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Brief article

A holistic account of the own-race effect in face recognition: evidence from a cross-cultural study

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Abstract

A robust finding in the cross-cultural research is that people's memories for faces of their own race are superior to their memories for other-race faces. However, the mechanisms underlying the own-race effect have not been well defined. In this study, a holistic explanation was examined in which Caucasian and Asian participants were asked to recognize features of Caucasian and Asian faces presented in isolation and in the whole face. The main finding was that Caucasian participants recognized own-race faces more holistically than Asian faces whereas Asian participants demonstrated holistic recognition for both own-race and other-race faces. The differences in holistic recognition between Caucasian and Asian participants mirrored differences in their relative experience with own-race and other-race faces. These results suggest that the own-race effect may arise from the holistic recognition of faces from a highly familiar racial group.

Keywords: Holistic account; Own-race effect; Face recognition; Cross-cultural study

1. Introduction

In the cross-cultural literature, it is well established that people are better at recognizing faces from their own race relative to faces from other races (for reviews see Bothwell, Brigham, & Malpass, 1989; Brigham & Malpass, 1985; Chiroro & Valentine, 1995).

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The *own-race effect*[1] is assumed to reflect differences in racial experience such that people have more exposure and practice recognizing faces from their own race relative to faces of other races. Although there is little disagreement that racial experience is linked to improved recognition, an enduring question in the literature revolves around *how* race-specific experience affects the processes of face recognition (Levin, 2000; Ng & Lindsay, 1994).

It has been suggested that through experience, people acquire the ability to differentiate faces based on the distinctiveness of their features and their configuration (i.e. the spatial relations between the features) (for a full discussion of featural and configural face processes, see Maurer, Le Grand, & Mondloch, 2002). According to the configural account of face recognition, sensitivity to configural information is particularly vulnerable to orientation effects and is disrupted when a face is turned upside down. Consistent with this view, many studies (Carey & Diamond, 1977; Diamond & Carey, 1986; Scapinello & Yarmey, 1970; Yarmey, 1971) have shown that inversion disproportionately impairs the recognition of faces relative to the recognition of other objects (e.g. automobiles, flowers, airplanes) – the so-called face inversion effect (Yin, 1969). Are people more sensitive to the configural information in own-race faces relative to other-race faces? As a test of the configural effects in own-race recognition, Chinese and Caucasian participants were asked to recognize upright and inverted Chinese and Caucasian faces (Rhodes, Tan, Brake, & Taylor, 1989). The main finding of this study was that participants demonstrated a larger inversion effect for their own-race faces relative to other-race faces suggesting that configural processes can be tuned to the recognition of faces from a specific, familiar race.

One limitation of the inversion paradigm is that configural processes are not directly examined, but only inferred by the degree to which inversion disrupts face recognition performance relative to the recognition of other objects (e.g. houses, airplanes) (Valentine, 1988). Therefore, other paradigms in which the spatial relations of features are specifically manipulated provide a more precise test of configural processes. In the Young, Hellawell, and Hay (1987) composite paradigm, for example, the top face half of a well-known person is joined with the bottom half of another well-known person. The participants' task is to identify the person shown in the top face while ignoring the face shown in the bottom half. Young et al. found that participants were slow to isolate the identity of a person in the top half of the composite face due to the configural interference produced by the face shown in the bottom half. Critically, configural interference was substantially reduced by misaligning the top and bottom halves of the composite face or by turning it upside down.

In contrast to the composite paradigm that measures the effects of global configuration on face recognition, the parts/wholes task measures the interdependence between featural and configural information in the face representation. In this paradigm, participants learned to name a series of upright, inverted or scrambled faces (e.g. Joe) or houses (e.g. Joe's house) (Tanaka & Farah, 1993; Tanaka & Sengco, 1997). After the naming phase, participants' memory for the face parts (e.g. Joe's nose) or house parts (e.g. Joe's door) was tested when shown in the whole face (or house) and in isolation. The main result was that parts from upright intact faces were better recognized when presented in the whole face than when presented in isolation (Tanaka & Farah, 1993; Tanaka & Sengco, 1997).

