Chapter 10

The Other-Race Effect Revisited: No Effect for Faces Varying in Race Only

Isabelle Bülthoff, Regine G.M. Armann, Ryo Kyung Lee, and Heinrich H. Bülthoff

Abstract The other-race effect refers to the observation that we perform better in tasks involving faces of our own race compared to faces of a race we are not familiar with. This is especially interesting as from a biological perspective, the category "race" does in fact not exist (Cosmides L, Tooby J, Krurzban R, Trends Cogn Sci 7(4):173–179, 2003); visually, however, we do group the people around us into such categories. Usually, the other-race effect is investigated in memory tasks where observers have to learn and subsequently recognize faces of individuals of different races (Meissner CA, Brigham JC, Psychol Public Policy Law 7(1):3–35, 2001) but it has also been demonstrated in perceptual tasks where observers compare one face to another on a screen (Walker PM, Tanaka J, Perception 32(9):1117–1125, 2003). In all tasks (and primarily for technical reasons) the test faces differ in race *and* identity. To broaden our general understanding of the effect that the race of a face has on the observer, in the present study, we investigated whether an other-race effect is also observed when participants are confronted with faces that differ only in ethnicity but not in identity. To that end, using Asian and Caucasian faces and a morph algorithm (Blanz V, Vetter T, A morphable model for the synthesis of 3D faces. In: Proceedings of the 26th annual conference on Computer graphics and interactive techniques – SIGGRAPH'99, pp 187–194, 1999), we manipulated each original Asian or Caucasian face to generate face "race morphs" that shared the same identity but whose race appearance was manipulated stepwise toward the other ethnicity. We presented each Asian or Caucasian face pair (original face and

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I. Bülthoff (✉) • H.H. Bülthoff
Max Planck Institute for Biological Cybernetics, Tübingen, Germany

Department of Brain and Cognitive Engineering, Korea University, Seoul, Republic of Korea
e-mail: Isabelle.buelthoff@tuebingen.mpg.de

R.G.M. Armann
Max Planck Institute for Biological Cybernetics, Tübingen, Germany

Department of Brain and Cognitive Engineering, Korea University, Seoul, Republic of Korea

Department of Psychology, University of York, York, UK

R.K. Lee
Department of Brain and Cognitive Engineering, Korea University, Seoul, Republic of Korea

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a race morph) to Asian (South Korea) and Caucasian (Germany) participants who had to judge which face in each pair looked “more Asian” or “more Caucasian”. In both groups, participants did not perform better for same-race pairs than for other-race pairs. These results point to the importance of identity information for the occurrence of an other-race effect.

Keywords Human face recognition • Other-race effect • Race vs identity information

10.1 Introduction

10.1.1 Identity Versus Other Face Properties

Faces shown as static images differ from each other in terms of their intrinsic properties like identity, sex, eye color, and age among many others. They can be further categorized in terms of non-rigid deformations (e.g. their facial expressions, open or closed mouth, etc.), while external variations of viewing conditions allow yet another way to differentiate between them. For example, faces can differ in terms of their orientation with regard to the camera (profile or side view) or the illumination (from above, from the side).

Although computationally images of different faces viewed under the same viewing conditions are more similar to each other than images of the same faces viewed under different viewing conditions or with different expressions [1], for the human visual system this only occurs when dealing with images of unfamiliar people. For familiar faces, the visual system seems to discard spontaneously those external variations; it becomes ‘blind’ for most of the identity-independent variance and correctly recognizes the same person across a huge range of image and instance variability.

These findings demonstrate that identity-related information (idiosyncratic information) is the most important property of a familiar face and many studies have shown that we process familiar faces at this level before processing their category affiliation, e.g. whether the face is male or female (sex category), or Asian or Caucasian (race category but see [2]). In contrast, for unfamiliar faces, idiosyncratic information is a less robust factor for grouping same-identity faces together in the presence of non-rigid deformation and/or external variations [3] and there might be differences in grouping various renditions of the same person’s face with better performance for same-race faces (e.g. [4]).

