The model including Flourishing revealed a significant effect of valence, b = −53.37, t = −12.83, $p < .001$, 95% CI [−61.53, −45.21], a significant effect of FS, b = 18.24, t = 2.60, p = .011, 95% CI [4.35, 32.13], and a nonsignificant interaction, b = −6.48, t = −1.50, p = .134, 95% CI [−14.97, 2.00]. These analyses implicate flourishing rather than positive emotionality, but findings were more parallel in other studies.

In summary, the Study 1 results supported the idea that higher levels of psychological well-being are associated with greater reaction intensity, irrespective of valence. We sought to replicate these results in a second study, with the idea that replication would increase confidence in the basic pattern.

Study 2

Method

Participants and General Procedures

Power considerations and general procedures for Study 2 were identical to those described in Study 1. Participants (n = 139, M age = 19.03; SD = 1.27, 53.24% women, 87.77% Caucasian) were recruited in the same manner and they completed the DART before reporting on levels of psychological well-being.

Psychological Well-Being Assessment

Psychological well-being instruments were identical to those described in Study 1 and consisted of the Flourishing Scale (FS; M = 5.66, SD = .97, α = .93) as well as the positive component of the Scale of Positive and Negative Emotion (PE; M = 3.85, SD = .62, α = .85). Because we were interested in the relationship between emotion reactivity and overall psychological well-being, we created a composite score by standardizing and then averaging the PE and FS scales (M = .021, SD = .94), which were correlated at r = .69.

Dynamic Affective Reactivity Task

Procedure Synopsis. The Study 2 DART paradigm was modified in two primary ways. First, the Study 2 paradigm did not include a "get ready" slide or a gray rectangle following offset of provocative images. Instead, affective stimuli were presented for 5 seconds, and were then followed by neutral IAPS images that served as a buffer. Second, momentary affective ratings were made using the computer mouse. The use of neutral image buffers, we think, better approximates daily life, which involves a continuous stream of pleasant, unpleasant, and neutral events (Suls & Martin, 2005). A mouse was used both because of its familiarity and because its use results in an instantaneous or seamless link between felt and reported affect (Girard, 2014).

To make a further case for generalizability, Study 2 used an affect-inducing image set that was different than Study 1. Specifically, affective reactions were manipulated through the use of images selected from the International Affective Picture System or IAPS (Lang et al., 2005). Critically, IAPS slides/images have been shown to alter the subjective, behavioral, and physiological components of both positive and negative emotion generation systems in many previous studies (Lang, 1995; Lang et al., 1998). Other than these changes, the Study 2 DART environment was identical to that used in Study 1 (see Figure 1).

Affective Stimuli. Ten images of each valence were first selected, based on SAM-based IAPS norms for valence and arousal (Lang et al., 2005). The pleasant images that were selected were more pleasant (M = 7.46) than the unpleasant images that were selected (M = 2.46), F(1, 18) = 1247.36, $p < .001$, but the two image sets did not differ in extremity (distance from valence midpoint), F(1, 18) = .05, p = .820, or arousal, F(1, 18) = .07, p = .799. Pleasurable affective images featured scenes such as sailing or cute animals, and unpleasant images featured disturbing scenes such as physical attacks, car accidents, or crime scene photos.

A total of 20 slides with neutral IAPS SAM norms (M pleasantness = 4.93, SD = .27, M arousal = 3.32, SD = .34) were also selected. Neutral images featured benign or nondescript objects such as a typical coffee mug, a pen, or a towel.

Reaction Intensity Quantification

In general, the DART scoring processes used in Studies 1 and 2 were identical. To isolate peak reaction intensities, two algorithms—identifying reaction starts and peaks—were developed in an iterative process, as described above.

Algorithms. Affective intensity streams were first converted to difference scores and reactions to negative slides were reverse-scored to allow for comparisons between valences. Because data patterns in the mouse-based output of Study 2 were quite different from the button-based output of Study 1, the resulting algorithms were also different. Here, the final *Reaction Start time* algorithm targeted the first sample number following image onset that was associated with both (a) two change scores in a row that were greater than zero as well as (b) three sequential change scores (two of which were included in the initial criterion) whose average was greater than four. This algorithm avoids small changes or inconsistent changes being coded as a reaction start.

Because the keyboard and mouse yielded different data patterns, it was desirable to develop a peak-based algorithm that was suited to mouse data. This algorithm, though, was developed using the same iterative process described in Study 1. Also, the algorithm was tested and refined until it matched visual inspections of data on 100% of randomly sampled trials.

The *Peak Time* algorithm identified the first sample following reaction start time that was associated with both (a) three emotion change scores in a row that were either zero or negative in combination with (b) the average of the following seven change scores being less than one. Criterion "a" would mean that the reaction was no longer significantly increasing (i.e., the reaction had either flattened or started returning to baseline). The average-of-seven component (criterion b) was included because people occasionally exhibited a brief pause in their reaction (e.g., for 600 ms) but then continued to report significant increases in emotion intensity. *Peak Intensity* was defined as the emotion rating corresponding to the peak time sample number.

