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Group Information Enhances Recognition of Both Learned and Unlearned Face Appearances

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Are people better at recognizing individuals of more relevant groups, such as ingroup compared to outgroup members or high-status compared to low-status individuals? Previous studies that associated faces with group information found a robust effect of group on face recognition but only tested it using the same images presented during the learning phase. They therefore cannot tell whether group information enhances encoding of the specific image presented during learning or encoding of the person who appears in it, which should generalize to other images of that person. In addition, the measures used in these studies do not sufficiently distinguish between sensitivity and response bias. In this article, we addressed these limitations and examined in three experiments the effect of group membership (Experiments 1 and 2) and social status (Experiment 3) on face recognition. In all experiments, we assessed recognition of both learned and unlearned views of the learned faces. Our results show improved recognition of ingroup members compared to outgroup members and of individuals of high-status groups compared to low-status groups for both learned and unlearned views. These effects emerged also when we used measures of memory accuracy that adequately control for response bias. These findings highlight the importance of group and status information in person recognition.

Statement of Limitations

This study examines the generalization of face memory through manipulation of only one aspect of the face (the head's view). Therefore, conclusions drawn from the study may be limited to recognition across views or across images taken in the same setting. In addition, this study examined only recognition of unfamiliar faces that were learned from just one or two images, and thus the effect that we report here might not generalize to recognition of familiar people or recognition of people that were initially learned in a rich visual context. Finally, in all three experiments, we used group manipulations that implied the importance or frequency of future social interactions, but we did not examine the effect of this factor directly.

Keywords: face recognition, group information, social status

Supplemental materials: https://doi.org/10.1037/pspa0000420.supp

Face recognition is critical for intact social interactions. We need to remember the faces of others in order to ask for a favor or repay it, exchange goods, seek and provide support, or to avoid a person whose company we find unpleasant. These examples suggest that memory for faces should be sensitive to the likelihood of a social encounter in which such memory would be important. A person's group identity—whether that person is a member of the ingroup and what is their social role—may be very valuable in determining whether recognizing their face is likely to be of value. Consistent with this idea, research has shown that face recognition is sensitive

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Galit Yovel and Nira Liberman contributed equally to this article. All data and analysis code are available on the Open Science Framework (https://osf.io/vum7q/?view_only=79fc94ad2f7b4f758a24822422248215). Experiment 1 was not preregistered. Experiment 2 was preregistered at https://aspredicted.org/gg6m-pvxd.pdf, and Experiment 3 was preregistered at https://aspredicted.org/vj5r-fxsz.pdf.

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to social group, such that people show better face recognition for ingroup than outgroup individuals (Bernstein et al., 2007; Hehman et al., 2010; Ng et al., 2016; Shriver et al., 2008; Young et al., 2010). Research has also shown that faces of individuals from high-status groups are recognized better than faces of individuals from low-status groups (N. J. Ratcliff et al., 2011; Shriver et al., 2008; Shriver & Hugenberg, 2010). It has been suggested that these effects reflect the importance assigned to these groups and the expectations for future interactions with their members. Consistent with this notion, Wilson et al. (2014; Experiment 2) found that although participants recognized ingroup faces better than outgroup faces, when they were told that interactions with the outgroup individuals would be as frequent as with ingroup individuals, this difference was reduced due to improved recognition of outgroup faces. Similarly, Van Bavel and Cunningham (2012; Experiment 3) showed that when participants were assigned a social role that required attention to outgroup members (i.e., a spy who is expected to infiltrate the other group), they recognized outgroup faces as well as ingroup faces. In contrast, participants who were assigned a social role that does not require such attention to the outgroup members (i.e., a soldier who is expected to serve his own group) recognized ingroup faces better than outgroup faces.

Taken together, these studies suggest that information about a social group can enhance memory for the faces of its members, especially when it indicates a probable social interaction with them. These studies also illuminate one mechanism by which stereotypes about outgroups and about low-status groups are created, maintained, and manifested. Specifically, they document a tendency to process members of some groups in a deindividuated manner, with relatively poor differentiation between individuals within that group (Hugenberg et al., 2010). Research on this important topic, however, left open two central questions. The first question is whether group information affected recognition of the person beyond the specific appearance that has been learned. As all previous studies presented the same image at both learning and testing, it is not clear if the effect they found would generalize to unlearned images of that person's face. If memory for faces serves to facilitate meaningful personal social encounters (e.g., to enable recognition of the person who promised to repay us a favor), then such information should facilitate not only memory for the specific appearance that we saw but also memory for other appearances of that person.