10.1.2 The Other-Race Effect and Other Category Effects

It has been shown that for unknown faces the familiarity with the category they belong to (e.g. own-race or other-race) influences how we process them and how well we can recognize them later. Many studies have demonstrated that we are better at recognizing faces belonging to categories which are more familiar to us. This is the case for the very well-known other-race effect (also called cross-race effect or own-race advantage), which describes the fact that we recognize faces of our own ethnicity better than other-race faces (for a recent review see [5]). The influence of familiarity has been reported for other categories, principally for age and sex. Same-age faces (for the observer) are better recognized than much younger or older ones [6, 7], and other studies even report a same-sex advantage [8–10]. Among these category effects, the other-race effect seems the most robust and the most abundantly studied, yet, the mechanisms at its base are still discussed [11].

10.1.3 Identity and Face Categories

Many studies involving faces of different categories, for example investigations of facial emotions, are based on stimuli which show the same identity exhibiting different facial expressions [12], thus there is no confound of changing identity information. So far, controlling identity while investigating the effect of only sex or race changes on face recognition has not been done (but see studies investigating sex alone [13, 14]). Most studies investigating the other-race effect or more generally the effect of race on face recognition have used stimuli displaying faces that differ not only in terms of their category affiliation but also in terms of their idiosyncratic features (among many other studies, see [15, 16]), leaving open the possibility that those effects might be somewhat dependent on the use of face stimuli of different identities.

10.1.4 Our Study

Greater expertise with own- than other-race faces is believed to be one of the explanations for the other-race effect as expertise gained from perceptual learning allows to better discriminate between members of a category after training [17]. Since ground-breaking advances in computer graphics and computer vision (for example [18]), it is possible to manipulate faces along high-level dimensions like sex, race and even perceived attractiveness or memorability while avoiding large changes at the level of idiosyncratic facial information. In the present study, we parametrically modified the race of individual faces without changing their identity to create “race morphs”. In other words, we targeted specifically race-related facial appearance and modified faces along that dimension only, leaving identity-related information mostly untouched. Our goal was to investigate whether stronger expertise with own-race faces would allow better discrimination between own-race faces and their race morphs than between other-race faces and their race morphs.

In two race comparison tasks, we asked the same participants to compare the race of two faces and to indicate which face was more Asian or more Caucasian looking. In our design, one face was always the original face (either Caucasian or Asian) and the other one of its race morphs. This comparison task is derived from the "better likeness task" designed by Beale and Keil ([19], see also [20]). In a 'parallel' task, both faces were presented simultaneously on the computer screen, thus memory load was reduced to a minimum in this task, while in a 'sequential' task, both images were shown sequentially, thus a small memory load was present.

10.2 Method

10.2.1 Participants

We tested 26 German participants (13 females, age: 21–63) at the Max Planck Institute for Biological Cybernetics in Tübingen, and 26 Korean participants (13 females, age: 18–30) at Korea University in Seoul. In accordance with the Declaration of Helsinki, the procedures were approved by local IRBs and signed consent forms were obtained from individual participants before the experiment.

Tübingen and Seoul participants answered orally a few questions prior testing to ensure that no participants had intensive contacts to individuals of the other race. All participants were paid volunteers and were naïve as to the purpose of the experiment.

10.2.2 Stimuli

We selected the faces of 20 Asian individuals (10 females) and 20 Caucasian (12 females) from our face database (http://faces.kyb.tuebingen.mpg.de, [18]). All faces were devoid of hair, facial hair, makeup, glasses or jewelry. Same-identity race morphs were created by morphing all original faces of one race category stepwise toward the other race while keeping their idiosyncratic features. We give here only a short description of the morphing method used to that end as it has been described in more detail elsewhere [18, 21, 22]. In our face database, all faces are in dense point-to-point correspondence. Using the morphable model of Blanz and Vetter [18] we created an Asian average face derived from all Asian faces and a Caucasian average face derived from all Caucasian faces. A race vector was then computed as the difference between both average faces for all points of the faces. We manipulated ethnicity by applying this race vector in full or in part to each original face to create a series of race morphs.

