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Positive mood broadens visual attention to positive stimuli

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Abstract In an attempt to investigate the impact of positive emotions on visual attention within the context of Fredrickson's (1998) broaden-and-build model, eye tracking was used in two studies to measure visual attentional preferences of college students ($n = 58$, $n = 26$) to emotional pictures. Half of each sample experienced induced positive mood immediately before viewing slides of three similarly-valenced images, in varying central-peripheral arrays. Attentional breadth was determined by measuring the percentage viewing time to peripheral images as well as by the number of visual saccades participants made per slide. Consistent with Fredrickson's theory, the first study showed that individuals induced into positive mood fixated more on peripheral stimuli than did control participants; however, this only held true for highly-valenced positive stimuli. Participants under induced positive mood also made more frequent saccades for slides of neutral and positive valence. A second study showed that these effects were not simply due to differences in emotional arousal between stimuli. Selective attentional broadening to positive stimuli may act both to facilitate later building of resources as well as to maintain current positive affective states.

Keywords Positive mood · Visual attention

Positive mood broadens visual attention

The broaden-and-build model of positive emotions (Fredrickson, 1998) suggests that positive emotions, such as joy, interest, contentment, elation, or love, temporarily broaden an individual's thought-action repertoire, thereby promoting the expansion of attention or interest in the environment and encouraging play and exploration. In turn, these broadening behaviors build lasting resources such as physical agility, social relationships, and heightened psychological resilience. This stockpiling of resources and skills allow an organism to be better prepared for future circumstances in which they might face adverse conditions or negative affective states (Fredrickson, 1998, 2000a, 2001). The current study focused on testing the broadening component of the model, which has received relatively scant attention in previous research on the theory.

Research demonstrating broadening

What exactly is broadening? Fredrickson (2000b, Article 7, 9) defines broadening as "having a wider array of perceptions, thoughts, and actions, with the consequences of broadening being flexible, creative and unusual thinking." Thus, research demonstrating broadening would show that positive emotions, as compared to negative or neutral emotions, act to expand thoughts or actions towards incorporating more aspects of one's environment. By having individuals watch short films, Fredrickson (2003) induced joy, serenity, fear, and sadness in individuals, and then had them perform a global-local visual-processing task. She found that individuals in a positive emotional state, as measured by self reports and electromyographic facial signals, showed a tendency to choose the global configuration (Fredrickson, 2003). A similar experiment conducted by Gasper and Clore (2002) found that individuals experiencing a sad mood were less likely than individuals experiencing a happier mood to classify figures on their global features and use accessible global concepts in attempting to reproduce a drawing from memory.

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In her studies of positive mood induction and behavior, Alice Isen has used induction procedures ranging from giving participants a small bag of candy to bestowing successful feedback. She has conducted several studies finding that positive mood induction did promote variations of expansive behavior. Specifically, participants experiencing induced positive emotion created more unusual word associations to neutral words (Isen, Johnson, Mertz, & Robinson, 1985; Kahn & Isen, 1993), demonstrated heightened creativity in associating word comparisons (Isen, Daubman, & Nowicki, 1987), and utilized more inclusive and flexible categories in word groupings (Isen & Daubman, 1984; Isen, Niedenthal, & Cantor, 1992). It is notable that even providing small gifts to participants has been adequate both to induce short-term positive affect as well as to find effects on information processing in a number of studies (e.g., Carnevale & Isen, 1986; Isen et al., 1987; Veenhoven, 1988).

While the studies described have focused on local/global processing and creativity as possible evidence of broadened thoughts, other studies have instead concentrated on how positive emotions may broaden by facilitating physiological recovery rates from stressors (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan & Tugade, 2000; Rudd, Joiner, & Rajab, 2001). The current study, instead, tries to find direct evidence for a broadening effect of positive mood by essentially "looking at looking," and thereby determining whether broadening is evident in the earliest attentional components of information processing. The broaden-and-build theory would predict that positive emotion should affect how an individual looks at a pictorial array, by pushing visual attention away from the center and toward the peripheral images and by increasing how much looking around the array takes place as well.

Isen (2000) has also noted that the predicted effects of positive mood are mediated by the nature of the stimulus material. Specifically, she has found in several studies that expansive behaviors only become evident among those in a positive mood if the stimuli are neutral or positive. As the broaden-and-build model would suggest that positive emotions dominate in times when the organism is safe and not under threat or stress, Isen has shown that if a real risk is present positive mood actually leads to behaviors of risk aversion and cautiousness (Isen, Nygren, & Ashby, 1988; Isen, 2000).

Visual attention to negative emotions: Anxiety and depression

As our environments hold a continual deluge of stimuli, we appear to have evolved mechanisms for cognitively processing stimuli through the development of highly selective visual and auditory attention, which filter information down to reasonable amounts for further processing (Parkhurst, Law, & Niebur, 2002). Individuals may demonstrate preferences in what aspects of their environment they attend to as a function of their affective state. Mogg, McNamara, Powys, Rawlinson, Seiffer & Bradley (2000) have shown that negative or threat stimuli often attract more attention than positive stimuli in highly anxious participants, as these individuals display a negativity bias when observing positive and negative stimuli concurrently. Past research has additionally shown that negative emotive states such as anxiety or fear narrow an individual's attentional focus (Derryberry & Tucker, 1994; Mogg et al., 2000; Mogg, Millar, & Bradley, 2002). Anxious individuals, for instance, selectively attend to threatening stimuli in eye-tracking experiments (Hermans, Vansteenwegen, & Eelen, 1999; Bradley, Mogg, & Millar, 2000; Mogg et al., 2000). Depressed individuals have also exhibited selective attention towards negative visual stimuli. In one study using a modified probe detection task, another tool for measuring attention to emotional stimuli, participants experiencing induced depressive mood showed a greater vigilance for depressive words (Bradley, Mogg, & Lee, 1997).

Therefore, local processing biases, representative of narrowed attention, appear to be associated with negative emotions such as anxiety and depression. In contrast, positive emotional states, such as high optimism and subjective well-being, appear to relate more to broadened attention (Derryberry & Tucker, 1994; Basso, Schefft, Ris, & Dember, 1996). However, the studies reviewed above share some methodological limitations in terms of making firm conclusions about the specific role of attention, a point we discuss in more detail next.

Attentional measures and emotion

The studies we have described above evaluating links between attention and emotion have primarily used the Emotional Stroop and the probe detection tasks. In the Emotional Stroop, an emotionally-valenced word is presented and the participant must name the color in which the word is written. Longer response latencies indicate greater attentional interference (Williams, Watts, MacLeod, & Mathews, 1997). One drawback is that there is competition between stimuli resulting in slowed reaction time (Buckley, Blanchard, & Hickling, 2002). The probe detection task involves a participant having to give a response (often a button press) to indicate where a probe appears in one of two locations where a pair of images or words had been previously simultaneously presented. In one relevant application, anxious individuals would perform the button press faster than non-anxious ones if the probe appeared in the same region as a threat word, with the opposite occurring whenever the probe appeared far from the threat word (MacLeod, Mathews, & Tata, 1986). The probe detection task does not allow for the possibility of multiple fixations or orientations (Bradley et al., 2000).

