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Emotion Guided Threat Detection: Expecting Guns Where There Are None

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Five experiments examine whether the ability of emotions to influence judgments of threat extends to a very basic process inherent in threat detection: object recognition. Participants experiencing different emotions were asked to make rapid judgments about whether target individuals were holding guns or neutral objects. Results across 4 experiments supported the hypothesis that anger increases the probability that neutral objects will be misidentified as ones related to violence, but not the converse. Of import, the findings demonstrate that this bias is not a simple function of the negative valence of an emotional state, but stems from specific threat-relevant cues provided by anger. Direct manipulation of participants' expectancies for encountering guns in the environment is shown not only to remove the bias among angry individuals when set to be low but also to produce a corresponding bias among neutral participants when set to be high. A 5th study demonstrates that the bias is amenable to correction given sufficient ability.

Keywords: anger, shooter bias, emotion specificity, threat detection, expectancies

The death of 23-year-old Amadou Diallo, who was shot and killed on February 4, 1999 by New York City Police officers, stands in most people's memories as a tragic example of rapid threat detection gone wrong. When the young African American man reached into his jacket to produce his wallet and identification, police officers—believing that he was in fact reaching for a gun—opened fire, shooting Diallo 19 times. Unfortunately, this incident and the subsequent upheaval it sparked do not represent an isolated event of the past. As a recently released video from a U.S. Army engagement in 2007 shows, threat detection based on the erroneous identification of objects seems to be capable of happening in any charged environment. In this case, an Army Apache helicopter crew mistakenly attacked and killed a Reuters photographer, Namir Noor-Eldeen, during a conflict in Baghdad. The leaked video clearly shows the helicopter gunners identifying Noor-Eldeen as holding a weapon before requesting permission to engage, when in fact he was merely holding a camera with a telephoto lens (Carey, 2010).

In cases such as Diallo's and Noor-Eldeen's, research has begun to illuminate the ways that race and racial stereotypes may exert influence on threat detection (Correll, Park, Judd, & Wittenbrink, 2002; Correll, Park, Judd, Wittenbrink, Sadler, & Keesee, 2007; Payne, 2001; Payne, Shimizu, & Jacoby, 2005). In such cases, people appear to rely on information contained in racial or ethnic stereotypes, which suggest higher likelihoods of violence or aggression, when making rapid decisions about danger. However, stereotypes are not the only factors that can provide information, accurate or not, about the actions of others in one's environs. For example, what if Diallo or Noor-Eldeen had been social actors of White European descent? Might there be other elements of the situation that could impact judgments of their threat level and lead to similarly grievous outcomes?

Situations involving the need to assess threats can frequently occur in the presence of heightened emotional states. What if police officers were angered by chasing the suspect first, or had just come from a particularly heated argument with a superior? What if on the battlefield, the soldiers were feeling quite angry or afraid when they had to judge whether another combatant was a potential danger? It seems probable that individuals' emotional states might constitute a primary influence on threat detection, particularly in situations where an intuition or feeling could mean the difference between life and death. As such, conflict-relevant emotions might well be expected to push individuals' judgments toward favoring the existence of a threat, thereby leading them to actively aggress against others who may not have posed an actual danger.

When encountering environs that may pose some kind of threat, especially a threat to physical safety, people likely draw upon all informational resources available to them. Moreover, detection of threat often occurs automatically, without conscious awareness or control, as the body prepares itself for rapid action in the face of relevant dangers (Ellsworth & Scherer, 2003; Fazio, 2001; Öhman, Hamm, & Hugdahl, 2000). Many posit that emotions evolved to function in just this manner: to provide pertinent information about one's immediate surroundings and to help people to act efficiently to address threats or to gain rewards. Emotions are theorized to "sensitize organisms to stimuli and give priority to responses of relevance to the particular state" (Wiens & Öhman, 2007, p. 257; cf. Frijda, 1986; LeDoux & Phelps, 2000). That is, emotions provide an evaluative gauge for one's surroundings and recruit one's resources for appropriate action (Barrett, Mesquita, Ochsner, & Gross, 2007; Clore, Gasper, & Garvin, 2001; Ellsworth &

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Scherer, 2003; Schwarz & Clore, 2007). The emotional system, therefore, may play an important role in automatic threat detection, acting first as an alarm system and second to prepare the mind and body to deal with what comes next. In short, once evoked, a central function of emotions is to provide information meant to "tune" subsequent thought and action to address potential challenges in one's environs (Barrett et al., 2007; Clore et al., 2001; Schwarz & Clore, 2007; Smith & Lazarus, 1990).

Situational Influences on Automatic Threat Detection: Is It a Gun or Not?

As previously noted, recent work has demonstrated how stereotypes associated with racial categories of individuals influence rapid threat detection (Correll et al., 2002; Correll, Park, Judd, & Wittenbrink, 2007; Correll, Park, Judd, Wittenbrink, Sadler, & Keesee, 2007; Payne, 2001; Payne et al., 2005). For example, Correll and colleagues (Correll et al., 2002; Correll, Park, Judd, & Wittenbrink, 2007; Correll, Park, Judd, Wittenbrink, Sadler, & Keesee, 2007), utilizing a task frequently termed the shooter bias paradigm, have shown that a target's membership in social groups associated with stereotypes of violence leads to increased erroneous judgments that the target may pose a threat. In the paradigm, participants play a perceptual game where they are forced to make rapid judgments about whether to "shoot" different target individuals. The stimuli depict target individuals embedded within complex background street scenes who are either holding a gun or an everyday object (e.g., a wallet, a camera, a soda can, or a cell phone). Participants are given less than a second to decide whether to shoot each target person, the goal being to shoot armed targets while not shooting unarmed targets as they appear.

In accord with other findings on race and weapons misidentification (e.g., Payne, 2001), Correll et al. (2002) found that participants' performance differed on the basis of the race of the target individual. When given very limited time to make a decision, participants made more errors shooting unarmed African American targets than unarmed White targets and made more errors not shooting armed White targets than armed African American targets. In other words, participants more often mistakenly evaluated African American targets as threatening compared to White targets and more often mistakenly evaluated White targets as nonthreatening compared to African American targets. Ostensibly, the automatic activation of stereotypes (i.e., spontaneously associating African American target individuals with violence) interfered with participants' ability to accurately evaluate potentially threatening individuals throughout the task. That is, activating beliefs associated with the stereotype increased participants' expectancy of encountering a threatening or violent stimulus, leaving participants more willing to "shoot" regardless of what stimulus actually appeared. Accordingly, it appears that the race of individuals like Diallo and Noor-Eldeen may have, in essence, set the priors for what the police officers and soldiers expected to encounter at those crucial moments, thereby increasing the likelihoods for certain interpretations and ensuing actions.

Social categories such as race undoubtedly influence expectancies for interactions in any given situation. Yet, information regarding the nature of one's environs stems from other psychological sources as well. As noted, providing information about threats and challenges in the immediate environment is a primary function of emotions (Schwarz & Clore, 2007). Accordingly, we believe it likely that the emotional states of perceivers will directly impact rapid decisions involving threat assessment.

Much research has examined the influence of emotions on perceptions of the risk or probability that specific events will occur, with results repeatedly demonstrating a clear impact of affective states on the computation of such likelihood estimates (DeSteno, Petty, Wegener, & Rucker, 2000; Johnson & Tversky, 1983; Lerner & Keltner, 2001; Loewenstein & Lerner, 2003). To arrive at such estimates, individuals often use the cues provided by their emotional states as a gauge for the status of their surroundings. For example, the experience of sadness leads people to inflate estimates for the occurrence of future events possessing an emotionally congruent overtone (e.g., losing a loved one to disease); similarly, anger leads people to inflate estimates for events possessing angering overtones (e.g., being stuck in traffic; DeSteno et al., 2000).

From a functional standpoint, it makes great sense that emotions bias such judgments because, once evoked, emotions subsequently prepare organisms to respond adaptively to salient or emerging challenges. Under canonical circumstances (though certainly not all), the evocation of an emotion, such as anger or fear for example, would stem from a source in one's immediate environment. Thereby, any subsequent emotion-induced increase in expectancies for aggressive or dangerous events would prepare individuals to respond more efficiently to the respective challenges posed by their surroundings. Indeed, Clore et al. (2001) have convincingly argued that information provided by the emotional system is meant to facilitate immediate action by helping individuals seize valuable opportunities or cope with ensuing dangers.

Presuming that the emotional system is functional, we theorized that emotional states should influence threat detection only to the degree that they provide information about the costs or opportunities of acting in a given environment. In essence, applicable emotions should set the priors for threats the mind "expects" to see and thus introduce a bias that is characterized by increased vigilance for the relevant threat. To demonstrate the specificity of any influence emotions may have on automatic threat detection, we designed an initial experiment to compare the effect of an applicable negative emotion (i.e., anger) to the effect of a nonapplicable emotion (i.e., happiness) using the shooter bias paradigm (Correll et al., 2002) with only White targets. In this way, we could assess the impact of emotion as distinct from intergroup prejudices. Such separation is necessary, as recent work has shown that happiness, long known to increase heuristic processing and thereby reliance on stereotypic knowledge (Bodenhausen, Mussweiler, Gabriel, & Moreno, 2001; Fredrickson & Branigan, 2005), can increase judgments that minority targets such as Arabs possess guns, resulting in more frequent mistaken "shootings" of Arab men within the context of the shooter bias paradigm (Unkelbach, Forgas, & Denson, 2008). When stereotypic knowledge or group prejudices are removed from consideration, we believe that anger, through signaling conflict in the environment, will increase perceptions of threat for any generic social targets (i.e., those not associated with stereotypes indicative of violence). That is, we expect that angry individuals will more frequently misidentify a neutral object as a gun than the converse. However, given that stereotypes based on social group differences in violent behavior are not associated with our targets, we expect that happiness will fail to systematically bias threat detection.

Assuming the predicted bias is found, Study 2 seeks to provide a replication of the effect while also examining its level of specificity with respect to distinct negative emotional states. Studies 3 and 4 explore the potential mediating role of expectancies in the predicted bias. By directly manipulating participants' expectancies of encountering threatening stimuli, we attempt to block the biasing effect of anger on threat detection as well as produce a matching bias in the absence of anger. In essence, by directly manipulating the predicted mediator, we are able to infer its potential causal role. Finally, Study 5 will investigate potential boundary conditions for the predicted bias in an attempt to examine whether it is amenable to correction.

