Anger Perceptually and Conceptually Narrows Cognitive Scope

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Abstract

For the past 50 years, research investigating the effect of emotions on scope of cognitive processing was based on models proposing that affective valence determined cognitive scope. More recently, our motivational intensity model suggests that this past work had confounded valence with motivational intensity. Research derived from this model supports the idea that motivational intensity, rather than affective valence, explains much of the variance emotions have on cognitive scope. However, the motivational intensity model is limited in that the empirical work has examined only positive affects high in approach and negative affects high in avoidance motivation. Thus, perhaps only approach-positive and avoidance-negative states narrow cognitive scope. The present research was designed to clarify these conceptual issues by examining the effect of anger, a negatively valenced approach-motivated state, on cognitive scope. Results revealed that anger narrowed attentional scope relative to a neutral state and that attentional narrowing to anger was similar to the attentional narrowing caused by high approach-motivated positive affects (Study 1). This narrowing of attention was related to trait approach motivation (Study 2 and Study 3). Anger also narrowed conceptual cognitive categorization (Study 4). Narrowing of categorization related to participants' approach motivation toward anger stimuli. Together, these results suggest that anger, an approach-motivated negative affect, narrows perceptual and conceptual cognitive scope. More broadly, these results support the conceptual model that motivational intensity per se, rather than approach-positive and avoidance-negative states, causes a narrowing of cognitive scope.

Key Words: anger, motivation, attention, categorization, scope

Anger Perceptually and Conceptually Narrows Cognitive Scope

Over 50 years of research have suggested that negative affects cause a narrowing of cognitive scope, whereas positive affects cause a broadening of cognitive scope (Easterbrook, 1959; Fredrickson, 2001). This conceptual and empirical work emphasized affective valence as the determinant of cognitive scope (Fredrickson, 2001). More recent research has suggested that motivational intensity, rather than affective valence, influences cognitive scope (Harmon-Jones, Gable, & Price, 2013; Kaplan, van Damme, & Levine, 2012). This more recent work suggested that the past work emphasizing valence had confounded valence with motivational intensity, such that previous research had only examined the influence of negative affects high in motivational intensity and positive affects low in motivational intensity on cognitive scope. With this confound removed, research revealed that positive and negative affects high in motivational intensity (e.g., fear, disgust, desire) narrowed cognitive scope, whereas positive and negative affects low in motivational intensity (e.g., sadness, amusement) broadened cognitive scope (Gable & Harmon-Jones, 2008, 2009, 2010a, 2010b, 2010c, 2011; Harmon-Jones & Gable, 2009; Hicks, Friedman, Gable, & Davis, 2012; Nittono, Fukushima, Yano, & Moriya, 2012; Price & Harmon-Jones, 2010). This motivational intensity model, however, is limited in that the empirical work has examined only positive affects high in approach and negative affects high in avoidance motivation. Thus, all obtained results suggesting that motivationally intense affective states per se cause a narrowing of cognitive scope could be interpreted as being due to approach-positive and avoidance-negative states. The present research was designed to clarify these conceptual issues by examining the effect of anger, a negatively valenced approach-motivated state, on cognitive scope.

The Influence of Positive vs. Negative Affect on Cognitive Scope

To begin, we define constructs examined in this research (Harmon-Jones et al., 2013). Affective states are psychophysiological constructs composed of underlying dimensions. The first is valence, the positive to negative evaluation of the subjectively experienced state (Harmon-Jones, Harmon-Jones, Amodio, & Gable, 2011). The second is motivational intensity, the strength of urge to move toward/away from a stimulus (Harmon-Jones, Harmon-Jones, & Price, 2013). The third is arousal, which can be measured subjectively and by activation of the sympathetic nervous system, and is a proxy for but not the same as motivational intensity (Gable & Harmon-Jones, 2013). Cognitive scope is similar to the breadth of cognitive expansiveness, and it can occur at perceptual, attentional, or conceptual levels (Harmon-Jones, Price, & Gable, 2012).

Several models have proposed that positive affective states broaden cognitive scope, whereas negative affective states narrow cognitive scope. One of the most widely cited models, the broaden-and-build model, proposed that positive emotions increase cognitive breadth (Fredrickson, 2001). In this model, positive emotions broaden momentary thought-action repertoires, whereas negative emotions narrow thought-action repertoires. Positive emotions are posited to broaden because they suggest a stable and comfortable environment, and thus encourage more attentional and cognitive breadth (Fredrickson, 2001).

Research consistent with this model has found that positive affect causes a broadening of cognitive scope in categorization (Isen & Daubman 1984), unusualness of word association (Isen, Johnson, Mertz, & Robinson,1985), social categorization (Isen, Niedenthal, & Cantor, 1992), visual-spatial processing (Rowe, Hirsh, & Anderson, 2007), attention (Fredrickson & Branigan, 2005), and the recall of memory details (Talarico, Berntsen, & Rubin, 2008). In these studies, positive affect was manipulated by having participants receive a gift (Isen, Daubman, &

Nowicki, 1987), watch films to induce amusement (Isen & Daubman, 1984) or contentment (Fredrickson & Branigan, 2005), listen to mood-inducing music (Rowe et al., 2007), or remember a positive life event (Talarico et al., 2008). Also, trait positive affect relates to a broadened cognitive scope (Hicks & King, 2007).

The Influence of Low vs. High Motivationally Intense Affect on Cognitive Scope

As noted above, when we first began work on the motivational intensity model of cognitive scope, we suspected that the positive affect inductions of previous research induced positive states that were low in motivational intensity. That is, receiving gifts, watching amusing films, and recalling positive life events rarely urge one to move toward the object. Instead, they induce a pleasant savouring of experiences, not an impulse to pounce. They occur after a goal has been received or they are not relevant to goal-directed action. However, a separate, broad class of positive affects exist; they motivate action, often with the goal of acquiring objects of desire. These positive affects are high in approach motivation and they often occur prior to a goal being acquired. Whereas positive affects low in approach motivation may broaden cognitive scope (for reasons specified in the broaden-and-build model), positive affects high in approach motivation may narrow cognitive scope to assist goal-directed behavior. That is, by zeroing in on the object to approach, the individual is more likely to successfully move toward the motivationally significant object.

In our initial studies, we manipulated low approach-motivated and high approach-motivated positive affect using film clips evoking amusement and desire, respectively, because past research on positive affect and broadening also used film clips (Gable & Harmon-Jones, 2008). Both films evoked similar levels of general positive affect, but differed in the extent they evoked desire and amusement. Compared to the low approach positive film clip, the high

approach positive film clip caused less broadening as measured by attentional scope (Kimchi & Palmer, 1982). Similar effects on cognitive scope were found when high and low approach positive affect was manipulated using pre-goal and post-goal positive manipulations (Gable & Harmon-Jones, 2010c, 2011).

Subsequent studies included a neutral affect comparison condition and measured attentional scope using other tasks. For example, studies revealed that appetitive stimuli (pictures of delicious desserts) caused a narrowing of attention (on Navon's [1977] task; Gable & Harmon-Jones, 2008, Study 2), and that individuals high in trait approach motivation showed even more attentional narrowing following appetitive stimuli (Gable & Harmon, 2008, Study 3). Similarly, alcohol-related pictures narrowed attentional scope for individuals motivated to consume alcohol (Hicks et al., 2012).

