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Children's representations of facial expression and identity: Identity-contingent expression aftereffects

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A B S T R A C T

This investigation used adaptation aftereffects to examine developmental changes in the perception of facial expressions. Previous studies have shown that adults' perceptions of ambiguous facial expressions are biased following adaptation to intense expressions. These expression aftereffects are strong when the adapting and probe expressions share the same facial identity but are mitigated when they are posed by different identities. We extended these findings by comparing expression aftereffects and categorical boundaries in adults versus 5- to 9-year-olds ($n = 20$/group). Children displayed adult-like aftereffects and categorical boundaries for happy/sad by 7 years of age and for fear/anger by 9 years of age. These findings suggest that both children and adults perceive expressions according to malleable dimensions in which representations of facial expression are partially integrated with facial identity.

Introduction

Face-to-face social interactions require rapid and accurate interpretation of both facial expressions and individual identity. Bruce and Young's (1986) classic model of face perception suggests independent and parallel processing of these two cues, a proposal supported by studies in cognitive psychology (Calder, Young, Keane, & Dean, 2000; Campbell, Brooks, de Haan, & Roberts, 1996; Young, McWeeny, Hay, & Ellis, 1986). Campbell and colleagues (1996) showed that judgments of lip-read speech, expression, and identity were not subject to interference by judgment-irrelevant factors (e.g., judgments of expression were not affected by changes in identity). Calder and colleagues

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(2000) presented three types of composite face stimuli produced by aligning the top half of one face with the bottom half of another face: same identity/different expression, different identity/same expression, and different identity/different expression. Adults were slower to identify the expression in the bottom half when the bottom half was aligned with a top half displaying a different emotional expression, but not when the bottom half was aligned with a top half of a different model displaying the same emotional expression. Similarly, adults' reaction time when naming the identity of the bottom half of a face was impaired when the top half had a different identity, but not when the top half had the same identity but was displaying a different facial expression. Calder and colleagues concluded that holistic processing underlies recognition of both identity and facial expressions but that different information may be relevant for the two types of processing.

Further evidence for Bruce and Young's (1986) model comes from cognitive neuropsychology. Prosopagnosics display impaired recognition of facial identity but intact recognition of facial expression, gender, and age (Tranel, Damasio, & Damasio, 1988), and following brain injury some individuals display impaired expression recognition but intact identity recognition, whereas others show the reverse pattern (Young, Newcombe, de Haan, Small, & Hay, 1993). Functional imaging studies have localized processing of facial identity to the lateral fusiform gyrus and processing of facial expression (and other changeable facial characteristics) to the superior temporal sulcus (see Haxby, Hoffman, & Gobbini, 2000, for a review). Based on this evidence, Haxby and colleagues (2000) proposed a distributed neural system for face perception where recognition of changeable and nonchangeable facial characteristics involves separable but overlapping neural structures.

Although processing of facial identity and expression appears to be dissociable, some integration must occur. Recognition of expression and identity may involve partially integrated representations, but the degree of functional integration may depend on information processing demands (Calder & Young, 2005). Indeed, the ability to integrate identity and expression cues allows individuals to recognize the same person in different affective states.

The purpose of our study was to investigate the integration of identity and expression cues in children. Although numerous studies have investigated the development of expert face recognition (Freire & Lee, 2001; Gilchrist & McKone, 2003; Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch, Geldart, Maurer, & Le Grand, 2003; Mondloch, Le Grand, & Maurer, 2002; Pellicano, Rhodes, & Peters, 2006) or expression recognition (Camras & Allison, 1985; Kolb, Wilson, & Taylor, 1992; Markham & Adams, 1992; Markham & Wang, 1996; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000), no research to date has assessed the integration of expression and identity in children. To do so, we used a relatively new technique that is useful for probing representations underlying various perceptual abilities: face adaptation.

Face adaptation

Adaptation aftereffects are used as a means of investigating visual perception. For example, following adaptation to a visual pattern tilted in one direction (e.g., clockwise), a vertically oriented pattern appears to be tilted in the opposite direction, and following adaptation to a waterfall, a stationary pattern appears to move upward (reviewed in Leopold & Bondar, 2005). Adaptation aftereffects have been observed for other visual characteristics, including luminance, contrast, and direction of motion, and are attributed to reduced neural activation following repeated stimulation (Ibbotson, 2005). Research in social and cognitive psychology has applied similar principles to explain a variety of sociocognitive phenomena such as lower than expected happiness levels in lottery winners (see Brickman, Coates, & Janoff-Bulman, 1978; Helson, 1964).

Adaptation studies indicate that face perception is a dynamic process; exposure to face stimuli biases subsequent perceptions of faces, producing face aftereffects (Fox & Barton, 2007; Leopold, O'Toole, Vetter, & Blanz, 2001; Webster, Kaping, Mizokami, & Duhamel, 2004). Following adaptation to consistently distorted faces (e.g., with very compressed features), unaltered faces appear to be distorted in the opposite direction (Webster & MacLin, 1999), consistent with Valentine's (1991) norm-based coding model. According to this model, faces vary continuously on multiple dimensions (e.g., eye size, distance between nose and mouth), each of which is represented as a vector in "face space." Faces near the prototype are rated as more normal and more attractive than faces that are farther