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The effects of information type (features vs. configuration) and location (eyes vs. mouth) on the development of face perception

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ABSTRACT

The goal of the current study was to investigate the development of face processing strategies in a perceptual discrimination task. Children (7–12 years of age) and young adults were administered the Face Dimensions Task. In the Face Dimensions Task, participants were asked to judge whether two simultaneously presented faces were the "same" or "different". For the "same" trials, the two faces were identical. For the "different" trials, the faces differed in either the spacing between the eyes, the spacing between the nose and the mouth, the size of the eyes, or the size of the mouth. The main finding was that 7- to 10-year-old children showed no difference in their ability to discriminate differences in eye size and eye spacing but showed a poor ability to discriminate differences in nose and mouth spacing and, to a lesser extent, mouth size. The developmental lag between nose–mouth discriminations and the other featural and configural discriminations was reduced in older children and eliminated by young adulthood. These results indicate that the type of face information (i.e., configural vs. featural) and its location (i.e., eye vs. mouth) jointly contribute to the development of face perception abilities.

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Introduction

During the first 30 min of life, neonates attend to face-like stimuli over non-face stimuli (Johnson, Dziurawiec, Ellis, & Morton, 1991). During childhood, 6-year-olds begin a steady linear improvement in their face recognition abilities that plateaus at around 10 years of age and then accelerates during adolescence (Lawrence et al., 2008), finally peaking at around 30 years of age (Germine, Duchaine, & Nakayama, 2011). Although human face abilities are impressive, it is less clear whether age-related gains in face processing reflect the maturation of general cognitive abilities or whether they signal a developmental shift in the nature of face processing (Crookes & McKone, 2009; Mondloch, Maurer, & Ahola, 2006; Tanaka, Meixner, & Kantner, 2011).

Several accounts have been offered to explain the changes in face processing strategies that occur across development. The configural hypothesis argues that the critical developmental change in face processing occurs when the child not only attends to the features of a face but also becomes increasingly sensitive to the spatial distances that separate the features (e.g., Mondloch, Le Grand, & Maurer, 2002). In contrast, the location hypothesis maintains that the critical shift in face processing development occurs when the child begins to attend equally to information in the eye, nose, and mouth regions (e.g., Ge et al., 2008). The aim of the Face Dimensions Task is to provide a psychophysics measure to evaluate the independent contributions of information type (configural vs. featural) and location (eye vs. mouth) to the development of face processing abilities. Face stimuli were designed such that featural information (i.e., size of the eyes, size of the mouth) and configural information (i.e., distance between the eyes, distance between the nose and the mouth) were independently manipulated. In the current study, children (7–12 years of age) and young adults were administered the Face Dimensions Task. The results revealed that both the type of information (featural vs. configural) and the location of information (eyes vs. mouth loci) were important factors for explaining the developmental shift in face processing.

Featural–configural processing view

From a perceptual standpoint, the human ability to perceive and distinguish identities of individual faces is truly exceptional. Faces constitute a structurally homogeneous class of objects in which all faces share the same features of two eyes, a nose, and a mouth that are arranged in a similar configuration (i.e., the eyes are located in the upper half of the face above the midline nose and mouth features). Thus, recognition of a particular face must depend on the ability to perceive subtle differences in the size and shape of the facial features and the configural distances that separate the features. A long-standing issue in the face processing literature is the role that featural and configural processes play in face recognition abilities and how these processes unfold over the course of development.

Based on looking paradigms, infants show an early ability to detect featural and configural differences in a face. By 3 months of age infants are sensitive to faces that differ in their featural information, and by 5 months of age they are able to discriminate faces that differ in the spatial distances between the eyes (Bhatt, Bertin, Hayden, & Reed, 2005; Leo & Simion, 2009; Simion, Leo, Turati, Valenza, & Dalla Barba, 2007). Infants' awareness of featural and configural changes seems to be biased toward information in the eye location over information in the mouth location (Quinn & Tanaka, 2009).

In contrast to the good configural abilities of infants, children seem impaired in their ability to use configural information in face recognition tasks. For example, 7-year-olds fail to detect configural changes of eyes and mouth in a familiarized face (Mondloch et al., 2006), in the face of a familiar peer (Mondloch & Thomson, 2008), and even in their own face (Mondloch, Leis, & Maurer, 2012). In addition, 6-, 8-, and 10-year-olds have more difficulty in encoding configural changes than in encoding featural changes in a face presented in either its upright or inverted orientation (Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch et al., 2002). Studies of cataract patients who experience early visual deprivation show that they are differentially impaired in their ability to detect spacing differences relative to featural differences (Le Grand, Mondloch, Maurer, & Brent, 2001). According to the