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An encoding advantage for own-race versus other-race faces

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Abstract. Studies have shown that individuals are better able to recognise the faces of people from their own race than the faces of people from other races. Although the so-called own-race effect has been generally regarded as an advantage in recognition memory, differences in the processing of the own-race versus other-race faces might also be found at the earlier stages of perceptual encoding. In this study, the perceptual basis of the own-race effect was investigated by generating a continuum of images by morphing an East Asian parent face with a Caucasian parent face. In a same/different discrimination task, East Asian and Caucasian participants judged whether the morph faces were physically identical to, or different from, their parent faces. The results revealed a significant race-of-participant by race-of-face interaction such that East Asian participants were better able to discriminate East Asian faces, whereas Caucasian participants were better able to discriminate Caucasian faces. These results indicate that an own-race advantage occurs at the encoding stage of face processing.

1 Introduction

Anecdotally, people claim that it is easier to recognise individuals from their own racial group than it is to recognise individuals from an unfamiliar racial group. Experimentally, the own-race effect has been tested and validated under a wide variety of experimental conditions (Barkowitz and Brigham 1982; Bothwell et al 1989; Kassin et al 1989; Lindsay et al 1991; Yarmey and Jones 1983). For instance, the own-race advantage has been shown in memory experiments with a retention interval as short as 2 min (O'Toole et al 1994) and as long as 4 days (Slone et al 2000). Employing an eyewitness memory paradigm, Wright et al (2001) found that South African and British participants were better able to identify suspects from a crime scene if they were from their own race than if they were from a different race.

The own-race effect does not seem to be attributable to the physiognomy of a particular racial group given that this advantage has been shown to be independent of the race of the participant and the race of the face. For example, in an experiment where identical sets of Asian and Caucasian stimulus faces were tested, Caucasian participants demonstrated a recognition advantage for Caucasian faces, whereas Asian participants showed superior recognition for Asian faces (O'Toole et al 1994). The robustness of the own-race effect has been substantiated by meta-analytic studies (Bothwell et al 1989; Meissner and Brigham 2001) where the own-race advantage has been demonstrated across a broad range of experiments. Thus, over two decades of research have validated the claim that people are better at recognising faces from their own racial group than faces from other racial groups.

The most straightforward account of the own-race effect is that people have more exposure to members of their own racial group relative to individuals outside of their

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racial group. According to the 'contact hypothesis', the own-race effect is not attributable to racial factors per se, only that a person's race is a useful indicator of own-race experience. Thus, the own-race effect can be explained in terms of the differential experience a person has with their own racial group compared to other racial groups (Brigham and Barkowitz 1978; Cross et al 1971; Malpass and Karvitz 1969; Slone et al 2000).

One prediction of the contact hypothesis is that individuals with more interracial experience will show a diminished own-race advantage (ie the relative difference between own-race and other-race recognition will be reduced) in comparison to individuals with less interracial experience. Consistent with this prediction, several studies have shown that individuals with more other-race contact (particularly recent contact) demonstrate improved recognition for other-race faces (Brigham et al 1982; Carroo 1986; Chiroro and Valentine 1996; Slone et al 2000). However, the evidence in support of the contact hypothesis has been mixed. Cross et al (1971) found Caucasian children from segregated neighbourhoods displayed a greater own-race face advantage than did Caucasian children from integrated neighbourhoods, but the same was not true for African-American children from segregated and integrated neighbourhoods. Other studies (Brigham and Barkowitz 1978; Luce 1974; Malpass and Kravitz 1969) have also found no correlation between reported interracial contact and recognition for other-race faces. Therefore, the measure of contact with other-race individuals is not necessarily a reliable predictor of how well other-race faces will be recognised.

