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# Individuation, Categorization, and the Other-Race Effect in Face Recognition


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## Abstract

Social-cognitive models propose that the other-race effect in face recognition is caused by different motivational tendencies when processing own- and other-race faces. More specifically, we tend to individuate own-race faces which facilitates face recognition, but racially categorize other-race faces which inhibits face recognition. This study tests whether a novel experimental manipulation aimed at promoting individuation or categorization encoding of faces moderates the other-race effect in an old/new recognition task. We found that categorization encoding eliminated the other-race effect when list length was short (Experiment 2) but not when list length was long (Experiment 1B). Inconsistent with social-cognitive predictions, individuation encoding failed to reduce the other-race effect, regardless of list length. We compare these findings with previous attempts to promote individuation and categorization encoding and suggest that the recognition benefits of individuation encoding might be more limited for faces that are most difficult to individuate i.e., other-race faces.



**Keywords:** face recognition; other-race effect; individuation; categorization


## Introduction

The other-race effect is one of the most robust findings in the face recognition literature. It refers to our tendency to recognize faces less accurately when they belong to a different race rather than our own (Meissner & Brigham, 2001; Sporer, 2001). Many researchers have attempted to explain the mechanisms underlying the other-race effect. These explanations typically belong to one of two broad theoretical perspectives: the social-cognitive account and the perceptual expertise account (Shriver et al., 2008).

The social-cognitive account proposes that the other-race effect is driven by differences in how we think about ingroup and outgroup members (Young et al., 2012). More specifically, we view ingroup members as heterogeneous, but view outgroup members as homogeneous (Hugenberg, Miller, & Claypool, 2007; Hugenberg & Sacco, 2008; Bernstein, Young, & Hugenberg, 2007; Shriver et al., 2008; Shriver & Hugenberg, 2010). When viewing a White face, for example, a White person is likely to 'individuate' the face, attempting to distinguish that face from other own-race faces (e.g., "That man looks like Jack"). When viewing a Black face, however, the same person is likely to racially categorize the face (e.g., "That man is Black"). According to the social-cognitive account, individuation facilitates face recognition by ensuring that distinguishable features of the face are encoded properly. Racial categorization, on the other hand, undermines face recognition as it promotes encoding of category-specific features that offer limited value for later recognition (Shriver et al., 2008). Thus, the social-cognitive account suggests that the other-race effect can be reduced by encouraging people to individuate other-race faces.

The perceptual expertise account proposes that the other-race effect is driven by our greater experience with own-race faces, which allows us to process them more efficiently than other-race faces (Wan et al., 2015). This could be because: (a) the distinguishing features of own-race faces are not as helpful when attempting to distinguish other-race faces (MacLin & Malpass, 2001), or; (b) our greater expertise with own-race faces allows us to process these faces in a more holistic or configural manner, whereas our more limited expertise with other-race faces causes us to process these faces in a more local or feature-based manner (Rhodes et al., 1989; Tanaka, Kiefer, & Bukach, 2004; Michel et al., 2006).

Whereas perceptual expertise models propose that skilled individuation is possible only through extensive training or experience, social-cognitive models propose that individuation can be successfully achieved through experimental instructions or manipulations. More specifically, Hugenberg et al. (2007) developed a set of instructions that informed participants about the other-race effect and advised them to "try especially hard when learning faces in this task that happen to be of a different race". Several studies have shown that when participants received these instructions prior to encoding, the other-race effect in later recognition can be successfully eliminated or reduced (e.g., Hugenberg et al., 2007; Rhodes et al., 2009, Experiment 2), although other studies have found that this is not always the case (e.g., Bornstein et al., 2013; Wan et al., 2015). Crucially, these instructions encourage participants to individuate other-race faces, rather than all faces equally.

The other method of promoting individuation encoding of faces is through experimental manipulations such as asking participants to rate the attractiveness of faces (e.g., Rhodes et al., 2009, Experiment 1) or make identity judgments about faces (e.g., Proietti et al., 2019). These manipulations have proven mostly ineffective in reducing the other-race effect. In one study, for example, some participants passively viewed one face at a time during encoding (control group), whereas




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other participants viewed two face images appearing alongside each other and indicated whether they depicted the same person or two different people (individuation group; Proietti et al., 2019). Participants were then tested on their memory for those faces. Relative to the control group, participants in the individuation group demonstrated an *increased* other-race effect during the recognition phase (Proietti et al., 2019). Note that Proietti et al. (2019) presented faces differently in the control and individuation conditions. The control group viewed 64 faces that were each presented individually for 2.5 seconds, whereas the individuation group viewed the same 64 faces presented in 32 face pairs for 5 seconds each. It is possible that their results were driven not by individuation encoding, but by differences in how faces were presented across the two conditions.

