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Attentional Consequences of Pregoal and Postgoal Positive Affects

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Decades of research have suggested that all positive affective states broaden attention. Recent studies have found that positive affects high in approach motivation narrow attention, whereas positive affects low in approach motivation broaden attention. However, these studies were limited because they used only affective pictures to manipulate positive affect. The pictures, rather than the affective states created by them, may have caused individuals to focus on the emotional details of the picture, and this attentional focus may have caused the narrowing of attentional scope. Moreover, no experiment has yet to examine both low and high approach-motivated positive affect within the same individuals in the same study. The current experiments manipulated pregoal (high approach) and postgoal (low approach) positive states by giving participants the opportunity to win money on a game. Results revealed that pregoal positive affect caused a narrowing of attention, whereas postgoal positive affect caused a broadening of attention.

Keywords: emotions, positive affect, attention, approach motivation, narrowing, broadening

For decades, scientists have theorized that positive and negative affective states have opposing consequences for attentional scope. Specifically, positive affective states cause broadening of attention, whereas negative affective states cause narrowing of attention (Easterbrook, 1959; Friedman & Förster, 2010; Isen, 2002). This emphasis on comparing positive and negative affects led Fredrickson (2001) to propose the broaden-and-build theory of positive emotions, which predicts that all positive emotions expand attention and cognition. This expansion or broadening of cognition and attention is predicated on the idea that all positive emotions suggest a stable and comfortable environment, and thus cause individuals to be more creative, more categorically inclusive, and more attentionally broad.[1]

Research has supported these predictions. Positive affect creates a broadening of cognitive processing in categorization (Isen & Daubman, 1984), unusualness of word association (Isen et al., 1985), social categorization (Isen et al., 1992), and recalling memory details (Talarico, Berntsen, Rubin, 2008). In these studies, positive affect was manipulated by having participants receive a gift (Isen & Daubman, 1984; Isen et al., 1992), watch a funny film (Isen et al., 1985; Isen et al., 1987), recall a pleasant memory (Murray, Sujan, Hirt, & Sujan, 1990), or remember a positive life event (Gasper & Clore, 2002; Talarico, Berntsen, Rubin, 2008).

Other research has tested the idea that positive affects broaden attentional scope. In 2005, Fredrickson and Brannigan measured the attentional broadening effects of discrete positive affects of amusement and contentment, which were evoked using film clips. Relative to neutral affective states, amusement and contentment broadened attentional scope. More recently, Rowe, Hirsh, and Anderson (2007) found positive moods, as compared with neutral moods, elicited by music resulted in broadened visual-spatial processing. Much research operates under the assumption that all positive affects expand attentional breadth.

Motivational Intensity in Affects

Previous research emphasizing the differences between positive and negative affective states focused on the valence dimension, but did not examine the underlying dimension of motivation. Affective states vary in motivational intensity. In the case of positive affects, some are low in approach motivation (e.g., feeling serene), and some are higher in approach motivation (e.g., feeling enthusiastic). Positive affective states high in approach motivation often occur in the pursuit of a goal (pregoal). In contrast, positive affective states low in approach motivation occur after a goal has been achieved (postgoal) or when there is no goal (goal irrelevant). We suspect that most of the prior studies on positive affect and broadening used positive affective states low in approach motivation (Harmon-Jones & Gable, 2008).

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[1] Previous research on positivity and cognition have used the term affect (Isen, 2002), mood (Gasper & Clore, 2002), or emotion (Fredrickson, 2001) to describe the positive state manipulated. Emotions are comprised of multiple moderately correlated components, including feelings of pleasure or displeasure, overt or covert motor behaviors, action readiness, physiological changes, and cognitive appraisals (Frijda, 1993; Lang, 1995). Moods are similar to emotions, except that moods are said to lack objects (Frijda, 1993). Although moods may be different than emotions, past research has found that both positive moods and positive emotions typically yield identical outcomes on cognitive processes related to broadening. Because of this and because it is difficult to empirically separate moods from emotions at the measurement level, we use the broader term "affect" to describe the state manipulated in experiments.

Approach-motivated positive affective states may be associated with narrowed attention, as organisms shut out irrelevant perceptions and cognitions while they approach and work toward a desired goal (Gable & Harmon-Jones, 2008, 2010d, 2010b, 2010d; Harmon-Jones & Gable, 2008; Harmon-Jones, Gable, & Price, 2011). Broadened attention during a pregoal state might cause distraction and hinder acquisition of the desired goal. In contrast, broadened attention may be adaptive following goal acquisition. Postgoal positive affective states may increase attentional broadening because such states suggest that things are going better than necessary and the organism can throttle back effort and become open to alternative opportunities (Carver, 2003).

Pregoal and postgoal positive affects relate to different components of reward processes. In a pregoal state, an organism is seeking to obtain a rewarding goal; it is appetitively motivated. In contrast, postgoal affect occurs during or after consummation of the reward (Knutson & Wimmer, 2007). Neurobiological differences exist between pregoal and postgoal attainment positive affect in the prefrontal cortex, nucleus accumbens, and other structures (Davidson & Irwin, 1999; Gable & Harmon-Jones, 2010a; Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008; Knutson & Peterson, 2005; Knutson & Wimmer, 2007).

Attentional Narrowing of Positive Affects High in Approach Motivation

Gable and Harmon-Jones (2008; Study 2) tested whether high approach positive affect reduced attentional breadth relative to a neutral condition. They manipulated positive affect with appetitive (desserts) and neutral (rocks) pictures. After each affective/neutral picture, attentional breadth (broadening or narrowing of attention) was examined using a Navon (1977) global-local visual bias task. This task measured whether individuals had a global (broad) or local (narrow) attentional bias using letter stimuli containing both global and local components. Results revealed that reaction times (RTs) to global targets were slower after appetitive pictures than after neutral pictures. In contrast, RTs to local targets were faster after appetitive pictures than after neutral pictures.

