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A New Mode of Fear Expression: Perceptual Bias in Height Fear

Bethany A. Teachman,
University of Virginia

Jeanine K. Stefanucci,
College of William & Mary

Elise M. Clerkin,
University of Virginia

Meghan W. Cody, and
University of Virginia

Dennis R. Proffitt
University of Virginia

Abstract

Emotion and psychopathology researchers have described the fear response as consisting of four main components – subjective affect, physiology, cognition, and behavior. The current study provides evidence for an additional component in the domain of height fear - perception - and shows that it is distinct from measures of cognitive processing. Individuals High (N = 35) and Low (N = 36) in acrophobic symptoms looked over a two-story balcony ledge and estimated its vertical extent using a direct height estimation task (visual matching), and an indirect task (size estimation); the latter task seems to exhibit little influence from cognitive factors. In addition, implicit and explicit measures of cognitive processing were obtained. Results indicated that, as expected, the High Fear group showed greater relative, implicit height fear associations and explicit threat cognitions. Of primary interest, the High (compared to Low) Fear group estimated the vertical extent to be higher, and judged target sizes to be greater, even when controlling for the cognitive bias measures. These results suggest that emotional factors such as fear are related to perception.

Keywords

visual perception; implicit associations; height fear; acrophobia

Individuals typically think about emotion in terms of the subjective affect they experience. Yet, emotion researchers have long recognized that there are other modes for expressing emotion. For example, Lang's (1979) seminal bio-informational theory proposed three components to the fear response - physiology, cognition, and behavior. More recently, Barlow (2002) and others (Davis & Ollendick, 2005) have noted the importance of the affective state in feeling fearful as well. While these four modalities encompass a large part

Correspondence concerning this paper should be addressed to Bethany A. Teachman at the Department of Psychology, University of Virginia, P.O. Box 400400, Charlottesville, VA 22904-4400. Phone: 434-924-0676, Fax: 434-982-4766, bteachman@virginia.edu.

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of the fear response, we propose an additional modality that is important to the fear construct: visual perception.

The current study was designed to expand the field's understanding of the many ways fear is expressed by introducing perceptual bias as a novel indirect measure of height fear. In addition, this study includes an indirect measure of cognitive bias - implicit height fear associations - to check that the perceptual bias does not simply reflect cognition. The study will examine whether individuals with high (relative to low) acrophobic symptoms view heights as higher and associate heights with fear outside of conscious control. Further, the relationship between height fear and perception will be evaluated while controlling for the explicit and implicit cognitive measures of fear to check that these cannot fully account for the expected group differences in perception.

The idea that fear might be associated with a biased perception of the feared object has been anecdotally noted in clinical work, but prior empirical evaluations have been limited. Intriguing work by Riskind, Kelly, Moore, Harman, and Gaines (1992) found that high (relative to low) spider-fear participants reported more rapid forward motion when watching a video of a spider. Moreover, Rachman and Cuk (1992) found that fearful participants verbally reported more snake flickering tongue and spider jumping movements. These results are provocative, but unfortunately the methods used in these studies to evaluate perception may have been contaminated by cognitive influence, as they relied on verbal self-report or retrospective judgments of the objects' perceptual properties.

The current hypothesis that non-optical factors, like fear, may be related to visual perception draws on recent studies demonstrating that perceived spatial layout is influenced by the physiological state of the observer (see Proffitt, 2006). For example, hills appear steeper to individuals who are fatigued, encumbered, or elderly (e.g., Bhalla & Proffitt, 1999). Further, there is some evidence that fearful stimuli can influence even low-level visual processes. Phelps, Ling, and Carrasco (2006) showed that when fearful (versus neutral) faces were presented before a contrast sensitivity discrimination task, the fearful stimuli evoked better contrast sensitivity. These findings are exciting because most theories of perception describe vision as a modular, encapsulated process that is unaffected by non-visual factors (e.g., Pylyshyn, 2003). The present study extends the investigation of psychological factors that influence spatial perception into the area of emotion dysregulation. If height fear is also associated with perception, this would imply that the emotional state of the individual might actually influence what is seen (though it is recognized that causal claims will not be possible outside of an experimental design). It is suspected that it is those psychological factors that affect the perceived costs associated with acting in the environment that will influence perception (Proffitt, 2006). For example, fear may lead to seeing a vertical extent as particularly high because it emphasizes the costs of potentially falling. Fear is thus a good candidate emotion for altering perception because of the adaptive importance of rapidly perceiving impending danger.