The present study employs a novel individuation encoding manipulation that presents faces in the same format across the control and individuation encoding conditions. In the individuation condition, participants complete a one-back task during which they view one face at a time and indicate whether each face belongs to the same identity as the previous face. In the control condition, participants passively view one face at a time without responding. Importantly, each face appears for the same duration in both conditions (see Figure 1 for an illustration). Social-cognitive models predict that this individuation manipulation should reduce the other-race effect in recognition, whereas perceptual expertise models predict that the manipulation should *not* moderate the other-race effect.

In addition to testing the impacts of individuation encoding, the present study also tests the impact of categorization encoding on the other-race effect. In Experiment 1B, participants complete a categorization encoding condition and a control condition. Like the individuation encoding condition outlined above, the categorization encoding condition requires participants to complete a one-back task. However, in the categorization encoding condition, participants indicate whether each face belongs to the *same or different race* as the previous face. In the control condition, participants passively view each face without responding. If racial categorization of other-race faces drives the other-race effect in recognition, then encouraging participants to categorize *own-race* faces should reduce the other-race effect by weakening recognition of own-race faces.

## Experiment 1A (Individuation)

### Method

**Participants** A total of 50 White undergraduate students completed the experiment (39 females, mean age = 22.80 years, *SD* = 8.66 years). Note that in all experiments, participants completed a contact questionnaire confirming that they had more experience with White than Black people.

**Materials and Stimuli** Study faces: The experimental stimuli consisted of 360 front-view color photographs of White and Black male faces (Meissner, Brigham, & Butz, 2005). The 360 photographs depicted 240 separate identities. For the 120 "old" identities that appeared during the learning phase (60 White identities and 60 Black identities), two images were used: one depicting a neutral facial expression, and another depicting a happy facial expression (total = 240 images). For the 120 "new" identities (60 White identities and 60 Black identities), only the image depicting a neutral facial expression was used. All images were cropped to remove external features such as clothing and background, although hair (including facial hair) remained.

**Procedure** Participants completed the study online (via the Pavlovia website) because of restrictions to in-lab testing of human participants due to the COVID-19 pandemic. The experiment consisted of four old/new face recognition blocks. Each block contained a learning phase and a test phase. During each learning phase, 60 images were presented one at a time, each for a duration of 1 second. The 60 images consisted of 30 identities (15 White identities and 15 Black identities) that were each presented twice, using different images. On some occasions, the same identity was presented twice consecutively – this occurred equally for White and Black identities. During each test phase, participants viewed 60 faces. Half of the faces were "old", meaning they had been presented during the learning phase. The remaining half were "new", meaning they had not been presented earlier. Participants indicated whether each face was old or new by pressing the 'o' or 'n' keys, respectively. During the test phase, each face remained on screen until participants responded. Note that during the test phase, only faces depicting neutral facial expressions were presented, whereas the learning phase contained both neutral and happy facial expressions. The use of neutral facial expressions during the test phase helped prevent participants from recognizing faces using highly distinctive facial expressions.

The experimental manipulation occurred during the learning phase of each block. Each participant completed two blocks in the control condition, and two blocks in the individuation condition. In the control condition, participants were instructed to pay attention to each face during the learning phase because their memory for those faces would be tested later. In the individuation condition, participants completed a one-back task during the learning phase. For each face that appeared during the learning phase (except for the first face), participants were instructed to indicate whether the face depicted the same identity as the previous image (by pressing the 's' key), or a different identity to the previous image (by pressing the 'd' key). This manipulation is illustrated in Figure 1. The order of the control and individuation blocks was counterbalanced, such that participants either completed two control blocks followed by two individuation blocks, or vice versa. Further counterbalancing was conducted to ensure that all faces presented during the learning phase were equally likely to belong to the control and individuation conditions. After counterbalancing, there were four versions of the experiment, and participants were randomly allocated to one of these four versions. Note also that the sequence of faces presented within learning phases was the same regardless of encoding condition, thus ensuring that encoding effects could not be due to variations in the ordering sequence of faces.