Study 1

Given that a primary function of emotions is to shape cognition toward adaptive ends, the influence of emotion on threat assessment should not be limited solely to effortful calculations concerning the presence of potential dangers or rewards (e.g., probability judgments) but should also be evident in more basic and rapid processes relevant to assessing challenges posed by one's surroundings. We expect that emotional states, through providing feedback to the mind, should influence judgments of perceptual categorization (cf. Niedenthal, 2007). Simply put, feeling that something is likely to be in one's environment should increase the odds that one will claim it is there, even when it is not actually present.

To examine this possibility, we made two modifications to Correll et al.'s (2002) original shooter bias paradigm. First, we held the ethnicity of targets constant (i.e., White) while still manipulating the type of objects held by targets (gun vs. neutral object). Second, we had participants simply identify the object being held by targets as opposed to having them decide whether to shoot the target. We made this modification in order to remove any basic link between induced emotions (e.g., anger) and direct, aggressive action tendencies (e.g., shooting someone).[1] That is, we wanted the primary decision to be one of identification as opposed to one of aggressive behavior.

We predicted that an applicable emotion, anger, through signaling a sense of threat, would make participants more likely to identify stimuli as guns, regardless of what is actually presented. Therefore, we expected that angry participants would make significantly more errors claiming that neutral objects were guns than errors claiming guns were neutral objects. Conversely, participants experiencing happiness or a neutral emotional state should not exhibit biased error rates. That is, experiencing an emotional state that is not indicative of enhanced threat should fail to influence participants' expectancies for encountering threatening stimuli and thus should not affect performance. Consequently, we expected that these participants would make approximately equivalent numbers of errors identifying neutral objects as guns as vice versa.

Method

Participants. Eighty-four undergraduates (49 women and 35 men) participated in partial fulfillment of a course requirement and were randomly assigned to one of three emotion conditions: neutral, angry, and happy. Some participants were removed from the analyses through the screening process described below.

Procedure. Participants were seated in front of computers in individual cubicles. They were informed that they would be completing several tasks meant to assess their cognitive abilities: a memory task, a hand–eye categorization task, and a short questionnaire. The hand–eye categorization task occurred in two blocks, with the memory measure occurring between the two. The memory measure, which involved recalling and describing in writing an emotionally evocative memory, actually functioned to induce the assigned emotional state. The blocks of the categorization task constituted the practice and critical trials for the primary dependent variable. Following the critical trials of the task, participants completed a manipulation check and measures collecting demographic information.

Manipulations and measures.

Emotion induction. Under the assumption that they were completing a memory task, participants were asked to write in detail about one of three types of events: their daily routine (neutral condition), an event that made them angry, or an event that made them happy (DeSteno, Dasgupta, Bartlett, & Cajdric, 2004). Participants were given 7 min to describe this memory. Written descriptions were checked to assure that they were in accord with the directions provided and, in the anger condition, to make certain that they did not detail any events involving direct violence and/or guns, which might suggest a direct influence of accessibility on subsequent judgments. Participants who generated descriptions that did not meet these criteria were removed from the sample prior to all analyses ($n = 6$).

To check the effectiveness of this manipulation, participants completed a questionnaire at the end of the experiment that contained a number of feeling descriptors. Participants indicated the degree to which each of the items described their feeling state using 7-point scales. Happiness was measured as the mean response to three items (Cronbach's $\alpha = .93$): happy, content, and pleasant. Anger was measured as the mean response to three items (Cronbach's $\alpha = .94$): angry, annoyed, and irritated.

Threat detection measure. All stimuli were obtained from Joshua Correll and are described in detail in Correll et al. (2002). The 10 target individuals (all of apparent White European ancestry) each appeared twice holding a gun and twice holding a neutral object of similar size and color (i.e., camera, wallet, soda can, cell phone), resulting in a total of 40 targets. Background images consisted of several different urban and suburban scenes (e.g., park, train station, street corner). For each of the 40 trials, participants were asked to identify the object being held by the target individual. The *z* and forward-slash keys were clearly marked as the gun and object responses, respectively.

During each trial, participants were randomly shown between one and four background images (the images themselves also

[1] Given the results of Unkelbach et al. (2008), it is very unlikely that negative emotions produce an effect on the shooter bias paradigm by increasing a general tendency to "shoot." Indeed, their work shows an enhancement of "shooting" certain types of targets when feeling happiness, an emotion known to decrease aggressive responses. As such, the effects of emotion appear to influence object identification in this paradigm and not generalized aggressive behavior.

being chosen at random from the total collection of background images), each for a random length of time between 500 ms and 1,000 ms. The final background image was then replaced by a target image, which consisted of the same final background image with a target individual embedded within it. From the point of view of the participant, the target individual simply appeared in the final background image following some random interval. The randomization of number and duration of background images was meant to keep the presentation of this target individual variable between trials and thus prevent participants from knowing when to expect a target individual to appear. The target image was displayed for 750 ms, and participants were asked to decide whether the target individual was holding a gun or a neutral object within that same 750 ms. Whenever participants did not respond within the 750-ms window, they received a message to speed up their future responses. No feedback about accuracy was given. In order to encourage participants to perform their best on the threat detection measure, they were informed that the top 20 scores (based upon the speed and accuracy of their responses) would be placed in a raffle for $100 at the end of the experiment.[2]

Prior to the emotion manipulation, participants engaged in a block of 10 practice trials. The practice trials were composed of different but similar target individuals and background images than those presented in the critical trials. This block was meant to familiarize participants with the nature of the task without allowing them to become familiar with the actual stimuli. Participants who failed to respond within the 750-ms window on nine or more of the critical trials (2 *SD*s above the mean number of trials on which participants failed to respond) were excluded from all analyses ($n = 6$). In addition, participants whose overall error rate exceeded 40% (2 *SD*s above the mean overall error rate) were excluded from all analyses ($n = 5$).[3] This resulted in a final sample of 67 participants (21 neutral, 25 angry, and 21 happy).

Results

Emotion manipulation check. A series of one-way analyses of variance (ANOVAs; one for each measured emotion: happiness and anger) confirmed the effectiveness of the emotion manipulations across induction conditions (Fs > 44.76, ps < .001). Paired comparisons revealed that happy participants experienced significantly more happiness ($M = 4.11$, $SD = 0.96$) than angry ($M = 1.72$, $SD = 0.66$) or neutral ($M = 2.98$, $SD = 0.97$) participants (ts > 3.95, ps < .001). Similarly, angry participants experienced significantly more anger ($M = 3.63$, $SD = 1.08$) than happy ($M = 1.43$, $SD = 0.49$) or neutral ($M = 1.69$, $SD = 0.83$) participants (ts > 6.76, ps < .001).

Error rates. A planned interaction contrast on error rates depicting an enhanced bias to perceive guns among angry participants confirmed the predicted moderation of error rates by emotion, $F(1, 64) = 10.91$, $p < .05$.[4,5] Angry participants were significantly more likely to misidentify an object as a gun than vice versa, paired $t(24) = 3.02$, $p < .01$, whereas type of error did not significantly differ among happy or neutral participants (paired ts < 1.73; see Figure 1). No significant main effects for emotion condition or error type emerged.

Signal detection analysis. To further investigate the nature of this bias, we subjected the data to a signal detection analysis, defining correctly identifying a gun as a *hit* and incorrectly identifying a neutral object as a gun as a *false alarm*.[6,7] We first calculated a decision criterion parameter (c), which can be thought of as a threshold mark before which participants always decide to press *object* and beyond which they always decide to press *gun*. Note that in order to investigate bias we centered the threshold at the midway point between distributions (Wickens, 2002): $c = -z(f) - 1/2d'$. Therefore, a positive value for c indicates a bias toward responding *object*, a negative value for c indicates a bias toward responding *gun*, and $c = 0$ indicates no bias in responding (i.e., the threshold falls directly between the object and gun distributions). In accord with previous findings concerning the role of race in automatic threat detection (Correll et al., 2002), we predicted that the value of c would be significantly negative for participants in the anger condition while failing to reach significance for participants in either the neutral or happy emotion conditions.

Criterion values for neutral ($c = .04$, $SD = .21$) and happy ($c = -.01$, $SD = .22$) participants did not differ from zero (ts < 0.78), thereby demonstrating the absence of response bias. As expected, however, the criterion value for angry participants ($c = -.10$, $SD = .21$) did significantly differ from zero, $t(23) = 2.35$, $p < .05$, indicating a bias toward responding *gun*. A planned contrast on these idiographic scores revealed that c was significantly lower in the anger condition compared to the other two emotion conditions, $t(59) = 2.10$, $p < .05$. Therefore, although neutral and happy

[2] The $100 was actually paid out to the winner of a random drawing from all participants in the study, and a separate drawing took place for each study.

[3] Because the meaning of a response outside the given 750-ms window is unclear, we chose to remove participants who repeatedly failed to respond in a timely manner so as to limit the influence of such instances in the analyses. We also screened for high overall error rates in order to eliminate participants for whom the task seemed unduly difficult, as the distribution of their errors was likely not the product of any experimental manipulation. In this and all other studies in the article, the exclusion of participants due to high time-out rates or overall error rates did not affect the overall pattern of results.

[4] Trials where participants exceeded the 750-ms response window were not included in error rate calculations. Error rates reflect the number of object (or gun) errors divided by the total number of valid trials. Object errors refer to errors on object trials, where participants wrongly claimed a neutral object was a gun. Gun errors refer to errors on gun trials, where participants wrongly claimed a gun was a neutral object.

[5] The contrast was doubly centered with weights of ± 2 for angry participant error rates and ± 1 for the remaining cells. The contrast residual was not significant. Residuals for all other contrasts presented in the article are also nonsignificant unless otherwise noted.

[6] False alarm rates (f) were calculated by dividing the number of errors on object trials by the total number of valid object trials for each participant. Hit rates (h) were calculated by dividing the number of correct classifications on gun trials by the total number of valid gun trials for each participant. Sensitivity values (d') were calculated for each participant from the following formula: $d' = z(h) - z(f)$.

[7] Because some participants possessed a false alarm rate of 0 or a hit rate of 1 (and these extreme values result in infinite z scores), we used a procedure recommended by Wickens (2002) and set a minimum false alarm rate of $\frac{1}{(n+1)}$ and a maximum hit rate of $1 - \frac{1}{(n+1)}$, where n represents the number of valid object and gun trials, respectively.

