Published in final edited form as:

J Res Pers. 2007 June 1; 41(3): 650–666. doi:10.1016/j.jrp.2006.07.003.

Tracking the Evil Eye: Trait Anger and Selective Attention within Ambiguously Hostile Scenes

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Abstract

Previous research has shown that trait anger is associated with biases in attention and interpretation, but the temporal relation between these two types of biases remains unresolved. Indeed, two very different models can be derived from the literature. One model proposes that interpretation biases emerge from earlier biases in attention, whereas the other model proposes that hostile interpretations occur quickly, even prior to the allocation of attention to specific cues. Within the context of integrated visual scenes of ambiguously intended harm, the two models make opposite predictions that can be examined using an eye-tracking methodology. The present study ($N = 45$) therefore tracked participants' allocation of attention to hostile and non-hostile cues in ambiguous visual scenes, and found support for the idea that high anger individuals make early hostile interpretations prior to encoding hostile and non-hostile cues. The data are important in understanding associations between trait anger and cognitive biases.

Keywords

trait anger; attention; interpretation; hostile attribution bias

Chronically high levels of anger have numerous adverse consequences, including an increased likelihood of aggressive behavior (Deffenbacher, 1992), relationship difficulties (Deffenbacher, 1992), and cardiovascular health problems (Smith, 1992). It is therefore important to understand the cognitive underpinnings of individual differences in trait anger. Such an understanding, for example, could have practical implications for anger reduction strategies among individuals prone to anger (Meier, Robinson & Wilkowski, 2006).

Previous work on the cognitive correlates of trait anger has highlighted biases related to both selective attention (e.g., Smith & Waterman, 2003) and the interpretation of ambiguously hostile behaviors (e.g., Graham, Hudley, & Williams, 1992). However, it is unclear how these two sets of biases are related to each other. We therefore outline two plausible models concerning relations between biases in attention and interpretation. We then suggest that these models make opposing predictions that can be tested in the context of visual scene perception, the focus of the current study.

Trait Anger, Attention, and Interpretation

Many studies have found that angry individuals preferentially attend to hostile cues or stimuli. This result has been found in studies using the emotional Stroop task (Eckhardt & Cohen, 1997; Smith & Waterman, 2003; Van Honk, Tuiten, de Haan, van den Hout, & Stam, 2001a; Van Honk et al., 2001b), visual search tasks (Cohen, Eckhardt, & Schagat, 1998; Smith & Waterman, 2004), and spatial cuing paradigms (Smith & Waterman, 2003; see also Wilkowski, Robinson, & Meier, in press). It is important to note that this bias has typically been measured with respect to isolated hostile and non-hostile stimuli rather than integrated visual scenes.

In addition to attention biases, there are also data linking trait anger to hostile interpretations of ambiguously hostile situations. An ambiguously hostile situation is a situation in which one person is harming another person, but it is unclear whether this harm was intended or not. In an important early study, Dodge (1980) found that aggressive children interpreted such ambiguously hostile situations as more hostile in nature. However, aggressive and non-aggressive children did not differ with respect to their interpretation of clearly intentional or unintentional situations. This basic finding has been termed the *hostile attribution bias* and has been replicated with children of numerous ages and nationalities (see Crick & Dodge, 1994, for a review), as well as with adult populations (Dill, Anderson, Deuser, 1997; Epps & Kendall, 1995; Hall & Davidson, 1996).

Subsequent studies have shown that individual differences in anger, rather than behavioral aggression per se, are most closely linked to interpretation biases. For example, the hostile attribution bias is found only among individuals who engage in angry forms of aggression (Crick & Dodge, 1996; Dodge & Coie, 1987). A direct link between biased interpretation and trait anger has been found in more recent studies (Epps & Kendall, 1995; Wingrove & Bond, 2005), and anger also mediates the relationship between interpretation biases and aggression (Graham et al., 1992). In sum, there is strong evidence that interpretation biases are closely linked to trait anger.

Toward an Integrated Framework

Crick and Dodge (1994) proposed that attention and interpretation are two separate stages at which biased information processing could lead to increased anger and aggression. Although the data are quite clear on this point, it is less clear how these biases relate to each other. One possibility is that attention biases feed forward, influencing later biases related to interpretation (e.g., Philippot, Baeyens, Douilliez, & Francart, 2004, p. 82). This hypothesis is intuitive and plausible. After all, attention is usually viewed as an early stage of stimulus processing, often (although not always) preceding more conscious inferences concerning the situation (e.g., Dhaene, 2005).

