The Happy Spotlight: Positive Mood and Selective Attention to Rewarding Information

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Positive mood states are thought to sensitize individuals to rewards in their environment, presumably in the service of approach-related decision making and behavior. From a selective attention standpoint, such mood-related effects should be associated with selective attention biases favoring rewarding stimuli. No prior results along these lines have been reported. Therefore, the authors conducted a systematic program of research designed to document such relations. Study 1 found that daily positive mood states were associated with attention to reward words in a spatial probe task. Studies 2-5 replicated this association in the context of mood manipulations. The latter studies also show that the effect generalizes across different mood manipulation procedures, is specific to positive mood states, and is particularly apparent in relation to rewarding (vs. non-rewarding) positive stimuli. The results extend our knowledge of mood-cognition relations and have important implications for understanding the social cognitive consequences of positive mood states.

Keywords: *mood; cognition; positive affect; attention*

Positive affect may facilitate the attainment of desirable outcomes (Frederickson, 2001). In support of this idea, high levels of positive mood states are associated with higher income, more successful social interactions, and a longer life span (Lyubomirsky, King, & Diener, 2005). What are the mechanisms by which positive mood states facilitate the attainment of desirable outcomes? In general terms, mood-cognition frameworks have emphasized mood-congruent processing, whether related to judgment (e.g., Schwarz & Clore, 1983), memory (e.g., Bower, 1981), or decision making (e.g., Peters, Vastfjall, Garling, & Slovic, 2006). By this reasoning, positive mood states should facilitate a selective focus on desirable features of the environment, and such selectivity effects, in turn, could potentially explain why it is that positive mood states facilitate the attainment of positive outcomes.

Although many mood-cognition frameworks invoke basic cognitive processes related to attention, encoding, and automatic spreading activation, it is striking that the data in support of such frameworks typically relate to relatively "downstream" correlates such as judgments or behavior (for a review, see Bower & Forgas, 2000). The latter outcomes are complex, and there are theoretical disputes concerning how to interpret them from a cognitive perspective (for a review, see Schwarz & Clore, 1996). Thus, we follow Niedenthal and Halberstadt (2000) in focusing on early cognitive effects of mood states, which should be useful in understanding why mood states have the downstream effects that they do. Specifically, we examine the possibility that positive mood states bias attention toward rewarding stimuli in selective attention tasks. This hypothesis is discussed in light of prior theory and data involving social cognition, mood states, and selective attention, as reviewed below.

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Social Cognition and Selective Attention

At any one time, the environment consists of a great variety of stimuli and cues. To effectively manage this diversity of cues, the individual needs to select certain stimuli over other stimuli for further processing, and such selection operations have proven of crucial significance in understanding both cognitive (Pashler, Johnston, & Ruthruff, 2001) and social cognitive (Fiske & Taylor, 1991) outcomes. Selective attention is likened to a spotlight that illuminates particular stimuli or cues at the expense of those occurring within other, nonattended spatial locations (Posner, 1978; Treisman, 1969). Selected stimuli receive limited-capacity processing resources, in turn making it more likely that such selected stimuli will guide subsequent judgments and behaviors (Fiske & Taylor, 1991; Pashler et al., 2001).

In support of this point, Fazio and colleagues have shown that accessible attitudes bias selective attention in favor of attitude-relevant stimuli (e.g., Roskos-Ewoldsen & Fazio, 1992), in turn biasing judgments in an attitude-consistent direction (e.g., Fazio, Roskos-Ewoldsen, & Powell, 1994). More broadly, selective attention operations can be conceptualized in terms of the "salience" of different sources of information. Salient information, both negative and positive in nature, has been shown to be of great impact in social cognitive studies of judgment, emotion, and behavior (for reviews, see Fiske & Taylor, 1991; Higgins, 1996; Wentura, Rothermund, & Bak, 2000). Although salience has been defined in different ways in different studies, the general point is that selected (vs. nonselected) sources of information are more important in predicting social cognitive outcome variables (Higgins, 1996). Thus, selective attention processes may be especially important to social cognitive outcomes, in that they determine the input to later judgment, emotion, and behavior (Fiske & Taylor, 1991). These considerations led us to focus on relations between mood states and selective attention.

Mood States and Selective Attention

Selective attention processes could potentially explain many of the downstream effects of mood states. If negative mood states are associated with tendencies to avoid undesirable end states (e.g., Carver, 2001), then they may increase the salience of undesirable information. Similarly, if positive mood states are associated with tendencies to approach desired end states (e.g., Coats, Janoff-Bulman, & Alpert, 1996; Cunningham, 1988), they may increase the salience of desirable information. Such mood-linked processing tendencies are likely to build on selective attention processes, which should favor undesirable stimuli in negative mood states and desirable stimuli in positive mood states (Watson, 2000).

Although both hypotheses appear plausible, the literature to date has only supported the link between negative mood states and selective biases favoring threatening information. Indeed, much of the literature on mood and selective attention has been conducted by clinical researchers, who have been centrally concerned with the role of selective attention biases in anxiety- and depression-related states (Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1997). Briefly, this research has shown that selective attention biases in relation to threatening stimuli are linked to anxiety disorders, are mitigated with successful psychotherapy, and are causal in the genesis of anxiety-related states (MacLeod, 1999).

Whereas substantial evidence to date demonstrates that negative mood states bias attention to threatening information in selective attention tasks, it is an open question whether positive mood states similarly bias attention toward rewarding stimuli. On the one hand, such effects might be expected from both mood-congruency (Bower & Forgas, 2000; Niedenthal & Halberstadt, 2000) and motivational (Carver, 2001; Mogg & Bradley, 1998) frameworks. On the other hand, it could be that biases in selective attention are particular to negative mood states. Threatening stimuli have been viewed as prepotent to the individual, but this is less true in relation to rewarding stimuli (LeDoux, 1996; Robinson, 1998). Indeed, prominent views of positive affect suggest that it is less tied to attention and reaction relative to negative affect (Fredrickson, 2001). Thus, it is not clear, from some prior frameworks, whether one would expect positive affect to somewhat automatically bias attention to positive stimuli (Fredrickson, 2001; Robinson, 1998).

