Brief Report

Pick on someone your own size: The detection of threatening facial expressions posed by both child and adult models

Vanessa LoBue *, Kaleigh Matthews, Teresa Harvey, Cat Thrasher

Department of Psychology, Rutgers University, Newark, NJ 07102, USA

ABSTRACT

For decades, researchers have documented a bias for the rapid detection of angry faces in adult, child, and even infant participants. However, despite the age of the participant, the facial stimuli used in all of these experiments were schematic drawings or photographs of adult faces. The current research is the first to examine the detection of both child and adult emotional facial expressions. In our study, 3- to 5-year-old children and adults detected angry, sad, and happy faces among neutral distracters. The depicted faces were of adults or of other children. As in previous work, children detected angry faces more quickly than happy and neutral faces overall, and they tended to detect the faces of other children more quickly than the faces of adults. Adults also detected angry faces more quickly than happy and sad faces even when the faces depicted child models. The results are discussed in terms of theoretical implications for the development of a bias for threat in detection.

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Introduction

Faces are an important social signal for humans, indicating when a situation is safe and when it is potentially dangerous. The propensity for the rapid detection of threatening or angry facial expressions has been an important topic of research for decades. In countless studies, researchers have reported that adults detect angry faces more quickly than a variety of other facial expressions (e.g., Calvo, Avero, & Lundqvist, 2006; Esteves, 1999; Tipples, Atkinson, & Young, 2002; Williams, Moss,

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* Corresponding author.
  E-mail address: vlobue@psychology.rutgers.edu (V. LoBue).

Bradshaw, & Mattingly, 2005). Recently, researchers have begun to extend these findings to children and infants, reporting that 5-year-olds also detect angry faces more quickly than happy, neutral, and sad faces (LoBue, 2009) and that even 9- to 12-month-old infants turn more quickly to look at angry faces than at happy faces (LoBue & DeLoache, 2010).

Despite numerous studies demonstrating an advantage for threatening faces in detection, evidence about what drives the rapid detection of threatening faces is more contentious. Many researchers have proposed that threat relevance, or the *threatening message* produced by these stimuli, is what facilitates detection (Eastwood & Smilek, 2005; Eastwood, Smilek, & Merikle, 2001, 2003; Lipp & Derakshan, 2005; Lipp & Waters, 2007; Lundqvist & Öhman, 2005; Öhman, Lundqvist, & Esteves, 2001). In support of this hypothesis, researchers have shown that the more aversive adults rate threatening stimuli, the more quickly they detect them (Beaver, Mogg, & Bradley, 2005; Lundqvist & Öhman, 2005). Furthermore, when threatening faces are inverted, which generally results in impaired face processing, they are no longer detected more quickly than happy faces (Eastwood et al., 2001; Fenske & Eastwood, 2003; Fox et al., 2000).

However, given that even 9- to 12-month-old infants detect angry faces more quickly than happy faces, it is possible that understanding the threatening message posed by angry faces is not necessary for their rapid detection. Thus, an alternative hypothesis for why threatening stimuli are detected so quickly is that *low-level perceptual features* of the stimuli drive detection (Becker, Horstmann, & Remington, 2011; Horstmann, 2009; Horstmann, Borgstedt, & Heumann, 2006; LoBue, 2013b; LoBue, Rakison, & DeLoache, 2010). For example, some researchers have shown that specific geometric shapes, such as the "V"-shaped brow characteristic of angry faces, are sufficient in eliciting rapid detection in the absence of any threatening or negative valence (Larson, Aronoff, & Stearns, 2007; LoBue & DeLoache, 2011; LoBue & Larson, 2010). Furthermore, when presenting participants with these features in non-face-like configurations, there is still an advantage in detection (Coelho, Cloete, & Wallis, 2011; Horstmann et al., 2006).

