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The Effect of Low Versus High Approach-Motivated Positive Affect on Memory for Peripherally Versus Centrally Presented Information

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Emotions influence attention and processes involved in memory. Although some research has suggested that positive affect categorically influences these processes differently than neutral affect, recent research suggests that motivational intensity of positive affective states influences these processes. The present experiments examined memory for centrally or peripherally presented information after the evocation of approach-motivated positive affect. Experiment 1 found that, relative to neutral conditions, pregoal, approach-motivated positive affect (caused by a monetary incentives task) enhanced memory for centrally presented information, whereas postgoal, low approach-motivated positive affect enhanced memory for peripherally presented information. Experiment 2 found that, relative to a neutral condition, high approach-motivated positive affect (caused by appetitive pictures) enhanced memory for centrally presented information but hindered memory for peripheral information. These results suggest a more complex relationship between positive affect and memory processes and highlight the importance of considering the motivational intensity of positive affects in cognitive processes.

Keywords: emotions, positive affect, memory, approach motivation, central versus peripheral presentation

Emotions influence attention and processes involved in the formation, retrieval, and distortion of memories (Brown & Kulik, 1977; Kensinger, 2009a). Although some research has suggested that positive affect categorically influences these processes differently than neutral affect (Kensinger, 2009a), recent research suggests that motivational intensity of positive affective states may influences these processes. For example, positive affects low in approach motivational intensity broaden attentional scope (Fredrickson & Brannigan, 2005; Gable & Harmon-Jones, 2008a), whereas positive affects high in approach motivational intensity narrow attentional scope (Gable & Harmon-Jones, 2008a; Harmon-Jones & Gable, 2009). These results suggest that positive affects of differing motivational intensity levels may have different influences on memory, an idea that has been recently proposed but not yet directly tested (Kensinger, 2009b; Larson & Steuer, 2009; Levine & Edelstein, 2009). The present research provides an initial test of this idea.

Approach-Motivational Intensity Levels Within Positive Affects

Positive affects vary in motivational intensity. Some positive affective states are low in approach motivation (serenity), whereas others are higher in approach motivation (desire). Positive affects high in approach motivation often occur in the pursuit of a goal (pregoal). In contrast, positive affects low in approach motivation occur after a goal has been achieved (postgoal) or when there is no goal (goal irrelevant). Neurobiological differences exist between pregoal and postgoal attainment positive affect in the prefrontal cortex, nucleus accumbens, and other structures (Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008; Knutson & Peterson, 2005; Knutson & Wimmer, 2007).

Approach-motivated positive affective states may be associated with narrowed attention and memories to assist organisms by shutting out irrelevant perceptions and cognitions while they approach and attempt to acquire desired objects (Gable & Harmon-Jones, 2008a; Harmon-Jones & Gable, 2008). Broad attention and memory for peripheral information might cause distraction and hinder acquisition of desired goals, but such cognitive states may be adaptive after goal acquisition. Positive affective states low in approach motivation increase attentional broadening and enhance memory for peripherally presented information because such states suggest that things are going better than necessary, coasting can occur, and the mind is open to unforeseen opportunities (Carver, 2003).

Research Examining Attentional Consequences of Positive Affects Varying in Motivation

Broadening versus narrowing of attention as a function of differing positive affective states has been examined in experiments using global-local visual bias tasks. In these tasks, individuals are presented with visual stimuli that could be viewed in a local (narrow) manner or a global (broad) manner. Low approach-motivated positive affect (e.g., amusement) causes broadened attention (Fredrickson & Brannigan, 2005; Gable & Harmon-Jones, 2008a; Gasper & Clore, 2002), whereas high approach-motivated positive affect (e.g., desire) causes narrowed attention (Gable &

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Harmon-Jones, 2008a, in press-b; Harmon-Jones & Gable, 2009). Specifically, low approach-motivated positive affect (amusement) broadens attentional focus relative to high approach-motivated positive affect (desire; Gable & Harmon-Jones, 2008a, Study 1). In addition, trait behavioral approach sensitivity and experimental manipulations of positive approach motivation have been found to predict attentional narrowing after appetitive stimuli (Gable & Harmon-Jones, 2008a, Studies 3–4). Neural activations involved in approach motivation—relative left frontal cortical activity—are associated with more narrowed attention after appetitive stimuli (Gable & Harmon-Jones, in press-b; Harmon-Jones & Gable, 2009).