Subsequent studies investigated whether the attentional narrowing caused by pictures and measured by Navon letters was due to approach motivation. For example, individuals high in behavioral activation sensitivity (BAS; Carver & White, 1994) showed more narrowed attention following appetitive pictures (Gable & Harmon-Jones, 2008; Study 3). In addition, a manipulated increase in the intensity of approach motivation to picture stimuli caused greater attentional narrowing following the appetitive pictures (Gable & Harmon-Jones, 2008; Study 4). Neural activations involved in approach motivation—relative left frontal cortical activity—were also associated with more narrowed attention following appetitive pictures (Harmon-Jones & Gable, 2009).

The Current Experiments

Previous studies have found that high approach-motivated positive affect narrows attentional scope. However, these previous studies have been limited because only pictures have been used to evoke high approach-motivated positive affect. Some research has shown that individuals focus on the emotional content of a picture (MacNamara, Foti, & Hajcak, 2009). When attention is directed to less emotional parts of an emotional picture, the picture has a reduced emotional impact (Dunning & Hajcak, 2009). Attention tends to be directed towards emotional pictures, even when looking at the emotional picture interferes with a task (Vuilleumier, 2005).

Given how strongly emotional content of a picture captures attention, it seems possible that this focus on emotional content may cause attentional narrowing. That is, in previous studies finding appetitive pictures to narrow attentional scope, participants may have been put into a narrowed attentional state because they were focusing on specific aspects or objects in the pictures. The present experiments were designed to resolve whether positive affective states created by stimuli other than emotional pictures would influence attentional breadth.

Also, going beyond past research on positive affect and attentional breadth, the current experiments examined both low and high approach-motivated positive affect within the same individuals within the same study. Previous studies have examined the attentional consequences of low or high approach-motivated positive affects in separate studies.

Moreover, in the current experiments, low and high approach-motivated positive affect was created in relation to the same goal. Pregoal (high approach-motivated) positive affect occurs when one is trying to achieve a likely goal, and postgoal (low approach-motivated) positive affect occurs once a goal has been accomplished.

Experiment 1

The current experiment evoked low and high approach-motivated positive affects using the monetary incentive delay task, which has been used in other experiments to create pre- versus postgoal positive affective states (Cooper, Hollon, Wimmer, & Knutson, 2009; Knutson & Greer, 2008; Knutson & Wimmer, 2007; Knutson, Westdorp, Kaiser, & Hommer, 2000). In this task, 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. In past experiments, pregoal positive cues indicating the possibility of gaining money activated anticipatory reward circuitry such as the nucleus accumbens. In contrast, postgoal positive cues indicating monetary gain activated the mesial prefrontal cortex (Knutson, Fong, Bennett, Adams, & Hommer, 2003). Furthermore, participants reported increased positivity during pregoal anticipated monetary gain and postgoal monetary gain, relative to a baseline state (Nielsen, Knutson, & Carstensen, 2008).

One important feature of this task is that the types of positive affective states created are related to the same goal. Moreover, the pregoal and postgoal positive affective states are manipulated without using emotional pictures. Based on past work, we predicted that pregoal positive affect (high in approach motivation) would cause a narrowing of attention, whereas postgoal positive affect (low in approach motivation) would cause a broadening of attention.

Method

Eighty introductory psychology students participated for course credit. Participants were informed that they had the chance to win approximately $10.

Twelve practice trials were included at the beginning of the game. Each trial (n = 96; See Figure 1) began with a white circle or square presented in the center of the computer monitor. Participants were told that the circles were reward cues indicating they could gain money on the trial based on their RTs, and the squares were neutral cues indicating they could not gain money on the trial based on their RTs. Half the trials were reward trials and half the trials were neutral trials.

Following instructions about the RT game, participants were told they would see "letters pictures appear after some of the shapes." They were told "these are unrelated to the game. However, it is important you respond quickly and accurately." After each of 32 pregoal cues (16 gain and 16 nongain), a Navon letter was presented in the center of the monitor. The Navon (1977) letters task was used to assess attentional breadth. In this task, each stimulus consists of a large letter composed of smaller letters (five closely spaced local letters on each vertical or horizontal line of the global letter). For example, a large *H* might be composed of small *F*s. Participants were asked to respond to each stimulus "as quickly as possible," pressing a key on the left if the picture contained the letter *T* and a key on the right if the picture contained the letter *H*. Global targets were those in which a large *T* or *H* was composed of smaller *L*s or *F*s. Local targets were those in which a large *L* or *F* was composed of smaller *T*s or *H*s. Faster responses to the large letters indicated a global (broad) attentional scope, whereas faster responses to the small letters indicated a local (narrow) attentional scope. Because RTs were positively skewed, and following recommendations for analyzing RT data (Fazio, 1990), RTs were logarithmically transformed. Trials with incorrect responses or with RTs more than 3 standard deviations from the mean for each stimulus were removed (8.54% of local targets and 8.15% of global targets; 9.29% of pregoal targets and 7.87% of postgoal targets).

Next, participants performed the goal-related task, which was a flankers 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 faster than the average college student, they would gain money on the trial, if the trial was a reward one.

Following the flankers task, 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). This gain versus no-gain postgoal feedback was manipulated, so that participants would believe they could beat the average RT and gain money.