The second question is whether the effects observed for ingroup faces are genuine mnemonic effects—sensitivity—or perhaps effects of bias. *Sensitivity* refers to the ability to distinguish between faces that were encoded and faces that were not encoded. It is the mnemonic interpretation that previous research has attributed to the enhanced performance observed for ingroup faces. However, an alternative explanation is that participants have an enhanced tendency to respond "yes, I have seen this face before" to ingroup and high-status faces as compared to faces of outgroup members and of low-status groups, irrespective of whether they were learned or not.

To address the source of better memory for learned ingroup faces, researchers have used measures that balance the Hit rates (HRs, the proportion of correct recognitions of stimuli as "learned") and False Alarm rates (FARs, the proportion of incorrect recognition of stimuli as "learned"). These measures include the difference between HRs and FARs (HR–FAR) and d' (Tanner & Swets, 1954) for assessing sensitivity. However, Rotello et al. (2008) as well as, more recently, Levi et al. (2024a) alerted researchers against such measures by showing that in recognition memory, they confound sensitivity and response bias. If group information affects recognition of its members, it is important to ensure that the effect reflects sensitivity rather than being a product of potential bias. In the following sections, we describe in more detail each of these questions, explain their importance, and present ways to examine them, which we then implement in Experiments 2 and 3.

Recognition Beyond Specific Appearances

So far, the group effect was demonstrated in recognition tasks that presented one face image of each person during learning and then the identical image at test. These studies, therefore, examined image recognition rather than person recognition (e.g., Armann et al., 2016; Jenkins et al., 2011; Liu et al., 2009; for a review, see Burton, 2013). Because of the great variability between different images of the same person, we can sometimes recognize a previously learned image of a face but fail to recognize a different image of the same person (Bruce, 1982). Successful person recognition relies on understanding how that face changes across different appearances (Burton et al., 2016). Person recognition can be tested only if we examine recognition across different appearances of the same person.

This question is particularly significant when studying the effect of social group on face recognition. This is because the effect of social group is thought to reflect anticipation for future interaction in which the learned face is likely to appear differently (Wilson et al., 2014). That is, to show that information about social group indeed facilitates face recognition in a socially meaningful setup, one needs to demonstrate an advantage not only with the specific appearance that was learned but also with different appearances of the same person. A recognition task that presents the same image at learning and at test cannot tell whether a view-invariant representation has been formed, and in that way is somewhat irrelevant to the proposed mechanism of anticipating future interactions.

To test whether effects of groups on face recognition indeed affect person- rather than image-based recognition, we adopted a paradigm recently developed by Schwartz and Yovel (2019). The paradigm examined how different judgments at learning affect face recognition for learned and unlearned head-views of the learned persons. Schwartz and Yovel (2019) showed that making social judgments about faces during learning (e.g., "How friendly does the face look?") improved person recognition from both learned and unlearned head views, compared to making perceptual judgments (e.g., "How wide is the face?") as well as compared to no judgments. Furthermore, the magnitude of the social over perceptual judgment benefit for face recognition was similar for the learned and unlearned views of the same person. In another study, Mattarozzi et al. (2019) also tested recognition of learned persons from unlearned head views and found that it improved when the faces were presented with supplemented affective information about the person. Specifically, participants learned frontal images of faces together with descriptions of positive, negative, or neutral behaviors (e.g., "He volunteered to stay late to help a coworker," "She insulted a stranger by making a racial slur," "He watched an old western on the late show"), or without any such description. One week later, they were presented with test faces, half of which were presented in the learned (frontal) view and half in an unlearned view (¾-turned to the left or to the right). Persons associated with negative behaviors were recognized better than those associated with positive behaviors, and both were recognized better than persons associated with neutral behaviors. This effect was similar across all test views, learned and unlearned.