The Present Experiments

On the basis of the aforementioned findings, we predicted that positive affects of varying levels of approach motivational intensity would differentially affect memory for centrally versus peripherally presented information. Specifically, high approach-motivated positive affect, as compared with a neutral state or low approach-motivated positive state, should cause better memory for centrally presented information. In contrast, low approach-motivated positive affect, as compared with a neutral state or high approach-motivated positive state, should cause better memory for peripherally presented information. In this initial examination of the effects of different positive affects on memory, the physical location of stimuli was varied to be central or peripheral. Across all affective states, centrally presented information may be better remembered than peripherally presented information; our predictions are focused on testing the differences between affective states on peripherally (or centrally) presented information.

Experiment 1

Low and high approach-motivated positive affects were manipulated with the monetary incentive delay paradigm, which has been used in other experiments to create low versus high approach-motivated positive affect or pre- versus postgoal positive affective states (Knutson, Westdorp, Kaiser, & Hommer, 2000; Knutson & Wimmer, 2007). In this paradigm, cues indicating the possibility of gaining money for subsequent task performance are used to evoke pregoal (high approach) positive affect. Different cues indicating the outcome of the task performance (i.e., whether a reward was obtained) are used to evoke postgoal (low approach) positive affect. Experiments using this task have found that pregoal positive cues indicating the possibility of gaining money activate anticipatory reward circuitry such as the nucleus accumbens. In contrast, postgoal positive cues indicating monetary gain activate the mesial prefrontal cortex (Knutson, Fong, Bennett, Adams, & Hommer, 2003). Furthermore, participants report greater positivity and arousal during pregoal anticipated monetary gain and greater positivity, but not arousal, after postgoal monetary gain (Knutson & Wimmer, 2007; Nielsen, Knutson, & Carstensen, 2008). We predicted that high approach-motivated (pregoal) positive affect would cause better memory for centrally presented information, whereas low approach-motivated (postgoal) positive affect would cause better memory for peripherally presented information.

Method

Twenty-seven introductory psychology students participated for course credit. Participants were informed that they had the chance to win a monetary prize of $10. Twelve practice trials were included at the beginning of the game.

Each trial (n = 120; see Figure 1) began with a white circle or square presented in the center of the computer monitor. Half of the participants were told that the circles were reward cues indicating that they could gain money on the trial on the basis of their reaction times, and the squares were neutral cues indicating that they could not gain money on the trial; the meaning of cues was reversed for the other half of the participants. Half the trials were reward trials and half the trials were neutral trials.

After 40 pregoal cues, a word was presented in a central or peripheral location on the monitor. Central words (n = 20) were presented in the center of the screen; peripheral words (n = 20) were presented in the center of one of four quadrants of the computer screen. Participants were told they would see words displayed but that these words were unrelated to the game. All words were neutral words from the Affective Norms of English Words (ANEW; Bradley & Lang, 1999).

Next, participants performed the goal-related task, which was a flanker task (Eriksen & Eriksen, 1974). Participants were instructed to indicate the direction of the center arrow by pressing buttons marked left or right as quickly and accurately as possible. Participants were told that if they correctly responded to the arrow

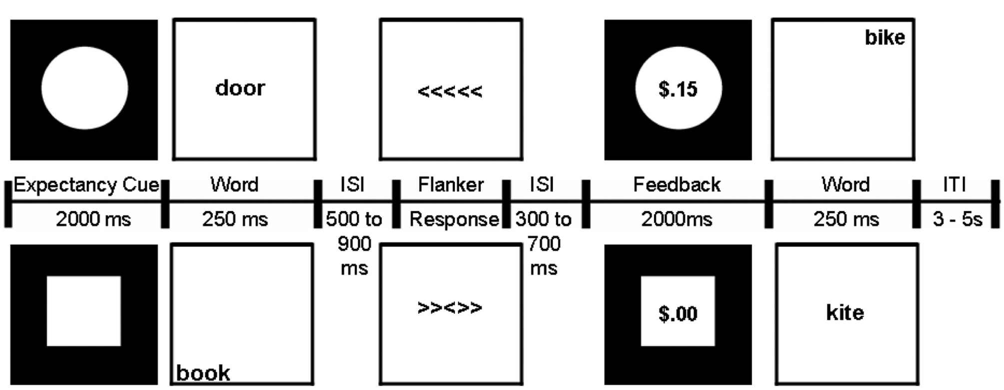

Figure 1. Experiment 1 example trials.

faster than the average college student, they would gain money on the trial, if the trial was a reward one.