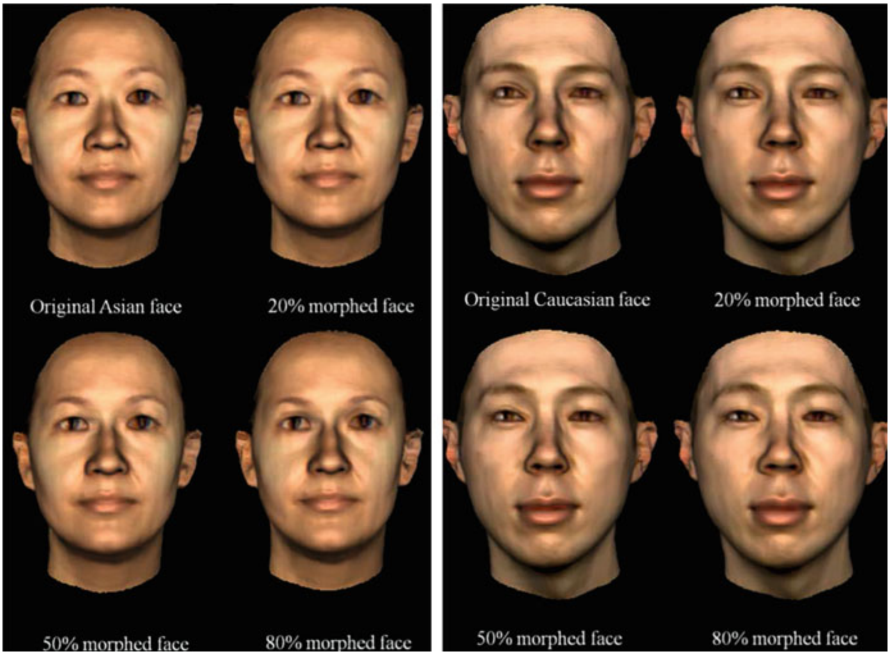

Fig. 10.1 *Left panel*: Example of an Asian original face and its morphs. *Right panel*: Example of a Caucasian original face and its morphs

Test images of all original faces and their race morphs were generated with all faces shown in frontal view. Each original face was morphed at three different levels toward the other ethnicity: 20, 50 and 80 %; with 0 % corresponding to the original face and 100 % meaning that the full ethnicity vector had been applied. Figure 10.1 shows examples of original faces of both ethnicities with their race morphs. All face images were 900-by-900 pixels in size and the approximate size of the face in the image was 600-by-730 pixels. 120 pairs were created by pairing each original face with each of its morphs. Four mask images were created by randomly mixing arbitrary face parts presented upside-down.

In each trial of the parallel task, the test faces were shown side by side on a computer screen, with the right edge of the left image and left edge of right image cut off by 50 pixels each, yielding a combined test image of 1700-by-900 pixels. For each pair, two test images were created to counterbalance left/right presentation location. In trials of the sequential task, the faces of each pair were shown alone, one after the other in the middle of the screen, with their presentation order counterbalanced across participants. The face size was the same as in the parallel task.

10.2.3 Design and Procedure

In each task participants viewed two faces in a trial. For half of the participants the question asked was “which face is more Asian?” and for the other half: “which face is more Caucasian?”. Race of participants (Seoul/Tübingen) was a between-subject independent variable and race of face stimuli (Asian/Caucasian origin) and race dissimilarity (the difference in morph levels between the faces of the test pair in a trial: 20, 50, and 80 %) were within-subject independent variables. The dependent variables were accuracy and response times (RT) from correct trials. Task order was randomized across participants.