Eye tracking alleviates these response time biases, permitting a more direct measurement of visual gaze and fixation, and thus of visual attention, in nearly real time. Eye tracking also is advantageous in that it allows for a continual measurement of attentional fixation beyond the time required for a response. Thus, eye tracking is a tool that may help refine our understanding of emotion-attention relationships (Isaacowitz, in press). However, only recently have positive emotions and mood states been investigated with eye tracking technology. In one recent set of studies on optimism using eye tracking, young optimists showed selective inattention to negative emotional images of melanoma, suggesting that optimists attend differently to the world than pessimists (Isaacowitz, 2005). Optimists' attentional bias away from negative stimuli, however, may be dependent on the self-relevance of the stimuli. Optimism as well as other positive mood states may help facilitate the processing of negative information and experiences (Larsen, Hemenover, Norris, & Cacioppo, 2003). In one study, self-affirming their kindness before being shown threatening stimuli caused individuals to be more open and less biased in their processing of the stimuli as well as to more quickly orient toward the self-relevant but threatening health-risk information (Reed & Aspinwall, 1998). In another study Aspinwall and Brunhart (1996) also found that individuals who held more optimistic beliefs about their own health showed greater attention to self-relevant threatening health information.

Design of the current studies

Utilizing eye tracking technology, the purpose of the present studies was to investigate the broaden-and-build theory's claim that positive emotion increases the breadth of visual attention. After inducing positive mood in some young adults by presenting them with a candy gift, participants had their eyes tracked as they viewed a series of photograph stimuli on a computer screen which were similar to what they might encounter in their everyday lives. In the first study, the images used varied in emotional valence levels between different slides. In a follow-up study, the slides continued to vary in emotional valence level; however, the emotional arousal level was also controlled.

Attentional breadth was the dependent variable in both studies and was assessed with two distinct measures. The first measure was gaze fixation percentage to peripheral images on the slides; significant differences between participants in a non-affective state and an induced positive mood condition in these gaze fixation percentages would therefore suggest the presence of broadened visual attention. The second measure was the number of saccades participants made per slide, which could also indicate the presence of broadened attention, as a higher numbers of saccades would denote an individual is looking around the screen more. It is important to note that we use the term "peripheral" images throughout the manuscript in reference to the two peripheral pictorial images used in each of the stimulus arrays. It does not refer to processing peripheral information within the retina.

Participants experiencing induced positive mood were hypothesized to show greater attentional breadth, as indicated by fixating more on peripheral information and making more frequent saccades, on average, as compared to the control participants. However, this broadening effect of positive mood was expected only for positive and neutral image conditions, but not for negative ones.

Study 1: Induced positive mood and attention to emotional images

The goal of the first study was to evaluate whether a positive mood induction would broaden the visual attention of individuals using images that varied on level of emotional valence from very negative to neutral to very positive. This appears to be the first study employing eye tracking to link induced positive mood with attention to emotional stimuli.

Method

Participants

Fifty-eight young adult (undergraduate students) ranging from age 18 to 26, ($M = 19.69$; $SD = 2.06$) served as participants in this study (28 females, 30 males). Participants were recruited from an Introductory Psychology class at Brandeis University or through flyers posted on campus. All subjects were offered either one class credit upon participation as a means to meet a course requirement or a small monetary stipend for their participation in a study on emotion and attention. Potential participants that wore hard contact lenses or had severe visual abnormalities were excluded from the experiment as they render unreadable data to the eye tracker. Four participants' data were not included in the analyses, as MATLAB produced a void file or their eyes were not trackable because of reflective glare.

Materials and apparatus

The apparatus used in the experiment was an Applied Science Laboratories Eye Tracking System Model 504 with Magnetic Head Transmitter. The Magnetic Head Transmitter acts as a compensatory device for head movements of the individual in the duration of the experiment. The eye tracker measures attentional gaze fixations, or fixations where a participant focuses within one visual degree of angle on a visual location for 100 ms or more, within pre-designated Areas of Interest (AOI) locations in nearly real time. The eye tracker specifically records the duration and location of the participant's left eye sixty times per second. Thus, the total viewing time within an AOI can be calculated. The data derived from the eye tracker was recorded as percent gaze fixation times, instead of mean values, in order to minimize the effects of momentary recording failures. The eye tracker records the location and order of visual fixations to stimuli. Fixplot and Eyenal software were used to translate visual eye fixation files into usable data. MATLAB software was utilized to automate the recording function of the tracker software with the appearance and duration of selected visual stimuli.

Visual stimuli

Visual stimuli of real-world images were selected from the International Affective Picture System (IAPS:CSEA-NIMH, 1999). Cumulative emotional valence rankings for the pictorial stimuli ranged on a Likert scale from 1 (being the most negative) to 9 (being the most positive). For study purposes images ranked with IAPS values from 1–4 for emotional valences were classified as negative images, values of 4–6 were classified as neutral, and values 6–9 were classified as positive images. These rankings were consistent with typical categorizations for positive, negative, and neutral images (e.g., Charles, Mather, & Carstensen, 2003). Images were presented to the participants in a slide-show format using MATLAB. Twenty-five slides with arrays of three images each were shown, for a total of seventy-five images. Images were consistently displayed with one central and two peripheral images in varying 2D spatial orientations. Five directional patterns were utilized: horizontal, vertical, diagonally left, diagonally right, or random. Thus, the computer screen was divided into nine quadrants of which an image could appear in any of the directional patterns. Emotional valence was held constant across images within a particular slide; however, slides varied in emotional valence (positive, negative, and neutral) between slides. Although IAPS images are sometimes themselves used as emotion inductions, the valence of the slides varied throughout the presentation in a way that would have served to mute any mood-changing effects of the images per se.

Color was not anticipated to bias attentional deployment as it is the extraction of emotional content of a scene, rather than attention to lower-level visual features, that is of primary relevance to task performance (LaBar, Mesulam, Gitelman & Weintraub, 2000). The dimensions of the slides were $13.8'' \times 10.25,''$ and the dimension of each image was $4'' \times 3''$. Participants were seated with their eye-level centered at $32''$ from the computer monitor. An inventory of the images used, their IAPS numbers, their categorizations in emotional valence for analytical purposes, the mean emotional valence values of the pictures displayed per slide as well as the mean values of the overall emotional valence values per analytical group can be found in the Appendix. Two image presentations were randomly compiled and randomly assigned to participants. In the final attentional analyses, the data collected for the snake photographs was excluded due to a technical error.