In addition to measuring attention, the motivational intensity model has assessed cognitive scope using other measures. Two studies (Price & Harmon-Jones, 2010) measured cognitive scope with a cognitive categorization task used by Isen and Daubman (1984). In this task, participants indicate how well example items fit into specific categories. In these studies, low vs. high approach-motivated positive affect was manipulated with body postures associated with these states (see review by Price, Peterson, & Harmon-Jones, 2012). Specifically, a smiling-reclining position was used to evoke a low approach-motivated positive state, but a smiling-leaning forward position was used to evoke a high approach-motivated positive state. Results revealed that a low approach-motivated positive state caused more inclusive (more broad) categorization, whereas a high approach-motivated positive state caused less inclusive (more narrow) categorization.

Further studies have revealed that neural activations associated with processing appetitive stimuli are correlated with narrowed cognitive scope. For instance, one study measured regional brain activity using electroencephalographic alpha power, and found that greater left-frontal cortical activity to appetitive pictures was associated with more narrowing of attention following these pictures (Harmon-Jones & Gable, 2009). Another study measured an event-related brain potential, the late positive potential, and found that larger late positive potentials to appetitive pictures were associated with more narrowing of attention following these pictures (Gable & Harmon-Jones, 2010a).

Although most of the evidence for the motivational intensity model has examined positive affect, two studies have tested whether negative affects varying in motivational intensity differentially influence cognitive scope. In these studies, disgust or sadness was evoked using pictures and compared to a neutral affect state (Gable & Harmon-Jones, 2010b). Consistent with predictions derived from the motivational intensity model, disgust, a negative affect high in withdrawal motivational intensity, caused a narrowing of attention relative to neutral affect. In contrast, sadness, a negative state low in motivational intensity, caused a broadening of attention.

Positive-Approach and Negative-Avoidance as the Underlying Cause?

Together, the reviewed evidence supports the motivational intensity model of cognitive scope (Harmon-Jones et al., 2013). However, in the past research, only positive affects high in approach motivation and negative affects high in withdrawal motivation were tested. As such, the motivational intensity model may not be an adequate or correct conceptualization of the influence of various affects on cognitive scope. Instead, these results may only support a model in which high approach-motivated positive and high withdrawal-motivated negative affects are the affective states that cause narrowing.

Most conceptual models concerned with affect and motivation, in fact, emphasize these states and suggest that motivational direction cannot be distinguished from affective valence. These prominent models emphasize that positive affects are linked with approach motivation, and negative affects are linked with withdrawal motivation (Davidson, 1998; Lang, 1995; Watson, 2000). For instance, Lang (1995) suggested that the approach and withdrawal motivation systems exclusively reflect positive and negative affect, respectively: "It is proposed that two motive systems exist in the brain—appetitive and aversive—accounting for the primacy of the valence dimension" (p. 374). Watson, Wiese, Vaidya, and Tellegen (1999) also proposed that arousing positive affect (i.e., positive activation) is directly related to appetitive motivation, whereas arousing negative affect (i.e., negative activation) is directly related to withdrawal motivation.

Given the present state of the obtained evidence on the influence of affect on cognitive scope, a conceptual model including both motivational intensity and motivational direction is necessary to explain the fact that positive affects high in approach motivation and negative affects high in avoidance motivation cause a narrowing of cognitive scope. But is this conceptual model necessary, or might the more parsimonious motivational intensity model be accurate? One way to address this question is to test anger, a negative affective state associated with approach motivation.

Anger as Negatively Valenced but Approach Motivated

Anger is a subjectively negative experience (Harmon-Jones, 2004; Harmon-Jones et al., 2011) associated with approach motivation (Carver & Harmon-Jones, 2009). Anger occurs when approach-oriented goals are blocked (Carver & Scheier, 2008; Dollard, Miller, Doob, Mowrer, & Sears, 1939), and it is associated with approach-motivated urges (Harmon-Jones et al., 2013) and

approach-oriented patterns of physiological responses (Jamieson, Koslov, Nock, & Mendes, 2013). Anger relates to more self-assurance, strength, bravery, and optimism, all of which are associated with approach motivation (Izard, 1991; Lerner & Keltner, 2001). Facial expressions of anger are perceived as similar to other approach-motivated states, such as determination (C. Harmon-Jones, Schmeichel, Mennitt, & Harmon-Jones, 2011). Anger increases visual attention to rewarding but not threatening information (Ford et al., 2010). Moreover, neural regions associated with approach motivation are activated during situational anger (see Gable & Poole, 2012; Harmon-Jones, Gable, & Peterson, 2010, for a review).

At the trait level, individuals who score high in behavioral approach system (BAS) sensitivity respond with more anger during laboratory anger inductions (Carver, 2004) and they score higher on measures of trait anger (Harmon-Jones, 2003). This latter relationship occurs particularly for external or outward expressions of anger (Cooper, Gomez, & Buck, 2007; Smits & Kuppens, 2005), consistent with the idea that BAS relates to approach-oriented aspect of anger. In addition, Gable and Poole (2012) measured trait BAS and then presented anger and neutral pictures. Trait BAS related to greater approach motivation to anger pictures as measured by neurophysiological responses (left-frontal asymmetry and Late Positive Potentials), but not to neutral pictures.

Anger and Cognitive Scope

Much past research suggests that anger is associated with approach motivation. We propose that by assessing the effects of anger on cognitive scope, we will be better able to determine whether motivational intensity per se relates to cognitive scope. Based on work associating anger with approach motivation, anger should cause a narrowing of cognitive scope

as individuals shut out irrelevant stimuli, perceptions, and distractions to approach the anger-evoking object.

Although the effect of anger on cognitive scope has not been directly examined, past research suggests that anger may narrow cognitive processing. Moons and Mackie (2007) found that as compared to a neutral state, anger facilitated discrimination between weak and strong arguments. In addition, anger has been found to inhibit processing of irrelevant non-target information in a flanker task (Finucane, 2011; but see Bruyneel et al. [2013] for evidence suggesting that the flankers task is not sensitive to some affective manipulations). Although these studies provided evidence consistent with our prediction, the evidence is a bit indirect as the measures are not ones typically used in the cognitive scope literature. Another study found an angry film clip to narrow participants' thought-action repertories in a thought-listing task (Fredrickson & Branigan, 2005). However, this measure of cognitive scope has only been used this one time in this literature, and the effect of the film clip was only marginally significant.

The Current Studies

In order to more clearly illuminate how affective and motivational variables influence cognitive scope, we examined the role of approach-motivated anger on attentional breadth and cognitive categorization in three studies. We predicted that anger would cause a narrowing of attention relative to a neutral state, and would narrow attentional scope similar to the narrowing occurring under high approach-motivated positive states (Study 1). Trait approach motivation was expected to relate to greater narrowing of attention during anger but not neutral states (Study 2 & 3). In addition, anger was predicted to reduce the scope of categorization (Study 4) relative to a neutral state.

Study 1

Method

Forty-nine introductory psychology students (36 females) provided informed consent and participated in exchange for partial course credit.

Participants viewed six neutral practice trials followed by 128 trials. Each trial began with a fixation cross (500 ms), followed by an affective picture (anger or high approach-motivated positive) or neutral picture (6 s). Anger pictures depicted anti-American scenes (e.g., flag-burning, 9/11 events). Past studies have found these pictures reliably evoke approach-motivated anger as assessed through self-reported emotion, relationship to trait measures of approach motivation, and neurophysiological measures of approach motivation (Gable & Poole, 2012; Harmon-Jones et al., 2011). The high approach-motivated positive pictures were appetitive images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005).[1] Each affective picture was matched with a neutral picture, such that objects (e.g., buildings) were matched by shape and size and scenes were matched for people presence and direct gaze or face presence. Picture sizes (1024 × 768) were equivalent. All pictures were presented in the center of a 20-inch computer monitor and superimposed over a black background.