However, there is also reason to suspect that hostile interpretations could occur prior to the allocation of attention to specific cues. Research on scene perception, for example, has demonstrated that the gist of a scene is derived from the overall structure of the scene, typically before the allocation of attention to specific cues (e.g., VanRullen & Thorpe, 2001; Venturino & Gagnon, 1992). Likewise, social psychologists have shown that people make

attributions and trait inferences quite automatically (Gilbert & Malone, 1995; Carlston & Skowronski, 1994; 1995; Winter & Uleman, 1984), perhaps before the allocation of attention. In the realm of anger and aggression more specifically, there are at least three studies that have shown that angry and aggressive individuals automatically interpret ambiguously hostile actions as hostile in nature, even when given no instructions to interpret such actions (Copella & Tata, 1990; Zelli, Cervone, & Huesmann, 1996; Zelli, Huesmann, & Cervone, 1995). In sum, there are reasons for thinking that angry individuals may interpret a situation as hostile before attending to specific cues in the situation.

In contrasting these attention-first and interpretation-first models, we rely on a very robust pattern. When people make interpretations quickly, they subsequently process interpretation-mismatching information for a longer period of time. Data of this sort are commonplace in the cognitive literatures on word reading (Zwaan & Radvansky, 1998) and scene perception (Henderson, Weeks, & Hollingworth, 1999; Gordon, 2004; Loftus & Mackworth, 1978). In the person perception literature, too, early interpretations lead one to focus on information that is inconsistent with these earlier inferences (Bargh & Thein, 1985; Hastie & Kumar, 1979; Stern, Marrs, Millar, & Cole, 1984). Across these various literatures, it has also been shown that this increase in attention is likely due to attempts to integrate interpretation-discrepant information with early interpretations (Gordon, in press; Hastie, 1980; Zwaan & Radvansky, 1998).

Therefore, if high trait anger individuals quickly interpret ambiguous behaviors as hostile, then they should somewhat paradoxically exhibit a subsequent bias toward non-hostile (i.e., interpretation-mismatching) relative to hostile (i.e., interpretation-matching) cues. Indeed, this sort of pattern has been shown in a word reading paradigm of some parallel to the current study. Wingrove and Bond (2005) presented sentences describing an ambiguously hostile behavior. They then presented a second sentence that reinforced either a hostile or non-hostile interpretation of the first sentence. High trait anger individuals exhibited slower reading times for sentences reinforcing a non-hostile interpretation, suggesting that they spontaneously interpreted the first sentence as hostile and were trying to understand how a non-hostile continuation sentence could be true of the situation.

In sum, if attention biases are temporally prior to later interpretation biases, then individuals high in trait anger should process *hostile* cues for a longer period of time. On the other hand, if interpretation biases are temporally prior to later attention biases, then individuals high in trait anger should process *non-hostile* cues for a longer period of time. The scene perception literature in cognitive psychology is uniquely capable of contrasting attention-first versus interpretation-first hypotheses (Gordon, in press; Henderson et al., 1999). We therefore sought to build on this literature, as reviewed next.

Attention within Visual Scenes

The current study made use of a paradigm from the cognitive literature on scene perception (e.g., Loftus & Mackworth, 1978). To investigate the allocation of attention in a continuous, time-locked fashion, it is useful to measure eye movements because they are both continuous and reflective of underlying movements of attention (Henderson &

Hollingworth, 1999; Rayner, 1998). Eye fixation data has been especially important in understanding the sorts of processes examined here, which relate to early interpretations of the scene and selective attention processes (Loftus & Mackworth, 1978; Henderson et al., 1999).

Indeed, eye-tracking data have shown that the gist of a scene is extracted based on the overall structure of the scene, and that this gist extraction occurs prior to the allocation of attention to specific cues in the scene (e.g., VanRullen & Thorpe, 2001; Venturino & Gagnon, 1992). This early “gist” interpretation is followed by increased attention to gist-incompatible visual cues (e.g., an octopus in a kitchen), relative to gist-compatible cues (e.g., a blender in a kitchen) (De Graef, Christianens, & d’Ydewalle, 1990; De Graef, de Troy, & d’Ydewalle, 1992; Gordon, 2005; Henderson et al., 1999; Loftus & Mackworth, 1978). This focus on gist-incompatible visual cues is primarily related to difficulties in processing such cues (Davenport & Potter, 2004; Gordon, in press).