For the postgoal trials on which participants had received a pregoal reward cue, two-thirds of the trials resulted in a gain (i.e., they received $0.15; *postgoal/expected outcome/gain condition*, n = 32). The other one-third of the trials did not result in a gain (i.e., they received $0.00; *postgoal/unexpected outcome/no-gain condition*, n = 16).

For the postgoal trials on which participants had received a pregoal neutral (no-gain) cue, two-thirds of the trials resulted in no gain (i.e., they received $0.00 as they expected; *postgoal/expected outcome/no-gain condition*, n = 32). The other one-third of the trials resulted in a gain (i.e., they received $0.15 even though they expected to receive $0.00; *postgoal/unexpected outcome /gain condition*, n = 16).

The postgoal/unexpected outcome/no-gain condition was included to give participants the impression that achieving the reward was a result of their efforts, as opposed to the game being fixed. Also, if participants responded incorrectly to the flankers task, they were given postgoal no-gain feedback, and the trial was excluded from analyses. The postgoal/unexpected outcome/gain condition was included to balance the experimental design and reduce the predictability of the game. Prior to starting the game, participants were told that some gains may occur on neutral pregoal expectancy trials and that these gains were unrelated to their RTs.

After postgoal feedback, participants responded to a Navon letter on 32 of the postgoal/expected outcome trials and 32 of the postgoal/unexpected outcome trials. Then, participants responded to another flankers task before the next trial began. After all trials were presented, participants were carefully debriefed using a funnel debriefing (Harmon-Jones, Amodio, & Zinner, 2007). All

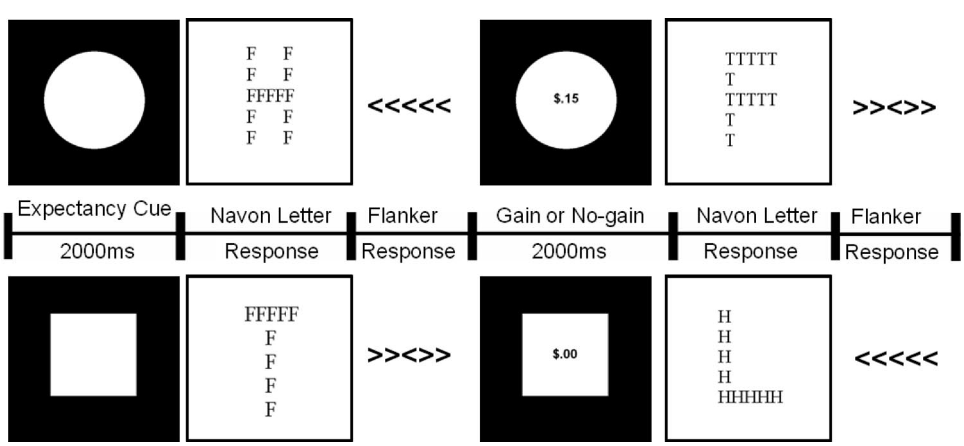

Figure 1. Experiment 1 example trials.

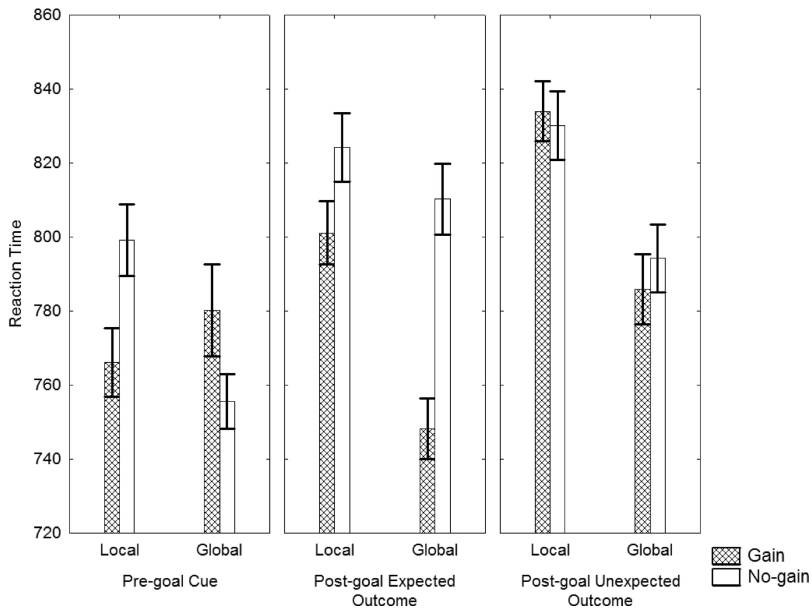

Figure 2. RTs for Experiment 1 for the 2 (gain vs. no-gain) × 2 (Navon letter: local vs. global) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction. Error bars indicate within-subject confidence intervals.[2]

participants believed that the cues in the game would give them money based on their RTs. Also, none reported any suspicion with the study. All participants were paid $10 and dismissed.

Results

Attentional scope RTs. A 2 (gain vs. no-gain) × 2 (Navon letter: local vs. global) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) analysis of variance (ANOVA) revealed a significant three-way interaction, $F(2, 158) = 9.65$, $p < .0001$, $\eta_p^2 = .11$ (see Figure 2). This three-way interaction was unpacked by examining the 2 (gain vs. no-gain) × 2 (local vs. global) interaction within the pregoal cue versus postgoal conditions.