Covariates

To test whether other variables influenced the relationship of positive mood to attention, several measures were included that might possibly clarify any relationships observed between the manipulation and attentional patterns. These measures tested for positive and negative affect, anxiety, optimism, and depressive symptoms. The PANAS inventory (Watson, Clark, & Tellegen, 1988) was used as a self-report measure of trait positive and negative affect. Depression was measured with the CES-D depression scale (Radloff, 1977). Anxiety was assessed with the Speilberger State/Trait Anxiety Scales (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and optimism was measured with the 12-item Life Orientation Test (Scheier & Carver, 1985). The alpha coefficients for the self-report affect scales were found to be adequate, ranging from .76 for optimism to .93 for trait anxiety.

Procedure

After obtaining informed consent, experimenters administered a Snellen Visual Acuity test to participants, to ensure adequate visual acuity, and then asked the individuals to complete a number of self-report measures including six demographic questions, the CES-D, STAI, PANAS, and LOT. Prior to the experiment, participants were assigned either to be in the control or experimental condition using a random number generator. Positive mood was induced in participants in the experimental group by presenting the participants with a small bag of candy (approximately five chocolate pieces) as a token of appreciation for their participation in the study after completion of the questionnaire packet and immediately prior to the slide presentation. Participants were asked not to eat the candy until the conclusion of the experiment, at which time control participants also received the candy gift. Candy has been found to be an effective means of inducing state positive affect in past research (Carnevale & Isen, 1986; Isen et al., 1987; Estrada, Isen, & Young, 1997). Upon their subsequent entry into the eye-tracker room and immediately prior to the eye calibration and stimulus slide show, participants were asked to rank their current affective state on a 1–10 Likert scale as a manipulation check. A score of 1–3 indicated a negative mood, 4–6 represented a neutral mood, and 7–10 represented a positive mood based on the scale anchors. The induced positive mood group scored as significantly happier than did the control group, $F(1, 54) = 6.36$, $p < .05$, with the mood manipulation group self-rating ($M = 8.27$, $SD = 1.04$) scoring approximately 2/3 of a standard deviation higher on this self-reported happiness scale than the control group ($M = 7.34$, $SD = 1.59$), suggesting that the manipulation was adequate in producing a short-term positive mood change. This manipulation check also speaks against the possibility that these widely-used instructions to wait to eat the candy until the end of the experiment might have caused ego-depletion among participants (e.g., Baumeister, Muraven, & Tice, 2000), because even after hearing those instructions to wait, the induced positive mood group reported significantly better moods than the comparison participants, who still knew nothing of the candy.

Next, participants' eyes were calibrated to the eye tracker by having them look at seventeen points on a 15-inch computer screen. Tracking was adjusted until the calibration was within one degree of visual angle error to the observed point. When the tracker was calibrated accurately, which took approximately 1.5 min (ranging from 1–3 min), the participants were asked to view a slide show of images presented on the monitor. Participants were asked to observe the slide show "naturally, viewing whatever interests you—as if watching a television show." The participant was told that they could look away from the images at any point of the presentation if they felt uncomfortable. Thus, the experimental setup reflects real world visual information processing in that participants are free to look at whatever they find interesting in stimuli presented of objects or situations they might encounter in daily activities.

Stimuli were presented in twenty-five trials, and each trial contained three images. The pictorial slides were presented for eight seconds, followed by three seconds of complete gray screen in between image slides. The valence of the images was randomly interspersed throughout the presentation, and two potential sequences of slideshow images were incorporated. Each slide has thus three areas of interest, corresponding with the three pictures displayed in varied directional patterns. The eye tracker measured attention to these areas in gaze fixation duration times, which were later converted to gaze fixation percentages, as well as saccades. After the stimulus presentation concluded participants, were debriefed as to the intent of the study.

Data analyses

Scores from the Snellen Visual Acuity Test indicated that all participants had adequate visual acuity to ensure proper visual processing of the stimuli; thus no participants' data was eliminated due to poor vision. Four participants, however, exhibited extensive reflective corneal glare while tracking, and their data was not included in analyses as a void file was recorded, this accounted for a loss of 7% of the total data from tracking. Due to the nature of the hypotheses, primary analyses consisted of investigating percentage fixation time to peripheral AOIs as well as frequency of visual saccades per emotional slide valence category. After conducting a mixed-model analysis to test for Condition X Valence effects for both the gaze fixation and saccade data, mean differences were analyzed primarily with one-way ANOVAs in which the conditions were compared separately for each emotional valence type.

Results

Data were collapsed across presentation order and central-peripheral array orientations as no significant effects were found for these variables. To test for gender effects, a 2 (Gender) × 2 (Mood Condition) × 7 (emotional valence) mixed-model analysis was conducted. No significant main effects were found for Gender, nor between Mood Condition × Gender, $F(1, 326) = 3.09$, *n.s.*, nor between Emotional Valence × Gender, $F(1, 90) = 1.91$, *n.s.*, nor Mood Condition × Gender × Emotional Valence, $F(1, 90) = 0.88$, *n.s.* Therefore, data was also collapsed across gender for further analyses.

Induced positive mood and attentional breadth

First, a mixed-model analysis tested for overall effects of the mood manipulation on the first measure of attentional breadth, percentage viewing time to various types of peripheral emotional stimuli. This mixed-model included one between-subjects factor, experimental mood condition (2 levels) and one within-subjects factor, emotional valence (7 levels: high positive, medium positive, low positive, neutral, low negative, medium negative, and high negative). Main effects of condition and valence, as well as the interaction, were tested in a mixed model analysis employing a Huynh-Feldt repeated covariance structure. A significant main effect was found for valence, $F(1, 296) = 2.25$, $p < .01$. Inspection of the means suggest that all participants, regardless of condition, viewed the periphery of the slides of the low negative valence for a longer percentage viewing time ($M = 58.66$, $SD = 1.58$) than the slides of other valences (high negative $M = 52.81$, $SD = 1.36$; medium negative $M = 51.90$, $SD = 1.42$; neutral $M = 55.44$, $SD = 1.26$; low positive $M = 52.59$, $SD = 1.39$; medium positive $M = 53.42$, $SD = 1.61$; high positive $M = 52.55$, $SD = 1.24$). Post-hoc pair-wise comparisons revealed significant differences in viewing time between low negative valence images and all other valence types. However, no significant main effects were found for condition, $F(1, 81) = 0.88$. A significant interaction between Mood Condition and Emotional Valence was found, $F(6, 296) = 2.25$, $p < .05$.