After another 500-ms fixation cross, a Navon (1977) letters picture was displayed until participants responded. The Navon (1977) letters stimuli were large letters composed of smaller letters. Each vertical and horizontal line of a large letter was made up of five closely spaced local letters (e.g., an *H* made up of *F*s). Participants were asked to indicate "as quickly as possible" whether the picture contained the letter *T* or the letter *H* by pressing the left shift key or the right shift key, respectively. Global targets were those in which a *T* or an *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 identify the large target letters or slower responses to identify the small target letters indicate a relatively broadened attentional scope, whereas faster responses to identify the small target letters or slower responses to identify the large target letters indicate a relatively narrowed attentional scope. Hundreds of studies using this task have revealed that individuals respond more quickly to global than local letters under neutral conditions (Kimchi, 1992). Past research has found motivationally intense approach-positive and avoidance-negative affects slow global reactions, speed local reactions, or both slow global and speed local reactions (Gable, & Harmon-Jones, 2008, 2010a, 2010b, 2011; Harmon-Jones & Gable, 2009). These results suggest that it is the difference in attentional scope between affective and neutral states that is of importance; becoming less broad (or less globally biased) and/or becoming more narrow (or more locally biased) should confer similar advantages in adaptively responding. After the Navon picture, an intertrial interval of three seconds occurred.

Affective pictures were presented in two blocks to avoid mixing affective states (Gable & Harmon-Jones, 2009). Each block consisted of 64 pictures: 32 pictures of one affective picture type and 32 matching neutral pictures. A Navon (1977) letters picture was presented after each picture. Block order was counter-balanced between participants.

Response times (RTs) on the letters task were logarithmically transformed. Trials with incorrect responses and trials on which the RT was more than three standard deviations from the mean for that stimulus were excluded from analyses (after anger pictures: 6%; after high approach-motivated positive pictures: 5%; after neutral pictures: 6%). Also, because there were two blocks of neutral pictures and RTs between blocks were similar for local ($r = .72$, $p < .001$) and global ($r = .70$, $p < .001$) targets, we combined the two neutral blocks to create aggregate RT scores for global and local targets after neutral pictures.

Results

A 3 (picture type: anger, high-approach-motivation positive, neutral) × 2 (target type: local or global) within-subjects ANOVA revealed a significant interaction, $F(2, 92) = 8.65$, $p = .0003$, $\eta_p^2 = .16$ (see Figure 1). Follow up analyses revealed the following effects. After neutral pictures, participants responded faster to global ($M = 6.56$, $SD = 0.20$) than local targets ($M = 6.58$, $SD = 0.24$), $p = .01$; this effect replicates the global bias that is typically found with the Navon stimuli under neutral conditions (Kimchi, 1992). After anger and approach-positive pictures, participants responded faster to local ($M = 6.58$, $SD = 0.27$; $M = 6.57$, $SD = 0.25$) than global ($M = 6.61$, $SD = 0.23$; $M = 6.61$, $SD = 0.23$) targets, ps $< .035$. These results suggest that anger and motivationally intense positive affect eliminated the typical global bias and caused a local bias of attentional scope. Also consistent with the hypothesis, participants responded slower to the global targets after anger and positive pictures than after neutral pictures, ps $< .0001$. That is, participants who were angry took longer to "see" the global configuration, because anger had reduced their cognitive scope. RTs to local targets did not differ between positive and neutral pictures, anger and neutral pictures, or anger and positive pictures, ps $> .27$.

Discussion

Study 1 found that attentional scope was narrowed when participants were in an approach-motivated anger state as compared to a neutral state. In addition, Study 1 demonstrated that anger narrowed attentional scope in a manner similar to that caused by positive affect high in approach motivation. These results suggest that anger narrows attentional scope. Moreover, these results support the hypothesis that approach motivation, regardless of its affective valence, narrows attentional scope.

Because trait approach motivation has been found to relate to attentional narrowing in high approach-motivated positive states (Gable & Harmon-Jones, 2008, 2013), we conducted a second study to examine whether trait approach motivation would relate to attentional narrowing in approach-motivated anger. This study was designed to replicate Study 1, comparing the attentional narrowing effects of anger with those of a neutral state. We predicted that trait approach motivation would relate to narrowed attentional scope after anger pictures.

Study 2

Method

One hundred and sixteen introductory psychology students (62 females) provided informed consent and participated in exchange for partial course credit. Participants completed Carver and White's (1994) BIS/BAS scales prior to beginning the study. BAS is comprised of three scales: BAS Drive, which contains four items pertaining ''to the persistent pursuit of desired goals''; BAS Reward Responsiveness, which contains five items that ''focus on positive responses to the occurrence or anticipation of reward''; and BAS Fun-Seeking, which has four items ''reflecting both a desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment'' (Carver & White, 1994, p. 322). BAS subscales were also aggregated into one overall measure of total BAS. The BIS scale contains seven items that measure reactions to the expectation of punishment. The methods in Study 2 were identical to those in Study 1, with the exception that participants only viewed one block comprised of anger and neutral pictures followed by Navon (1977) letters. Trials with incorrect responses and trials on which the RT was more than three standard deviations from the mean for that stimulus were excluded from analyses (after anger pictures: 5%; after neutral pictures: 5%).

Finally, participants viewed the anger and neutral pictures again (2 s each), and indicated how positive (vs. negative) and arousing (vs. calming) each picture was (1 = *positive*/*excited*; 9 = *negative*/*calm*). Participants also rated how they felt toward the pictures on the following words: anger, mad, sad, down, proud, determined, and fear (from 1 [*not at all*] to 9 [*strongest emotion*]). Words assessing similar affective responses were averaged across picture type to form indices of anger (angry and mad; Cronbach's alphas > .97) and sadness (sad and down; Cronbach's alphas > .90).

Results

Local-Global reaction times to Navon letters task. A 2 (picture type: anger or neutral) × 2 (target type: local or global) within-subjects ANOVA revealed a significant interaction, $F(1, 111) = 15.36$, $p < .001$, $\eta_p^2 = .12$. Follow up analyses revealed the following effects. After neutral pictures, participants responded faster to global ($M = 6.58$, $SD = 0.23$) than local ($M = 6.62$, $SD = 0.22$) targets, $p < .0001$, replicating the global bias from Study 1 and that typically found with the Navon stimuli under neutral conditions. After anger pictures, participants' response times did not differ between global ($M = 6.65$, $SD = 0.22$) and local ($M = 6.63$, $SD = 0.23$) targets, $p = .23$. These results suggest that anger eliminated the typical global bias. Also consistent with the hypothesis, participants responded slower to the global targets after anger pictures than after neutral pictures, $p < .0001$. RTs to local targets were marginally slower after anger pictures than after neutral pictures, $p = .08$. These latter results suggest that anger pictures caused a trend toward a general slowing of reaction times to both types of Navon target letters. However, the interaction revealed that this slowing primarily occurred to global rather than local targets, consistent with the hypothesis that anger would narrow cognitive scope. Also, the current findings are consistent with past research findings that positive affects high in motivational

intensity slow global reactions (Gable, & Harmon-Jones, 2008, 2010a, 2010b, 2011; Harmon-Jones & Gable, 2009).