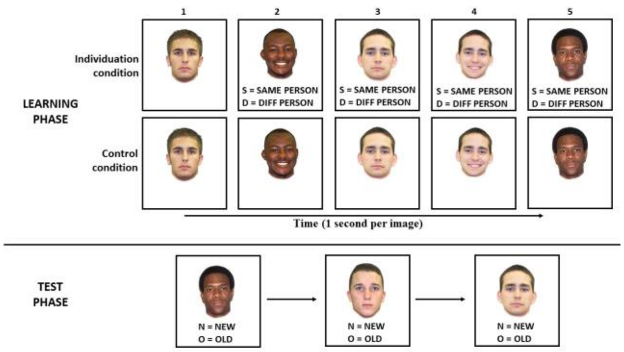


Figure 1: Individuation encoding task

Before commencing the individuation condition, participants completed a practice block in which the learning phase contained eight celebrities (four White celebrities and four Black celebrities). Each celebrity was presented twice with different images, with each image appearing for 1 second, consistent with the experimental task. Sometimes, the same celebrity was presented twice consecutively – again, this occurred equally for White and Black celebrities. Participants indicated whether each celebrity face was old or new by pressing 'o' or 'n' on their keyboard, respectively.

## Results

**Encoding performance** Participants individuated White faces (M = 96.6%, *SD* = 3.90) more accurately than Black faces (M = 94.7%, *SD* = 4.73), $t(49) = 4.211$, $p < .001$, Cohen's d = 0.596, and $BF_{10} = 213.035$. Note that accuracy refers to the percentage of trials answered correctly.

**Sensitivity** A 2 (race: White, Black) x 2 (encoding condition: control, individuation) repeated measures ANOVA was conducted with sensitivity (d-prime) as the dependent variable. The main effect of race was significant, $F(1, 49) = 32.737$, $p < .001$, $\eta_p^2 = .401$, and $BF_{10} > 1000$. Participants showed greater sensitivity for White faces (M = 1.12, *SD* = 0.57) than for Black faces (M = 0.84, *SD* = 0.50). The main effect of encoding condition was non-significant, $F(1,49) = 0.046$, $p = .831$, $\eta_p^2 < 0.001$, and $BF_{10} = 0.214$. The two-way interaction between race and encoding condition was also non-significant, $F(1,49) = 0.004$, $p = .952$, $\eta_p^2 < .001$, and $BF_{10} = 0.155$, suggesting that individuating encoding of study faces did not reduce the other-race effect in recognition (see left panel of Figure 2; note error bars depict standard error).

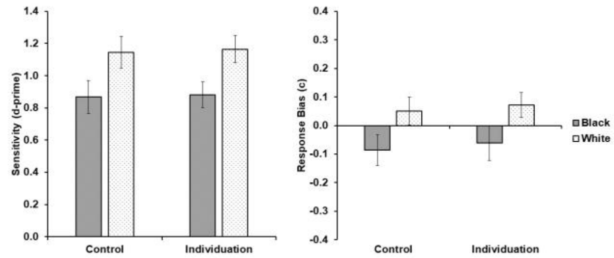


Figure 2: Experiment 1A sensitivity (left) and response bias (right)

**Response Bias** The same analysis was repeated with response bias (c) as the dependent variable. Note that a liberal bias indicates a tendency to say that faces are "old", whereas a conservative bias indicates a tendency to say that faces are "new". The main effect of race was significant, $F(1,49) = 7.793$, $p = .007$, $\eta_p^2 = .054$, and $BF_{10} = 8.916$. Participants responded more liberally for Black faces (M = -0.07, *SD* = 0.31) than for White faces (M = 0.06, *SD* = 0.24). The main effect of encoding condition was non-significant, $F(1,49) = 0.206$, $p = .652$, $\eta_p^2 = 0.002$, and $BF_{10} = 0.160$. The two-way interaction between race and encoding condition was also non-significant, $F(1,49) = 0.002$, $p = .964$, $\eta_p^2 < .001$, and $BF_{10} = 0.208$, suggesting that individuating study faces did not moderate the other-race effect in response bias (see right panel of Figure 2).

# Experiment 1B (Categorization)

## Method

**Participants** A total of 51 White undergraduate students completed the experiment (39 females, mean age = 21.80 years, *SD* = 7.11 years).

