Journal of Experimental Child Psychology 126 (2014) 103–111

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

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

No childhood development of viewpoint-invariant face recognition: Evidence from 8-year-olds and adults

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ARTICLE INFO

Article history:
Received 5 December 2013
Revised 19 March 2014

Keywords:
Face recognition
Face perception
Development
Viewpoint
Invariant
Cross-view recognition

ABSTRACT

Performance on laboratory face tasks improves across childhood, not reaching adult levels until adolescence. Debate surrounds the source of this development, with recent reviews suggesting that underlying face processing mechanisms are mature early in childhood and that the improvement seen on experimental tasks instead results from general cognitive/perceptual development. One face processing mechanism that has been argued to develop slowly is the ability to encode faces in a view-invariant manner (i.e., allowing recognition across changes in viewpoint). However, many previous studies have not controlled for general cognitive factors. In the current study, 8-year-olds and adults performed a recognition memory task with two study–test viewpoint conditions: *same view* (study front view, test front view) and *change view* (study front view, test three-quarter view). To allow quantitative comparison between children and adults, performance in the same view condition was matched across the groups by increasing the learning set size for adults. Results showed poorer memory in the change view condition than in the same view condition for both adults and children. Importantly, there was no quantitative difference between children and adults in the size of decrement in memory performance resulting from a change in viewpoint. This finding adds to growing evidence that face processing mechanisms are mature early in childhood.

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http://dx.doi.org/10.1016/j.jecp.2014.03.010
0022-0965/

Introduction

The ability to recognize individuals from their faces is an important aspect of human social interaction. Given the computational difficulty of discriminating such visually similar stimuli, there has been much research into how this complex skill develops. Despite evidence of prodigious individuation ability in newborns (e.g., Turati, Bulf, & Simion, 2008; Turati, Macchi Cassia, Simion, & Leo, 2006), performance on laboratory face tasks shows substantial improvement across childhood, not reaching adult levels until well into adolescence (e.g., Carey, Diamond, & Woods, 1980; de Heering, Rossion, & Maurer, 2012; Lawrence et al., 2008; O'Hearn, Schroer, Minshew, & Luna, 2010). However, the source of this protracted development is debated.

Historically, the majority of studies have argued that development on face tasks is driven by improvements in face-specific processing. Early seminal studies suggested that there are qualitative changes across childhood in the way faces are processed (Carey & Diamond, 1977; Carey et al., 1980). These studies suggested that holistic processing, a key hallmark of adult-like face processing, did not even emerge until 10 years of age. It was argued that before this age faces are processed in a piecemeal part-based manner akin to object processing. More recent evidence has suggested that holistic processing is present in children as young as 3 to 6 years; that is, children and adults process faces in the same way (for a review, see McKone, Crookes, Jeffery, & Dilks, 2012). The original theory, therefore, has been somewhat modified to argue that although there may be no *qualitative* change across childhood in the way faces are processed, there is *quantitative* development in the strength of, or reliance on, face-specific processing mechanisms (e.g., Carey & Diamond, 1994; de Heering et al., 2012).

However, there is growing evidence for an alternative view—that face processing mechanisms are fully quantitatively mature early in childhood and that improvement with age observed on face tasks results entirely from general development rather than face-specific development. Many perceptual and cognitive factors that have the potential to affect performance on face tasks develop across childhood, including metamemory, strategy use, concentration ability, spatial attention, and vernier acuity (for a review, see Crookes & McKone, 2009). Studies that have accounted or controlled for this general development have found no age-related quantitative improvement in the size of key face processing effects across childhood (e.g., inversion effect: Crookes & McKone, 2009; distincitiveness effects on recognition memory: Gilchrist & McKone, 2003; adaptation aftereffects: Jeffery, Rathbone, Read, & Rhodes, 2013; for a review, see McKone et al., 2012). However, tests of this approach have been applied to only some aspects of face processing.

One fundamental aspect of face processing that has been argued to be particularly slow to develop is the ability to encode a new face in such a way as to allow recognition to occur across a transformation in expression or viewpoint, that is, the ability to extract invariant information from a face (Carey, 1992; Ellis, 1990; Mondloch, Geldart, Maurer, & Le Grand, 2003). Despite cross-viewpoint recognition being implicated as one of the key face skills to improve with age, there has been relatively little investigation on the topic. Newborns and older infants show discrimination of previously unfamiliar faces across a change in viewpoint between front and three-quarter views in habituation studies (e.g., Kelly et al., 2007; Turati et al., 2008). Despite this evidence of early ability, a small number of studies have reported improvement of this ability throughout childhood. However, these studies have not accounted for domain-general development and important methodological factors.

Simply showing that children perform worse than adults on tasks requiring recognition across a change in viewpoint (Anzures et al., 2014; Carey et al., 1980; Ellis, 1990, 1992; O'Hearn et al., 2010) does not indicate that cross-view recognition is specifically delayed. Young children perform worse than older children and adults on face tasks even when there is no change in image between study and test (e.g., Carey et al., 1980; Crookes & McKone, 2009; Goldstein & Chance, 1964), presumably due, at least in part, to immaturity of general cognitive factors such as concentration. As with other areas of face recognition recently tested, to detect a specific delay in cross-view recognition, a comparison condition is required.