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Shades of emotion: What the addition of sunglasses or masks to faces reveals about the development of facial expression processing

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ABSTRACT

Three studies investigated developmental changes in facial expression processing, between 3 years-of-age and adulthood. For adults and older children, the addition of sunglasses to upright faces caused an equivalent decrement in performance to face inversion. However, younger children showed *better* classification of expressions of faces wearing sunglasses than children who saw the same faces un-occluded. When the mouth area was occluded with a mask, children under nine years showed no impairment in expression classification, relative to un-occluded faces. An early selective focus of attention on the eyes may be optimal for socialization, but mediate *against* accurate expression classification. The data support a model in which a threshold level of attentional control must be reached before children can develop adult-like configural processing skills and be flexible in their use of face- processing strategies.

1. Introduction

Why do young children have difficulty classifying facial expressions of emotion? If basic expressions of some human emotions (plural) (happiness, anger, fear, surprise, sadness and disgust) are generated by innate biological affect programs (Ekman, Friesen, & Ellsworth, 1972) what skills need to develop in order to interpret these expressions on other people's faces?

By the age of two children appear to understand emotions as internal feelings, separate from their external causes (Wellman, Harris, Banerjee, & Sinclair, 1995). By three or four they can match two images of expressions of the same emotion and identify emotions from emotional stories (Widen & Russell, 2003). Yet they consistently over-extend labels like 'happy' or 'sad' to inappropriate expressions, especially when pairs of facial expressions share the same valence (Russell, 1994; Shelley-Tremblay & Mack, 1999). Accurate decoding of facial expressions improves only gradually through childhood and continued refinement of categorization has been observed into adolescence (Camras & Allison, 1985).

Despite intensive investigation, the cause of these difficulties remains unclear (Tanaka, Kay, Grinnell, Stansfield, & Szechter, 1998; Wallace, Coleman, & Bailey, 2008). Children might have some particular difficulty in accessing existing emotion categories from facial expressions, either because their knowledge is less accessible in some response modalities[1] or because children have less stable, more task-dependent classification criteria than adults. Alternatively, the task may demand a sophisticated level of perceptual processing that they have yet to achieve.

Adults are able to process complex configural aspects of faces when judging identity (Bruce, Doyle, Dench, & Burton, 1991; Rhodes, Brake, & Atkinson, 1993; Tanaka & Farah, 1993), and to take multiple features into account

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[1] When verbal and manual responding has been directly contrasted, children often pointed to a correct choice, but said the incorrect one (Zelazo, Frye & Rapus, 1996).

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when judging expressions (Barrett, Lindquist, & Gendron, 2007).

Adult face processing strategies are complex and flexible, (Maurer, Le Grand, & Mondloch, 2002), and impaired by face inversion (McKelvie, 1995; Yin, 1969). Crucially, adults are able to switch strategies between face processing tasks so that they can ignore changes in expression when judging identity, and ignore changes in identity when judging expression. Young children appear to be less flexible, so that while they may be able to process face identity independently from facial expressions, changes in identity interferes with their ability to judge emotion from facial expressions (Krebs et al., 2011). The ability to use different processing strategies for the two tasks may appear rather abruptly, if it depends on the achievement of some attentional threshold (e.g. Schwarzer, 2000).

There is considerable debate as to when adult-like flexibility of face processing emerges (Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch, Geldart, Maurer, & Le Grand, 2003). Although young children show a recognition advantage for individual facial features in the context of a whole face (Tanaka et al., 1998), and have adult-like difficulty in identifying the top half of composite faces when the top and the bottom half are misaligned (de Heering, Houthuys, & Rossion, 2007; Konar, Bennett, & Sekuler, 2010), they may continue to rely on external features, such as hair, when identifying familiar faces, (Diamond & Carey, 1986). Children under 7 show no decrement in face identification for inverted faces and rely strongly on a single attribute of the face for a range of judgments (Schwarzer, 2000; Kestenbaum and Nelson, 1990). Adult levels of facial expression decoding may be achieved relatively late because it requires holistic processing so that, for example, a judgment of the emotion displayed by wide open, staring eyes can be modulated by the shape of the mouth in order to distinguish fear from either pleasant or unpleasant surprise, (Farah, Wilson, Drain, & Tanaka, 1998).

Problematic for developmental investigations of these issues is the fact that image manipulations that disrupt contextual aspects of identity or expression, all result in further impairments of performance on a task on which young children already make frequent errors. Transformations that disrupt the horizontal 'barcode' sequence of the face such as misalignment of two halves of the face, or part / whole changes, result in disproportionate impairment of adult face processing (Dakin and Watt, 2009), increase task difficulty and distort the expressions that children are being asked to classify. This limits their effectiveness in investigating the causes of children's prolonged difficulties in decoding facial expressions of emotion and increases the difference between adults' and children's performance (see Mondloch et al. (2004), Tanaka et al. (1998) or Valentine (1995) for discussions of these issues).

In the present studies, a more ecologically valid manipulation was used to explore the perceptual processing of facial expressions of emotion. In one manipulation, sunglasses were added to images of facial expressions. This condition should have obliged participants of all ages to shift their attention from the eyes, and instead to attend to the mouth. In the second, the addition of masks obscured the mouth area of the same faces.

If young children's difficulties in expression processing arise because they are unable to process expression as an independent attribute of faces, no systematic reduction in performance should occur. If they arise through selective attention to the eye area in faces (Schwarzer & Zauner, 2003), and lack the attentional control to attend to more informative features (e.g. the mouth), then the addition of sunglasses should improve expression classification, but the addition of surgical masks should harm it, relative to the full-face condition. If participants are processing configural aspects of the face, similar reductions in accuracy should occur from either the addition of sunglasses or of masks.

Since occlusion of any part of the face reduces the available feature information, as well as disrupting configural processing, in Experiment 1, the effect of sunglasses was compared to inversion in adults, 9–10 year olds and 5–6 year olds.

2. Experiment 1

Experiment 1 compared children's and adults' processing of facial expressions of emotion with upright face, inverted faces and faces with sunglasses occluding the eye area. The addition of sunglasses disrupts both configural and featural processing. However, if 5–6 year-olds do not yet use configural processing, then inversion of the full-face should not disrupt their recognition of emotional expressions, but the addition of sunglasses should, because they obscure the preferred feature. Such disruption should be particularly evident for angry faces, because happy faces can still be accurately classified on the basis of the mouth alone. The difference between conditions should be reduced in older children, who should have at least begun to process the faces configurally and should be minimal in adults, for whom equal disruption is predicted.

2.1. Method

2.1.1. Participants

Twenty 5–6 year-olds (8 females, mean age 5 years 7 months) and twenty 9–10 year-olds (11females, mean age 9 years 6 months) recruited with parental consent from local schools in Essex and 20 adult students from the University of Essex (11 females, mean age 21 years) took part in Experiment 1. All had normal or corrected-to-normal eyesight.

2.1.2. Stimuli

Photographs of a male and a female model posing five expressions of emotion (happiness, surprise, anger, fear and sadness) were taken from the set of images created by Montagne and colleagues and form the basis for 'The Emotion Recognition Task' (Montagne, Kessels, De Haan, & Perrett, 2007). The set are well validated and have been used in a wide range of published neuropsychological and developmental research. All the images were cropped to remove external features and were shown in a front view, resized to 250 × 250 pixels. All faces had been adjusted to match in skin tone, overall brightness, and contrast levels.