Using recognition-induced forgetting to assess forgetting of racial minority faces

Research Thesis

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by

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Abstract

Recognition-induced forgetting is a forgetting effect whereby items held in visual long-term memory are forgotten as a consequence of recognizing other items of the same category. Previous research has demonstrated that recognition-induced forgetting occurs for White faces but not Black faces. Specifically, while recognizing one White face leads to the forgetting of another, memory for Black faces is undisturbed in the same situation. In the real world, the immunity of Black faces to recognition-induced forgetting could cause disproportionately more positive eyewitness identifications of Black suspects than White suspects. Are racial minority faces immune to recognition-induced forgetting? Here we tested recognition-induced forgetting of Asian faces. Despite replicating the immunity of Black faces to recognition-induced forgetting, Asian faces were susceptible to recognition-induced forgetting. These findings suggest that racial minority status of the face does not create immunity to recognition-induced forgetting.

Using recognition-induced forgetting to assess memory for racial minority faces

Recognition-induced forgetting is a forgetting effect that occurs between items of the same semantic category, whereby repeatedly retrieving one item (i.e., green vase) from long-term visual memory, induces the forgetting of another related item (i.e., blue vase) (Fukuda, Pall, Chen, & Maxcey, in press; Maxcey, 2016; Maxcey & Bostic, 2015; Maxcey, Bostic, & Maldonado, 2016; Maxcey, Dezso, Megla, & Schneider, 2019; Maxcey, Glenn, & Stansberry, 2017; Maxcey & Woodman, 2014; Maxcey, Janakiefski, Megla, Smerdell, & Stallkamp, 2019; Maxcey, McCann, & Stallkamp, 2020; Rugo, Tamler, Woodman, & Maxcey, 2017; Scotti, Janakiefski, & Maxcey, 2020). This forgetting effect in visual long-term memory is surprising because memory for pictures is better than memory for words (Standing, 1973). Research on forgetting from long-term memory has largely focused on verbal, not visual, material (Maxcey, 2016; Palmer, 1999), despite the high stakes of forgetting visual material, as in eyewitness testimony. The recognition-induced forgetting paradigm enables the strategic testing of a variety of visual materials that map on to real-world circumstances, such as faces in eyewitness testimony.

The typical recognition-induced forgetting experiment is split into three phases: the study, practice, and test phases. Throughout the phases, participants see a series of items and are either instructed to remember them (i.e., study phase) or their memory is tested for the items (i.e., recognition and test phases). Memory is tested in the practice and test phases using an old-new recognition judgment task. The experimental design creates three types of old items: practiced, related, and baseline items (**Fig. 1**). *Practiced items* and *related items* share a categorical identity (i.e. they are both pictures