Importantly, in all of these studies, the stimuli were schematic faces or photographs of real faces taken from standardized emotional facial expression sets such as the Ekman face set (Ekman & Friesen, 1976) and the NimStim set (Tottenham et al., 2009). Such sets contain photographs of adults posing for various emotional facial expressions. No research to date has examined the detection of *children's facial expressions.* This is important because even the work with child and infant participants described above uses stimulus sets of adult faces. Developmentally, it is possible that children might have more difficulty in identifying the facial expressions of adults than of children their own age. Indeed, researchers have reported that children recognize faces the most accurately when they are within 2 years of their own age (Hills & Lewis, 2011). However, until recently, a standardized set of child facial expressions was not available. The current study examines the detection of child angry, happy, and sad facial expressions using a new stimulus set—the Child Affective Facial Expression (CAFE) set. CAFE is a racially and ethnically diverse set of photographs of 4- to 6-year-old children posing for angry, disgusted, fearful, happy, neutral, sad, and surprised facial expressions (LoBue & Thrasher, 2013).

Here we examined the detection of both child and adult emotional facial expressions. The findings have theoretical implications for what drives the detection of threatening faces. Although an angry child's face has the same features as an angry adult's face, these faces do not necessarily carry the same meaning. In the current research, 3- to 5-year-old children and adults were asked to detect angry, sad, and happy faces among neutral distracters. In half of the conditions, they detected faces of 4- to 6-year-old children from the CAFE set. In the other half, they detected adult facial expressions from the NimStim set. If the threatening message produced by adult angry faces drives their rapid detection, children posing angry faces might not produce the same results in adult participants because an angry 5-year-old is likely not very threatening to adults. Conversely, for child participants, an angry 5-year-old and an angry adult may both attract attention equally because both faces could constitute an imminent threat. Alternatively, if specific features of threatening faces such as an angry face's V-shaped brow drive their rapid detection, angry faces should be detected more quickly than other facial expressions regardless of whether the model is a child or an adult.

Method

Adopting the touchscreen paradigm used by LoBue and DeLoache (2008), both preschool children and adults were presented with 3 × 3 matrices of color photographs depicting angry, sad, and happy facial expressions and were asked to touch a target on the screen as quickly as possible. In half of the conditions the matrices were composed of photographs of adult faces, and in the other half the matrices were composed of photographs of child faces.

Participants

Child participants were 18 preschool children (11 female and 7 male) ranging from 35 to 61 months (M = 46.9 months). Children were recruited from an urban child care center in New Jersey on the U.S. East Coast, and the experiment took place in a small quiet room at the center. Of the total sample, 13 children (7 female and 6 male) successfully completed all of the adult face and child face conditions. Because of limited attendance while data were being collected, an additional 3 children (2 female and 1 male) completed all child face conditions but did not complete all adult face conditions, 1 child (female) completed all adult face conditions but not did not complete the child face conditions, and 1 child (female) completed all except for the happy face due to extremely high rates of error on that condition. Parental consent was given for all children.

Adults participants were 18 university students (11 female and 7 male, mean age = 22 years, range = 18–45). The number of adult participants and their genders were selected to match those of the child participants. None of the participants had children. Adults were recruited from the Rutgers University human subjects participant pool and received course credit (Psychology 101 or 102) for their participation. The Rutgers University institutional review board approved all procedures, and all participants signed an informed consent.

Materials

The stimuli consisted of two sets of photographs, each set depicting various facial expressions. Each set was composed of 24 angry, 24 happy, 24 sad, and 24 neutral expressions. One set of photographs was taken from the NimStim face set obtained from the MacArthur Foundation Research Network on Early Experience and Brain Development. The NimStim set depicts adult models posing for various facial expressions (Tottenham et al., 2009). The second set of photographs was taken from the CAFE set. CAFE is a stimulus set of 4- to 6-year-old children posing for six basic emotional expressions—happy, sad, disgust, surprise, angry, and fear—and a neutral expression (LoBue & Thrasher, 2013). An equal number of male and female faces were used, and photographs were varied for race based on the availability of different races/ethnicities in each set. In the current study, the NimStim faces used were 20% African American, 14% Asian, 57% Caucasian, and 9% Latino; the CAFE faces were 23% African American, 13% Asian, 47% Caucasian, and 18% Latino.

The photographs were arranged in 3 × 3 matrices and presented using a 61-cm (24-inch) color touchscreen monitor. Each matrix was composed of one photograph from a target category and eight photographs from the distracter category. Target categories were angry, happy, and sad. Neutral photographs served as the distracter category for every target condition. Each of the 24 photographs in the target category served as the target only once, and 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 handprints was located on the table in front of the monitor.