Local-Global reaction times relating to BIS/BAS. To test whether individual differences in approach motivation related to a more narrow or less broad cognitive scope after anger pictures, we examined the relationship between BAS and reactions to local targets after anger pictures. Past research examining attentional narrowing to affective targets has found that motivational intensity can speed local target reactions after affective (vs. neutral) stimuli, slow global target reactions after affective (vs. neutral) targets, or both (Gable, & Harmon-Jones, 2008, 2010a, 2010b, 2011; Harmon-Jones & Gable, 2009). Because of this, we controlled for either local target reactions after neutral pictures or global target reactions after anger pictures using partial correlations. Subsequently, we refer to the relationship between BIS/BAS and reactions to local targets as narrowed attention, regardless of the controlling variable. Higher Reward Responsiveness related to more narrowed attention after anger pictures (*partial r* = -.20, *p* = .03), controlling for global target reactions after anger pictures. Drive, Fun-Seeking, total BAS, and BIS did not relate to narrowed attention after anger pictures (*partial r*s < .15, *p*s > .12), controlling for global target reactions after anger pictures. Drive related to less narrowed attention after anger pictures (*partial r* = .27, *p* = .004), controlling for local target reactions after neutral pictures. BIS related to more narrowing after anger pictures (*partial r* = -.23, *p* = .01), controlling for local target reactions after neutral pictures. Reward Responsiveness, Fun, and total BAS did not relate to narrowed attention after anger pictures (*partial r*s < .15, *p*s > .11), controlling for local target reactions after neutral pictures.

Because the relationship between BIS and attentional narrowing was marginally significant, we examined what happened when both Reward Responsiveness and BIS were

entered as predictors of attentional narrowing after anger pictures, controlling for global target reactions after anger pictures. This analysis revealed that Reward Responsiveness remained a (marginally) significant predictor of narrowed attention (β = -.10, p = .08). In contrast, BIS was not a significant predictor of narrowed attention (β = -.05, p = .32). However, a one-tailed test of the difference between correlations with one variable in common revealed no difference between correlations, z = 0.46, p = .32.

Picture ratings. Anger pictures were rated as more negative (M = 7.47, SD = 1.46) and arousing (M = 4.77, SD = 2.01) than neutral pictures (M = 4.46, SD = 1.06; M = 7.15, SD = 1.57, respectively), ts > 11.32, ps < .0001. A 2 (picture type: neutral, anger) × 5 (emotion rating: angry, sad, proud, determined, fear) within-subjects ANOVA revealed a significant interaction, $F(4, 436) = 138.37$, $p < .0001$, $\eta_p^2 = .55$. Follow-up analyses revealed that participants reported feeling more angry, sad, determined, and fearful toward the anger (vs. neutral) pictures (ps < .0001), but they reported feeling equally proud when viewing the anger and neutral pictures, p = .84. Importantly, participants reported feeling more anger than any other emotion toward the anger pictures, ps < .081. Participants reported feeling greater sadness than pride, determination, and fear to the anger pictures, ps < .0001. They also reported feeling greater fear toward the anger pictures than determination and pride (ps < .0001), and greater determination than pride, p < .0001. These results suggest that participants experienced a variety of emotions to anger pictures, but anger was the most intense emotion they experienced.

We correlated the BIS/BAS scales with anger ratings. Higher overall BAS related to more anger after anger pictures, r = .24, p = .01. Reward Responsiveness and Drive related to more anger after anger pictures, r = .31, p = .001, r = .19, p = .05. Fun-Seeking did not relate to anger ratings to anger pictures, r = .08, p = .39. BIS was also related to anger ratings after anger

pictures, $r = .27$, $p = .004$. Similar to past research, these results show that both BAS and BIS are related to the anger ratings (Carver, 2004; Gable & Poole, 2012; Harmon-Jones, 2003; Smits & Kuppens, 2005). Self-reported arousal and anger to anger pictures did not relate to attentional narrowing, $r = -.07$, $p = .45$; $r = -.009$, $p = .92$. This latter result is consistent with past research which found that self-reported affect variables did not relate to attentional narrowing (Gable & Harmon-Jones, 2008, 2010, 2011, 2012, 2013).

Discussion

Study 2 found that attentional scope was narrowed when participants were in an approach-motivated anger state as compared to a neutral state. These results conceptually replicate those of Study 1. In addition, Study 2 demonstrated that individual differences in approach motivation (specifically, Reward Responsiveness) related to a more narrow attentional scope after anger pictures. Together, these results support that anger narrows attentional scope and this narrowing is related to individual differences in approach motivation.

Consistent with the current results, past research has found that BAS Reward Responsiveness relates to experiences of anger (Carver, 2004; Gable & Poole, 2012; Harmon-Jones, 2003; Wingrove & Bond, 1998). Carver and White (1994) conceptualized Reward Responsiveness as being one manifestation of the behavioral approach system. Why did Reward Responsiveness in particular relate to narrowed attention? A possible reason is suggested by the fact that the images used in this study portrayed situations in which already acquired incentives or beliefs about justice were now in danger of being lost. Perhaps the violation of these preexisting beliefs could be thought of as the loss of some previously-attainted reward. Thus the experience of anger most closely related to Reward Responsiveness. This view of Reward Responsiveness in anger states is similar to that proposed by Carver (2004), who found that

Reward Responsiveness but not other BAS subscales predicted anger to situations in which acquired incentives were in danger of being lost.

The current findings that BIS and BAS are related to narrowing during anger states is consistent with some studies which have found that both behavioral approach and avoidance relate to anger (Carver, 2004; Cooper et al., 2007; Gable & Poole, 2012; Harmon-Jones, 2003; Smits & Kuppens, 2005). However, in this past work, these relationships were differentially associated with the way anger is expressed. BAS was positively associated with external expressions of anger, but BIS was inversely related to outward expressions. In addition, in this past work, when both BIS and BAS were entered into regression models to predict anger, only BAS remained a significant predictor of anger (e.g., Carver, 2004; Harmon-Jones, 2003). Similarly, in the current study, when both BIS and BAS were into a regression model to predict attentional narrowing during anger states, only BAS was a significant predictor. However, because of the novel association between BAS and narrowing and the magnitude of the relationship between BIS and narrowing, we replicated the methods of Study 2 in a subsequent study to assess whether these results would replicate.

Study 3

Method

One hundred seventy four introductory psychology students (65 females) provided informed consent and participated in exchange for partial course credit. Participants completed Carver and White's (1994) BIS/BAS scales. The methods in Study 3 were identical to those in Study 2. Participants viewed anger and neutral pictures followed by Navon (1977) letters. Trials with incorrect responses and trials on which the RT was more than three standard deviations

from the mean for that stimulus were excluded from analyses (after anger pictures: 3%; after neutral pictures: 3%). One participant was excluded from analyses because they had an outlying BAS score (> 3 SDs from the mean). Finally, participants viewed and rated the anger and neutral pictures again using the same scales as Study 2.

Results

Local-Global reaction times to Navon letters task. A 2 (picture type: anger or neutral) × 2 (target type: local or global) within-subjects ANOVA revealed a significant interaction, $F(1, 172) = 21.77$, $p < .001$, $\eta_p^2 = .11$ (See Figure 3). Follow up analyses revealed the following effects. After neutral pictures, participants responded faster to global ($M = 6.74$, $SD = 0.21$) than local ($M = 6.77$, $SD = 0.23$) targets, $p < .0001$, replicating the global bias found in Studies 1 and 2. After anger pictures, participants' response times did not differ between global ($M = 6.79$, $SD = 0.21$) and local ($M = 6.79$, $SD = 0.23$) targets, $p = .11$. These results suggest that anger eliminated the typical global bias. Also consistent with the hypothesis, participants responded slower to the global targets after anger pictures than after neutral pictures, $p < .0001$. RTs to local targets were slower after anger pictures than after neutral pictures, $p = .03$. These latter results suggest that anger pictures caused a trend toward a general slowing of reaction times to both types of Navon target letters. Consistent with Study 2, the interaction revealed that this slowing primarily occurred to global rather than local targets, consistent with the hypothesis that anger would narrow cognitive scope.

