Psychological Topics 18 (2009), 2, 247-266

Original scientific article – UDC – 159.942.2
159.923.3

The Contributions of Positive and Negative Affect to Emotional Well-Being

Randy Larsen

Washington University in St. Louis

Abstract

In this paper, the definitions of subjective well-being have been reviewed with a focus on its emotional core, which we consider to be the ratio of positive to negative affect over time. The reviewed evidence showed that negative emotions tend to be of longer duration than positive and that the NA system produces stronger emotional responses than the PA system. Also, a variety of experimental results show that negative stimuli make unique demands on cognitive resources (particularly perception and attention) compared to positive stimuli. The evidence that the negative affect system produces stronger affective output, per unit input, than the positive affect system, is a phenomenon known as negativity bias. I also went so far as to argue that negativity exceeds positivity by a factor of pi (3.14) and that efforts to speed adaptation to negative events may be more important to overall SWB then efforts to prolong responses to positive events (Larsen and Prizmic, 2008). The fact that negativity is stronger than positivity, combined with the notion of differential adaptation (people adapt faster to good events than to bad events), creates the conditions that drive the hedonic treadmill. However, most people are, to some degree, able to overcome the psychological forces of the hedonic treadmill and maintain at least a modicum of emotional well-being (Biswas-Diener, Vitterso, & Diener, 2005). It is likely that the ability called "emotional intelligence" refers in large part to the capacity to manage negative affect following unpleasant or stressful events (Larsen & Learner, 2006). Moreover, such an ability is likely to be made up of particular behaviors and strategies that each contributes specifically to the management of negative emotions (Larsen & Prizmic, 2004).

Keywords: emotinal well-being, positive affect, negative afecct

In everyday life people react to events with different pleasant or unpleasant emotions. People are also able to reflect to their life as a whole over a specific time period and provide a global judgment of their level of happiness or subjective well-

✉ Randy Larsen, Department of Psychology, Washington University in St. Louis, Campus Box 1125, One Brookings Drive, St. Louis, MO 63130, US. E-mail: *rlarsen@wustl.edu*

being (Diener, 2000). The topic of subjective well-being has captivated the attention of researchers for over three decades. By examining what is the "good life" for an individual and making inferences what is the "good life" of population, researchers invoke many other disciplines beside psychology (Diener, Kesebir, & Lucas, 2008; Dolan, Peasgood, & White, 2008). However, psychologists have also given some attention to the components or building-blocks of subjective well-being.

Components of Subjective Well-Being

In psychological terms, subjective well-being (SWB) is a multi-faceted construct, consisting of several components, such as evaluative judgments of one's life, positive memories, feeling a purpose in life, optimism, and the relative amounts of positive and negative affect over time (Kim-Prieto, Diener, Tamir, Scollon, & Diener, 2005). Empirically, however, the facets of this construct coalesce into three distinct components; a cognitive component consisting of judgments of life satisfaction, and an emotional component consisting of high levels of positive affect and low levels of negative affect (Arthaud-Day, Rode, Mooney, & Near, 2005; Diener, 2006).

Although those components are empirically correlated, they are nevertheless theoretically discriminable from each other (Lucas, Diener, & Suh, 1996). In population studies these three components emerge as distinct but related factors, and some studies show different roles for positive and negative emotions in terms of how they relate to life satisfaction judgments in different nations (Arthaud-Day et al. 2005; Kuppens, Realo, & Diener, 2008).

Life satisfaction correlates moderately with high positive affect (PA) and inversely with negative affect (NA), but is nevertheless a cognitive judgment that is at least conceptually distinct from affective processes. Life satisfaction show high levels of stability in adulthood (Diener & Larsen, 1984; Diener, Lucas, & Scollon, 2006; Eid & Diener, 2004) and is most likely difficult, though not impossible (Lucas, Clark, Georgellis & Diener, 2004), to change in substantial ways (Fujita & Diener, 2005; Pavot & Diener, 2008). Although life satisfaction to some extent may be influenced by affective states or contextual factors, mostly it represents an integrated judgment of how one's life as a whole is going, and it is based on many different aspects or domains of person's life (see review Pavot & Diener, 2008). The emotional components of positive and negative affect, on the other hand, are much more reactive to situational influences, and more amenable to efforts to manage or remediate these affective states (Chow, Ram, Fujita, Boker, & Clore, 2005).

The Emotional Core of Subjective Well-Being

Emotional well-being (EWB) can be conceived of as a composite of PA and NA that comes and goes and has a momentary character reflecting one's emotional status quo at any given moment. As these momentary states accumulate over time, they summate into something like a running composite, such that they begin to reflect a central tendency or characteristic level of EWB, around which the person fluctuates. As such, trait measures of EWB always inquire about some time period (e.g., "how have things been over the past ten years") rather than about some moment in time (e.g., "how are you feeling right now," Larsen & Prizmic, 2006). Evaluating people's emotional experience over time using some form of experience sampling (i.e. ecological momentary assessment, day reconstruction method) rather than restrospective reports, should be more accurate for assessing the relation between positive and negative emotions as well as for understanding how a series of affective states, both positive and negative, are integrated into an overall judgment of happiness (Kahneman & Krueger, 2006; Schimmack, 2003).

There are interesting questions about how people integrate their momentary states into an aggregated judgment of their long-term SWB (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004). For example, more recent emotional states appear to be more heavily weighted in such overall judgments than states more distal in time (Redelmeier & Kahneman, 1996). Nevertheless, people do make this integration when asked "over time" questions, and their answers to such questions conform to typical psychometric standards of reliability for trait measures. Moreover, answers to affective questions worded in trait terms also appear to have construct validity, i.e., converge with concurrent SWB measures, predict future measures, correlate with related constructs such as self-esteem and peer reports, and show discriminant validity (Larsen & Augustine, 2008; Larsen & Diener,1985).

