Neuropsychologia 49 (2011) 2505–2513

Contents lists available at ScienceDirect

Neuropsychologia

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

Training with own-race faces can improve processing of other-race faces: Evidence from developmental prosopagnosia

Joseph DeGutis[a,b,*], Christopher DeNicola[c], Tyler Zink[d], Regina McGlinchey[a], William Milberg[a]

[a] Geriatric Research Education and Clinical Center (GRECC), Boston VA Healthcare System, Jamaica Plain, MA, United States
[b] Vision Sciences Laboratory, Department of Psychology, Harvard University, United States
[c] University of Louisville, Department of Psychological and Brain Sciences, United States
[d] Boston University, Department of Psychology, United States

ARTICLE INFO

Article history:
Received 12 October 2010
Received in revised form 27 April 2011
Accepted 27 April 2011
Available online 6 May 2011

Keywords:
Prosopagnosia/developmental
Continental Population Groups
Discrimination learning
Face
Recognition (psychology)
Visual perception

ABSTRACT

Faces of one's own race are discriminated and recognized more accurately than faces of an other race (other-race effect – ORE). Studies have employed several methods to enhance individuation and recognition of other-race faces and reduce the ORE, including intensive perceptual training with other-race faces and explicitly instructing participants to individuate other-race faces. Unfortunately, intensive perceptual training has shown to be specific to the race trained and the use of explicit individuation strategies, though applicable to all races, can be demanding of attention and difficult to consistently employ. It has not yet been demonstrated that a training procedure can foster the *automatic* individuation of *all* other-race faces, not just faces from the race trained. Anecdotal evidence from a training procedure used with developmental prosopagnosics (DPs) in our lab, individuals with lifelong face recognition impairments, suggests that this may be possible. To further test this idea, we had five Caucasian DPs perform ten days of configural face training (i.e. attending to small spacing differences between facial features) with *own-race* (Caucasian) faces to see if training would generalize to improvements with *other-race* (Korean) faces. To assess training effects and localize potential effects to parts-based or holistic processing, we used the part-whole task using Caucasian and Korean faces (Tanaka, J. W., Kiefer, M., & Bukach, C. M. (2004). A holistic account of the own-race effect in face recognition: evidence from a cross-cultural study. *Cognition, 93*(1), B1–9). Results demonstrated that after training, DPs showed a disproportionate improvement in holistic processing of other-race faces compared to own-race faces, reducing their ORE. This suggests that configural training with own-race faces boosted DPs' general configural/holistic attentional resources, which they were able to apply to other-race faces. This provides a novel method to reduce the ORE and supports more of an attentional/social-cognitive model of the ORE rather than a strictly expertise model.

Published by Elsevier Ltd.

1. Introduction

A consistent and robust finding in the face recognition literature is that faces of one's own race are recognized more accurately than faces of an other race. This has become known as the other-race effect (ORE; for review, see Meissner & Brigham, 2001; Sporer, 2001). The ORE begins to develop in infancy (Ferguson, Kulkofsky, Cashon, & Casasola, 2009; Sangrigoli & De Schonen, 2004) and continues to be influenced by ones environment throughout development and into adulthood. For example, greater contact with members of other races has shown to improve recognition of faces from that race (Hancock & Rhodes, 2008; Sangrigoli, Pallier, Argenti, Ventureyra, & de Schonen, 2005). Own-race faces have been consistently shown to be encoded in a more configural and holistic manner than other-race faces, which may account for some of the greater proficiency with own-race face recognition (Michel, Caldara, & Rossion, 2006; Michel, Rossion, Han, Chung, & Caldara, 2006; Tanaka, Kiefer, & Bukach, 2004; but see McKone, Brewer, MacPherson, Rhodes, & Hayward, 2007 for an exception).

Two predominant models account for the ORE – perceptual expertise and social-cognitive (for a review, see Sporer, 2001). The perceptual expertise model suggests that repeated discrimination, over a period of weeks to years, engages configural and holistic processing and enhances the ability to categorize stimuli, in an automatic manner, at a more subordinate or individual level of categorization (Gauthier, Tarr, Anderson, Skudlarski, & Gore, 1999; Rhodes, Tan, Brake, & Taylor, 1989). With regard to the ORE, this suggests that repeated discrimination of faces of

* Corresponding author at: Geriatric Research Education and Clinical Center (GRECC), Boston VA Healthcare System, Boston, MA 02130, United States.
Tel.: +1 510 734 7705; fax: +1 857 364 4544.
E-mail address: degutis@wjh.harvard.edu (J. DeGutis).

0028-3932/$ – see front matter. Published by Elsevier Ltd.
doi:10.1016/j.neuropsychologia.2011.04.031

one's own race leads to more efficient recruitment of configural and holistic processing to better individuate these faces. One key assumption of expertise theories is that training configural and holistic skills with one race will not generalize to faces of other races, possibly due to featural and structural differences between faces of different races (Zhuang, Landsittel, Benson, Roberge, & Shaffer, 2010). Supporting the expertise account, Kelly et al. (2007) showed that infants at 3 months are able to recognize both own- and other-race faces equally. However, by 9 months they demonstrate a robust advantage for recognizing own-race faces (Kelly et al., 2007), suggesting that the ORE develops with more own-race face experience and, perhaps, perceptual narrowing mechanisms to preferentially process own-race faces. Additionally, Sangrigoli et al. (2005) demonstrated that cross-cultural adoption at a young age abolishes the ORE (for the race of the adopting parents), suggesting that experience individuating other-race faces can overcome children's ORE (Sangrigoli et al., 2005).

