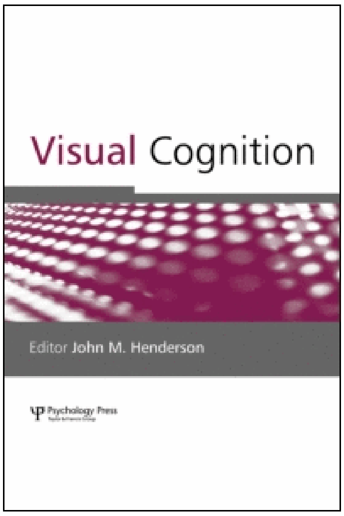

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What makes an angry face look so ... angry? Examining visual attention to the shape of threat in children and adults

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What makes an angry face look so ... angry? Examining visual attention to the shape of threat in children and adults

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Threatening facial expressions like anger can signal potential danger. Past research has established that both adults and children have an attentional bias for angry faces, visually detecting their presence more quickly than happy or neutral faces. More recent research has suggested that specific features of angry faces (such as the downward-pointing "V" shaped brow) are the effective stimulus in their rapid detection. However, research examining this issue has only been done with adults. In the current research, we examine the detection of the features of the downward-pointing "V" in both adults and preschool children using a touchscreen visual search procedure. In two experiments, both adults and children detected the downward-pointing "V" more quickly than an upward-pointing "V". As the first evidence that young children exhibit the same superior detection of the features of threatening facial expressions that adults do, this research provides important support for the existence of an evolved attentional bias for threatening stimuli.

Keywords: Detection; Threat; Visual attention; Faces; Children.

The transmission of emotional information from one person to another has important survival value (Hansen & Hansen, 1988). Facial expressions like anger suggest potential danger or threat. Throughout evolutionary history, humans who were able to quickly visually detect the presence of threat may have been more likely to escape predators and survive to reproduce. Eventually, this may have led to the evolution of some aspects of the human

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visual system that quickly and efficiently detect the presence of certain threatening stimuli (Isbell, 2006). Consistent with this logic, Hansen and Hansen (1988) proposed the "face in the crowd hypothesis", arguing that humans may have evolved a predisposition to quickly detect the presence of threatening facial expressions in visual attention. In other words, an angry or threatening face should be detected more quickly than a happy or benign face.

Hansen and Hansen's (1988) claim has received substantial support from experiments using a standard visual search paradigm in which participants are presented with 3×3 matrices of photographs of two categories of stimuli—generally happy and angry schematic faces (i.e., very simple line drawings of faces). Each trial consists of either nine faces from one of the categories or eight faces from one category and one face from the other. Participants are generally asked to decide as quickly as possible whether a discrepant face is present in each matrix. Using this and other similar paradigms, several researchers have examined visual search for schematic faces and have found that angry schematic faces are detected more quickly than happy or neutral ones (Calvo, Avero, & Lundqvist, 2006; Esteves, 1999; Fox et al., 2000; Lundqvist & Öhman, 2005; Mather & Knight, 2006; Öhman, Lundqvist, & Esteves, 2001).

Although research on the detection of threatening schematic faces has been consistent with the face in the crowd hypothesis, experiments with adults using pictures of *real* faces have not been as consistent. In fact, only a few studies using real faces have yielded a search advantage for angry over happy faces (i.e., Gilboa-Schechtman, Foa, & Amir, 1999; Horstmann & Bauland, 2006), and several others have failed to find such an advantage (i.e., Eastwood et al., 2005; Juth, Lundqvist, Karlsson, & Ohman, 2005; Purcell, Stewart, & Skov, 1996). In fact, Juth, Lundqvist, Karlsson, and Ohman (2005) and Williams, Moss, Bradshaw, and Mattingley (2005) reported an advantage for *happy* faces over both fearful and angry ones.