Local-Global reaction times relating to BIS/BAS.

To test whether individual differences in approach motivation related to a more narrow or less broad cognitive scope after anger pictures, we examined the relationship between BAS and reactions to local targets after anger pictures, controlled for either local target reactions after

neutral pictures or global target reactions after anger pictures using partial correlations. Higher total BAS related to more narrowed attention after anger pictures (*partial r* = -.16, *p* = .03), controlling for local target reactions after neutral pictures. Reward Responsiveness and Drive were marginally related to more narrowed attention after anger pictures (*partial r* = -.14, *p* = .07; *partial r* = -.13, *p* = .09), controlling for local target reactions after neutral pictures. Fun-Seeking and BIS did not relate to narrowed attention after anger pictures (*partial r*s < .09, *p*s > .20), controlling for local targets after neutral pictures. target reactions after anger pictures. None of the BAS or BIS scales related to narrowed attention after anger pictures (*partial r*s < .09, *p*s > .24), controlling for global target reactions after anger pictures.

Picture ratings. Anger pictures were rated as more negative (*M* = 6.60, *SD* = 1.26) and arousing (*M* = 5.54, *SD* = 1.79) than neutral pictures (*M* = 4.20, *SD* = 1.26; *M* = 7.30, *SD* = 1.73, respectively), *t*s > 10.75, *p*s < .0001. A 2 (picture type: neutral, anger) × 5 (emotion rating: angry, sad, proud, determined, fear) within-subjects ANOVA revealed a significant interaction, $F(4, 680) = 177.50$, $p < .0001$, $\eta_p^2 = .52$.

We correlated the BIS/BAS scales with anger ratings. Higher overall BAS related to more anger after anger pictures, *r* = .27, *p* < .001. Reward Responsiveness and Drive related to more anger after anger pictures, *r* = .19, *p* = .01, *r* = .27, *p* < .001. Fun-Seeking did not relate to anger ratings to anger pictures, *r* = .11, *p* = .14. BIS was also related to anger ratings after anger pictures, *r* = .21, *p* = .006. Self-reported arousal and anger to anger pictures did not relate to attentional narrowing, *r* = -.08, *p* = .284; *r* = .06, *p* = .45.

Discussion

Study 3 replicated the results of Study 2 and found that attentional scope was narrowed when participants were in an approach-motivated anger state as compared to a neutral state. In

addition, Study 3 demonstrated that individual differences in trait approach motivation, as assessed by overall BAS, related to a more narrow attentional scope after anger pictures. There was no significant association between BIS and narrowing after anger pictures. These results provide further support that anger narrows attentional scope and this narrowing is related to individual differences in approach motivation.

To test whether anger would narrow cognitive scope at a more conceptual rather than perceptual level, we conducted a fourth study and measured cognitive categorization with a widely used measure of categorization (Isen & Daubman, 1984; Price & Harmon-Jones, 2010). Past research has shown that approach-motivated positive states cause participants to narrow their conceptual categories by excluding more items from a particular category (Price & Harmon-Jones, 2010). Thus, in Study 4 we manipulated an anger state or a neutral state before participants completed a cognitive categorization task. We predicted that participants would exclude more items from a category after viewing anger pictures than after viewing neutral pictures. In addition, we predicted that approach motivation toward the anger pictures would relate to a greater exclusion of items particularly after participants viewed anger pictures.

Study 4

Method

One hundred and nine introductory psychology students (74 females) provided informed consent and participated in exchange for partial course credit. In this study, participants completed a categorization task modeled after work by Isen and Daubman (1984). In the categorization task, participants were given one of four categories (e.g., vehicle). Then, they indicated to what extent specific items (e.g., car, camel) belonged in the category (Price & Harmon-Jones, 2010). For each category, participants were asked to rate 10 items on a seven-

point scale (1 = *definitely does belong to the category*, 7 = *definitely does not belong to the category*). Two strong, three moderate, and five weak items (exemplars) were presented for four categories. Exemplars were derived from Rosch's (1975) testing, and are consistent with other work using this task (Price & Harmon-Jones, 2010). Belongingness ratings were aggregated for strong, moderate, and weak exemplars across categories. Higher scores indicated more exclusion of the exemplar.

Each trial consisted of participants viewing an anger or neutral picture (6 s), then the category, item, and category-belongingness rating scale (4 s). Intertrial interval was two seconds. Participants completed a total of 20 anger and 20 neutral trials presented in a semi-blocked fashion. All pictures of one type (anger vs. neutral) were presented in a block. Block order and category type were counter-balanced between participants. Six participants' data were excluded from analyses because their category belongingness ratings were greater than three standard deviations from the mean and one participant was excluded because they did not complete the categorization measure.

After the categorization task, participants viewed the anger and neutral pictures again (2 s each), and indicated how positive (vs. negative) and arousing (vs. calming) each picture was (1 = *positive*/*excited*; 9 = *negative*/*calm*), as well as the degree to which they wanted to move toward or away from each picture (1 = *move toward*; 9 = *move away*). Ratings were aggregated within each picture type.

Results

Category belongingness ratings. A 3 (exemplar strength: weak, moderate, strong) × 2 (picture type: anger or neutral) within-subjects ANOVA revealed a significant interaction, $F(2, 202) = 15.57$, $p < .0001$, $\eta_p^2 = .13$. Results showed a main effect for exemplar strength, $F(2, 202)$

= 265.11, $p < .0001$, $\eta_p^2 = .72$. Exemplar belongingness increased from the weak to the moderate to the strong exemplars, suggesting that participants accurately judged exemplar belongingness. In addition, there was a main effect for picture type, $F(1, 101) = 73.75$, $p < .0001$, $\eta_p^2 = .42$. After anger pictures, exemplars were rated as less belonging than after neutral pictures (see Figure 4). To unpack the significant interaction, follow-up analyses comparing each exemplar type after anger vs. neutral pictures were conducted. Participants were more narrow in their categorizations (i.e., rated exemplars as less belonging) after anger pictures than after neutral pictures to the weak, moderate, and strong exemplars, *p*s < .0001. These results suggest that anger caused a narrowing of cognitive categorization. It is important to note that participants in the angry state were still relatively accurate in their category judgments as evidenced by more inclusion of strong vs. moderate exemplars, and of moderate vs. weak exemplars (see Figure 2).

Picture ratings. Anger pictures were rated as more negative ($M = 6.07$, $SD = 2.03$) than neutral pictures ($M = 5.17$, $SD = 1.35$), $t(101) = 3.01$, $p = .003$. Participants rated the anger pictures ($M = 5.14$, $SD = 1.81$) and neutral pictures ($M = 5.47$, $SD = 2.11$) as equally arousing, $t(101) = 1.07$, $p = .29$. Participants reported no difference in their desire to move toward/away from the anger pictures ($M = 5.65$, $SD = 2.08$) and the neutral pictures ($M = 5.21$, $SD = 1.42$), $t(100) = 1.50$, $p = .14$. However, consistent with predictions, desire to move toward the anger pictures related to the exclusion of exemplars for the weak ($r = -.43$, $p < .001$), moderate ($r = -.57$, $p < .001$), and strong ($r = -.61$, $p < .001$) exemplars. Desire to move toward the neutral pictures was unrelated to exclusion of exemplars, *r*s < .14, *p*s > .16. Together, these results suggest that approach motivation to anger pictures related to more conceptual narrowing of categorization. Arousal toward the anger pictures related to the exclusion of exemplars for the weak ($r = .33$, $p = .001$), moderate ($r = .34$, $p < .001$), and strong ($r = .34$, $p = .001$) exemplars.

