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Three-month-olds' visual preference for faces and its underlying visual processing mechanisms

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Abstract

This study was aimed at investigating the face preference phenomenon and its underlying mechanisms at 3 months of age. Using an eye-tracker apparatus, Experiment 1 demonstrated that 3-month-olds prefer natural face images to unnatural ones, replicating and extending previous evidence obtained with schematic facelike stimuli. Experiments 2 and 3 showed that the general mechanisms that induce face preference in newborns could not explain the same phenomenon at 3 months of age, when infants are attracted by perceptual cues more specific to faces. This suggests that signs of a process of cognitive specialization are already present in 3-month-olds' visual behavior toward faces.

Keywords: Face perception; Infant; Cognitive specialization

Introduction

One central issue in cognitive science is how knowledge of specific domains is processed in the human brain. Face processing is an interesting topic in that respect

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because several lines of evidence suggest that, in adults, face processing rests on an anatomical and/or a functional specialization of cerebral circuits (e.g., Farah, 2000; Kanwisher, 2000). However, what determines this specialization and how this specialization emerges during development still remain largely unknown. The aim of this study is to examine cognitive specialization during early infancy through the investigation of the development of infants' abilities to process faces.

Three major approaches to the developmental origins of face processing have been distinguished (de Haan & Halit, 2001). A first view argues that the development of face specialization is an experience-*independent* process (Farah, Rabinowitz, Quinn, & Liu, 2000). Due to the relevance of faces in our lives, natural selection led, through phylogenesis, to the evolution of innate face-specific devices that would be available prior to any postnatal experience. Within this perspective, it is suggested that the functional and anatomical distinction that characterizes face processing is "explicitly specified in the genome" (Farah et al., 2000). A second approach characterizes the development of face specialization as an experience-*dependent* process. Extensive and prolonged experience with faces would gradually render humans exceptionally expert in recognizing individual exemplars belonging to this class of stimuli. In this approach, general learning processes, which can occur at any time during development and might involve any class of visual stimuli, are considered to be sufficient to explain the gradual emergence of a cortical system for the rapid and efficient processing of faces (Diamond & Carey, 1986; Gauthier & Logothetis, 2000; Tarr & Gauthier, 2000). Within the frame of a third (more recent) approach, the development of face processing has been explained in terms of an experience-*expectant* process. In this view, the cortical tissue has gained, through evolutionary pressures, the potential to become specialized for face processing. However, this specialization would emerge only if the critical type of input is provided within the crucial time windows (Nelson, 2001, 2003). This approach is contingent on a probabilistic epigenesis of cognitive development that views interactions among genes, structural brain changes, and psychological functions as bidirectional (Black, Jones, Nelson, & Greenough, 1998; Greenough & Black, 1992). More specifically, the partial functioning of neural pathways would shape subsequent development of neural structures and circuits that are the basis for further functional development. This ring-shaped process would result in the progressive tuning of certain cerebral tissues, from a broad range of visual information to the specific type of information conveyed by faces (Johnson, 2000; Johnson & de Haan, 2001; Nelson, 2001, 2003).

One way of disentangling the long-standing issue of the development of cognitive specialization for faces might be to study the developmental time course of a phenomenon present a few days from birth—newborns' visual preference for faces. When presented with face and nonface patterns, newborns spontaneously look longer at and orient more frequently toward the configuration that represents a face (Johnson & Morton, 1991; Macchi Cassia, Turati, & Simion, 2004; Valenza, Simion, Macchi Cassia, & Umiltà, 1996).

The well-known model of the development of face processing proposed independently by Johnson and Morton (1991) and de Schonen and Mathivet (1989) explained newborns' preference for faces by hypothesizing the presence at birth of a