Given that it is already well established that fear influences cognitive biases (see Mathews & MacLeod, 2005) and because of the challenge of disentangling measures of cognition from measures of perception (Philbeck & Loomis, 1997), it is important to address the concern that the study could be measuring cognitive biases rather than perceptual effects. In other words, participants could be *reporting* a different height even though they did not *see* a different height. If the study used only verbal reports, then the possibility of a cognitive bias would be a significant issue. It is because of this concern that the study employs measures of height perception that previous research has shown are less likely to be biased by conscious judgments. Specifically, participants estimated balcony height using a visual matching measure that does not require verbal report or rely on memory; moreover, size estimations of a target object on the ground were also obtained. The size estimate provided a converging measure of perceived height given the size/distance invariance hypothesis (i.e., the frequently found relation between apparent size and distance; Epstein, 1973).

To further demonstrate that the perceptual measures are not redundant with the cognitive measures, both direct (explicit threat cognitions) and indirect (implicit fear associations as measured by the Implicit Association Test; Greenwald, McGhee, & Schwartz, 1998) measures of cognitive biases associated with height fear were obtained to check whether the perceptual biases exist even after accounting for group differences in cognition. Measuring implicit fear associations has recently been established in healthy and phobic populations (e.g., Huijding & deJong, 2006; Teachman & Woody, 2003), and the current study introduces a new application of this measure to height fears. The term “implicit association” is used here to refer to memory-based links between two concepts that can be measured outside conscious control, and perhaps outside awareness. Notably, these associations share some of the qualities ascribed to fear schema because the cognitive structures referred to in schematic processing are often described as interconnected associations in memory (Segal, 1988). There has been growing interest in the role of implicit cognitive processing in psychopathology research (see De Houwer, 2002), and recognition that the uncontrollable nature of threat processing is considered the hallmark of automaticity in anxiety (McNally, 1995). By including a cognitive bias measure (like implicit associations) that is difficult to strategically control (see Greenwald et al., 1998), it is possible to compare the measure to the perceptual tasks that are also hard to control.

It is hypothesized that height fearful participants will demonstrate perceptual and cognitive biases, literally seeing, as well as interpreting, height stimuli as more threatening, but that the differences in perception will not be redundant with the differences in cognition, suggesting they are unique modes of fear expression.

Method

Participants

Participants were students (N = 36 Low Fear, 53% female; N = 35 High Fear, 47% female) enrolled in psychology courses who were pre-selected based on responses to the “height” distress item on the Fear Survey Schedule-III (*FSS-III*; Wolpe & Lang, 1964) and community volunteers responding to flyers seeking individuals with extreme height fear. Participants who rated their height fear as 1 or 2 (low fear group) or as 4 or 5 (high fear group) were invited to participate, following comparable recruitment procedures for analogue phobic samples from Teachman, Gregg, and Woody (2001). Mean age was 19 years (SD = 5.40), and 72% reported race and/or ethnicity as Caucasian, 1% African American, 3% Hispanic, 14% Asian, 8% biracial, and 1% as Middle Eastern. There were no significant group differences for age ($t_{(69)} = 1.24$, $p > .10$, $d = 0.30$), gender ($\chi^2 = .34$, $p > .10$), race ($\chi^2 = 7.10$, $p > .10$), or eye height (relevant for estimating the balcony height; $t_{(68)} = .73$, $p > .10$, $d = 0.18$).

Materials

Traditional Height Fear Responses—To establish the validity of the fear group classification, participants completed traditional height fear measures reflecting subjective affect, behavior, and self-reported physiological reactions. These included the Acrophobia Questionnaire (AQ; Cohen, 1997), a widely used measure of height phobia with anxiety and avoidance subscales. Additionally, participants climbed a ladder to measure self-reported fear (on a 0–100 verbal analogue scale) and behavioral avoidance (operationalized as time to ascend ladder); a common provocation in acrophobia research (Menzies & Clarke, 1995).