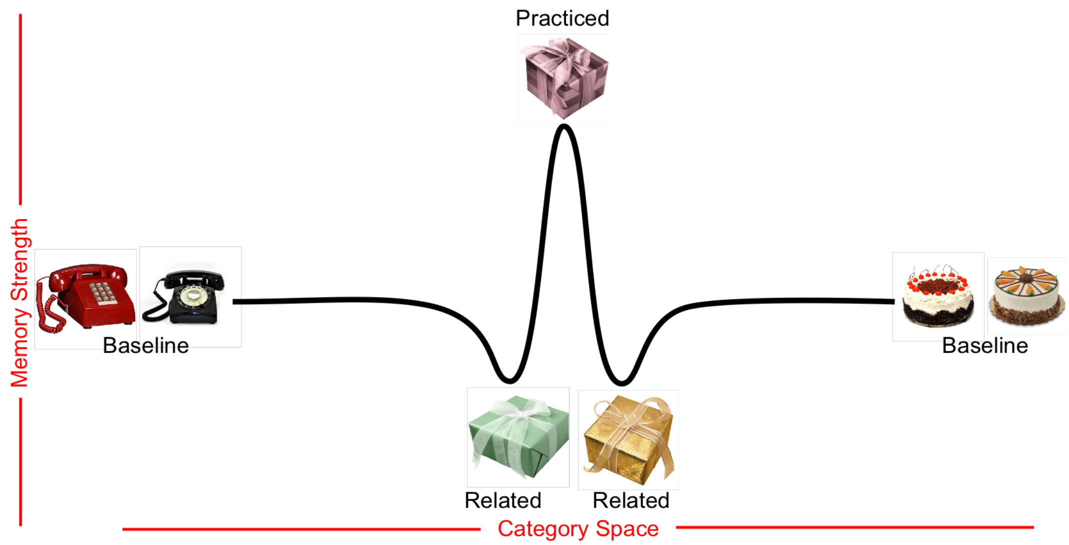

Fig 1. Difference-of-Gaussian activation pulse. The activation pulse demonstrates how the three item types differ based on memory strength. Practiced items (e.g., the purple gift) are seen multiple times during the experiment, increasing memory strength. The act of repeatedly retrieving the practiced items from the long-term memory induces the forgetting of the related items (e.g., the green and gold gifts), thus decreasing memory strength. Memory strength for baseline items (e.g., telephones and cakes) remains unaffected because they are not being influenced by the practicing of the other item categories (i.e., the gifts).

of vases) and were both studied during the study phase. The difference is that participants will engage in recognition of the practiced item in the practice phase, while memory of the related item is tested only during the final test phase. Recognition-induced forgetting is measured by comparing memory of the related items, which are presumably suppressed or selected against during recognition practice (Maxcey & Woodman, 2014), to *baseline items*. Baseline items are drawn from a different category than practiced and related items. Like related items, they are only seen at the beginning and end of the experiment, in the study and test phases. Baseline items serve as a reference point for memory for items that were not involved in practice. The hallmark of recognition-induced forgetting is reliably lower memory (measured in hit rate) for related items compared to memory for baseline items.

Studies of recognition-induced forgetting have repeatedly demonstrated that the memory for everyday objects can be forgotten (Maxcey & Woodman, 2014; Maxcey et al., 2016; Maxcey et al., 2019). The present study tests the forgetting of faces. Faces are considered objects of expertise, in part because all seeing humans are familiarized with the faces of other humans from birth (Chase & Simon, 1973). Our lab has previously tested recognition-induced forgetting of faces to determine if objects of expertise would be subject to the forgetting effect (Rugo et al., 2017). In that study, faces were overall susceptible to recognition-induced forgetting. However, the forgetting effect was driven by White faces. Black faces were immune to forgetting. Here we ask which face was the exception and which was the rule. In other words, are White faces the only faces susceptible to forgetting, or are Black faces the only faces immune to forgetting?

Black faces may have been immune to recognition-induced forgetting because racial minority faces are novel (i.e., on average, individuals have fewer pre-existing exemplars of racial minority faces) and thus better encoded into long-term memory.[1] This is supported by the *novelty encoding hypothesis*, which posits that unfamiliar stimuli are more likely to be stored in long-term memory (Tulving & Kroll, 1995; Tulving, Markowitsch, Craik, Habib, & Houle, 1996). The novelty hypothesis has some support, with evidence that racial minority faces are more salient in working memory, regardless

[1] Throughout this paper, we chose to use the word race as opposed to ethnicity (i.e., shared cultural characteristics), because we were testing memory of physical differences, in line with APA standards (American Psychological Association, 2020).

of the race of the participant (Gonzalez & Schyner, 2019). The novelty hypothesis would suggest that other racial minority faces would also be immune to recognition-induced forgetting.

Black faces may also be immune to recognition-induced forgetting due to emotional arousal. Specifically, Black faces elicit an emotionally arousing response (Phelps, O'Connor, Cunningham, & Funayama, 2000; Senholzi, Depue, Correll, Banich, & Ito, 2015), and emotional arousal is linked to improved memory (McGaugh, 2004). This *emotional arousal hypothesis* would suggest that only Black faces, not all racial minority faces, are immune to recognition-induced forgetting.

Here we tested recognition-induced forgetting of White, Black, and Asian faces. We chose to favor the novelty encoding hypothesis because research from our lab suggests that some emotionally arousing stimuli are susceptible to recognition-induced forgetting (Maxcey, Mancuso, Misbrener, & Spinelli, in preparation). We predict that we will replicate recognition-induced forgetting for White faces but not Black faces. We predict, consistent with the novelty encoding hypothesis, that Asian faces will be immune to recognition-induced forgetting.

Methods

Subjects

A G*Power power analysis (Faul, Erdfelder, Lang, & Buchner, 2007) using the smallest effect size from our previous face study (Rugo et al., 2017) determined that we would need 92 subjects to to find recognition-induced forgetting with 95% power, given a .05 criterion of significance. However, because we included three conditions instead of two (as in Rugo et al.) we decided to aim for 138 subjects.