[1] The own-race effect is also referred to as the own-race bias or as the other-race effect or disadvantage.

Moreover, changes in spatial configuration (e.g. increasing inter-eye distance) impaired recognition of the affected features (e.g. eyes) and features whose spatial location remained unchanged (i.e. nose, mouth) (Tanaka & Sengco, 1997). In contrast, identification performance for parts from inverted faces, scrambled faces and houses was the same whether tested in the whole face (or object) or in isolation. Based on this evidence, Tanaka, Farah, and colleagues argued that in normal face processing, the encoding of a facial feature is combined with its spatial relations to other features in what they referred to as a *holistic* representation (Tanaka & Farah, 1993; Tanaka & Sengco, 1997).[2]

As an account of the own-race effect, it is plausible that people recognize faces from their own race more holistically than other-race faces. In the current experiment, the holistic hypothesis was examined by asking Caucasian and Asian participants to recognize face parts from Caucasian and Asian faces in isolation and in the whole face. According to the holistic account, it is predicted that the part-whole advantage should be greater for own-race faces than other-race faces.

2. Method

2.1. Participants

A total of 21 Caucasian undergraduates from the University of Ulm, Germany and 21 Asian undergraduates from the University of Victoria participated. The Caucasian subject group was comprised of 21 (12 female/9 male) right-handed native German participants with an average age of 28.2 years (range 20–44 years). These participants were recruited from a rural area in Southern Germany with a predominantly Caucasian population. The administrative center of this area, the city of Ulm, where subject testing took place, is a medium-sized university town of a predominantly Caucasian population.

The Asian group was comprised of 21 (14 female/7 male) participants of Asian descent with an average age of 19.8 years (range 18–39 years). These participants were registered in an introductory psychology course at the University of Victoria, Canada, and volunteered for optional course credit. The University of Victoria and surrounding area has a predominantly Caucasian population.

2.2. Materials

Twelve Caucasian and 12 Asian composite faces (half male, half female) were generated from digitally scanned photographs of Asian and Caucasian individuals found in college yearbooks. Each composite face was composed of a face template depicting the face and hair outline of either an Asian male, Asian female, Caucasian male or Caucasian female. To form the face composite, eyes, nose and mouth features from three different

[2] Although the terms "configural" and "holistic" are often used interchangeably to mean the processing of the "whole" face, we define "holistic" more narrowly as the case in which information about the features of a face and their configuration are processed together. In a holistic representation, the two kinds of information are interdependent such that changes in one form of information influence the perception of the other.

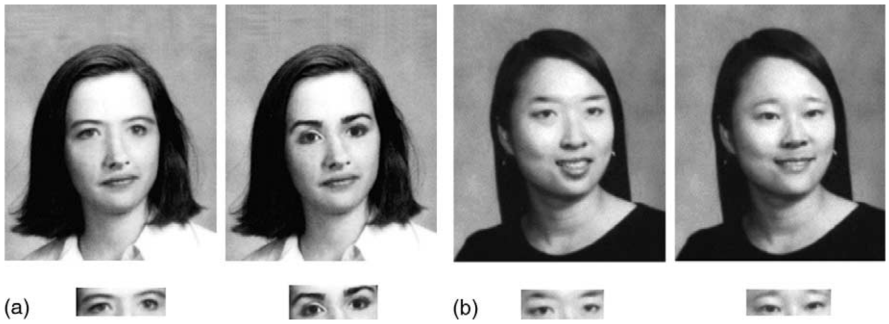

Fig. 1. Sample Caucasian (a) and Asian (b) target and foil stimuli shown in the whole face and the isolated part test conditions. Note that the study stimulus was always a whole face.

faces of the corresponding gender and race were placed inside the face template (as shown in Fig. 1a,b). There were six exemplars of each of the four face templates, making a total of 24 whole face targets. Whole face foils were created by substituting only one critical part (either the eyes, nose or mouth) from a different target face of the same race and gender. In addition, three face part stimuli depicting only one critical internal feature (eyes, nose or mouth) were created for each of the 24 target faces. See Fig. 1 for sample stimuli. Stimuli were presented at a resolution of 800×600 pixels and a color depth of 256 grays.