Almost all of measures of SWB correlate highly with EWB, defined as the ratio of positive affect (PA) to negative affect (NA) in a person's life over a representative time period. For example, Larsen and Diener (1985) had subjects keep daily records of the emotions they were feeling for a period of between 30 to 90 days. The authors then calculated the ratio of total positive to total negative affect for each subject over entire period of daily reporting. This measure correlated moderately to strongly with a wide variety of questionnaire measures of subjective well-being that are widely used in surveys and psychological research. The authors concluded that, although different theorists define SWB differently, most SWB measures correlate highly with the ratio of PA to NA assessed over time, suggesting an emotional core to global subjective well-being. Even life satisfaction judgments are highly correlated with the ratio of PA to NA assessed over time (Diener, Emmons, Larsen, & Griffin, 1985). The following formula depicts the emotional core of well-being:

$$EWB = \sum(PA) / \sum(NA)$$

This formula for emotional well-being (EWB) has several important and interesting implications. One implication is that, for this ratio to convey maximum information, the numerator (PA) and the denominator (NA) must be orthogonal. To date, there is a great deal of evidence that, when assessed over time (i.e., as traits or average tendencies), the amount of positive affect in people's lives is uncorrelated with the amount of negative affect (e.g., Diener & Emmons, 1985; Schmukle, Egloff, & Burns, 2002). This independence of trait PA and trait NA is important because the ratio of highly correlated scores would provide redundant information with the components, making the EWB ratio less useful. Moreover, the basic finding that trait PA and trait NA are uncorrelated has lead researchers to search for the specific mechanisms that give rise to each (Larsen, & Prizmic, 2006).

A second important implication from the above ratio formula is that it suggests two routes to increasing EWB; one might work on maximizing the numerator (PA) through the pursuit of frequent pleasures, or one might work toward minimizing the denominator (NA) through the diminishment of unpleasant emotions. This notion is similar to William James' idea about how happiness is the ratio of one's aspirations to one's accomplishments in life, wherein he suggested that one could increase happiness by either decreasing one's aspirations or increasing one's accomplishments (or both). Moreover, the ratio formula for PA and NA assumes equality between the numerator and the denominator, such that efforts geared toward increasing PA could be redirected toward decreasing NA, and the overall effect on SWB would be the same. This assumption that PA and NA influence SWB equally (though of opposite sign) is questionable.

Asymmetry Between PA and NA

The contribution of PA and NA to emotional well being is not equal in magnitude. Many researchers have pointed to an asymmetry in PA and NA, with the negative affect system being more reactive than the positive affect system. Ito and Cacioppo (2005) described positive and negative motivational systems with their separable activation functions. The PA system is characterized by the positivity offset, which refers to a tendency for the positive motivational system to be above the neutral point at rest, i.e., when evaluative input is weak or absent. Secondly, the negative motivational system is characterized by a negativity bias, which refers to greater responsiveness at increasing levels of input, i.e., demonstrating a gain in output per unit input. In accordance with this theory, evidence supports greater responsivity to negative stimuli than positive stimuli (Cacioppo & Gardner, 1999; Ito & Cacioppo, 2005; Ito, Larsen, Smith, & Cacioppo, 1998). Also, the existence of the negativity bias is largely supported in the literature (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001). Baumeister and colleagues (2001) review and summarize a great deal of data, from a variety of sources, all of which converge on the general idea that "bad is stronger than good," and that there is tendency in humans to be more attentive to, and more thoroughly process and recall, negative information compared to positive information. In general, a negative event of value -X will produce a stronger affective response than positive event of value +X. As implied by the negativity bias, there appears to be a gain function built into the negative affect system such that this system produces a larger response, per unit input, than the positive affect system. Larsen (2002) reviewed evidence that negative affect is stronger than positive affect. Larsen (2002) also reported on several studies that directly compare negative and positive affect in terms of their reactivity, duration and cognitive involvement.

Reactivity Asymmetry

In one experience sampling study Larsen (2002) demonstrated that equivalent levels of objectively bad and good events produce relatively higher levels of NA than PA, respectively. He had 62 subjects record their daily emotions and life events everyday for 56 consecutive days. Each day, in the evening, subjects assessed a variety of emotions scored for positive affect (PA) and negative affect (NA). Subjects also recorded the best and worst event that day, which were later separately rated by independent raters for how good or bad those events would be for the average person. Based on those objective event ratings, days with good event ratings greater than one standard deviation above the mean and days with bad event ratings greater than one standard deviation above the mean were separately aggregated. The results showed that self-reported PA on the good days and self-reported NA on the bad days significantly differed on days that are, on average, equivalent in hedonic severity. Expressed in standard score units, average PA on the positive days was .78, whereas average NA on the bad days was 1.33. The difference is significant and consistent with the idea that NA reactivity has a gain function, such that equivalent levels of objectively bad and good events produce relatively higher levels of NA than PA, respectively.

Duration Asymmetry

It has long been argued that people adapt to good events at a faster rate than they adapt to bad events (Brickman, Coates, & Janoff-Bulman, 1978), suggesting that positive emotions habituate or return to baseline faster than negative emotions. Also, the asymmetry of duration of positive and negative emotions on cardiovascular activity is reported in work of Brosschot and Thayer (2003). They found that duration of cardiovascular responses after a negative stimulus was more prolonged than the cardiovascular response after a positive stimulus.

In another experience sampling study, Larsen (2002) directly examined the question of duration of positive and negative affect. Three times a day over 28 days subjects rated their level of PA and NA. The occasions with PA and NA greater that one standard deviation above the subject's mean (time T) were lagged. Then the participants' following three occasions were examined (i.e., at time T+1, T+2, and T+3). In other words, the rate of adaptation for PA following an especially positive event, and the rate of adaptation for NA following an especially negative event were examined by looking how fast they return toward baseline following somewhat extreme (+ 1 SD) emotions. Results showed that PA droped to baseline fairly quickly after an extreme PA occasion (within one time period, which was six hours), while NA remained higher than expected for two time periods following an extreme NA occasion. This result is consistent with the hypothesis that the rate of adaptation, defined as a return toward baseline, is faster for PA than for NA.