**Materials and Stimuli** All experimental stimuli were identical to Experiment 1.

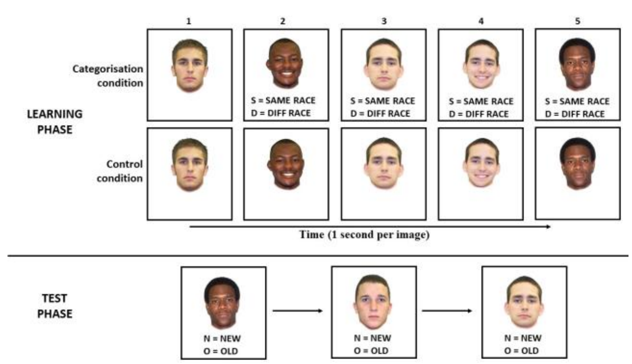


Figure 3: Categorization encoding task

**Procedure** The experimental procedure was identical to Experiment 1A, with one exception. Instead of completing two individuation encoding blocks, participants completed two categorization encoding blocks. In the categorization encoding condition, participants completed a one-back task during the learning phase. For each face that appeared during the learning phase (except for the first face), participants indicated whether the face belonged to the same race as the previous face (by pressing the ‘s’ key), or a different race to the previous face (by pressing the ‘d’ key; see Figure 3). The counterbalancing process was also identical to Experiment 1A. Before commencing the categorization task, participants completed a practice categorization task using the same stimuli as Experiment 1A.

## Results

**Encoding performance** Accuracy on the categorization encoding task was not significantly different for White faces (M = 89.5%, *SD* = 10.14) and Black faces (M = 90.3%, *SD* = 10.10), $t(50) = 1.394$, $p = .169$, Cohen’s d = 0.195, and $BF_{10} = 0.378$.

**Sensitivity** A 2 (race: White, Black) x 2 (encoding condition: control, categorization) repeated measures ANOVA was conducted with sensitivity (d-prime) as the dependent variable. The main effect of race was significant, $F(1, 50) = 6.384$, $p = .015$, $\eta_p^2 = .113$, and $BF_{10} = 2.033$. Participants demonstrated greater sensitivity for White faces (M = 0.86, *SD* = 0.62) than for Black faces (M = 0.70, *SD* = 0.44). The main effect of encoding condition was also significant, $F(1,50) = 12.703$, $p < .001$, $\eta_p^2 = .203$, and $BF_{10} = 209.007$. Participants demonstrated weaker sensitivity in the categorization encoding condition (M = 0.63, *SD* = 0.42) than in the control condition (M = 0.89, *SD* = 0.67). However, the two-way interaction between race and encoding condition was non-significant, $F(1,50) = 0.591$, $p = .446$, $\eta_p^2 = .012$, and $BF_{10} = 0.256$ (see left panel of Figure 4).

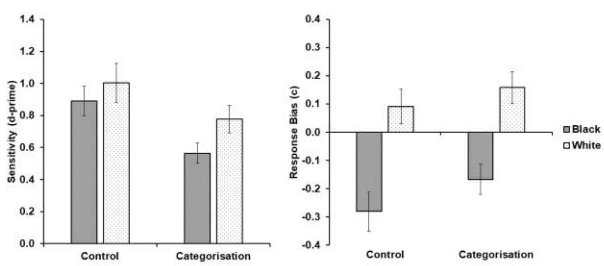


Figure 4: Experiment 1B sensitivity (left) and response bias (right)

**Response Bias** The same analysis was repeated with response bias (c). The main effect of race was significant, $F(1,50) = 46.946$, $p < .001$, $\eta_p^2 = .484$, and $BF_{10} > 1000$. Participants responded more liberally for Black faces (M = -0.20, *SD* = 0.37) than for White faces (M = 0.13, *SD* = 0.33). The main effect of encoding condition was marginally non-significant, $F(1,50) = 3.155$, $p = .082$, $\eta_p^2 = 0.059$, and $BF_{10} = 1.050$. The two-way interaction between race and encoding condition was also non-significant, $F(1,50) = 0.684$, $p = .412$, $\eta_p^2 = .013$, and $BF_{10} = 0.218$ (see right panel of Figure 4).