Because this overall interaction was significant, it was followed by further analysis of simple peripheral viewing time differences between groups at each level of emotional valence. To investigate what levels of emotional valence

Table 1 Differences in percentage viewing time to peripheral emotional stimuli by mood group

	Study 1			Study 2		
Valence category	Positive mood *M*	Control *M*	*F*	Positive mood *M*	Control *M*	*F*
High negative	52.68 (9.28)	52.95 (7.22)	0.02	54.45 (18.28)	67.11 (9.73)	4.55*
Medium negative	51.85 (9.52)	52.46 (7.59)	0.06	57.71 (18.74)	67.50 (9.83)	2.61
Low negative	56.47 (12.84)	61.22 (10.93)	2.12	48.65 (20.22)	55.59 (13.57)	1
Neutral	55.09 (8.71)	55.88 (9.57)	0.1	63.09 (14.52)	57.76 (16.01)	0.73
Low positive	50.72 (10.32)	54.46 (9.49)	1.92	63.93 (23.31)	62.40 (11.92)	0.04
Medium positive	54.12 (8.17)	52.72 (10.03)	0.31	65.33 (14.28)	67.27 (11.61)	0.14
High positive	55.53 (8.17)	49.57 (9.37)	6.11*	74.38 (9.63)	55.83 (13.97)	14.35**

Note. Standard deviations are in parentheses.

*Signifies groups are significantly different from each other at $p < 0.05$.

**Signifies groups are significantly different from each other at $p < .001$.

influenced attention to peripheral stimuli between the control and the induced positive mood groups; the simple mean percent fixation differences between groups were compared. Table 1 displays the group differences in affective condition by emotional ratings for peripheral stimuli. One simple effect was significant: The experimental group fixated more on peripheral images of highly positive emotional valence than the control group, $F(1, 53) = 6.11, p < .05$. Participants in the induced mood condition viewed the peripheral images of high positive valence for a significantly longer percentage viewing time ($M = 55.53$, $SD = 8.17$) than their peers in the control condition ($M = 49.57$, $SD = 9.37$). An example of the broadened visual pattern of an induced positive mood participant as compared to their control peer to an image within the highly positive emotional valence category is displayed in Fig. 1.

Data was then analyzed for the second measure of attentional breadth, the number of saccades between fixations that participants made while viewing the slides. A mixed model ANOVA demonstrated that there was a significant interaction between Mood Condition (2 levels) × Emotional Valence (7 levels: high positive, medium positive, low positive, neutral, low negative, medium negative, high negative) on quantity of saccades made per valence category, $F(6, 281) = 2.38$, $p < .05$. Further investigation showed that participants experiencing induced positive mood were found to make significantly more frequent saccades than their control counterparts for almost all the neutral and positive emotional valence categories as shown in Table 2. The only exceptions were that the high positive valence category was not significantly different between groups. No significant group differences emerged in number of saccades made while viewing stimuli of negative valence.

Controlling for possible confounds

To test whether the effect of positive mood on attention to peripheral stimuli of high positive valence levels was unique to induced positive mood, rather than due to the effects of other psychological confounds, a univariate analysis was performed in which percentage fixation time to peripheral stimuli in the high positive valence slide was the dependent variable. All other possible predictors (depression, trait anxiety, state anxiety, negative affect, optimism, and positive affect) were then entered into the model as covariates, using experimental condition as the fixed factor. As gender was not found to be significant in previous analyses on these particular image groups, it was not included as a covariate. Participants in the induced positive mood condition showed selective attention towards the peripheral stimuli for slides showing the highest valence positive pictures even after controlling for these potential psychological confounds, $F(1, 53) = 5.55$, $p < .05$. In addition, a univariate analysis was conducted on the saccade data to test for the effects of psychological confounds. Frequency of saccades was the dependent variable and all other possible predictors (depression, trait anxiety, state anxiety, negative affect, optimism, and positive affect) were entered as covariates with experimental condition as the fixed factor. No covariates were significant for the medium or low positive valence conditions; however, for the neutral condition, positive affect was significant, $F(1, 54) = 3.93$, $p < .05$. Participants in the induced positive mood condition made more frequent saccades for slides showing the medium positive images even after controlling for these potential psychological confounds, $F(1, 54) = 4.50$, $p < .05$. Upon controlling for these psychological constructs in the low positive image condition, this effect became only marginally significant, $F(1, 54) = 3.76$, $p < .06$. Finally, for the neutral image condition, even after controlling for psychological constructs, the effect remained significant, $F(1, 53) = 10.71, p < .01$.

Discussion

In this study, participants who had been induced into positive mood demonstrated enhanced attentional breadth, as indicated by both increased attention to peripheral images of