Data Cleaning. In Study 2, the algorithms were not able to code both a reaction start time and a peak time on 4.68% of trials. Because emotional reactions were the focus of the present studies, these trials were dropped.

Results

To examine whether more intense emotion reactions were linked to higher psychological well-being composite scores (level 2 individual difference), and also whether image valence (level 1 within-subject variable) moderated any such effects, we performed an MLM using SAS PROC MIXED (Singer, 1998). Psychological well-being scores were z-scored, and valence was coded as -1 for negative images and $+1$ for positive images ($M = 0$, $SD = 1$). To compare reactivity across valence, Peak Intensity scores associated with unpleasant stimuli were multiplied by -1.

Results of this model were quite similar to those of Study 1. The intercept was significantly nonzero, $b = 291.16$, $t = 41.63$, $p <$ .001, 95% CI [277.36, 305.24], indicating a moderate to strong average Peak Intensity. There was also a significant effect of valence, $b = -51.42$, $t = -11.57$, $p < .001$, 95% CI [−60.13, −42.71], indicating that positive images triggered less intense peak reactions than negative images (Robinson, Irvin, et al., 2021).

More importantly, this model revealed a significant level 2 main effect of the psychological well-being composite on Peak Intensity scores such that greater Peak Intensity was linked to higher psychological well-being, $b = 22.48$, $t = 3.20$, $p = .002$, 95% CI [8.60, 36.36]. Further, estimated means revealed that happier individuals (+1 *SD* psychological well-being: $M = 313.67$) reported higher intensity reactions than less happy people (−1 *SD* psychological well-being: $M = 268.71$). Also supporting hypotheses, image valence did not significantly interact with this effect, $b = 2.32$, $t =$ .53, $p = .603$. Even so, we further probed the data by considering each valence separately. In Study 2, individuals with higher psychological well-being levels displayed more intense reactions to both positive, $b = 24.72$, $t = 2.81$, $p = .006$, 95% CI [7.46, 41.97], and negative, $b = 20.49$, $t = 2.63$, $p = .009$, 95% CI [5.23, 35.74], stimuli.

Follow-up analyses replacing the psychological well-being composite with FS or PE revealed the same hypothesized pattern of significant and nonsignificant effects. Both FS ($b = 6.89$, $t =$ 3.14, $p = .001$, 95% CI [9.36, 36.62]) and PE ($b = 17.56$, $t = 2.53$, $p = .013$, 95% CI [3.81, 31.31]) positively predicted emotional intensity peaks and neither the FS effect ($p = .958$) nor the PE effect ($p = .367$) was associated with a significant interaction with valence. Together, these results support the idea that higher levels of context-appropriate emotional reactivity are linked to higher levels of psychological well-being.

Study 3

The results of Studies 1 and 2 suggest that stronger reactions—to stimuli known to elicit strong reactions—tend to be functional, in that they are linked to higher levels of psychological well-being. Study 3 sought to better understand the functional basis of these effects. Following psychological flexibility theories (Kashdan & Rottenberg, 2010; Waugh et al., 2011) as well as the results of the first two studies, we hypothesized that happy individuals would exhibit more robust behavioral reactions to pleasant versus unpleasant stimuli, as defined in terms of avatar placements for a virtual self that favored pleasant regions of space to a greater extent (Robinson, Klein, et al., 2021).

Method

Participants and General Procedures

With respect to a priori power considerations, the Study 3 data structure and related statistical analyses examine effects that are very similar to those examined in Studies 1 and 2. Specifically, the key hypothesized effect in Study 3 is an MLM-based level 2 main effect. For this reason, sample size considerations in Study 3 were identical to those described in Study 1. Participants ($n = 98$, *M* age = 19.41, $SD = 4.1$, 72.45% women, 85.71% Caucasian) were recruited and compensated via SONA. All laboratory facilities were as described in Study 1, and informed consent/IRB approval was obtained. Participants completed an emotion and action task presented via E-Prime 2.0, and then completed well-being measures via MediaLab.

Psychological Well-Being Assessment

The Study 3 psychological well-being instruments were identical to those of Study 1. To obtain theoretically inclusive quantifications of both positive emotional experiences as well as broader judgments about the contents of one's life, we administered both the Flourishing Scale (Diener et al., 2010), or FS ($M = 5.75$, $SD =$ .71, $\alpha = .88$), and the positive component of the Scale of Positive and Negative Emotion (Diener et al., 2010) or PE ($M = 3.70$, $SD =$ .60, $\alpha = .85$). Because the primary question concerned the relationship between adaptive behavior and overall psychological well-being, a composite happiness score was created by standardizing and averaging the PE and FS scales ($M = -.014$, $SD = .91$), which were correlated at $r = .63$.