## Discussion

Experiment 1A tested the impact of individuation encoding relative to a control condition in which participants passively viewed each face during the study phase. Individuation encoding did not improve sensitivity, nor did it moderate the other-race effect in sensitivity or response bias. Experiment 1B tested the impact of categorization encoding. Although categorization encoding weakened overall sensitivity, it did so equally for Black and White faces. One limitation with both experiments is that participants who completed the individuation or categorization condition first could have carried that encoding strategy into the subsequent control condition. Such a carry-over effect would reduce the observed impact of the individuation and categorization encoding conditions. It is also worth noting that participants had to remember many faces. Participants viewed 30 faces (presented twice) during each of four study phases, resulting in a total of 120 study faces across the entire experiment. Recent evidence has shown that encoding manipulations can have a greater impact on face recognition when the number of studied items is reduced (Ding, Whitlock, & Sahakyan, 2022). To address these potential issues, Experiment 2 tested the same individuation and categorization manipulations using a between-subjects design to help ensure that participants: (i) could not transfer encoding strategies from one condition to another; and (ii) completed a smaller number of trials, thus reducing the likelihood that encoding effects might be swamped by task difficulty.

# Experiment 2

## Method

**Participants** A total of 207 White undergraduate students completed the experiment, including 73 participants in the control group (52 females, mean age = 20.80 years, *SD* = 5.03 years), 68 participants in the individuation group (49 females, mean age = 20.78 years, *SD* = 5.03 years), and 66 participants in the categorization group (50 females, mean age = 20.64 years, *SD* = 5.80 years).

**Materials and Stimuli** The experimental stimuli were a subset of the faces used in Experiments 1A and 1B and included 90 photographs depicting 60 different identities, with two images for 30 “old” identities plus a single (neutral) image of 30 “new” identities.

**Procedure** The procedure was identical to Experiments 1A and 1B, except participants completed only one block instead of four. Participants were randomly allocated to the control, individuation, or categorization encoding group. Each group completed a single study phase of 30 faces and a test phase of 60 faces. The same faces were presented in the same order across the three encoding conditions; hence any observed effects cannot be attributed to differences in the memorability of faces nor the order in which faces were presented.

## Results

**Encoding performance** A 2 (stimulus race: White, Black) x 2 (encoding condition: individuation, categorization) mixed ANOVA was conducted, using accuracy as the dependent variable. Stimulus race was manipulated within subjects, and encoding condition was manipulated between subjects. The main effect of stimulus race was non-significant, $F(1, 132) = 0.390$, $p = .533$, $\eta_p^2 = .003$, and $BF_{10} = 0.122$. The main effect of encoding condition was significant, $F(1, 132) = 10.545$, $p = .001$, $\eta_p^2 = .074$, and $BF_{10} = 26.569$. The stimulus race x encoding condition interaction was significant, $F(1, 132) = 22.005$, $p < .001$, $\eta_p^2 = .143$, and $BF_{10} = 2269.658$. Participants individuated White faces (M = 94.8%, *SD* = 9.2) more accurately than Black faces (M = 91.4%, *SD* = 9.4), $t(67) = 5.130$, $p < .001$, Cohen's d = 0.622, and $BF_{10} > 1000$. However, participants categorized Black faces (M = 88.3%, *SD* = 14.3) more accurately than White faces (M = 85.7%, *SD* = 12.3), $t(65) = 2.355$, $p = .022$, Cohen's d = 0.290 and $BF_{10} = 1.749$.

**Sensitivity** To observe the effects of individuation on sensitivity, a 2 (stimulus race: White, Black) x 2 (encoding condition: individuation, control) mixed ANOVA was conducted. The main effect of race was significant, $F(1, 139) = 14.381$, $p < .001$, $\eta_p^2 = .094$, and $BF_{10} = 101.470$, with higher sensitivity for White faces (M = 1.22, *SD* = 0.83) than Black faces (M = 0.97, *SD* = 0.73). The main effect of encoding condition was non-significant, $F(1,139) = 0.971$, $p = .326$, $\eta_p^2 = .007$, and $BF_{10} = 0.335$. The race x encoding condition interaction was also non-significant, $F(1,139) = 2.675$, $p = .104$, $\eta_p^2 = .019$, and $BF_{10} = 0.626$. To observe the effects of categorization on sensitivity, a 2 (stimulus race: White, Black) x 2 (encoding condition: categorization, control) mixed ANOVA was conducted. The main effect of race was significant, $F(1, 137) = 5.407$, $p < .022$, $\eta_p^2 = .038$, and $BF_{10} = 1.935$, with higher sensitivity for White faces (M = 1.03, *SD* = 0.86) than Black faces (M = 0.87, *SD* = 0.73). The main effect of encoding condition was non-significant, $F(1,137) = 2.884$, $p = .092$, $\eta_p^2 = .021$, and $BF_{10} = 0.745$. However, the race x encoding condition interaction was significant, $F(1,137) = 8.683$, $p = .004$, $\eta_p^2 = .060$, and $BF_{10} = 8.763$. The other-race effect was significant in the control group (M = 0.36, *SD* = 0.81), $t(72) = 3.776$, $p < .001$, Cohen's d = 0.442, and $BF_{10} = 69.401$, but was eliminated in the categorization group (M = -0.04, *SD* = 0.78), $t(65) = 0.435$, $p = .665$, Cohen's d = 0.054, and $BF_{10} = 0.148$.