Participants were 141 subjects from The Ohio State University and Vanderbilt University who participated for course credit. Participants self-reported normal color vision and normal or corrected-to-normal vision. All subjects provided informed consent and experiments were approved by the appropriate institutional review board. Additional demographic details (e.g., age, gender, ethnicity) are currently unavailable due to COVID-19 campus closures. Final analyses of gender and ethnicity (e.g., the same-race effect, same-gender effect, Rugo et al., 2014) will be completed upon the opening of campuses.

Stimuli

The total stimulus set consisted of 90 male faces and 90 female faces (see **Fig. 2** for sample stimuli) from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015). The set was comprised of an even distribution of Black, White, and Asian faces. Faces were standardized images of adults wearing a gray shirt with a neutral expression. Participants in the experiment were presented only with either male or female faces, counterbalanced across subjects. The 180 faces were selected based on their levels of prototypicality and unusualness according to ratings from a survey (Ma et al., 2015). Prototypicality was defined as how well a face's physical features seemed to align with other facial features faces of the corresponding ethnic group, while unusualness was defined as how well a

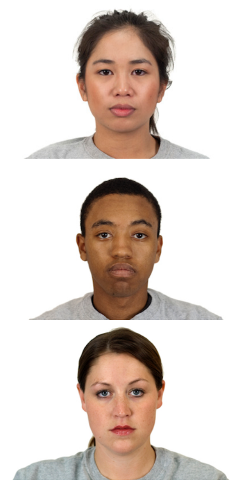

Fig. 2. Sample of stimuli. Faces were gathered from the Chicago Face Database. Stimuli used in the experiment were refined by prototypicality and unusualness.

certain face would stand out in a crowd. We aimed to select faces high on prototypicality and low on unusualness measures in order to eliminate faces that have unique features or that may be more racially ambiguous.

Procedure

The first phase of the experiment was the study phase. Faces were presented sequentially for 5 seconds each, interleaved with a 500 ms fixation cross (**Fig. 3**). Participants were instructed to memorize faces with as much visual detail as possible for a later memory test. The study phase consisted of 10 faces from each racial category (i.e., Asian, Black, and White), totaling 30 trials. Following the study phase was