The present study asked individuals to process a number of visual scenes, some of which depicted ambiguously hostile actions. In order to create such ambiguous scenes, we relied on a previous operationalization of ambiguity within the literature on hostile attribution biases (Dodge & Newman, 1981; Epps & Kendall, 1995; Mikulincer 1998). Specifically, the scenes contained two mismatching cues. One cue in the picture (e.g., a surprised facial expression) suggested a non-hostile interpretation of a depicted harmful action, whereas the other cue (e.g., an angry facial expression) suggested a hostile interpretation of the same action.

The dependent measure pertained to the length of time required to first process the hostile and non-hostile cues in the ambiguously hostile situations. In the scene perception literature, this dependent measure is known as *first pass gaze duration*, and measures the length of time that the fovea remains fixated on a cue after first landing on it. This measure appears to be especially sensitive to encoding operations, and has the additional advantage of excluding later processing unrelated to encoding (Henderson et al., 1999).

As reviewed above, the attention-first model suggests that high trait anger participants should preferentially attend to hostile cues, whereas the interpretation-first model suggests that high trait anger participants should preferentially attend to non-hostile cues. The conflicting nature of such predictions motivated the present study, which offers unique personality-related data on the question of whether attention-first or interpretation-first models make better predictions in relation to early encoding operations involving ambiguously hostile visual scenes.

Method

Participants

Forty-five male undergraduate psychology students (42 Caucasians, 1 Asian-American, 2 African-Americans; M age = 20.5 years) at North Dakota State University participated in exchange for extra credit. The study was limited to males for practical reasons. Ambiguously hostile scenes depicted acts of physical rather than verbal aggression, since

only the former can easily be depicted in the context of a static visual scene. Acts of physical aggression are more common among males (e.g., Crick & Nelson, 2002). In addition, for purposes of control, it seemed useful to limit the scenes to one sex of perpetrator and victim, and we chose male protagonists here. The result of such stimulus factors led us recruit male participants for the study. We do believe that the present results would characterize females as well, but can provide no data in direct support of this point.

Apparatus

All participants completed the study on a Windows-based computer using EyeLink Experiment Builder and E-Prime software. This computer was connected to an EyeLink 2 eye-tracker, which was used to collect eye fixation data.

Stimuli

A set of 99 visual scenes depicted acts of apparent harm. We hired a computer programmer to create these scenes, and she did so using Adobe Illustrator CS software. This software allows one to pose figures, and to move only those aspects of the scene that one wants moved. This allows for relatively realistic pictures, which are nevertheless tightly controlled for experimental purposes. All scenes depicted one male individual harming another male individual. The same two individuals were depicted in all scenes. In half of the scenes, the blonder of the two individuals was the apparent aggressor; in the other half of the scenes, the darker-haired of the two individuals was the apparent aggressor.

Prior to designing an ambiguous version of each scene, we first created a version that involved relatively clear intentions to harm. In the example depicted in Figure 1, one individual is kicking a soccer ball through another's window, and two cues agree to support a hostile interpretation of this action. Specifically, the harm-doer is looking at the window, and his leg is directed towards the window. These cues suggest that there was no accident involved, and instead suggest that hostile intent was present. We next created an unintentional version of the same scene. In the example depicted in Figure 2, the harm-doer is looking away from the window, and his leg is directed away from the same window. Such cues agree to suggest that the incident was likely non-intentional.

If the variation of these two cues is sufficient to alter the interpretation of the scene, including one cue from each of the above (intentional and unintentional) versions of the scene should result in ambiguity (see Dodge, & Newman, 1981; Epps & Kendall, 1995; Mikulincer, 1998). In the ambiguous scene presented in Figure 3, the harm-doer's leg is pointed at the window, but his gaze is directed elsewhere. The disagreement of these cues creates some ambiguity in interpretation. Perhaps the harm-doer intended to break the window, but looked away to make it seem an accident. Alternatively, perhaps the harm-doer was truly unaware of the location of the window as he kicked the ball in that direction.

With respect to scenes besides the soccer incident, we adopted similar procedures for creating ambiguity. In order to insure the generality of the present results, a variety of actions were depicted, from less serious (e.g., spilling a beverage) to more serious (e.g., choking). The nature and location of the hostile and non-hostile cues also differed across the scenes. Hostile and non-hostile cues could potentially appear in connection with the harm-

doer or the victim. Hostile cues included angry facial expressions, raised fists, and direct eye gaze, among other possibilities. Non-hostile cues included happy or surprised facial expressions, averted gaze, and apparent loss of balance, among other possibilities. In short, the depiction of ambiguously hostile actions was quite diverse across incidents. This was done in order to support the generality of the present results.