Procedure

Participants were seated approximately 40 cm from the base of the touchscreen monitor and were told to place their hands on the handprints located on the table in front of the monitor. This was done
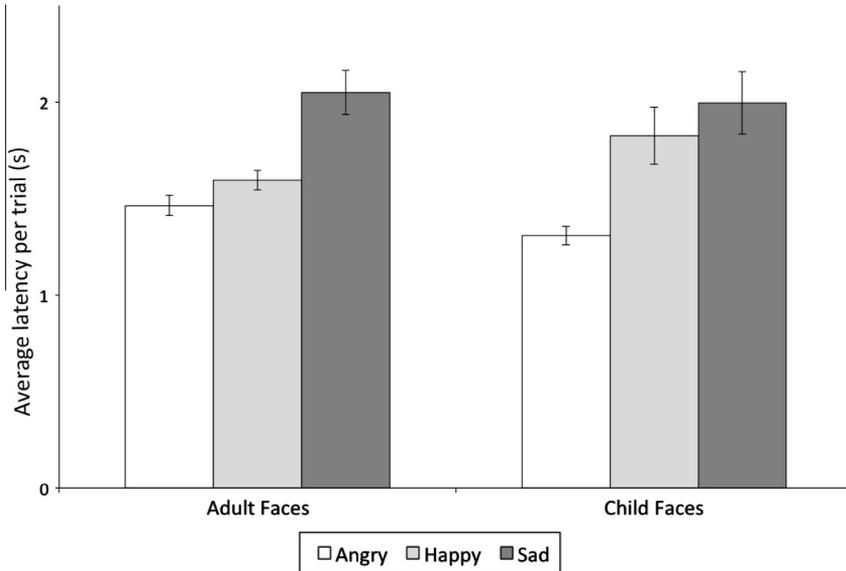
Fig. 1. Average latency for adult participants to detect the target stimuli in the experiment. Bars show standard errors.

to ensure that participants' hands were in the same place at the onset of every trial. The experimenter stood alongside the monitor and instructed participants throughout the procedure.

To teach participants how to use the touch-screen, they were given 7 practice trials. For the first 2 practice trials, participants were asked to touch a single picture (one from the target category and one from the distracter category) on the screen. For the next 2 practice trials, participants were presented with two pictures on the screen, one target and one distracter, and were asked to touch only the target picture. Following these trials, participants were presented with 3 final practice trials, each composed of a nine-picture matrix with one target amid eight distracters. They were asked to touch only the target picture. All participants quickly learned the procedure.

Following practice trials, a series of 24 test trials were presented, each containing one target and eight distracters. A smiley face appeared in the center of the screen between each trial. For child participants, the experimenter touched the face when she determined that children's full attention was on the screen. This was done to ensure that children were alert and ready at the onset of each trial. Adult participants were instructed to press the smiley face when they were ready to advance to the next trial. Latency to touch was automatically recorded from the onset of each matrix. There were three conditions—angry, sad, and happy—for each set of target faces (adult and child), for a total of 144 test trials. Child participants completed the conditions in two test sessions within a week—one test session for adult faces and one session for child faces. The order of the sessions was counterbalanced. Adult participants completed the experimental conditions in a single testing session. To keep the procedure similar to that of the child participants, adults were tested in two blocks that were counterbalanced—one block for adult faces and one block for child faces. The order of the three conditions (angry, sad, and happy) within each test session/block was randomized.