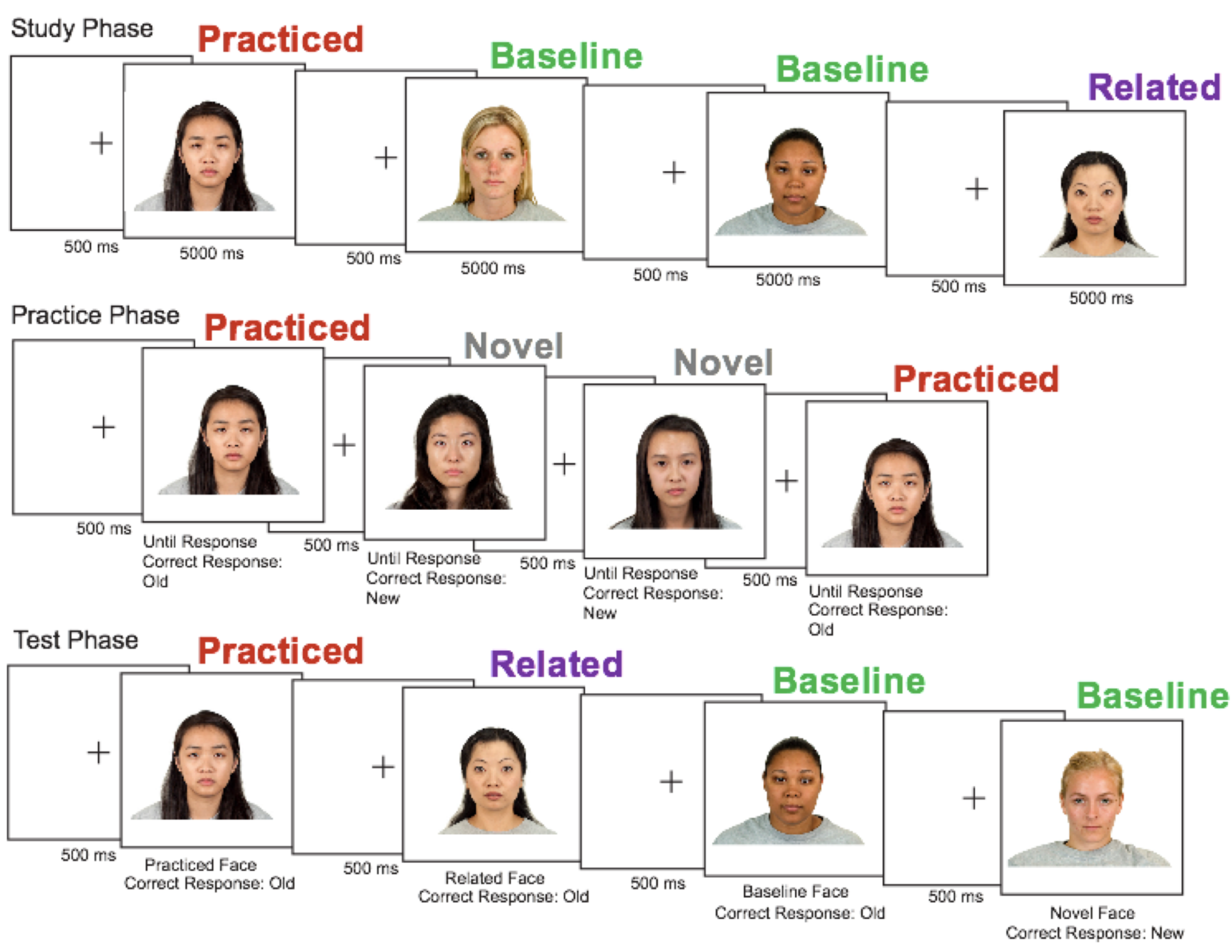

Fig. 3. Sample trials. Here we demonstrate practicing female Asian faces. Baseline items consist of White and Black faces.

a 5-minute delay task of *Where's Waldo*. The delay task ensured we were studying long-term memory and prevented the visual rehearsal of the faces.

The second phase of the experiment was the practice phase. Participants completed an old-new recognition judgment task in response to half of the faces from one of the racial categories. The specific race practiced was counterbalanced across participants. Faces were sequentially presented and remained on the screen until response. Participants indicated whether the face was old or new by button press using their right or left index and middle fingers. Each old (i.e., practiced) face was presented twice, on two separate trials, totaling 10 trials in which the correct response was *old*. To create a 50/50 old/new response distribution, 10 novel faces were drawn from the same racial category, to which the correct response was *new*. Accuracy, not speed, was stressed to the participants.

The task in the final phase, the test phase, was identical to the task in the recognition practice phase. The faces included in the test phase were (1) 5 practiced faces, (2) 5 related faces, (3) 20 baseline faces, and (4) 30 novel faces. In the test phase, participants viewed the practiced faces for the fourth time in the experiment (i.e., once in the study phase, twice in the practice phase, and now once in the test phase) and baseline and related faces for the second time (i.e., once in the study phase and now once in the test phase). None of the novel faces from the practice face were presented in the test phase.

Results

Of the 141 participants, 61 subjects were excluded from further analyses because their baseline memory performance was at or below chance (50%). The following results include the remaining 80 subjects. We first analyzed average memory performance collapsing across practiced racial category (**Fig. 4a**). Overall, subjects' memory for practiced faces (87%) was reliably higher than memory for baseline faces