Pre-Testing of Stimuli

To ensure that the manipulation of scene type was successful, 34 pretest participants were asked to rate the extent to which the depicted harm was intentional along a 1 (not intended at all) to 9 (definitely intended) scale. A repeated-measures ANOVA, with scene type (hostile versus ambiguous versus non-hostile) as the sole factor, indicated that the manipulation was successful, $F(2, 66) = 140.85, p < .0001$. Hostile scenes were rated as intentional ($M = 7.33$), non-hostile scenes were rated as non-intentional ($M = 3.54$), and ambiguous scenes were viewed as somewhat ambiguously intentional ($M = 5.50$). A closer examination of each scene set revealed that the ambiguous scene was associated with ratings in between the intentional and unintentional pictures in the vast majority of scene sets. However, this was not true in the case of two of the 33 sets. These two sets were therefore dropped, resulting in a total of 93 scenes (31 of each scene type) that were retained for use in the eye-tracking study.

Measures

Attention Task—During the eye-tracking portion of the study, participants were asked to keep their heads motionless by resting their chins on a chin-rest. The computer randomized trials for each participant. A trial consisted of the following sequence: A dot first appeared on the screen in a position half-way between the two relevant cues for the subsequent picture. In the case of the ambiguous pictures, which were most important to our hypotheses, these cues consisted of one hostile and one non-hostile cue. Participants were asked to focus on this dot, and then press enter on the keyboard. The computer corrected for any drift involved in the lock on the participant's eyes at this time. As soon as the participant pressed enter, a picture was presented for 8 seconds.

Each of the 93 pictures was presented once. This included the intentional, unintentional, and ambiguous versions of each picture. The inclusion of all three types was done to ensure that any obtained results were not due to the repeated presentation of the more puzzling ambiguous scenes. By design, however, only the ambiguous scenes could compare attention to hostile and non-hostile cues during encoding. Therefore, only the ambiguous scenes are relevant to our predictions. The eye-tracker began recording eye fixations with the initial presentation of the picture, and halted recording with the picture's disappearance. To insure that participants were actually processing the pictures, we asked general questions about each scene after it was presented.

Personality Questionnaire—To make somewhat general conclusions, we sought to assess several measures of trait anger subsequent to the eye-tracking portion of the study. The Anger subscale of Buss and Perry's (1992) Aggression Questionnaire (AQ-A) asks participants to rate how well a series of seven statements related to anger (e.g., "I have

become so mad I have broken things.”) describe the self in general. Ratings are made using a 1 (very inaccurate) to 5 (very accurate) scale. Past research has shown that the scale is reliable and valid. For example, this scale predicts informant reports of anger (Buss & Perry, 1992), and correlates well with other measures of trait anger (Martin, Watson, & Wan, 2000). In the present study, α was .75.

The Spielberger (1988) Trait Anger Scale (STAS) asks participants to rate the extent (1 = Almost Never; 4 = Almost Always) to which ten items indicative of high levels of trait anger (e.g., “I have a fiery temper.”) characterize the self in general. The scale has been extensively validated in prior studies (see Deffenbacher, 1992, for a review). For example, it has been shown that this scale predicts daily reports of state anger better than state trait anxiety or state sadness measures (Deffenbacher, 1992). In the present study, α was .83.

Finally, we administered the Hostility subscale of Watson and Clark’s (1994) Positive Affect and Negative Affect Schedules-Expanded version, trait form (PANAS-H). This scale asks participants to rate how intensely (1 = Very Slightly; 5 = Quite a Bit) they generally tend to feel six mood markers related to anger and hostility (items: *angry, hostile, irritable, scornful, disgusted, loathing*). The scale correlates well with other measures of trait anger, and also possesses discriminant validity in that it is more highly correlated with other trait anger scales than with scales seeking to tap the attitudes or behaviors associated with aggression (Martin et al., 2000). In the present study, α was .76.

We computed descriptive statistics for the three trait anger scales, the results of which are presented in Table 1. The three trait anger scales were positively correlated with each other, but the correlations did not reach unity (AQ-A & STAS, $r = .59$; AQ-A & PANAS-H, $r = .61$; STAS & PANAS-H, $r = .60$, all $ps < .01$). Therefore, a replication across the three trait anger scales should be viewed as support for a relatively robust pattern of findings.