However, to the extent that both negative and positive mood states are designed to support approach- and avoidance-related goals, respectively, one might expect that positive mood states, too, would bias attention, in this case in favor of rewarding stimuli in the environment (Carver, 2001; Watson, Wiese, Vaidya, & Tellegen, 1999). Similarly, mood-congruency frameworks tend to maintain that the effects of positive and negative mood states are similar, in that both are thought to bias information in favor of mood-congruent stimuli (Bower, 1981; Bower & Forgas, 2000). Although these frameworks typically posit, rather than measure, selective attention processes, it is nevertheless apparent that there are theoretical precedents for our prediction that positive mood states are likely to bias attention toward positive or rewarding stimuli. Because mood-congruency frameworks are particularly well known in the social cognition literature, we discuss our predictions in light of this prior literature.

Related Models of Mood and Cognition

According to Bower's (1981) network theory and related network models (e.g., Clark & Isen, 1982), affect influences cognition by activating semantic memory representations that are mood-congruent. However, the model highlights later stages of information processing such as those related to memory and judgment and makes no predictions for earlier stages related to perception and attention (Forgas, 1995). Thus, although the current focus on selective attention is broadly consistent in spirit with mood-congruent processing frameworks, our predictions are novel to the literature.

Borrowing to some extent from Bower's (1981) theory, Niedenthal and colleagues have investigated whether mood states might prime mood-related items in lexical decision and word pronunciation tasks. The authors have found support for this prediction, but the nature of these effects is relatively circumscribed (for a review, see Niedenthal & Halberstadt, 2000). First, the results involve lexical access processes rather than selective attention. Second, and of more theoretical importance, the model and data pertain to very specific priming effects in which mood states are thought to prime access to synonyms of one's current mood state (e.g., the word *joy* in the case of a happy mood state), but not mood-related material of a broader nature (e.g., the word *sexy* or *wisdom* in the case of a happy mood state). Thus, this lexical access model would not predict the broader sorts of selectivity effects predicted here, in that we used stimuli indicative of potential rewards (e.g., *fun, praise*) rather than synonyms for happy mood states.

In sum, the present studies were informed by mood-congruent processing models but seek to extend them in a novel manner. Following motivational frameworks of positive affect (e.g., Watson et al. 1999), we predicted that positive mood states would sensitize individuals to potential rewards in the environment, here in terms of selective attention processes favoring them. In relation to prior theory and data on mood-congruent processing (e.g., Niedenthal, Halberstadt, & Innes-Ker, 1999), our studies focus on earlier attention-related processes and posit broader effects on selective processing than have been previously reported. Data along these lines would constitute a significant contribution to the literature, in that they would help us to understand why positive mood states have the downstream social cognitive effects that they do.

The Present Studies

The spatial probe task has been recommended in the clinical literature on threat-related attention biases (Mogg & Bradley, 1998). In the spatial probe task, two words are presented simultaneously in different locations. The pair is then removed, followed by a spatial probe occurring in the area of one of the two words. Individuals are faster to respond to the probe stimulus when it is presented in an attended rather than unattended region of the visual display (MacLeod, Mathews, & Tata, 1986). The detection latency for the probe is therefore a sensitive measure of selective attention (Navon & Margalit, 1983). When the pairs contain words that differ in affective tone, the task can be used to examine selective attention to particular classes of affective stimuli (MacLeod et al., 1986). We modified such spatial probe tasks to examine selectivity effects involving positive stimuli.

All studies focused on the prediction that positive mood states would bias attention toward positive stimuli. Study 1 examined this prediction by assessing positive mood states in daily life. Studies 2-5 sought to extend our analysis to manipulated mood states. We hypothesized that positive mood states would bias attention toward positive stimuli, in comparison to neutral (Studies 2, 4, and 5) or negative (Studies 2 and 3) mood inductions. To further support the generality of the findings, mood states were measured naturalistically (Study 1), manipulated by autobiographical recall (Study 2), guided imagery procedures (Studies 3-4), or music (Study 5). Such a diversity of procedures has been recommended in the literature (Niedenthal & Halberstadt, 2000; Rusting, 2001).

Studies 4-5 also explored the nature of the selectivity effects by manipulating the nature of the positive stimuli. It was predicted that positive mood states would bias attention toward rewarding stimuli (e.g., words like *sexy*) relative to merely pleasant stimuli of a nonrewarding nature (e.g., words like *safe*). Such effects would be consistent with theoretical frameworks linking positive affect to approach-related cognitive and behavioral tendencies (e.g., Carver, 2001).

STUDY 1

In Study 1, we measured daily mood states in an experience-sampling protocol, which is thought to capture mood states as they are naturalistically lived (e.g., Robinson & Clore, 2002). We predicted that experiences of daily positive, but not negative, mood would be associated with patterns of selective attention favoring positive rewarding stimuli in a spatial attention task.

Method

Participants

Ninety-five undergraduate students at the University of Illinois participated in the study. Students received course credit for their participation in the lab portion of the study and $20 for their participation in the experience- sampling portion of the study.

Materials

Dot Probe Task. Word pairs were briefly presented on the screen, with one word on the right side of the screen and the other word on the left (each of which was 2.6 cm from the edge of the computer screen). Following the word pair, a white cross (i.e., spatial probe) was presented in the position formerly occupied by one of the words. Participants were instructed to press the 1 key if the spatial probe appeared to the left and to press the 9 key if it appeared to the right. To encourage attention to the words, participants were told that they might be asked to recall the words later in the session, but that their main goal was to respond to each spatial probe as quickly and accurately as possible (Mogg & Bradley, 1998). The task included 40 neutral-reward word pairs. Eight reward words and 12 neutral words (see appendix) were chosen based on normative valence ratings (Bradley & Lang, 1999; Toglia & Battig, 1978). Reward words (M = 8.07) were rated as more pleasant than neutral words (M = 5.42), according to these prior norms. Reward and neutral words were equal in word length and word frequency, Fs < 1.