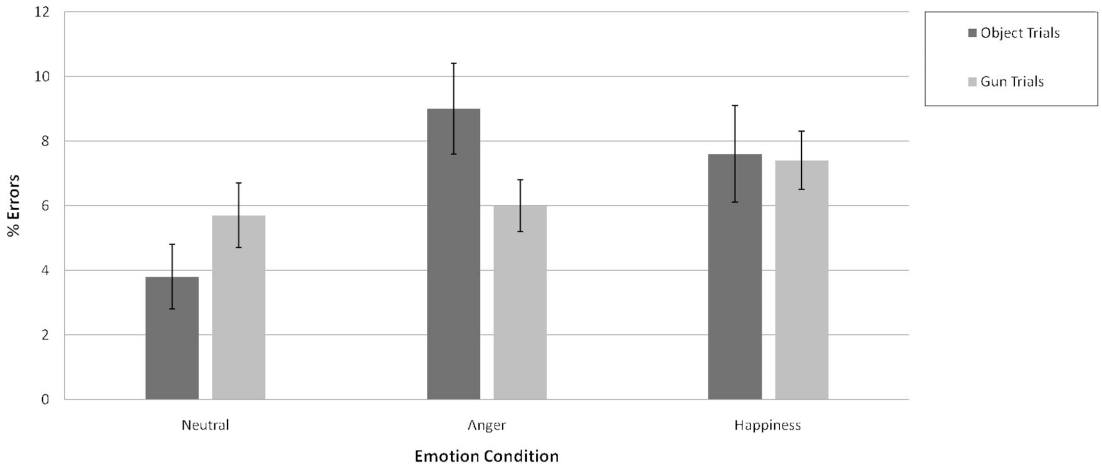

Figure 1. Error rate as a function of stimulus type and emotional state in Study 1. Error bars equal ±1 *SE*.

participants did not show a bias in object identification, angry participants evidenced a clear bias toward identifying stimuli as guns.

In addition, although we had no specific hypotheses regarding sensitivity, examination of the sensitivity parameter (d') revealed that it was significantly greater than zero in all conditions (ts $>$ 12.71), indicating that participants in all conditions were able to distinguish between trials containing guns and trials containing neutral objects.[8] However, sensitivity did not significantly vary among the emotion conditions.

Discussion

In signal detection analysis, it is assumed that noise (object) and signal (gun) trials vary along some judgment-relevant dimension. In the current investigation, that dimension could be thought of as how threatening a target individual appears to be. Presumably, targets holding guns should, by and large, be more threatening than targets holding neutral objects, as the gun signals a potential threat to one's physical safety. Results suggest that anger influences the types of errors participants are willing to make when detecting potential threats without influencing their sensitivity to the distinction between threatening and nonthreatening stimuli. If anger were increasing participants' sensitivity, we would expect that angry participants would make significantly fewer errors overall, with the underlying assumption being that anger enhances people's ability to differentiate between threats (guns) and nonthreats (neutral objects). As previously noted, however, the results suggest that this is not the case, as sensitivity was not significantly different across emotion conditions, and there was not a significant difference in overall error rates. Instead, anger appears to affect solely response bias, as the placement of angry participants' criterion value or decision threshold differed across conditions.

When participants are experiencing a neutral or nonapplicable emotional state (i.e., happiness), they make roughly equivalent proportions of errors claiming threatening targets are nonthreatening and vice versa. However, when participants are experiencing an emotional state that signals the presence of potentially violent or aggressive threats (i.e., anger), they make many more errors claiming nonthreatening targets are actually threatening than vice versa. That is, angry participants set a much lower threshold for saying that a target is holding a gun; they require much less information before they are willing to claim a target individual is threatening. Essentially, compared to participants in other emotion conditions, angry participants are more ready to identify as threatening even those target individuals who are inherently lacking on the judgment-relevant dimension (i.e., potential threat).

Thinking about this result from an evolutionary perspective, the influence of anger on criterion values should make great sense. Enhanced accuracy alone would not favor one's own safety and survival in the way that a biased decision criterion does. It is more adaptive to mistakenly harm a nonthreatening (unarmed) person than to risk being harmed or even killed by a threatening person; survival-wise, it is better to be safe than sorry when one's emotions are signaling the presence of potential dangers. Conversely, if an individual is experiencing an emotion that does not signal the presence of threats (i.e., happiness), he or she should not exhibit biased errors on a threat detection task. Although Study 1 demonstrated this to be the case with an emotion of positive valence (happiness), negatively valenced emotions that are not applicable in situations involving potential violent or aggressive threats should also fail to bias participants' performance on the current threat detection task.

Study 2

In Study 2, we sought to replicate and extend our initial demonstration of an emotion-specificity bias in automatic threat detection. More specifically, we explored whether specificity would exist, as predicted, with respect to different emotions of negative valence. According to a functionalist view, emotions

[8] Mean sensitivity values for each of the emotion conditions in Study 1 were as follows: neutral ($d' = 2.61$, $SD = 0.53$), anger ($d' = 2.19$, $SD = 0.73$), and happiness ($d' = 2.15$, $SD = 0.76$).

have specific informational and motivational, or goal-directed, components (Clore et al., 2001; Smith & Kirby, 2001; Smith & Lazarus, 1990). In line with this view of the emotional system is the idea that many emotion-based effects should be specific to only those emotional states that are informative concerning the situation at hand. That is, only when an environmental challenge could elicit a particular emotional state will the informational and motivational components of that emotion be applied to decisions about acting in that environment. Moreover, such effects should diminish or even disappear when less applicable emotional states are being experienced. Research in the area of emotion has revealed the prevalence of many emotion-specific effects. For example, anger and sadness have been shown to differentially affect likelihood estimates for angering and saddening future events (DeSteno et al., 2000). Similarly, anger and disgust have been shown to modulate implicit prejudice against outgroups as a function of applicability constraints; each emotion increased bias only for groups whose stereotype suggests a threat applicable to the emotion (Dasgupta, DeSteno, Williams, & Hunsinger, 2009).

In order to demonstrate that the bias identified in Study 1 functions in accord with applicability constraints, as opposed to simply representing a broad effect of emotional valence, we predicted that the error bias exhibited by angry participants—whereby participants misidentify more nonthreatening objects as guns than vice versa—would not necessarily be exhibited by participants who are experiencing any negative emotion. More specifically, we expected that participants experiencing negative emotional states that are not applicable to the gun–object judgment (e.g., sadness and disgust) would not demonstrate systematically biased error rates.

Method

Participants. One hundred and eighty-two undergraduates (105 women and 77 men) participated in partial fulfillment of a course requirement and were randomly assigned to one of four emotion conditions. Some participants were removed from the analyses through the screening process described below.

Procedure. The procedure for Study 2 was identical to that of Study 1 with the exception of the emotions induced. Here, we employed four emotion conditions: neutral, anger, disgust, and sadness. As in Study 1, participants were asked to write about a time when they experienced one of these emotions. Eleven participants (7.1%) were excluded because their written descriptions were not in accord with the directions provided or because they detailed events involving direct violence and/or guns.

Manipulations and measures.

Emotion manipulation check. At the end of the experiment, participants responded to a series of feeling descriptors on 7-point scales. Anger was measured as the mean response to three items (Cronbach's $\alpha = .90$): angry, annoyed, and frustrated. Disgust was measured as the mean response to three items (Cronbach's $\alpha = .83$): disgusted, sick, and queasy. Sadness was measured as the mean response to three items (Cronbach's $\alpha = .93$): sad, down, and gloomy.

Perception measure. As before, participants who did not respond within the 750-ms window on nine or more of the trials (2 *SD*s above the mean number of trials on which participants failed to respond) were excluded from all analyses ($n = 7$), and participants whose overall error rate exceeded 39% (2 *SD*s above the mean overall error rate) were excluded from all analyses ($n = 6$). Four additional participants were removed due to extremely aberrant emotion scores.[9] This resulted in a final sample of 154 participants (40 neutral, 42 angry, 37 disgusted, and 35 sad).

Results

Emotion manipulation check. A series of one-way ANOVAs (one for each emotion scale) confirmed the effectiveness of the emotion manipulations (Fs > 18.60, ps < .001). Paired comparisons revealed that angry participants experienced significantly more anger ($M = 3.65$, $SD = 1.13$) than neutral ($M = 1.95$, $SD = 0.89$), disgusted ($M = 2.41$, $SD = 1.17$), or sad ($M = 2.47$, $SD = 1.03$) participants (ts > 4.77, ps < .005). Similarly, disgusted participants experienced significantly more disgust ($M = 3.16$, $SD = 1.32$) than neutral ($M = 1.45$, $SD = 0.69$), angry ($M = 2.13$, $SD = 1.06$), or sad ($M = 2.18$, $SD = 0.88$) participants (ts > 3.69, ps < .005). Finally, sad participants experienced significantly more sadness ($M = 3.75$, $SD = 0.92$) than neutral ($M = 1.57$, $SD = 0.66$), angry ($M = 2.42$, $SD = 1.05$), or disgusted ($M = 2.01$, $SD = 0.99$) participants (ts > 5.85, ps < .001).

Error rates. A planned interaction contrast again confirmed the predicted pattern of bias in error rates, $F(1, 150) = 4.86$, $p < .05$.[10] As illustrated in Figure 2, angry participants made significantly more errors in calling a neutral object a gun than vice versa, paired $t(41) = 3.10$, $p < .005$, whereas participants in all other conditions (neutral, disgust, and sadness) did not demonstrate a significant difference in types of errors made (paired ts < 1.23, *ns*).

A 4 (emotion: neutral, angry, disgusted, sad) × 2 (error type: object vs. gun) ANOVA with error type as a repeated measures variable revealed a significant main effect for error type, suggesting that all participants made more object errors than gun errors, $F(1, 150) = 10.02$, $p < .005$. However, this main effect appears to be a function of the interaction, driven by the significant difference between error types in the angry condition alone.

Signal detection analysis. To further investigate the nature of this bias, the data were again subjected to a signal detection analysis. The criterion value for angry participants ($c = -.14$, $SD = .25$) was once again significantly less than zero, $t(41) = 3.30$, $p < .005$, indicating a bias toward responding *gun*. In addition, a planned contrast revealed that the criterion value was significantly lower in the anger condition compared to the other three emotion conditions, $t(150) = 2.11$, $p < .04$. The criterion values for neutral ($c = -.05$, $SD = .25$), disgusted ($c = -.03$, $SD = .21$), and sad participants ($c = -.05$, $SD = .23$) did not differ

[9] We trimmed the distributions due to the presence of four individuals (disbursed across conditions) whose emotion scores were highly deviant from the norms for their conditions (>2 *SD*s from the group mean and skewed to one tail). These individuals' scores most likely reflected preexisting highly intensified or flattened emotional states stemming from idiosyncratic factors. Their removal did not alter the general pattern of the findings.

[10] The contrast was doubly centered with weights of ±3 for angry participant error rates and opposite sign ±1 for the remaining cells. The contrast residual was not significant.