Procedure

Participants completed the experimental sessions individually, and these sessions were conducted by the first author. Participants arrived, gave informed consent, and were informed of the general nature of the study by the experimenter. They then began a process of calibrating the eye-tracker to follow their eye movements, a careful process that could take as long as ten minutes. Participants then completed the eye tracking task in a silent and well-controlled experimental environment. Finally, they completed the trait questionnaires on the computer. The implicit to explicit ordering of cognitive and trait measures has been recommended in the personality literature (Robinson & Neighbors, 2006).

Results

Treatment of Eye Tracking Data

The eye-tracker sampled eye positions every 2 ms, and thus generated a relatively continuous stream of times and eye positions. In order to reduce this stream of data, Eye Link EDF converter software was first used to reduce this stream to periods when the eye was fixated upon a particular location, versus periods when it was moving from one location to another (i.e., a saccade). A specially designed computer program was then used to define

the regions of interest for each scene in terms of x and y coordinates. Regions of interest were specifically defined in terms of the smallest rectangular area that could encompass the relevant hostile or non-hostile cues in the specific visual scene. A third computer program then compared participants' fixations to the regions of interest for each picture, and outputted the time from the first entry into a region of interest until the first exit from that same region. This value represents First Pass Gaze Duration – i.e., the amount of time spent encoding the cue following initial fixation on it (Henderson et al., 1999).

Gaze duration scores were log-transformed to correct for a positively skewed distribution (Cohen, 2001). Values 2.5 SD s above and below the mean (2.09% of all trials) were then classified as outliers, and replaced with these cutoff values in order to reduce their undue influence (Cohen, 2001). Although all analyses used these log-transformed scores, means are reported in terms of the original millisecond unit for ease of interpretation.

Primary Analyses

To examine normative trends, we first conducted a repeated-measures ANOVA on gaze durations (GD). Cue Type (hostile versus non-hostile) was the sole within-subject factor. The analysis revealed a significant main effect of Cue Type, $F(1, 44) = 22.59, p < .0001$, such that participants processed the non-hostile cues for a longer period of time ($M = 451$ ms) than they processed the hostile cues ($M = 403$ ms). Thus, participants apparently found non-hostile cues, relative to hostile ones, to be more difficult to integrate with the overall gist of the ambiguously hostile scenes, a pattern that comports with prior data in the scene perception literature (De Graef et al., 1990; De Graef et al., 1992; Gordon, 2005; Henderson et al., 1999; Loftus & Mackworth, 1978).

Following the normative analysis, we then sought to examine individual differences, which were of most interest here. To accommodate the combination of continuous between-subjects variables (i.e., trait anger scores) with the discrete within-subject manipulation (i.e., gaze durations for hostile versus non-hostile cues), we used the General Linear Model (GLM) Procedures of SAS, which are well-suited to this sort of design (Robinson, in press). We performed three GLM analyses, one for each of the trait anger measures. Trait anger measures were standardized prior to these analyses.

All analyses replicated the main effect of Cue Type reported above. There was also a main effect for STAS, $F(1, 43) = 5.34, p = .02$. To interpret this main effect, a regression was conducted with STAS predicting the mean GD time, averaged across both hostile and non-hostile cue types. The regression equation was then used to estimate the mean gaze duration of those low (1 SD below the mean) or high (1 SD above the mean) on this scale (Aiken & West, 1991). The regression indicated that individuals low on STAS spent less time looking at cues ($M = 395$ ms) than did those high on STAS ($M = 459$ ms). This main effect was not predicted, and it was not replicated in the analyses involving AQ-A or PANAS-H scores, $ps > .22$. Furthermore, it must be interpreted in light of the interaction reported below.

Central to our hypotheses were potential interactions between trait anger and differential fixations on hostile versus non-hostile cues. In fact, all three GLM analyses indicated a significant Trait Anger x Cue Type interaction, whether trait anger was measured in terms of

AQ-A, $F(1, 43) = 14.66, p = .0004$, partial $\eta^2 = .25$, STAS, $F(1, 43) = 4.66, p = .03$, partial $\eta^2 = .09$, or PANAS-H, $F(1, 43) = 6.01; p = .01$, partial $\eta^2 = .12$. As Cohen's (1987) norms for η^2 indicate that a medium effect size corresponds to $\eta^2 = .0588$ whereas a large effect size corresponds to $\eta^2 = .1379$, these effects range from moderately large to large in nature.