In contrast to perceptual expertise theories, social-cognitive theories suggest that the manner in which a face is processed depends on whether the face is perceived as a member of one's in-group or out-group: in-group members are processed more at the individual level and recruit more configural and holistic processes, whereas out-group members are processed less deeply (Hugenberg, Young, Bernstein, & Sacco, 2010) and may even be processed more efficiently at the level of race (Levin, 2000; Ge et al., 2009; though see Rhodes, Locke, Ewing, & Evangelista, 2009). Levin and colleagues (2000) provided initial support for this model, demonstrating that searching for an other-race face among an array of own-race distractors is faster than searching for an own-race face among an array of other-race distractors. This finding suggests that the automatic bias to individuate own-race faces interferes with detecting own-race faces but that other-race faces that are less automatically individuated are easier to detect. Additional evidence from Michel, Corneille, and Rossion (2007) reveals that participants recruit less holistic processing when they perceive the same ambiguous race faces as from an other-race than when they were perceived as from one's own-race (Michel et al., 2007; though see Rhodes, Lie, Ewing, Evangelista, & Tanaka, 2010). Furthermore, in-group/out-group membership has shown to enhance/impair face recognition ability, respectively, in a manner very similar to the ORE: more individuating resources are devoted to in-group members and out-group effects have shown to be reduced with volitional attention (Bernstein, Young, & Hugenberg, 2007). This suggests that the ORE may be a special case of more general in-group/out-group effects (Sporer, 2001).

Over the last 40 years several methods have been employed to enhance processing of other-race faces and reduce the ORE (Elliott, Wills, & Goldstein, 1973; Hills & Lewis, 2006; Hugenberg, Miller, & Claypool, 2006; Tanaka & Pierce, 2009). Most of these methods have been motivated by expertise models and involve mass discrimination of other-race faces. For example, Eliot and Goldstein (1973) showed that after Caucasian participants performed paired associate learning with Asian faces, they significantly improved their ability to recognize novel Asian faces. More recently, Hills and Lewis (2006) improved other-race recognition by training participants, for several hours, to attend to facial features more diagnostic for recognition of other-race faces (such as wider noses in African American faces). Furthermore, Tanaka and Pierce (2009) demonstrated that *individuation* training with other-race faces, but not *categorization* training, can enhance other-race recognition and reduce the ORE. They found improvements in recognition for other-race faces after participants trained for several hours to label individual other-race faces, likely engaging configural/holistic processing. However, there was no improved recognition for other-race faces when participants trained to categorize these faces at the level of race over the same time period. This underscores the importance of active individuation, rather than passive experience, as a mechanism that can both produce or abolish an own-race advantage. Collectively, the effects of these short-term training procedures have shown to be specific to the race of the training faces rather than producing race-general enhancements and support expertise models of the ORE. These effects may be from enhancing attention to configural/holistic information in the trained faces, from tuning configural and holistic perceptual mechanisms to other-race faces (Tanaka & Pierce, 2009), or from enhancing attention to specific areas of the face more diagnostic for individuation (Hills & Lewis, 2006).

In contrast to these intensive training procedures, recent demonstrations suggest that other-race recognition can be enhanced by simply instructing participants to individuate other-race faces (Hugenberg et al., 2006; Rhodes et al., 2009). After participants were explicitly informed about the ORE and instructed to try to individuate other-race faces (Hugenberg et al., 2006), they showed significantly improved recognition of other-race faces, suggesting that volitional attention to individuating aspects of faces can provide a race-general strategy to overcome the ORE. It also suggests that individuals have latent skills to successfully encode and recognize other-race faces, but only utilize these skills when there is enough motivation to do so. One negative implication of this finding is that volitional attention may be required to gain access to these race-general individuation skills, which pits other-race individuation against several other ongoing processes for control of volitional attention (for example, see Knudsen, 2007). In the current study, we investigated whether a face training procedure could create a more automatic bias to attend to configural and holistic aspects of other-race faces, and that similar to Hugenberg's demonstration, if this more automatic bias could create a race-general effect.

Evidence from a training procedure developed in our lab based on configural training with computer-generated faces suggests that this is possible. This procedure was used to enhance the general face recognition ability in an individual suffering from developmental prosopagnosia (DP), a lifelong deficit in learning and recognizing faces (DeGutis, Bentin, Robertson, & D'Esposito, 2007; Duchaine & Nakayama, 2006a). Compared to healthy controls, DPs have been shown to be consistently deficient in using configural (Barton, Cherkasova, Press, Intriligator, & O'Connor, 2003; Carbon, Gruter, Weber, & Lueschow, 2007) and holistic information to individuate faces (Yovel & Duchaine, 2006). Since our initial successful demonstration of using this procedure to improve general face recognition in a single DP, a different DP that successfully completed training reported that she became particularly better at being able to discriminate other-race (Asian) faces in her everyday life. This report was remarkable in that the version of her training only used computer-generated faces with own-race (Caucasian) features. This self-report suggested that our procedure may have created a general bias towards attending to configural and holistic aspects of all faces, including faces from other races.

To further test the idea that own-race training can produce race-general processing improvements and shed more light on the nature of the other-race effect, the current study had five new DPs perform ten days (~40 min/day) of configural face training (as described below) using computer-generated faces with Caucasian features and measured how this affected their perceptual discrimination abilities of Caucasian and Korean faces using the part-whole task (Tanaka et al., 2004). Using the part-whole task allowed us to directly measure holistic processing, the mode of processing that has consistently shown to be recruited more for own-race faces (Michel et al., 2006a, 2006b; Tanaka et al., 2004).

Based on the one DP's self-report, we hypothesized that after training DPs would exhibit enhanced attention to configural and holistic aspects of all faces, including Korean faces. This could either