To date, the own-race advantage has largely been shown as a bias in recognition memory where own-race faces were more accurately identified than other-race faces over retention intervals ranging from a few minutes to several days. However, it remains an open question whether an own-race advantage exists at the earlier stage of perceptual encoding. In one test of the encoding hypothesis, Caucasian and African-American participants were asked to identify Caucasian and African-American faces immediately following their tachistoscopic presentation (Lindsay et al 1991). Caucasian participants recognised Caucasian faces better than African-American faces whereas African-American participants recognised Caucasian and African-American faces equally well. Thus, in a task where the memory load was significantly reduced, Caucasian participants nevertheless demonstrated an encoding advantage for own-race versus other-race faces. The own-race recognition advantage can be regarded as a type of visual expertise such that objects in the domain of expertise—in this case own-race faces—become more differentiated as a consequence of perceptual experience [see Goldstone (1998) for a discussion of perceptual learning and expertise]. As own-race experts, individuals see faces from their own race as perceptually more distinctive and unique than individuals with less experience who view the same faces as perceptually more homogeneous.

The central goal of this experiment was to directly examine whether own-race faces are perceived as more differentiated than other-race faces by using a same/different sequential matching task. Following the technique applied in previous face-perception studies (Beale and Keil 1995; Calder et al 1996; Levin 2000), an East Asian parent face and a Caucasian parent face were morphed together generating a continuum of Asian-to-Caucasian morph faces. East Asian or Caucasian participants viewed either an East Asian or Caucasian parent face, followed by a mask and then either the same parent face (a 'same' trial), or an Asian–Caucasian morph face (a 'different' trial). The participants judged whether the two faces were the same or different. The main prediction is that individuals would exhibit an own-race preference such that they would be better able to detect differences in own-race faces than other-race faces. The same/different matching task provides a good test of the perceptual encoding advantage because it requires very little memory processing.

As a measure of the exposure to other-race individuals, participants completed the Social Experience Questionnaire (Brigham and Meissner 2001) to determine their level of other-race contact in past and present situations. It was expected that other-race experience would act as a predictor for participant accuracy on the other-race-face discrimination task. Those individuals with greater other-race experience should perform better on the perceptual discrimination task than individuals with less other-race experience.

2 Method

2.1 *Participants*

Participants were seventy-two Caucasian undergraduate students from Oberlin College, Ohio, USA and thirty-eight Asian undergraduate students from the University of Victoria, Canada. Ninety of these participants were enrolled in an introductory psychology course and received experimental credit for their participation, and the remaining twenty participants were paid for their participation. The Asian participants were East Asian international students studying in Canada or immigrants to Canada. Sixty-seven of the participants were females (forty-three Caucasian and twenty-two Asian) and forty-three participants were males (twenty-seven Caucasian and sixteen Asian).

2.2 *Stimuli and materials*

Photographs of eighty-seven college-aged, male and female, Caucasian and East Asian individuals were taken with a digital camera. The individuals were photographed in a frontal pose in a neutral expression at a distance of 75 cm. Of the eighty-seven individuals photographed, twenty faces (five East Asian males, five East Asian females, five Caucasian males, and five Caucasian females) that contained no facial hair or glasses and little hair covering the forehead were selected as face stimuli. The face images were converted to gray-scale and hair and clothing information was removed with Adobe Photoshop™ graphics program. The faces were then scaled to an image size of 339×400 pixels. Two of the unselected faces (one male, one female) were inverted and tiled in Photoshop™, and used as masking stimuli.

The twenty faces were paired according to gender (each Caucasian male face with an East Asian male face; each Caucasian female face with an East Asian female face). With the program Morph 2.5, face pairs were averaged together on a linear continuum, equivalent to a process described by Beale and Keil (1995). Key points for facial features were kept constant, with 12 points on the mouth, 7 points on each eye, 9 points on the nose, 5 points on each eyebrow, and 22 points for the outline of the face. In the morphing process, a Delauny tessellation technique was applied to which neighbouring control points were connected to form non-crossing triangular regions on a planar surface. The triangular regions were optimised such that pixels within a given region were closer to the control points at the vertices of the triangle than to any other control points on the surface. Applying a warping algorithm, control points for the morph face were generated by moving 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, and 90% of the total distance along the vector that connected corresponding control points in parent face 1 and parent face 2. The locations of intervening pixels were linearly interpolated across the surface on the basis of the position of the nearest control point (Wolberg 1990). A fade process was then employed in which the brightness values for each corresponding pixel were weighted according to the contribution of each parent image.