In contrast, arousal toward the neutral pictures was inversely related to the exclusion of exemplars for the weak (r = -.22, p = .027), but not the moderate (r = .08, p = .41), or strong (r = .04, p = .70) exemplars.

Discussion

Results of Study 4 further demonstrated that anger narrows cognitive scope by showing that participants became more exclusive in their categorization of exemplars after viewing anger pictures than after viewing neutral pictures. In addition, we found that approach motivation toward the anger pictures related to more exclusion of exemplars, further demonstrating a link between approach-motivated anger and narrowed categorization. Thus, measures of state approach motivation relate to anger narrowing cognitive scope.

General Discussion

We tested whether anger causes a relative narrowing of cognitive scope by investigating the effects of anger on perceptual attention and cognitive categorization, two of the most widely used measures of cognitive scope. Across four studies, results suggested that anger perceptually and conceptually narrows cognitive scope. That is, an approach-motivated negative state narrowed cognitive scope.

In Study 1, anger narrowed attentional scope relative to a neutral state. Moreover, anger narrowed attentional scope in a manner similar to positive affect high in approach motivation. Studies 2 and 3 provided additional support for the hypothesis by demonstrating that individual differences in behavioral approach motivation sensitivity related to a narrowed attentional scope after anger was evoked. Study 4 demonstrated that anger narrows cognitive processes in addition to attentional scope by showing that anger conceptually decreased cognitive breadth in a cognitive categorization task. In addition, approach motivation toward the anger pictures related

to this cognitive narrowing. Taken together, evidence from these studies supports the hypothesis that anger perceptually and conceptually narrows attentional scope. More importantly, these results with anger, an approach-motivated negative affect, expand past work on approach-positive and avoidance-negative affect, by demonstrating that motivational intensity per se narrows cognitive scope, regardless of its relationship with affective valence and motivational direction.

The linking of anger, an approach-oriented but negatively valenced state, with narrowed cognitive scope extends past research on motivational intensity and cognitive scope and provides important new support for the motivational intensity model of cognitive scope (Harmon-Jones et al., 2013). This extension is important because past research had only examined positive affects high in approach motivation and negative affects high in withdrawal motivation. Thus, prior to the current research, the motivational intensity model may not have been an adequate conceptualization of the influence of various affects on cognitive scope.

Individual Differences in Anger and Approach Motivation

The current research was based on past theory and evidence linking anger with approach motivation (see Carver & Harmon-Jones, 2009). Consistent with this past work and with the current predictions, individuals who were high in trait approach motivation (i.e., overall BAS and Reward Responsiveness) evidenced even more narrowing of attention following the evocation of anger (Study 2 and 3), and individuals who felt more approach motivated toward the anger-evoking stimuli evidenced more narrowing of categorization following the evocation of anger (Study 4).

The current results are the first to demonstrate that anger narrows cognitive scope. They suggest a novel mechanism by which anger may cause some of its more molar and obvious

outcomes. For example, anger may be related to aggressive behaviors, in part, because the narrowed cognitive scope associated with anger makes it less likely that angry individuals will see alternative ways of addressing the problem that caused the anger. Much research has revealed that individual differences in trait anger relate to differences in cognitive control particularly in hostile contexts (Wilkowski & Robinson, 2007, 2008; Wilkowski, Robinson, & Troop-Gordon, 2010). In particular, within hostile contexts, individuals who score lower in trait anger recruit more cognitive control resources than individuals who score higher in trait anger. This body of evidence may be conceptually connected with the present results in that a narrowed cognitive scope may undermine cognitive control within hostile or angry contexts. Future research is needed to test this interesting possibility.

This series of experiments contributes to the areas of motivation within personality psychology. The current results suggest that cognitive scope is driven by motivational intensity rather than emotional valence. Following from this line of research, we would predict that other individual differences related to approach motivation but more typically associated with positive affect (e.g., extraversion) may relate to attentional narrowing and may even contribute to approach-motivated anger. Evidence obtained from young children (4-9 years old) indicates an overlap of the temperaments of exuberance and anger (Deater-Deckard et al., 2010).

Do all instances of anger necessarily involve approach motivation or motivationally intense states? Based on past research, we suggest that anger may not be associated with approach motivation when other avoidance motivational states (e.g., fear) are more strongly aroused (e.g., Zinner, Brodish, Devine, & Harmon-Jones, 2008), when opportunities to approach are blocked (e.g., Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, 2003), or in individuals whose anger is not approach oriented (e.g., Hewig Hagemann, Seifert, Naumann, & Bartussek,

2004; Kelley, Hortensius, & Harmon-Jones, 2013). These situations and/or individuals may experience approach-avoidance conflicts and consequently not be in a motivationally intense or focused state. Consequently, they should not show a more narrowed cognitive scope. Indeed, the current results support this interpretation by demonstrating that individuals high in trait (Study 2 & 3) or state (Study 4) approach motivation showed the most narrowing of cognitive scope.

Limitations and Future Directions

As in past studies demonstrating that affects high in motivational intensity narrow attention, one potential and almost inherent confound in the current studies is arousal. That is, stimuli used to induce high approach affect also induce high levels of self-reported arousal (Gable & Harmon-Jones, 2008a; 2008b; 2009; 2010b; 2011). Thus, perhaps arousal (i.e., a non-valenced, non-motivational arousal) is causing attentional narrowing, rather than motivational intensity, as we have posited (Gable & Harmon-Jones, 2010a; Harmon-Jones & Gable, 2008). We regard arousal as only a rough proxy for motivation and posit that arousal and motivation are not identical (Harmon-Jones, Gable, & Price, 2011).

We recently (Gable & Harmon-Jones, 2013) provided evidence in support of this view by testing whether manipulations of arousal (evoked with stationary bicycle pedaling), independent of affective motivation, modulate attentional scope and larger late positive potentials (LPPs), event-related brain potentials associated with motivated attention. Results revealed that appetitive (vs. neutral) pictures evoked greater attentional narrowing and larger LPPs over central and left-frontal regions. Individual differences in approach motivation predicted more attentional narrowing following appetitive stimuli. Manipulated arousal (vs. no arousal manipulation) increased heart rate. However, manipulated arousal did not influence attentional scope or LPPs to stimuli. Such results suggest that cognitive narrowing and neurophysiological

effects of affects high in motivational intensity are related to approach motivation rather than enhanced general arousal.

Study 2 and 3 found that anger pictures evoked other emotions in addition to anger, consistent with other research that has suggested anger often co-occurs with other negative emotions (Philippot, 1993). Despite anger being the most intense emotion evoked by the anger pictures, the anger pictures also evoked greater determination, sadness, and fear than neutral pictures. Because determination and sadness are associated with approach-related traits and states (Gable & Poole, 2012; C. Harmon-Jones et al., 2011; Harmon-Jones & Harmon-Jones, 2010), reactions to anger pictures seem to be predominantly approach-motivated. In addition, although the anger pictures evoked some avoidance (e.g., fear) in some individuals, individuals who were high in trait approach motivation (Study 2 & 3) or state approach motivation (Study 4) evidenced even more narrowing of cognitive scope following the evocation of anger.

In the present studies, we used affective pictures because they reliably evoke approach-motivated anger. Is it possible that emotional pictures in general evoke narrow cognitive scope? In past studies, we have found that affective pictures can narrow as well as broaden attentional scope depending on the motivational intensity evoked by the pictures. For example, Gable and Harmon-Jones (2010) demonstrated that affective pictures evoking low motivational intensity (e.g., sadness) broaden attentional scope, but affective pictures evoking high motivational intensity (e.g., disgust) narrow attentional scope. Thus, affective pictures (low in motivational intensity) have been shown to broaden attentional scope using emotional pictures.