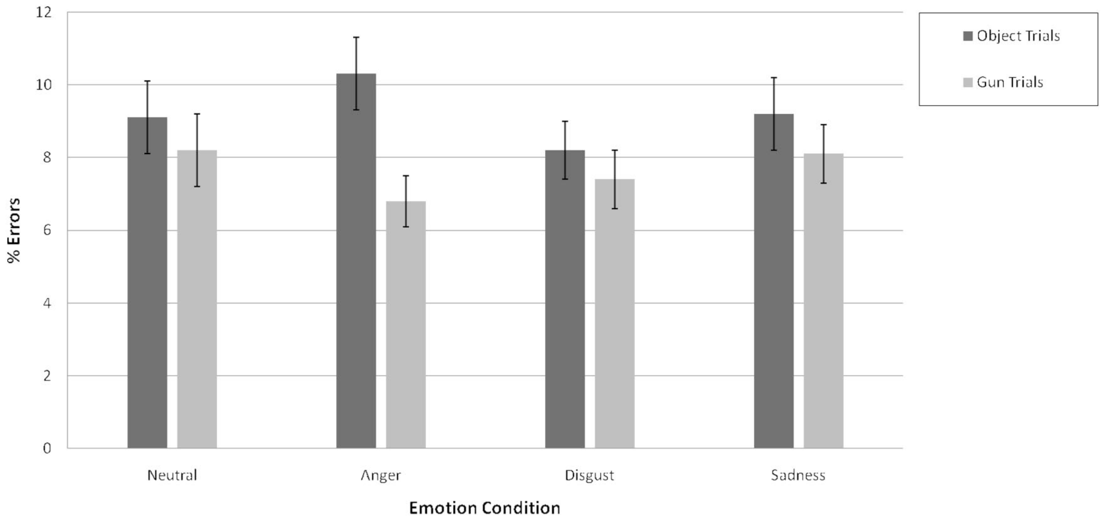

Figure 2. Error rate as a function of stimulus type and emotional state in Study 2. Error bars equal ±1 *SE*.

significantly from zero (ts $<$ 1.40, ps $>$ .17), indicating the absence of response bias. Therefore, in accord with our hypotheses, angry participants evidenced a clear bias toward identifying stimuli as guns, whereas participants experiencing negative emotional states that were not applicable to the threat-related judgment at hand failed to demonstrate this bias in object identification.

As before, the sensitivity parameter (d') was significantly greater than zero for each of the four emotion conditions (ts $>$ 17.08, ps $<$ .001), indicating that participants in all conditions were able to distinguish between trials containing guns and trials containing neutral objects.[11] There were no significant differences in sensitivity between emotion groups.

Discussion

As predicted, the emotion-based bias in threat detection appears to function in accord with applicability constraints. The majority of emotion theories suggest that each emotion is elicited only in response to a given set of circumstances, and thus each emotional state can uniquely motivate or prepare an individual to contend with those given circumstances in a unique, adaptive way (Dalgleish, 2003; Ellsworth & Scherer, 2003; Smith & Kirby, 2001). In accord with this view of the emotional system as functional, the demonstrated bias in threat detection should result only when a participant is experiencing an applicable emotional state—that is, an emotional state that could ostensibly be elicited in response to the given challenges or opportunities posed by the current environment.

When participants were experiencing emotional states that were not applicable to judgments about potential violent or aggressive threats, they failed to exhibit a systematic bias in the types of errors made throughout the threat detection task, even when the nonapplicable emotion was negative in valence. Sadness, for example, should not be elicited in response to a situation involving potential violent or aggressive threats. Thus, experiencing sadness should provide no informational value for decisions regarding how threatening different target individuals appear to be. Not surprisingly, sad participants made the same proportion of errors claiming that nonthreatening individuals were threatening as vice versa. Although disgust should signal the presence of certain types of threats in the environment, specifically threats of contamination or disease, disgust should not provide information about the likelihood of encountering the type of threat represented by a gun (i.e., threat of physical violence) even though it is a negative, high arousal state. The results from Study 2 support this view, as disgusted participants also did not exhibit biased error rates.

Conversely, anger is applicable for judgments about how threatening potentially armed target individuals appear, as anger is elicited in response to situations involving conflicts and competition where a gun could presumably be present. It appears conceivable that anger may alert an individual to the presence of certain classes of threat in the immediate environment (i.e., threats of potential aggression or violence), and by so doing, may prepare an individual to act efficiently in the face of such threats. That is, by increasing vigilance for relevant dangers, anger actively helps an individual avoid harm. As such, angry participants are willing to make more errors claiming nonthreatening individuals are actually threatening in order to avoid making errors where they fail to accurately identify an anger-relevant threat when it is present. However, the mechanism by which anger leads to this bias remains unexplored.

Study 3

Findings from the signal detection analyses in Studies 1 and 2 can help begin to disambiguate the processes underlying anger's influence on decisions in the current threat detection task. Since no significant differences were found in participants' sensitivity to the stimuli as a function of emotion condition, anger does not appear

[11] Mean sensitivity values for each of the emotion conditions in Study 2 were as follows: neutral (d' = 2.04, SD = 0.72), anger (d' = 2.07, SD = 0.73), disgust (d' = 2.13, SD = 0.59), and sadness (d' = 2.02, SD = 0.70).

to enhance or detract from one's general ability to distinguish between threatening and nonthreatening objects. That is, anger does not make it easier to correctly distinguish a gun from a neutral object or vice versa. Because sensitivity did not vary by emotion, the bias appears to be driven by changes in the criterion parameter alone: Angry participants were setting a much lower threshold—they needed much less information about how threatening a target might be before they were willing to claim a gun was present. Signal detection theory specifies that three factors impact the placement of an observer's decision threshold. In essence, observers should adjust their strategies for deciding whether a signal (i.e., a gun) is present under conditions of uncertainty in accord with actual or subjective changes in three relevant factors (Green & Swets, 1966/1988; Lynn, Cnaani, & Papaj, 2005). Consequently, it is likely that the ability of anger to produce the bias in question stems from its influence on one of these factors.

The first factor corresponds to the distribution of the signal trials (i.e., gun trials), which may be interpreted as a participant's confidence that each gun is in fact a gun and not something else. As such, changes in the signal distribution largely reflect changes in how easily identifiable each gun stimulus is (i.e., changes in the clarity or size of gun images or variation in the prototypicality of gun stimuli). However, as identical and highly prototypical stimuli were used for participants in all conditions, it seems unlikely that anger is affecting participants' signal distributions in the present threat detection task.

The second factor concerns the rewards or costs associated with each decision outcome (i.e., whether one type of error is more costly than the other). Although one could theorize that missing a gun might be more costly than missing a neutral object, at least in terms of threat detection, it seems that this subjective difference in relative costs should be similar across emotion conditions. (i.e., there is no reason to believe that neutral participants value not getting killed less than angry participants). Moreover, we explicitly set constraints in the previous experiments to dampen any such asymmetry in cost. That is, we instructed participants to be as accurate as possible on all trials, thereby making all errors of equal cost. Moreover, to make the costs real, participants were told, as noted above, that they would be given the opportunity to win money if they indeed had low error rates.

Consequently, we believe that the third factor, which involves the probability of encountering the different stimuli in the environment, stands as the most likely candidate to be mediating anger's influence on threat detection. In the context of our experiment, this third factor involves the relative frequency of gun and object trials—either the difference in the actual probabilities of encountering threatening versus nonthreatening objects or the difference in the subjective probabilities of doing so. If individuals expect to encounter an equal proportion of threatening and nonthreatening objects, then there is no reason for them to be predisposed toward responding *gun* or *object*. Given that both types of stimuli are equally likely to appear, there is no strategic advantage to favoring one response over the other. Conversely, if individuals expect to encounter a larger proportion of threatening versus nonthreatening objects, they should adopt a lenient decision threshold that requires them to have less information, or less certainty, before deciding an object is threatening (Green & Swets, 1966/1988; Lynn et al., 2005; Wickens, 2002). To be precise, if they expect that guns will be encountered more frequently in the stimulus set or environment, they should favor the *gun* response, as this strategy will increase the probability of a correct response under conditions of uncertainty. We believe that anger causes just such a change in expectancies; that is, anger may be causing participants to expect to encounter more guns than neutral objects, which in turn causes them to adopt a more lenient decision threshold, requiring less information to claim a gun is present.

As previously mentioned, there is an abundance of prior research demonstrating that emotions exert an influence on the perceived probability that specific emotionally congruent events will occur (e.g., DeSteno et al., 2000; Johnson & Tversky, 1983; Lerner & Keltner, 2001; Loewenstein & Lerner, 2003). These studies have demonstrated the impact of affective states on the computation of likelihood estimates, such that participants experiencing a given emotion will report a higher probability for encountering events of an emotionally congruent tone in the future. For instance, happy participants believe they are more likely to encounter events that would make them happy, whereas sad participants believe they are more likely to encounter events that would make them sad (Johnson & Tversky, 1983). More specifically, DeSteno et al. (2000) have shown that this bias is not a function of valence but rather demonstrates emotion specificity. For example, angry participants believed they were more likely to get stuck in traffic or be intentionally sold a lemon by a dishonest car salesman compared to neutral or sad participants.

In order to investigate the role that emotion-biased expectancies might be playing in the current paradigm, we first need to establish that angry participants do in fact expect to encounter more threats than neutral participants. Study 3 was designed to address this issue by having participants "identify" stimuli as neutral objects or guns in the absence of any actual exposure to either stimulus. That is, we informed participants that they would be subliminally exposed to images containing either guns or wallets, and they were asked to guess which stimulus had been shown. In reality, on each trial of the shooter bias task, participants were merely shown an image of random noise (black and white dots) in the hand of the target individual, which was very quickly covered with a gray oval as a mask. This was done to give participants the impression that they had indeed been shown something but that it had flashed so briefly on the screen that they were unable to consciously recognize it. We predicted that participants experiencing anger would guess that a gun was hidden behind the gray oval more frequently than would participants experiencing a neutral state. In other words, angry participants would expect to encounter more threats than would neutral participants, thereby supporting the first leg of the proposed meditational model.

Method

Participants. Fifty undergraduates (36 women and 14 men) agreed to participate in this study in partial fulfillment of a course requirement. On the basis of the aforementioned screening procedure, participants were removed from the analyses if the descriptions written for the emotion induction did not follow instructions or contained direct mention of guns/violence ($n = 3$). In addition, one participant was removed from the neutral condition because he or she made no gun responses. This resulted in a final sample of 46 participants across two conditions: neutral ($n = 24$) and angry ($n = 22$).