The morphing method generated a gradient of morph faces of 10/90, 20/80, 30/70, 40/60, 50/50, 60/40, 70/30, 80/20, 90/10 where the numerator indicated the percent contribution to the morph face from the East Asian parent and the denominator indicated the percent contribution from the Caucasian parent (see figure 1). Faces subtended 11 deg and 7 deg in the vertical and horizontal dimensions, respectively. Face stimuli were presented on a computer monitor with a resolution of 72 dots per inch. Parent and morph faces were displayed in Superlab. Each trial in Superlab consisted of a parent face, followed by a mask, then either the same face ('same' trial) or a morph face ('different' trial).

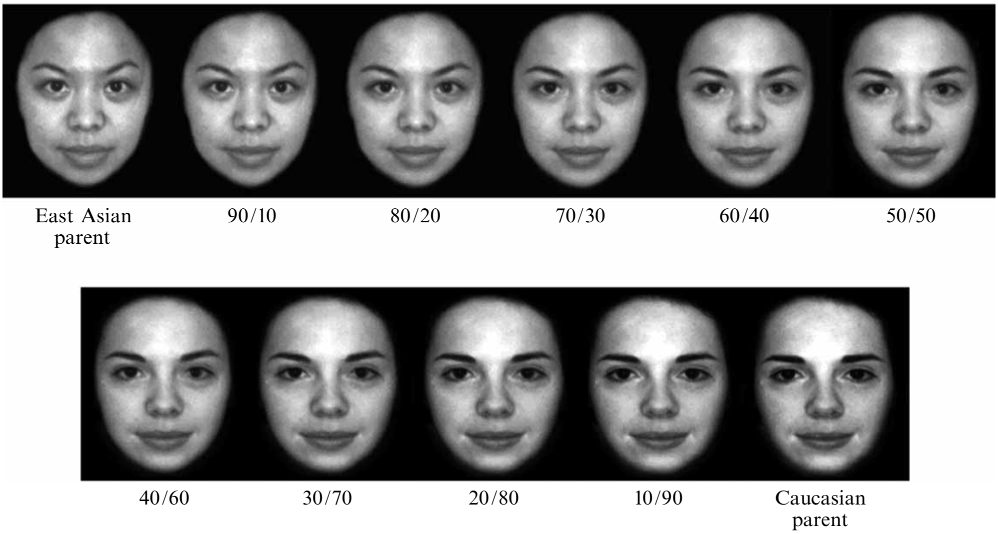

Figure 1. Example of the continuum of morph faces produced by image averaging of an East Asian and Caucasian face pair. The numerator indicates the percent contribution to the morph face from East Asian parent and the denominator indicates the percent contribution from the Caucasian parent, so that morph faces in the continuum were produced in 10% intervals.

The Social Experience Questionnaire (Brigham and Meissner 2001) used in this study contained 15 questions which sought to determine the participants' relative exposure to the other race. Participants were asked about the number of other-race individuals that attended their schools, grew up in their neighbourhoods, and were in their group of friends (with regards to both social intimate and non-intimate situations). For example, participants were asked to answer on a scale of 0 – 9 "how any of your nine closest friends in high school were of the other-race (East Asian/Caucasian)?" or, "how many Caucasians/East Asians do you have conversations with a week during recreational activities (sports, parties, clubs, etc)?". Caucasian participants were asked about their exposure to East Asians, and East Asian participants were asked about their exposure to Caucasians.

2.3 *Procedure*

At the beginning of each trial, the participant viewed an Asian or Caucasian parent face for 1 s that was then masked for 1 s and followed by either the same parent face or a different morph face. The participant was instructed to judge whether the second probe face was the same or different from the first face via a keyboard response. It was emphasised that a 'same' response indicated that the participant believed that the two faces were physically identical. After each response, a blank screen appeared for 1 s and then the next trial began. During different trials, the Asian (Caucasian) parent face was followed by a morph face consisting of 90%, 80%, 70%, 60%, or 50% contribution from that parent face and the remaining percent contribution provided by the Caucasian (Asian) parent face. Hence, for each parent face, there were five 'different' trials and an equal number of 'same' trials where same parent face was shown for the first and second presentations. Male and female face trials were blocked and separated by a short break, and the presentation order of these two sections was counterbalanced across participants. Within each gender block, the Asian and Caucasian trials were presented randomly. There were 100 'same' trials and 100 'different' trials for a total of 200 trials in the experiment. After the same-face or different-face perceptual task, participants completed the Social Experience Questionnaire using the keyboard numbers to enter their responses.