Results

The results for the adult and child participants are presented in Figs. 1 and 2, respectively. As in previous visual search research, only trials in which participants made correct responses were used in analyses, and errors were eliminated (children: <10% of the data; adults: <0.2% of the data). Preliminary analyses were conducted on gender and the order in which the faces were presented (adult or
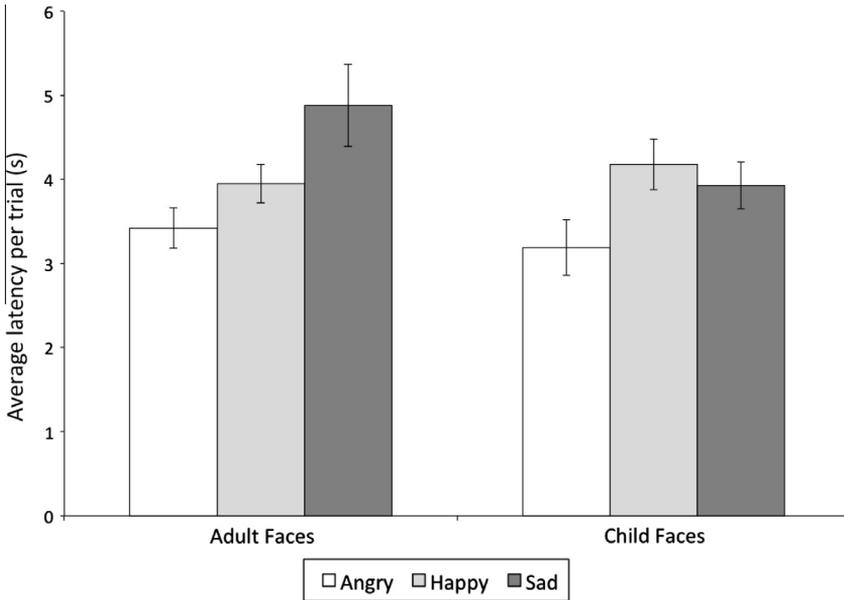
Fig. 2. Average latency for child participants to detect the target stimuli in the experiment. Bars show standard errors.

child faces first). Gender had no significant effect on any of the variables of interest, so it was not included in the main analyses. Order, however, did produce a significant interaction, so it was included in the analyses below.

The main analysis was a 3 (Target Expression: angry, happy, or sad faces) × 2 (Target Age: child or adult faces) × 2 (Participant Age: child or adult participants) × 2 (Face Order: adult or child faces first) repeated-measures analysis of variance (ANOVA) on average latency to detect the target in each condition, with target expression and target age as within-participants variables and with participant age and face order as between-participants variables. There were significant main effects of participant age, $F(1,29) = 134.1$, $p < .001$, $\eta^2 = .832$, and target expression, $F(1,29) = 36.2$, $p < .001$, $\eta^2 = .573$, with a target age by target expression interaction, $F(1,29) = 9.9$, $p = .004$, $\eta^2 = .269$, a target age by face order interaction, $F(1,29) = 8.4$, $p = .007$, $\eta^2 = .797$, and a target age by participant age interaction that was approaching significance, $F(1,29) = 3.4$, $p = .077$, $\eta^2 = .112$.

The main effect of participant age indicated that adults detected targets ($M = 1.7$ s) significantly faster than children ($M = 3.6$ s). The main effect of target expression showed that there were significant differences between the detection of the various facial expressions. According to several pairwise comparisons (least significant difference, LSD), both adults and children detected angry faces ($M = 2.2$ s) significantly faster than both happy faces ($M = 2.7$ s) and sad faces ($M = 3.0$ s), $p < .001$, and they detected happy faces significantly faster than sad faces, $p = .017$. However, the target age by target expression interaction suggested that this pattern differed for adult and child facial expressions. For adult facial expressions, angry faces ($M = 2.3$ s) were detected more quickly than happy faces ($p = .009$) and sad faces ($p < .001$), and happy faces ($M = 2.6$ s) were detected more quickly than sad faces ($M = 3.2$), $p < .001$; for child facial expressions, angry faces ($M = 2.1$ s) were detected more quickly than happy faces ($p < .001$) and sad faces ($p < .001$), but happy faces ($M = 2.8$ s) were detected just as fast as sad faces ($M = 2.8$ s), $p = .389$. This pattern was similar when the results were examined separately for child and adult participants. Adult participants detected adult angry faces more quickly than happy faces ($p = .033$) and sad faces ($p < .001$), and they detected adult happy faces more quickly than adult sad faces ($p < .001$). Adult participants also detected child angry faces more quickly than happy faces ($p = .001$) and sad faces ($p < .001$), with no differences between child happy and child sad faces ($p = .285$) (see Fig. 1). Child participants detected adult angry faces more quickly than happy

faces (p = .043) and sad faces (p < .006), and they detected adult happy faces more quickly than adult sad faces (p < .015). Child participants also detected child angry faces more quickly than happy faces (p < .001) and sad faces (p = .001), and they detected child sad faces more quickly than child happy faces (p = .032) (see Fig. 2).