Approach–Avoidance Behavior

Procedure Synopsis. Based on previous manikin or avatar tasks (Krieglmeyer & Deutsch, 2010), a computerized spatial affective environment was created in which individuals could "move around" as a way of studying approach–avoidance processes, which are thought to play an essential role in self-regulation (Lewin, 1935). Specifically, when emotion systems are working properly, individuals should be motivated to approach pleasant stimuli and avoid unpleasant stimuli (Elliot, 2006). To model processes of this type in a behavioral manner, we created a computerized environment that contained both a pleasant stimulus and an unpleasant stimulus, and participants were asked to choose where they "want to be" in this environment. On each of 50 trials, two 4.2 × 3.1-in. IAPS images (one pleasant and the other unpleasant) were initially presented to the left and right side of the computer screen. Participants were first asked to rate their reactions to the images, primarily to ensure that the respective valences had been encoded (Phaf et al., 2014), following which a behavioral decision was made.

Instructions were as follows: "On this portion of the experiment . . . you will first see two slide images. You will be asked to rate the pleasantness of each slide in turn. Next, you will see a spatial layout with 'you' in the center and the images to your figure's left and right. Your task is to freely choose a location along the line that reflects where you would like to 'be' for that trial. It is totally up to you where you decide to go along the line, including near the center or near one of the images."

Affective Stimuli. Image selection procedures were similar to those used in Studies 1 and 2. Fifty IAPS images of each valence were selected, and these images were matched for valence extremity and arousal.

Trial Procedures. The task involved 50 trials with paired stimuli. All trials had two major components—an image rating task and an avatar placement task. On each trial, an image appeared on either the left or right side of the screen, and, following a 2,000-ms delay, participants were asked to rate how "pleasant or unpleasant" the image felt for them (1 = *very unpleasant*, 7 = *very pleasant*). Once a rating was made, this process was repeated for the second image. As mentioned above, the primary purpose of the rating task was to ensure that image valences had been encoded (Phaf et al., 2014), but we also examined whether happy individuals had more decisive emotional reactions, here defined in terms of a valence difference rating score (i.e., a more pleasant reaction to the positive image than to the negative image).

Trials always included a pleasant image and an unpleasant image, but left/right placement of the images was randomly determined. Following image ratings, the emotional behavior environment was presented, as displayed in Figure 3. During this stage, the mouse cursor was replaced with an avatar icon labeled "you," which could then be controlled by the mouse. The trial ended when the participant moved the self-avatar to the preferred position for the trial and then made a mouse click. There were 12 different possible locations for the avatar, spanning the space in between the left and right images.

Emotion Reactivity Measure. Images were paired and feeling reactions needed to be examined in a paired manner, which was done by subtracting the feeling rating for the negative image from the feeling rating for the positive image. The mean of these difference scores was 4.14 ($SD = 2.13$), indicating that participants tended to have more pleasant reactions to positive relative to negative stimuli, but such scores also varied across trials and individuals. Similar feeling rating procedures were used by Waugh et al. (2011) in their study of psychological flexibility processes related to resilience.

Behavioral Assessment. It is emotionally rational to approach pleasant stimuli and avoid unpleasant stimuli (Elliot, 2006). Avatar placements, conceptualized in terms of approach–avoidance processes, were examined by scoring these placements such that negative numbers indicated closer placements to the negative stimulus and positive placements indicated closer placements to the positive stimulus (range -5.5 to $+5.5$: $M = 3.79$, $SD = 1.70$).

Results

Several MLMs were performed using the SAS PROC MIXED platform, with random intercepts (Singer, 1998). The psychological well-being composite variable predicted feeling ratings, such that happier individuals made feeling ratings that were more polarized with respect to valence, $b = .39$, $t = 3.83$, $p < .001$, 95% CI [.19, .59]. This result accords with Studies 1 and 2, although the Study 3 paradigm involved comparative ratings and peaks could not be isolated. Of note, results were similar for each element of the composite variable (FS: $b = .41$, $t = 4.11$, $p < .001$, 95% CI [.21, .61]; PE: $b = .29$, $t = 2.72$, $p = .008$, 95% CI [.08, .50]).

Next, we were interested in examining emotion–behavior relationships in a within-subject manner, independent of psychological well-being levels. Consistent with theorizing (Elliot, 2006; Frijda, 2004), trials associated with a more pronounced feeling difference score were also trials on which individuals placed the avatar self closer to the pleasant image, $b = .39$, $t = 13.51$, $p < .001$, 95% CI [.34, .45]. Also, in an analysis that included both pleasant and unpleasant feeling scores, both pleasant feelings (in response to positive images), $b = .61$, $t = 14.87$, $p < .001$, 95% CI [.53, .69], and unpleasant feelings (in response to negative images), $b = .23$, $t = 7.29$, $p < .001$, 95% CI [.17, .30], predicted avatar placements. What these results indicate is that the average person displayed larger approach–avoidance effects when they experienced more pronounced pleasant or unpleasant feelings on a given trial (i.e., feelings guided behaviors).