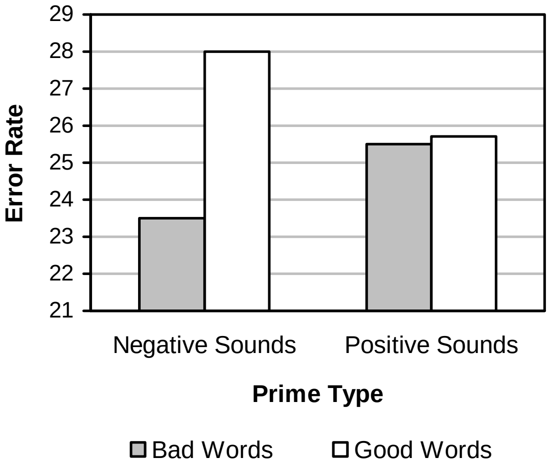
Asymmetry in the Cognitive Processing of Positive and Negative Stimuli

Several studies in the literature have shown that negative events, compared to positive events, capture more attentional resources and are stored in memory in a more accessible manner (Musch & Klauer, 2003). Larsen and Prizmic (2008) reviewed several examples how attentional resources are more involved in the processing of negative events than positive events. For example, in an emotional Stroop task, where subjects have to respond as quickly as possible to name the color of a presented word, it has been found that negative words elicit slower color naming as compared to neutral words (McKenna & Sharma, 1995; Pratto & John, 1991). The few studies that have investigated positive words (e.g., Dalgleish, 1995; Pratto & John, 1991; White, 1996) typically do not find any attentional capture effects for positive words, i.e., they are processed at about the same speed as neutral words.

Affective priming is another cognitive paradigm used for studying the cognitive processing of affective stimuli. Generally, in affective priming studies, an affective prime (e.g., a word such as "rotten") is briefly presented (for example 200 ms), followed by another word, the target, that is either emotionally consistent with the prime (e.g., "maggot") or inconsistent (e.g., "kitten"). The subject's task is to categorize the target word as positive or negative as quickly as possible. In such experiments, results typically show significant congruency effects; that is, faster word evaluation when prime and target have the same valence than when they are of opposite valence. Beside this outcome, the effects of positive and negative emotional primes are not symmetric; stronger priming effects are observed for negative primes than for the positive primes (Hietanen & Korpela, 2004; Smith, et al., 2006).

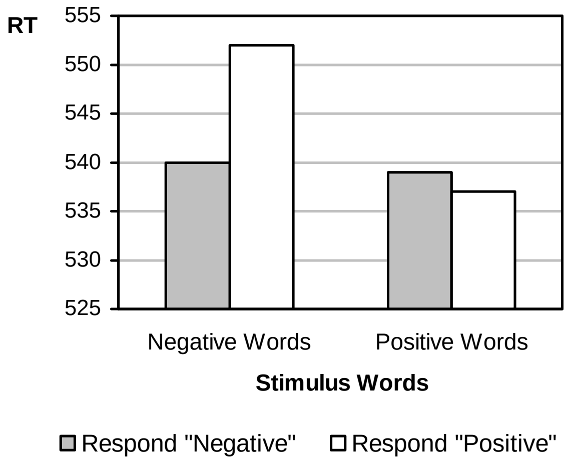
In a study of cross-modality affective priming (Nesse & Larsen, 2009) we used auditory primes (positive and the negative sounds) followed by visually presented target word that the participants must categorize as positive or negative as quickly as possible. For example, positive sounds were children laughing and negative sounds were of a woman being beaten. The emotional sound primes were obtained from the Center for the Study of Emotion and Attention (Bradley & Lang, 2007). Affective sounds were presented through earphones, and the target word appeared on a computer screen five seconds after the sounds had started. The subject's task was to categorize the target word as positive or negative as quickly as possible after it appeared on the screen. Accuracy was calculated as error rates for each congruent (e.g., negative sound paired with a negative word) and incongruent (e.g., negative sound paired with a positive word) condition, as well as separately for negative and positive primes. Results are presented in Figure 1. The highest rate of errors was found in trials where negative sounds preceded positive words (e.g., negative incongruent condition) while errors rates with positive sounds as a prime, in both congruent and incongruent conditions, produced essentially similar error rates. Results suggest that negative sounds produce substantially more affective interference than positive sounds.

Figure 1. Affective Priming Results:
The average errors rates for congruent and incongruent conditions with positive and negative sounds as prime type, and bad and good words as target



The Affective Simon task is another example of a cognitive task used in research on cognition and emotion, developed by DeHouwer and colleagues (DeHouwer, Crombez, Baeyens, & Hermans, 2001; DeHouwer & Eelen, 1998). In this paradigm the participant is instructed to respond by saying "positive" or "negative" to words depending on whether they appear in upper or lower case, while ignoring the content of the words themselves. The words, however, are valenced, and hence the positivity or negativity of the word can be congruent or incongruent with the correct response. Subjects are faster to respond "positive"(than "negative") to a positive word, and faster to respond "negative" (than "positive") to a negative word, which simply demonstrates a congruency effect. However, when the valence of the word is incongruent with the response, interference is created and reaction time is slower for incongruent compared to congruent trials. Moreover, the interference effects are not symmetric for positive and negative stimuli. Having to say "positive" to a word that is negative produces a much larger interference effect than having to say "negative" to a word that is positive (Larsen & Yarkoni, 2009). Results are presented in Figure 2. These findings support the notion that negative stimuli capture more attentional resources than positive stimuli, thereby interfering more with providing a correct response to negative incongruent stimuli (to which one must say "positive") than positive incongruent stimuli (to which one must say "negative").