After the flankers, participants received postgoal feedback. A white circle or square appeared with a monetary value displayed in the circle/square indicating the amount of money gained ($0.15 or $0.00). To give participants the expectancy that they could beat the average reaction time and gain money, we manipulated gain and nongain postgoal feedback. Two thirds of the trials with the expectancy of monetary gain resulted in gaining money. In contrast, on the nonreward trials, two thirds of the trials resulted in no gain. After 40 postgoal gain feedback cues and 40 postgoal no-gain feedback cues, another neutral word was presented centrally or peripherally. A total of 120 neutral words (40 pregoal and 80 postgoal) were presented.

One third of the reward expectancy trials resulted in no gain. This was done to give participants the impression that their efforts were resulting in achieving the reward as opposed to the game being fixed. Also, one third of the nonreward expectancy trials resulted in monetary gain, so we could examine whether such affected memory. Participants were instructed at the beginning of the game that gains on these trials were unrelated to their reaction time.

After all trials were presented, memory was measured. The old words (10 words in each of the 12 conditions; e.g., postgoal gain reward-expectancy centrally presented words) and 80 new neutral foil words were presented one at a time until participants responded whether they remembered seeing the word. Finally, participants were paid $10 and debriefed.

Results

A 2 (reward expectancy vs. nonreward expectancy) × 2 (word presentation: central vs. peripheral) × 3 (pregoal cue vs. postgoal gain feedback vs. postgoal no-gain feedback) analysis of variance (ANOVA) revealed a significant three-way interaction, $F(2, 50) = 5.09$, $p = .01$, $\eta_p^2 = .17$ (see Figure 2). This three-way interaction was unpacked by examining the 2 (reward expectancy) × 2 (word presentation) interaction within the pregoal cue, postgoal feedback, and postgoal no-gain feedback conditions.

In response to the pregoal cue, an interaction occurred, $F(1, 25) = 5.45$, $p = .03$, $\eta_p^2 = .18$. Centrally presented words after reward expectancy were recognized significantly more than centrally presented words after nonreward expectancy ($p = .0007$). Peripherally presented words after reward expectancy did not differ from peripherally presented words after nonreward expectancy ($p = .57$). Centrally presented words were recognized more than peripherally presented words for both trial types (ps $<$ .0001).

In response to the postgoal gain feedback, an interaction occurred, $F(1, 25) = 3.81$, $p = .06$, $\eta_p^2 = .13$. Peripherally presented words after reward gain were recognized significantly more than peripherally presented words after nonreward ($p = .01$). Centrally presented words after reward gain did not differ from centrally presented words after nonreward ($p = .93$). Centrally presented words were recognized more than peripherally presented words for both trial types (ps $< .004$).

As expected, within the postgoal no-gain feedback condition, the 2 (reward expectancy) × 2 (word presentation) interaction was not significant, $F(1, 25) = 0.59$, $p = .45$, $\eta_p^2 = .02$.

Discussion

As compared with a neutral state, a high approach-motivated (pregoal) positive state caused better memory for centrally presented stimuli. A low approach-motivated (postgoal) positive state, however, caused better memory for peripherally presented stimuli, as compared with a neutral state. This improved memory for peripheral information occurred only after participants were in a