Despite inconsistency in the literature with real faces, several researchers have taken this research a step further and asked what the effective stimulus is for the rapid detection of angry schematic faces, and, more specifically, whether low level features of angry faces expressions are responsible (Lundqvist & Öhman, 2005; Tipples, Atkinson, & Young, 2002). Larson, Aronoff, and Stearns (2007) found that adult participants detected threatening facial features of schematic faces more rapidly and often more accurately than other neutral shapes. More specifically, participants detected the downward-pointing "V" shape that represents the eyebrows of threatening faces more quickly than an upward-pointing "V". Further, these researchers also found that presenting participants with the downward-pointing "V" alone was enough to activate the same neural networks that are active when humans view and detect various emotionally valenced stimuli, particularly threatening stimuli (Larson, Aronoff, Zhu, & Sarinopoulos, 2009).

These studies present support for the idea that certain features of angry faces cause them to "pop out" in visual attention, but other researchers challenge this assertion. Schubo, Gendolla, Meinecke, and Abele (2006), for example, found no detection advantage when the downward-pointing "V" was presented alone, not embedded in a face-like context. Similarly, Tipples, Atkinson, and Young (2002) presented participants with a series of visual search tasks in which the experimenters systematically removed some combination of the facial features of the stimuli (i.e., mouth, eyebrows, nose). They found that the individual features of threatening facial expressions alone were not enough to elicit faster detection; only features that are embedded in a face-like configuration were detected more rapidly than nonthreatening features. Thus, these studies suggest that although low-level perceptual features may aid in the detection of threatening facial expressions, it is ultimately the context of the face or the emotional message of the face itself that leads to its rapid detection.

In summary, the results of these studies indicate that the "V" shape may be an important feature for the detection of threatening facial expressions. However, if humans have an evolved bias to detect the features of threat-relevant faces, the single downward-pointing "V" shape should be detected more quickly than similar shapes regardless of the age and experience of the participants. Further, if humans do in fact have a predisposition to quickly detect these stimuli, it is crucial that this tendency be present at varying ages and levels of experience. However, until recently, this issue has been addressed only in adults, and never in young children. Strong evidence for an evolved bias for the detection of the features of threatening faces would come from young children who have had less experience with relevant stimuli.

In order to examine this important issue, LoBue (2009) recently investigated the visual detection of threatening facial expressions in young children. In a series of experiments, a modified visual search paradigm was used in which preschool children and adults were shown a single target stimulus among eight distractors on a touchscreen monitor and were asked to find the target and touch it as quickly as possible. In these experiments, both children and adults detected all negative facial expressions more quickly than positive ones, detecting angry, fearful, and sad faces more quickly than happy and neutral ones. Most importantly, they detected negative, threat-relevant faces (angry, fearful) more quickly than all other facial expressions (happy, neutral)—even more quickly than negative, nonthreat-relevant faces (sad). Further, adults and children also detected *schematic* angry faces more quickly than happy or sad ones. This research was the first to establish that young children share adults' propensity to rapidly detect threat-relevant faces.

The primary goal of the current experiments was to examine the detection of the features of angry faces, specifically downward-pointing "V's", from a developmental perspective, using the touchscreen paradigm with both adults and young children. LoBue (2009) found a detection advantage for both angry and fearful faces; here we will only focus on the detection of the features that are characteristic of angry faces, although the issue of fearful faces will be revisited in the General Discussion. If humans are predisposed to detect angry faces because of this feature, both adults and children should detect downward-pointing "V's" more quickly than upward-pointing "V's".

GENERAL METHOD

In each of the following experiments, 3-year-old children and adults were presented with nine pictures on a touchscreen monitor. One was labeled as the target and the adults and children were instructed to find the target on the screen and touch it as quickly as possible. We reasoned that if humans have a predisposition to detect angry faces because of the downward-pointing brows, both age groups should detect downward-pointing "V" shapes more quickly than upward-pointing "V's". Three-year-olds were chosen as the target age group because, according to pilot data, they were the youngest age group capable of completing the touchscreen task with the current stimuli. It is worth noting that LoBue (2009) also examined preschool children using the same paradigm with actual faces, but used 5-year-olds instead of 3-year-olds. Five-year-olds were used instead of 3-year-olds because real faces are rich and complex stimuli for children, and 3-year-olds were unable to perform the detection task with these stimuli. However, previous research has suggested that 3- to 5-year-olds demonstrate the same pattern of responding in the touchscreen visual search task with other threatening stimuli, such as snakes (LoBue & DeLoache, 2008). Since all preschool children showed the same pattern of responding when they were asked to detect threatening snakes, presumably they would also show the same pattern of detection for other categories of threat-relevant stimuli as well. Thus, 3-year-olds are not only an appropriate age group for the current research, but also are the best age group for the current research since they are the *youngest* age group possible.