**Response Bias** To observe the effects of individuation encoding on response bias, a 2 (stimulus race; White, Black) x 2 (encoding condition; individuation, control) mixed ANOVA was conducted, with response bias (c) as the dependent variable. The main effect of race was significant, $F(1,139) = 7.083$, $p = .009$, $\eta_p^2 = .048$, and $BF_{10} = 3.410$. Participants responded more liberally when viewing Black faces (M = -0.21, *SD* = 0.54) than White faces (M = -0.08, *SD* = 0.46). The main effect of encoding condition was also significant, $F(1,139) = 8.916$, $p = .003$, $\eta_p^2 = 0.060$, and $BF_{10} = 9.784$. Participants in the individuation condition responded more liberally (M = -0.23, *SD* = 0.30) than participants in the control condition (M = -0.05, *SD* = 0.44). The race x encoding condition interaction was non-significant, $F(1,139) = 0.666$, $p = .416$, $\eta_p^2 = .005$, and $BF_{10} = 0.250$. An equivalent analysis was used to test the impact of categorization encoding on response bias. The main effect of race was significant, $F(1,137) = 5.643$, $p = .019$, $\eta_p^2 = .040$, and $BF_{10} = 1.765$. Participants responded more liberally to Black faces (M = -0.10, *SD* = 0.53) than to White faces (M = 0.21, *SD* = 0.49). The main effect of encoding condition was non-significant, $F(1,137) = 0.064$, $p = .800$, $\eta_p^2 < 0.001$, and $BF_{10} = 0.193$. The race x encoding condition interaction was also non-significant, $F(1,137) = 0.365$, $p = .547$, $\eta_p^2 = .003$, and $BF_{10} = 0.214$.

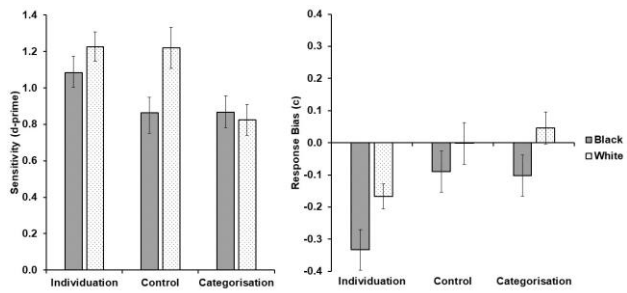


Figure 5: Sensitivity (left) and response bias (right)

## Discussion

As in Experiments 1A and 1B, Experiment 2 tested whether individuation and categorization encoding could moderate the other-race effect in face recognition. However, unlike Experiments 1A and 1B, Experiment 2 employed a between-subjects design to prevent carry-over effects and reduce the number of faces to be remembered. Results from the learning phase indicated that people individuated White faces more accurately than Black faces and categorized Black faces more accurately than White faces. Results from the test phase indicated that individuation encoding did not significantly reduce the other-race effect in sensitivity or response bias, whereas categorization encoding eliminated the other-race effect in recognition sensitivity (but not response bias), primarily due to a decline in sensitivity for own-race faces.

## General Discussion

This study assessed whether an encoding manipulation designed to promote individuation or categorization of faces could moderate the other-race effect in face recognition. The encoding manipulation was a one-back task, in which participants viewed one face at a time and indicated whether the face belonged to the same identity (individuation encoding) or the same race (categorization encoding) as the preceding face. Experiments 1A and 1B produced a reliable other-race effect in sensitivity and response bias, with participants responding less accurately and more liberally when recognizing Black faces than White faces. However, neither individuation nor categorization encoding moderated the other-race effect in recognition sensitivity or response bias. Experiment 2 employed a between-subjects design and reduced the number of faces presented to participants. Again, individuation encoding did not significantly reduce the other-race effect in recognition sensitivity or response bias. However, categorization encoding eliminated the other-race effect in recognition sensitivity (but not response bias).