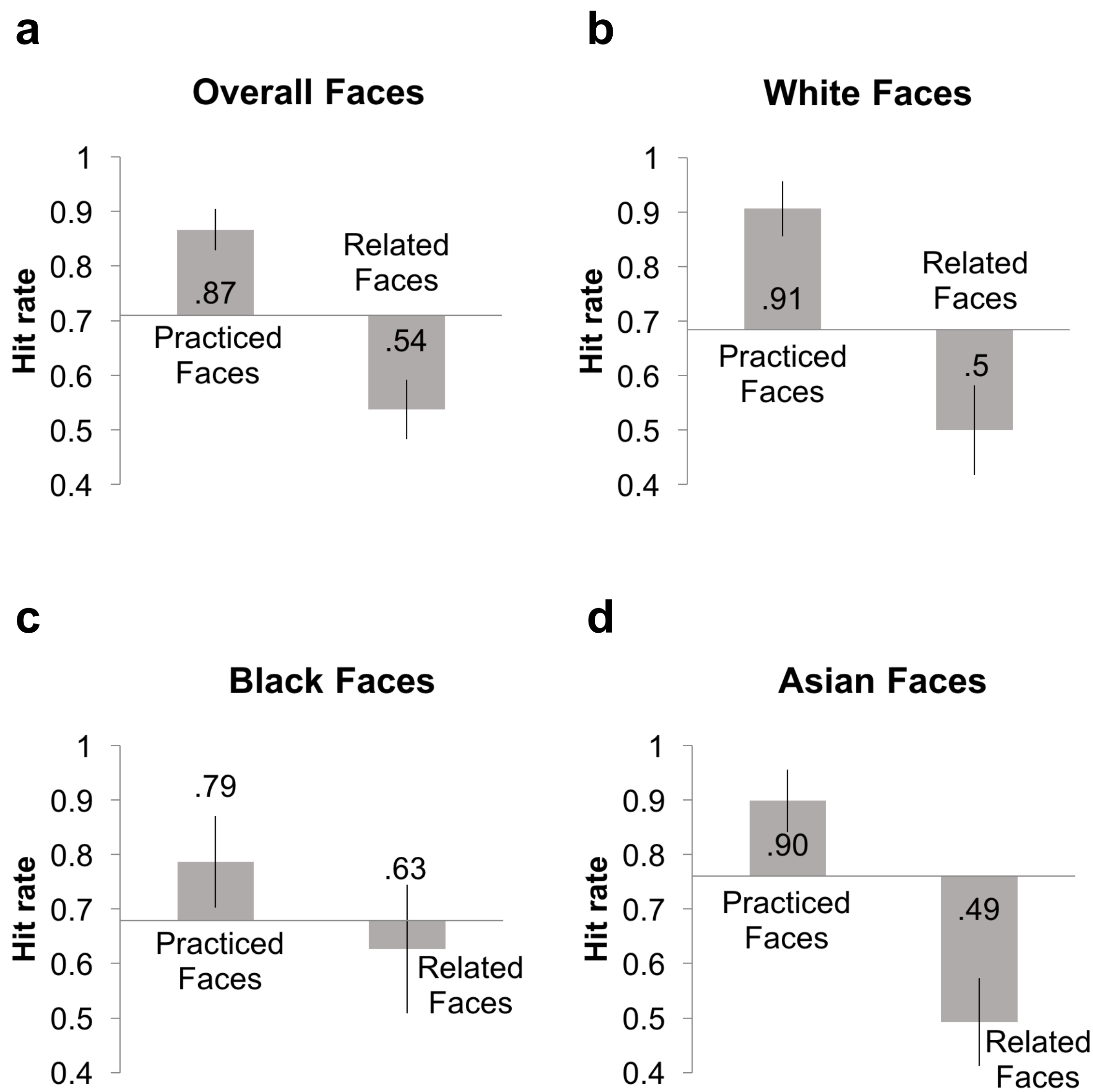

Fig. 4. Hit rates of practiced and related faces from the test phase. We were able to replicate the prior study results, finding recognition-induced forgetting for White but not Black faces. Against our hypothesis, we also found recognition-induced forgetting for Asian faces, indicating that minority racial status does not modulate the forgetting effect.

(71%), $t(79) = -5.292$, $p < .001$, $d = .857$, $JZS_{alt} = 13958.18$.[2] Better memory for practiced items relative to baseline is referred to as the practice effect, and is not surprising because the practice items were seen four times during the experiment and baseline items were seen twice. Memory for related faces (54%) was reliably lower than memory for baseline faces (71%), $t(79) = 4.426$, $p < .001$, $d = .684$, $JZS_{alt} = 598.604$, indicating reliable recognition-induced forgetting across all faces, replicating our previous work using White and Black faces (Rugo et al., 2017).[3]

We next analyzed memory as a function of the race of the practiced face. When the practiced face was White, recognition-induced forgetting was found with significantly worse memory for related faces (50%) than baseline faces (68%), $t(78) = 3.438$, $p = .001$, $d = .735$, $JZS_{alt} = 31.893$ (**Fig. 4b**).[4] This replicates our previous study in which White faces were susceptible to recognition-induced forgetting. For subjects who practiced Black faces, memory for related faces (63%) was not significantly lower than baseline faces (68%), $t(78) = .848$, $p = .399$, $d = .172$, $JZS_{null} = 2.969$ (**Fig. 4c**).[5] This replicates our previous study in which Black faces were immune to recognition-induced forgetting. Finally, when Asian faces were practiced, memory for related faces (.49%) was reliably lower than memory for baseline faces (.76%), $t(78) = 5.260$, $p < .001$, $d =$

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[2] The overall practice effect was reliable accounting for false alarm rate with practice (.68) above baseline (.53), $t(79) = -5.292$, $p < .001$, $d = .697$, $JZS_{alt} = 13958.18$.