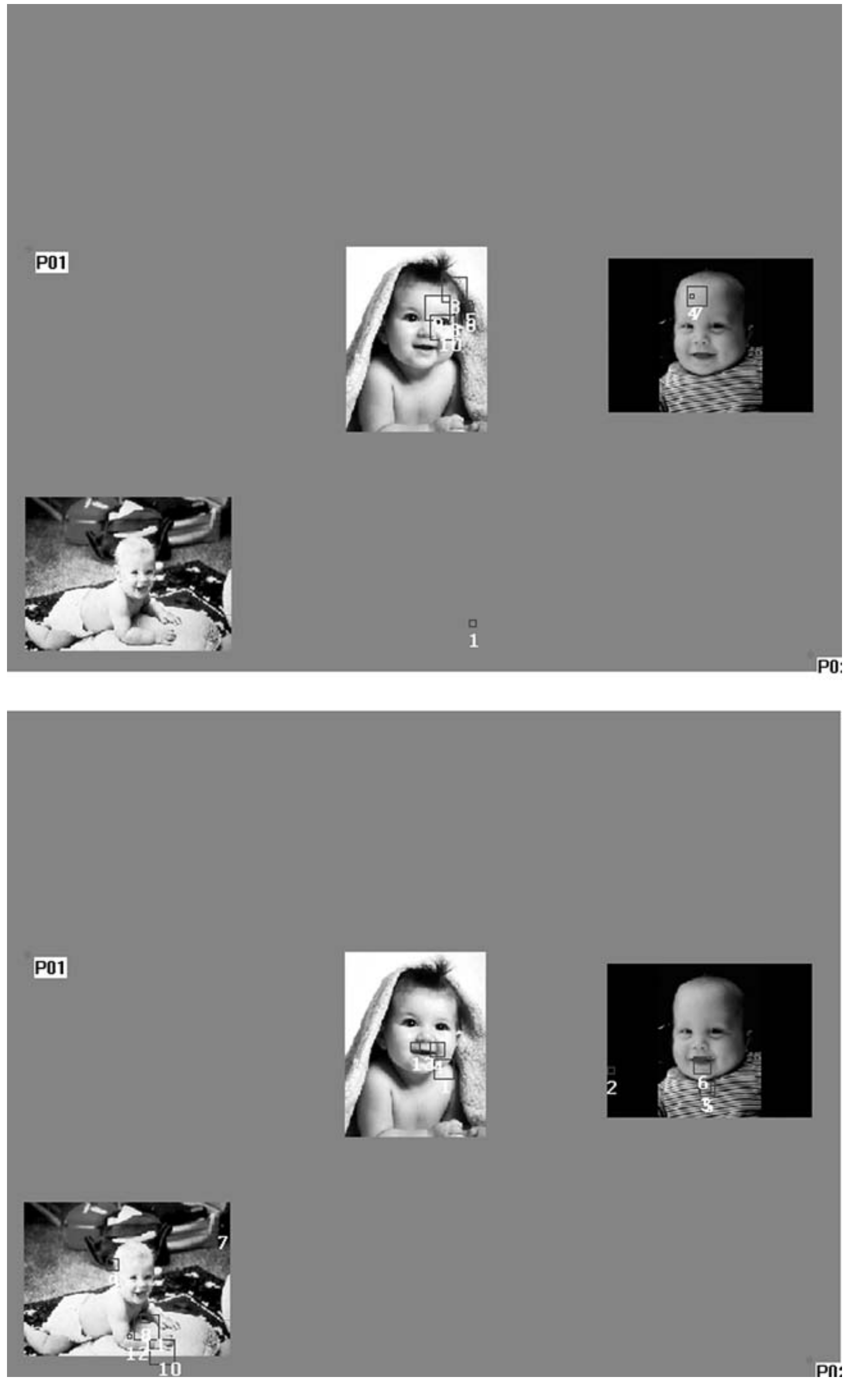

Fig. 1 Fixation patterns of an individual experiencing induced positive mood (bottom) and an individual in the control condition (top) to an image of high, positive emotional valence in Study 1. Numbers signify the order of fixations (1 = first fixation), and box size acts as an indicator of fixation length, with larger boxes signifying a longer fixation at that location. For the bottom panel, the participant experiencing induced positive mood showed a 24.5% percent fixation within the central AOI and a 75.5% fixation within the peripheral AOI. The individual in the control condition (top panel) fixated 80% within the central AOI and 15.5% within the peripheral AOI (the remaining 4.5% can be accounted for as a fixation not within any AOIs or gray screen). Note that the individual under induced positive mood viewed the peripheral stimuli for a longer amount of time and displayed more total fixations than the control participant.

high positive valence as well as by more frequent saccades to stimuli of low and medium positive and neutral valence. However, no effects emerged for images of negative valence. These findings provide qualified support for our hypothesis that induced positive mood would be related to attentional broadening, but only for positive and neutral stimuli.

It is interesting to note that stimuli of high positive valence showed more fixation but not more saccades among the induced positive mood group. Thus, it appears that individuals with induced positive mood states generally saccade more and look longer at positive images, but when confronted with the most positive images they continue to attend more in the periphery but they also seem to look around less.

These findings nonetheless suggest that participants experiencing induced positive mood broaden their visual attention through increased viewing time to peripheral images of high positive valence and by making more frequent saccades to images of varying levels of positive and neutral valence. However, an important possible confound in this study involves the differential arousal level of the stimuli used in the

Table 2 Differences in saccade frequency to emotional stimuli by mood group

Valence category	Study 1			Study 2		
	Positive mood *M*	Control *M*	*F*	Positive mood *M*	Control *M*	*F*
High negative	9.33 (1.96)	8.46 (1.86)	2.83	19.54 (3.23)	22.00 (5.94)	1.69
Medium negative	8.85 (2.24)	8.15 (2.26)	1.31	17.00 (3.72)	19.50 (3.15)	3.26
Low negative	9.64 (2.70)	8.83 (2.13)	1.53	18.77 (4.90)	19.92 (5.02)	0.33
Neutral	10.92 (3.07)	8.54 (1.94)	12.0**	15.69 (5.30)	17.92 (4.78)	1.21
Low positive	9.56 (2.23)	8.35 (2.20)	4.00*	16.46 (3.80)	16.92 (4.60)	0.73
Medium positive	9.86 (2.43)	8.22 (1.80)	8.03*	19.85 (2.67)	21.42 (3.45)	1.63
High positive	9.78 (2.40)	9.10 (2.15)	1.20	14.69 (3.84)	17.00 (3.49)	2.50

Note. Standard deviations are in parentheses.

*Signifies groups are significantly different from each other at $p < 0.05$.

**Signifies groups are significantly different from each other at $p < 0.01$.

experiment. Berlyne (1958) suggests that arousal is a function of collative stimulus properties like novelty, complexity, incongruity, and uncertainty. He posits that moderate levels of arousal are correlated with positive affect whereas high levels of arousal are correlated with negative affect. Participants, regardless of induction condition, looked the longest at the peripheral images of low negative valence which contained images of threatening animals (tarantulas, sharks, and snakes). Thus these images might have elicited higher levels of emotional arousal and therefore may have encouraged stronger orientation reactions toward the peripheral pictures than images of medium or high negative emotional valences, which were of a less arousing nature (pollution, garbage). In other words, because both emotional valence and arousal level co-varied, it was impossible from this study to disentangle the specific effects of mood on attentional broadening.

Study 2: Links between positive mood and attentional breadth when controlling for arousal

To address this confound, we conducted a follow-up study in which arousal level was controlled between all sets of stimuli. Study 2 employed the same procedure as Study 1, but whereas emotional valence continued to vary between slides, arousal level was held constant.

Method

Participants

Participants for Study 2 included 26 young adults ranging from age 20 to 27, ($M = 20.88$; $SE = 0.98$). The sample included 13 women and 13 men. Participants were recruited from flyers posted on campus. All subjects were offered a small monetary stipend for their participation in a study on emotion and attention. The same participation stipulations applied in Study 2 as in Study 1.

Materials and apparatus

The ASL Eye tracking System Model 504 with Magnetic Head Transmitter, software, and measures of gaze fixation equipment were identical as in Study 1.

Visual stimuli

Visual stimuli were again selected from the International Affective Picture System (IAPS:CSEA-NIMH, 1999). The same emotional valence categories were used as in Study 1; however, only one slide was used per image valence category. Emotional valence was held constant across images within a particular slide; however, slides varied in emotional valence (positive, negative, and neutral) between slides. In addition, emotional arousal was held constant both between and within slides (*M* arousal = 4.28). The IAPS arousal level of all images was within a low-moderate arousal range, and the images did not differ significantly from each other on arousal level. A list of the Study 2 images can also be found in the Appendix. Images were again presented to the participants in a slide-show format using MATLAB. Seven slides with arrays of three images each were shown, for a total of twenty-one images. Images were displayed consistently in horizontal arrays with one central and two peripheral images, as array orientation was not found to have any significant effects from Study 1. As image presentation did not generate any main effects from Study 1, only one image presentation was used in Study 2.