All pictures were presented in eight-bit color format on a 24-inch flat monitor screen of a Tobii T 60 XL eye tracker with 1920 × 1200 pixels screen resolution (refresh rate 60 Hz). Each face covered approximately an angular size of around 17 deg × 14 deg. Participants were seated in front of the computer monitor at a distance of approximately 60 cm to 70 cm.

The experiment was designed with Tobii Studio 3.1.2 software and run with a special monitor that allowed to record participants’ eye gaze position in addition to their response. The eye tracking data are described elsewhere [23, 24].

In the parallel task, a trial started with a 500 ms fixation cross replaced by a response-terminated display of one face pair. Participants pressed one of two keys to indicate their choice of the left or right image. A blank screen appeared for 1 s before the start of the next trial. Presentation order of all face pairs was randomized across participants. In each trial, both face images originated from the same identity and one of them was always the original face. Every possible pair (three for each identity) was shown once. Left or right placement of the original image was randomized across trials and for each pair it was counterbalanced across participants. Though there was no time limit, participants were asked to answer as correctly and as quickly as possible. The RT in this experiment was measured from the onset of the face images to the subject’s key press.

In the sequential task, each trial started with a fixation cross for 500 ms, followed by the first face for 2500 ms and a mask for 500 ms. The mask image was then replaced by a response-terminated display of the second face. Participants pressed one of two keys to indicate their choice of the first or second image. All other details are the same as in the parallel task. RT in the sequential experiment was measured from the onset of the second image to the subject’s key press.

Recognition performance was measured as percent correct response (accuracy) and correct response times (RT) measured as explained above for each test condition. The RT and accuracy data were submitted to a 2 (group: Seoul vs Tübingen) × 2 (face race: Asian vs Caucasian) × 3 (pair dissimilarity: 20 % vs 50 % vs 80 %) mixed repeated-measures ANOVA, with face race and pair dissimilarity as within-participant factors and group as a between-participant factor. Statistical significance was set at $\alpha = .05$. We report partial eta-squared (η_p^2) as an index of effect size, with values of 0.01, 0.06, and 0.14 representing small, medium, and large effect sizes, respectively (Cohen, 1988).

10.3 Results

Because of time constraints, two of the 26 German participants and one of the Korean participants performed only one of both tasks. In addition, the data of one German participant in the sequential task was removed because he had inverted the response buttons in that task (indicated by an excessive error rate). We compared accuracy for both questions (i.e. depending on the question asked: "which one is more Asian?" versus "which one is more Caucasian?") at each race dissimilarity level. For Seoul participants, no differences in accuracy were found across both questions for the parallel task and the sequential tasks (independent t-tests: all ps > .20, all ps > .19 respectively). Similarly, no differences were found for the Tübingen participants (independent t tests: all ps > .19, all ps > .20, respectively). Therefore we collapsed all results across questions for all analyses. In agreement with the difference in memory load, participant overall performance was better in the parallel task (80 %) than in the sequential task (73 %). Owing to the nature of the tasks, response times cannot be compared.

In both tasks, for the smallest race dissimilarity level (20 %), that is when the original face and the morphed face were quite similar to each other, both Tübingen and Seoul participants performed better than chance (50 %) for both types of face stimuli (one sample t-tests, all ps < .001), while for the easiest condition (80 % difference) they performed significantly worse than perfect performance (all ps < .001). Thus the tasks did not appear to be either too hard or too easy.