The finding that individuation encoding did not moderate the other-race effect is inconsistent with the social-cognitive perspective, which suggests that encouraging people to individuate other-race faces should reduce the other-race effect (Hugenberg et al., 2007). Regardless of whether participants completed a larger (Experiment 1) or smaller number of trials (Experiment 2), individuation encoding did not moderate the other-race effect, although we note that the Bayes Factor for the interaction in Experiment 2 provides only anecdotal evidence in favor of the null. The ineffectiveness of the individuation encoding manipulation in moderating the other-race effect can be more easily explained by the perceptual expertise perspective. This perspective implies that individuation is a marker of perceptual expertise and an ability that can be acquired only through sufficient experience and practice (Gauthier & Tarr, 1997; Tanaka, 2001; Anaki & Bentin, 2009). Relevantly, during the learning phase of both Experiment 1A and Experiment 2, participants individuated White faces more accurately than Black faces. The same finding emerged in Proietti et al. (2019), where participants matched White faces more accurately than Black faces during encoding. Whereas the Hugenberg et al. (2007) instructions encourage participants to attend more to Black faces than White faces during encoding, the manipulations employed in the present study and Proietti et al. (2019) require participants to individuate all faces regardless of race. Evidence from the learning phase of both studies suggests that White participants do this more effectively for White than Black faces, and thus the other-race effect in recognition remains intact. Note that this difficulty with individuating faces may be specific to the other race, and not any "out-group" faces. Proietti et al., (2019) also employed an individuation encoding manipulation while investigating the own-age bias. On that occasion, participants individuated own-age and other-age faces with equal accuracy, and the own-age bias in later recognition was subsequently eliminated.

The finding that categorization encoding eliminated the other-race effect in Experiment 2 can be explained using either the social-cognitive or perceptual expertise accounts. These accounts provide different explanations as to how *individuation* encoding can be achieved. However, both accounts agree that interventions that promote *categorization* encoding might reduce the other-race effect by undermining individuation of own-race faces. Indeed, when participants racially categorized faces during the learning phase, their recognition memory for White faces declined to such an extent that it matched the low sensitivity for Black faces that was found in both the categorization and control groups. Although categorization encoding eliminated the other-race effect in recognition sensitivity, this effect was found only when participants viewed the smaller sample of face stimuli. Meissner and Brigham (2001) highlighted several experimental factors that influence the other-race effect, including the amount of study time and whether facial images are altered from study phase to test phase. The results of the present study highlight how the number of face stimuli presented to participants can moderate the impact of encoding manipulations on the other-race effect. It is also worth noting that previous attempts to induce categorization encoding have failed to reduce the other-race effect (Rhodes et al., 2009). It is likely that our categorization one-back task placed greater cognitive load on participants' working memory during encoding. Indeed, categorization accuracy in our task was weaker than race coding accuracy in Rhodes et al. (2009). It is possible that categorization encoding of faces can reduce the other-race effect, but only if the categorization task itself reaches a certain threshold level of difficulty, beyond which participants can no longer process individual features in a manner suitable for subsequent recognition.

We note that only White participants were included in this study. The use of half-design experiments in which only White participants are tested is a common limitation among studies of the other-race effect (Wells & Olson, 2001). In this study, we focused on White participants because this is the group that shows the strongest other-race effect (Meissner & Brigham, 2001). However, future research could employ a fully crossed-over design to determine whether the impacts of individuation or categorization encoding might vary across participant race.

In conclusion, the present study tested whether an encoding task requiring participants to individuate or categorize faces could reduce the other-race effect in recognition. Across two experiments, participants individuated own-race faces more accurately than other-race faces during encoding, and this individuation encoding did not moderate the other-race effect in recognition sensitivity or response bias. These findings align more closely with the perceptual expertise account than the social-cognitive account and suggest that experimental manipulations designed to promote individuation encoding are unlikely to reduce the other-race effect in recognition. The present study also employed a similar one-back task designed to promote racial categorization of faces during encoding and found that this encoding manipulation can eliminate the other-race effect in recognition sensitivity (but not response bias) by weakening sensitivity for own-race faces. It appears that the most effective way to reduce the other-race effect is not to improve memory for other-race faces, but to weaken memory for own-race faces.

