Journal of Applied Research in Memory and Cognition xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

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

Improving Identity Matching of Newly Encountered Faces: Effects of Multi-image Training

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Humans are error-prone at matching identity in photos of unfamiliar faces, especially in ambient images that incorporate natural variability in appearance. Nonetheless, matching faces to photographs is heavily relied upon in applied settings (e.g., when crossing the border). Whereas past training protocols emphasized discriminating highly similar identities, we incorporated within-person variability in appearance during training and in our identity-matching task. On each of five training days, participants learned six images per each of six identities. Accuracy improved on an identity-matching task for new images of trained identities, with no generalization to different identities. Experiment 1b suggests that learning multiple images of each identity was key; we found no significant improvement when training involved learning a single image of 12 identities. Collectively, our results have implications for understanding the process of face learning and improving recognition in applied settings.

General Audience Summary

Two photos of the same person can look very different; likewise, photos of two different people can look very similar. Making identity judgements (e.g., do these photos belong to the same person or two different people?) can be very challenging when viewing unfamiliar faces, especially when the face is of a different race than the perceiver. These decisions are made daily in a variety of settings and so improving accuracy is important. We trained people to recognize six images of six previously unfamiliar people on each of five training days. Pre- and post-training we administered a task in which observers made same/different judgements for both trained and wholly unfamiliar faces. Post-test performance was more accurate than pre-test performance for trained, but not untrained, identities. A follow-up study suggests that incorporating multiple images of each person is key to improved performance; training people to recognize one image of twelve people on each of five training days provided no benefit. Our results have implications for models of face learning and forensic settings.

Keywords: Identity matching, Face training, Perceptual learning

Humans are often required to verify identity by matching photo identification to unfamiliar faces; professionals (passport officers, bartenders) need to detect when the photo identification does not match the bearer (to discriminate between identities) and recognize when the identification is valid despite changes in the bearer's appearance. Society's reliance on photo identification stems from the ease with which we recognize images of familiar people. Familiar face recognition is highly accurate despite distortions to the face (Hole, George, Eaves, & Rasek, 2002), poor viewing conditions (Burton, Wilson, Cowan, & Bruce, 1999) and variability in appearance (Jenkins, White, Van Montfort, & Burton, 2011). However, humans are highly error-prone when judging unfamiliar faces, even when viewing two highly similar photographs (e.g., Bruce et al., 1999; Bruce, Henderson, Newman, & Burton, 2001; Burton, White, & McNeill, 2010; Kemp, Towell, & Pike, 1997; Megreya & Burton, 2006, 2008; Megreya, Sandford, & Burton, 2013). Unconstrained

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This research was funded by an NSERC Discovery Grant awarded to C. J. Mondloch. We thank Kathryn Bunda for her assistance with organizing and testing the participants and Tom Nelson for his outstanding programming skills.

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Please cite this article in press as: Matthews, C. M., & Mondloch, C.J. Improving Identity Matching of Newly Encountered Faces: Effects of Multi-image Training. *Journal of Applied Research in Memory and Cognition* (2017), https://doi.org/10.1016/j.jarmac.2017.10.005

within-person variability in appearance (e.g., changes in lighting, expression, makeup, pose, age) makes identity matching even more challenging; when asked to sort 40 ambient images of two unfamiliar faces, participants perceive about seven different people to be present (Jenkins et al., 2011). Even trained professionals (passport officers) are error-prone at matching the identity of unfamiliar faces (White, Kemp, Jenkins, Matheson, & Burton, 2014; but see White, Phillips, Hahn, Hill, & O'Toole, 2015 for evidence that forensic face examiners are more accurate).

Given the serious consequences of such errors in forensic contexts (e.g., allowing an imposter to cross the border or preventing an innocent person from returning home), developing protocols to improve unfamiliar face matching is imperative. We aimed to create a training protocol to improve matching the identity of newly learned faces and tested the generalization of that training to wholly unfamiliar identities—the challenge faced daily by professionals.

Research designed to improve identity matching has produced mixed results. Training participants to recognize identities based on face shape yielded no benefit (Towler, White, & Kemp, 2014). Trial-by-trial feedback improved participants' performance on a simultaneous matching task, but training only transferred to new face pairs for low performing participants (White, Kemp, Jenkins, & Burton, 2014). Training participants to recognize identities across different poses improved recognition across different illuminations (Liu, Bhuiyan, Ward, & Sui, 2009) and expressions (Chen & Liu, 2009), but training across illuminations or expressions did not generalize to different poses. To date, only feature-comparison based training comparable to that received by many forensic examiners benefitted face recognition (Towler, White, & Kemp, 2017).