Results of Studies 2 and 3 suggest that approach motivation may contribute only about 4% of the variance. This effect size is consistent with previous findings demonstrating trait BAS relates to attentional narrowing under high approach-motivated positive states (Gable &

Harmon-Jones, 2008). Together, these studies suggest that trait behavioral approach may only account for a small amount of the variance between anger and attentional narrowing. Although individual differences in BAS relate to anger, the correlation of BAS and anger is modest. As such, some individuals high in BAS may not be susceptible to anger, and these individuals may drive down the correlation of BAS with narrowing after anger is induced. Along these lines, Study 4 found that a measure of approach motivation for the angering stimuli specifically predicted about 30% of the variance in cognitive narrowing.

In other research derived from the conceptual model regarding the influence of motivational intensity on cognitive scope, we have found that manipulations of cognitive scope influence motivational intensity. Specifically, when participants were assigned to identify Navon letters with only local or global response, those who identified only global configurations had smaller electrophysiological reactions to appetitive stimuli in one study (Gable & Harmon-Jones, 2011) and aversive stimuli in another study (Gable & Harmon-Jones, 2012). Based on this past research, we could predict that a manipulated broadening of cognitive scope would influence responses to anger-inducing stimuli. Research has already begun testing this prediction, but more work is needed to fully understand the extent to which manipulated increases in the breadth of cognitive scope will reduce anger-related responses.

Conclusions

Research from over 15 published experiments conducted over the last five years has challenged the idea that positive affect broadens and negative affect narrows cognitive scope (for reviews, see Harmon-Jones, Gable, & Price, 2012, 2013). This new research was derived from a model concerned with the effects of motivational intensity on cognitive scope and the body of

research had revealed that: (1) positive affects high in approach motivational intensity narrowed cognitive scope; (2) negative affects high in avoidance motivational intensity narrowed cognitive scope; (3) positive affects low in approach motivational intensity broadened cognitive scope; and (4) negative affects low in avoidance and approach motivational intensity broadened cognitive scope. The present research addresses an important lacuna in past research on the effect of motivation on cognitive scope by testing the influence of a negative affect high in approach motivational intensity. Without this test, it was impossible to determine whether a combination of affective valence and motivational direction caused a narrowing of cognitive scope (i.e., approach-positive or avoidance-negative) or whether motivational intensity per se was responsible for the narrowing of cognitive scope. By discovering that anger, a negative affect associated with approach motivation, caused a narrowing of cognitive scope, the present research supported the motivational intensity model.

Footnotes

1. The following IAPS pictures were used in Study 1: neutral pictures (2038, 2190, 2210, 2214, 2215, 2396, 2397, 2440, 2441, 2493, 2493, 2499, 2516, 2595, 2890, 5531, 5535, 6150, 7002, 7006, 7010, 7020, 7034, 7035, 7038, 7056, 7059, 7160, 7161, 7170, 7175, 7179, 7185, 7187, 7211, 7217, 7233, 7235, 7247, 7640, 7950, 9070); and high approach-motivated positive pictures (1441, 1463, 1710, 1750, 1920, 2040, 2070, 2071, 2080, 2091, 2150, 2165, 2340, 2345, 2550, 4608, 4650, 4652, 4660, 4676, 4680, 4687, 4689, 4694, 4695, 7283, 7330, 7340, 7390, 7402, 7410, 7430).

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Figure 1. Study 1 reaction times for local and global targets as a function of condition. Asterisks indicate differences ($p < .05$) between local and global targets.

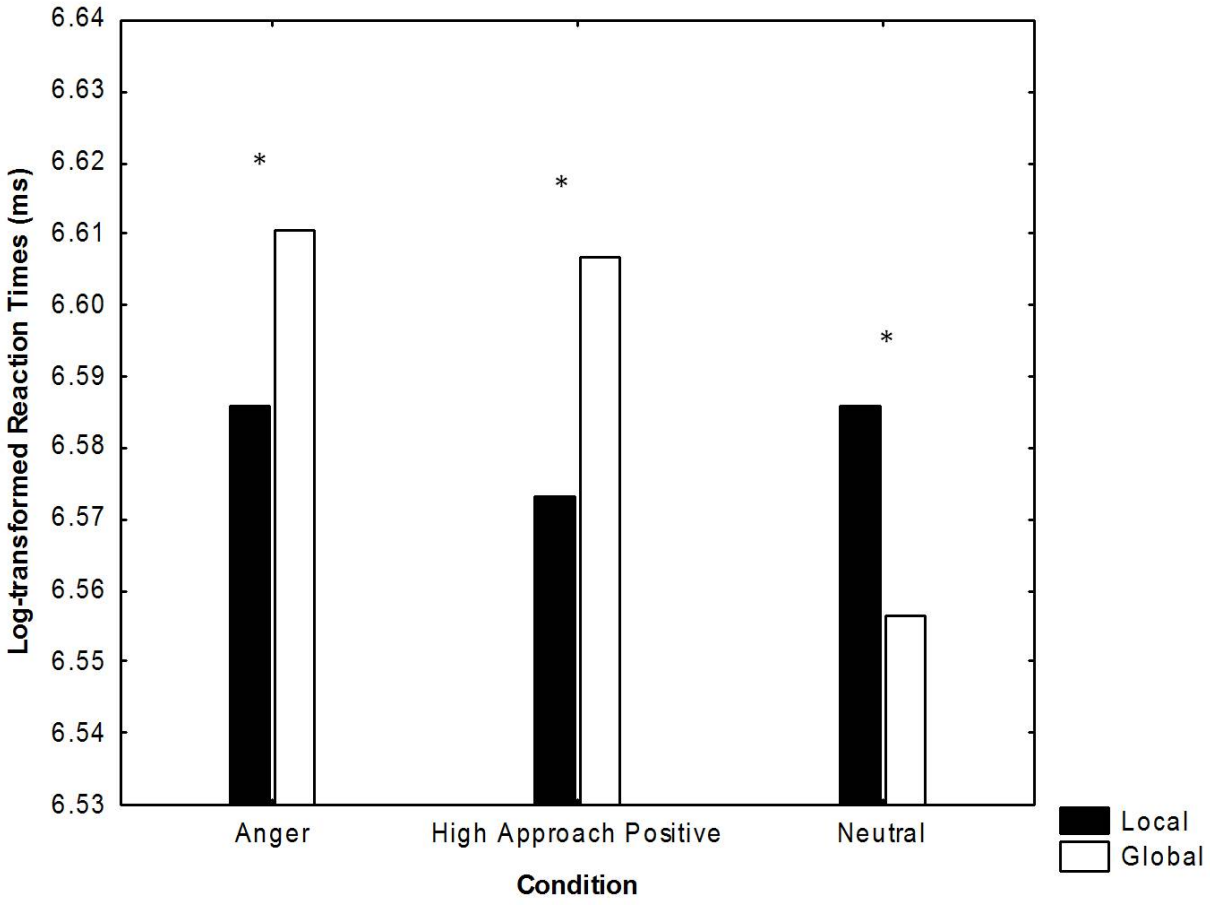

Figure 2. Study 2 reaction times for local and global targets as a function of condition. Asterisks indicate differences ($p < .05$) between local and global targets.

