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Getting to know you: The development of mechanisms underlying face learning

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ABSTRACT

Nearly every study investigating the development of face recognition has focused on the ability to tell people apart using one or two tightly controlled images to represent each identity. Such research ignores the challenge of recognizing the same person despite variability in appearance. Whereas natural variation in appearance makes unfamiliar faces difficult to recognize, by 6 years of age people easily recognize multiple images of familiar faces. Two mechanisms are proposed to underlie the process by which adults become familiar with newly encountered faces. We provide the first examination of the development of these mechanisms during childhood (6–11 years). In Experiment 1, we examined children's (6- to 10-year-olds') and adults' ability to engage in ensemble coding—the ability to rapidly extract an average representation of an identity from several instances. In Experiment 2, we examined children's ability to use within-person variability in appearance to recognize novel instances of a newly encountered identity. We created a child-friendly perceptual matching task, and the number of images to which participants were exposed varied across targets. Although children were less accurate than adults overall in Experiment 2, we found no age-related improvement in either ensemble coding or the ability to benefit from exposure to within-person variability in appearance when learning a new face, suggesting that both abilities are developed by 6 years of age. We discuss the implications of these findings for understanding the nature of mechanisms underlying face learning and other developmental processes such as language and music.

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Introduction

Recognizing the identity of individual faces is critical for daily social interactions and in numerous applied settings (e.g., the security industry, eyewitness testimony). A vast literature has investigated adults' expertise in face recognition and its development during childhood. To ensure that discrimination and recognition could not be attributed to pictorial cues (e.g., hairstyle, shadows, freckles), researchers used tightly controlled images in which all photographs were taken from the same distance, with the same camera, and under identical lighting conditions. Each identity typically was represented by a single image (or two nearly identical images), hair and clothing were covered, and blemishes were removed. Using such stimuli, researchers have investigated the development of identity matching (Bruce et al., 2000; Crookes & Robbins, 2014; Megreya & Bindemann, 2015; Mondloch, Geldart, Maurer, & Le Grand, 2003), holistic processing (Macchi Cassia, Picozzi, Kuefner, & Casati, 2009; Mondloch, Pathman, Maurer, Le Grand, & de Schonen, 2007; Pellicano & Rhodes, 2003), sensitivity to feature shape and spacing (Baudouin, Gallay, Durand, & Robichon, 2010; Freire & Lee, 2001; McKone & Boyer, 2006; Mondloch, Le Grand, & Maurer, 2002), and norm-based coding, a process by which each face is compared with the average of previously encountered faces (Anzures, Mondloch, & Lackner, 2009; Jeffery et al., 2010; Nishimura, Maurer, & Gao, 2009; Nishimura, Maurer, Jeffery, Pellicano, & Rhodes, 2008; Short, Hatry, & Mondloch, 2011; Short, Lee, Fu, & Mondloch, 2014). These studies show that the mechanisms underlying adults' expertise emerge by 6 years of age, with many mechanisms showing continued improvement throughout childhood.

Despite providing numerous insights into children's ability to recognize and discriminate facial images, such studies ignore an important aspect of identity perception—recognizing identity despite natural variability in appearance (see Burton, 2013). In daily life, the appearance of any individual face varies because of changes in both intrinsic factors (e.g., makeup, hairstyle, emotional expression, health) and extrinsic factors (e.g., lighting, distance, point of view)—the very factors that were controlled in the vast majority of developmental studies. Recognizing identity in ambient images—images that capture natural variability in appearance—is challenging. Two pictures of the same person can look very different, and pictures of two different people can look highly similar. Nonetheless, it is this ability that allows children to recognize their peers at school, in the movie theater, and on the soccer field. It is only recently that researchers have turned to this side of adults' face recognition; almost nothing is known about its development.

Adults' ability to recognize faces despite variability in appearance

Adults' ability to recognize identity in ambient images is dramatically affected by familiarity. Jenkins, White, Van Montfort, and Burton (2011) asked adults to sort 40 photographs into piles such that each pile contained all of the images of one person. Unbeknownst to participants, the pile comprised 20 pictures of two people. Whereas participants who were familiar with the identities made two piles, those who were unfamiliar with them made about seven piles (i.e., perceived seven identities).

The impact of familiarity on adults' ability to recognize faces is attributed to familiar and unfamiliar faces differing in the extent to which their representations are image dependent. Whereas familiar faces are characterized as having robust abstract representations allowing recognition across a range of inputs, recognition of unfamiliar faces relies on lower-level image properties and is heavily tied to a specific instance (see Burton, Jenkins, Hancock, & White, 2005; Burton, Jenkins, & Schweinberger, 2011; Hancock, Bruce, & Burton, 2000; Johnston & Edmonds, 2009).

How do adults build a robust representation of a newly encountered face? Exposure to variability in appearance is key (Andrews, Jenkins, Cursiter, & Burton, 2015; Bindemann & Sandford, 2011; Dowsett, Sandford, & Burton, 2016; Menon, White, & Kemp, 2015; Ritchie & Burton, 2017). For example, adults' ability to find a target face in an array of 30 photographs improves as the number of sample images of the target increases from one to six (Dowsett et al., 2016), and their ability to recognize new instances of an identity increases with the variability of images to which they were previously