[3] Accounting for false alarms, overall recognition-induced forgetting was reliable with memory for related items (.36.) falling significantly below baseline (.53), $t(79) = 4.426$, $p < .001$, $d = .597$, $JZS_{alt} = 598.604$.

[4] Recognition-induced forgetting was reliable for White faces, factoring false alarms, with memory for related items (.35) falling significantly below baseline (.51), $t(78) = 2.505$, $p = .014$, $d = .559$, $JZS_{alt} = 3.380$.

[5] Recognition-induced forgetting was naturally absent in Black faces, factoring false alarms, with memory for related items (.49) not falling significantly below baseline (.44), $t(78) = -.649$, $p = .519$, $d = .145$, $JZS_{null} = 3.370$.

1.189, JZS_{alt} = 10962.29 (**Fig. 4d**).[6] The susceptibility of Asian faces to recognition-induced forgetting is inconsistent with the prediction that racial minority faces were immune to the effect of the novelty hypothesis.

To ensure that forgetting of Asian faces was not due to overall lower memorability of Asian faces, we compared baseline memory across the three racial groups (**Fig. 5**). Overall, Asian faces were more memorable than both Black and White faces, meaning recognition-induced forgetting of Asian faces here is indeed induced by recognition and not due to poor memorability.

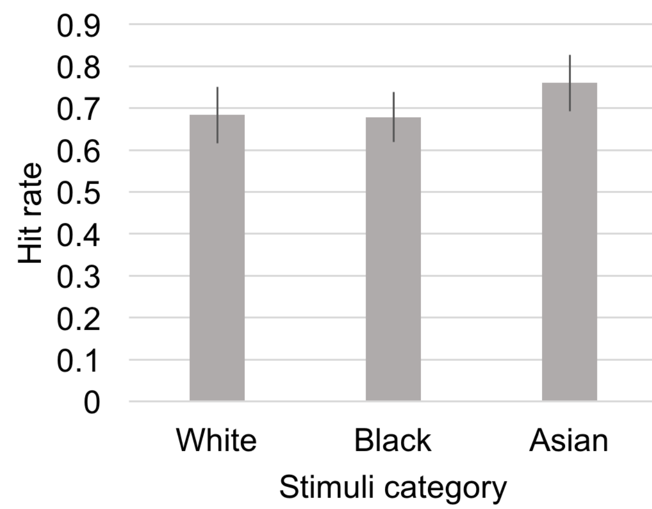

Fig. 5. Baseline hit rate analysis of stimuli by race. Asian faces were more memorable than Black and White faces, meaning their forgetting is indeed recognition induced, not due to poor memorability.

Discussion

Our lab has demonstrated that while recognition-induced forgetting occurs for White faces, it does not occur for Black faces (Rugo et al., 2017). The novelty hypothesis posits that the forgetting effect is modulated by racial minority status. In the present study, we sought to test this hypothesis by including a third category of faces, Asian faces. We predicted that as racial minority faces, Asian faces would replicate

[6] Recognition-induced forgetting was reliable for Asian faces, factoring false alarms, with memory for related items (.35) falling significantly below baseline (.56), $t(78)$ = 3.306, p = .001, d = .775, JZS_{alt} = 22.477.

Black faces and not be susceptible to the forgetting effect. Importantly, we replicated the Rugo et al. study, finding recognition-induced forgetting for White faces but not Black faces. Contrary to our prediction, Asian faces were susceptible to recognition-induced forgetting. This finding is inconsistent with the novelty hypothesis, which explained the immunity of Black faces to recognition-induced forgetting as driven by increased memorability due to their racial minority status. Instead, it appears that an explanation in which Black faces are uniquely remembered, such as that made by the emotion hypothesis, explains why Black faces are immune to recognition-induced forgetting while other faces (i.e., White and Asian) are susceptible to forgetting.

Our results may have real-world implications, such as on eyewitness testimony. For example, in a line-up scenario, recognizing suspects of the same race could trigger recognition-induced forgetting to occur. The consequence of recognition-induced forgetting in this scenario is that the face of a perpetrator could be forgotten. Knowledge that this effect unevenly applies across races means that if the suspect is Black, they may not be forgotten. This increased memory for Black faces suggests a disproportionately larger number of Black suspects could be identified and ultimately convicted relative to Asian and White suspects.

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