Each trial began with two iterations of a flashing green fixation in the center of the screen. Then a word pair was presented for 500 ms, as is typical in dot probe studies (Mogg & Bradley, 1998). When the word pair disappeared, it was immediately followed by a white cross (i.e., the probe), which remained on the screen for 1,000 ms or until participants made a response. If participants made an incorrect response, a visual error message was presented for 2 s before the next trial began. Trials were separated by an intertrial interval of 1 s.

Procedure

The study included a lab session and an experience-sampling protocol. First, participants came into the lab in groups of two to four. After giving informed consent, they were seated in front of a personal computer and completed the dot probe task. Second, several weeks following the lab section, participants completed the experience-sampling protocol. They carried a palmtop computer for 7 days. The computer issued six beeps per day, randomly, between the hours of 10:00 A.M. and 10:00 P.M. When paged, participants were asked to complete a mood survey (presented on the palmtop computer). Although participants were instructed to complete the mood ratings immediately after being signaled, we realized that this might not always be possible (e.g., during a shower). For this reason, we allowed participants to make the ratings anytime within a 5-minute window. Participants were asked to complete the survey at least five times a day. Of the 35 required responses (5 required responses per day × 7 days), the average participant completed 31.71 (90.6%).

Mood Survey. To assess daily moods, participants rated the extent to which they felt different mood states. The positive items consisted of *calm, cheerful, confident, enthusiastic, excited, happy, proud,* and *relaxed,* whereas the negative items consisted of *afraid, angry, anxious, ashamed, downhearted, guilty, irritable, nervous,* and *sad.* Positive and negative mood scores were created by averaging across pages and then items (alphas were .95 and .92 for the positive and negative mood scores, respectively).

Results

Scoring Selective Attention Biases

Accuracy rates were high, with 97% accuracy across trials. To examine performance on the dot probe task, we followed the recommendations of Ratcliff (1993) and Robinson (in press). First, we deleted inaccurate trials. Second, we reduced the impact of reaction time (RT) outliers by replacing RTs two standard deviations above or below the grand latency mean with these cut-off values (3% of trials). Third, we log-transformed the data to reduce the skew typical of RT distributions.

To examine the extent to which individuals were faster to respond to reward (vs. neutral) words, we first calculated average RT scores when the probe replaced neutral words (NNR) versus reward ones (RNR). Then, to score selective attention biases, we subtracted RNR scores from NNR scores, such that higher numbers indicated a greater tendency to selectively attend to reward words. We refer to such scores as REWBIAS scores.

Mood Effects on Selective Attention

We hypothesized that positive mood states, but not negative ones, would predict REWBIAS scores. To examine these predictions, positive and negative mood scores were entered into a linear regression as simultaneous predictors of REWBIAS scores. As predicted, positive daily mood was a significant predictor of REWBIAS scores, $\beta = .27$, $SD = .003$, $t(94) = 2.63$, $p < .01$, whereas negative daily mood was not, $\beta = .01$, $SD = .005$, $p > .90$.

Discussion

The results of Study 1 provide initial support for the hypothesis that positive mood states bias selective spatial attention in favor of rewarding stimuli. More important, such relations were specific to positive mood states, in that negative mood states did not predict such bias scores. The advantage of the Study 1 design is that it ensures that the findings are relevant to everyday, naturalistic experiences of mood (Rusting, 2001). The remaining studies, however, sought to provide causal evidence for our predictions.

STUDY 2

In Study 2, we tested several hypotheses. First, we sought to show that positive mood exerts a causal effect on selective attention to rewarding information. Therefore, we randomly assigned participants to mood manipulation conditions. Second, we sought to show that positive mood directs attention to rewarding information rather than to valenced information more generally. Therefore, we examined attentional biases to both negative and rewarding stimuli. Third, we sought to show that positive mood states are unique in producing attentional biases to reward. Therefore, we included positive, neutral, and negative mood conditions.

Compared to participants in the neutral and negative mood conditions, we predicted that participants in the positive mood condition would exhibit an attentional bias to rewarding words, but not negative words. Concerning the question of whether mood condition would affect negative attentional biases, we were unsure. We manipulated sad mood states in Study 2, and such mood states have been shown to be inconsistent in the prediction of negative attentional biases (Williams et al., 1997). Regardless, the inclusion of negative-neutral stimulus pairs allowed us to make a case for the discriminant validity of our effects.

A final goal of Study 2 involved the time course of the hypothesized effects. It takes roughly 200 to 300 ms to make an attentional shift from one spatial target to another (Pashler, 1998; Posner & Peterson, 1990). The pair-exposure time used in Study 1 was 500 ms, meaning that the relevant effects could pertain to early fixations of attention or to biases subsequent to such early fixations. To gain insight concerning such issues, Study 2 presented both short (300 ms) and longer (900 ms) exposure durations. If the present effects are due to early fixations of attention, they should be exhibited in relation to *both* exposure durations.

Method

Participants

Participants were 85 undergraduate students at the University of Illinois, who received $7 for their participation.

Materials

Mood Induction. To induce positive or negative mood states, participants were asked to report on a happy or a sad event from their lives, respectively (Tamir, Robinson, & Clore, 2002). Participants in the positive or negative mood conditions were asked to recall a happy or sad event from their past and write about it for 10 minutes. Participants in the neutral mood condition were asked to describe the contents of their bedroom for 10 minutes.

The mood manipulation check in Study 2 was inadequate in that it occurred very late in the session. Therefore, to determine the extent to which the mood manipulation used in Study 2 influences mood states more proximate to the mood manipulation, we ran a pilot study. In the pilot study, participants (N = 87) were randomly assigned to one of the three conditions mentioned above. A few minutes after the mood manipulation, they reported on the extent to which they felt several positive feelings (e.g., *happy*, *enthusiastic*; α = .83) and several negative feelings (e.g., *sad, anxious*; α = .84).