Further, after looking over the balcony, participants reported on their initial fear (on the 0–100 scale), as well as their fear-related bodily sensations on the Body Sensations Questionnaire (BSQ; Chambless, Caputo, Bright, & Gallagher, 1984). Finally, given that the implicit cognitive measure (see below) evaluates fear of heights relative to fear of spiders, an item measuring spider fear (on a 1–5 scale, following the format of the FSS-III) was also included with the pre-selection materials.

Cognitive Biases

Explicit: Participants reported their fearful cognitions (e.g., that they might fall) on the Agoraphobic Cognitions Questionnaire-Heights version (ACQ; Chambless et al., 1984).

Implicit: The Implicit Association Test (IAT; Greenwald et al., 1998) is a reaction time task that purportedly reflects strength of association between concepts. The associations are automatic in the sense that evaluations occur outside conscious control, and at times, outside awareness. The IAT has adequate psychometric properties (Greenwald & Nosek, 2001), and involves comparing the time taken to classify stimuli when paired categories match versus contradict a person's automatic associations. When categories match associations, participants are expected to classify stimuli more quickly.

In the present study, participants evaluated associations toward heights paired with the concepts "Afraid" versus "Unafraid." The IAT is a relative measure, so evaluation of heights was compared to evaluation of spiders. This contrast category was selected because it is also a common phobia. The task requires participants to categorize words and pictures as quickly as possible into superordinate categories. There are two critical conditions; one reflecting non-fearful associations toward heights and one reflecting fearful associations (condition order is counterbalanced across participants). In one condition, items representing the category *Height* (e.g., pictures looking down from tall buildings) were categorized with the same response key as items representing the category *Afraid* (e.g., words such as scared), while items representing *Spider* were categorized with the same response key as items representing *Unafraid*. In the other condition, *Height* and *Unafraid* items were categorized with one response key, and *Spider* and *Afraid* items were categorized with the other. See Figure 1a. The difference in average categorization latency across conditions is intended to indicate relative strength of automatic associations.

Perceptual Bias—In the visual matching task, participants viewed the vertical extent from a two-story, 26-foot high balcony with a target disk placed on the ground beneath the balcony. Participants estimated the height of the balcony by positioning an experimenter to be the same distance from them along the balcony as the participants were to the target on the ground (see Figure 1b). Participants also gave size estimates of the target disk by instructing a nearby experimenter to adjust a tape measure in the frontal plane to match the diameter of the target. (The blank side of the tape faced participants.) For both tasks, participants were encouraged to look back and forth between the experimenter and the target as often as they needed. Importantly, the size estimation task measures height perception indirectly by assuming that apparent size is related to estimates of apparent distance (or height). (Following simple trigonometry, for a target subtending a given visual angle, the greater the distance, the greater the target size.) Further, both measures used methods that do not require verbal report and participants were unaware that fear was expected to influence their perceptions of height or size. Hence, there is reason to believe that the converging height measures reflect perception, and not simply judgment biases or demand effects.[1]

Procedure

Following informed consent, participants were taken onto the balcony and instructed to look over the ledge while reporting their initial fear level. They then completed the visual matching task followed by the target disk size estimate. After returning indoors, they completed the ACQ and BSQ. Next, the IAT was administered, followed by the ladder task in which participants were asked to climb a 12-foot ladder up to the 7th rung, if they were willing, and to report on their fear level. The experimenter discreetly recorded time to reach the highest step. Finally, the AQ was completed, and an exit interview was conducted to check for knowledge of the hypotheses before participants were debriefed. (Note, participants were not informed they were recruited based on their height fear level until the conclusion of the study.)