To interpret these interactions, two regressions were performed for each trait anger measure, with the relevant trait anger measure predicting the mean gaze duration for the hostile and non-hostile cues in separate regressions. The resulting equations were used to estimate the mean gaze durations for those low ($-1 SD$) or high ($+1 SD$) on each scale (Aiken & West, 1991). Figure 4 displays the results of these regressions. The figure reveals that individuals high in trait anger exhibited longer gaze durations for non-hostile cues relative to hostile cues. Low anger individuals, by contrast, exhibited little difference in their gaze durations with respect to hostile and non-hostile visual cues. The interactive pattern supports the interpretation-first model outlined in the introduction. Specifically, the interactive pattern suggests that only individuals high in trait anger made an early hostile interpretation of the ambiguous visual scenes.

To support this interpretation of the Trait Anger x Cue Type interactions, post-hoc analyses were conducted. We specifically sought to examine whether the simple effect of Cue Type was significant at low and high levels of trait anger. We found that, when the intercept of trait anger was adjusted to represent high levels of trait anger ($1 SD$ above the mean), the Cue Type main effect was highly significant, AQ-A: $F(1, 43) = 42.88, p < .0001$; STAS: $F(1, 43) = 25.14, p < .0001$; PANAS-H: $F(1, 43) = 27.78, p < .0001$. This suggests that high anger participants exhibited a very pronounced tendency to dwell on non-hostile cues. However, the same main effect did not reach significance when the intercept of trait anger was adjusted to represent low levels of trait anger ($1 SD$ below the mean), AQ-A: $F(1, 43) = 1.22, p = .28$; STAS: $F(1, 43) = 3.77, p = .058$; PANAS-H: $F(1, 43) = 3.18, p = .08$. Thus, low anger participants did not exhibit a reliable tendency to dwell upon non-hostile cues.

Additional Analyses

The above analyses focusing on First Pass Gaze Durations support predictions derived from the interpretation-first account. However, the eye-tracking data can be used to assess other aspects of attention, including earlier aspects that could potentially support the attention-first account. In order to examine very early aspects of selective visual attention, we calculated another variable that is frequently quantified in the scene perception literature, namely Time Till Target Fixation (TTTF; see Henderson et al., 1999). This variable represents the length of time transpiring from the initial presentation of the visual scene until first fixations upon a particular cue. The variable is thought to represent the early prioritization of selective attention to different types of cues (Henderson et al., 1999).

Analysis of TTTF yielded a significant main effect of Cue Type, $F(1, 44) = 6.62, p = .01$, such that participants fixated upon regions associated with non-hostile cues ($M = 889$ ms) more quickly than they fixated upon regions associated with hostile cues ($M = 1056$ ms). This normative effect replicated the normative effect for gaze duration reported above, suggesting that non-hostile cues were more capable of drawing and holding attention within ambiguously hostile scenes. However, none of the trait anger measures interacted with this

Cue Type main effect, $ps > .18$. The lack of systematic interactions effectively rules out an attention-first account of our findings, in that there was simply no support for prioritization of hostile cues, either earlier or later in processing, among individuals high in trait anger.

Our hypotheses were based on prior literatures linking individual differences in anger to selective attention (e.g., Smith & Waterman, 2003) and interpretation (e.g., Epps & Kendall, 1995). Importantly, both of these literatures have presented mixed stimulus cues – i.e., both hostile and non-hostile ones. Further, these literatures give no reason to expect that trait anger would affect attention allocation in clearly intentional or clearly unintentional hostile scenes (e.g., Dodge, 1980). Still, the present procedures were novel and so we analyzed for potential trait anger effects in relation to the intentional and unintentional harm scenes. Analyses revealed that there were no main effects or interactions involving any measure of trait anger, $ps > .13$. Thus, the present data, like prior data (e.g., Dodge, 1980; Smith & Waterman, 2003), indicate that individual differences in anger are primarily apparent in ambiguously hostile situations.

General Discussion

Previous literatures have linked trait anger to at least two robust cognitive biases, one related to selective attention and one related to hostile interpretations of ambiguously hostile situations. However, prior research has not generally examined the question of how these biases are related to each other. To investigate this important question in a relatively naturalistic manner, we focused on gaze duration patterns in relation to hostile and non-hostile cues presented within ambiguously hostile visual scenes.