3 Results

3.1 *Reaction times*

A repeated-measures analysis of variance (ANOVA) test was performed with race of the participant (Asian or Caucasian) as a between-subjects factor, and race of the face (Asian or Caucasian) and level of morph (90%, 80%, 70%, 60%, and 50%) as within-subjects factors. An analysis of the response latencies revealed no significant main effects or interactions ($p > 0.10$).

3.2 *Accuracy*

Participant performance on the discrimination task was evaluated by assessing the number of correct rejections. A repeated-measures analysis of variance (ANOVA) test was performed with race of the participant (Asian or Caucasian) as a between-subjects factor and race of the face (Asian or Caucasian) and level of morph (90%, 80%, 70%, 60%, and 50%) as within-subjects factors.

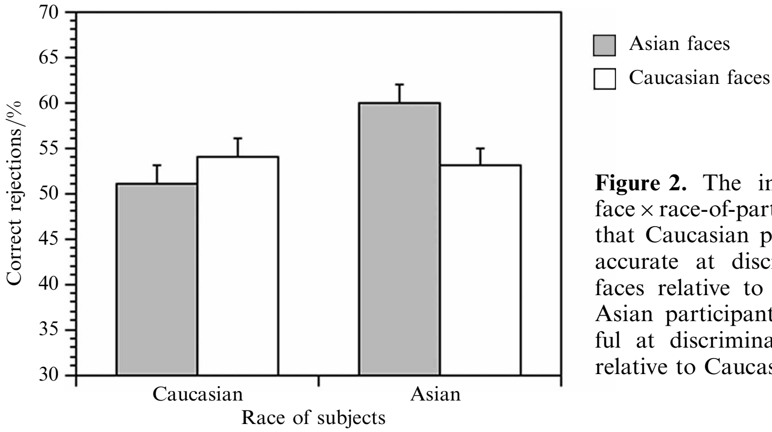

Figure 2. The interaction of race-of-face × race-of-participant demonstrates that Caucasian participants were more accurate at discriminating Caucasian faces relative to Asian faces, whereas Asian participants were more successful at discriminating the Asian faces relative to Caucasian faces.

The ANOVA showed that the main effect of race of participant was not reliable ($F_{1,108} = 2.53$, $\text{MSE} = 38.84$, $p > 0.10$). The within-subjects factor morph level was reliable ($F_{4,108} = 703.63$, $\text{MSE} = 1775.94$, $p < 0.0001$). The within-subjects factor, race of face, was also reliable ($F_{1,108} = 9.13$, $\text{MSE} = 14.81$, $p < 0.005$) demonstrating that, overall, participants were better at detecting differences in Asian faces than Caucasian faces. This main effect was qualified by a reliable race-of-face × race-of-participant interaction ($F_{1,108} = 34.13$, $\text{MSE} = 55.36$, p, < 0.0001). As shown in figure 2, Caucasian participants were more accurate at discriminating Caucasian faces relative to Asian faces and Asian participants demonstrated an opposite pattern as they were more successful at discriminating between Asian faces than Caucasian faces. Separate comparisons of the subgroups demonstrated that participants were better at discriminating between faces of their own race over another (Asian participants: $F_{1,108} = 30.46$, $p < 0.0001$; Caucasian participants: $F_{1,108} = 5.71$, $p < 0.05$). Planned comparisons were also performed for the accuracy of Asian and Caucasian participants per level of morph. The Asian participants showed that they were significantly better at discriminating Asian faces than Caucasian faces at different levels (90% morph, $F_{1,108} = 10.36$, $p < 0.005$; 70% morph, $F_{1,108} = 8.66$, $p < 0.005$; 60% morph, $F_{1,108} = 9.78$, $p < 0.005$; and 50% morph, $F_{1,108} = 4.48$, $p < 0.05$—see figure 3a). Caucasian participants demonstrated significant success in discriminating between 60% morphs ($F_{1,108} = 10.58$, $p < 0.005$—see figure 3b).