2.3. Design and procedure

The experimental design was a $2 \times 2 \times 2$ mixed factorial design, with Race of Participant (Asian or Caucasian) as the between subjects factor, and Race of Target Face (Asian or Caucasian) and Test Type (whole face or face part) as the within subjects factors.

The paradigm was a two-alternative, forced-choice procedure. Each trial began with a central fixation for 500 ms. A whole study face was then presented centrally for 500 ms (Asian participants) or 1000 ms (Caucasian participants). Pilot-testing indicated that a longer exposure duration of the study face was necessary for the German participants in order to raise their performance above chance levels. The study face was followed by a 500 ms scrambled face mask. The target stimulus and a foil were then presented side by side and remained on the screen until a response was made. Subjects chose the stimulus that correctly matched the initial study face by pressing the appropriate key marked "left" or "right". There was a 1500 ms pause before the next trial began. The position of the correct target was presented equally often on the right and left. On half of the trials, the target and foil stimuli were whole faces varying by only one internal feature (eye, nose or mouth), and for the other half, the target and foil stimuli were isolated critical face parts of the target and foil. The initial study stimulus, however, was always a whole face. Half of the trials were Caucasian faces, and the other half were Asian. There was a total of 144 trials, and the order of trials was randomized.

Following the experiment, participants were asked to report their ethnicity and to rate the amount of interaction with individuals of Caucasian and Asian races separately, both prior to and since coming to the University. A scale of 1–5 was used, with 5 indicating the most interaction.

3. Results and discussion

3.1. Racial experience

According to the participants' estimates of their own-race and other-race experiences (as shown in Table 1), the Caucasian participants reported extensive exposure to other Caucasians ($M = 5.00$) and relatively little contact with Asians ($M = 1.40$). The Asian participants, on the other hand, reported having slightly more contact with Caucasians ($M = 3.60$) than Asians ($M = 3.43$). The analysis of variance (ANOVA) test with Race of the Participant (Asian, Caucasian) as a between-groups factor and Racial Contact (Asian, Caucasian) and Time of Contact (Recent, Past) as within-group factors showed a significant main effect of Racial Contact ($F(1, 40) = 92.537$, $MS = 150.482$, $P < 0.0001$), and a significant interaction between Race of Participant and Racial Contact ($F(1, 40) = 74.850$, $MS = 121.720$, $P < 0.0001$). No other main effects or interactions were significant.

3.2. Parts and wholes test

3.2.1. Accuracy

An ANOVA was performed on recognition accuracy with the between-groups factor of Race of Participant (Asian, Caucasian) and the within-group factors of Race of Target Face (Asian, Caucasian) and Test Type (Part, Whole). There was a significant effect of Test Type ($F(1, 40) = 44.693$, $MS = 0.247$, $P < 0.0001$), demonstrating that recognition of the part was better in the context of the whole face than in isolation. The interaction between Test Type and Race of Target Face was also significant ($F(1, 40) = 8.543$, $MS = 0.032$, $P < 0.01$), showing a greater part-whole effect for Caucasian faces than for Asian faces. Importantly, the three-way interaction between Race of Participant, Race of Target Face and Test Type was reliable ($F(1, 40) = 6.277$, $MS = 0.024$, $P < 0.02$), indicating that the magnitude of the part-whole difference was mediated by both the race of the participant and the race of the face stimulus. No other main effects or interactions were significant.

Further analyses were carried out for the separate groups of Caucasian and Asian participants. For Caucasian participants (as shown in Fig. 2a), there was a significant main effect of Test Type ($F(1, 20) = 33.451$, $MS = 0.146$, $P < 0.001$), and an interaction

Table 1
Means and standard deviations (in parentheses) of the level of recent and past interactions (1, no or low degree of interaction; 5, high degree of interaction) with Caucasians and Asians reported by Caucasian and Asian participants