In response to the pregoal cue, individuals were faster to identify local targets presented after gain expectancy cues than after no-gain (neutral) cues ($p = .002$). Individuals were marginally slower to global targets after gain as compared with no-gain expectancies ($p = .07$). In addition, after gain expectancy cues, individuals did not differ in their RTs to local versus global targets ($p = .48$). In contrast, after no-gain (neutral) expectancy cues, individuals responded faster to global targets than to local targets ($p < .0001$). This finding replicates the global bias that typically occurs during neutral states (Navon, 1977). These simple effects were supported by a 2 (gain vs. no-gain pregoal expectancy) × 2 (local vs. global) interaction in the pregoal cue conditions, $F(1, 79) = 12.52$, $p = .0006$, $\eta_p^2 = .14$. Thus, individuals were relatively more locally biased as they approached a reward, when approach-motivated positive affect was high.

The postgoal/expected outcome/gain condition, which should evoke postgoal, low approach-positive affect, was compared with postgoal/expected outcome/no-gain condition, which should evoke a neutral state at a similar point in time to the postgoal/expected outcome/gain condition. After an expected gain, individuals were faster to identify global targets than after an expected no-gain ($p < .0001$). They were also slightly faster to identify local targets after an expected gain than after an expected no-gain ($p = .06$). After expected gain cues, participants responded faster to global targets than to local targets ($p < .0001$). After expected no-gain cues, participants' RTs did not differ between local and global targets ($p = .24$). These simple effects for the postgoal conditions were supported by a significant 2 (postgoal/expected outcome/gain vs. postgoal/expected outcome/no-gain) × 2 (local vs. global) interaction, $F(1, 79) = 7.02$, $p = .009$, $\eta_p^2 = .08$. Thus, individuals were relatively more globally biased following the receipt of an expected gain, when they were in a positive affective state associated with low approach motivation.

Next, we tested whether a postgoal unexpected gain increased broadening of attention compared with a neutral state. Because the postgoal/expected outcome/no-gain condition evoked a neutral state at a similar point in time to the postgoal/unexpected outcome conditions, the unexpected outcome conditions were compared with the postgoal/expected outcome/no-gain condition. After an unexpected gain, individuals were faster to identify global targets than after an expected no-gain ($p = .035$). Individuals did not differ in their RTs to local targets ($p = .33$). After unexpected gain cues, participants responded faster to global targets than to local targets ($p < .0001$). These effects for the postgoal conditions were supported by a significant 2 (postgoal/unexpected outcome/gain

[2] Within-subjects confidence intervals were calculated following the methods of Cousineau (2005). For each variable, the average of the individual subject's repeated measures variables were subtracted from the subject's individual scores. Then, the average for all variables across all subjects was added to the resulting difference.

vs. postgoal/expected outcome/no-gain) × 2 (local vs. global) interaction, $F(1, 79) = 4.89$, $p = .03$, $\eta_p^2 = .06$. Thus, individuals were relatively more globally biased following the receipt of an unexpected gain, when they were in a positive affective state associated with low approach motivation.

In addition, we examined whether expected outcomes as opposed to unexpected outcomes affected attentional scope in the postgoal conditions. For both the postgoal/gain conditions (2 [postgoal/expected outcome/gain vs. postgoal/unexpected outcome/gain] × 2 [local vs. global]) and the postgoal/no-gain conditions (2 [postgoal/expected outcome/no-gain vs. postgoal/unexpected outcome/no-gain] × 2 [local vs. global]), no significant interaction occurred, *p*'s > .23.

Consistent with our past experiments that used affective pictures to study the effect of low versus high approach positive affect on attentional scope using the Navon task, we predicted that the pregoal/postgoal manipulations of the current experiment would primarily influence RTs to Navon stimuli. The above results are consistent with this prediction. However, the current experiment yielded larger error rates than past experiments, probably because of the complexity of the overall task (i.e., having to perform the Navon task and flankers task in the same trial). Therefore, we investigated whether the RT results could be explained by a speed-accuracy trade-off; that is, did participants have more errors in response to cues that evoked faster response times?

Attentional scope error rates. Error rates were calculated by determining the percentage of incorrect trials for each condition (across all conditions, there was an 8.3% error rate). These error rates were submitted to a 2 (gain vs. no-gain) × 2 (Navon letter: local vs. global) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) ANOVA, which revealed a significant interaction, $F(2, 158) = 9.14$, $p = .0001$, $\eta_p^2 = .10$. This three-way interaction was unpacked by examining the 2 (gain vs. no-gain) × 2 (local vs. global) interaction within the pregoal cue versus postgoal conditions.

In response to the pregoal cue, individuals made fewer errors identifying local targets presented after gain expectancy cues ($M = 7.34$, $SD = 10.65$) than after no-gain (neutral) cues ($M = 10.46$, $SD = 10.97$; $p = .06$). Error rates did not differ to global targets after gain ($M = 10.62$, $SD = 12.44$) as compared to no-gain expectancies ($M = 8.75$, $SD = 11.14$; $p = .26$). After gain expectancy cues, individuals produced fewer errors to local than global targets ($p = .05$). After no-gain (neutral) expectancy cues, errors were similar to both global and local targets ($p = .31$). These simple effects were supported by a 2 (gain vs. no-gain pregoal expectancy) × 2 (local vs. global) interaction in the pregoal cue conditions, $F(1, 79) = 4.45$, $p = .03$, $\eta_p^2 = .05$. Thus, individuals were relatively more accurate in identifying local targets as they approached a reward, when approach-motivated positive affect was high.