Although variability in appearance poses a challenge to recognizing unfamiliar faces, exposure to such variability is a route to learning both in the lab (Andrews, Jenkins, Cursiter, & Burton, 2015; Bindemann & Sandford, 2011; Dowsett, Sandford, & Burton, 2016; Menon, White, & Kemp, 2015a, 2015b; Murphy, Ipser, Gaigg, & Cook, 2015, Ritchie & Burton, 2017) and in daily life (see Burton, Kramer, Ritchie, & Jenkins, 2016). In Ritchie and Burton's study participants learned 10 images of 20 people; the images contained either high or low variability in appearance. Participants in the high-variability condition recognized new images of these identities more accurately. This improvement is attributed to the formation of an abstract representation that facilitates recognition of it across new instances (White, Burton, Jenkins, & Kemp, 2014). In these studies, the learning observed was identity-specific (i.e., it did not generalize to novel identities), consistent with research suggesting that within-person variability is idiosyncratic in nature (Burton et al., 2016). Although these findings are well established for own-race faces, the influence of exposure to variability in appearance has not been studied with other-race faces. It is important to study learning of other-race faces because they pose even greater difficulty to perceivers (see Meissner & Brigham, 2001; Laurence, Zhou, & Mondloch, 2016), providing a sensitive measure of the effectiveness of exposure to variability in appearance.

Here we developed a more extensive training protocol with a unique combination of features: participants (a) learned 30 different identities; (b) learned multiple images of each identity to criterion and (c) were trained over several days. Furthermore, we trained participants with other-race faces. Developing a training protocol with other-race faces has distinct advantages. Whereas adults have a life-time of experience discriminating and recognizing own-race faces despite natural within-person variability in appearance, they have much less experience doing so with other-race faces. Consequently, eyewitness misidentifications (see meta-analysis by Meissner & Brigham, 2001) and wrongful convictions (Innocence Project, 2016) increase when the witness and suspect are of different races. In laboratory studies, other-race faces are harder to remember than own-race faces in both old/new recognition (e.g., Golby, Gabrieli, Chiao, & Eberhardt, 2001; MacLin & Malpass, 2001; Wright, Boyd, & Tredoux, 2003) and eyewitness lineup paradigms (e.g., Evans, Marcon, & Meissner, 2009; Jackiw, Arbuthnott, Pfeifer, Marcon, & Meissner, 2008; Meissner, Tredoux, Parker, & MacLin, 2005). They also are harder to match in perceptual tasks (Megreya, White, & Burton, 2011; Meissner, Susa, & Ross, 2013; Mondloch et al., 2010), especially when images capture within-person variability in appearance (Laurence et al., 2016). Finally, learning new other-race faces appears particularly difficult (Hayward, Favelle, Oxner, Chu, & Lam, 2017).

The difficulty with which identity is perceived in other-race faces means that other-race face matching is likely to be most sensitive to any effects of training. Simultaneously, it provides a strong motivation for developing an effective training protocol; improved performance in this worse-case scenario would provide evidence of the protocol's effectiveness.

To date, the very few attempts to improve recognition of other-race faces used tightly controlled stimuli (created by swapping features and with only one image representing each identity). Tanaka and Pierce (2009) trained participants to individuate eight unfamiliar other-race faces over five days. These participants showed improved recognition of unfamiliar faces in an old/new recognition task compared to controls who simply categorized faces (Tanaka & Pierce, 2009) or made eye-luminance judgments (McGugin, Tanaka, Lebrecht, Tarr, & Gauthier, 2011). Their protocol emphasized image discrimination; the challenge of recognizing identity across changes in appearance was ignored (Burton, 2013).

We designed a novel and extensive training protocol that emphasizes identity matching across changes in appearance using other-race faces as stimuli. Participants were trained to individuate six images of six other-race identities on each of five training days. Identity matching was assessed using a same/different task before and after training using novel images of the trained identities. We used two measures to investigate whether training generalized to novel faces. First, we included images of untrained identities in both the pre- and post-test; generalization would be evident if performance increased from pre- to post-test for both trained and untrained identities. Second, we assessed whether the number of errors made on each day of training decreased across the five days; generalization would be evident if it did.

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