	Caucasian participants			Asian participants		
	Recent	Past	Mean	Recent	Past	Mean
Contact with Caucasians	5.00 (0.00)	5.00 (0.00)	5.00	3.62 (1.20)	3.67 (1.32)	3.64
Contact with Asians	1.38 (0.59)	1.43 (0.98)	1.41	3.33 (0.91)	3.57 (1.33)	3.45

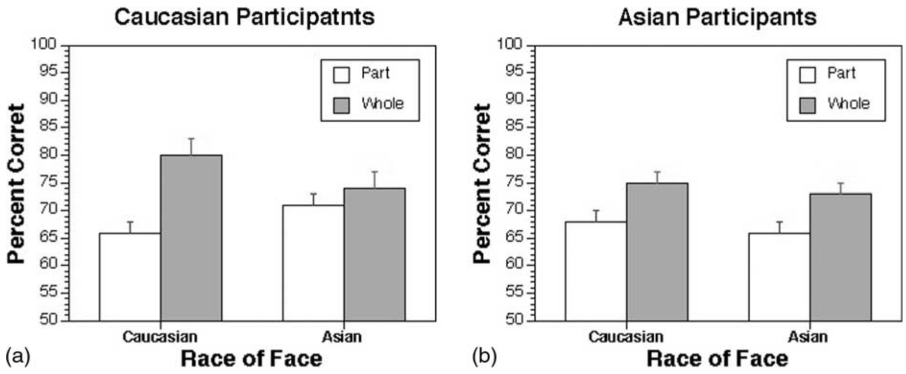

Fig. 2. Graph of recognition accuracy of Caucasian participants (a) and Asian participants (b) for their memory of Caucasian and Asian target faces tested in isolation and in the whole face.

between Race of Target Face and Test Type ($F(1, 20) = 18.436$, $MS = 0.056$, $P < 0.001$). Planned comparisons showed that face parts from Caucasian faces were better recognized by the German participants in the whole face ($M = 79\%$ correct) than in isolation ($M = 66\%$) ($P < 0.0001$). However, recognition of face parts from Asian faces was not reliably different when presented in the whole face ($M = 74\%$) than when presented in isolation ($M = 71\%$) ($P > 0.07$). Direct comparisons between Caucasian and Asian faces showed that the isolated parts were more accurately identified by German participants in the Asian faces relative to the Caucasian faces ($P < 0.01$). However, when identifying the whole face, German participants demonstrated an own-race effect such that face parts were better identified in the whole Caucasian face as compared to whole Asian face ($P < 0.01$). These findings indicate that the own-race effect shown by German participants was attributed to their holistic encoding of Caucasian faces relative to their featural encoding of Asian faces.

A different pattern of results emerged for the Asian participants. The ANOVA showed a significant main effect of Test Type ($F(1, 20) = 15.398$, $MS = 0.103$, $P < 0.001$), but Test Type did not interact with the Race of the Face ($F(1, 20) = 0.073$, $MS = 0.001$, $P > 0.10$). As shown in Fig. 2b, Asian participants displayed better recognition of the face parts presented in the whole Asian face ($M = 74\%$) or whole Caucasian face ($M = 76\%$) relative to when they were shown in isolation ($M = 67\%$ and 68% accuracy for isolated Asian and Caucasian face parts, respectively) ($P < 0.01$). Moreover, Asian participants, in contrast to their German counterparts, did not differ in their ability to recognize the face parts of Asian faces and Caucasian faces shown in isolation or in the whole face ($P > 0.10$). Thus, as indicated by their part-whole recognition scores, Asian participants demonstrated equivalent levels of holistic encoding for both Asian and Caucasian faces.

3.2.2. Reaction time

To examine for possible speed–accuracy trade-offs, an ANOVA was performed for correct reaction times with the between-groups factor of Race of Participant (Asian, Caucasian) and the within-group factors of Race of Target Face (Asian, Caucasian) and Test Type (Part, Whole). The factor of Test Type was reliable ($F(1, 40) = 10.987$,

$MS = 2,029,281$, $P < 0.01$), indicating that whole judgments ($M = 2546$ ms) took longer than part judgments ($M = 2327$ ms). No other main effects or interactions reached reliable levels ($P > 0.10$), suggesting that the participant's reaction time was not affected by the race of the face.