Finally, we examined the novel question of whether happy individuals displayed context-appropriate approach–avoidance behavior to a greater extent, as assessed by avatar placements. The psychological well-being composite variable did predict these placements, such that happier individuals placed themselves closer to the positive image and further from the negative image, $b = .33$, $t = 3.75$, $p < .001$, 95% CI [.15, .50], and similar results were found for each of the elements of the composite (FS: $b = .39$, $t = 4.65$, $p < .001$, 95% CI [.22, .55]; PE: $b = .20$, $t = 2.13$, $p = .036$, 95% CI [.01, .38]). In other words, it is generally adaptive to approach positive stimuli while avoiding negative stimuli (Epstein, 2013; Krieglmeyer et al., 2013), and happy individuals displayed such tendencies to a greater extent.

Figure 3
Task Environment for Study 3

Note. See the online article for the color version of this figure.

Study 4

Study 4 sought to extend Study 3 and the primary focus was again a behavioral one. The key question was whether feelings would influence choices made with respect to reviewing images later in the session and we hypothesized that feelings would guide these behavioral choices to a greater extent at higher levels of psychological well-being. Such results would be consistent with the purported behavioral benefits of achieving higher levels of psychological flexibility (Hayes et al., 2006; Kashdan & Rottenberg, 2010).

Method

Participants and General Procedures

The key hypothesized effect in Study 4 is an MLM-based level 2 main effect. Thus, sample size considerations in Study 4 were identical to those described in Study 1. Participants (n = 134, M age = 19.20, 51.16% women, 82.17% Caucasian) were recruited and compensated via SONA. All laboratory facilities were as described in Study 1, and informed consent as well as IRB approval were obtained. Participants completed an emotion and action task presented via E-Prime 2.0 and then well-being assessments, which were programmed in MediaLab.

Psychological Well-Being Assessment

The psychological well-being instruments used in Study 4 were identical to prior studies (FS: M = 5.48, SD = .88, α = .86; PE: M = 3.70, SD = .64, α = .81). The two scales were correlated at .73 and a composite well-being variable was created by standardizing and then averaging FS and PE scores (M = 0, SD = .93).

Behavioral Task

Overview. Both feeling ratings and behavioral decisions were made in Study 4, as in Study 3. Instructions stated that the experiment included two blocks. In block 1, each image was presented twice and paired with a different question each time. In a randomized order, participants reported either the emotions they felt while viewing each image or their degree of preference for seeing the image again later in the experiment. Participants were deceived and told that their answers to the second (behavioral choice) question would determine which stimuli were repeated a third time, in a second block that did not occur.

Trial Procedures. Images were presented in the center of the computer screen and participants viewed the images for 1,500 ms prior to making a response, with questions appearing toward the bottom of the screen. With the image continuously present, one question asked individuals to rate the pleasantness of their feelings in response to the image while viewing it, when they were ready to make this rating (1 = *extremely unpleasant*; 9 = *extremely pleasant*). The other (behavioral) question asked how willing participants were to see the particular image again, in terms of a percentage (0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%). For this second question, participants were led to believe that the percentages chosen would precisely govern probabilities of image repeats later in the study (e.g., an 80% response would lead to an 80% likelihood of seeing the image again during a third viewing of pictures).

Affective Stimuli. The Study 4 task presented 49 IAPS (Lang et al., 2005) images. In contrast to previous studies, these images varied across the entire valence spectrum in that seven images each had IAPS valence norms of 1.5–2.5 (*very unpleasant*), 2.5–3.5 (*moderately unpleasant*), 3.5–4.5 (*slightly unpleasant*), 4.5–5.5 (*neutral*), 5.5–6.5 (*slightly pleasant*), 6.5–7.5 (*moderately pleasant*), and 7.5–8.5 (*very pleasant*). In an image-as-unit database, the seven-level valence category variable was significantly associated with IAPS image pleasantness norms, $t = 214.11$, $p < .001$, $\beta = 1.00$, but not arousal norms, $t = -.66$, $p = .509$, $\beta = -.10$.

Results

Analyses of the Stimulus-Feeling Relationship

Stimuli varied in extremity, from neutral to normatively extreme. That stimuli varied in this manner provided a unique opportunity to examine context-appropriate feelings, which could be defined in terms of more polarized feeling ratings in response to stimuli that are more extreme. To examine stimulus-feeling relationships in this manner, we recoded several variables. First, we redefined the stimulus valence factor such that it indexed stimulus extremity (0, 1, 2, or 3, with 0 representing neutral stimuli and 3 reflecting the most extreme levels of valence, either positive or negative). Second, we redefined the feeling rating variable such that it reflected distance from the feeling midpoint (i.e., distance from 5, which reflects a neutral feeling: $M = 2.36$). Then, we performed an MLM on the feeling polarization variable as it responded to the combined set of predictors of stimulus extremity (person-centered), categorical valence (-1 for negative stimuli, 0 for neutral stimuli, and $+1$ for positive stimuli), and the psychological well-being composite variable (z-scored).

In this analysis, there was a main effect for stimulus extremity, $b = .64$, $t = 26.28$, $p < .001$, 95% CI [.59, .69], such that feeling ratings were more polarized in the context of more extreme stimuli. There was also a main effect for categorical valence, such that feeling ratings were more polarized in the context of negative ($M = 2.77$) relative to positive ($M = 2.36$) stimuli. This effect interacted with stimulus extremity, $b = -.09$, $t = -4.41$, $p < .001$, 95% CI [$-.13$, $-.05$], such that greater feeling polarization for negative stimuli was particularly evident for the most extreme stimuli (e.g., for the extremity level of 1, polarization *M*s = 1.88 and 2.17 for positive and negative stimuli; for the extremity level of 3, *M*s were 2.81 and 3.43).