Figure 2. Affective Simon Task:
The average reaction time in ms for congruent and incongruent conditions



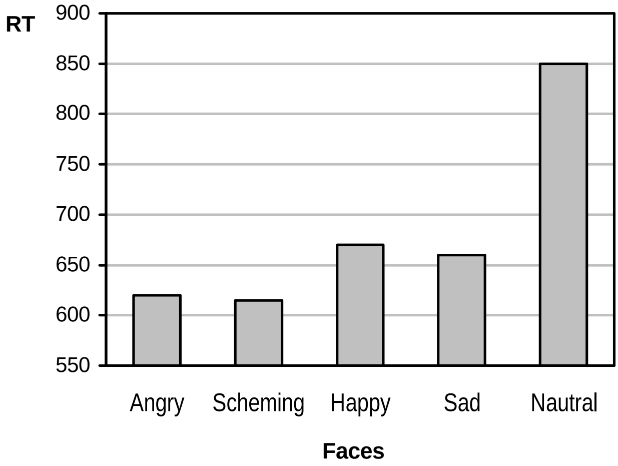
Another paradigm used to study the cognitive processing of emotional stimuli is in the area of facial expressions. Studies using visual search paradigms typically find that people are faster in detecting threatening faces than nonthreatening faces (e.g., Fox, et al., 2000; Tipples, Atkinson, & Young, 2002). In such experiments, researchers have used schematic faces created by manipulation of the eyebrow angle (i.e. $\wedge$ or $\vee$ angle) and the shape of the mouth (i.e. $\cap$ or $\cup$ shape), which at the same time allows the researchers to control total stimulus value of the schematic faces. Fox and colleagues (Fox et al., 2000) found that participants were faster to detect angry faces against an array of either happy faces or neutral faces compared to the detection of happy faces in the same conditions (but against the neutral and angry faces). Another study showed that scheming faces (smiling but with a furrowed brow) are also detected faster than happy ones, supporting the idea that in general threatening faces, not only specific ones, are detected faster than nonthreatening ones (Tipples, Atkinson, & Young, 2002).

Larsen and colleagues (Larsen, Bono, Augustine, & Prizmic, 2009) replicated these experiments using for stimuli schematic faces that portrayed five different expressions: angry, scheming, happy, sad and neutral. The schematic faces were displayed in each of the nine cells of a 3 x 3 display matrix, with half trials containing one face different from surrounding faces, and the other half displaying faces that were identical to each other. The participants had to search the nine faces and decide as quickly as possible if there was one different face, or if all faces in the nine cells were the same. Participants responded "same" or "different" by pressing a button as quickly as possible. Mean reaction times to detect a unique facial expression displayed within a matrix of other faces are presented in Figure 3. As predicted, participants were faster to detected angry and scheming facial expressions than all others. These findings also support asymmetry of the perceptual processing of positive and negative stimuli, in that threatening faces (angry and scheming) were detected much faster than all other unique faces.

A final task used to study the cognitive processing of emotional stimuli is the flanker task. Originally developed in studies that examine whether people can exclude distracting stimuli while responding to relevant ones (Eriksen & Eriksen, 1974), the flanker task is now used in many modified versions (Horstmann, Borgstedt, & Heumann, 2006; Pecchinenda & Heil, 2007). Generally, in this task participants respond to a flanker stimuli that appear on the sides of a central stimuli, while ignoring that central stimuli. For example, a color word (e.g., GREEN) can be the central stimuli, and the flanker can be a color patch that is congruent (e.g., green) or incongruent (blue) with the target stimulus. The subject is instructed to ignore the central stimuli and respond to the flanker. In this example, which has much in common with the original Stroop task, the participant’s job is to ignore the word GREEN and process and respond to the color patch to the side of that stimuli.

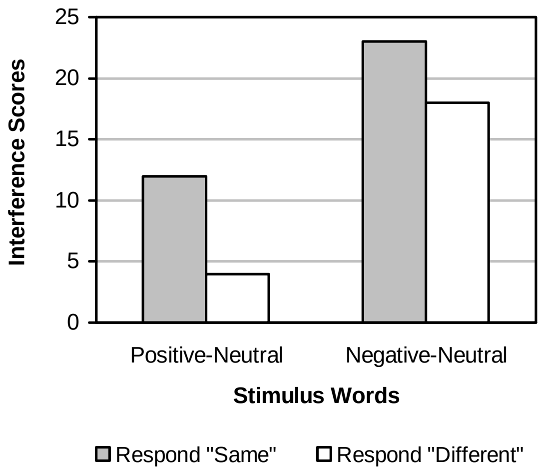
In the emotion version of this flanker task used by Larsen et al. (2009), the target was an emotion word that was either positive (e.g., "serene") or negative (e.g., "morgue") or neutral (e.g., "noodle"). Flanking the central stimulus word were two digits, one on the left and one on the right of the central stimulus word. The participant’s job is to respond "same" if the two digits were the same number, or "different" if the two digits were different numbers. As they scan their eyes over the two numbers, participants invariably read and semantically process the central word, even though they are told to "ignore the word that appears on the screen and only tell us if the two numbers on either side of it are the same or different from each other." The hypothesis is that, if threatening stimuli (i.e., the negative words) capture more attentional resources than positive words, then the reaction time to judge the flanker numbers will be longer for the negative words than the positive words (calculated as interference scores by controlling for how long it takes to

Figure 3. Visual Search Results: Average reaction time in ms for detecting each of presented schematic faces as 'same' or 'different' in the 3x3 matrix



respond to the neutral words). Results are presented in the Figure 4 and show that in both conditions (i.e. to respond "same" or "different") reaction times were much slower when negative words were used as the central stimulus, compared when positive or neutral words were used. These findings support the hypothesis that negative stimuli interrupt cognitive processing to a significantly greater extent than positive stimuli.