Results

Validity of Fear Group Classification: Traditional Height Fear Responses

As expected, the groups differed on the questionnaire measure of height fear (AQ), with higher scores for the High Fear group for both the anxiety ($t_{(62)} = 6.72$, $p < .001$, $d = 1.71$) and avoidance ($t_{(61)} = 3.96$, $p < .001$, $d = 1.01$) subscales. When asked to climb the ladder, the High Fear group also reported greater peak fear ($t_{(61)} = 4.55$, $p < .001$, $d = 1.17$) and took longer to reach the highest step (7.59 seconds for Low Fear group, 9.94 seconds for High Fear group; $t_{(60)} = 2.63$, $p = .01$, $d = 0.68$). Further, after looking over the balcony, the High Fear group reported more initial fear ($t_{(69)} = 5.15$, $p < .001$, $d = 1.24$), and bodily sensations on the BSQ ($t_{(69)} = 3.06$, $p = .003$, $d = 0.74$).[2] These findings support the validity of the fear group classification.

Cognitive Biases

Explicit—As expected, the High Fear group indicated more fearful cognitions on the ACQ ($t_{(69)} = 3.45$, $p < .001$, $d = 0.83$) than did the Low Fear group, and the ACQ was related to a number of traditional height fear measures: AQ anxiety ($r = .49$, $p < .001$) and avoidance ($r = .45$, $p < .001$), fear on the balcony ($r = .26$, $p = .03$), the BSQ ($r = .76$, $p < .001$), and time to ascend the ladder ($r = .25$, $p = .047$).

Implicit—The IAT data were scored according to the scoring algorithm developed by Greenwald, Nosek, and Banaji (2003) to create a D score, which reflects the difference in mean reaction time across critical conditions divided by the standard deviations across conditions. No participants' IAT data were deleted because of high error rates or unusually fast or slow response times (overall error rate = 4.6%).

Scores above the zero point indicate relatively more height (versus spider) fear associations; scores below the zero point indicate the opposite pattern. As hypothesized, the High Fear group was faster at completing the task during the height fearful association condition, relative to the Low Fear group ($t_{(68)} = 3.38$, $p = .001$, $d = 0.82$). Further, this group difference remained significant when covarying the measure of spider fear ($t_{(67)} = 3.09$, $p = .003$, $d = 0.76$), increasing confidence that group differences reflect height fear associations.

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[1]Note that the decision to use different references for the height estimate (based on the horizontal distance to a person) versus for the size estimate (based on the vertical drop to a disc) was based on past research indicating that people are accurate at estimating to either people or to objects (see Loomis, Da Silva, Fujita, & Fukusima, 1992). Further, because the current study focuses on between-group differences, and the different references are present for both groups, any influence of the references is expected to have a comparable impact on both groups.

[2]Note that the changes in degrees of freedom across tests are due to missing data on some variables. For instance, it was not possible to complete the ladder climbing task on a small number of occasions due to inclement weather that would have made climbing the ladder dangerous.

See Figure 2a. This finding suggests height fearful associations exist outside of conscious control. Moreover, these fearful associations were related to a number of traditional height fear measures, including the AQ anxiety (r = .36, p = .004) and avoidance (r = .39, p = .002), fear on the balcony (r = .26, p = .03), and time to ascend the ladder (r = .22, p = .09).

Perceptual Bias—On the Visual Matching Task it was expected that the High Fear group would see the balcony as higher than the Low Fear group. As evident in Figure 2b, the High Fear group estimated the balcony height to be nearly five feet higher than the Low Fear group's estimate ($t_{(68)}$ = 2.13, p = .04, d = 0.52). Moreover, the group difference remained significant even when covarying the cognitive measures (IAT and ACQ), suggesting the difference is specific to perception ($t_{(65)}$ = 2.33, p = .02, d = 0.58). Also, as anticipated, overestimation of the vertical extent was found for both groups. In general, people overestimate large vertical extents viewed from above (Jackson & Cormack, in press; Stefanucci & Proffitt, 2006). Further, while the group difference on the target disk size estimate did not reach significance before the cognitive measures were entered into the model (High Fear M = 20.73 inches, SD = 5.82, Low Fear M = 19.08 inches, SD = 4.96; $t_{(69)}$ = 1.23, p > .10, d = 0.30), the difference was significant after covarying the cognitive bias measures ($t_{(66)}$ = 2.25, p = .03, d = 0.55). Moreover, the balcony height and disk size estimates were positively correlated (r = .30, p = .01), but were unrelated to the cognitive measures (r range = −.18 to .07, all p > .10). This pattern of correlations increases confidence that the height estimate reflects perception, rather than reflecting only cognitive processes or demand effects, because it is unlikely that the size estimate could be influenced by expectations about the task given that participants would be unaware of the size/distance invariance hypothesis. Finally, the height estimates, while clearly distinguishing the fear groups, were not significantly related to the traditional fear measures (comprised of subjective affect, behavior, and self-reported physiological indicators; r range = −.21 to .11, all p > .09).