As expected, participants in the positive condition reported significantly more intense positive mood (M = 2.91) compared with those in the neutral (M = 2.46) and negative (M = 1.99) mood conditions, $t(84) > 2$, ps < .05. On the other hand, participants in the negative mood condition reported significantly more negative mood (M = 2.57) compared with participants in the neutral (M = 1.78), $t(84) = 3.54$, $p < .05$, and positive (M = 1.78) mood conditions, $t(84) = 3.83$, $p < .05$. The pilot study thus confirms the effectiveness of the mood manipulation procedures used in Study 2.

Dot Probe Task. The probe task was similar to the one used in Study 1, with several changes. First, it included reward-neutral and negative-neutral word pairs. In addition to the reward and neutral words used in the dot probe task in Study 1, eight negative words were included (see appendix). Reward words (M = 8.07) were rated as more pleasant than neutral words (M = 5.42), which were rated as more pleasant than negative words (M = 2.29). These differences were confirmed in t tests contrasting each word valence category with each other word valence category, ts > 10, ps < .001. All words were equivalent in length and frequency, Fs < 2. The task included 52 word pairs of each type.

Second, to examine the potential time course of the positive attentional bias, we varied the exposure time of the word pairs on a randomized trial-to-trial basis. On half of the trials, word pairs were presented for 300 ms; on the other half, word pairs were presented for 900 ms. Participants were asked to respond to each spatial probe (1 = left, 9 = right) when it appeared.

Procedure

After giving informed consent, participants were randomly assigned to mood condition. All mood groups were told that the study concerns the link between memories and cognitive performance. The positive and negative mood groups were further told that because autobiographical memories are often related to emotions, they might be asked to recall emotional memories. The neutral mood group was told that autobiographical memories are often neutral in nature and that they would be asked to recall memories of this type. Following such general instructions, participants wrote about their autobiographical event, whether positive, neutral, or negative. They then completed the dot probe task.

Results

Scoring Selective Attention Biases

Accuracy rates for all conditions were very high, averaging 97%. We computed RT scores following the procedure described in Study 1. To create REWBIAS scores, we subtracted RNR scores from NNR scores. To create NEGBIAS scores, we performed a parallel analysis in relation to neutral-negative pairs. Higher NEGBIAS scores represent selective biases favoring negative, relative to neutral, words in neutral-negative pairs. These procedures were performed separately for each exposure duration, resulting in four bias scores particular to REWBIAS at the short duration (REWBIAS3), REWBIAS at the long duration (REWBIAS9), NEGBIAS at the short duration (NEGBIAS3), and NEGBIAS at the long duration (NEGBIAS9).

Mood Effects on Selective Attention

To examine effects of mood condition on selective attention, we conducted a repeated-measures ANOVA to test the full 3 (Mood Condition: Positive, Neutral, Negative) × 2 (Valence Bias: REWBIAS vs. NEGBIAS) × 2 (Exposure Duration: 300 ms vs. 900 ms) model, in which Mood Condition was a three-level between-subjects variable, and Valence Bias and Exposure Duration were two-level within-subject variables. This analysis resulted in a main effect for Mood Condition, $F(1, 82) = 4.53$, $p < .05$, but this main effect was qualified by the predicted Mood Condition × Valence Bias interaction, $F(2, 82) = 3.63$, $p < .05$. No other effects were significant, *F*s < 1. Figure 1 shows means and standard errors for REWBIAS and NEGBIAS scores for each mood condition, averaged across exposure durations. For ease of interpretation, bias scores are presented in millisecond values. As shown in the figure, the highest

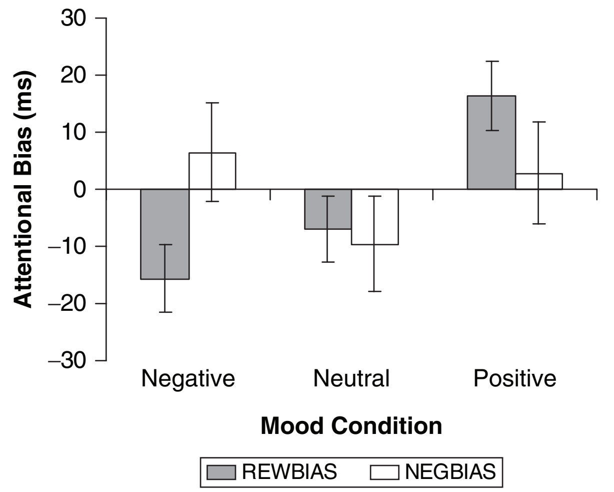

Figure 1 Attentional selectivity to reward (REWBIAS) and negative (NEGBIAS) words as a function of Mood Condition, Study 2.
NOTE: Error bars represent one standard error of the mean.

REWBIAS scores were observed in the positive mood condition, as hypothesized.

To further explore the nature of the interaction, we performed separate one-way ANOVAs for REWBIAS and NEGBIAS scores considered separately. There was a main effect of Mood Condition for REWBIAS scores, $F(1, 82) = 8.40$, $p < .001$, but not for NEGBIAS scores, $F < 1$. Thus, mood states, as manipulated in Study 2, affected selective attention in relation to rewarding stimuli but not negative stimuli. To further explore mood effects on REWBIAS scores, we ran pairwise comparisons contrasting each mood condition with each other one. As predicted, the comparison between the positive and neutral mood conditions was significant, $F(1, 55) = 10.31$, $p < .005$, as was the comparison between the positive and negative mood conditions, $F(1, 53) = 15.05$, $p < .001$. The negative and neutral mood conditions did not significantly differ from one another, $F < 1$. These analyses indicate that the positive attentional bias was specific to the positive mood condition.

Discussion

Consistent with the pattern in Study 1, positive (vs. neutral or negative) mood states led participants to selectively attend to rewarding information in the dot probe task. The findings also demonstrate that positive mood states bias attention to rewarding information, rather than to valenced information more generally. Such attentional biases were demonstrated with shorter and longer stimulus exposure times, suggesting that the effect appears to involve early orienting processes (Pashler, 1998; Posner & Peterson, 1990).