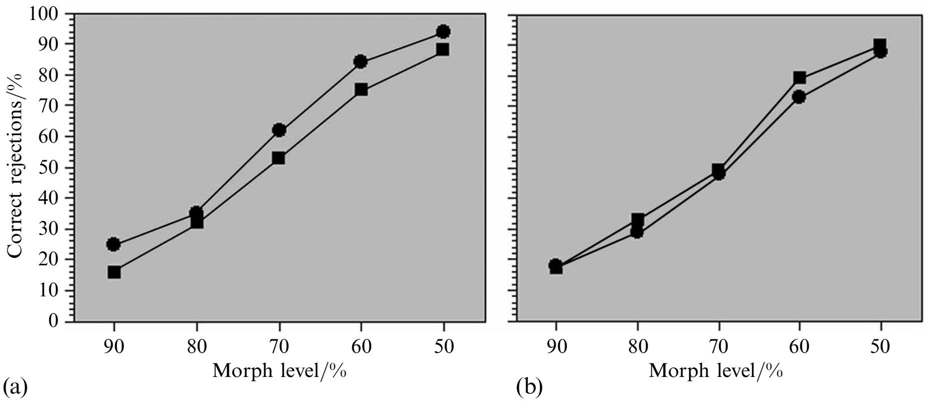

Figure 3. The percentage of correct rejections by (a) Asian participants and (b) Caucasian participants on the same/different discrimination task across the five morph levels (50%, 60%, 70%, 80%, and 90%) and two racial groups of faces [Asian faces (solid circles) and Caucasian faces (solid squares)].

3.3 *Social Experience Questionnaire*

Responses to the 15-item Social Experience Questionnaire were highly intercorrelated. The internal consistency was high (Cronbach's alpha 0.92; 0.89 for Caucasian and 0.89 for Asian subgroups). An index of social experience was constructed for each respondent by computing the mean response to the 15 items (each on a nine-point scale). Table 1 illustrates the means and standard deviations for both East Asian and Caucasian respondents. This index was then used, along with respondents' sex and race, to predict their accuracy scores for Caucasian and Asian faces. Respondents' sex was included because it correlated negatively ($r = 0.22$, $p < 0.05$) with experience. Males reported more interracial experience than females.

Table 1. Means and standard deviations (in parentheses) of responses (on a nine-point scale) to the Social Experience Questionnaire shown by race and gender of the participant.

Caucasian	East Asian		
female	male	female	male
1.9 (1.2)	2.4 (1.5)	4.0 (2.3)	5.4 (1.9)

The main effects of experience, sex, and race were first entered as predictor variables into the regression analysis. Then the interaction between experience, sex, and race was entered. The regression of Caucasian faces yielded an effect of race ($b = -6.53$, $t_{109} = -2.35$, $p < 0.05$), supporting the ANOVA results, such that race of participant acted as a significant predictor for accuracy on the discrimination task. This finding was qualified by a marginal interaction between race and experience ($b = 1.47$, $t_{109} = 1.97$, $p < 0.06$) suggesting that race of participant and level of experience act as predictor variables for face discrimination accuracy. Separate regressions for Asian and Caucasian respondents indicated a positive effect of experience for Asians ($b = 1.06$, $t_{37} = 2.11$, $p < 0.05$) but not for Caucasians ($p > 0.3$). The regression of accuracy scores for Asian faces yielded a similar result with a significant interaction between race and experience ($b = 1.66$, $t_{109} = 2.18$, $p < 0.05$). Separate regressions for Asian and Caucasian respondents demonstrated the positive effect of experience on the accuracy of Asian faces for Asian respondents ($b = 1.31$, $t_{37} = 2.43$, $p < 0.05$) but not for Caucasians ($p > 0.3$).

The regression results demonstrated that the level of interracial experience (when controlling for sex of participant) was a significant predictor of the performance for Asian participants on the face discrimination task. Specifically, Asian participants with higher levels of interracial experience showed increased discrimination accuracy for both Caucasian and Asian faces.