Discussion

The current study provides initial evidence that perceptual biases are associated with extreme fear. This suggests fearful persons are not just interpreting the world in a threatening way, but may actually see it differently. Importantly, this study used a perceptual matching task and did not rely on verbal or retrospective report. An indirect measure of perceived height, apparent size, was also employed. Thus, the experimental tasks were unlikely to have been strongly influenced by cognitive factors. Moreover, the group differences in height perception remained even after removing their covariation with the cognitive tasks. Finally, the cognitive and perception tasks showed minimal relationships to one another, whereas the two perceptual measures were significantly related.

Establishing the distinctiveness of the cognitive and perception tasks was critical for this initial demonstration of perceptual biases in height fear. However, it is plausible that the measures will be significantly related under certain circumstances, and when using other measure of cognitive biases. Although speculative at this stage, we expect that perceptual estimates will relate to cognitive and other fear-relevant biases when they are each activated by concerns about acting in the environment. This follows from the hypothesis that perception informs us about the opportunities for action and also the costs associated with these actions (Proffitt, 2006). As a result, perceiving spatial layout combines the geometry of the world with our behavioral goals and the costs associated with achieving these goals. The inherent costs of behaving near the edge of a high drop-off include both physical injury and psychological distress. We propose that geographical height perception is influenced by these risks, so highly fearful individuals may amplify the immediate danger of being on the balcony (increasing the subjective costs of acting near its edge; e.g., falling), and thereby, evoke an increase in the apparent vertical extent.

Although speculative because the current study cannot make claims about the direction or causal nature of the fear-perception relationship, the proposed sequence may help explain why the height estimates were unrelated to traditional fear measures in the current study. Specifically, most of the other measures were obtained away from the balcony, and thus, outside the context where participants feared having to act in the height environment. It will be important for future research to evaluate the temporal relationship between fear and perception, and mediators of this relationship (e.g., perceived danger of acting in the environment) to determine the conditions under which perceptual biases will predict other fear responses. Further, the current study emphasized the role of height fear as a predictor of perceptual bias (because participants were pre-selected based on their preexisting height fear), but we suspect that perceptual bias may also enhance height fear.

Our study also offers novel evidence of implicit height fear associations, adding to the growing literature highlighting the importance of uncontrollable fear responding. It is particularly notable that the IAT was associated with the traditional fear measures, given its lack of shared method variance with them and relative design (i.e., comparing heights to spiders).

Taken together, these findings suggest that in addition to physiology, cognition, behavior and subjective affect, the fear response is also characterized by perceptual biases. Establishing the clinical importance of these biases, such as their role in vulnerability to disorder and response to treatment, will be exciting next steps.

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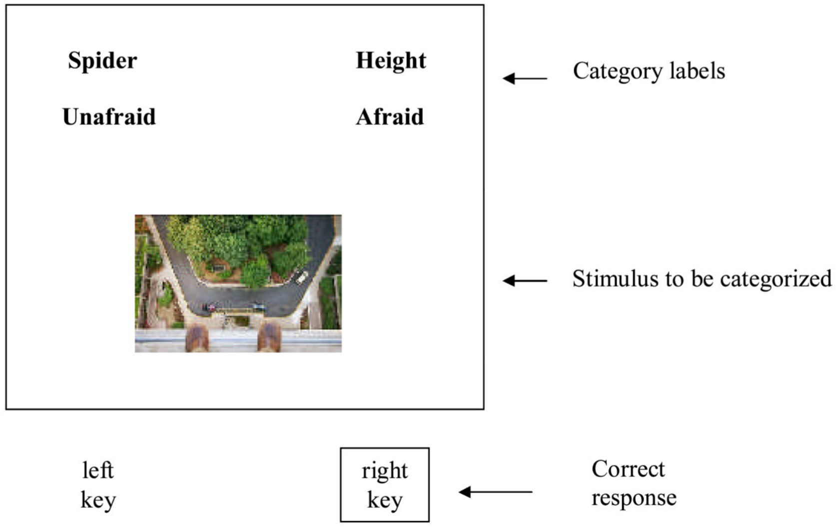
1a) Implicit Association Test procedure