Procedure

The procedure for Study 1 was replicated in Study 2. Participants completed measures of visual acuity and self-report measures (demographics, CES-D, STAI, PANAS, and LOT) then were randomly assigned to the control or positive induction condition. Positive mood was again induced in the experimental group using a candy gift (5 chocolate pieces) after completion of the questionnaires and immediately prior to the slide presentation. Control participants also received the candy gift at the end of the experiment. Another Likert mood scale manipulation check was presented as in Study 1, immediately after participants received the candy or at the equivalent time for the control group. The induced positive mood group again scored as happier than did the control group, $F(1, 24) = 4.19$, $p < .05$, with the mood manipulation group self-rating ($M = 8.38$, $SD = 1.04$) approximately 3/4 of a standard deviations higher on this self-reported happiness scale than the control ($M = 7.08$, $SD = 2.02$), suggesting that the manipulation was successful.

After calibration, participants were asked to view a slide show of images presented on the monitor "looking naturally at whatever interests you—as if watching a television show." Stimuli were presented in seven trials, each trial containing three images. All slides were presented for eight seconds, with three seconds of complete gray screen in between image slides.

Results

Induced positive mood and attentional breadth

Mixed-model analyses tested for overall effects of the mood manipulation on attentional breadth, including one between-subjects factor, experimental mood condition (2 levels) and one within-subjects factor, emotional valence (7 levels: high positive, medium positive, low positive, neutral, low negative, medium negative, and high negative). The model was first run with fixation percentage as the dependent variable. No main effects of Mood Condition or Valence were found; however, there was a significant interaction between the two, $F(6, 38) = 3.96$, $p < .01$. Further analysis of simple peripheral viewing time differences between groups at each level of emotional valence revealed the mood induction group viewed the peripheral images of high positive valence for a significantly longer time, $F(1, 23) = 14.35$, $p < .001$, ($M = 74.38$, $SD = 9.63$) than their peers in the control condition ($M = 55.83$, $SD = 13.97$). In addition, participants in the control condition viewed the peripheral images in the highly negative valenced slides for a significantly longer time ($M = 67.12$, $SD = 9.73$) than the induced positive group ($M = 54.45$, $SD = 18.28$), $F(1, 24) = 4.55$, $p < .05$. All mean values and group differences for peripheral viewing time to emotional slides by affective condition can be found in Table 1.

The mixed model was re-run using number of saccades as the dependent variable. There was no main effect of Mood Condition (2 levels) or Emotional Valence (7 levels), nor was there a significant interaction between the two, $F(6, 38) = 3.79$, *n.s.*, see Table 2.

Controlling for confounding psychological constructs

In order to assess whether the effect of positive mood on attention to peripheral stimuli was unique to induced positive mood, rather than due to effects of other psychological confounds, a univariate analysis was performed in which percentage fixation time to peripheral stimuli in the high positive valence slide was the dependent variable. All other possible predictors (depression, trait anxiety, state anxiety, negative affect, optimism, and positive affect) were entered as covariates with experimental condition as the fixed factor. No covariates were significant. Participants in the induced positive mood condition showed broadened attention towards the peripheral stimuli for slides of the highest positive valence even after controlling for these potential psychological confounds, $F(1, 22) = 9.47$, $p < .01$.

Discussion

Study 2 generally replicated the findings from Study 1, using stimuli in which arousal level was held constant. As in Study 1, individuals experiencing induced positive mood attended more to peripheral stimuli when stimuli was of a high positive valence, even after controlling for several potential psychological confounds. In addition, participants in the control condition viewed the most negatively-valenced peripheral stimuli for significantly longer than did those in the induced positive mood participants. Thus, in processing emotional stimuli matched in arousal level without any manipulation of the relevance of such stimuli, individuals in positive moods appear to broaden their attention to peripheral positive information and narrow their attention away from peripheral negative information. These findings are consistent with an earlier study in which Isaacowitz (2005) found that college-aged dispositional optimists pay less attention to negative images of melanoma. Taken together these results suggest the broadening effect of positive moods are a function of the valence rather than the arousal level of the stimuli being observed.

General discussion

The current studies represented a first attempt to test Fredrickson's (1998) broaden-and-build hypothesis of positive emotions using eye-tracking as a measure of visual attention. Eye tracking permitted recording eye movements in nearly real time as participants viewed pictorial arrays of emotional stimuli. Half of the participants in both studies were induced into a positive mood. Attentional breadth was assessed in two ways: first, examining the percentage of fixation during which participants viewed peripheral images, and second through evaluating the frequency of visual saccades made by participants.

In the first study, participants in an induced positive mood showed heightened attentional breadth, as indicated by a higher percentage fixation time, or looking longer at the peripheral images, than their peers in the control group for images of high positive emotive valence. This relationship persisted even upon controlling for various psychological constructs such as the PANAS, CES-D, STAI, and LOT. Thus, the gaze fixation data supports the broaden-and-build model in broadening visual attention, but only for highly positive emotional stimuli. In Study 1 saccade analyses also suggested that the positive mood induction group showed heightened attentional breadth as they made more frequent saccades for images of neutral, low positive, and medium positive valence than the control participants. These saccade results illustrate that participants under positive induced mood are broadening their attention toward neutral and positive images by looking around the screen more frequently. In the second study, even after controlling for the arousal of the stimuli, participants in the induced mood condition continued to have longer viewing times to the peripheral images in the slides of high positive valence.

Taken together, these two studies provide strong support that individuals experiencing an induced positive mood expand their attentional breadth as compared to normal control participants, but only towards positive and neutral stimuli. More specifically, the nature of the affective landscape appears to moderate how this visual broadening manifests. If the affective milieu is of a high positive valence, broadening behavior seems to be displayed through longer viewing times to peripheral information; while if the affective backdrop is neutral or of a lower to moderate positive valence, broadening seems to be exhibited in a higher frequency of visual saccades. This is congruent with Isen's (2000) prediction that valence of stimulus material, specifically neutral or positive stimuli, plays a key role in determining if individuals experiencing positive mood will show broadening behaviors.

Mood maintenance and broadening

The broaden-and-build hypothesis of positive emotions suggests these broadening patterns may have evolutionary origins and adaptive benefits; a related but distinct possible explanation for the above finding is that positive mood simply acts as a moderator for its own self-preservation, as suggested by the Hedonic Contingency Model. The HCM, proposed by Wegener and Petty, (1994) posits that individuals experiencing a positive mood have been conditioned through experience to purposely pursue activities that will perpetuate or elevate their benevolent affective states. Thus the HCM might suggest that individuals would only broaden to images of similar valence, regardless of their location, in order to maintain their current affective mood. While the HCM explanation was not entirely confirmed in the current studies, as image location did play a role in broadening the gaze fixation data, the HCM may still suggest an additional mechanism of broadening. Recent research has demonstrated that the HCM may not only be a product of conditioning, but that positive mood maintenance has become an automated response resultant of overlearning (Handley, Lassiter, Nickell, & Herchenroeder, 2004). Handley et al. (2004) found that individuals who have watched a positively valenced video for fifteen minutes evaluated their preference for future activities based upon a nonconscious and automatic tendency to seek experiences that would sustain their positive mood.