4 Discussion

In this study, an own-race advantage was found such that Asian participants more accurately detected differences in Asian faces than in Caucasian faces; Caucasian participants, on the other hand, more accurately detected differences between Caucasian faces than between Asian faces. The fact that the identical set of faces produced opposite effects in Asian and Caucasian populations suggests that differences in discrimination performance were not an artifact of the stimuli, but were related to the participants' racial background. The current finding is consistent with previous studies that have reported an own-race advantage in face processing (Brigham and Malpass 1985; Byatt and Rhodes 1998; Chiroro and Valentine 1995; O'Toole et al 1994; Slone et al 2000; Wright et al 2001). However, contrary to those studies that have focused on biases at the recognition stage of face processing, the present study demonstrated an own-race advantage at an earlier stage of perceptual encoding. These results can be contrasted to the opposite findings reported by Levin (2000), in which Caucasian subjects who showed a memory advantage for Caucasian faces paradoxically exhibited a perceptual advantage for African-American faces in a discrimination test. Different encoding strategies employed for our sequential same/different task versus Levin's simultaneous matching task or differences between Asian and African-American faces might account for the disparate findings.

Although the current findings showed that participants' race influenced their ability to differentiate Asian and Caucasian faces, it was curious that the Social Experience Questionnaire responses failed to predict participants' performance on the discrimination task. Participants who reported high levels of other-race contact on the Social Experience Questionnaire performed no better on other-race discrimination than individuals who reported low levels of other-race contact. Although the amount of other-race experience did not predict a participant's ability to discriminate other-race faces, other-race contact did predict the extent to which Asian participants could discriminate Asian and Caucasian faces in general. That is, Asian participants who reported high levels of other-race contact demonstrated increased accuracy in their ability to discriminate Caucasian and Asian faces. Conversely, Asian participants with less other-race experience more poorly discriminated faces from both races. These findings are similar to the results of Slone et al (2000) showing that Caucasians with high levels of recent other-race (African-American) contact demonstrated an overall improvement in face recognition accuracy for both own-race and other-race faces. These results suggest that increased interracial experience may improve one's ability to discriminate and recognise faces in general, regardless of race. Nonetheless, a more sensitive measure for determining other-race experience may illuminate subtle differences in the effect other-race experience may have on other-race-face perceptual expertise.

Consistent with the contact hypothesis, it is assumed that the discrimination advantage for own-race faces was attributed to the greater exposure that participants had to people of their own race relative to people outside of their race. The failure of the Social Experience Questionnaire scores to predict performance on the discrimination task suggests that this measure was not sensitive to racial differences in perceptual encoding. The Social Experience Questionnaire (Brigham and Meissner 2001) used in this study required participants to recall the number of other-race friends and interactions they had had in particular past and present situations. This self-report measure does not provide a way of assessing whether certain individuals recalled such experiences more accurately than others, or whether there may have been a response bias, such that individuals with less experience actually reported more in order to appear politically correct. A greater focus on close personal other-race interactions and relationships, as opposed to general other-race encounters, may also prove a more effective means of judging the amount of experience.

It is also debatable whether interracial contact or social experience by itself is sufficient to facilitate the perception and recognition of other-race faces. Levin (2000) has suggested that, while people tend to individuate members from their own racial group, they tend to ignore individuating information that would differentiate members from other races. Person individuation is similar to the shifts to subordinate level recognition that occur as a result of expertise in specialised object domains (Tanaka and Taylor 1991). For example, bird expertise requires that birds be individuated at the species or subspecies level of abstraction, such that bird experts are as fast to recognise objects in their domain of expertise at subordinate levels of abstraction (eg "sparrow", "robin") as they are to recognise objects at the basic level ("bird") (Tanaka and Taylor 1991). Similarly, the pressure to individuate members from one's own race might produce a perceptual advantage or expertise for own-race faces that is similar to object expertise (Tanaka and Gauthier 1997). Conversely, if people lack the motivation to individuate members from another race, it is unlikely that their ability to perceive and recognise other-race faces will improve despite an extensive amount of contact or exposure.

In summary, this study employed a perceptual discrimination task wherein a minimal demand was placed on memory processing. With this perceptual encoding task, an own-race advantage was found, such that Asian participants were more accurate in detecting differences in Asian faces than in Caucasian faces. Conversely, Caucasian participants were more accurate in detecting differences in Caucasian faces than in Asian faces. These results indicate that an own-race advantage occurs not simply at the stage of recognition, but at the stage of perceptual encoding.

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