Materials. All of the target images from previous studies were modified such that the object or gun being held by each target individual was covered completely with a small shape made up of a random assortment of black and white dots. The shape was roughly circular with irregular rounded edges; the same image of the same size was used for all targets. Thus the new target images were all identical to those used in previous studies except that the same "noise" shape covered the hand of the individual in each image. After saving this new set of target images, the images were modified a second time by placing a gray oval over the noise shape in each image. Again, the same gray oval was used in modifying all images. These two new sets of images were used in Study 3 in place of the original target images for the threat detection task.

Procedure. The procedure for Study 3 was quite similar to that of the previous two studies: Participants completed a block of practice trials, an emotion induction task, a block of critical trials, and finally a short questionnaire consisting of the manipulation check and demographic information. However, there were two significant changes. First, participants were randomly assigned to one of two emotion conditions: anger or neutral. Second, the threat detection task was modified in order to have participants make predictions about the relative base rates of gun and object trials in the task without ever actually exposing them to the stimuli of interest.

To accomplish this goal, the new modified sets of target images (as described above) were used in place of the original target images from previous studies. Aside from this replacement, the threat detection task was completed in the same manner as it was in the first two studies. After a random number of background images were each shown for a random duration of time, each trial of the task ended with the presentation of a target image. First, the image with the target individual's hand covered with the irregular noise shape flashed on the screen for 50 ms. This was immediately followed by the same target image (same background and individual) but with the gray oval covering his hand. The target image with the gray oval remained on the screen for another 700 ms, during which time participants were required to respond. As before, this left a total of 750 ms as a response window from the time of stimulus onset. The brief presentation of the random noise shape was meant to give the participant the subjective impression that some true stimulus had indeed been flashed very rapidly before he or she was required to respond.

For each trial, participants were asked to identify which stimulus they believed had been presented by pressing one of two marked keys on the keyboard. Unlike in previous studies, participants were asked to respond *wallet* or *gun* instead of *object* or *gun*. We felt that in the absence of any actual stimulus information, it would be easier for participants to respond that they had seen one of two specific stimuli instead of one of two classes of stimuli. Participants made this decision for each of the 40 critical trials. In addition, the 10 practice trials were also modified to be in accord with the changes described here.

Results and Discussion

An independent sample *t* test confirmed the effectiveness of the emotion manipulation: Angry participants experienced significantly more anger ($M = 3.80$, $SD = 0.08$) than neutral participants ($M = 2.15$, $SD = 1.15$), $t(44) = 5.61$, $p < .001$. Of import, an independent samples *t* test also confirmed the predicted pattern of responding such that angry participants guessed that a higher proportion of trials contained guns ($M = 0.51$, $SD = 0.07$) than did neutral participants ($M = 0.45$, $SD = 0.12$), $t(44) = 2.07$, $p < .05$.[12]

These results clearly demonstrate that angry participants expected to encounter a larger percentage of threatening objects in comparison to neutral participants. It is important to note that the base rate of expectation for the presence of wallets versus guns in the environment by neutral participants may reflect several influences. First, it is likely that wallets are a more common occurrence than guns in daily experience. Second, the shape of the noise stimulus may arguably have been more similar to the prototypical shape of a wallet than a gun. Nonetheless, the presence of anger resulted in a significant increase in guessing that the stimulus behind the gray mask was a gun, thereby reflecting an elevated expectancy for the occurrence of guns in the environment. Consequently, it is the subjective relative as opposed to the absolute level of frequencies that is central here.

These results not only contribute to the already substantial body of research demonstrating that emotions influence people's expectancies of encountering certain classes of events or objects but also extend its reach by demonstrating that such emotion-based effects can occur even at time pressures favoring intuitive, as opposed to explicitly calculated, judgments. As such, Study 3 provides strong evidence to suggest that such emotion-biased expectancies may underlie participants' performance on the threat detection task. Nevertheless, as Study 3 involved participants making identification judgments in the absence of actual stimulus exposure, it fails to address whether an emotion's impact on likelihood estimates can account for the biased responding reported earlier where actual images of neutral objects and guns that were demonstrably distinguishable were being shown. As such, additional evidence is necessary to successfully address whether these biased expectancies actually play a causal role in mediating anger's impact on threat detection.

Study 4

In order to examine the viability of the demonstrated anger-induced increase in expectancies as a mediator for the previously identified bias in threat detection, we decided to use an experiment-based strategy suggested by MacKinnon (2008). This methodology involves decoupling the mediator from the independent variable through direct control or manipulation of the mediator. As such, it allows causal inferences that typical meditational analyses based on covariance structure modeling do not allow. In the current experiment, we accomplished this goal by directly manipulating participants' expectancies for the frequencies of guns, thus preventing individuals from forming or utilizing their own subjective, emotion-induced expectancies about the propor-

[12] As in previous studies, trials on which the participants failed to respond within the 750-ms window were removed from all analyses. Thus, the proportion of trials that a participant predicted to contain guns was calculated as the total number of gun responses divided by the total number of valid trials.

tion of threatening versus nonthreatening stimuli they would encounter in our version of the shooter bias task.

Using a blocking strategy, we attempted to prevent angry participants from forming heightened expectancies of encountering threatening objects in two ways. We explicitly told them that half of the trials they would encounter contained guns and half of the trials contained neutral objects. We also modified the practice blocks to emphasize this distribution; participants completed more practice trials containing an equal frequency of gun and object trials compared to in previous studies. Because emotion biases in expectancies occur only when uncertainty about the quantities to be estimated exists (cf. Schwarz & Clore, 2007), this technique was expected to block the ability of anger to enhance expectancies for encountering guns, and thereby to stop angry participants from adopting a decision strategy based on such biased expectancies. Thus, if expectancies mediate anger's influence, angry participants told to expect an equal number of guns and objects should not evidence a lower criterion for deciding a gun is present. That is, angry participants should appear similar to neutral participants in terms of decision thresholds.

In a separate condition, we attempted not to block the mediator but to enhance it where it normally was not enhanced. Specifically, we sought to raise the expectancies among neutral participants to determine if they would subsequently match the pattern of biased responding exhibited by angry participants. To accomplish this goal, we explicitly told some participants that 67% of the trials would contain guns and 33% would contain neutral objects. In addition, we modified the practice trials accordingly. The result, we expected, would be that these neutral participants would adopt a decision strategy that favored the *gun* response to account for these differential expectancies. That is, they would exhibit a significantly lower criterion that matched that of angry participants.

If differential expectancies about the likelihood of encountering threatening versus nonthreatening objects are indeed playing a mediational role, then the manipulation of participants' expectancies should eliminate any main or interactive effect of induced emotion, leaving only a main effect for expectancies. That is, emotional states should evidence no causal efficacy to shape bias outside of direct manipulation of expectancies. On the other hand, if differential expectancies are not playing a mediating role, then the difference in the decision criterion between emotion conditions should remain intact when participants' expectancies are manipulated, although there should be, in addition, a main effect for manipulated expectancies (cf. Lynn et al., 2005; Wickens, 2002). If, as we hypothesize, we are able both to block the effect of anger on threat detection as well as to create an effect that matches that of anger by manipulating participants' expectancies, then we will have built a strong case for the mediating role of expectancies in the impact of anger on threat detection.

Method

Participants. One hundred and forty-two undergraduates (109 women and 33 men) participated in partial fulfillment of a course requirement. On the basis of the aforementioned screening procedure, participants were removed from the analyses if the descriptions written for the emotion induction did not follow instructions or contained direct mention of guns/violence ($n = 3$). As in previous studies, participants who failed to respond within the given time window on 11 or more of the trials (2 *SD*s above the mean number of trials on which participants failed to respond) were removed from all analyses ($n = 8$), as were participants whose overall error rate exceeded 38% (2 *SD*s above the mean overall error rate; $n = 3$). This resulted in a final sample of 128 participants across four conditions: neutral/even split ($n = 30$), anger/even split ($n = 29$), neutral/high-frequency gun ($n = 34$), and anger/high-frequency gun ($n = 35$).

Procedure. The procedure for Study 4 was quite similar to that of the previous three studies: Participants completed a block of practice trials, an emotion induction task, a block of critical trials, and finally a short questionnaire consisting of the manipulation check and demographic information. However, there were three significant changes. First, participants were randomly assigned to one of two emotion conditions: anger or neutral. Second, the proportion of gun and object trials was manipulated between subjects, and participants in the anger and neutral conditions were randomly assigned to a high-frequency gun condition or an even-split condition. In the high-frequency gun condition, participants were explicitly informed that two thirds (~67%) of all trials would contain guns and one third (~33%) of the trials would contain neutral objects. In the even-split condition, participants were explicitly informed that half (50%) of all trials would contain guns and half (50%) would contain neutral objects. The proportion of gun and object trials in both the training and critical blocks was, in fact, manipulated to be consistent with these instructions. Finally, the number of overall trials was increased to ensure that participants perceived the aforementioned base rates: The participants all completed a block of 24 practice trials and a block of 60 critical trials.[13] The practice trials consisted of similar but different stimuli than the critical block, and both blocks were consistent with the expressed proportion of gun and object trials (e.g., two thirds of the trials in the practice block and the critical block were guns for participants in the high-frequency gun condition). Therefore, Study 4 is a 2 (emotion: neutral vs. anger) by 2 (expectancy: high-frequency gun vs. even split) between-subjects design.

Results

Emotion manipulation check. As expected, the emotion manipulations were again successful. Participants who wrote about an angering event ($M = 3.77$, $SD = 0.88$) reported experiencing significantly more anger than did participants who wrote about their daily routine ($M = 1.91$, $SD = 0.93$), $t(126) = 11.63$, $p < .001$.

[13] For the critical block, participants in the even-split expectancy condition first responded to the 40 original stimuli as described in Studies 1 and 2 in a randomized order, and then they responded to 20 of the stimuli (selected to be 10 gun trials and 10 neutral object trials) a second time in a random order. Therefore, the critical block consisted of 30 trials with guns and 30 trials with neutral objects for the even-split expectancy condition. Participants in the high-frequency gun condition first responded to 30 of the 40 original stimuli as described in Studies 1 and 2 (i.e., all 20 stimuli containing guns and 10 of the stimuli containing objects) in a random order, and then they responded to the same 30 stimuli a second time, again in a random order. Therefore, the critical block consisted of 40 trials with guns and 20 trials with neutral objects for the high-frequency gun condition.

Response bias. The analysis of differences in errors by stimulus type in Study 4 is complicated by the fact that participants across conditions were not all exposed to equal numbers of object and gun trials. This fact results in differential opportunities to make object and gun errors and confounds the interpretation and comparison of error rate differences. Instead, biased responding can be analyzed by comparing the signal detection parameters c and d' across conditions, as the calculation of these parameters takes into account the varying number of gun and neutral object trials.