In the postgoal/expected outcome conditions, individuals made fewer errors to global targets after an expected gain ($M = 3.91$, $SD = 6.77$) than after an expected no-gain ($M = 8.75$, $SD = 11.14$; $p = .0005$). Error rates did not differ between local targets after an expected gain ($M = 8.75$, $SD = 11.83$) versus after an expected no-gain ($M = 10.47$, $SD = 10.97$; $p = .25$). After expected gain cues, participants had fewer errors to global targets than to local targets ($p = .0005$). After expected no-gain cues, participants' errors did not differ between local and global targets ($p = .25$). These simple effects for the postgoal conditions were supported by a significant 2 (postgoal/expected outcome/gain vs. postgoal/expected outcome/no-gain) × 2 (local vs. global) interaction, $F(1, 79) = 11.22$, $p = .001$, $\eta_p^2 = .12$. Thus, individuals were relatively more accurate in identifying global targets following the receipt of an expected gain, when they were in a positive affective state associated with low approach motivation.

In the postgoal/unexpected outcome condition, individuals made fewer errors to global targets after an unexpected no-gain ($M = 6.25$, $SD = 8.89$) than after an unexpected gain ($M = 10.63$, $SD = 13.21$; $p = .004$). Error rates did not differ between local targets after an unexpected no-gain ($M = 9.68$, $SD = 11.93$) versus after an unexpected gain ($M = 7.81$, $SD = 10.02$; $p = .21$). After unexpected no-gain cues, participants had fewer errors to global targets than to local targets ($p = .02$). After unexpected gain cues, participants made fewer errors to local than global targets ($p = .06$). These simple effects for the postgoal/unexpected outcome conditions were supported by a significant 2 (postgoal/unexpected outcome/gain vs. postgoal/unexpected outcome/no-gain) × 2 (local vs. global) interaction, $F(1, 79) = 8.68$, $p = .004$, $\eta_p^2 = .09$.

Taken together, the above results are not consistent with a speed–accuracy trade-off but are instead consistent with the hypotheses. That is, pregoal positive affect cues narrowed attention as revealed by individuals being more accurate in identifying local targets. In addition, postgoal positive affect cues broadened attention as revealed by individuals being more accurate in identifying global targets.

Flankers task RTs. In response to the flankers tasks, a significant 2 (reward expectancy vs. nonreward expectancy) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction occurred, $F(2, 102) = 10.121$, $p = .0001$, $\eta_p^2 = .17$. Participants responded faster to the flankers task following pregoal gain cues than pregoal no-gain (neutral) cues, $p < .0001$. These results suggest that the pregoal cue was indeed motivating. Participants were marginally faster to respond to flankers targets after postgoal/expected outcome/gain trials than after postgoal/expected outcome/no-gain trials, $p = .06$. No other differences emerged, *p's* > .11. In addition, RTs on the flankers task did not relate to local or global RTs.

Flankers task error rates. A 2 (gain vs. no-gain) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) ANOVA for flanker task error rates was not significant, $F(2, 100) = 0.91$, $p = .41$, $\eta_p^2 = .01$. Participant error rates on the flankers task did not vary across pregoal ($M = 6.9\%$) and postgoal ($M = 6.5\%$) trials.

Discussion

As compared with a neutral state, a high approach-motivated (pregoal) positive state narrowed attentional scope. In contrast, a low approach-motivated (postgoal) positive state broadened attentional scope, as compared with a neutral state.

The results of Experiment 1 illuminate the diverse effects that pregoal and postgoal positive affect states can have on basic cognitive processes such as attentional scope. The method used in Experiment 1 was novel in its application to studying basic cognitive processes associated with positive affect. Specifically, the findings in Experiment 1 are novel in the following ways: (a) positive affective states were created by stimuli other than emotional pictures and they influenced attentional breadth; (b) both low and high approach-motivated positive affect states were manipulated within the same individuals within the same study; and (c) low and high approach-motivated positive affect states were created in relation to the same goal.

In Experiment 2, we sought to conceptually replicate the effects of Experiment 1 using a different goal-related task that was less perceptual (e.g., linguistic). Specifically, we replaced the flankers tasks of Experiment 1 with a lexical-decision task in Experiment 2. This change allowed us to test whether some characteristics of the flankers task may have contributed to the observed outcomes on attentional scope (e.g., the perceptual flankers task may have narrowed attention when rewarded). In addition, Experiment 2 assessed how participants felt in response to the different cues used in the task. Past research has found the pregoal and postgoal positive affect cues activate nucleus accumbens and mesial prefrontal cortex, respectively (Knutson, Fong, Bennett, Adams, & Hommer, 2003), and other studies have found these cues cause increased self-reported positive affect (Nielsen, Knutson, & Carstensen, 2008). In Experiment 2, to measure positive affect, we included words used in past research to tap general positive affect. We expected that both pregoal and postgost gain cues would evoke greater positive affect than neutral cues.

Experiment 2

Experiment 2 included a lexical-decision task as the goal-related task as well as measures of self-reported emotions felt at different points during the task. It was predicted that pregoal and postgoal reward conditions would replicate the effects on attentional scope observed in Experiment 1, and these conditions would cause greater positive affect than pregoal and postgoal neutral conditions.

Method

Twenty-five introductory psychology students participated for course credit. Participants were informed that they had the chance to win money on a RT game.

Trials were identical in number and order to those in Experiment 1 with one exception: the flankers task was replaced with a lexical-decision task. In the lexical-decision task, participants were instructed to indicate whether the word presented was a real word or a nonword by pressing buttons marked word or nonword as quickly and accurately as possible. All words were neutral words from the Affective Norms of English Words (Bradley & Lang, 1999). Nonwords were created using parts of the various words and were matched to words used for character length.

Methods for processing RTs to Navon letters followed those of Experiment 1. RTs were logarithmically transformed. Trials with incorrect responses or with RTs more than 3 standard deviations from the mean for each stimulus were removed (6.42% of local targets and 7.08% of global targets; 6.50% of pregoal targets and 6.88% of postgoal targets; Fazio, 1990).