4. Discussion

To summarize our results, it was found that Caucasian participants demonstrated holistic processing for the recognition of Caucasian faces and featural processing for the recognition of unfamiliar Asian faces. Asian participants demonstrated holistic recognition for both Asian and Caucasian faces. Given that participants in this study had extensive exposure to members of their own race, these findings indicate that experience of own-race faces promotes holistic processing. Consistent with the experience claim, Asian participants who had frequent interactions with Caucasian people demonstrated comparable levels of holistic recognition for Caucasian faces as they did for Asian faces. The obtained results are compatible with the account that experience is important for holistic face recognition and provide supporting evidence for a holistic account of the own-race effect.

However, experience alone may not be sufficient to ensure holistic recognition. According to an expertise position, a holistic encoding strategy is necessary when a stimulus (face or object) must be individuated from other stimuli in memory according to its configural or second-order relational properties (Diamond & Carey, 1986). However, some types of face processing, such as classification by gender, age or race, do not require individuation. Indeed, Levin (2000) has argued that people may be less motivated to encode other-race faces at the individual level and are more likely to classify these faces as members of a broader racial group (e.g. Caucasian, Asian). "Failure to individuate" might explain why participants may evidence a robust own-race effect despite having extensive contact with members of the other race (Brigham & Malpass, 1985). Hence, experience of other-race faces by itself may not guarantee holistic face recognition.

The current study emphasized the encoding aspects of the own-race advantage in a task where there were minimal memory demands placed on the participants. Although the majority of studies in the face recognition literature have focused on the own-race advantage as a long-term memory effect, a few studies have examined the own-race effect from the standpoint of perceptual encoding. For example, it was found that Caucasian participants recognized tachistoscopically presented Caucasian faces better than African-American faces whereas African-American participants recognized briefly presented Caucasian and African-American faces equally well (Lindsay, Jack, & Christian, 1991). In a recent test of visual discrimination, East Asian participants differentiated perceptually similar morph faces of Asians better than Caucasian participants whereas Caucasian participants demonstrated the converse pattern of performance (Walker & Tanaka, in press). In the current part-whole task, a holistic advantage was found for faces from highly familiar racial groups even when the study face was immediately followed by the test faces. Thus, the present study indicates that a holistic own-race advantage occurs at a relatively early point in processing.

Previous studies have shown that holistic processing is recruited for general face recognition (Tanaka & Farah, 1993; Tanaka & Sengco, 1997) and as suggested by the current results for the specialized recognition of own-race faces. However, it is not clear whether holistic processing is indicative of a more general, expert recognition strategy. Studies of object expertise have yielded mixed results. On one hand, it has been shown that Greeble experts are more sensitive to configural changes than novices (Gauthier & Tarr, 1997) and recognize some Greeble parts more holistically than novices (Gauthier & Tarr, 2002; Gauthier, Williams, Tarr, & Tanaka, 1998). On the other hand, there is no evidence to indicate that the overall strategies of experts are more holistic than the strategies of novices (for a more detailed discussion, see Tanaka & Gauthier, 1997). Tanaka and Farah (2003) have argued that holistic recognition is most likely to be found when: (1) exemplars of the object category share the same degree of visual complexity and structural similarity as faces; and (2) fast, accurate and specific (i.e. expert) recognition of these objects is required. Although some of the Greeble results suggest that the holistic approach may be used for the expert recognition of non-face objects, face recognition remains the most robust form of holistic recognition.

In conclusion, this research addresses a long-standing issue in the cross-cultural literature by providing a testable account of the own-race effect (Levin, 2000; Ng & Lindsay, 1994). Our findings indicate that the own-race effect may be the consequence of a specialized strategy associated with the recognition of own-race versus other-race faces. According to the holistic hypothesis, faces from a familiar racial group that are individualized by the perceiver are more likely to be recognized holistically whereas undifferentiated faces from an unfamiliar racial group are more likely to be recognized featurally. These findings suggest that the strategy by which own-race and other-race faces will be encoded and recognized will be jointly influenced by the life experiences and motivations of the perceiver.

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