10.3.1 Parallel Task

For the parallel task, the analyses show that Seoul and Tübingen participants did not differ from each other in terms of their accuracy performance (F < 1, ns). There was a main effect of *pair dissimilarity*, as participants' performance increased with larger race difference between the faces to compare (F(2,96) = 138.56, $p < .001$, $\eta_p^2 = .833$). There was also a main effect of *face race*, with better performance with Caucasian faces than with Asian faces (F(1,48) = 6.81, $p = 0.012$, $\eta_p^2 = .124$). These results were qualified by an interaction between *face race* and *participant group* (F(1,48) = 8.23, $p = 0.006$, $\eta_p^2 = .146$). There was no other significant interaction (all ps > .115). Separate ANOVAs for each group of participants showed a significant main effect of face race for the Seoul group (F(1,26) = 17.52, $p < .001$, $\eta_p^2 = 0.10$) as participants performed better with Caucasian faces (M = 83.9 %) than Asian faces (M = 77.7 %,), while Tübingen participants performed equally well with Asian faces (M = 81 %) and Caucasian faces (M = 81 %, F < 1, ns). Figure 10.2 shows the detailed accuracy results for both groups of participants.

Depending on conditions, participants needed on average between 2.5 and 7 s to enter their answer. The RT data were subjected to a mixed repeated-measures ANOVA involving *participant group* as between-subjects variable and

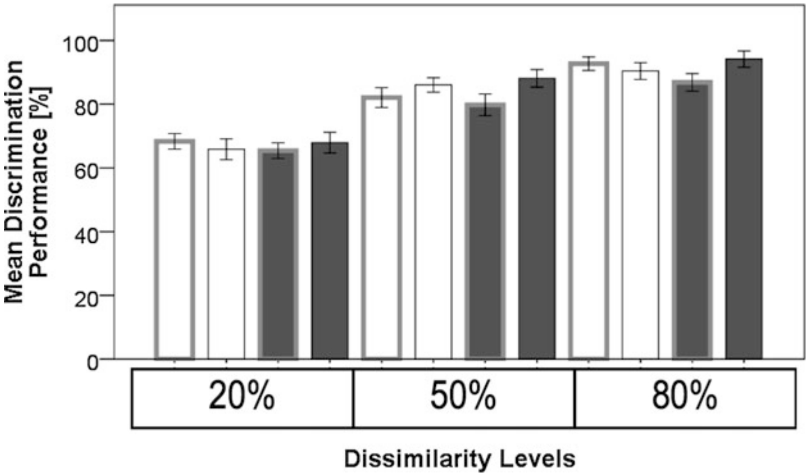

Fig. 10.2 Mean accuracy for the parallel task for Seoul and Tübingen participants as a function of race dissimilarity between test face pairs (20, 50 and 80 %) and face race (Asian or Caucasian). Each dissimilarity level is shown four times. *White bars* represent data for participants of Tübingen, grey bars for Seoul participants. Bars with a *black outline* depict the results for the Caucasian pairs, bars with a *thick grey* outline depict the results for the Asian pairs. Error bars represent SE

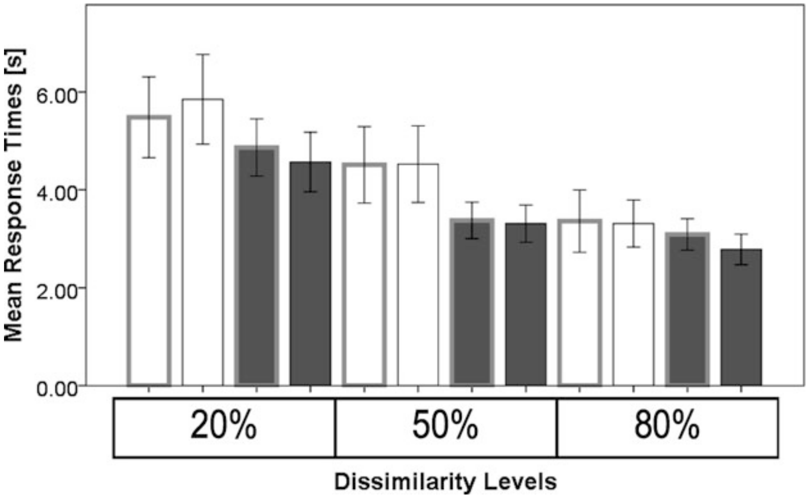

Fig. 10.3 Mean correct response times for the parallel task. For full legend, see Fig. 10.2

pair dissimilarity and *face race* as within-subjects variables. The analysis shows that only the factor *pair dissimilarity* had a significant impact on RT ($F(2,96) = 40.55$, $p < 0.001$, $\eta_p^2 = .458$). Figure 10.3 shows that participants responded more rapidly when the task was easier (i.e. for larger dissimilarity between the faces to compare). Although Tübingen participants ($M = 4.6$ s, $SE = 0.54$) were slower than Seoul

