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Holistic face processing is mature at 4 years of age: Evidence from the composite face effect

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Abstract

Although it is acknowledged that adults integrate features into a representation of the whole face, there is still some disagreement about the onset and developmental course of holistic face processing. We tested adults and children from 4 to 6 years of age with the same paradigm measuring holistic face processing through an adaptation of the composite face effect [Young, A. W., Hellawell, D., & Hay, D. C. (1987). Configurational information in face perception. *Perception, 16,* 747–759]. In Experiment 1, only 6-year-old children and adults tended to perceive the two identical top parts as different, suggesting that holistic face processing emerged at 6 years of age. However, Experiment 2 suggested that these results could be due to a response bias in children that was cancelled out by always presenting two faces in the same format on each trial. In this condition, all age groups present strong composite face effects, suggesting that holistic face processing is mature as early as after 4 years of experience with faces.

Keywords: Development; Children; Face; Holistic; Composite effect

Introduction

An important paradox characterizes the development of humans' face processing abilities. On the one hand, neonates tested several hours after birth already show face processing abilities, preferring to orient their attention toward face-like patterns as compared to

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scrambled faces (Goren, Sarty, & Wu, 1975; Morton & Johnson, 1991) or being able to differentiate their mother's face from a stranger's face (Bushnell, 2001; Bushnell, Sai, & Mullin, 1989; Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995). On the other hand, developmental studies have shown that face processing abilities develop rather slowly and progressively (Geldart, Mondloch, Maurer, de Schonen, & Brent, 2002). For instance, children's performance in identity and facial expression processing improves tremendously between 4 and 11 years of age (Bruce et al., 2000) and reaches maturity only after puberty (Carey, Diamond, & Woods, 1980; Chung & Thomson, 1995; Mondloch, Le Grand, & Maurer, 2002).

It is yet unclear whether children simply process faces less efficiently than adults (i.e., a quantitative difference) or whether qualitatively different processes are used by adults and children. For instance, it is widely acknowledged that adults' face recognition relies not only on the process of individual facial features but also on the relations between these features, the so-called configuration of faces (for a review, see Mondloch et al., 2002). The ability of children to process faces configurally has been debated frequently in the literature (e.g., Baenninger, 1994; Brace et al., 2001; Freire & Lee, 2001; Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch, Geldart, Maurer, & Le Grand, 2003; Mondloch et al., 2002). The current view is that adult expertise in configural processing is especially slow to develop (Mondloch et al., 2002) even if it already emerges during infancy (Turati, Sangrigoli, Ruel, & de Schonen, 2004) and early childhood (Cohen & Cashon, 2001; Deruelle & de Schonen, 1998). To complicate matters further, the definition of *face configuration* varies considerably between authors and may appear to be somewhat confusing in the face literature. There are at least two types of configuration that have been conceptually differentiated (Goffaux & Rossion, 2006; Maurer, Le Grand, & Mondloch, 2002; Rossion & Gauthier, 2002). First, configural information may refer to metric distances between facial features such as the interocular or eye–mouth distance. These distances between facial features can be measured and manipulated on the stimulus, and the sensitivity of the face processing system to perceive and encode this information can be tested in discrimination or recognition tasks (e.g., Barton, Keenan, & Bass, 2001; Freire, Lee, & Symons, 2000; Haig, 1984; Leder, Candrian, Huber, & Bruce, 2001). The second type of configuration is referred to as *holistic* processing. It is more difficult to grasp because it refers to a way of handling a face stimulus rather than information that can be manipulated independently of the observer. The concept was probably first introduced by Francis Galton, who noticed that facial features were not perceived and analyzed separately; that is, the face stimulus was processed as a whole unit or as a *Gestalt* (Galton, 1883). Numerous phenomena exemplify this holistic processing of faces in real-life situations or in the laboratory (e.g., Davidoff & Donnelly, 1990; Farah, Wilson, Drain, & Tanaka, 1998; Goffaux & Rossion, 2006; Hole, 1994; Homa, Haver, & Schwartz, 1976; Sergent, 1984; Tanaka & Farah, 1993; Young, Hellawell, & Hay, 1987).

Two experimental paradigms have been widely used to provide evidence for face holistic processing: the *composite face* paradigm (Young et al., 1987) and the *whole–part* paradigm (Davidoff & Donnelly, 1990; Tanaka & Farah, 1993). In the whole–part paradigm, participants are trained to name a series of faces, and they recognize face features (eyes, nose, or mouth) better when these features are embedded in the whole face stimulus than when they are presented in isolation (Tanaka & Farah, 1993). In the initial composite face paradigm, a composite stimulus was made by joining the top half of a familiar face (cut below the eyes) with the bottom half of another familiar face. Observ-