As mentioned earlier, we adopted the touchscreen paradigm used by LoBue (2009) and LoBue and DeLoache (2008), and presented both preschool children and adults with 3×3 matrices of pictures and asked them to touch a target on the screen as quickly as possible.

Again, two procedural changes to the standard visual-search task were instituted to make the procedure appropriate for young children. First, to make it possible to obtain reliable reaction time data from 3-year-olds, we presented the stimuli on a touchscreen monitor, asking each participant to touch the target on the screen as quickly as possible. Second, only target-present matrices were presented, because the touchscreen procedure precluded the inclusion of no-target matrices. Despite these differences, previous results using this paradigm with adults have replicated previous findings using a standard visual search paradigm (LoBue, 2009; LoBue & DeLoache, 2008).

Materials

The stimuli for each experiment consisted of two categories of pictures. All of the target pictures were taken from Larson et al. (2007) and were adjusted to 325×245 pixel images. The pictures were arranged on a touchscreen computer screen in 3×3 matrices, with one target picture from one category and eight distractor pictures from the other category. The stimulus categories for Experiment 1 were two simple geometric shapes: A downward-pointing "V" (similar to the geometric configuration in an angry face), and an upward-pointing "V". Similarly, the stimulus categories for Experiment 2 were downward- and upward-pointing triangles as the targets, and a trapezoid as the distractor (see Figure 1).

A MultiSync LCD 2010X colour touchscreen monitor was used to present each picture matrix on a 61 cm (24-inch) screen. The overall matrix

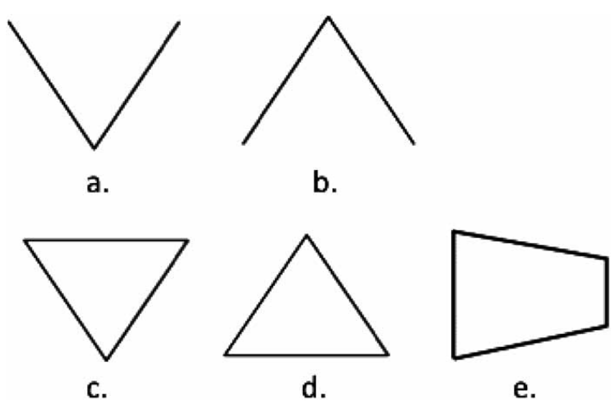

Figure 1. Stimuli from Experiments 1 and 2. In Experiment 1, children and adults were asked to detect the downward-pointing "V" among (a) upward pointing "V's" or (b) the reverse. In Experiment 2, children and adults were asked to detect closed-figure downward-pointing "V's" among (c) trapezoid distractors, (d) closed-figure upward-pointing "V's", or (e) trapezoid distractors.

was 39.4 cm $\times$ 39.4 cm, with 1.27 cm between rows and 0.64 cm between columns. The individual projected pictures measured 11.47 $\times$ 8.64 cm. Each of the targets appeared in each of the nine positions in the matrix two or three times. One stimulus order was created by randomly arranging matrices, and the second order was the reverse of the first. An outline of a child's handprints was located on the table immediately in front of the monitor.

Procedure

The child was seated in front of the touchscreen monitor (approximately 40 cm from the base of the screen) and told to place his or her hands on the handprints. This ensured that the child's hands were in the same place at the start of each trial, making it possible to collect reliable reaction time data. The experimenter stood alongside to monitor and instruct the child throughout the procedure.