Remaining effects included the psychological well-being (PWB) predictor. Of importance, there was a main effect for PWB, $b = .12$, $t = 2.46$, $p = .016$, 95% CI [.02, .22], such that happier people displayed greater polarization in their feeling ratings, a result that is consistent with prior studies. There was also a valence category by PWB interaction, $b = -.06$, $t = -2.35$, $p = .020$, 95% CI [$-.12$, $-.01$], whose pattern was akin to Study 1, in that the PWB/polarization relationship was evident for normatively negative, $b = .11$, $t = 2.30$, $p = .023$, 95% CI [.02, .19], but not normatively positive, $b = .08$, $t = 1.31$, $p = .19$, 95% CI [$-.04$, .19], stimuli. Of most relevance to the idea of context-appropriate feelings, there was also a stimulus intensity by PWB interaction, $b = .05$, $t = 2.24$, $p = .027$, 95% CI [.01, .10], that was not qualified by valence, $b = .01$, $t = .74$, $p = .460$, 95% CI [$-.02$, .05]. When stimulus extremity was low (0 or 1 level), the PWB main effect was not significant, $b = .06$, $t = .94$, $p = .349$, 95% CI [$-.06$, .18]. When stimuli were extreme (3 or 4 level), by contrast, the PWB main effect was significant, $b = .17$, $t = 3.46$, $p < .001$, 95% CI [.07, .26]. The tendency for happier individuals to report stronger feelings, that is, was particularly evident as stimulus extremity increased.

In follow-up analyses, we reran the full MLM model, but replaced PWB with either positive emotionality or flourishing. In the model involving positive emotionality (PE), there was a main effect for PE, $b = .12$, $t = 2.31$, $p = .022$, 95% CI [.02, .21], a PE by valence category interaction, $b = -.07$, $t = -2.59$, $p = .011$, 95% CI [$-.13$, $-.02$], but no PE by stimulus extremity interaction, $b = .04$, $t = 1.48$, $p = .141$, 95% CI [$-.01$, .08]. In the model involving flourishing (FL), there was a main effect for FL, $b = .11$, $t = 2.25$, $p = .026$, 95% CI [.02, .21], an FL by stimulus extremity interaction, $b = .06$, $t = 2.71$, $p = .008$, 95% CI [.02, .11], but no FL by valence category interaction, $b = -.05$, $t = -1.80$, $p = .075$, 95% CI [$-.10$, .00]. In total, the results indicate that higher levels of both PE and FL are linked to more polarized feeling ratings, but the interaction with stimulus extremity was more robust when well-being was defined in terms of flourishing relative to positive emotionality.

Analyses of the Feeling-Behavior Relationship

When analyzing the feeling-behavior relationship, stimulus extremity was not included as a factor and the analysis was more straightforward. In specific terms, we performed an MLM that included a person-centered version of the original feeling rating dimension (from unpleasant to pleasant) along with a *z*-scored version of the psychological well-being composite variable. In this analysis, the feeling by PWB interaction was of particular relevance and the dependent variable consisted of one's willingness to see particular images again.

A main effect for feeling pleasantness revealed that the average person was more willing to review images that had induced pleasant feelings, $b = 2.46$, $t = 45.18$, $p < .001$, 95% CI [2.35, 2.56]. There was no main effect for psychological well-being (nor was one hypothesized), $b = -.02$, $t = -.30$, $p = .763$, but the cross-level interaction was significant, $b = .17$, $t = 3.13$, $p = .002$, 95% CI [.06, .27]. Estimated means (± 1 *SD*) revealed that individuals with higher, relative to lower, psychological well-being levels were both less willing to review an image that they experienced as unpleasant (estimated *M*s = 25.0% versus 29.4%), $b = .18$, $t = 2.63$, $p = .010$, 95% CI [.05, .32], when limiting the analysis to negative or neutral images, as well as more interested in reviewing an image that they experienced as pleasant (estimated *M*s = 69.4% versus 64.6%), $b = .15$, $t = 2.23$, $p = .028$, 95% CI [.02, .28], when limiting the analysis to neutral or positive images. Furthermore, the same interactive pattern was observed when the well-being composite was replaced with flourishing scores, $b = .17$, $t = 3.29$, $p = .001$, 95% CI [.07, .27], or positive emotion scores, $b = .14$, $t = 2.54$, $p = .011$, 95% CI [.03, .24].

These results conceptually replicate Study 3 in that feelings were more consequential in behavioral decisions among individuals with higher levels of psychological well-being. Such results can provide an explanation as to why higher levels of emotional reactivity appear to be beneficial to the person, in that they support behavioral decisions that exhibit a greater degree of affective rationality (e.g., by serving to render it more likely that one will experience pleasant relative to unpleasant feelings in the future, on the basis of one's stimulus choices).

