The other-race effect in face learning: Using naturalistic images to investigate face ethnicity effects in a learning paradigm

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RUNNING HEAD: THE OTHER-RACE EFFECT IN FACE LEARNING

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Abstract

The other-race effect in face identification has been reported in many situations and by many different ethnicities, yet it remains poorly understood. One reason for this lack of clarity may be a limitation in the methodologies that have been used to test it. Experiments typically use an old-new recognition task to demonstrate the existence of the other-race effect, but such tasks are susceptible to different social and perceptual influences, particularly in terms of the extent to which all faces are equally individuated at study. In this paper we report an experiment in which we used a face learning methodology to measure the other-race effect. We obtained naturalistic photographs of Chinese and Caucasian individuals, which allowed us to test the ability of participants to generalize their learning to new ecologically valid exemplars of a face identity. We show a strong own-race advantage in face learning, such that participants required many fewer trials to learn names of own-race individuals relative to other-race individuals, and were better able to identify learned own-race individuals in novel naturalistic stimuli. Since our methodology requires individuation of all faces, and generalization over large image changes, our finding of an other-race effect can be attributed to a specific deficit in the sensitivity of perceptual and memory processes to other-race faces.

People commonly report that members of ethnicities different from their own are difficult to identify and remember. This effect, termed the "other-race effect" (e.g., Brigham & Malpass, 1985; Chance & Goldstein, 1996; Hayward, Crookes, & Rhodes, 2013; Meissner & Brigham, 2001), has been widely studied and verified across a broad range of cultures. The effect does not seem to stem from members of one ethnic group being physically more similar to each other, but rather from the way in which observers process different types of faces perceptually and cognitively. Thus, individuals raised in Caucasian-dominant countries often have greater difficulty remembering Chinese faces than Caucasian faces, whereas people who have grown up in Asian-dominant countries show the opposite result (e.g., Hayward, Rhodes, & Schwaninger, 2008; Michel, Caldara, & Rossion, 2006; Michel, Rossion, Han, Chung, & Caldara, 2006). These results suggest that explanations for the other-race effect rest in the psychology of the perceiver, rather than in the properties of a set of faces themselves.

Although the other-race effect has been demonstrated in many different situations, its basic cause is not yet clear. An early conjecture was that the effect was due to a lack of experience or *expertise* at recognizing other-race faces (e.g., Rhodes, Tan, Brake, & Taylor, 1989). For example, a Chinese person raised in Hong Kong may have had much more experience at recognizing and identifying Chinese faces than the faces of people from other ethnic groups, and therefore this person's face perception processes are likely to be optimized for individuating Chinese faces. Support for this view comes from studies showing that the other-race effect becomes weaker as people gain more experience at recognizing other-race individuals (Meissner & Brigham, 2001; Rhodes, Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009), or as they are trained on configural aspects of an other-race face that are thought to be helpful for identification (Lebrecht, Pierce, Tarr, & Tanaka, 2009).

More recently however, another potential cause of the other-race effect has been proposed. Research on *social categorization* has shown that people are predisposed to classify other in-group members at an individual level, but out-group members at the group level (e.g., Levin, 1996, 2000; Sporer, 2001; Taylor, Fiske, Etcoff, & Ruderman, 1978). Hugenberg and colleagues (e.g., Bernstein, Young, & Hugenberg, 2007; Hugenberg, Young, Bernstein, & Sacco, 2010) extended this logic, arguing that when an observer sees someone that they consider part of "their" group, they will be likely to encode aspects of the face that provide individuating information; however, when they see someone from a "different" group, they may automatically encode features of the face that specify the group, rather than individual, identity. Clearly, such a strategy would serve the observer poorly if they were then asked to recognize any of the individuals, since they would have only encoded sufficient information for that task for members of "their own" group.

The potential influences of expertise and social categorization on the other-race effect are not mutually exclusive and could conceivably work in complementary fashion (e.g., Young & Hugenberg, 2012). However, social categorization provides an explanation for judgments of familiarity, which is only one aspect of the other-race effect as it is manifested in the real world. The practical difficulties that people report in encounters with individuals of other ethnicities extend beyond mere recognition to the learning of names and personal characteristics of such individuals. For example, the time taken to learn someone's name, and then extending that knowledge of the individual to new situations and appearances, does not seem well explained by an automatic tendency to individuate members of some groups over others, since the act of name learning itself requires individuation.