First, a set of seven practice trials was given to teach the child how to use the touchscreen. On the first two trials, a single picture appeared on the screen, and the child was asked to touch it. The first picture was from the target category and the second from the distractor category. (All pictures used in the practice trials were chosen randomly from the original sets of 24.) Next, the child was presented with two trials with one target and one distractor picture and asked to touch only the target picture. Three practice trials followed, each involving a different nine-picture matrix. The child was told that for each trial, his or her task was always to find the "X" (target) among "Y" (distractors) as quickly as possible, touch it on the screen, and then return his or her hands to the handprints.

A series of 24 test trials followed. A different picture matrix containing one target and eight distractors was presented on each trial. In between trials, a large smiley face appeared on the screen. To ensure that the child's full attention was on the screen before each matrix appeared, the experimenter pressed the face when she judged that the child was looking at it, causing the next matrix to appear. Latency was automatically recorded from the onset of the matrix to when the child touched one of the pictures on the screen.

After the child had completed all 24 trials, his or her parent was tested in exactly the same manner. The parent had not been told about the experimental hypothesis and had not been present while the child was tested. After both the parent and child were tested in one experiment, they were tested in exactly the same manner for the second.

Analyses

The analyses of the experiments reported here were 2 (target: Downward-pointing vs. upward-pointing "V") × 2 (age: Children vs. adults) mixed effects model ANOVAs (Bagiella, Sloan, & Heitjan, 2000; Gueorguieva & Krystal, 2004) on the latency to touch the target per trial. Following standard procedures for visual search tasks, only trials in which the correct target was selected were counted. In Experiment 1, 24 children made errors, with a total of 114 total errors across all of the children (approximately 15% of the data). In Experiment 2, 22 children made errors, with a total of 52 errors across all of the children (approximately 7% of the data). None of the adults in either experiment erred. Errors did not vary by target.

EXPERIMENT 1

Participants

The participants were 32 3-year-old children (mean = 41.6 months, range = 36.1–47.4 months), half male and half female, and their 32 accompanying parents. All but two of the parents were female. Ten additional 3-year-olds were tested but eliminated from subsequent analyses for failure to follow the experimenter's directions. The participants in all experiments presented here were recruited from records of birth announcements in the local community and were predominantly Caucasian and middle class. There were equal numbers of boys and girls in the child group, and each child was randomly assigned to one of two target conditions and one of two stimulus orders. For convenience, the parent was assigned to the same condition as the child. The parent was not present in the room while the child was being tested.

Results and discussion

The results for Experiments 1 and 2 are presented in Figure 2. In the 2 (target) × 2 (age) mixed effects ANOVA on the latency to touch the target in each trial yielded significant main effects of age, $F(1, 1530) = 711.0$, $p < .01$, and a significant effect of target stimulus, $F(1, 1530) = 28.1$, $p < .01$, with an Age × Condition interaction, $F(1, 1530) = 22.9$, $p < .01$. As expected, the adults located the targets significantly faster than the children did. Most importantly, both the children and adults who were asked to find the downward-pointing "V" among upward-pointing distractors did so significantly faster than those asked to locate the lone upward-pointing "V" among downward-pointing distractors (children, downward-pointing "V" = 4.16 s, upward-pointing "V" = 5.42 s; adults, downward-pointing