Study 5

Having explored the functional benefits of reacting to valenced stimuli in more robust manners, we returned to the DART procedures in Study 5. The question of interest was whether higher levels of peak reaction intensity, as quantified in Studies 1 and 2, could be used to predict psychological well-being up to 4 weeks later.

Method

Participants and General Procedures

Power considerations were identical to prior studies and the sample size afforded adequate power. Study 5 was a two-part study that included an initial laboratory portion followed by a 14-day daily diary protocol. The lab portion was prescheduled to run for two consecutive weeks and we recruited a college-aged sample (n = 128, M age = 19.08, SD = 2.99, 63.28% women, 88.28% Caucasian). The daily protocol began assessing daily well-being levels 1 week after the lab sessions were complete and continued for 14 consecutive days. Based on an a priori plan, 10 participants were dropped prior to data analysis for failing to complete at least nine daily dairy assessments.

Dynamic Affect Reactivity Task

Procedure Synopsis. In a randomized order, participants viewed 10 pleasant and 10 unpleasant images selected from the IAPS (Lang et al., 2005). After viewing a "get ready" message for 3 seconds, provocative images were presented for 5 seconds (see Figure 1). After 5 seconds, the slide was replaced with a blue screen containing instructions to continue monitoring and rating one's feelings. Participants rated their emotions using a computer mouse.

Affective Stimuli. Image selection procedures were similar to those used in Study 1. Ten images of each valence/pleasantness were first selected, based on IAPS norms for valence and arousal (Lang et al., 2005). The pleasant images were more pleasant (M = 7.07) than the unpleasant images (M = 2.96), $F(1, 18) = 2570.21$, $p < .001$, $\eta_p^2 = .99$. By contrast, ANOVAs indicated that valence category was not related to affective extremity, $F(1, 18) = .14$, p = .716, or arousal, $F(1, 18) = .69$, p = .416. Pleasurable affective images featured enjoyable scenes such as cute animals or sporting adventures and unpleasant images featured disturbing scenes such as physical attacks, car accidents, or crime scene photos.

Trial Procedures. The task included 20 trials. Images were sized 10.5 in. × 9.25 in. and presented for 5 seconds followed by a 15-second blank screen. Rating bar locations were recorded every 100 milliseconds and ranged from −500 to +500, depending on current affective feelings.

Data Management

Algorithms. The reaction start time and peak time algorithms were identical to those described in Study 2. To verify the reliability of the algorithm outputs, we again randomly sampled and visually compared outputs to time/emotion plots generated by Excel. The algorithm output closely matched visual coding on 100% of the trials that were sampled. Algorithms were not able to code both a reaction start and a peak for 8.7% of trials, and these trials were therefore dropped from primary analyses.

Reaction Intensity Quantification. The scoring process for Peak Intensity was identical to the processes described in Studies 1 and 2. To use these Peak Intensity scores as predictors of daily psychological well-being, we needed to collapse across trials to create single scores for each individual. The key predictor was *Average Peak Intensity*, with higher numbers indicating stronger reactions to both positive and negative stimuli (i.e., a nonspecific tendency toward higher peak reactions, irrespective of valence [M = 260, SD = 76]). For comparative purposes, we also computed an *Average Intensity Difference* score by subtracting peak intensity averages for negative image trials from peak intensity averages for positive image trials (M = −114, SD = 116).

Daily Protocol

After a 2-week laboratory portion, the daily diary phase began. Participants received e-mail reminders with Qualtrics survey links at 7 p.m. on each of 14 consecutive days. To limit retrospection, these links remained active for exactly 12 hr. To increase the power and validity of the results, participants completing fewer than nine surveys were excluded from the study (West et al., 2011). The final dataset included 1,607 daily reports.

Daily Satisfaction. Thus far, we have relied on the Flourishing Scale (Diener et al., 2010) to assess global quality of life judgments. However, the FS assesses highly specific life dimensions that were not expected to show robust intraindividual variation on a day-to-day basis (e.g., "I am a good person and live a good life"). Accordingly, the FS was replaced with general domain satisfaction judgments for two key domains—the self and global health. In specific terms, on each day, participants rated the extent to which (1 = *not at all*, 5 = *extremely*) they were "satisfied with myself" (M = 3.30, SD = 1.04) and "satisfied with my health" (M = 3.28, SD 1.09).

Daily Positive Emotionality. The Positive Emotionality component of the SPANE (Diener et al., 2010) was altered to target daily emotions. Each day, participants indicated the extent to which (1 = *not at all*; 5 = *extremely*) they felt each of three wide-ranging, nonspecific positive feeling states (Positive, Happy, Excited). For analysis purposes, a PA total score, for each day, was computed (M = 3.60, SD = .95, α = .92).

Daily Negative Emotionality. Although we did not form hypotheses about the presence or absence of ill-being markers, we included Negative Emotionality as a contrast variable. For this purpose, three wide-ranging, nonspecific negative feeling states (Sad, Negative, Distressed) were chosen from the SPANE (Diener et al., 2010) and participants rated the extent to which (1 = *not at all*, 5 = *extremely*) they felt these feelings on each day. For analysis purposes, a NA total score was computed (M = 1.88, SD = .86, α = .86).