Figure 4. Digital Flanker Test:
The average interference scores (RT to emotion word minus RT to neutral control word) in ms for congruent and incongruent conditions for positive and negative words



The results of these experiments on the cognitive processing of positive and negative stimuli consistently support the negativity bias and show that negative stimuli are more impactful than positive stimuli when it comes to perceptual and attentional tasks. Across a variety of cognitive paradigms, ranging from visual search to priming tasks, there is substantial evidence that the effects of positive and negative stimuli are asymmetrical, with negative stimuli producing larger effects than positive stimuli.

Implications of PA and NA Asymmetry in SWB Research

The asymmetry between PA and NA in terms of reactivity, duration, and cognitive involvement has important implications for understanding their respective roles in determining overall emotional well-being. In order to maintain a positive hedonic balance (the ratio of PA to NA over time) one would need to balance many PA experiences to make up for each NA experience. In other words, because "bad is stronger than good" one would need to compensate for each negative affective episode with stronger or more frequent positive episodes. By implication, if one could limit or shorten one's experience of negative emotions, this would have a larger impact on overall emotional well-being than equal efforts directed toward amplifying or prolonging positive emotions.

To give an example of how PA and NA do not equally contribute to SWB we turn to a report on results of an experiment on physiological reactivity to pleasant and unpleasant stimuli (Larsen, Cruz, Ketelaar, Welsh, & Billings, 1990). Here the authors recorded skin conductance, heart rate, and facial muscle contractions while subjects viewed pleasant and unpleasant photographic images. They predicted that a questionnaire measure of SWB would correlate with diminished NA reactivity and enhanced PA reactivity in terms of physiological responses to the hedonic stimuli. However, they found only the former. That is, happy people did *not* exhibit increased autonomic activation to the positive images, rather they exhibited diminished autonomic reactivity to the *negative* images. In more than a metaphorical sense, happy people did not smile more, they mainly frowned less, i.e., were less reactive to the negative stimuli. It could be that the key to maintaining a positive hedonic balance is not so much to seek out pleasure and positive emotions as much as it is an ability to short-circuit negative emotions. Because NA has a stronger impact on our subjective sense of well-being, self-regulation efforts to limit NA would be more effective than the same amount of effort directed toward increasing PA.

How Much Stronger is NA over PA?

While many researchers have documented that NA is stronger than PA, few have taken up the question of just *how much* stronger NA is compared to PA. This question is important to well-being researchers, because the answer will tell them the minimum ratio of PA to NA that is required for a satisfying level of SWB. However, there are inherent difficulties in any empirical attempt to quantify how much stronger NA is compared to PA. On the surface, the question appears to be a simple dose-response type of question; how much larger must the "dose" of positive stimulation be to evoke a positive response that is equivalent in size, but opposite in valence, to a given negative response? Or, alternatively, how much different are PA and NA responses to equivalent "doses" of hedonic stimulation? One might be tempted to approach the question with psychophysical methods. After all, emotions are internal representations of events in the external world, just as sensations are internal representations of the physical world. Psychophysical methods yielded great advances in our understanding of sensory processes. However, in sensory psychophysics, exact sensory responses were determined because the researchers had the ability to precisely control, manipulate, and objectively measure a physical stimulus, e.g., light intensity, weight, sound pressure, etc. Sensory responses could then be precisely mapped onto objective levels of stimulation, and response functions could be determined. For example, auditory sensation conforms to a log rhythm function of input stimulation. We do not, however, have equivalent manipulation or measurement precision in the area of emotional stimulation. It is simply impossible, at this point, to equate or manipulate emotional inputs with enough precision to allow precise mappings of emotional response onto emotional input. We simply cannot calculate emotional response functions for PA and NA with anywhere near the precision we can do so for visual or auditory response systems.

Despite this inherent difficulty, a few researchers have come forth with statements about just how much stronger NA is compared to PA. Usually the statements are in the form of the critical ratio of PA to NA necessary to maintain some global state. Perhaps the first researcher to venture such a statement was the marital researcher John Gottman (e.g., 1994). In this research program Gottman was examining differences between couples whose marriages were satisfying and long lasting and couples whose marriages were dissatisfying and in dissolution (they had filed for divorce). Gottman (1994) had each couple engage in a conversation on a topic of conflict in their marriage, and videotaped the conversations. Later the videotapes were coded for positivity and negativity expressed both verbally and in observable expressions of emotion. Among the couples in satisfying marriages, the ratio of positive to negative emotions expressed in their conversations was 5.1 to 1 for verbal content and 4.7 to 1 for emotional expressions. Among the couples who had filed for divorce, the ratio of positive to negative emotions was 0.9 to 1 for verbal content and 0.7 to 1 for emotional expressions. In other words, the unsatisfied couples experienced and expressed far fewer positive to negative responses in their conversations compared to happily married couples.

Larsen (2002), using two different experience sampling data sets, with daily emotion ratings gathered over 30 to 90 consecutive days, calculated the percentage of days where PA exceeded NA. Over all subjects, the percentage of days that PA exceeded NA turned out to be 73% in one sample and 76% in the other. In other words, the average person would expect to have three good days for each bad day, leading him to the conclusion that positive emotions must prevail over negative emotions by a force of 3-to-1 if a person is to maintain an average level of SWB. Viewed this way, one negative day has the counter-valent force of three positive days. Larsen (2002) also examined the beta weights using average daily PA and average daily NA in regression equations predicting questionnaire measures of SWB. Across a number of global SWB reports, the standardized beta weights for NA were approximately 3 times the size of the standardized beta weights for PA. So, while average daily PA and average daily NA are uncorrelated with each other, and while they both contribute to, or significantly correlate with, global SWB measures, the overlap between SWB and NA nevertheless exceeds the overlap of SWB and PA by a factor of approximately 3-to-1.