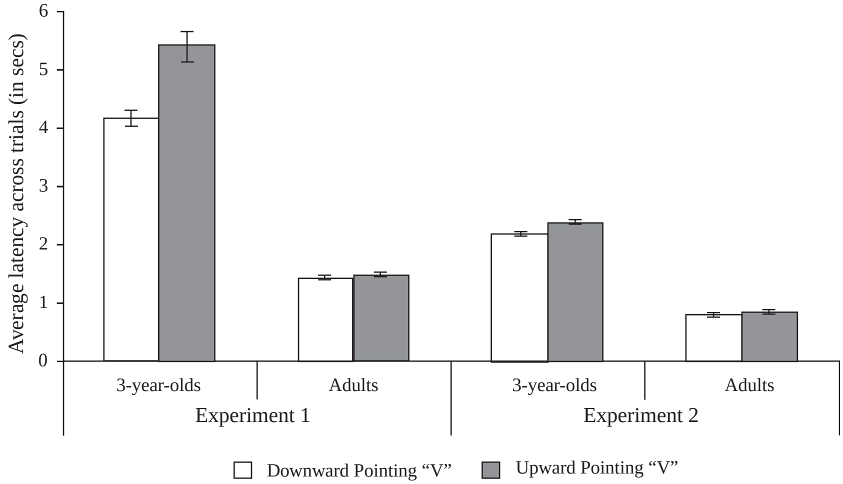

Figure 2. Results of Experiments 1 and 2. In both studies children and adults detecting downward-pointing "V's" more quickly than upward-pointing "V's".

"V" = 1.42 s, upward-pointing "V" = 1.49 s). The interaction indicates a greater effect of condition for children, $F(1, 657) = 20.4$, $p < .01$, than for adults, $F(1, 873) = 3.4$, $p = .06$, although the same pattern of responding was present in both age groups. These results demonstrate that children show the same pattern of detection that adults have shown in previous research, and detect downward-pointing "V" shapes significantly faster than upward-pointing "V" shapes.

EXPERIMENT 2

The results of Experiment 1 provide strong support for the idea that humans have a predisposition to detect shapes that resemble the features of threatening faces in visual attention, demonstrating that both adults and 3-year-olds children detect downward-pointing "V" shapes more quickly than upward-pointing "V" shapes. However, there are two methodological details of Experiment 1 that could have led to the current results. First, as mentioned by Larson et al. (2007), the two target stimuli used in Experiment 1 (upward- and downward-pointing "V's") had one important perceptual difference that could have led to a search advantage for the downward-pointing "V's". A downward-pointing "V" is a recognizable letter in the alphabet whereas an upward-pointing "V" is not. Although 3-year-olds do not typically read, they generally have exposure to the alphabet and can recognize many letters. Thus, it is possible that the downward-pointing "V" was detected particularly quickly in Experiment 1 because it is a readable letter and not because of its threat-like features. In our previous work examining the "V" shape, we found identical attentional bias effects for closed "V's" (triangles) (Larson et al., 2007), suggesting that the presence of the downward-pointing acute angle was the key feature driving capture of attention, not whether the "V" was open or closed. Thus, for Experiment 2 capture of attention was assessed using upright and inverted triangles.

Second, in Experiment 1, downward-pointing "V's" were presented both as targets and as distractors when upward-pointing "V's" were the targets. It is thus possible that downward-pointing "V's" both attracted attention as the targets and distracted from the upward-pointing "V" targets. Past research has suggested that angry faces (and possibly their features) not only attract attention, but can also distract from nonthreatening targets (Eastwood, Smilek, & Merikle, 2003; Fenske & Eastwood, 2003). Thus, it is possible that in Experiment 1, the downward-pointing "V's" were detected more quickly than upward-pointing "V's" because the downward-pointing distractors diverted attention from the upward-pointing targets.

Accordingly, in Experiment 2, the target stimuli were closed-shaped upward- and downward-pointing "V's", or, more descriptively, upward- and downward-pointing triangles (see Figure 1). Further, in Experiment 2, the distractor stimuli were always trapezoids. Pilot data suggested that using circles as the distractor stimuli (as used in Larson et al., 2007) was too easy for both adult and child participants and led to very fast detection with little variability. Thus, we chose to use a more complex figure with straight edges like a triangle to make the task slightly more difficult.

Participants

The participants were 32 3-year-old children (mean = 42.4 months, range = 36.8–53.3 months), half male and half female, and their 32 accompanying parents. All but one parent was female. Four additional 3-year-olds were tested but eliminated from subsequent analyses for failure to follow the experimenter's directions.