Results

Results Involving Average Peak Intensity

Key hypotheses involved the average peak intensity score, with higher numbers reflective of higher levels of reactivity to both positive and negative images. Such hypotheses—and the more exploratory analyses that follow—were examined in a series of PROC MIXED MLMs with intercepts set to random. As hypothesized, the primary models revealed a positive relationship between Average Peak Intensity (level 2, *z*-scored independent variable) and each of the well-being indicators (level 1 DVs): Satisfaction with Self, $b = .147$, $t = 2.26$, $p = .026$, 95% CI [.02, .27]; Satisfaction with Health, $b = .159$, $t = 2.21$, $p = .029$, 95% CI [.02, .30]; and Positive Emotionality, $b = .166$, $t = 2.78$, $p = .006$, 95% CI [.05, .28]. By contrast, Peak Intensity on the DART task was not predictive of daily Negative Affect, $b = -.014$, $t = -.26$, $p = .799$, 95% CI [−.12, .09], and the findings therefore implicate processes involving well-being rather than ill-being. Overall, these results provide converging evidence for a link between psychological flexibility (as manifest in stimulus-appropriate tendencies toward reactivity) and happiness or well-being.

Results Involving a Reactivity Difference Score

In more exploratory terms, we also used a second predictor that subtracted peaks for negative images from peaks for positive images. This difference score was not predictive of Positive Emotionality in daily life, $b = .083$, $t = 1.36$, $p = .177$, 95% CI [−.04, .20], or Negative Emotionality, $b = -.090$, $t = -1.70$, $p = .091$, 95% CI [−.19, .01], but was predictive of daily satisfaction with Self, $b = .200$, $t = 3.11$, $p = .002$, 95% CI [.07, .32], and Health, $b = .255$, $t = 3.67$, $p < .001$, 95% CI [.12, .39], suggesting that greater degrees of positivity (independent of overall levels of reactivity) were associated with higher levels of daily satisfaction. The latter results, although they suggest valence-specific processes, were not evident in Studies 1 and 2.

Follow-Up Analyses

Given that both average peak intensity and the reactivity difference score predicted several of the daily outcomes, we performed MLMs with both predictors simultaneously controlled. As displayed in Table 1, higher levels of average peak intensity continued to predict positive affect, satisfaction with self, and satisfaction with health when controlling for the reactivity difference score. Similarly, the reactivity difference score continued to predict satisfaction with self and satisfaction with health when controlling for average peak intensity. These findings attest to the independence of the two predictors.

Table 1
Average Peak Intensity and Reactivity Difference Scores as Simultaneous Predictors of Daily Outcomes, Study 5

Daily outcome and predictor	*b* [95% CI]	*t*	*p*
Positive affect			
Peak intensity	.177 [.060, .293]	2.97	.004
Difference score	.102 [−.015, .218]	1.71	.090
Negative affect			
Peak intensity	−.024 [−.127, .080]	−0.44	.659
Difference score	−.092 [−.196, .011]	−1.74	.085
Satisfaction with self			
Peak intensity	.170 [.048, .292]	2.71	.008
Difference score	.217 [.095, .339]	3.46	<.001
Satisfaction with health			
Peak intensity	.188 [.055, .321]	2.77	.007
Difference score	.275 [.142, .408]	4.04	<.001

Because both predictors mattered, reactions to positive images considered alone should predict the well-being outcomes, in that stronger reactions to positive images would be consistent with higher peak intensity as well as a stronger difference score favoring positive reactivity. Consistent with this analysis, higher positive peaks were predictive of daily positive affect, $b = .19$, $t = 3.26$, $p = .001$, 95% CI [.08, .31], satisfaction with self, $b = .25$, $t = 4.01$, $p < .001$, 95% CI [.13, .37], and satisfaction with health, $b = .30$, $t = 4.35$, $p < .001$, 95% CI [.16, .43], but not daily negative affect, $b = -.07$, $t = -1.30$, $p = .197$, 95% CI [−.17, .04]. Reactions to negative images considered alone should possess little predictive power in the current study, however, because such reactions would positively contribute to average peak intensity but negatively contribute to the reactivity difference score. Consistent with this analysis, higher negative peaks did not predict daily PA, $b = .08$, $t = 1.28$, $p = .203$, 95% CI [−.04, .20], daily NA, $b = .04$, $t = .78$, $p = .439$, 95% CI [−.06, .15], satisfaction with self, $b = -.00$, $t = -.04$, $p = .967$, 95% CI [−.13, .13], or satisfaction with health, $b = -.03$, $t = -.35$, $p = .724$, 95% CI [−.17, .12]. In light of these findings, we underline the importance of the results reported in Table 1, in that they support the idea that higher peak intensity, irrespective of valence, predicts stronger daily experiences of positive affect and satisfaction, even when controlling for differential reactivity to positive versus negative stimuli.