In the even-split condition, where we prevented participants from having a subjectively inflated estimate of gun trials, we were successful in blocking the bias among angry participants. As predicted, angry participants' criterion values were not significantly different from zero, indicating an absence of the usual response bias, $t(28) = 1.82$, *ns*. Moreover, c did not significantly differ between neutral and angry participants in the even-split condition, $t(57) = 0.69$, *ns* (see Figure 3).

In the high-frequency gun condition, we were successful in producing a response bias in neutral participants that matched that of angry participants. The criterion value for neutral participants in the high-frequency gun condition was significantly lower than zero, $t(33) = 8.35$, $p < .001$), indicating a bias toward responding *gun*. Moreover, c did not significantly differ between neutral and angry participants in the high-frequency gun condition, $t(67) = 1.06$, *ns*.

Subjecting these data to a 2 (emotion: neutral vs. anger) by 2 (expectancy: high-frequency gun vs. even split) ANOVA with c as the dependent variable confirmed the predicted pattern of results. There was a significant main effect for expectancy, such that participants in the high-frequency gun condition ($c = -.26$, $SD = 0.31$) had a significantly lower criterion value than participants in the even-split condition ($c = 0.05$, $SD = 0.34$), $F(1, 124) = 69.43$, $p < .001$. Also as expected, there was no main effect for emotion and no interaction between emotion and expectancy (Fs < 1.5, *ns*). Taken together, the results from Study 4 strongly support the proposed mediating role of expectancies in anger's influence on threat detection.

Finally, as before, the sensitivity parameter (d') was significantly greater than zero for each of the four conditions (ts > 17.73, ps $< .001$), indicating that participants in all conditions were able to distinguish between trials containing guns and trials containing neutral objects.[14] There were no significant differences in sensitivity between groups ($F < 1$).

Discussion

Results from Study 4 support the predicted mediating role of participants' expectancies in anger's influence on threat detection. When participants were prohibited from developing and utilizing their own subjective expectations about the probability of encountering threatening versus nonthreatening objects, differences in the decision threshold between emotion conditions disappeared. Angry participants who were told to expect the same number of gun and neutral object trials failed to set thresholds that significantly differed from the zero mark. That is, angry participants who were blocked from forming a heightened expectancy of encountering threatening objects behaved more like the neutral participants than the angry participants from previous studies: They no longer demonstrated a bias toward responding *gun*. Conversely, neutral participants who were led to expect more trials to contain guns than objects demonstrated a significantly lower threshold to decide stimuli were threatening. That is, like the angry participants in previous studies, they needed less information before they were willing to respond *gun*.

Put differently, both neutral and angry participants set similar decision thresholds within each expectancy condition, suggesting that this threshold placement was influenced primarily by the expected proportions of gun and object trials. Thus, as shown in Study 3, it appears angry participants in previous studies indeed held heightened expectancies of encountering threatening objects; otherwise the manipulation of expectancies in Study 4 would not have eliminated the main effect of emotion in this way. Moreover, the three parameters previously discussed as influences on the placement of an individual's criterion are thought to be independent of one another (Green & Swets, 1966/1988; Lynn et al., 2005). Therefore, if one of the other two parameters were indeed contributing significant additional influence in producing the demonstrated bias, we should have found that angry participants still set a significantly lower criterion than did neutral participants in both expectancy conditions. As no emotion main effect was found, it is thus highly unlikely that differences across emotion conditions in the other parameters are contributing to the demonstrated response bias found among angry participants. That is, it appears that neither relative differences in the subjective costs associated with the different types of identification errors nor differences in the signal distribution are causing or playing a significant role in the observed differences in biased responding found between emotion conditions. In essence, it appears that anger sets the priors for the threats the mind expects to encounter and readies the body to cope with those potential dangers by increasing vigilance for relevant threats.

These findings are consistent in process with previous work on threat detection and racial stereotypes by Correll, Park, Judd, and Wittenbrink (2007), suggesting that emotional states may serve a similar informational, or prediction-based, function with respect to identifying stimuli. By manipulating the covariance of race and guns in a preliminary set of trials, Correll et al. demonstrated the mediating role of this covariance, or expectancy, information in participants' propensities to shoot African American targets and not shoot White targets. That is, participants exposed to a larger number of trials containing stereotype-consistent information (armed African Americans and unarmed Whites) exhibited a more pronounced bias in a subsequent task than did participants initially exposed to a larger number of trials containing stereotype-inconsistent information (unarmed African Americans and armed Whites).

Unfortunately, it does not seem likely that manipulating expectancies is a viable means of intervention for preventing anger-based bias in threat detection in the real world. As individuals move through different environs, it would be quite cumbersome to have to inform them of the appropriate base

[14] Mean sensitivity values for each of the four conditions in Study 4 were as follows: neutral/even split ($d' = 2.29$, $SD = 0.71$), anger/even split ($d' = 2.38$, $SD = 0.63$), neutral/high-frequency gun ($d' = 2.38$, $SD = 0.75$), and anger/high-frequency gun ($d' = 2.23$, $SD = 0.70$).

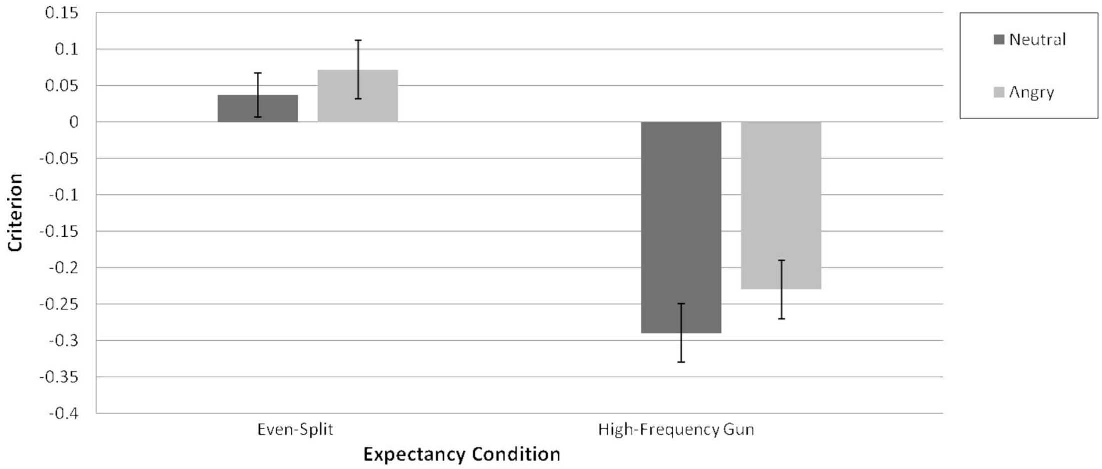

Figure 3. Criterion value as a function of expectancy and emotional state in Study 4. Error bars equal ±1 *SE*.

rates for judgments at hand (e.g., the likelihood of encountering guns). Moreover, any explicit description of the likelihood of certain classes of events may likely be neglected in the decision process when an individual has myriad other sources of information to draw upon (cf. Bar-Hillel, 1980; Kahneman & Tversky, 1973; Lyon & Slovic, 1976; Moser, 1990). Therefore, the manipulation of explicit expectancy information does not appear to be an efficient candidate for intervention programs designed to aid those for whom such a bias is especially relevant (e.g., military or security personnel).

Study 5

Having established the existence of an emotion-based bias in threat detection, it is essential to put careful consideration toward what, if anything, one can do to diminish the impact of anger on decisions about potential threats. Although anger may typically serve an adaptive function, by preparing individuals to act efficiently in the face of potential dangers, it is not difficult to envision instances in which this survival-driven bias would be problematic. For instance, police officers and soldiers, who are commonly placed in emotionally evocative situations, are expected to make rapid, accurate decisions regarding potential threats without allowing their emotions to exert any undue influence. Given that the results from Studies 1 and 2 demonstrate the biasing effect of anger at one of the most basic and automatic levels of processing (i.e., object recognition), there is reason to question whether the demonstrated bias is amenable to correction. In fact, it is not clear from the previous studies whether participants are even aware of the errors they are committing. Accordingly, an exploration of potential boundary conditions may prove fruitful in addressing these concerns. Therefore, Study 5 investigates participants' ability to identify and correct for errors in the threat detection task when they are given the opportunity to change their initial responses.

Optimistically, there is reason to predict that angry participants will be able to recognize and fix their biased decisions. Preliminary research on how racial stereotypes impact weapon misidentifications has demonstrated that people are aware of their mistakes (Payne et al., 2005). When given the opportunity and sufficient time to respond again after making an initial, rapid identification judgment, participants were able to correct their mistakes without seeing the target image for any additional length of time. That is, they were, at least in hindsight, aware of the mistakes they made in their initial judgments of whether an object was a gun or a more neutral stimulus and were able to indicate the correct response when given the opportunity to engage in further processing. It appears that it was only the necessity of their initial response being very rapid that prevented them from always making accurate decisions.

It is certainly possible that limiting responses to a very strict time window results in uncertainty about object identification. As such, participants must rely on other strategies or other available information in order to increase their chances of making accurate decisions about whether a stimulus is threatening under these conditions of uncertainty. In the case of the study by Payne et al. (2005), participants primed with African American faces may have adopted a decision strategy that incorporated their heightened expectancy of encountering threatening objects following an African American face for their initial time-limited response, but they were able to utilize more accurate decision strategies when the time restraint was lifted. Because emotional states and primed concepts such as racial stereotypes are often thought to operate through the same or similar mechanisms (Clore et al., 2001), there is reason to believe that participants experiencing anger may also be aware of and able to correct for their errors in the threat detection task. That is, although angry participants under time pressure appear to employ a decision strategy based on their heightened expectancy of encountering guns, they should opt for more accurate decision strategies that rely less heavily on likelihood estimates when given the opportunity to respond without the strict time constraints.

Given that Studies 1 and 2 demonstrated the existence of the bias only among angry participants, we focused our examination on those experiencing anger. Moreover, to explore the potential limits of the bias, we used a methodology similar to Payne et al.

(2005).[15] In short, the design follows the one used in Studies 1 and 2, with the exception that participants were offered the opportunity to change their initial responses immediately following the normal 750-ms response window. If participants are unaware of their initial errors, we would expect that they would have no reason to correct their responses (i.e., to say that they really saw an object when they first indicated seeing a gun). However, we predicted that when angry participants are given the opportunity to engage in correction, the systematic error bias for reporting guns relative to neutral objects should disappear. That is, angry participants should be aware of their initial mistakes, at least after having further processing time, and thus should evidence no greater errors in categorizing objects than in categorizing guns when they are given an opportunity to respond a second time.