STUDY 3

Study 2 results indicated no main effect of mood condition on negative attentional biases. We attribute this null effect to the induction of sad mood states in Study 2, which have been inconsistently linked to negative attention-related biases in previous studies (Williams et al., 1997). Study 3, therefore, manipulated anxious mood states instead. We predicted that positive mood states would bias attention toward rewarding (but not negative) stimuli and that anxious mood states would bias attention toward negative (but not rewarding) stimuli. Such a dissociation, if it occurred, would offer further support for our mood-attention model.

Method

Participants

Participants were 68 undergraduate students at the University of Illinois, who participated in return for partial credit toward a course requirement.

Materials

Mood Induction. We manipulated mood states by using guided imaginary vignettes, following Larsen and Ketelaar (1991). Participants in the positive condition were asked to imagine themselves at a big celebration following their success in an important competition. Specifically, they were asked to imagine themselves waiting to hear the results of a competition they have participated in that is very important to them, hearing that they won the first prize, participating in the award ceremony, and then going out with friends and family to celebrate the occasion. Participants in the negative condition were asked to imagine themselves trying to cram for an important and very difficult exam the night before the test. Specifically, they were asked to imagine themselves in the midst of Finals week, trying to study for a critical exam, discovering that they did not go over a big chunk of the material, and that they are likely going to fail the exam. We used these manipulations because they should produce positive and negative mood states that are somewhat equivalent in their level of arousal.

Dot Probe Task. The dot probe task involved 10 reward words, 10 negative words, and 20 neutral words (see appendix). As in previous studies, reward words were rated as more pleasant (M = 8.13) than neutral words (M = 5.43), which were rated as more pleasant than negative words (M = 2.14), ps < .01. Words were equated for length and frequency, Fs < 2. Words were randomly paired with the constraint that there were 40 reward-neutral and 40 negative-neutral pairs. Each pair was repeated three times, for a total of 240 trials. The exposure duration was 700 ms.

Mood Scale. Participants rated their current mood state following the induction. Positive mood was measured by averaging across the items *euphoric, elated,* and *enthusiastic* (α = .91). Negative mood was measured by averaging across the items *fearful, anxious,* and *nervous* (α = .83).

Procedure

To mask the purpose of the mood manipulation, participants were told that the study concerned memory and cognitive performance. They were then asked to listen to a story on a tape player. They were instructed to "get into the feeling" of the story to remember it for a later recall test. Participants then listened to a detailed description of the mood-inducing situation on a tape player for approximately 7 minutes and then rated their mood and completed the dot probe task.

Results

Mood Manipulation Check

To examine whether the mood conditions affected mood states, Mood Condition was entered as a predictor of positive and negative mood ratings in two separate one-way ANOVAs. As expected, participants reported more intense positive feelings in the positive (M = 2.73) compared with the negative (M = 1.78) mood condition, $F(1, 67) = 24.48$, $p < .001$. Participants also reported more intense negative feelings in the negative (M = 2.30) compared with the positive (M = 1.53) mood condition, $F(1, 67) = 18.81$, $p < .001$. These findings indicate that our mood manipulations were successful.

Mood Effects on Selective Attention

Accuracy rates averaged 98%. Selectivity scores related to rewarding, and negative stimuli were calculated as in Study 2, with the exception that there was only one exposure duration in Study 3. We predicted that participants in the positive mood condition would be faster to respond to the probe when it replaced a reward (vs. neutral) word (i.e., REWBIAS scores). Although less relevant to our main hypothesis, we also predicted that participants in the negative mood condition would be faster to respond to the probe when it replaced a negative (vs. neutral) word (i.e., NEGBIAS scores).

We ran a repeated-measures ANOVA to examine the effects of the 2 (Mood Condition: Positive vs. Negative) × 2 (Valence: REWBIAS vs. NEGBIAS) design, with Mood

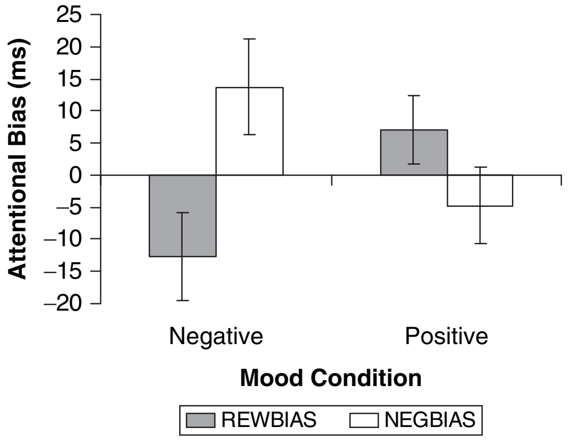

Figure 2 Attentional selectivity to reward (REWBIAS) and negative (NEGBIAS) words as a function of Mood Condition, Study 3.
NOTE: Error bars represent one standard error of the mean.

Condition as a two-level between-subjects variable and Valence as a two-level within-subject variable. As predicted, there was a significant Mood Condition × Valence Bias interaction, $F(1, 66) = 6.93$, $p < .05$. Figure 2 displays REWBIAS and NEGBIAS scores (in ms, for ease of interpretation) as a function of mood condition. As shown in the figure, positive attention-related biases were higher among participants in the positive mood condition, whereas negative attention-related biases were higher among participants in the negative mood condition.

We conducted follow-up ANOVAs focusing on the effects of mood condition on REWBIAS and NEGBIAS scores considered separately. There was a significant effect of Mood Condition on REWBIAS scores, $F(1, 67) = 5.72$, $p < .05$, such that participants in the positive mood condition exhibited higher REWBIAS scores. There was a marginal effect of Mood Condition on NEGBIAS scores, $F(1, 67) = 3.42$, $p = .07$, such that participants in the negative mood condition tended to exhibit higher NEGBIAS scores. The results, overall, demonstrate that positive, but not negative, mood states bias attention toward reward.

