



Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp



Influence of intensity on children's sensitivity to happy, sad, and fearful facial expressions

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ARTICLE INFO

Article history:

Received 5 May 2008

Revised 5 November 2008

Available online 4 January 2009

Keywords:

Facial expressions

Development

Children

Intensity

Happy

Sad

Fearful

ABSTRACT

Most previous studies investigating children's ability to recognize facial expressions used only intense exemplars. Here we compared the sensitivity of 5-, 7-, and 10-year-olds with that of adults ($n = 24$ per age group) for less intense expressions of happiness, sadness, and fear. The developmental patterns differed across expressions. For happiness, by 5 years of age, children were as sensitive as adults even to low intensities. For sadness, by 5 years of age, children were as accurate as adults in judging that the face was expressive (i.e., not neutral), but even at 10 years of age, children were more likely to misjudge it as fearful. For fear, children's thresholds were not adult-like until 10 years of age, and children often confused it with sadness at 5 years of age. For all expressions, including even happy expressions, 5- and 7-year-olds were less accurate than adults in judging which of two expressions was more intense. Together, the results indicate that there is slow development of accurate decoding of subtle facial expressions.

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Introduction

Facial expressions are an important source of social information. Accurate recognition of facial expressions allows us to make inferences about other people's feelings, thereby guiding our social behavior. Normal human adults are fast and accurate at recognizing facial expressions, even from still photographs (Ekman, 1993). This ability is seen universally; there is high agreement among adults from different cultures on what emotion is shown in still photographs of facial expressions of basic emotions (happiness, sadness, anger, surprise, fear, and disgust) (Ekman & Friesen, 1971; Ekman et al., 1987; Elfenbein & Ambady, 2002; Izard, 1971). However, the development of this ability remains largely unclear.

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Most previous studies investigating children's ability to recognize facial expressions used photographs of intense facial expressions of basic emotions. Children's performance in identifying emotion from such photographs improves with age (reviewed in Herba & Phillips, 2004), with positive expressions recognized earlier and more accurately than negative expressions (Boyatzis, Chazan, & Ting, 1993; Camras & Allison, 1985; Widen & Russell, 2003). Overall, the improvement can be characterized by a large increment in accuracy between 3 and 7 years of age (Camras & Allison, 1985; Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007; Markham & Wang, 1996; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000) and an increment in speed between 7 and 10 years of age (De Sonneville et al., 2002). The developmental patterns for intense emotional expressions are similar across studies that used photographs of children's faces (Boyatzis et al., 1993; Camras & Allison, 1985; Widen & Russell, 2003), photographs of adults' faces (Durand et al., 2007; Markham & Wang, 1996; Vicari et al., 2000), or both (De Sonneville et al., 2002). At least with some stimulus sets, there is continued improvement in accuracy into early adolescence (Kolb, Wilson, & Taylor, 1992). Moreover, children's pattern of brain activation when processing different intense facial expressions differs from that of adults until at least 11 years of age for functional magnetic resonance imaging (fMRI) activation to neutral versus fear (Thomas et al., 2001; see also Monk et al., 2003) and until late adolescence for event-related potential (ERP) patterns (Batty & Taylor, 2006).

The previous studies with intense emotional expressions documented that children are accurate in judging intense exemplars by approximately 7 years of age, with subsequent changes in reaction time and neural specificity. However, in everyday life, we see less intense facial expressions more frequently than intense facial expressions. The ability to recognize less intense facial expressions and subtle changes in the intensity of facial expressions (e.g., to see that someone is mildly amused by a joke) facilitates smooth social interactions. Therefore, it is important to investigate children's ability to recognize facial expressions of lower intensity.

The intensity of a facial expression is determined by the amount of muscle displacement away from a neutral state (Hess, Blairy, & Kleck, 1997). For example, the intensity of a happy expression can be characterized by the degree of displacement of zygomaticus major and orbicularis oculi muscles relative to their relaxed states (Duchenne de Boulogne, 1990). Three recent studies of children used a morphing process to move the positions of features in a neutral face toward their positions in an intense emotional face, a change simulating the consequences of facial muscle movements. One study compared children with and without psychopathic tendencies in a program for troubled children (Blair, Colledge, Murray, & Mitchell, 2001). Children with psychopathic tendencies needed significantly more intensity to recognize the sad expression, and they were more likely to mistake the fearful expression for another expression even at full intensity. However, the children spanned the age range of 9 to 17 years, and the authors did not investigate the effect of age on thresholds or errors. In a second study, Herba and colleagues (2008; see also Herba, Landau, Russell, Ecker, & Phillips, 2006, for related results on matching expression across intensity) used 10 levels of intensity to investigate the effect of familiarity on 4- to 15-year-olds' perception of five facial expressions (happiness, sadness, anger, fear, and disgust) in familiar and unfamiliar adult faces. Sensitivity improved with increasing ages for happy and fearful expressions but not for disgust, sad, and angry expressions, with no facilitation by familiarity for any facial expression and in fact some evidence that familiarity degraded sensitivity. However, because there was no adult comparison group, it is not possible to determine when sensitivity reaches adult levels. A different pattern emerged in a recent study that used morphing to create six intermediate intensities between neutral and expressions of fear and anger; children (7–13 years of age) and adolescents (14–18 years of age) were less sensitive than adults for both anger and fear (Thomas, De Bellis, Graham, & LaBar, 2007). These data suggest that the development of sensitivity to at least some facial expressions continues into adolescence. However, the authors used wide age groupings and did not analyze misidentifications. Adults tend to make systematic confusions among facial expressions. For example, they often confuse fear with surprise and also confuse anger with disgust (Ekman & Friesen, 1971; Etcoff & Magee, 1992; Young et al., 1997). Little information is known about whether children show the same pattern of confusion among facial expressions as do adults.

The purpose of our study was to build on these previous findings by including more intensity levels and a method that allowed us to measure both thresholds for each expression and confusions among expressions. We systematically manipulated the intensity of three facial expressions (happiness, sad-

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