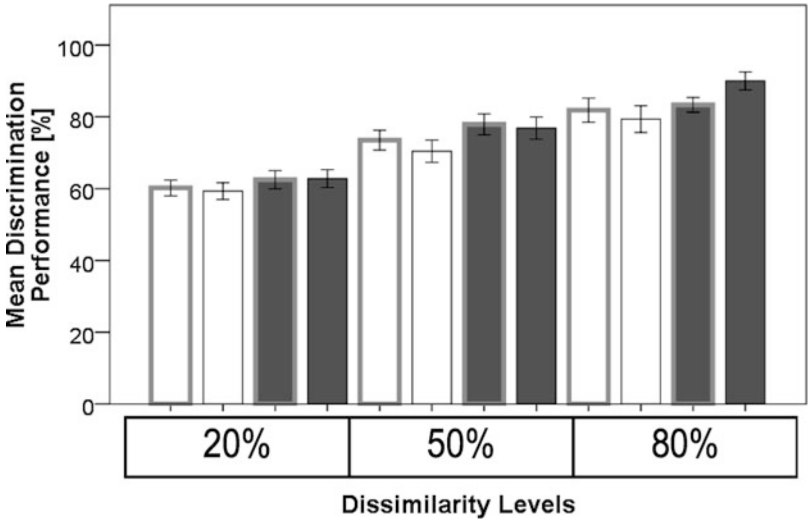

Fig. 10.4 Mean accuracy for the sequential task. For full legend, see Fig. 10.2

participants (M = 3.4 s, SE = 0.53) the difference was not significant because of the large variability of RT responses. There was also no significant main effect for *participant group* or *face race* (all Fs < 1, ns) and no significant interaction (all *p*s > .129). These results indicate that the factor *pair dissimilarity* affected response times to same-race and other-race face pairs for both groups similarly.

10.3.2 Sequential Task

When the faces were shown sequentially, Seoul participants were better overall than Tübingen participants, but this difference did not reach significance (F(1,48) = 3.53, $p = 0.066$, $\eta_p{}^2 = 0.068$). The factor *face race* did not affect response accuracy (F < 1, ns), so that the only significant main effect was for the *pair dissimilarity*, (F(2,96) = 112.25, $p < 0.001$, $\eta_p{}^2$ .700). As the faces got more dissimilar, accuracy improved. There was no significant interaction (all *p*s > .089). Figure 10.4 shows the details of the accuracy data.

Depending on condition, participants needed on average between 1.6 and 2.2 s to answer. Figure 10.5 shows that participants responded more rapidly as the dissimilarity increased (F(2,96) = 9.58, $p < 0.001$, $\eta_p{}^2 = .166$), no other significant main effects or interactions were found (all *p*s > 0.072). These results indicate that the factor dissimilarity affected response times to same- and other-race face pairs for both groups similarly.