Method

Participants. Twenty-seven undergraduates (17 women and 10 men) participated in partial fulfillment of a course requirement. On the basis of the aforementioned screening procedure, participants were removed from the analyses if descriptions written for the emotion induction did not follow instructions or contained direct mention of guns/violence ($n = 2$) or if they failed to respond within the given window on the first attempt on seven or more trials (2 *SD*s above the mean number of trials on which participants failed to respond; $n = 2$). In addition, an extreme outlier with an overall error rate of 60% was excluded from analyses. This resulted in a final sample of 22 participants.

Procedure. The procedure for Study 5 was quite similar to that of Studies 1 and 2: Participants completed a block of 10 practice trials, an emotion induction task, a block of 40 critical trials, and finally a short questionnaire consisting of the manipulation check and demographic information. However, there were two significant changes. First, an adjustment to the threat detection measure (in both the practice and the critical blocks) was made to assess whether participants were able to identify and correct for errors when not under time pressure. After each trial, participants were given the opportunity to change their response. That is, after participants responded to the target image during the initial 750 ms for which it was displayed (exactly as they had in Studies 1–4), they were taken immediately to another screen that allowed them to change their answer if they believed it to be incorrect. They did not see the image for any additional time, as the new screen immediately overwrote the previous screen with large text reading: “Please Respond Again: Was the person you just saw actually holding a gun or some other object?” There was no time limit for this second response; participants moved on to the next trial after making their second decision. Second, all participants completed the anger emotion induction, making Study 5 a completely 2 (attempt: first vs. second) × 2 (error type: object error rate vs. gun error rate) within-subjects design.

Results

Error rates. Replicating the findings of the previous studies, angry participants’ initial responses (i.e., those made within the 750-ms window) evidenced more errors identifying neutral objects as guns than vice versa, paired $t(21) = 1.76$, $p = .09$ (see Figure 4). However, when participants were allowed to revisit their decision without time pressure, errors in both object and gun trials were practically nonexistent; the mean overall error rate dropped to 2.4%, with 16 of the 22 participants making absolutely no errors at all. Thus, when given the opportunity to consider their judgments more carefully, participants did not make a significantly different amount of errors identifying objects as guns or identifying guns as objects, paired $t(21) = 1.44$, *ns*.

A 2 (error type: object error rate vs. gun error rate) × 2 (attempt: first vs. second) fully repeated-measures ANOVA revealed the presence of the predicted interaction between error type and attempt, $F(1, 21) = 6.59$, $p < .02$, thereby confirming the differential impact of anger on the first and second responses. Although anger resulted in the predicted bias in errors when under time pressure, its impact on threat detection disappeared when this particular constraint on responding was lifted.

Discussion

These results suggest that participants are, at least in hindsight, by and large aware of the errors they make in the threat detection task under time pressure, which supports the view that an emotion-based bias in threat detection is amenable to correction. These findings are consistent with research on how racial stereotypes result in weapon misidentifications (Klauer & Voss, 2008; Payne et al., 2005), suggesting that emotional states, like racial stereotypes, do not appear to influence weapon identification when participants are given the opportunity to respond without time constraints.

It again appears that anger leads participants to show a bias toward identifying objects as guns in the face of uncertainty due, as shown earlier, to anger-induced heightened expectancies for encountering conflict-relevant stimuli. However, the results of Study 5 also demonstrate that angry participants are able to identify and correct for this propensity to respond *gun* when given the opportunity to respond without time pressure, even without any additional exposure to the target stimulus. That is, without time constraints, participants were able to use a more accurate decision strategy that did not depend chiefly on their expectancy of encountering threatening versus nonthreatening objects. This suggests that the biasing influence of anger on threat detection is not unreceptive to attempts at correction and may be able to be alleviated or even eliminated completely with minimal increases in the time necessary to reach a decision. As such, Study 5 opens a promising avenue of inquiry into the discovery or development of potential interventions or training strategies for those individuals who must

[15] It should be noted that in the original study by Payne et al. (2005), the initial stimulus exposure was much briefer than used here (100 ms). Their study was designed to explore whether participants’ errors were actual perceptual errors (i.e., they believed they actually saw a gun following an African American face) or were the result of executive failure under time pressure. However, the present Study 5 is not attempting to make any such distinction regarding potential underlying mechanisms. In using a methodology similar to Payne et al.’s, we are simply exploring potential boundary conditions on the demonstrated bias—namely, whether participants can identify the errors they’ve made if given the chance to correct their responses. The longer presentation times also reflect the need to process images of greater complexity; Payne et al.’s stimuli consisted of single simple objects.

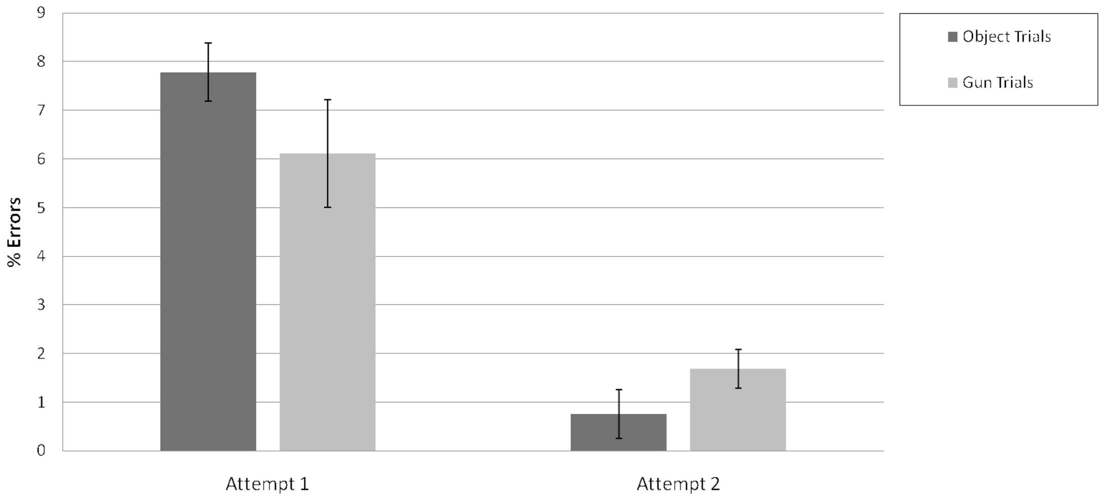

Figure 4. Error rate as a function of stimulus type and attempt in Study 5. Error bars equal ±1 *SE*.

make fairly rapid decisions about potentially threatening stimuli on a regular basis.

General Discussion

Results from Studies 1 and 2 supported our hypothesis that anger would bias the types of errors participants made in a task where they were identifying potential threats; angry participants made significantly more errors claiming that neutral objects were guns than vice versa. Moreover, we demonstrated that this emotion-induced bias is not merely driven by differences in emotional valence but is subject to applicability constraints. That is, the bias occurred only when participants were experiencing an emotion, such as anger, that was relevant to their decisions about potential threats. As demonstrated by Studies 3 and 4, this bias appears to be driven by changes in participants' subjective, emotion-induced expectancies of encountering certain classes of stimuli in their environments. In essence, it appears that anger leads participants to form heightened expectancies of encountering violence-related threats relative to nonthreats. Optimistically, findings from Study 5 suggest that individuals should be able to overcome this emotion-based bias if given even relatively minor additional processing time for decisions about potential threats.

Together, these studies hold important consequences not only for future avenues of inquiry but also for practical application. For instance, given that individuals systematically vary with respect to the intensity, specificity, and awareness of emotional states (Barrett & Salovey, 2002), as well as sensitivity to threat and rewards (Higgins, 2000), such dispositional factors might moderate the influence of emotion on threat detection. Ideally, knowledge of such situational and dispositional constraints on the ability of emotion to bias threat detection might be of high value in the development of interventions or training programs meant to sharpen decision making among those for whom such rapid decisions hold high consequence (e.g., police officers, military analysts).

Such training or intervention programs would need to address not only the processes through which an emotion-based bias is operating but also the circumstances that allow for anger to bias threat detection in the first place. For instance, the bias should emerge only when people lack the motivation or ability to make accurate decisions regarding potential threats. In the current investigation (cf. Wegener & Petty, 1995), it is fair to assume that participants were motivated to be accurate in the threat detection task, as they were told that the top 20 scores would be placed in a raffle for $100 at the conclusion of the experiment. However, participants lacked the ability to make accurate decisions regarding the identity of stimuli due to the strict time constraints of the task. Following this logic, the inverse situation where an individual has the ability but lacks the motivation to be accurate should also result in biased assessments of threat, and such circumstances may be more frequent in everyday life than those that necessitate very rapid action and thus limit ability.

However, the combination of high motivation and low ability exemplified in the current set of studies does duplicate the conditions involved in some very important real-world situations, such as the police engagement that ended in the tragic death of Diallo or incidences of friendly fire among members of our armed forces who, constantly facing potential threats, must regularly determine whether another individual is an ally or enemy. It is safe to assume that the individuals who are forced to make such rapid assessments of threat are highly motivated to be accurate in their judgments. As results from Study 5 demonstrate, allowing relatively brief amounts of additional processing time in these situations, even without continued exposure to the stimulus of interest, seems to eliminate errors almost entirely. Unfortunately, allowing such additional time is not always an option, as some decisions *must* be made very rapidly.

In such instances, training people to be aware of their emotions as well as the potential influence of those emotions on assessments of threat may represent one possibility for enhancing accuracy. For example, Gasper and Clore (2000) demonstrated that current mood influenced participants' judgments of risk if they said that they do not typically attend to their feelings, but it failed to affect the risk judgments of participants who claimed that they do typically attend to their feelings. This suggests that more stable differences in how frequently people attend to emotional information can moderate the influence of emotion on judgments of risk. Accordingly, programs designed to improve the accuracy of individuals who must make rapid decisions (e.g., police officers) might find the most success in eliminating emotion-based biases by training individuals to be aware of their emotions and the sources of those emotions. Although research on the viability of such training would be necessary, continual strategic thought highlighting the potential impact of emotion on expectancies might prove to be useful in limiting bias in relevant situations.

Future research should also continue to investigate factors that may contribute to angry participants' use of a decision strategy with a low threshold. Although Studies 3 and 4 demonstrate the role of expectancies in setting the decision threshold for angry participants, they do not completely rule out the potential influence of other factors as well. For instance, it seems possible that the costs associated with the different types of errors (either from some subjective bias or an explicit point value) may influence thresholds. In the current paradigm, participants were asked to be as accurate overall as possible, resulting in errors of equal cost. However, if one type of error is subjectively more costly to neutral or angry participants in the absence of the external constraints (e.g., monetary incentives), then individuals might adjust their decision strategy to minimize the more subjectively costly error. Although it is certainly possible that such inherent costs could affect participants' decision strategies in a modified version of the current threat detection task, it is unclear what the appropriate relative costs should be or why they might differ for angry participants. Future research should investigate whether anger's influence on threat detection differs in the absence of explicit instructions about cost as well as when the costs and rewards associated with the different errors and correct decisions are varied.