Results and discussion

The 2 (target) $\times$ 2 (age) mixed effects ANOVA on the average latency to touch the target yielded significant main effects of age, $F(1, 1483) = 739.6$, $p < .001$, and a significant main effect of target stimulus, $F(1, 1483) = 4.21$, $p < .05$. There was no significant interaction. Not surprisingly, the adults located the targets significantly faster than the children did. Further, the effect of condition indicates, as predicted, that downward-pointing triangles were detected more quickly than upward-pointing triangles (children, downward-pointing "V" = 2.19 s, upward-pointing "V" = 2.38 s; adults, downward-pointing "V" = 0.79 s, upward-pointing "V" = 0.84 s). The lack of a Target × Age interaction indicates that the trend was present in both age groups. These results confirm and strengthen the results of Experiment 1, demonstrating that both adults and preschool children detect the presence of downward-pointing "V" shapes more quickly than upward-pointing "V" shapes.

GENERAL DISCUSSION

In two experiments, the current research demonstrates that participants detect the presence of a single downward-pointing "V"—a shape that is characteristic of the downward-pointing brow of an angry face—more quickly than similar benign upward-pointing "V" shapes. This study is a replication and extension of previous work with adults using a new (touchscreen) paradigm. Most importantly, this study is the first to examine the detection of these shapes in children, demonstrating that, like adults, even preschool children detect the presence of shapes characteristic of angry faces more quickly than neutral shapes. This research is important to the theory that humans have an evolved predisposition to detect angry faces because of their downward-pointing brows: Indeed, if humans are predisposed to detect such shapes in visual attention, this bias should be evident regardless of age and experience with the relevant stimuli.

Our findings thus lend important support for the view that humans have a predisposition to detect threat-relevant stimuli in visual attention because of low-level features that characterize threatening faces. However, one question that remains is *why* the downward-pointing "V" shape is detected particularly quickly. One possibility is that the downward-pointing "V" carries a negative valence (since it is a prominent characteristic of angry faces), causing it to rapidly capture visual attention. Another possibility is that objects that are narrow at the bottom like the downward-pointing "V" are detected more rapidly in general than objects that are more narrow on top, and angry faces capture visual attention because of a low-level perceptual bias for these simple shapes. A third and final possibility is that a bias for simple perceptual shapes *and* a bias for negative valence both contribute to the rapid detection of angry faces. For example, while children and adults detected the downward-pointing "V" shape particularly quickly when presented alone, it is also possible that if this shape were to be presented in a face-like context, detection would have been even faster. Furthermore, it has been previously demonstrated that the angular shapes, and the downward "V" shape in particular, are subjectively perceived as more aversive (Bar & Nehta, 2006, 2007; Larson et al., 2007).

Regardless of why the downward-pointing "V" is detected particularly quickly, at a broader conceptual level, our research demonstrates that the rapid detection of threat is facilitated by the presence of simple underlying features that are common across a number of threat stimuli, thus permitting the affective value of the stimulus to be quickly extracted without the need for more thorough visual processing (Larson et al., 2007, 2009). Growing evidence suggests that simple geometric forms, such as angularity and roundedness (Bar & Nehta, 2006, 2007; Larson et al., 2007, 2009) may represent one such simple, common mechanism for detecting potential threat. The findings from the present study, together with previous subjective, behavioural, and neuroimaging work (Larson et al., 2007, 2009), further support the hypothesis that the downward "V" shape in particular is an effective signal of threat, despite being devoid of contextual information. The "V" shape is clearly apparent in facial displays of anger (Aronoff, Barclay, & Stevenson, 1988; Bassili, 1978); however, additional research has highlighted the role of the "V" form in convey affect in such disparate stimuli as tribal masks (Aronoff et al., 1988), patterns of physical movement by "bad" characters in ballet (Aronoff, Woike, & Hyman, 1992), and simple everyday objects, such as couches (Bar & Neta, 2006). Collectively, these findings highlight the possibility that the downward "V" form aids in detection of a variety of real-world threat cues.

One of the primary features of the adult research on the detection of the features of threat that was not tested in these studies is *automaticity* of participants' responses. Ohman and Mineka (2001) asserted that rapid responses to threat should be automatic and relatively immune to cognitive influences. In previous work, most researchers have tested for this by varying the number of distractors in each stimulus matrix. Detection speed of targets is presumed to be automatic if it is not affected by the number of distractors in each matrix (Treisman & Gelade, 1980). One limitation of the current work is that we did not vary the number of distractors in each stimulus matrix to make the task easy enough for children. Future research in this area using new paradigms may help elucidate whether these targets can indeed be detected automatically in children.