After all trials were presented, participants were asked to complete a questionnaire assessing how they felt on a 1 (*very slightly or not at all*) to 7 (*extremely*) scale during each of the 12 events (pregoal vs. postgoal, expected outcome vs. unexpected outcome, gain vs. no-gain) occurring during the game. The emotion words were: angry, anxious, down, enthusiastic, excited, glad, happy, mad, nervous, and sad. Five participants did not indicate a feeling state on at least one of the items causing variance in the degrees of freedom for these analyses. For each condition, ratings to positive words were averaged together to form a positive affect index (Cronbach's α's $>$ .80), and ratings to negative words were averaged together to form a negative affect index. In the pregoal/expected outcome/gain and postgoal/expected outcome/gain conditions, the Cronbach's alphas for the negative affect indices were low (.65 and .69), probably because in these conditions participants reported almost no negative affect. All other conditions had negative affect indexes with sufficient internal consistency (Cronbach's α's $>$ .77).

After all trials were presented, participants were carefully debriefed. None reported any suspicion with the study.

Results

Attentional scope RTs. A 2 (gain vs. no-gain) $\times$ 2 (Navon letter: local vs. global) $\times$ 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) ANOVA revealed a significant three-way interaction, $F(2, 48) = 10.13$, $p = .0002$, $\eta_p^2 = .30$ (see Figure 3).

In response to the pregoal cue, individuals were slower to identify global targets presented after gain expectancy cues than after no-gain (neutral) cues ($p = .001$). Individuals did not respond faster to local targets after gain as compared with no-gain expectancies ($p = .45$). In addition, after gain expectancy cues, individuals did not differ in their RTs to local versus global targets ($p = .24$). In contrast, after no-gain (neutral) expectancy cues, individuals responded faster to global targets than to local targets ($p = .004$). These simple effects were supported by a 2 (gain vs. no-gain pregoal expectancy) $\times$ 2 (local vs. global) interaction in the pregoal cue conditions, $F(1, 24) = 9.57$, $p = .004$, $\eta_p^2 = .28$. Thus, this pattern of findings conceptually replicates the results of Experiment 1, even though the pregoal gain cue seemed to exert more of an effect on slowing global than speeding local attentional processing in the current study (see Gable & Harmon-Jones, 2008, for similar results). That is, individuals were relatively more narrowly focused, as measured by slow global processing, as they approached a reward.

The postgoal/expected outcome/gain condition, which should evoke postgoal, low approach-positive affect, was compared with postgoal/expected outcome/no-gain condition, which should evoke a neutral state at a similar point in time to the postgoal/expected outcome/gain condition. After an expected gain compared with an expected no-gain, individuals were faster to identify global targets ($p = .0001$). Individuals did not respond faster to local targets after an expected gain than after an expected no-gain ($p = .58$). After expected gain cues, participants responded faster to global targets than to local targets ($p < .0001$). After expected no-gain cues, participants' RTs did not differ between local and global targets ($p = .89$). These simple effects for the postgoal conditions were supported by a significant 2 (postgoal/expected outcome/gain vs. postgoal/expected outcome/no-gain) $\times$ 2 (local vs. global) interaction, $F(1, 24) = 13.24$, $p = .001$, $\eta_p^2 = .35$. Thus, individuals were relatively more globally biased following the receipt of an expected gain, when they were in a positive affective state associated with low approach motivation.

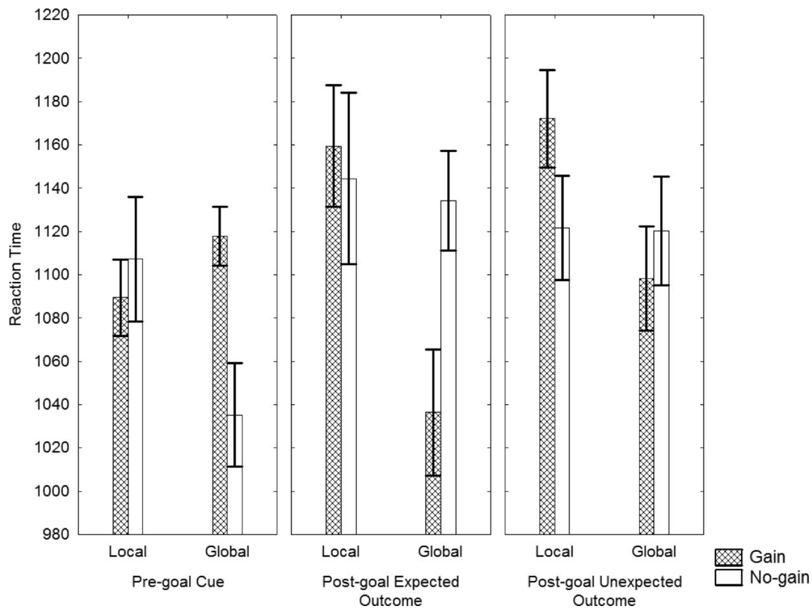

Figure 3. RTs for Experiment 2 for the 2 (gain vs. no-gain) × 2 (Navon letter: local vs. global) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction. Error bars indicate within-subject confidence intervals.

Next, we were interested in testing whether a postgoal unexpected gain increased broadening of attention compared with a neutral state. The unexpected outcome conditions were compared with the postgoal/expected outcome/no-gain condition, which is the postgoal neutral condition. After an unexpected gain, individuals were marginally faster to identify global targets than local targets (p = .08). After an unexpected gain, individuals did not differ in their RTs to local targets (p = .51) or global targets (p = .24). There was not significant interaction for the 2 (postgoal/unexpected outcome/gain vs. postgoal/expected outcome/no-gain) × 2 (local vs. global) interaction ANOVA, $F(1, 24) = 1.79$, $p = .19$, $\eta_p^2 = .07$. These results provide some, albeit weak, support for the idea that postgoal positive affect created by an unexpected gain causes a broadening of attention.