The Hedonic Contingency Model, however, does not take into account situations where it might be advantageous for individuals in positive moods to attend to negative information. Several studies have found that individuals experiencing positive mood and optimists do attend to negative, especially threatening, information when it is self-relevant and may hold a future advantage for them (Aspinwall & Brunhart, 1996; Estrada et al., 1997; Reed & Aspinwall, 1998; Larsen et al., 2003). Instead of individuals in positive moods merely viewing positive stimuli to maintain their moods, these individuals may instead actively seek out the most adaptive strategy in their information processing for future gains, even at the cost of short-term pleasure. If there is a necessary or beneficial reason to pay attention to negative information, individuals in positive moods may do so. Since there was no advantage in paying attention to the negative information in the current study, participants in the induced mood condition could simply broaden their attention towards the stimuli that would enhance their positive mood.

The upward spiral

When there are no environmental threats, individuals experiencing induced positive mood may seek out more positive mood, in an effort to further perpetuate what Fredrickson and Joiner (2002) have deemed their "upward spiral," thus regulating their attention (consciously or unconsciously) towards positive environmental conditions. Happy individuals may also scan their environments more when there are potentially "good" things in it or when there is no apparent threat to their well-being, as suggested by their more frequent saccades during the positive and neutral images. However when negative pictures are apparent—especially strongly negative pictures—these "broadeners" seem to demonstrate a viewing technique to preserve their upbeat mood in that they do not to broaden their attention towards the negative images. Participants experiencing an induced positive mood do broaden their attention, not to all stimuli, but only to neutral or mood-congruent peripheral stimuli.

Limitations and conclusions

While these findings offer preliminary support that eye tracking technology can be used to demonstrate attentional broadening in relation to affective state, there are several evident limitations to the current studies. We were only able to look at overall fixation patterns during the entire time a slide was presented; future studies might try to analyze data in dynamic patterns allowing for a second-by-second investigation of emergent attentional patterns. Further investigations may also further explore the influence of different levels of emotional arousal on attention to peripheral stimuli. In addition, future studies might provide a final mood rating at the end of the viewing period to ensure the positive mood induction lasts throughout the entire experiment. Another limitation of the study was that even though the IAPS stimuli are very well-validated and prevalent in their usage, participants did not rate their valence themselves, thus future studies might add an extra check for participants' ratings of valence. In addition, there is some possibility that assessing positive or negative affect with the PANAS (Watson et al., 1988) may confound actual moods given its bias towards activation or arousal levels; using other measures could reduce this possible confound. Finally, a more thorough future analysis might provide data from a more varied ethnic sample and would include data from middle-aged or older individuals.

In summary, the present study demonstrated that positive mood impacts visual attention, as participants induced into positive moods demonstrated heightened attentional breadth as indicated by longer visual fixations to peripheral stimuli of high positive valence and more frequent saccades when viewing stimuli of neutral and positive valence. Individuals experiencing positive moods may selectively (albeit not necessarily consciously) broaden their attention towards peripheral images only when the images are of highly positive emotional valence. In its application to visual attention, the broaden-and-build model may be further refined as predicting "selective broadening" for especially positive and neutral images. The findings suggest that individuals experiencing "happy" moods may in fact experience their environment in a different manner than other individuals, finding more that is positive in the world around them, and staying happy because of what they find.

Appendix

The Title, IAPS Numbers, Mean IAPS Slide Valence Scores, and Overall Mean Valence Group Scores for all Pictures used in Study 1 and Study 2, Displayed by Analytical Categories

Emotional valence scores

Title	IAPS no	*M*	Title	IAPS no	*M*
High negative			High positive		
1. Car wreck	9910, 9911, 9920	2.29	1. Mountain	5600, 5660, 5700	7.48
2. Toilet	9300, 9301, 9320	2.39	2. Money	8501, 8502, 8503	7.48
3. Garbage	9290, 9340, 9373	2.89	3. Family	2311, 2360, 2395	7.58
4. Dead Animal	9180, 9181, 9182	2.92	4. Baby	2040, 2050, 2071	8.08
5. Cemeteries*	9000, 9001, 9010	2.43	5. Animals*	1440, 1460, 1750	8.23
	Group *M*	2.62		Group *M*	7.66
Medium negative			Medium positive		
1. Pollution	9330, 9341, 9342	3.04	1. Candy	7400, 7410, 7430	7.01
2. Gun	6190, 6200, 6210	3.24	2. Cake	7260, 7270, 7282	7.15
3. Injection	9102, 9592, 9594	3.48	3. Couple	4599, 4623, 4641	7.15
4. Criminal acts*	2722, 2751, 9101	3.48	4. Cloud	5593, 5891, 5982	7.37
			5. Children*	2341, 2391, 2650	7.25
	Group *M*	3.25		Group *M*	7.17
Low negative			Low positive		
1. Tarantula	1200, 1201, 1205	3.72	1. Motorcycle	8250, 8251, 8260	6.18
2. Snake	1051, 1110, 1113	3.82	2. Butterfly	1602, 1603, 1604	6.84
3. Shark	1930, 1931, 1932	3.88	3. Skier	8021, 8031, 8193	6.85
4. Waste*	9080, 9171, 9472	4.05	4. Food*	7284, 7472, 7475	6.26
	Group *M*	3.81		Group *M*	6.62
Neutral					
1. Appliance	7000, 7040, 7150	4.80			
2. Furniture	7025, 7175, 7235	4.82			
3. Utensil	7004, 7034, 7080	5.09			
4. Mushroom	5500, 5532, 5534	5.15			
5. Geometric Design*	5535, 7182, 7830	5.08			
	Group *M*	4.97			

Note. Individual mean emotional valence scores for each slide (calculated from the three pictures shown per slide) are displayed. In addition emotional valence group mean scores are also displayed (calculated from the mean scores of all the slides within the group).
IAPS = International Affective Picture System. Group means do not reflect pictures used in Study 2, as the slide mean is the group mean for this study.

*Pictures were used in Study 2.

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References

Aspinwall, L. G., & Brunhart, S. M. (1996). Distinguishing optimism from denial: Optimistic beliefs predict attention to health threats. *Personality and Social Psychology Bulletin*, *22,* 993–1003.

Basso, M. R., Schefft, B. K., Ris, M. D., & Dember, W. N. (1996). Mood and global-local visual processing. *Journal of the International Neuropsychological Society*, *2,* 249–255.

Baumeister, R. F., Muraven, M., & Tice, D. M. (2000). Ego depletion: A resource model of volition, self-regulation, and controlled processing. *Social Cognition*, *18*(2), 130–150.