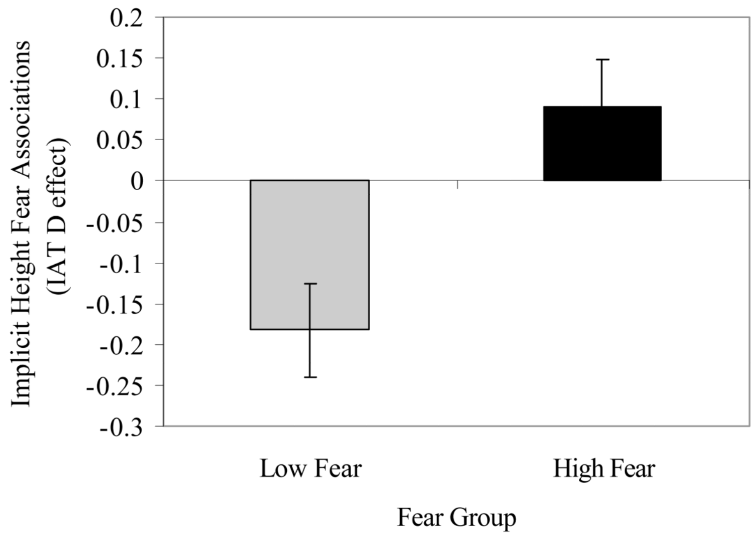


Note. Participants classify the stimulus using either the right or left key. This classification trial would represent an associatively matched category pairing for a height-fearful individual.

1b) Visual Matching Task

Figure 1.
Pictures depicting the a) Implicit Association Test procedure, and b) Visual Matching Task.

2a) Implicit Height Fear Associations



Note. Higher scores indicate greater implicit height (relative to spider) fear associations.

2b) Estimate of Balcony Height

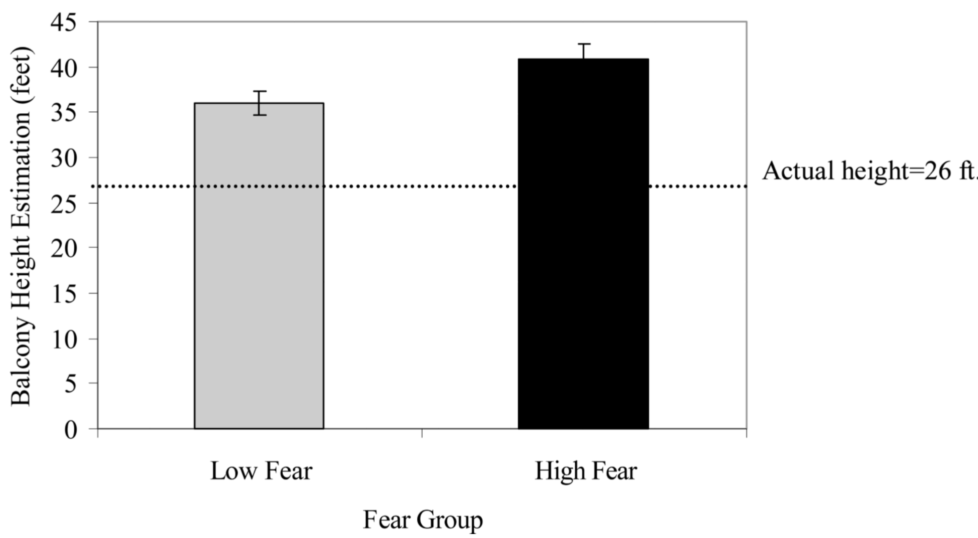


Figure 2.
Fear group differences a) on the IAT and b) in estimates of balcony height.