In addition, we examined whether expected outcomes as opposed to unexpected outcomes affected attentional scope in the postgoal conditions. For both the postgoal/gain conditions (2 [postgoal/expected outcome/gain vs. postgoal/unexpected outcome/gain] × 2 [local vs. global]) and the postgoal/no-gain conditions (2 [postgoal/expected outcome/no-gain vs. postgoal/unexpected outcome/no-gain] × 2 [local vs. global]), no significant interaction occurred, p's > .39.

Attentional scope error rates. A 2 (gain vs. no-gain) × 2 (Navon letter: local vs. global) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) ANOVA was not significant, $F(2, 48) = 2.47$, $p = .10$, $\eta_p^2 = .09$. Follow-up 2 (gain vs. no-gain) × 2 (local vs. global) interactions within the pregoal cue versus postgoal conditions did not reveal significant effects for error rates; however, mean percentages were in similar directions to those in Experiment 1 (Grand Mean = 6.75%, SD = 12.08; p's > .21). These error rate results do not replicate those observed in Experiment 1, perhaps because of the lower sample size of the current experiment.

Lexical-decision RTs. In response to the lexical-decision tasks, a significant 2 (reward expected outcome vs. nonreward expected outcome) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction occurred, $F(2, 48) = 10.121$, $p = .0001$, $\eta_p^2 = .17$. Participants responded faster to the lexical-decision task following pregoal gain cues than pregoal no-gain (neutral) cues, p = .04. Participants were not faster to respond to lexical targets after postgoal/expected outcome/gain trials than after postgoal/expected outcome/no-gain trials, p = .17. Participants were faster to respond to lexical-decision targets after postgoal/unexpected outcome/gain trials than after postgoal/unexpected outcome/no-gain trials, p = .005. In addition, RTs on the lexical task did not relate to local or global RTs. These results indicate that participants were more motivated to respond to the lexical-decision task when they were in a pregoal positive state as compared with a neutral state. In contrast, participants were similarly motivated to respond to the lexical-decision task in a postgoal positive state as compared with a neutral state.

Lexical-decision error rates. A 2 (gain vs. no-gain) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) ANOVA for lexical-decision error rates was not significant, $F(2, 48) = 0.36$, $p = .69$, $\eta_p^2 = .01$. Participant error rates on the lexical-decision task did not vary across pregoal (15.5%) and postgoal (15.9%) trials.

Self-reported affect. For self-reported positive affect, a significant 2 (gain vs. no-gain) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction occurred, $F(2, 36) = 41.30$, $p < .0001$, $\eta_p^2 = .69$. As shown in Table 1, all cues associated with gains evoked greater positive affect than cues associated with no gain. In addition, postgoal/expected outcome/gain cues evoked significantly greater positive affect than postgoal/unexpected outcome/gain cues.

Table 1
Positive and Negative Affect Mean Ratings by Condition

	Pregoal cue		Postgoal expected outcome		Postgoal unexpected outcome	
	Gain	No-gain	Gain	No-gain	Gain	No-gain
Positive affect	3.89 (1.41)^{ac}	1.68 (0.99)^{b}	4.06 (1.45)^{a}	1.53 (0.88)^{b}	3.63 (1.76)^{c}	1.42 (0.75)^{b}
Negative affect	1.87 (0.81)^{ac}	2.19 (1.34)^{a}	1.51 (0.69)^{ac}	2.25 (1.49)^{a}	1.44 (0.90)^{c}	2.81 (1.48)^{b}

Note. Standard deviations are in parentheses. T-tests were used to compare means. Within rows, different subscripts indicate differences at $p < .05$. Subscripts with a matching letter do not differ.

For self-reported negative affect, a significant 2 (gain vs. no-gain) × 3 (pregoal cue vs. postgoal expected outcome vs. postgoal unexpected outcome) interaction occurred, $F(2, 36) = 10.01$, $p = .0003$, $\eta_p^2 = .36$. As shown in Table 1, the only cues that occurred at similar points in time that produced significant differences were the following: postgoal/unexpected outcome/no-gain cues evoked significantly greater negative affect than postgoal/unexpected outcome/gain cues and postgoal/expected outcome/no-gain cues. Also, postgoal/expected outcome/no-gain cues evoked greater negative affect than postgoal/unexpected outcome/gain cues.

Individual emotion items were assessed to test the hypothesis that not receiving an expected reward can cause both anger and sadness in individuals. As expected, individuals reported being more angry and mad to postgoal/unexpected outcome/no-gain cues ($M = 2.72$, $SD = 2.11$; $M = 2.58$, $SD = 2.01$) than postgoal/expected outcome/no-gain cues ($M = 2.00$, $SD = 1.75$; $M = 1.74$, $SD = 1.41$), $t(17) = 2.17$, $p = .04$, $t(18) = 2.73$, $p = .01$. Also, individuals reported being more sad and down to postgoal/unexpected outcome/no-gain cues ($M = 2.89$, $SD = 1.91$; $M = 3.05$, $SD = 1.65$) than to postgoal/expected outcome/no-gain cues ($M = 2.00$, $SD = 1.67$; $M = 1.89$, $SD = 1.37$), $t(18) = 3.39$, $p = .003$, $t(18) = 3.75$, $p = .001$. Participants did not differ on other negative emotions (e.g., nervous and anxious), t's <1.32, p's $> .21$.