The target age by face order interaction indicated that when the child faces were presented second (2.4 s), they were detected significantly faster than the adult faces (M = 2.7 s), p = .005. There were no significant differences in detection when the child faces were presented first (M_{adult} = 2.7 s, M_{child} = 2.8 s), p = .430. Finally, the target age by participant age interaction indicates that although there were no differences between the detection of adult and child faces within adult participants (M_{adult} = 1.7 s, M_{child} = 1.7 s), p = .890, children showed a tendency to detect child faces more quickly than adult faces (M_{adult} = 3.7 s, M_{child} = 3.4 s), p = .133. Although this interaction was only approaching significance (p = .077), a lack of statistical power (.427) due to our small sample size might have kept it from reaching significance at the .05 level.

Together, these results replicate previous work showing that both children and adults detect threatening or angry adult faces faster than happy and sad faces (LoBue, 2009). Most important, they demonstrate for the first time that both preschool children and adults show the same advantage for threatening faces with photographs of children as they do with photographs of adults, and the results provide the first replication of previous work with the CAFE set. Finally, these results also provide some evidence, albeit weak, that children detect the facial expressions of other children more quickly than those of adults.

Discussion

The goal of the current investigation was to examine the detection of various emotional facial expressions posed by both adult and child models. The results demonstrate that both preschool children and adults detect angry faces more quickly than sad and happy faces regardless of whether they are posed by adult or child models. These results have implications for what drives the rapid detection of threatening faces and how such a bias develops.

Until recently, biases for threat in detection were studied only in adult participants, and the origins of such biases were merely speculative. As mentioned above, several researchers have proposed that the threatening message produced by angry faces is what facilitates detection, whereas others have posited that specific features of threatening faces drive their rapid detection. The current work replicates previous findings, demonstrating that by 3 years of age children show the same bias for threat in detection that adults show, detecting adult angry faces faster than happy and sad faces. Furthermore, we showed that children are biased to detect child angry faces more quickly than child happy and sad faces as well. If these faces are detected particularly quickly because of the threatening message they present, we would expect that adults would detect only angry adult faces, and not angry child faces, more quickly than other facial expressions because an adult posing an angry face is more threatening to an adult than a child posing an angry face. Indeed, several studies have already shown that the more aversive or negatively adults rate threatening stimuli, the more quickly they detect them (Beaver et al., 2005; Lundqvist & Öhman, 2005).

The results of the current work, however, do not support this contention. Instead, our data show that both adults and children detect angry faces more quickly than happy and sad faces regardless of the age of the model. This provides support for the second hypothesis—that humans quickly detect angry faces because of some low-level features of the expressions that attract our attention. Other previous developmental data also support this idea, demonstrating that specific geometric shapes, such as the V-shaped brow characteristic of angry faces and the curvilinear shape common to snakes, are sufficient in eliciting rapid detection in children as young as 3 years in the absence of any threatening or negative valence (LoBue, 2013a; LoBue & DeLoache, 2011; LoBue & Larson, 2010). Together, this work suggests that humans have an early developing bias for certain features common to threat-relevant stimuli, and interpreting the degree to which a stimulus is threatening is not necessary in order to elicit rapid detection.

An alternative explanation for these findings is that *negative valence* more generally is responsible for the rapid detection of angry faces regardless of the age of the model. In other words, it was not the threatening message itself that drove rapid detection; rather, it was that, in general, all stimuli that are negatively valenced are processed more quickly and efficiently than stimuli that are positive or neutral (Cacioppo, Gardner, & Berntson, 1999). In social psychology, this is referred to as a general negativity bias and has received substantial support across a number of studies (for a review, see Baumeister, Bratslavsky, & Finkenauer, 2001; Vaish, Grossman, & Woodward, 2008). However, if this was the case in the current investigation, sad faces should have also been detected more quickly than happy faces. Thus, it is unlikely that the general negative valence of the angry faces produced the current results.