We contrasted two models in our predictions. One model proposes that angry individuals differentially attend to hostile relative to non-hostile cues, and this selective bias helps to create later biases related to interpretation. Clearly, this model was not supported. First, trait anger did not predict the time till target fixation measure, which can be interpreted as an early selective bias in favor of cues of either a hostile or non-hostile nature. Second, although trait anger did predict the length of fixation times for hostile versus non-hostile cues, this pattern was opposite to the selective attention hypothesis. That is, high trait anger individuals actually fixated on non-hostile, rather than hostile, cues for a longer period of time. Thus, there was no support for the attention-first model. It is important to note that we do believe attentional biases of the sort demonstrated in previous research (e.g., Smith and Waterman, 2003; Van Honk et al., 2001a; 2001b) will prove have some causal relevance to trait and state anger. The current data, however, indicate that this relevance does not operate by giving rise to early hostile interpretations of visual scenes.

A second model proposes that individuals high in trait anger interpret ambiguously hostile acts as hostile in nature before allocating attention to specific cues in the situation (e.g., Zelli et al., 1995; 1996). In support of the second model, the present study found that high anger individuals displayed longer fixation times in relation to non-hostile cues, whereas low anger individuals displayed no differential tendency to fixate on hostile or non-hostile cues for a longer period of time. The present data therefore support the idea that individuals high

in trait anger quickly make the inference that ambiguous actions are hostile in nature, even *before* encoding specific hostile or non-hostile cues in the situation.

Toward an Integrated Model of Anger-Related Cognitive Biases

The current research therefore builds upon the previous literature related to hostile cognitive biases, and helps move the field toward an integrated understanding of these biases. In relation to attention biases, the current results qualify previous studies in which high trait anger individuals preferentially allocated attention to hostile cues (e.g., Smith & Waterman, 2003; Van Honk et al., 2001a; 2001b). To understand the difference between our results and those obtained in prior selective attention paradigms, it is critical to recognize that prior studies presented hostile and non-hostile spatial cues which were isolated, distinct, and unsupportive of any larger interpretative context (Cohen et al., 1998; Smith & Waterman, 2003). For example, if a participant is shown two words (e.g., “hit” and “hug”) on the computer screen, without any larger context, there is no “story” and no larger interpretation that can be sought.

By contrast, the current study presented hostile and non-hostile cues as parts of an integrated scene. These cues were meaningfully related to one another, and thus, participants could potentially come to an early interpretation of the scene. This is critical because “gist” interpretations of integrated scenes occur early in visual processing, precede fixations, and are associated with robust attention biases favoring gist-inconsistent cues (Davenport & Potter, 2004; Gordon, in press; Henderson et al., 1999). By contrast, the presentation of separate visual cues fails to create a scene at all, much less one that could be interpreted at early stages of visual processing. We therefore suggest that the use of integrated scenes is the crucial reason that the present results diverge from prior studies involving isolated visual cues (Cohen et al., 1998; Smith & Waterman, 2003).

While such results are novel, in that they offer the most definitive evidence to date for the interpretation-first model, we do note that our conclusions are consistent with other results reported in the literature. Other studies point to emergence of interpretational biases at very early and automatic stages of information processing (Copella & Tata, 1990; Zelli et al., 1995; 1996). Furthermore, one selective attention study introduced interpretation-related factors and yielded results that parallel our own. Smith and Waterman (2004) asked participants to read scenarios related to aggression before completing a dot-probe measure of attention to hostile or non-hostile words. Consistent with the current study, angry individuals exhibited greater selective attention to non-hostile cues in this condition. Similarly, Wingrove and Bond (2005) found that angry individuals exhibited longer reading times for non-hostile sentences following ambiguously hostile sentences.

The convergence of our study with this prior data (Smith & Waterson, 2004; Wingrove & Bond, 2005; Zelli et al., 1995; 1996) suggests some general conclusions. First, angry individuals may often extract a hostile interpretation of an ambiguous situation quickly and automatically (cf. Zelli et al., 1995; 1996). Second, such inferences precede, rather than follow, a detailed analysis of the hostile and non-hostile cues present. Third, angry individuals may be confused by non-hostile cues occurring in an ambiguously hostile

situation. This point is consistent with the broader literature on scene-perception (e.g., Davenport & Potter, 2004; Gordon, in press).