Discussion

Study 3 replicated Studies 1 and 2 by showing that positive mood states biased attention toward reward (vs. neutral) words within the probe task. As predicted, the results of Study 3 also provided further support for the discriminant validity of our findings. First, the results demonstrate that positive mood states bias attention to positive but not negative information. Second, consistent with the findings in Study 2, the results demonstrate that attention to reward is driven by positive mood states exclusively, and not by sad or anxious states.

STUDY 4

Study 4 was designed to extend the results of Studies 1-3 by exploring the specificity of the positive attentional bias. We have suggested that positive mood states sensitize individuals to rewards in the environment. However, not all pleasant stimuli are rewarding. For example, stimuli related to comfort or safety may be pleasant, but not linked to the high arousal characteristic of the reward-seeking or approach-motivated system (Carver, 2001). Briefly, holding valence constant, the more arousing the stimulus, the more likely it is to trigger the relevant motivation system (Cuthbert, Bradley, & Lang, 1996). Following this distinction, Study 4 sought to examine attentional biases related to both positive-high arousal (i.e., rewarding) and positive-low arousal (i.e., pleasant, nonrewarding) stimuli. Based on the theoretical and empirical link between positive affect and approach motivation and behavior (Watson et al., 1999), it was predicted that the selectivity effects of positive mood states might be specific to positive-high arousal stimuli.

Method

Participants

Participants were 43 volunteers from the University of Illinois, who were paid $8 for their participation.

Materials

Mood Induction. We induced a positive mood state through the use of the same vignette situation used in Study 3. To induce a neutral mood state, we created a new audiotape in which individuals imagined themselves sleeping in on a Saturday morning, reading the morning newspaper, and making plans for the rest of the day. Both tapes lasted 7 minutes.

Dot Probe Task. We selected 8 stimulus words that were positive and high in arousal, 8 words that were positive and low in arousal, and 48 words that were neutral (see appendix). Based on valenced norms (Bradley & Lang, 1999) and relevant *t* tests, the positive high-arousal ($M = 7.56$) and positive low-arousal ($M = 7.36$) words were equally pleasant, and both sets of words were more pleasant than the neutral words ($M = 5.21$), ps < .001. Positive high-arousal words ($M = 7.14$) were also higher in arousal than either positive low-arousal ($M = 3.66$) or neutral ($M = 3.97$) words, ps < .001. All three categories of words were equivalent in word length and frequency, Fs < 2.9. Stimuli from the word categories were randomly paired, subject to the constraint that there were 50 unique pairs of each of the two pair types (i.e., neutral high-arousal positive and neutral low-arousal positive). The dot probe task consisted of 100 trials involving word pair exposure times of 600 ms.

Mood Scale. Participants rated the extent to which they felt positive feelings (e.g., *happy*, *enthusiastic*) and negative feelings (e.g., *sad*, *anxious*) on a scale of 1 (*very slightly to not at all*) to 5 (*extremely*). We computed separate positive mood ($\alpha = .83$) and negative mood ($\alpha = .67$) scores by averaging across ratings of negative and positive mood items, respectively.

Procedure

The procedure was identical to that of Study 3.

Results

Mood Manipulation Check

To examine whether our mood manipulation was effective, we ran two one-way ANOVAs, in which mood condition was the predictor of either positive or negative mood states. As predicted, the effect of mood condition on positive mood states was significant, $F(1, 44) = 10.89$, $p < .005$, with participants in the positive mood condition reporting greater positive feelings ($M = 3.37$) compared with those in the neutral mood condition ($M = 2.74$). On the other hand, mood conditions did not differ significantly in negative mood (Ms = 1.34 and 1.56 in the positive and neutral conditions, respectively), $F(1, 44) = 3.0$, $p > .05$.

Mood Effects on Selective Attention

Accuracy rates were high, averaging 99% overall. Scores were computed as in prior studies, separately for the two types of positive word pairs. For the sake of brevity, we refer to REWBIAS and PLEASBIAS scores to reflect attentional selectivity in favor of positive high-arousal words (REWBIAS), and positive low-arousal words (PLEASBIAS). To examine whether mood condition affected these two types of positive selectivity biases, we ran a repeated-measures ANOVA involving the variables of mood condition (positive vs. neutral) and bias type (REWBIAS vs. PLEASBIAS). As predicted, there was a significant Mood Condition × Bias Type interaction, $F(1, 43) = 5.78$, $p < .05$. No other effects were significant, Fs < 1.

To further test whether the effects were specific to rewarding (i.e., positive high-arousal) words, we performed separate one-way ANOVAs on REWBIAS and PLEASBIAS scores, each considered separately. The first ANOVA revealed that REWBIAS scores were higher in the positive ($M = 9.32$ ms) compared with the neutral mood condition ($M = -6.37$ ms), replicating prior studies, $F(1, 44) = 4.84$, $p < .05$. By contrast, Mood Condition had no effect on PLEASBIAS scores, $F < 2.1$, $p > .14$. The effects of manipulated positive mood, therefore, appear to be specific to biases favoring rewarding stimuli rather than biases favoring positive stimuli of a low arousal type.

Discussion

One useful way to conceptualize the distinction between positive high-arousal and positive low-arousal stimuli is to refer to the distinction between *wanting* and *liking* (Berridge & Robinson, 1998). A positive stimulus that is wanted is one that excites the dopaminergic systems responsible for approach behavior. By contrast, a positive stimulus that is merely liked is one that does not excite such dopaminergic systems but nevertheless produces pleasure when encountered (Berridge & Robinson, 1998). It was on the basis of these ideas that we sought to systematically contrast attentional biases involving positive high-arousal and positive low-arousal words in Study 4.

As hypothesized, manipulated positive mood biased attention toward positive high-arousal, but not positive low-arousal, stimuli. These results extend the findings in Studies 1-3, in which we used primarily positive high-arousal (i.e., rewarding) stimuli (see appendix). The findings of Study 4 are consistent with the idea that positive mood states sensitize individuals to rewarding stimuli rather than positive stimuli more broadly construed. This distinction between two types of positive stimuli was further explored in Study 5.