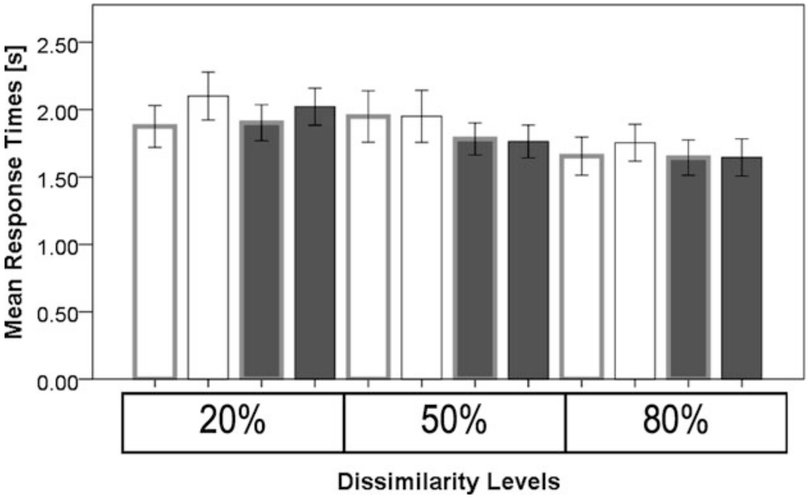

Fig. 10.5 Mean correct response times for the sequential experiment. For full legend, see Fig. 10.2

10.4 Discussion

In this study, we investigated whether participants showed better performance for same-race than other-race faces in a race comparison task. Although the ethnicity of the faces used as stimuli have been shown to influence participants' response in many previous studies (for example, among many others: [11, 25]; for a review see [26]), most of the faces used in these earlier studies displayed concomitant changes of ethnicity and identity. In the present work we specifically avoided any changes in identity when manipulating face race. We tested participants in a parallel and a sequential task. In both tasks, only race-specific information needed to be processed in the face stimuli for participants to complete the task successfully and the changes in ethnicity were never associated with changes in identity. Using this paradigm, we found neither an other-race effect for response times nor for response accuracy. In both tasks, the difference in race information between both faces in a pair (the race dissimilarity level) had a significant effect on performance; participants answered more correctly and also faster with increasing dissimilarity level.

In a study by Walker and colleagues [27], participants performed a same/different sequential task using Asian and Caucasian face stimuli and morphs between them. In that experiment, the faces to compare in each trial differed in race and identity. In contrast to our findings, the authors found a clear other-race effect in the accuracy data, participants performed better for same-race faces, while they found no effect in RT data, as we did. The differences between their experiments and ours are that they compared faces differing in race and identity and that they used a different task. In one of our previous studies on the perception of identity and sex in Caucasian faces [21] participants compared faces differing in sex but not in identity in both a same/different task (as in the Walker & Tanaka study) and a discrimination task (as in our present study) and gave in both tasks qualitatively identical results. This suggests that the use of different tasks cannot explain the qualitative discrepancy between our present findings and those of Walker & Tanaka. We thus argue that the absence or occurrence of an other-race effect – as observed in our study and that of Walker and Tanaka – is mostly due to the absence or presence of an identity change between faces to compare and not because of differences in paradigms. Thus it highlights the importance of processing changing facial identity information alongside race information for the occurrence of the other-race effect.

In another related study, Megreya and his colleagues [28] tested participants in a simultaneous matching task on photographs of people of different ethnicities. They found an other-race effect with their participants showing better matching performance for same-race than other-race faces, suggesting that the other-race effect occurs in the absence of a memory load. In our present study, we found no evidence of an other-race effect in the presence as well as in the absence of a memory load. Together with our study, the findings of Megreya and colleagues [28] and of Walker and Tanaka [27] suggest that an other-race effect can occur, independent of the memory load, as long as an identity change is involved in the faces to compare or to match.

Many models have been proposed for face recognition, one of the most influential ones [29] proposes parallel routes for category processing (e.g. race or sex, called *directed visual processing*), and identity processing. This separation of routes has been questioned in a few studies (for example: [30, 31, 32]). Furthermore, Bruyer and his colleagues [33] have shown that race classification is affected by familiarity with the face stimuli that are judged. Similarly, [14] showed that the emergence of a categorical effect for face sex was linked to participants being familiar with the test identities. In view of these findings and the current study we propose that identity information is not processed separately from other facial information like sex and race.

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