Another important question for future research is what the effective stimulus is for the detection of other categories of threat-relevant faces, such as fearful faces. Recently, LoBue (2009) found that children and adults detect both angry and fearful faces more quickly than happy ones. Although the current research suggests that the downward-pointing "V" is the effective stimulus in the detection of angry faces, fearful faces do not typically contain downward-pointing "V" shapes. Recent research has shown that the amygdala is responsive to the "wide-eyed" expression of fearful faces: Just showing participants the enlarged white space of fearful eyes is enough to induce amygdala activation in adult participants (Whalen et al., 2004). Other recent work based on the notion that rounded, "babyish" features elicit protectiveness on the part of caregivers and others (Berry & McArthur, 1985), has found that fear faces, which are more rounded in composition, tend to elicit approach behaviour and are perceived as kinder and more affiliative (Hess, Blairy, & Kleck, 2000; Marsh, Adams, & Kleck, 2005). Thus, more rapid detection of fear faces may rest in part on a geometric configuration that facilitates the evolutionarily adaptive functions of affiliation and protectiveness. These findings are consistent with the general premise that simple geometric shapes can facilitate recognition of salient affective stimuli, including facial expressions of emotion.

In conclusion, the current research takes the important step of examining the detection of the shapes characteristic of threatening faces in children as well as adult. Research demonstrating that children (who have far less experience with threat than do adults) detect shapes that are characteristic of threat-relevant stimuli more quickly than similar but benign shapes not only lends important support for the idea that low-level stimulus characteristics are responsible for the detection of angry faces, but also for the theory that humans have an inborn bias for the detection of threat more broadly. Future research on this topic that includes children and even infants is not only important, but also crucial to supporting this evolutionary-based view.

REFERENCES

Aronoff, J., Barclay, A. M., & Stevenson, L. A. (1988). The recognition of threatening facial stimuli. *Journal of Personality and Social Psychology*, *54*, 647–655.

Aronoff, J., Woike, B. A., & Hyman, L. M. (1992). Which are the stimuli in facial displays of anger and happiness? Configural bases of emotion recognition. *Journal of Personality and Social Psychology*, *62*, 1050–1066.

Bar, M., & Neta, M. (2006). Humans prefer curved visual objects. *Psychological Science*, *17*, 645–648.

Bar, M., & Neta, M. (2007). Visual elements of subjective preference modulate amygdala activation. *Neuropsychologia*, *45*, 2191–2200.

Bassili, J. N. (1978). Facial motion in the perception of faces and of emotional expression. *Journal of Experimental Psychology: Human Perception and Performance*, *4*, 373–379.

Bagiella, E., Sloan, R. P., & Heitjan, D. F. (2000). Mixed-effects models in psychophysiology. *Psychophysiology*, *37*, 13–20.

Berry, D. S., & McArthur, L. Z. (1985). Some causes and consequences of a babyface. *Journal of Personality and Social Psychology*, *48*, 312–323.

Calvo, M. G., Avero, P., & Lundqvist, D. (2006). Facilitated detection of angry faces: Initial orienting and processing efficiency. *Cognition and Emotion*, *20*, 785–811.

Eastwood, J. D., Smilek, D., & Merikle, P. M. (2003). Negative facial expression captures attention and disrupts performance. *Perception and Psychophysics*, *65*, 352–358.

Eastwood, J. D., Smilek, D., Oakman, J. M., Farvolden, P., van Ameringen, M., Mancini, C., & Merikle, P. M. (2005). Individuals with social phobia are biased to become aware of negative faces. *Visual Cognition*, *12*, 159–179.

Esteves, F. (1999). Attentional bias to emotional facial expressions. *European Review of Applied Psychology*, *49*, 91–97.