Berlyne, D. E. (1958). The influence of complexity and novelty in visual figures on orienting responses. *Journal of Experimental Psychology*, *55,* 289–296.

Bradley, B. P., Mogg, K., & Lee, S. C. (1997). Attentional biases for negative information in induced and naturally occurring dysphoria. *Behavioral Research Therapy*, *35,* 911–927.

Bradley, B. P., Mogg, K., & Millar, N. H. (2000). Covert and overt orienting of attention to emotional faces in anxiety. *Cognition and Emotion*, *14,* 789–808.

Buckley, T. C., Blanchard, E. B., & Hickling, E. J. (2002). Automatic and strategic processing of threat stimuli: A comparison between PTSD, panic disorder, and non-anxiety controls. *Cognitive Therapy and Research*, *26,* 97–115.

Carnevale, P. J. D., & Isen, A. M. (1986). The influence of positive mood and visual access on the discovery of integrative solutions in bilateral negotiation. *Organizational Behavior and Human Decision Processes*, *37,* 1–13.

Center for the Study of Emotion and Attention [CSEA-NIMH] (1999). *International affective picture system: Digitized photographs*. Gainsville, FL: The Center for Research in Psychophysiology, University of Florida.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: the forgettable nature of negative images for older adults. *Journal of Experimental Psychology*, *132,* 310–324.

Derryberry, D., & Tucker, D. M. (1994). Motivating the focus of attention. In P. M. Neidenthal & S. Kitayama (Eds.), *The heart's eye: Emotional influences in perception and attention* (pp. 167–196). San Diego, CA: Academic Press.

Estrada, C. A., Isen, A. M., & Young, M. J. (1997). Positive affect facilitates integration of information and decreases anchoring in reasoning among physicians. *Organizational Behavior and Human Decision Processes*, *72,* 117–135.

Fredrickson, B. L. (2003). The value of positive emotions. *American Scientist*, *91*, 330–335.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology. *American Psychologist*, *56,* 218–226.

Fredrickson, B. L. (2000a). Cultivating positive emotions to optimize health and well-being. *Prevention and Treatment, 3*, Article 0001a. Retrieved January 1, 2003, from http://journals.apa.org/prevention/volume3/pre0030001a.html

Fredrickson, B. L. (2000b). Cultivating positive emotions to optimize health and well being. *Prevention and Treatment*, *3,* Article 0001a. Retrieved January 1, 2003, from http://journals.apa.org/prevention/volume3/pre0030001a.html

Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology*, *2,* 300–319.

Fredrickson, B. L., & Joiner, T. (2002). Positive emotions trigger upward spirals towards emotional well-being. *Psychological Science*, *13,* 172–175.

Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition and Emotion, 12,* 191–220.

Fredrickson, B. L., Mancuso, R. A., Branigan, C., & Tugade, M. M. (2000). The undoing effect of positive emotions. *Motivation and Emotion*, *24,* 237–259.

Gasper, K., & Clore, G. L. (2002). Attending to the big picture: Mood and global versus local processing of visual information. *Psychological Science*, *13,* 34–40.

Handley, I. M., Lassiter, G. D., Nickell, E. F., & Herchenroeder, L. M. (2004). Affect and automatic mood maintenance. *Journal of Experimental Social Psychology*, *40,* 106–112.

Hermans, D., Vansteenwegen, D., & Eelen, P. (1999). Eye movement as a continuous index of attention deployment: Data from a group of spider anxious students. *Cognition and Emotion*, *13,* 419–434.

Isaacowitz, D. M. (2005). The gaze of the optimist. *Personality and Social Psychology Bulletin*, *31,* 407–415.

Isaacowitz, D. M. (in press). The Oxford Handbook of Methods in Positive Psychology. In A. Ong & M. van Dulmen (Eds.), *Positive psychology and measurement*. New York: Oxford University Press.

Isen, A. M., & Daubman, K. A. (1984). The influence of affect on categorization. *Journal of Personality and Social Psychology*, *47,* 1206–1217.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52,* 1122–1131.

Isen, A. M., Johnson, M. M. S., Mertz, E., & Robinson, G. F. (1985). The influence of positive affect on the unusualness of word associations. *Journal of Personality and Social Psychology*, *48,* 1413–1426.

Isen, A. M., Niedenthal, P. M., & Cantor, N. (1992). An influence of positive affect on social categorization. *Motivation and Emotion*, *16*(1), 65–78.

Isen, A. M., Nygren, T. E., & Ashby, F. G. (1988). Influence of positive affect on the subjective utility of gains and losses: It is just not worth the risk. *Journal of Personality and Social Psychology*, *55*(5), 710–717.

Isen, A. M. (2000). Part V: Cognitive factors. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (2nd ed., pp. 417–520). New York: Guilford Press.

Kahn, B. E., & Isen, A. M. (1993). The influence of positive affect on variety seeking among safe, enjoyable products. *Journal of Consumer Research*, *20*(2*),* 257–270.

LaBar, K. S., Mesulam, M. M., Gitelman, D. R., & Weintraub, S. (2000). Emotional curiosity: Modulation of visuospatial attention by arousal is preserved in aging and early-stage Alzheimer's disease. *Neuropscyhologia*, *38,* 1734–1740.

Larsen, J. T., Hemenover, S. H., Norris, C. J., & Cacioppo, J. T. (2003). Turning adversity into advantage: On the virtues of the coactivation of positive and negative emotions. In L. G. Aspinwall & U. M. Straudinger (Eds.), *A psychology of human strengths: Fundamental questions and future directions for a positive psychology* (pp. 211–255). Washington, DC: American Psychological Association.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95,* 15–20.

Mogg, K., McNamara, J., Powys, M., Rawlinson, H., Seiffer, A., & Bradley, B. P. (2000). Selective attention to threat: A test of two cognitive models of anxiety. *Cognition and Emotion*, *14,* 375–399.

Mogg, K., Millar, N., & Bradley, B. P. (2002). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology*, *109,* 695–704.

Parkhurst, D., Law, K., & Niebur, E. (2002). Modeling the role of salience in the allocation of overt visual attention. *Vision Research*, *42,* 107–123.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1,* 385–401.

Reed, M. B., & Aspinwall, L. G. (1998). Self-affirmation reduces biased processing of health-risk information. *Motivation and Emotion*, *22,* 99–132.

Rudd, M. D., Joiner, T., & Rajab, M. H. (2001). *Treating behavior: An effective time-limited approach*. New York: Guilford.

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized coping expectancies. *Health Psychology*, *4,* 219–247.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Veenhoven, R. (1988). The utility of happiness. *Social Indicators Research*, *20,* 333–354.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Development*, *54,* 1063–1070.

Wegener, D. T., & Perry, R. E. (1994). Mood management across affective states: The hedonic contingency hypothesis. *Journal of Personality and Social Psychology*, *66,* 1034–1048.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). New York: Wiley.