General Discussion

The results, in total, indicate that psychological well-being is associated with more intense reactions to both positive and negative stimuli. Such intense reactions, additional results indicate, are likely to motivate context-appropriate approach–avoidance choices and behaviors that render future exposures to negative events less likely. Although the findings are novel, they are consistent with prominent theories of emotion and motivation (Frijda, 2004; Lang, 1995) as well as theoretical perspectives emphasizing the adaptive benefits of emotional context sensitivity as well as psychological flexibility (Bylsma et al., 2008; Kashdan & Rottenberg, 2010).

Methodological Implications

The present findings may seem inconsistent with research linking the overall magnitude of negative emotional reactivity to variables like neuroticism (Bolger & Schilling, 1991; Gross et al., 1998), but they are not. What we have shown is that greater *peak* or *maximum* emotional intensities—to stimuli that are known to be evocative—seem to support well-being and adaptive choice. However, other parameters of reactivity—such as overreactions to minor stimuli (Suls & Martin, 2005) or elongated emotional responses—are likely to be problematic for psychological health. In other words, it may be crucial to unpack what emotional reactivity means, in terms of its various parameters, and these include peak reaction intensity, reaction thresholds, and reaction durations, etc. (Davidson, 1998, 2000). In addition, it may be important to know how affectively polarized a given set of stimuli or events are because responding strongly to nonevocative stimuli is likely to be problematic.

The present results are also important because the DART represents an advancement in affective reactivity assessment in that it allows for the quantification of emotional reaction intensity without using assessment approaches that confound it with other constructs such as reaction duration. The DART accomplishes this by isolating peak intensity at any point that it occurs within a stream of affective data, thus taking into account intra- and interindividual differences in the precise time points at which emotions reach their peak intensities. This flexibility allows one to measure individual differences in reaction intensity without specifying that reactions occur at any particular or arbitrary time point. Such procedures may decrease measurement error given that different peak intensities occur at different times (Davidson, 1998, 2000). Although the DART must be completed in a controlled laboratory setting, its parameters can be linked to daily life outcomes, as indicated by the results of Study 5.

Theoretical and Applied Implications

When emotional reactions elicited by normatively pleasant and unpleasant stimuli are captured with temporal precision, stimulus-congruent emotional reactions of greater maximal intensity appear to be linked to greater psychological health and adaptive choices. Such findings are consistent with perspectives such as the Emotional Context Insensitivity theory of depressed mood (Rottenberg & Hindash, 2015). They are also consistent with the psychological flexibility theory of mental well-being (Kashdan & Rottenberg, 2010), and they help to extend this theory into the realm of emotional reactivity processes (also see Waugh et al., 2011). Psychological flexibility theory proposes that a cornerstone of mental health is the ability to adapt or adjust to changing environments, and our results suggest that situation-congruent emotion reactivity may be a key feature of this functional flexibility. If so, the present results also suggest that interventions that have been shown to increase psychological flexibility could be especially viable approaches to increasing psychological health (Fledderus et al., 2010). Examples of such interventions include acceptance-oriented (Levin et al., 2012) and mindfulness-oriented (Kangasniemi et al., 2014) instructional and/or training procedures.

In addition, the present results have mechanistic or process-related implications in that they point to adaptive behavioral decision-making as one mechanism by which robust emotion reactivity may increase quality of life. In a basic sense, emotion reactivity can be thought of as a homeostatic process (Craig, 2003; Damasio & Carvalho, 2013). Organisms must possess some mechanism that motivates them to modify their cellular/bodily activity to match changing environments—that is, to behave flexibly. To survive, for example, creatures must consume in the presence of food and flee in the presence of danger, and emotional reactions are thought to facilitate such behaviors (Nesse & Ellsworth, 2009; Watson, 2000). Overreliance on avoidant behaviors across situations has been identified as an important risk factor in the development of psychopathology (e.g., Jacobson & Newman, 2014), and situational flexibility represents an alternative. The results of Studies 3 and 4 highlight the important role that context-appropriate emotional reactions are likely to play in this form of behavioral governance (Craig, 2003; Damasio & Carvalho, 2013).

An important future direction for research of this type is to develop new versions of the DART paradigm. It may be, for example, that constructs such as neuroticism are problematic in part because the person reacts to mildly negative or even neutral events in negative affective terms (Lahey, 2009). Such processes might be evident in terms of lower thresholds for responding rather than in terms of tendencies to react to normatively negative stimuli with some degree of emotional upset. Modifications could also be made to capture reaction durations, given that the present DART paradigms were not designed to reliably capture emotional reactions to from start to finish (Verduyn et al., 2012). Such an undertaking would require substantial piloting, and relevant research is currently underway.

An important limitation of the present work is that the findings are based on convenience samples, such that generalization to other groups is unknown. Another caveat is that reactivity was elicited in the laboratory, using nonpersonalized images on the computer screen. Relations between the processes examined and reactions to daily life events (Suls & Martin, 2005) therefore require further study. Regardless, the present data provide key support for a psychological flexibility perspective on well-being and they point to the value of isolating emotional reactivity parameters such as peak intensity.

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