STUDY 5

Study 5 was designed to test two hypotheses. First, we sought to replicate the findings of Study 4, by showing that positive mood states bias attention toward rewarding stimuli in particular rather than pleasant stimuli more generally. Second, we sought to demonstrate that the findings reported in Studies 2-4 are due to emotional experience rather than semantic priming effects related to the induction methods. In this connection, the induction methods in the prior manipulation studies relied on verbal material. In contrast, Study 5 used a music manipulation. Because the music selections had no lyrics or words, they should induce mood states in a manner that is not dependent on priming verbal material (Niedenthal & Halberstadt, 2000). Therefore, replication in this context would suggest that mood states per se are responsible for the biasing effects of positive mood states on attention to rewarding stimuli.

Method

Participants

Participants were 74 volunteers from the University of Illinois, who were paid $8 for their participation.

Materials

Mood Induction. To induce a positive mood state, participants listened to recordings of allegros from *Eine Kleine Nachtmusik* and Divertimento No. 136 by Mozart. To induce a neutral mood state, participants listened to a recording of John Adam's *Common Tunes in Simple Time*. These musical pieces have been used in prior research to induce positive and neutral mood, respectively (Niedenthal & Halberstadt, 2000; Niedenthal, Setterlund, & Jones, 1994).

Dot Probe Task. We selected four stimulus words that were positive and high in arousal, four words that were positive and low in arousal, and 24 words that were neutral (see Appendix). As in Study 4, the positive/high-arousal (M = 8.14) and positive/low-arousal (M = 8.01) words were equally pleasant, and both sets of words were more pleasant than the neutral words (M = 5.34), ps < .001. Positive high-arousal words (M = 6.11) were also higher in arousal than either positive low-arousal (M = 5.10) or neutral (M = 3.74) words, ps < .001. All three categories of words were statistically equal in word length and frequency, Fs < 1.50. The task included 100 trials, 50 involving positive low-arousal words and 50 involving positive high-arousal words. Word pairs were presented for 700 ms.

Mood Scale. Participants rated their current mood state (1 = *very slightly to not at all*, 5 = *extremely*). Positive mood was measured by ratings of *happy*, *excited*, *relaxed*, *up*, *good mood*, *elated*, *enthusiastic*, and *pleased* (α = .86). Negative mood was measured by ratings of *sad*, *down, bored*, *anxious, dull*, *frustrated*, *bad mood*, and *depressed* (α = .82).

Procedure

To mask the purpose of the mood manipulation, participants were told the study examined the relationship between music and cognitive processing (Niedenthal & Halberstadt, 2000). Participants were randomly assigned to either the positive or the neutral mood condition. They were given a tape player and a set of headphones and instructed to listen to the music until they were told otherwise. Following the procedure described in Niedenthal and Halberstadt (2000), participants listened to the music for 8 minutes and then continued listening to it while completing the dot probe task. Participants then stopped listening to the music and rated their current mood states.

Results

Mood Manipulation Check

To examine the effect of the mood manipulation on self-reported mood, we entered Mood Condition as the predictor in two one-way ANOVAs, with positive and negative mood ratings as the predicted outcomes. As desired, participants in the positive mood condition reported significantly greater positive feelings (M = 3.00) compared with participants in the neutral mood condition (M = 2.56), $F(1, 73) = 5.18$, $p < .01$. The conditions did not differ in terms of negative feelings (Ms = 1.63 and 1.87 in the positive and neutral mood conditions, respectively), $F < 2.2$, $p > .13$.

Effects on Selective Attention

Accuracy rates averaged 99%. Scores were computed as in Study 4, resulting in separate attentional bias scores for reward words (REWBIAS) and pleasant words (PLEASBIAS). To test the effects of mood condition on these selectivity biases, we ran a repeated-measures ANOVA with Mood Condition (positive vs. neutral) as the between-subjects predictor and Bias Type (REWBIAS vs. PLEASBIAS) as the within-subject variable. As hypothesized, there was a significant Mood Condition × Bias Type interaction, $F(1, 73) = 5.59$, $p < .05$. Follow-up ANOVAs supported our predictions by showing that participants in the positive (vs. neutral) mood condition exhibited greater REWBIAS scores, $F(1, 73) = 12.38$, $p < .005$, but that there were no differences with respect to PLEASBIAS scores, $F < 1$. Millisecond REWBIAS scores were 13.68 in the positive mood condition and –22.30 in the neutral mood condition.

Discussion

Because we used a music induction in Study 5, and the relevant music had no lyrics or words, Study 5 was important in suggesting that the attentional biases induced by positive mood appear to be reflective of mood states rather than semantic priming effects. In addition, the findings from Study 5 confirm those from Study 4 in showing that the biasing effects of positive mood states appear to be somewhat particular to rewarding stimuli rather than pleasant stimuli more generally considered (for related data and a theoretical account, see Mogg & Bradley, 1998).

GENERAL DISCUSSION

Phrases such as "What you see is what you get!" suggest an important role for selective attention processes in goal-directed pursuit and relevant outcomes. To the extent that affect signals the motivational significance of objects, it should be able to bias early information processing in favor of affect-relevant stimuli (Kitayama & Niedenthal, 1994). In the selective-attention literature, such effects have been linked to anxiety-related states and relevant clinical disorders (MacLeod, 1999).

Our intuition was that positive mood states, too, would play an important role in determining which stimuli capture and hold attention. In five studies, we found that both daily (Study 1) and manipulated (Studies 2-5) positive mood states influence selective attention in a manner consistent with the prioritization of potentially rewarding stimuli. Such effects were unique to positive mood states, compared with both neutral (Studies 1, 2, 4, 5) and negative (Studies 1-3) mood states. Such effects were also unique to rewarding stimuli compared to neutral and negative stimuli (Studies 1-3) and to rewarding relative to pleasant stimuli more broadly considered (Studies 4-5). The effect of positive mood on selective attention was found following different types of mood induction procedures (i.e., autobiographical recall, guided imagery, and music), using different word stimuli and multiple exposure durations, ranging from 300 ms to 900 ms. In total, the results support the hypothesis that positive mood states bias selective attention in favor of rewarding stimuli.