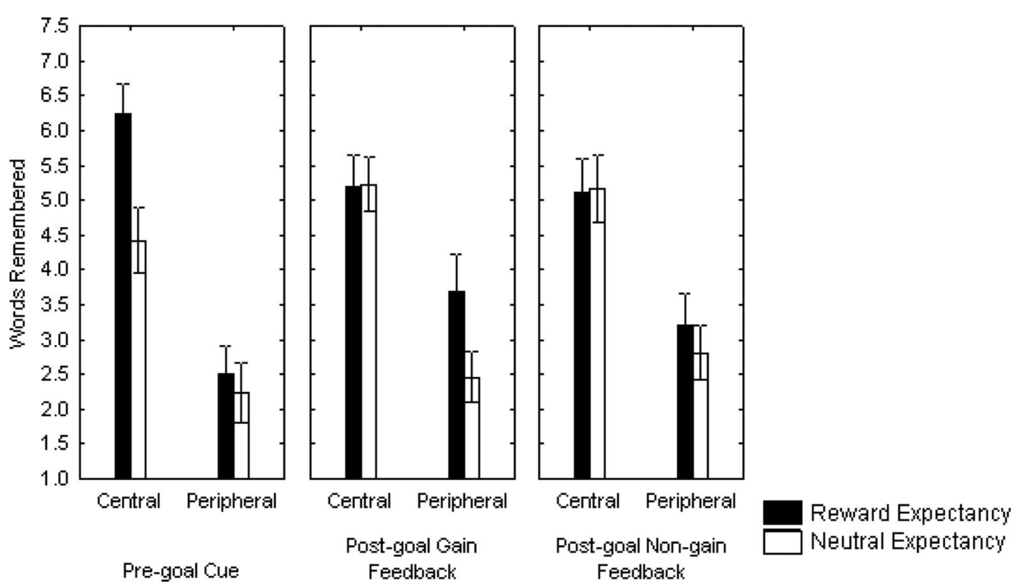

Figure 2. Recognition memory for the 2 (expectancy: reward, no reward) × 2 (word presentation: central, peripheral) × 3 (pregoal cue, postgoal gain feedback, postgoal no-gain feedback) interaction. For each bar, there were 10 words presented that could be recognized.

pregoal positive state; it did not occur to monetary gain when there was no expectancy for the gain.

The no-gain conditions produced no differences in central or peripheral memory. Failing to receive an expected reward has been shown to produce anger for some individuals but sadness for others (Crossman, Sullivan, Hitchcock, & Lewis, 2009). Anger, a high-approach negative affect (Harmon-Jones, Harmon-Jones, Abramson, & Peterson, 2009), likely produces a narrowing of attention and cognition, whereas sadness, a low-approach negative affect, produces a broadening of attention and cognition (Gable & Harmon-Jones, in press-a). These diverse emotional outcomes may have led to the lack of differences in the no-gain conditions.

Some of our results—postgoal positive affect causing better memory for peripheral information—are conceptually consistent with other findings (Berntsen, 2002; Storbeck & Clore, 2005; Talarico, Berntsen, & Rubin, 2008), if we assume that the past studies evoked positive affects that were low in approach motivation. This is likely the case. Storbeck and Clore (2005) used pleasant music, and Berntsen (2002) and Talarico et al. (2008) had participants recall pleasant memories. The affective states created by these manipulations are not associated with specific goal-directed action tendencies and unlikely to be associated with strong approach motivation.

The results of Experiment 1, particularly the enhanced central memory after the activation of approach-motivated positive affect, are novel. Thus, we thought it important to replicate the finding that pregoal positive affect causes better memory for centrally presented stimuli. We sought to conceptually replicate this effect using a different manipulation of approach-motivated positive affect.

Experiment 2

In Experiment 2, we used pictorial stimuli that have been found to reliably evoke approach-motivated positive affect (Gable & Harmon-Jones, 2008a, 2008b, in press-b; Harmon-Jones & Gable, 2009). We hypothesized that appetitive pictures would cause better memory for centrally presented stimuli than neutral pictures.

Method

Eighty-eight introductory psychology students participated. Four practice trials occurred at the beginning of the game. Each trial ($n = 120$) began with an appetitive (dessert, $n = 60$) or neutral (rock, $n = 60$) picture presented full screen on a 17-in. (43.18-cm) computer monitor (2 s), followed by an interstimulus interval (ISI) of 400–800 ms. After 20 of the appetitive and 20 of the neutral pictures, a neutral word was displayed for 250 ms in the center or periphery, as in Experiment 1. Next, the flanker task of Experiment 1 occurred. ITI varied between 3 and 5 s. Finally, memory for the words was measured, as in Experiment 1. Forty old words (10 in each of the four conditions) and 40 new neutral foil words were presented.