Another alternative explanation for these findings is that adults indeed find child faces to be threatening. Not all adults are necessarily able to defend themselves against a threatening child (e.g., the elderly) and, thus, would still avoid such an individual in a confrontation. Furthermore, because of its importance for survival, many researchers have suggested that our rapid detection of threat has evolutionary origins. More specifically, humans evolved a fear module in the brain that is activated automatically at the sight of threat (for a review, see Öhman & Mineka, 2001). If this is the case, it is possible that such an adaptation would not necessarily be sensitive to specific characteristics of the threatening individual such as age. Thus, although a child is not necessarily threatening to most adults, a child's angry face might still elicit the same automatic response as a threatening adult. However, the issue of automaticity in detection is a controversial one in the literature, and future research is needed to determine to what extent the detection of threatening stimuli is automatic and immune to cognitive influences.

Besides theoretical importance, the current work has methodological implications for what type of stimuli is most appropriate in detection tasks or tasks that involve emotional facial expressions more generally. Although adults detected child and adult faces equally quickly overall, child participants showed some evidence of facilitated detection for faces that are closer to their age. This is consistent with previous work on the "own-age bias," demonstrating that children recognize faces most accurately when they are within 2 years of their own age (Hills & Lewis, 2011). It is possible that children are more adept at detecting child faces than adult faces because they have more experience in looking at the faces of other children than at the faces of adults or because they have experience in posing for such expressions. This is still an open question. However, regardless of why children detect the faces of other children more quickly than those of adults, this is a potentially important finding because most stimulus sets of emotional facial expressions consist exclusively of photographs of adults posing the various expressions. The current work uses a new stimulus set—the CAFE set—that for the first time features photographs of 4- to 6-year-old children posing the various emotions. When conducting research on emotional development in child participants, such stimulus considerations should be taken into account because when asking children to perform tasks that involve adult emotional faces instead of faces representing their own age group, researchers might be at risk for underestimating children's abilities.

It is important to note that although children showed a tendency to detect child faces more quickly than adult faces, the result was weak and only approaching significance. It is possible that with more statistical power, the result would have achieved significance at the .05 level and indicates that children do indeed show facilitated detection of faces closer to their own age. However, an alternative possibility is that this effect can be attributed to the fact that we used two differently normed sets of stimuli. Based on Fig. 2, it appears that child participants demonstrated an advantage for child over adult faces only for negative emotions (angry and sad); such an advantage was not present for happy faces. Furthermore, a closer look at both Figs. 1 and 2 reveals a very similar pattern of responding in both child and adult participants across faces in both stimulus sets. Thus, although it is possible that children show a general advantage for child faces over adult faces, specific characteristics of the stimulus sets (CAFE vs. NimStim) might also be driving differences within each facial expression. Future research using the CAFE set might clarify some of these issues.

It is interesting that although adults detected faces faster than children, adults and children showed a very similar *pattern* of responding across facial expressions, detecting angry faces the most quickly, followed by happy faces and then sad faces. Previous research suggests that preschool-age children show adult-like competence only in *labeling* happy faces and that the ability to identify other

facial expressions, particularly sad and angry faces, does not reach adult-like competence until beyond 10 years of age (Gao & Maurer, 2010). This suggests that the detection of the various facial expressions might develop more quickly than children's ability to label these expressions. One possibility is that immature language ability during the preschool years causes researchers to underestimate children's ability to recognize the various emotional facial expressions. Future research might examine the relationship between recognizing differences between emotional facial expressions and children's ability to label each emotion. The CAFE set might be particularly helpful for future work in this domain.

In conclusion, the current work is the first to examine the detection of various emotional facial expressions posed by both child and adult models. The results demonstrate that regardless of whether or not the model is actually a threat, both adult and child participants detect angry faces more quickly than happy and sad faces, suggesting that the features of angry faces might play a particularly important role in driving their rapid detection. Furthermore, the current work has provided some evidence that children are more adept at detecting facial expressions of other children than at detecting facial expressions of adults. This has methodological implications for future research on emotional development because using photographs of adults posing for emotional facial expressions in research with child participants might underestimate children's abilities. The CAFE set can provide researchers with a new means of conducting such research with age-appropriate emotional stimuli.

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