Theoretical Implications

Our theoretical predictions were based on the informative functions of affect (Clore, Gasper, & Garvin, 2001; Schwarz & Clore, 1983) and on the role of selective attention in alerting individuals to goal-related objects in the environment (Fiske, 1995). Because negative mood states (e.g., anxiety) signal undesirable outcomes, they have been shown to bias selective attention toward threatening stimuli (Mogg & Bradley, 1998; Williams et al., 1997). The present studies were unique because they demonstrate that attentional biases are not limited to negative mood states. Instead, positive mood states also bias selective attention. This is an important theoretical contribution in light of suggestions that positive mood states may function in a very different manner than negative mood states (Fredrickson, 1998), in that only the latter may be associated with automatic selective attention biases (Öhman, 1997; Robinson, 1998). Because our results suggest that this is not so, they encourage further work on the effects of positive mood on early cognitive processing operations.

Our findings also support approach-related frameworks of positive affect (Carver, 2001; Watson et al., 1999) by demonstrating that manipulated positive mood states predict selective attention to rewarding stimuli specifically rather than positive stimuli more generally considered (in Studies 4-5). These effects, which were replicated across two studies, imply that reward-based frameworks of positive affect (e.g., Berridge & Robinson, 1998), relative to more general valence-based models (e.g., Bower, 1981), may better capture the cognitive processing effects linked to positive affect (Depue & Collins, 1999; Lucas & Diener, 2001; Watson et al., 1999). Thus, it may be useful, in future studies, to focus on the appetitive cognitive consequences of positive mood states somewhat specifically (Berridge & Robinson, 1998).

Future Directions

Our findings are novel in demonstrating that positive mood states selectively direct visual attention toward rewarding information in the environment. However, they also pose important questions for future research. First, our investigation focused on the role of positive mood states in biasing selective attention. To what extent do positive and negative mood states exert separable effects on selective attention to positive and negative information? The results of Studies 2 and 3 were relatively conclusive in suggesting that positive mood states are associated with selective biases favoring rewarding stimuli. However, the results involving the induction of negative mood states were weaker in nature. Therefore, we suggest that future research explores the parallel effects of positive and negative mood states on selective attention to threats and rewards.

Second, to what extent are the current attentional biases involuntary? Whereas intensive attention is intentional, selective attention presumably occurs without conscious planning (Matthews & Wells, 1999). Selective attention, however, can vary in the degree to which it involves executive resources (Posner & Raichle, 1994). To examine whether the attentional biases reported here were involuntary, we manipulated exposure duration in Study 2. The positive attentional bias was replicated across both relatively long (900 ms) and short (300 ms) exposure durations. Assuming exposures below 500 ms do not involve voluntary allocation (Mogg & Bradley, 1998), our results suggest that the obtained effects may be involuntary. However, such conclusions seem to require further replication with even shorter, and perhaps subliminal, exposure durations (Mogg, Bradley, Williams, & Mathews, 1993).

Broader Implications

Finally, what are the implications of the current attentional biases in the real world? We believe that by biasing attention to desirable information, positive affect may actively contribute to the successful pursuit of desirable goals. There are several ways in which attentional biases might play a role in approach-related self-regulation. First, the likelihood of achieving rewards is probably enhanced by the ability to notice them in the environment. Because selective attention facilitates the processing of attended information (Posner, 1978), people who are fast to attend to rewards may also be faster to act in such a way as to be more successful in obtaining them.

Second, attentional biases related to rewarding information may serve to maintain or even intensify existing positive mood states. Indeed, attentional processes appear to play a role in the regulation of emotional states (Compton, 2000; Rueda, Posner, & Rothbart, 2004). Prior research has suggested that attentional allocation related to threats plays a causal role in the experience of anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Similarly, attentional biases related to rewarding information could serve to maintain positive mood states. The present findings advocate these future directions by demonstrating that positive mood states direct early selective attention toward rewarding stimuli.

APPENDIX

WORDS USED IN THE SPATIAL PROBE TASKS IN STUDIES 1-5

Study	*Words*
1	*Reward:* reward, victory, success, fun, happiness, pleasure, praise, love
	Neutral: document, situation, moment, history, pencil, sound, table, plate, theory, square, apartment, method
2	*Reward:* reward, victory, success, fun, happiness, pleasure, praise, love
	Neutral: document, situation, moment, history, pencil, sound, table, plate, theory, square, apartment, method
	Negative: punishment, enemies, pain, rejection, insult, conflict, misery, failure
3	*Reward:* admired, cheerful, happy, fame, affection, kiss, fun, passion, sexy, success
	Neutral: Basket, engine, theory, industry, street, circle, method, lamp, chair, window, history, pencil, table, moment, plant, fabric, elbow, wagon, custom, museum
	Negative: abuse, agony, assault, cancer, danger, horror, disaster, pain, mutilate, violence
4	*Reward:* sexy, kiss, passion, ski jump, erotic, desire, holiday, adventure
	Neutral: stove, truck, avenue, barrel, basket, circle, column, cork, corridor, curtains, elbow, elevator, engine, egg, fabric, fork, glacier, golfer, hairpin, cabinet, journal, kettle, lamp, metal, museum, paint, pencil, phase, poster, sphere, spray, statue, taxi, tool, tower, truck, umbrella, vest, wagon, yellow, contents, glass, icebox, iron, stomach, storm, tank
	Pleasant: comfort, carefree, warm, cozy, secure, gentle, safe, wise
5	*Reward:* pleasure, love, gifts, success
	Neutral: geology, event, hall, land, plant, chair, fabric, board, elbow, symbol, collection, metal, land, green, circle, couch, string, situation, square, afternoon, ankle, clock, sauce, stone
	Pleasant: enjoyment, friendship, delight, reward

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