Schwartz and colleagues (Schwartz, 1997; Schwartz et al. 2002) took up the question of the ratio of PA to NA in a study of psychotherapy for depression. PA and NA were measured both before and after treatment in a sample of 66 depressed men. Before treatment, the ratio of PA to NA averaged 0.5 for this sample of depressed males. After treatment, participants showing typical levels of remission of their depressive symptoms (N = 23) were found to have a PA/NA ratio of 2.3, whereas those participants showing optimal remission (judged by self-report and clinical ratings, N = 15) were found to have a PA/NA ratio of 4.3. Those subjects who showed no remission of their depressive symptoms were found to have a PA/NA ratio of 0.7, a value not significantly different from pre-treatment baseline.

Fredrickson and Losada (2005) explicitly take up the question of the critical value of PA-to-NA ratio necessary for flourishing, and they put this question to several different data sets. In one data set they examined the interpersonal behaviors of business teams as they worked on an annual strategic plans. The verbal behaviors of each team member were coded for expressed PA (e.g., showing support, encouragement or appreciation) and NA (e.g., expressing disapproval, sarcasm, or cynicism). Objective indicators of performance (e.g., profitability, customer satisfaction, evaluations by superiors, etc) were used to derive an index of overall quality of the team. Without going into the complex dynamical analysis, Fredrickson and Losada (2005) concluded that a PA-to-NA ratio of 2.9 to 1 divided those teams who were flourishing from those teams that were languishing.

Using another data set, Fredrickson and Losada (2005) report the results of an experience sampling study on college students covering 28 consecutive days of emotion reports. For each participant they calculated a PA/NA ratio over the month of daily reporting. They divided the samples into participants who were flourishing versus those who were not using a measure of positive social and psychological functioning. The authors report that, in the two samples, the participants who were flourishing had a PA/NA ratio of 3.2 and 3.4, whereas those participants who were not flourishing had PA/NA ratios of 2.3 and 2.1.

In searching for the answer to how much stronger NA is compared to PA, Larsen and Prizmic (2008) summarize from the above studies that the magnitude difference between PA and NA has a wide range, going from 2.3 to 5.1 across samples in the published literature. Such a range is likely due to sampling fluctuation, i.e., influenced by the nature of the measures that go into calculating PA and NA, as well as by the specific life domains in which the measures are obtained, e.g., marital behaviors, affect displayed during team work, etc. Moreover, any estimated value will always be within a range determined by the reliability of the measures of the component indices (i.e., the measures of PA and NA). Larsen and Prizmic (2008) suggested that in the absence of a precise value, a good first estimate would be the expected value or average of the estimates found in the literature. Since the average of the estimates found in the literature is slightly over 3.0, Larsen and Prizmic (2008) suggest that the value of pi (π or 3.14) be used as the best estimate of how much stronger NA is to PA. In other words, the negativity bias refers to the fact that negative experiences produce effects that are approximately three times larger than positive experiences.

The negativity bias, according to Larsen and Prizmic (2008), can thus be defined mathematically as:

$$|PA| * \pi = |NA|$$

where the absolute value of NA is pi times the absolute value of PA. Consequently, the equation for affect balance necessary to achieve minimal levels of emotional well-being can be restated as:

$$EWB = \sum(PA) / (\sum(NA/\pi)$$

Negativity Bias and the Hedonic Treadmill

A theory of well-being relevant to the negativity bias concept is the hedonic treadmill theory, originally proposed by Brickman and Campbell (1971). This theory holds that people adapt to both good and bad events and return, over time, to their hedonic set points. For example, after an extremely good event, such as marriage to the person of their dreams, a person initially reacts with strong positive affect but eventually adapts and returns to his or her baseline level of positive affect. A similar adaptation process occurs for negative events; after a bad event a person initially reacts with strong NA but eventually adapts and returns to his or her baseline level of NA. The hedonic treadmill theory received some support in Brickman, Coates, and Janoff-Bullman's (1978) classic study of lottery winners and paraplegics. Studying both lottery winners and persons who lost their ability to walk, Brickman et al. (1978) concluded that both groups were not substantially different from control groups one year after the good (winning the lottery) or bad (becoming paraplegic) events.

In a re-analysis of the Brickman et al. (1978) data, Diener, Lucas and Scollon (2006) report that the paraplegic subjects were actually 0.75 standard deviation units lower in subjective well being than the control group after one year, suggesting that full adaptation to this negative event had not yet occurred. This finding is consistent with the negativity bias concept, that negative events produce relatively more intense and longer lasting affective reactions than positive events. This adds a twist to the hedonic treadmill theory by implying that adaptation rates to good and bad events are not symmetrical; we adapt more quickly to good events than equally hedonic (but opposite in sign) bad events. This notion was implied in Brickman et al.'s (1978) conclusions, lending an especially pernicious quality to the hedonic treadmill model. That is, not only do we adapt to good events, but we do so at a faster rate than we do to bad events. If we assumed that good and bad events in life happened randomly, and in equal proportions, then human life would be doomed to a preponderance of misery and negative affect.

In a rarely cited commentary on Brickman and Campbell's (1971) introduction of hedonic treadmill theory, McClelland (1971) reacted to the deterministic nature of the hedonic treadmill, which, as portrayed, acts as a universal law forcing all into the role of victim of hedonic principles. McClelland urged an alternative view on the ubiquity and power of the hedonic treadmill: "But surely there must be some element of choice here. A man can be taught the laws of hedonic relativism and learn how to gain greater satisfaction from life. He can choose his own goals and comparison groups and use all that we know about how to minimize dissatisfaction or maximize satisfaction to make a better life for himself and others." (McClelland, 1971, p. 304). In other words, people may learn to regulate their affective responses to overcome the effects of the hedonic treadmill.