Fenske, M. J., & Eastwood, J. D. (2003). Modulation of focused attention by faces expressing emotion: Evidence from flanker tasks. *Emotion*, *3*, 327–343.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and Emotion*, *14*, 61–92.

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The Face-in-the-Crowd paradigm. *Cognition and Emotion*, *13*, 305–318.

Gueorguieva, R., & Krystal, J. (2004). Move over ANOVA: Progress in analyzing repeated-measures data and its reflection in papers published in the *Archives of General Psychiatry. Archives of General Psychiatry*, *61*, 310–317.

Hansen, C. H., & Hansen, R. D. (1988). Finding the face in the crowd: An anger superiority effect. *Journal of Personality and Social Psychology*, *54*, 917–924.

Hess, U., Blairy, S., & Kleck, R. E. (2000). The influence of facial emotion displays, gender, and ethnicity on judgments of dominance and affiliation. *Journal of Nonverbal Behavior*, *24*, 265–283.

Horstmann, G., & Bauland, A. (2006). Search asymmetries with real faces: Testing the anger-superiority effect. *Emotion*, *6*, 193–207.

Isbell, L. (2006). Snakes as agents of evolutionary change in primate brains. *Journal of Human Evolution*, *51*, 1–35.

Juth, P., Lundqvist, D., Karlsson, A., & Ohman, A. (2005). Looking for foes and friends: Perceptual and emotional factors when finding a face in the crowd. *Emotion*, *5*, 379–395.

Larson, C. L., Aronoff, J., & Stearns, J. J. (2007). The shape of threat: Simple geometric forms evoke rapid and sustained capture of attention. *Emotion*, *7*, 526–534.

Larson, C. L., Aronoff, J., Zhu, D. C., & Sarinopoulos, I. C. (2009). Recognizing threat: A simple geometric shape activates neural circuitry of threat detection. *Journal of Cognitive Neuroscience*, *8*, 1523–1535.

LoBue, V. (2009). More than just another face in the crowd: Superior detection of threatening faces in children and adults. *Developmental Science*, *12*, 305–313.

LoBue, V. (2010). And along came a spider: Superior detection of spiders in children and adults. *Manuscript under review.*

LoBue, V., & DeLoache, J. S. (2008). Detecting the snake in the grass: Attention to fear-relevant stimuli by adults and young children. *Psychological Science*, *19*, 284–289.

Lundqvist, D., & Öhman, A. (2005). Emotion regulate attention: The relation between facial configurations, facial emotion, and visual attention. *Visual Cognition*, *12*, 51–84.

Marsh, A. A., Ambady, N., & Kleck, R. E. (2005). The effects of fear and anger facial expressions on approach- and avoidance-related behaviors. *Emotion*, *5*, 119–124.

Mather, M., & Knight, M. R. (2006). Angry faces get noticed quickly: Threat detection is not impaired among older adults. *Journal of Gerontology: Psychology Sciences*, *61B*, P54–P57.

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: An anger superiority effect with schematic faces. *Journal of Personality and Social Psychology*, *80*, 381–396.

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review*, *108*, 483–522.

Purcell, D. G., Stewart, A. L., & Skov, R. B. (1996). It takes a confounded face to pop out of a crowd. *Perception*, *25*, 1091–1108.

Schubo, A., Gendolla, G. H. E., Meinecke, C., & Abele, A. E. (2006). Detection emotional faces and features in a visual search paradigm: Are faces special? *Emotion*, *6*, 246–256.

Tipples, J., Atkinson, A. P., & Young, A. W. (2002). The eyebrow frown: A salient social signal. *Emotion*, *2*, 288–296.

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology*, *12*, 97–136.

Whalen, P. J., Kagan, J., Cook, R. G., Davis, F. C., Kim, H., Polis, S., et al. (2004). Human amygdala responsibility to masked fearful eye whites. *Science*, *306*, 2061.

Williams, M. A., Moss, S. A., Bradshaw, J. L., & Mattingly, J. B. (2005). Look at me, I'm smiling: Visual search for threatening and nonthreatening facial expressions. *Visual Cognition*, *12*, 29–50.

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