For these same reasons, it seems important to extend measurement of the other-race effect beyond simple old-new recognition. The extensive use of the old-new recognition task in the literature likely has multiple causes, in particular due to its high validity as a psychophysical methodology (allowing for bias-free measures of memory sensitivity, for example) and its similarity to eyewitness identification via a lineup containing a suspect and multiple foils. Notwithstanding the strengths of the task, requiring participants to study faces simply for the purposes of making a decision as to whether a test face has been seen before overlooks a great deal of the real-world experiences associated with recognizing faces. As demonstrated by other studies from this volume (see also, Rhodes & Byatt, 1998), much of our time spent processing faces comes from situations when an observer is learning an individual's personal characteristics such as their name. This process builds over time and requires strong individuation of each face. In the real world, it also requires the observer to generalize over different appearances of the person. Developmental work has shown that infants naturally learn to individuate unfamiliar stimuli like monkey faces if the faces are associated with individual, as opposed to categorical, labels (Scott & Monesson, 2009, 2010). However, few studies have sought to test whether the other-race effect is captured in attempts to learn names for own-race and other-race faces. One such study was conducted by Longmore, Liu, & Young (2008); participants in their study learned names for own-race and other-race faces, where exemplar images of the same individual might vary in viewpoint and lighting. In a test after all participants had reached a criterion for successful name learning, Caucasian participants were no better at reporting names for own-race than other-race faces. Although this study did not find an advantage for learning own-race over other-race faces, few other studies of the other-race effect have adopted learning methodologies, and so more specific investigation of this issue appeared warranted.

We adopted a face learning approach to the other-race effect in the current study. Rather than passively viewing faces and then measuring memory within a signal detection framework, we required participants of two different ethnicities (each living in locations where their ethnicity was dominant) to learn names for eight individuals of the same ethnicity, sex, and age, and then generalize that learning to new photographs of these same individuals. Face images had high ecological validity, showing each individual across a large range of natural appearances, thus requiring highly realistic generalization (see for example, Megraya, et al., 2011; Meissner et al., 2013; Laurence et al., 2015). Using this framework, we were able to assess a number of different indicators of learning. First, during two different learning phases, we were able to measure the time it took to learn faces to criterion, with the hypothesis that participants would take fewer trials to reach the learning criterion for own-race faces relative to other-race faces. Second, we assessed the generalization of learning by asking participants to identify previously unseen exemplars in a final test. In this test phase, we predicted more accurate responses for individuals of the same ethnicity as the participants, relative to those of different ethnicities.

Method

Participants. In this experiment we tested 32 participants, of whom 16 were ethnically Caucasian and lived in Australia (tested at the University of Wollongong) and 16 were Chinese and lived in Hong Kong (tested at the University of Hong Kong). They were given a small amount of money as compensation for their participation. The duration of the experiment varied, depending upon the speed with which participants successfully learned the faces; however, all were paid the same amount, so that there was no incentive to take longer (by making learning errors).

Materials. We contacted eight men and eight women of each ethnicity (Caucasian and Chinese), and gained permission from them to download photographs depicting them from their Facebook photo albums. All were young adults. We verified the identity of the individual depicted in each image as the account owner using the Facebook tagging tool. Experimenters then chose appropriate photos, which were then cropped and edited. Independent raters then judged these images based upon their within-identity similarity (i.e., "Looks much like person" - "Looks very unlike person"). Finally, we selected five images of each identity that fell in the middle of this spectrum, and were therefore not too easy or difficult to associate with a particular identity. We converted each image to grayscale (to remove colour cues), placed an oval around the face of the individual and turned everything else in the image to black, and then standardized the size of the image to 400 x 300 pixels. Size of the face, expression, and placement of the face within the image were not controlled. Gaze direction was also not controlled, although most images showed the face looking at the camera. See Figure 1 for examples of the stimuli.

Figure 1 about here

Design. There were two dependent variables: number of trials to achieve learning criterion in the learning phases, and accuracy rate in the test phase. For both dependent variables we included a within-participant independent variable of face race (own-race or other-race). For the number of trials to reach criterion, we had an additional within-participant independent variable of Block (there were two learning blocks that occurred after the initial face introduction block). There was one between-participants variable, which was race of participant (Caucasian or Chinese).