In a more recent review of hedonic treadmill theory, Diener, Lucas, and Scollon (2006) come to a similar conclusion. While agreeing with the basic facts of hedonic adaptation, Diener et al. (2006) offer several revisions to the hedonic treadmill theory to account for the fact that people are not doomed to unhappiness. One important revision, consistent with McClelland's observation, is that there are wide individual differences in adaptation rates. Diener et al. (2006) present data that adaptation is not nearly so inevitable or automatic as is implied by the original theory. The rate and extent of adaptation to various events shows wide variability across individuals.

From the perspective of the evidence reviewed in this paper, the hedonic treadmill represents the strong pull of the negativity bias on human subjective well-being. This pull is overcome to the extent that people are able to manage their negative emotions. Because the negative affect system is more reactive, of longer duration, and more demanding on our cognitive processes, the best route to increased emotional well being will be the one that focuses on remediating and managing our negative emotions. Does this mean that there is no role for managing positive emotions? Of course not, positive emotions are important. But evidence reviewed here suggests that negative emotions are three times more important in terms of influencing overall emotional well being.

REFERENCES

Arthaud-Day, M.L., Rode, J.C., Mooney, C.H., & Near, J.P. (2005). The subjective well-being construct: A test of its convergent, discriminant, and factorial validity. *Social Indicators Research, 74,* 445-476.

Baumeister, R.F., Bratslavsky, E., Finkenauer, C., & Vohs, K.D. (2001). Bad is stronger than good. *Review of General Psychology, 5,* 323-370.

Biswas-Diener, R., Vitterso, J., & Diener, E. (2005). Most people are pretty happy, but there is cultural variation: The Inughuit, the Amish, and the Maasai. *Journal of Happiness Studies, 6,* 205-226.

Bradley, M.M., & Lang, P.J. (2007). *The International Affective Digitized Sounds (2nd Edition; IADS-2: Affective ratings of sounds and instruction manual.* Technical report B-3. University of Florida, Gainesville, Fl.

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

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

Brosschot, J., & Thayer, J. (2003). Heart rate response is longer after negative emotions than after positive emotions. *International Journal of Psychophysiology, 50*, 181-187.

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

Chow, S., Ram, N., Fujita, F., Boker, S.M., & Clore, G. (2005). Emotion as a thermostat: Representing emotion regulation using a damped oscillator model. *Emotion, 5,* 208-225.

Dalgleish, T. (1995) Performance on the emotional Stroop task in groups of anxious, expert, and control subjects: A comparison of computer and card presentation formats. *Cognition and Emotion, 9,* 341-362.

Diener, E. (2000). Subjective well-being: The science of happiness and a proposal for a national index. *American Psychologist, 55*, 34-43.

Diener, E. (2006). Guidelines for national indicators of subjective well-being and ill-being. *Journal of Happiness Studies, 7*, 397-404.

Diener, E., & Emmons, R.A. (1985). The independence of positive and negative affect. *Journal of Personality and Social Psychology, 47*, 1105-1117.

Diener, E., Emmons, R.A., Larsen, R.J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment, 49*, 71-75.

Diener, E., Kesebir, P., & Lucas, R. (2008). Benefits of accounts of well-being: For societies and for psychological science. *Applied Psychology: An International Review, 57,* 37-53.

Diener, E., & Larsen, R.J. (1984). Temporal stability and cross-situational consistency of affective, cognitive, and behavioral responses. *Journal of Personality and Social Psychology, 47*, 871-883.

Diener, E., Lucas, R.E., & Scollon, C.N. (2006). Beyond the hedonic treadmill: Revising the adaptation theory of well-being. *American Psychologist, 61*, 305-314.

DeHouwer, J., Crombez, G., Baeyens, F., & Hermans, D. (2001). On the generality of the affective Simon effect. *Cognition and Emotion, 15*, 189-206.

DeHouwer, J., & Eelen, P. (1998). An affective variant of the Simon paradigm. *Cognition and Emotion, 12*, 45-61.

Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology, 29,* 94-122.

Eid, M., & Diener, E. (2004). Global judgments of subjective well-being: Situational variability and long-term stability. *Social Indicators Research, 64*, 245-277.

Eriksen, B., & Eriksen, C. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics, 16,* 143-149.

Fox, E., Lester, V., Russo, R., Bowles, R., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition & Emotion, 14*, 61-92.

Fredrickson, B.L., & Losada, M.F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist, 60,* 678-686.

Fujita, F., & Diener, E. (2005). Life satisfaction set point: Stability and change. *Journal of Personality and Social Psychology, 88,* 158-164.

Gottman, J.M. (1994). *What predicts divorce? The relationship between marital processes and marital outcomes.* Hillsdale, NJ: Erlbaum.

Hietanen, J.K. & Korpela, K. (2004). Do both negative and positive environmental scenes elicit rapid affective processing? *Environment and Behavior, 36*, 558-577.

Horstmann, G., Borgstedt, K., & Heumann, M. (2006). Flanker effects with faces may depend on perceptual as well as emotional differences. *Emotion, 6,* 28-39.

Ito, T.A., & Cacioppo, J.T. (2005). Variations on a human universal: Individual differences in positivity offset and negativity bias. *Cognition and Emotion, 19*, 1-26.

Ito, T.A., Larsen, J., Smith, N., & Cacioppo, J. (1998). Negative information weighs more heavily on the brain: The negativity bias in evaluative categorizations. *Journal of Personality and Social Psychology, 75,* 887-900.

Kahneman, D., & Krueger, A. (2006). Developments in the measurement of subjective well-being. *Journal of Economic Perspectives, 20,* 3-24.

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.

Kim-Prieto, C., Diener, E., Tamir, M., Scollon, C., & Diener, M. (2005). Integrating the diverse definitions of happiness: A time-sequential framework of subjective well-being. *Journal of Happiness Studies, 6,* 261-300.