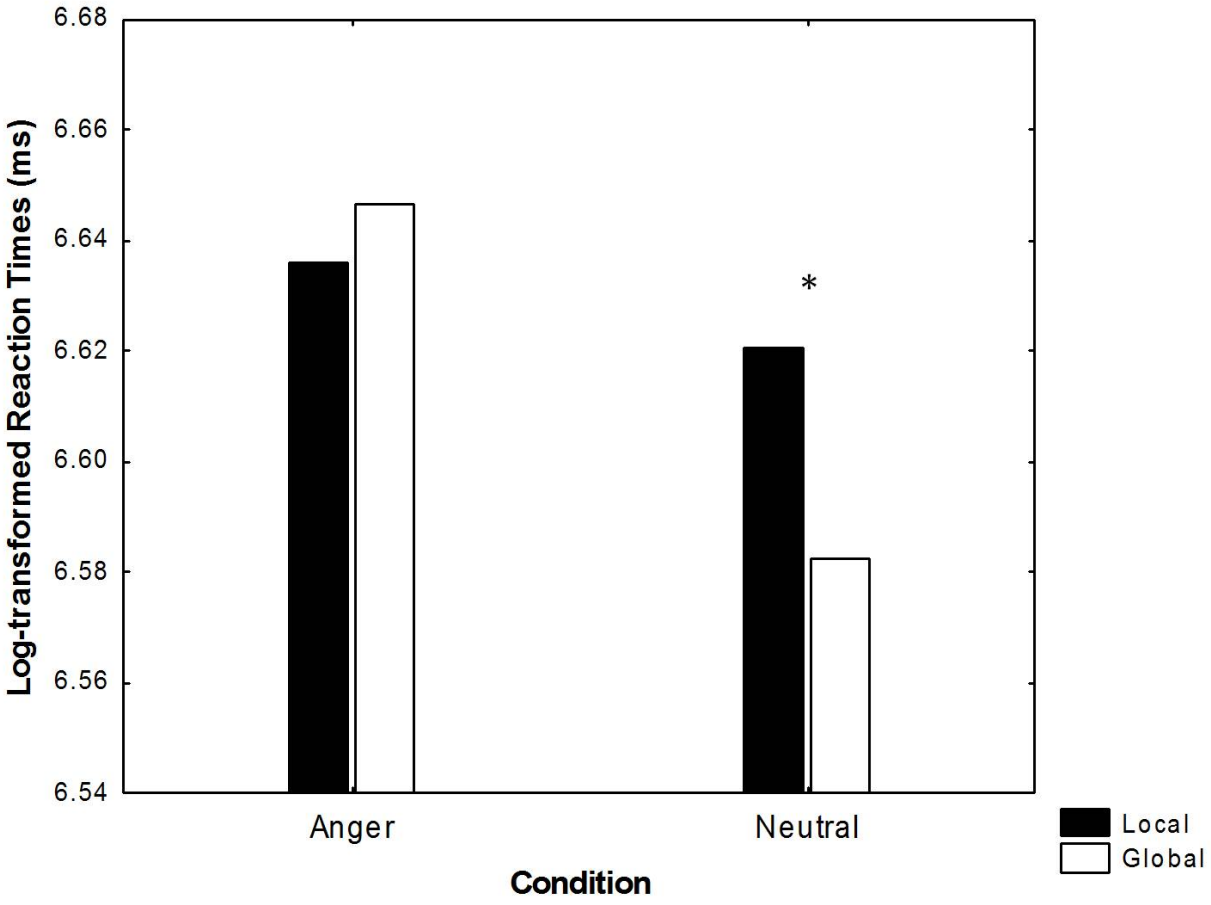

Figure 3. Study 3 reaction times for local and global targets as a function of condition. Asterisks indicate differences ($p < .05$) between local and global targets.

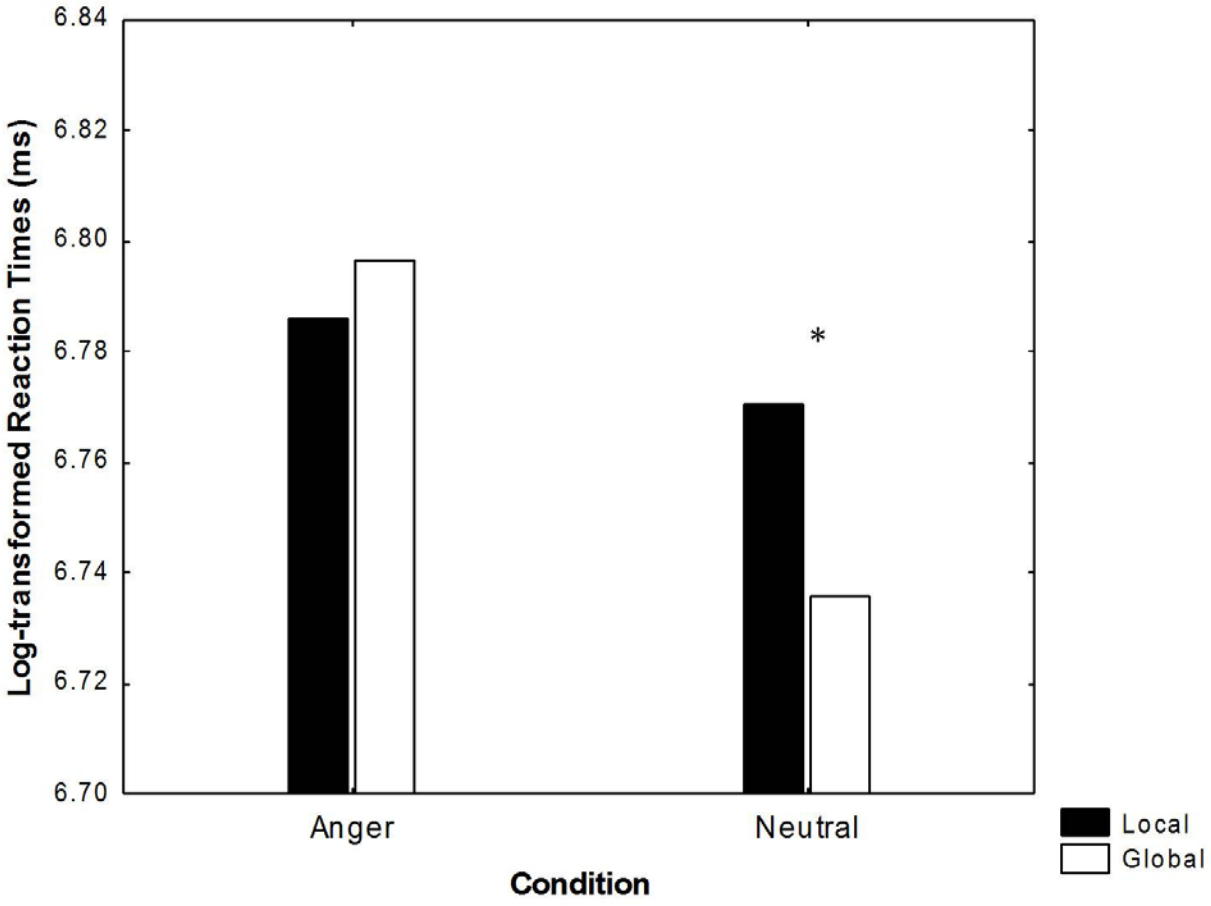

Figure 4. Study 4 average item ratings as a function of item belonging-strength and picture type. Ratings were made on a 1 (*definitely does belong to the category*) to 7 (*definitely does not belong to the category*) scale. Higher scores indicated more exclusion (less belonging) of the exemplar items. Asterisks indicate differences ($p < .05$) between weak and moderate, and moderate and strong items.