Procedure. Participants were tested at the University of Wollongong and the University of Hong Kong. Participants were instructed that they would learn faces for which they would initially be given names, but for which they would later be just shown faces and be asked to report the name. There were four blocks, one for each combination of race and sex (that is, one block for Chinese females, one for Chinese males, one for Caucasian females, and one for Caucasian males). Order of blocks was counterbalanced with a Latin Square. Each block started with an initial phase to introduce the eight individuals, using a single face image of each. The face was presented for two seconds, along with a name that was placed under the face. Each name started with a letter on the middle row of the keyboard (A, S, D, F, G, H, J, K). Different names were used in the four blocks; see the Appendix for details.

After this introduction phase, the first learning phase occurred. In this phase, the same eight images from the introduction phase were again shown, but this time without a name. Participants were required to report the first letter of the correct name using the keyboard. If they made an error, they were shown the correct name. Each face was displayed until participants made a response. The eight faces were presented consecutively in a randomised order, cycling through to a new randomised order every time one sequence was completed. This first learning phase continued until participants made sixteen consecutive correct responses. The number of trials it took each participant to reach criterion was recorded.

The second learning phase occurred immediately after the first learning phase. Participants were informed that two new images (and only those new images) of each person they had just learned would be displayed, and they should continue to report the correct identity. Each new face (two per identity) was presented on a separate trial. No names were presented with faces in this phase (unless they made an error). This phase was again completed when participants made sixteen consecutive correct responses.

After the two learning phases, the final part of each block was a test phase. Participants were informed that they would see two more new images of each individual that they had already learned (i.e., 16 new images), and again they should press the key that corresponded to the correct name. As in the previous phase, each face was presented separately. Unlike the learning phases, photographs in this phase were presented only once and no feedback was given after each response. The accuracy of responses was recorded in this phase.

Upon the completion of each block, participants were given a short break, and then began a new block. They completed all four blocks within a single session.

Results

Figure 2 about here

Learning phases. The number of trials each participant took to reach the learning criteria in the two learning phases were subject to a three-way mixed analysis of variance (ANOVA), with independent variables of participant race (between), face race, and learning phase (both within). Results can be seen in Figure 2. The main effect of face race was significant, $F(1,30)=66.1$, $MSe=4318.2$, $p<.001$, $\eta_p^2=.69$, due to markedly quicker learning performance for own-race than other-race faces. The main effect of phase was significant, $F(1,20)=14.23$, $MSe=3226.4$, $p<.001$, $\eta_p^2=.32$, showing that participants took longer to reach criterion in the second learning phase than the first learning phase; this was not surprising given that they were learning two novel face images rather than one previously seen image. The main effect of participant race was not statistically significant, $F(1,30)=3.0$, MSe=11325.3, $p=.092$, $\eta_p^2=.09$, showing that both groups of participants learned the faces at similar rates, although the Australian participants took longer numerically. No interactions were statistically significant; participant race x face race, $F(1,30)=2.7$, MSe=3226.4, $p=.113$, $\eta_p^2=.081$; all others F<1.

An equivalent analysis using the raw number of incorrect responses generated in each block (rather than the total number of trials to reach criterion) showed a similar pattern of results, with no meaningful differences from the analysis reported above.

Test accuracy. Accuracy of name identification for photographs in the test phase were subject to a two-way mixed ANOVA. Participant race was again the between-participants variable, and face race was a within-participants variable. Results can be found in Figure 2. The pattern of results closely matched the time taken to reach criterion in the learning phases. The main effect of face race was statistically significant, $F(1,30)=21.6$, $MSe=0.05$, $p<.001$, $\eta_p^2=.42$, showing more accurate identification of own-race individuals. The main effect of participant race was not significant, *F<1,* showing that performance of the two groups was very similar in the test. The interaction of participant race and face race was marginally significant; $F(1,30)=3.6$, $MSe=0.05$, $p=.067$, $\eta_p^2=.11$. Although not meeting the criterion for statistical significance, this result shows some indication of a larger difference between own-race and other-race faces for Caucasian participants compared to Chinese participants in the novel face test.

Discussion

In this experiment, we wanted to test whether we could demonstrate the other-race effect using a face-learning paradigm with ecologically valid stimuli. We attempted to create a highly realistic learning situation within the laboratory. We used a range of photos with considerable variations in size, position, occlusion, and expression. We required participants to successfully individuate faces in order to complete each block so that the potential effects of social processes (that might induce a tendency to individuate some faces more than others) would be reduced. Finally, we measured performance using two very different dependent variables. Despite all these variations from typical investigations of the other-race effect, we found strong and robust performance advantages for faces that matched the participants' own ethnicity. We believe that this finding has considerable significance because it demonstrates that expertise with ethnicity can influence the processes involved in acquisition of knowledge about a face, rather than simply judgments of face familiarity.