Kuppens, P., Realo, A., & Diener, E. (2008). The role of positive and negative emotions in life satisfaction judgment across nations. *Journal of Personality and Social Psychology, 95*, 66-75.

Larsen, R.J. (2002). Differential contributions of positive and negative affect to subjective well-being. In J.A. Da Silva, E.H. Matsushima, and N.P. Riberio-Filho (Eds.), *Annual meeting of the International Society for Psychophysics* (vol. 18, pp. 186-190). Rio de Janeiro, Brazil: Editora Legis Summa Ltda.

Larsen, R.J., & Augustine, A.A. (2008). Basic personality dispositions related to approach and avoidance: Extraversion/neuroticism, BIS/BAS, and positive/negative affect. In A.J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 151-163). Mahwah, NJ: Lawrence Erlbaum.

Larsen, R.J., Bono, T., Augustine, A.A., & Prizmic, Z. (2009). *Effects of emotion across several cognitive processing paradigms.* Unpublished manuscript, Washington University in St. Louis.

Larsen, R.J., Cruz, M., Ketelaar, T., Welsh, W., & Billings, D. (1990). Individual differences in trait happiness and physiological response to emotional stimuli. *Psychophysiology*, *27*(Suppl. 4A), 47.

Larsen, R.J., & Diener, E. (1985). A multitrait-multimethod examination of affect structure: Hedonic level and emotional intensity. *Personality and Individual Differences, 6*, 631-636.

Larsen, R.J., & Lerner, C. (2006). Emotional intelligence and mood regulation following the attack of September 11. In A. Delle Fave, (Ed.), *Dimensions of well-being. Research and intervention* (pp. 489-511). Milano, Italy: FrancoAngeli.

Larsen, R.J., & Prizmic, Z. (2004). Affect regulation. In R. Baumeister and K. Vohs (Eds.), *Handbook of self-regulation research* (pp. 40-60). New York: Guilford.

Larsen, R.J., & Prizmic, Z. (2006). Multimethod measurement of emotion. In M. Eid and E. Diener (Eds.), *Handbook of measurement: A multimethod perspective* (pp. 337-352).Washington, DC: American Psychological Association.

Larsen, R.J., & Prizmic, Z. (2008). The regulation of emotional well-being: Overcoming the hedonic treadmill. In M. Eid and R.J. Larsen (Eds.), *The science of subjective well-being* (pp. 258-289). New York: Guilford.

Larsen, R.J., & Yarkoni, T. (2009). *Negative is stronger than positive in producing interference effects in the affective Simon task.* Unpublished manuscript, St. Louis, MO.

Lucas, R.E., Clark, A.E., Georgellis, Y. & Diener, E. (2004). Unemployment alters the set point for life satisfaction. *Psychological Science, 15,* 8-13.

Lucas, R., Diener, E., & Suh, E. (1996). Discriminant validity of well-being measures. *Journal of Personality and Social Psychology, 71,* 616-628.

McClelland, D.C (1971). Comment on "Hedonic relativism and planning the good society". In M.H. Appley (Ed.), *Adaptation-level theory: A symposium* (pp. 303-304). New York: Academic Press.

McKenna, F., & Sharma, D. (1995). Intrusive cognitions: An investigation of the emotional stroop task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21(6), 1595-1607.*

Musch, J., & Klauer, K.C. (2003). *The psychology of evaluation*. Mahwah, NJ: Erlbaum.

Nesse, L., & Larsen, R.J. (2009). *Cross-modal affective priming: The effect of emotional sounds on responses to emotional words*. Manuscript submitted for publication, Washington University in St. Louis.

Pavot, W., & Diener, E. (2008). The Satisfaction With Life Scale and the emerging construct of life satisfaction. *The Journal of Positive Psychology, 3*, 137-152.

Pecchinenda, A., & Heil, M. (2007). Role of working memory load on selective attention to affectively valent information. *European Journal of Cognitive Psychology, 19,* 898-909.

Pratto, F., & John, O.P. (1991). Automatic vigilance: The attention-grabbing power of negative social information. *Journal of Personality and Social Psychology, 61,* 380-391.

Redelmeier, D.A., & Kahneman, D. (1996). Patients' memories of painful medical treatments: Real-time and retrospective evaluations of two minimally invasive procedures. *Pain*, *66*, 3-8.

Rozin, P., & Royzman, E.B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review, 5,* 296-320.

Schimmack, U. (2003). Affect measurement in experience sampling research. *Journal of Happiness Studies, 4,* 79-106.

Schmukle, S.C., Egloff, B., & Burns, L.R. (2002). The relationship between positive and negative affect in the Positive and Negative Affect Schedule. *Journal of Research in Personality*, *36*, 463-475.

Schwartz, R.M. (1997). Consider the simple screw: Cognitive science, quality improvement and psychotherapy. *Journal of Consulting and Clinical Psychology, 65*, 970-983.

Schwartz, R.M., Reynolds, C.F., III, Thase, M.E., Frank, E., Fasiczka, A.L., & Haaga, D.A. F. (2002). Optimal and normal affect balance in psychotherapy of major depression: Evaluation of the balanced stats of mind model. *Behavioural and Cognitive Psychotherapy, 30*, 439-450.

Smith, N.K., Larsen, J.T., Chartrand, R.L., Cacioppo, J.T., Katafiasz, H.A., & Moran, K.E. (2006). Being bad isn't always good: Affective context moderates the attention bias toward negative information. *Journal of Personality and Social Psychology 90,* 210-220.

Tipples, J., Atkinson, A., & Young, A. (2002). The eyebrow frown: A salient social signal. *Emotion, 2,* 288-296.

White, M. (1996). Anger recognition is independent of spatial attention. *New Zealand Journal of Psychology, 25*, 30-35.

Received: December 29, 2008