Clinical Implications

The central premise of cognitive-behavioral therapies for the treatment of anger and aggression is that altering such cognitive biases is paramount to effective treatment (e.g., Beck, 1999). This literature has sometimes been criticized for an over-reliance on what could be viewed as a somewhat vague reference to cognition as a monolithic entity, despite the fact that cognitive processes are typically very specific and differentiated in nature (Robinson & Compton, in press; Williams, Watts, MacLeod, & Mathews, 1988). From this perspective, research on the specific nature of anger-related cognitive biases could be useful in guiding the cognitively-oriented treatment of anger and hostility.

Past interventions targeting the hostile attribution bias (e.g., Hudley & Graham, 1993) have been multi-faceted in nature, and included components that encouraged clients to seek out and attend to mitigating information. Our data suggest that such an emphasis is unnecessary, in that angry individuals actually fixate on such cues for a prolonged period of time. This suggests that components encouraging a search for mitigating cues may be a superfluous element in such multi-faceted clinical interventions. Rather, our data suggest that anger-reduction may be better achieved by short-circuiting early interpretation biases linked to high levels of trait anger.

Future Directions

Although the present results provide support for the interpretation-first account, it must be noted that further research is needed to more fully support this account. First, the current study did not consider possible gender differences, in that only male participants were included. This was a pragmatic decision based on the male characters and physical violence depicted in these scenes. Thus, the question of whether the present results would generalize to females must remain a question for future research.

With respect to our stimulus materials, we suggest that the use of ambiguously hostile pictures made sense in the present context. Indeed, the literature on the hostile attribution bias routinely uses ambiguously hostile scenarios, but not ambiguous scenarios unrelated to hostile attribution biases (Crick & Dodge, 1994; Epps & Kendal, 1995). However, we must also admit that we did not examine visual scanning patterns in relation to other sorts of scene ambiguity, such as whether a character is experiencing happiness or sadness. Nevertheless, we regard it unlikely that individuals high in trait anger are especially sensitive to *all* sources of emotional ambiguity. In support of this point, Copella and Tata (1990) found that individual differences in trait hostility predicted biased interpretations of ambiguously hostile sentences, but did not predict biased interpretations of ambiguously threatening sentences. We therefore suggest, tentatively, that the pattern of findings found here is likely to be specific to trait anger and ambiguously hostile actions.

With regard to personality measures, we provided evidence for the convergent validity for our hypothesis, in that three measures of trait anger were correlated with the same

attentional pattern. However, the current study did not provide evidence for divergent validity, in that measures of trait anxiety, depression, or broader forms of neuroticism were not included. This decision seemed legitimate because our hypotheses related to trait anger, but not to other forms of negative affect. However, previous studies focused on such issues of discriminant validity have shown that hostile biases in cognition remain significantly related to trait anger after controlling for trait anxiety (Copella & Tata, 1990; Van Honk et al., 2002a; 2002b). Thus, there is reason to believe the current pattern is likely specific to trait anger, and not an epiphenomenal manifestation of some other trait.

Conclusions

The purpose of the present study was to examine relations between trait anger and the early allocation of attention to hostile and non-hostile cues within ambiguously hostile visual scenes. The findings supported the idea that individuals high in trait anger make an early hostile interpretation of such scenes, whereas individuals low in trait anger do not. Moreover, the present findings highlight, more than any prior results, the fact that hostile interpretations among angry individuals may often precede a careful analysis of hostile and non-hostile cues present in the situation.

Acknowledgments

The authors acknowledge support from NIMH (068241) and additionally thank Jeff Bouffard for his many helpful comments.

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Figure 1.
Example of a Hostile Scene

Figure 2.
Example of a Non-Hostile Scene

Figure 3.
Example of an Ambiguously Hostile Scene

Figure 4. Trait Anger and Cue Type as Predictors of Gaze Duration Times: Interactions Involving Buss/Perry Anger (AQ-A: Top Panel), Spielberger Trait Anger (STAS: Middle Panel), and PANAS-X Hostility (PANAS-H: Bottom Panel)

Table 1

Descriptive Statistics Pertaining to the Trait Anger Scales

<i>Trait Measure</i>	AQ-A	PANAS-H	STAS
Mean	2.34	1.78	1.85
SD	.64	.51	.44
Minimum	1.28	1.00	1.10
Maximum	3.71	3.16	3.10
Rating Scale	1 to 5	1 to 5	1 to 4

Note: Trait anger was measured by three scales: The anger subscale from the Buss and Perry (1992) Aggression Questionnaire (AQ-A), the hostility subscale from the PANAS-X (PANAS-H: Watson & Clark, 1994), and the Spielberger Trait Anger Scale (STAS: Spielberger, 1988).