This result is at odds with a previous study by Longmore, et al. (2008), in which no other-race effect was found in naming recently learned own-race and other-race faces. There are several differences between our study and that of Longmore et al. that help explain this difference. First, we measured the number of exposures taken to learn names, whereas Longmore et al. simply measured performance in a final test once a learning criterion had been met (although we used a similar test in addition to our learning measure). Second, we required greater generalization since the different photographs we used were uncontrolled. Third, we ensured that stimulus differences could not influence our results since we used two different participant ethnicities. Finally, it is possible that the test used by Longmore et al. was simply insensitive to race differences in identification.

Our result seems difficult to explain on the basis of social categorization effects, and differences in natural tendencies to individuate in-group and out-group faces. Such effects are thought to be response-based and not to reflect memory sensitivity. For example, Hugenberg, Miller, and Claypool (2007) demonstrated that an own-race advantage in memory sensitivity for White participants examining White and Black faces was eliminated by giving the White participants an instruction to individuate all faces (and background information on how differences in individuation might underlie the other-race effect). Similarly, our experiment induced participants to individuate faces, not by giving a specific instruction but rather as an intrinsic aspect of the task itself. Further, participants' time spent in the laboratory was minimized by successful individuation, and since they gained no extra reward by taking longer on the task, a cost-benefit analysis was maximized by successful individuation. But whereas Hugenberg, et al. found that individuation eliminated their effect, we found a robust other-race effect despite our incentives for individuation. What might account for this apparent discrepancy?

Several differences exist between our experiment and those of Hugenberg, et al. (2007). Apart from the differences in task (name learning vs old-new familiarity), the studies are also differentiated by the variability, or lack thereof, of studied images over the course of the experiment. We employed five highly variable photographs of each individual and required participants to generalize across them. Hugenberg, et al. used one single photograph of each target individual, repeating it between study and test. Thus, when given the instruction to individuate the faces, participants would have been successful with a strategy that focused on small, image-specific aspects of the stimuli, since that information would be available in the test. In contrast, such an image specific strategy would have been unsuccessful in our experiment as we were constantly introducing new stimuli, and in the final test participants encountered novel stimuli only once to eliminate any image-specific learning. Previous research shows that a requirement to generalize over image-specific details typically enhances the other-race effect (e.g., Meissner & Brigham, 2001; Sporer & Horry, 2011).

Of course, it is impossible to rule out any influence of social categorization. Our experimental task set up a situation in which participants' motivation was to individuate all faces, and this allowed us to compare our results with those of Hugenberg, et al. (2007), who did a similar manipulation. However, it is possible that some social influences may be outside of conscious control, and may continue to influence identification judgments. We note that such influences are likely impossible to separate from perceptual and cognitive limitations, and therefore have limited explanatory power.

Our study demonstrates that the other-race effect can be observed in the speed with which faces are learned, and in the generalization of that learning to new exemplars, two aspects of face memory that are often experienced in real life. As such, we believe that our methodology provides a useful framework with which to broaden our understanding of the other-race effect. Many face memory researchers have, in recent years, stressed the recognition of familiar faces as the key problem to be solved in the field (e.g., Burton, 2013; Sandford & Burton, 2014). The mechanisms by which faces become familiar are not well captured by the old-new memory paradigm, despite its valuable psychophysical properties. Studies in the current volume, including our own, have a much stronger claim to the basis by which faces go from being unfamiliar to specifying a person about whom we know much semantic information, including their name. As such, we believe that a face learning approach represents a key aspect of the other-race effect that has not been widely studied up to this point. We hope with this paper to encourage other researchers to investigate the nature of ethnicity differences in face processing using measures during and after faces have been successfully learned. We hope that over time this approach will give us a fuller understanding of the other-race effect in face memory.