Similarly, future research should seek to investigate the role of perceptual distortion in producing biased threat detection with stimuli that are more ambiguous and less prototypical. Although the results of Studies 3 and 4 suggest that only differences in the expectancy of encountering threats is driving anger's impact on threat detection, it is possible that perceptual distortion may have additional biasing influence on threat detection performance when there is some perceptual ambiguity inherent in the target stimuli. It is not difficult to envision instances in which visibility might impact one's ability to make accurate object identifications: police officers pursuing a suspect at night or in a fog; soldiers in moving helicopters at a great distance from their targets or trying to see through sand or dirt in the air during a conflict. In such instances, it is possible that angry individuals would be more willing to identify neutral objects as guns because, in addition to anticipating encountering more guns, they might also perceive neutral objects as actually looking more like guns. An exploration of when and if perceptual distortion might occur is an important next step to understanding emotion's impact on threat detection.

In addition, although the current research demonstrates the lack of response bias in several distinct nonapplicable emotional states, it does not suggest how biases in threat detection may differ among different applicable emotional states. Of particular interest is the experience of fear. Although fear differs from anger on many relevant dimensions of appraisal (Lerner & Keltner, 2001), we would expect fear to produce a response bias similar to that demonstrated by participants experiencing anger in the current threat detection task. That is, whereas anger is associated with appraisals of high certainty and control and fear is associated with appraisals of low certainty and control, we hypothesize that the heightened expectation of threats having to do with violence that occurs in both emotional states would mediate their influence on automatic threat detection. In any aggressive conflict, the expectations for violence and harm are elevated. The experience of fear should thus motivate or prepare individuals to cope in the face of potential violent or aggressive threats by heightening their expectancy of encountering such threats—predisposing them to identify stimuli in their environment as dangerous.

Indeed, although Lerner and Keltner (2001) demonstrated that fear and anger have opposing effects on risk perception, their findings show that the nature of the effect depends on the ambiguity of the risks being assessed with respect to appraisals of certainty and control. As the sudden appearance of a dangerous individual wielding a gun is very unambiguous on these appraisal dimensions (i.e., it is a risk that is very uncertain and very uncontrollable), it is unlikely that responses will differ between emotions due to differences in how the dimensions of certainty and control are appraised. Accordingly, the influence of emotion here is more likely to be driven by its informational value with respect to expectancies for the presence or absence of specific threats in one's environs (cf. DeSteno et al., 2000). Moreover, it has already been demonstrated that emotions associated with opposing appraisals of both certainty and control (happiness high, sadness low) fail to produce biased threat detection within this paradigm. Although research on the effect of fear would likely necessitate methodologies for emotion induction that differ from those used in the current investigation (e.g., threat of shock), it would contribute to a growing body of literature detailing when and how the different underlying dimensions of an emotion contribute to decision making and behavior more generally.

Conclusion

Emotional states constitute a central factor involved in tracking the salient costs, opportunities, and risks posed by individuals' surroundings. Through providing feedback to the mind, emotional states appear to guide threat detection at even the most basic and automatic level. Simply put, feeling that something is likely to be in one's environment (i.e., experiencing the phenomenological feedback that would signal the presence of a specific object or threat) increases the odds that one will claim it is there, even when it is not actually present. As such, anger emerges as an evolutionarily adaptive emotion, despite the negative behavioral consequences frequently attributed to its experience. It appears that anger actively promotes survival and the avoidance of harm by helping individuals to identify and efficiently cope with potential threats amidst ever-changing environs. However, like all emotions, when the anger experienced is not directly relevant to the judgment at hand, the usefulness of its influence on judgment can become tenuous.

References

Bar-Hillel, M. (1980). The base rate fallacy in probability judgments. *Acta Psychologica, 44,* 211–233. doi:10.1016/0001-6918(80)90046-3

Barrett, L. F., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annual Review of Psychology, 58,* 373–403. doi:10.1146/annurev.psych.58.110405.085709

Barrett, L. F., & Salovey, P. (Eds.). (2002). *The wisdom in feeling: Processes underlying emotional intelligence.* New York, NY: Guilford Press.

Bodenhausen, G. V., Mussweiler, T., Gabriel, S., & Moreno, K. N. (2001). Affective influences on stereotyping and intergroup relations. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 319–343). London, England: LEA.

Carey, B. (2010, April 8). Psychologists explain Iraq airstrike video. *The New York Times,* p. A6.

Clore, G. L., Gasper, K., & Garvin, E. (2001). Affect as information. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 121–144). London, England: LEA.

Correll, J., Park, B., Judd, C. M., & Wittenbrink, B. (2002). The police officer's dilemma: Using ethnicity to disambiguate potentially threatening individuals. *Journal of Personality and Social Psychology, 83,* 1314–1329. doi:10.1037/0022-3514.83.6.1314

Correll, J., Park, B., Judd, C. M., & Wittenbrink, B. (2007). The influence of stereotypes on decisions to shoot. *European Journal of Social Psychology, 37,* 1102–1117. doi:10.1002/ejsp.450

Correll, J., Park, B., Judd, C. M., Wittenbrink, B., Sadler, M. S., & Keesee, T. (2007). Across the thin blue line: Police officers and racial bias in decision to shoot. *Journal of Personality and Social Psychology, 92,* 1006–1023. doi:10.1037/0022-3514.92.6.1006

Dalgleish, T. (2003). Information processing approaches to emotion. In R. Davidson, K. Scherer, & H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 661–673). Oxford, England: Oxford University Press.

Dasgupta, N., DeSteno, D., Williams, L., & Hunsinger, M. (2009). Fanning the flames: The influence of specific incidental emotions on implicit prejudice. *Emotion, 9,* 585–591. doi:10.1037/a0015961

DeSteno, D., Dasgupta, N., Bartlett, M. Y., & Cajdric, A. (2004). Prejudice from thin air: The effect of emotion on automatic intergroup attitudes. *Psychological Science, 15,* 319–324. doi:10.1111/j.0956-7976.2004.00676.x

DeSteno, D., Petty, R. E., Wegener, D., & Rucker, D. T. (2000). Beyond valence in the perception of likelihood: The role of emotion specificity. *Journal of Personality and Social Psychology, 78,* 397–416. doi:10.1037/0022-3514.78.3.397

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In R. Davidson, K. Scherer, & H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 572–595). Oxford, England: Oxford University Press.

Fazio, R. H. (2001). On the automatic activation of associated evaluations: An overview. *Cognition & Emotion, 15,* 115–141.

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition & Emotion, 19,* 313–332.

Frijda, N. H. (1986). *The emotions.* Cambridge, England: Cambridge University Press.

Gasper, K., & Clore, G. L. (2000). Do you have to pay attention to your feelings to be influenced by them? *Personality and Social Psychology Bulletin, 26,* 698–711.

Green, D. M., & Swets, J. A. (1988). *Signal detection theory and psychophysics.* Los Altos, CA: Peninsula. (Original work published 1966)

Higgins, E. T. (2000). Making a good decision: Value from fit. *American Psychologist, 55,* 1217–1230. doi:10.1037/0003-066X.55.11.1217

Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45,* 20–31. doi:10.1037/0022-3514.45.1.20

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237–251. doi:10.1037/h0034747

Klauer, K. C., & Voss, A. (2008). Effects of race on responses and response latencies in the weapon identification task: A test of six models. *Personality and Social Psychology Bulletin, 34,* 1124–1140. doi:10.1177/0146167208318603

LeDoux, J. E., & Phelps, E. A. (2000). Emotional networks in the brain. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotion* (2nd ed., pp. 157–172). New York, NY: Guilford Press.

Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology, 81,* 146–159. doi:10.1037/0022-3514.81.1.146

Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision making. In R. Davidson, K. Scherer, & H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 619–642). Oxford, England: Oxford University Press.

Lynn, S. K., Cnaani, J., & Papaj, D. R. (2005). Peak shift discrimination learning as a mechanism of signal evolution. *Evolution, 59,* 1300–1305.

Lyon, D., & Slovic, P. (1976). Dominance of accuracy information and neglect of base rates in probability estimation. *Acta Psychologica, 40,* 287–298.

MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis.* New York, NY: Erlbaum.

Moser, K. P. (Ed.). (1990). *Rationality in action: Contemporary approaches.* Cambridge, MA: Cambridge University Press.

Niedenthal, P. (2007). Embodying emotion. *Science, 316,* 1002–1005. doi:10.1126/science.1136930

Öhman, A., Hamm, A., & Hugdahl, K. (2000). Cognition and the autonomic nervous system: Orienting, anticipation, and conditioning. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of psychophysiology* (2nd ed., pp. 533–575). New York, NY: Cambridge University Press.

Payne, K. B. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology, 81,* 181–192. doi:10.1037/0022-3514.81.2.181

Payne, K. B., Shimizu, Y., & Jacoby, L. L. (2005). Mental control and visual illusions: Toward explaining race-biased weapon misidentifications. *Journal of Experimental Social Psychology, 41,* 36–47. doi:10.1016/j.jesp.2004.05.001

Schwarz, N., & Clore, G. L. (2007). Feelings and phenomenal experience. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (2nd ed., pp. 385–407). New York, NY: Guilford Press.

Smith, C. A., & Kirby, L. D. (2001). Affect and cognitive appraisal processes. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 75–94). London, England: LEA.

Smith, C. A., & Lazarus, R. S. (1990). Emotion and adaptation. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 609–637). New York, NY: Guilford Press.

Unkelbach, C., Forgas, J. P., & Denson, T. F. (2008). The turban effect: The influence of Muslim headgear on aggressive responses in the shooter bias paradigm. *Journal of Experimental Social Psychology, 44,* 1409–1413. doi:10.1016/j.jesp.2008.04.003

Wegener, D. T., & Petty, R. E. (1995). Flexible correction processes in social judgment: The role of naive theories in corrections for perceived bias. *Journal of Personality and Social Psychology, 68,* 36–51. doi:10.1037/0022-3514.68.1.36

Wickens, T. D. (2002). *Elementary signal detection theory.* New York, NY: Oxford University Press.

Wiens, S., & Öhman, A. (2007). Probing unconscious emotional processes: On becoming a successful masketeer. In J. A. Coan & J. J. B. Allen (Eds.), *Handbook of emotion elicitation and assessment* (pp. 65–90). Oxford, England: Oxford University Press.

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