## References


Anaki, D., & Bentin, S. (2009). Familiarity effects on categorization levels of faces and objects. *Cognition, 111*, 144-149.

Bernstein, M. J., Young, S. G., & Hugenberg, K. (2007). The cross-category effect: Mere social categorization is sufficient to elicit an own-group bias in face recognition. *Psychological Science, 18*(8), 706-712.

Bornstein, B. H., Laub, C. E., Meissner, C. A., & Susa, K. J. (2013). The Cross-Race Effect: Resistant to instructions. *Journal of Criminology, Article 745836*, 1-6.

Ding, H., Whitlock, J., & Sahakyan, L. (2022). Can intentional forgetting reduce the cross-race effect in memory? *Psychonomic Bulletin and Review, 29*, 1387-1396.

Gauthier, I., & Tarr, M. J. (1997). Becoming a "Greeble" expert: Exploring mechanisms for face recognition. *Vision Research, 37*(12), 1673-1682.

Hugenberg, K., Miller, J., & Claypool, H. M. (2007). Categorization and individuation in the cross-race recognition deficit: Toward a solution to an insidious problem. *Journal of Experimental Social Psychology, 43*, 334-340.

Hugenberg, K., & Sacco, D. F. (2008). Social categorization and stereotyping: How social categorization biases person perception and face memory. *Social and Personality Psychology Compass, 2*, 1052-1072.

MacLin, O. H., & Malpass, R. S. (2001). Racial categorization of faces: The ambiguous race face effect. *Psychology, Public Policy, and Law, 7*(1), 98-118.

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law, 7*(1), 3-35.

Meissner, C. A., Brigham, J. C., & Butz, D. A. (2005). Memory for Own and Other-Race Faces: A Dual-Process Approach. *Applied Cognitive Psychology, 19*, 545-567.

Michel, C., Rossion, B., Han, J., Chung, C., & Caldara, R. (2006). Holistic processing is finely tuned for faces of one's own race. *Psychological Science, 17*, 608-615.

Proietti, V., Laurence, S., Matthews, C. M., Zhou, X., & Mondloch, C. J. (2019). Attending to identity cues reduces the own-age but not the own-race recognition advantage. *Vision Research, 157*, 184-191.

Rhodes, G., Brake, S., Taylor, K., & Tan, S. (1989). Expertise and the configural coding in face recognition. *British Journal of Psychology, 80*, 313-331.

Rhodes, G., Locke, V., Ewing, L., & Evangelista, E. (2009). Race coding and the other-race effect in face recognition. *Perception, 38*, 232-241.

Shriver, E. R., & Hugenberg, K. (2010). Power, individuation, and the cross-race recognition deficit. *Journal of Experimental Social Psychology, 46*, 767-774.

Shriver, E. R., Young, S. G., Hugenberg, K., Bernstein, M. J., & Lanter, J. R. (2008). Class, race, and the faces: Social context modulates the cross-race effect in face recognition. *Personality and Social Psychology Bulletin, 34*(2). 260-274.

Sporer, S. L. (2001). The Cross-Race Effect: Beyond recognition of faces in the laboratory. *Psychology, Public Policy, and Law, 7*(1), 170-200.

Tanaka, J. W. (2001). The entry point of face recognition: Evidence for face expertise. *Journal of Experimental Psychology: General, 130*(3), 534-543.

Tanaka, J. W., Kiefer, M., & Bukach, C. M. (2004). A holistic account of the own-race effect in face recognition: Evidence from a cross-cultural study. *Cognition, 93*, B1-B9.

Wan, L, Crookes, K., Reynolds, K. J., Irons, J. L., & McKone, E. (2015). A cultural setting where the other-race effect on face recognition has no social-motivational component and derives entirely from lifetime perceptual experience. *Cognition, 144*, 91-115.

Wells, G. L., & Olson, E. A. (2001). The other-race effect in eyewitness identification: What do we do about it? *Psychology, Public Policy, and Law, 7*(1), 230-246.

Young, S. G., Hugenberg, K., Bernstein, M. J., & Sacco, D. F. (2012). Perception and motivation in face recognition: A critical review of theories of the cross-race effect. *Personality and Social Psychology Review, 16*(2), 116-142.