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Appendix: Names used in each block

Males

A. Alan, Stephen, David, Felix, Gordon, Henry, Jimmy, Kelvin
B. Andy, Simon, Derek, Frankie, Gary, Howard, Joseph, Kenneth

Females

A. Amy, Sarah, Donna, Frances, Gloria, Hilda, Joanne, Karen
B. Annie, Shirley, Doris, Florence, Gladys, Helen, Janice, Kelly

Figure Captions

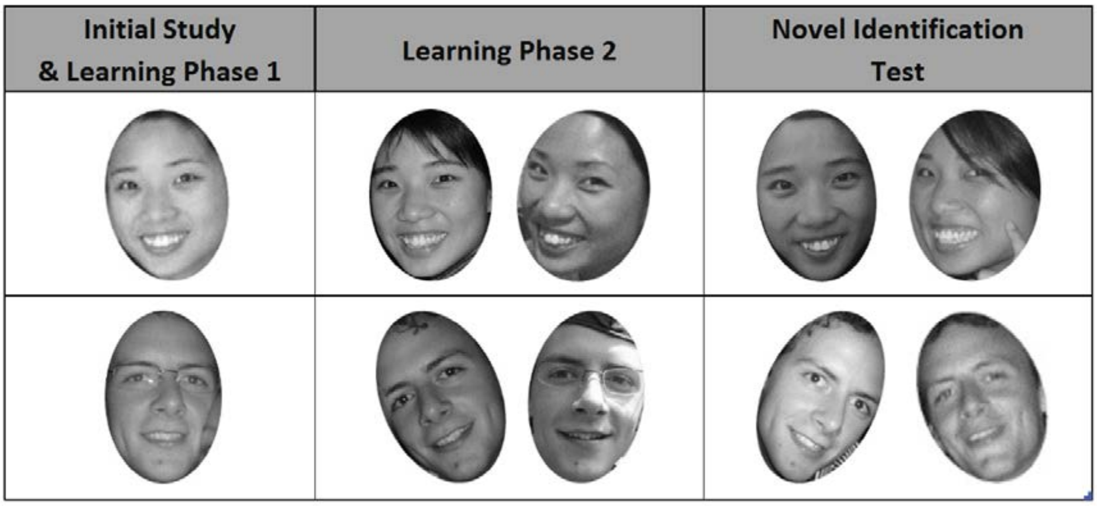

Figure 1. Example faces used in the experiment, showing images used in each phase. Note that considerable generalization across exemplars of each face was required.

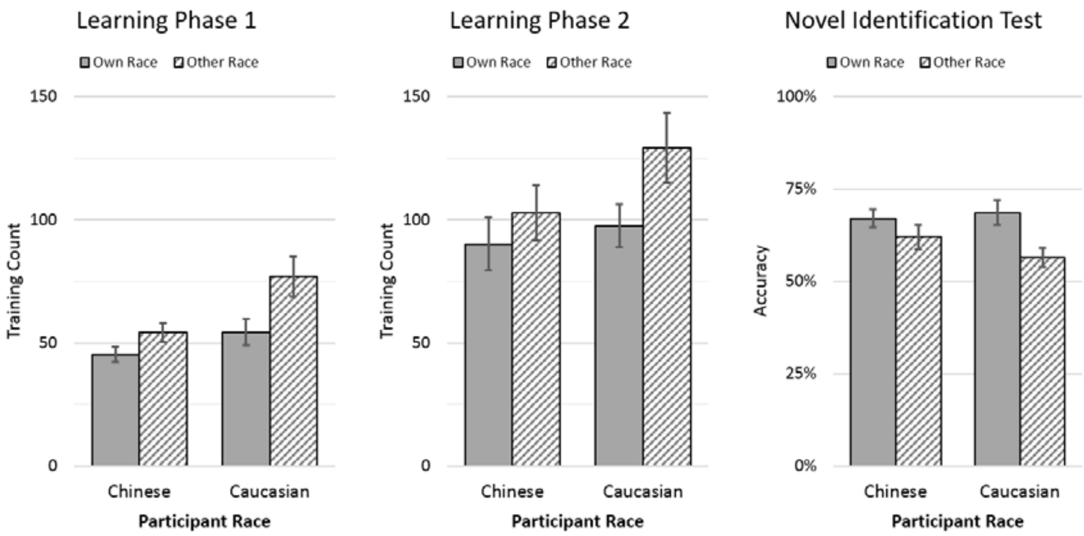

Figure 2. Performance in Learning Phase 1, Learning Phase 2, and Test Phase. The first two graphs show average number of trials to reach learning criterion. The final graph shows percentage accuracy at naming novel exemplars. Error bars show the standard error of the mean.