Results and Discussion

A 2 (picture type: appetitive vs. neutral) × 2 (word presentation: central vs. peripheral) ANOVA produced a significant interaction, $F(1, 87) = 24.17$, $p < .0001$, $\eta_p^2 = .22$. Centrally presented words after appetitive pictures ($M = 5.62$, $SD = 2.74$) were recognized significantly more than centrally presented words after neutral pictures ($M = 4.89$, $SD = 2.53$, $p < .0001$). In contrast, peripherally presented words after neutral cues ($M = 2.50$, $SD = 2.15$) were recognized significantly more than peripherally presented words after appetitive pictures ($M = 2.00$, $SD = 2.02$, $p = .006$). Centrally presented words were recognized more than peripherally presented words for both picture types, $p\text{s} < .0001$.

The results of Experiment 2 conceptually replicated the results of Experiment 1 with stimuli used that have been found to consistently evoke approach-motivated positive affect and narrowed attention. Appetitive, as compared with neutral, pictures caused better recognition of centrally presented words and worse recognition of peripherally presented words.

General Discussion

The present results indicate that approach-motivated positive affect enhances memory for centrally presented stimuli. In Experiment 1, approach-motivated positive affect was manipulated with an expectancy to win rewards, as in other research (Knutson et al., 2000; Knutson & Wimmer, 2007). In Experiment 2, approach-motivated positive affect was manipulated with appetitive pictures, as in other research (Gable & Harmon-Jones, 2008a, 2008b). Although different methods were used in the two experiments, both found improved memory for centrally presented information. These results agree conceptually with experiments showing that approach-motivated positive affect narrows attention (Gable & Harmon-Jones, 2008a; Harmon-Jones & Gable, 2009).

In contrast, postgoal, low approach-motivated positive affect enhanced memory for peripherally presented stimuli (in Experiment 1). This affective state was created through accomplishing the goal of winning rewards, as in other research (Knutson & Wimmer, 2007). This manipulation of low approach-motivated positive affect produced results conceptually consistent with past research that demonstrated that positive affect causes a broadening of memory (Berntsen, 2002; Storbeck & Clore, 2005; Talarico et al., 2008).

Of note is that the affective states in the present experiments affected memory for stimuli unrelated to the affective state. These results indicate that the memory consequences of high and low approach-motivated positive affects are general and not specifically tied to memory for the affective stimuli.

Is approach motivational intensity the best explanation for the present results? Might emotional intensity or arousal account for the effects? We suggest that approach motivational intensity provides a better explanation than emotional intensity or arousal. Regarding emotional intensity, past experiments on the attentional consequences of low- versus high-approach positive affect found that low- and high-approach positive affect evoked similar levels of self-reported happiness but differed on amusement (low approach) and desire (high approach; Gable & Harmon-Jones, 2008a). These results suggest that emotional intensity, as measured by self-reported emotional experience, cannot account for the attentional differences produced, which parallel the memory effects found here.

Regarding arousal, we view motivational intensity as being closely related to the arousal level of affective states (Bradley & Lang, 2007). However, arousal and motivation are not identical. In a recent experiment, the effect of general arousal on attentional narrowing was tested by having participants respond to an attentional bias task after appetitive and neutral pictures while undergoing stationary physical exercise. Although physical exercise heightened arousal as measured by heart rate, the increased arousal level did not cause narrowing of attention (Harmon-Jones, Gable, & Hobbs, 2009). In addition, some affective states, such as amusement, are high in arousal or a "higher activation state" (Fredrickson & Brannigan, 2005, p. 326), and these states cause attentional and memory broadening (Fredrickson & Brannigan, 2005; Gable & Harmon-Jones, 2008a; Talarico et al., 2008). We posit that these states are low in approach motivation because they were not associated with strong urges to act. Moreover, low- and high-approach positive affect differ in relative left frontal cortical activation, which is associated with approach motivational intensity (Harmon-Jones et al., 2008).

Finally, our conceptual model explains both the narrowing of attention and memory associated with high approach motivation and the broadening of attention and memory associated with low approach motivation. We are aware of no theories based on emotional intensity and arousal that would predict both narrowing and broadening.

The present research highlights the importance of incorporating motivation into studies on affect, an idea that has been called for in research on central and peripheral memory (Larson & Steuer, 2009; Levine & Edelstein, 2009).

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