Discussion

Results of Experiment 2 conceptually replicated the results of Experiment 1. As compared with a neutral state, a high approach-motivated (pregoal) positive state caused a relative narrowing of attentional scope. A low approach-motivated (postgoal) positive state, however, caused a relative broadening of attentional scope, as compared with a neutral state. Unlike Experiment 1, error rates on the attentional scope task did not differ by condition. The lower sample size of in Experiment 2 likely caused this null effect.

In addition, results of Experiment 2 extended the results of Experiment 1 by assessing participants' affective responses. Pregoal/expected outcome/gain and postgoal/expected outcome/gain cues evoked significantly greater self-reported positive affect than pregoal/expected outcome/no-gain and postgoal/expected outcome/no-gain (neutral) cues, respectively. Also, self-reports indicated that the pregoal/expected outcome/no-gain and postgoal/expected outcome/no-gain (neutral) conditions evoked a neutral state when considering the patterns of means.

General Discussion

The current experiments created pregoal and postgoal positive states by giving participants the opportunity to win money on a RT game, as has been done in much prior research (Cooper, Hollon, Wimmer, & Knutson, 2009; Knutson & Greer, 2008; Knutson & Wimmer, 2007; Knutson, Westdorp, Kaiser, & Hommer, 2000). Local-global attentional scope was measured under both a pregoal or high approach-motivation positive affective state and a postgoal or low approach-motivation positive affective state. Results revealed that under a pregoal positive affective state, participants had a narrowed attentional scope. In contrast, under a postgoal positive affective state, participants had a broadened attentional scope. Taken together, these results are consistent with the idea that high approach-motivated positive affective states narrow attention to assist in promoting goal-directed action. During goal-directed action, broadened attention and cognition may hinder goal pursuit and acquisition (Gable & Harmon-Jones, 2008, 2010b, 2010d; Harmon-Jones & Gable, 2008; Harmon-Jones, Gable, & Price, 2011). On the other hand, low approach-motivated positive affective states broaden attention and cognition because these positive states suggest that things are going better than necessary and motivational engagement can be reduced leaving one open to new alternative opportunities (Carver, 2003).

The findings of the current experiments produced conceptually similar results to previous studies that used affective picture stimuli (Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009). However, the current experiments extended this past work by demonstrating that positive affective states low and high in approach motivational intensity have opposite consequences for attentional scope, even when these affective states are manipulated with tasks rather than affective pictorial stimuli. Moreover, the present results extend past results by showing that low versus high approach-motivated positive affective states influence attentional scope in opposite directions within the same individuals within the same study.

Although Experiment 2 conceptually replicated the results of Experiment 1, overall RTs to the attentional scope task (Navon, 1977) were faster in Experiment 1 than in Experiment 2 (see Figures 1 and 2). The methods were identical in the two experiments, except for the goal-related task: flankers versus lexical decision. Thus, it seems most likely that the difference in goal-related tasks affected overall RTs. Specifically, the flankers task used in Experiment 1 was highly perceptual, where as the lexical-decision task used in Experiment 2 was not. The perceptual nature of the flankers task most likely sped overall RTs on the subsequent Navon targets in Experiment 1. In addition, the flankers task may have been easier for participants, as error rates to the flankers task were smaller than error rates to the lexical-decision task. However, the flankers task did not account for the effects of cues on attentional scope observed in the Experiment 1, as similar effects were also observed in Experiment 2. Also, overall error rates to Navon letters were similar in both experiments. The observed differences in overall RTs between experiments cannot account for the observed differences in attentional scope by condition.

Attentional scope was not influenced by the postgoal/ unexpected outcome/no-gain cue compared with the neutral cue in either experiment. Failing to receive an expected reward has been shown to produce anger and sadness (Crossman, Sullivan, Hitchcock, & Lewis, 2009). Self-report affect measures from Experiment 2 were consistent with these past results. Participants reported more anger and sadness when they unexpectedly did not receive a reward. Anger, a high approach negative affect, produces a narrowing of attention and cognition (Gable, Poole, & Harmon-Jones, 2011), whereas sadness, a low approach-negative affect, produces a broadening of attention and cognition (Gable & Harmon-Jones, 2010c). The fact that the postgoal/unexpected outcome/no-gain condition created both anger and sadness may assist in explaining why this manipulation did not cause greater global or local attentional scope.

The postgoal/unexpected outcome/gain cues did not evoke as much positive affect as postgoal/expected outcome/gain. This likely occurred because gaining a reward as a result of a goal-directed-effort was more meaningful than gaining a reward unassociated with such effort. However, postgoal/unexpected outcome/ gain cues did evoke greater positive affect than postgoal/expected outcome/no-gain cues. The fact that the current experiments found that unexpected gain caused a slight increase in positive affect probably explains why the unexpected gain caused a slight broadening of attentional scope.

Consistent with a growing body of work pointing to the importance of motivation in emotion (Gable & Harmon-Jones, 2010d; Harmon-Jones, Gable, & Peterson, 2010; Harmon-Jones, Harmon-Jones, Abramson, & Peterson, 2009; Price & Harmon-Jones, 2010) and emotion-cognition processes (Larson & Steuer, 2009; Levine & Edelstein, 2009), the present work demonstrated that pregoal (high approach) positive affect narrows attention, whereas postgoal (low approach) positive affect broadens attention. Given the large body of evidence elucidating the neural pathways underlying pre- versus postgoal positive affect (Knutson & Greer, 2008), future studies should examine how the neural processes involved in these affective states relate to neural processes involved in attentional scope, to better reveal how affective states influence attentional scope.

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