In the present study, we examine whether information about social group affects recognition of faces beyond the specific appearance. We conducted a recognition task that compared the effect of social group on images presenting both learned and unlearned head views of the learned persons. The test phase included the original, learned image of each face as well as unlearned images of that face, taken from an angle that increasingly differed from the original image (see Figure 1). For the learned views, we expected a replication of the previously found effect of social group, so ingroup members and individuals of high-status groups would be recognized better than outgroup members and low-status individuals. Consistent with prior research on recognition across changing viewpoints (O'Toole et al., 1998), we expected that recognition of learned persons pictured from different, unlearned views will be generally worse than recognition from learned views. Moreover, we expected that recognition accuracy would decrease as the viewpoints at test become increasingly divergent from the learned one. Our design also allowed us to examine whether the effects of social group and view would interact and, if so, in which way (see Figure 1).

A View-Specific Group Effect

The effect of social group will be evident only for the learned view, such that members of the ingroup and high-status groups will be recognized better than members of the outgroup and low-status groups when presented in the learned view but not when presented in unlearned views (Figure 1a). Some models of face processing predict that generalization to unlearned appearances of learned faces can be achieved only by providing additional visual information (Bruce & Young, 1986; Kramer et al., 2018). These models would predict that group information might facilitate recognition of the specific appearance presented at learning but would not generalize to unlearned appearances of the same person. This pattern would indicate that the previously found effects of social group only reflect better image-based recognition rather than better memory for the person.

A Group Main Effect

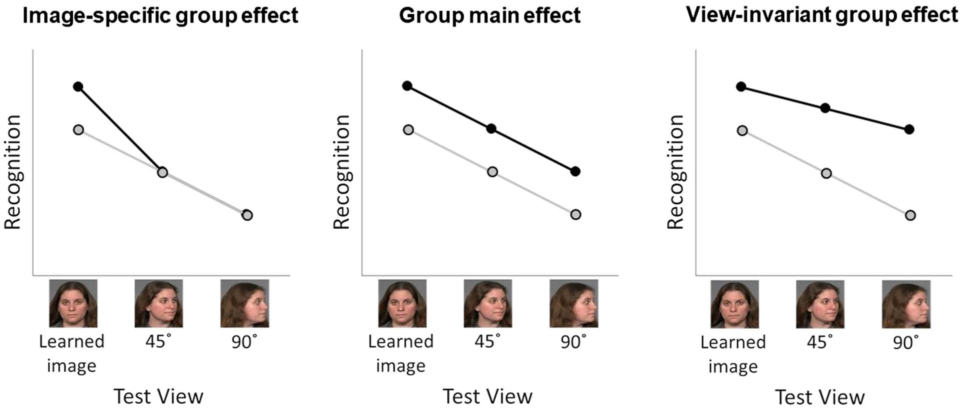
The effect of social group will be evident and similar in both learned and unlearned views of the same person. It is possible that ingroup and high-status (vs. outgroup and low status) group information would not only boost memory for the specific view but would also contribute to a better encoding of the person's identity, for example, by helping one to extract facial features that remain constant across different head views (Abudarham et al., 2019; Abudarham & Yovel, 2016). This pattern was recently found by Schwartz et al. (2023) and Schwartz and Yovel (2019), who demonstrated better recognition for faces that were socially, compared to perceptually, evaluated during learning. This pattern of results, if obtained, would suggest that the effects of ingroup versus outgroup and of high- versus low-status groups reflect better memory of the person that goes beyond specific appearances and would be consistent with the notion that the function of these effects is to support person recognition in novel situations.

A View-Invariant Group Effect

Worse recognition with increasingly dissimilar head-view will be less evident for ingroup and high-status faces compared to outgroup and low-status faces. This pattern is typically found when comparing recognition of familiar to unfamiliar faces (Armann et al., 2016; Bruce, 1982). It means that the representation of familiar faces is identity-based and therefore more invariant across different views than the representation of unfamiliar faces, which is more image-based and therefore view-dependent. Researchers typically assumed that the difference between familiar and unfamiliar faces stems from

Figure 1

Three Possible Patterns of Findings That Indicate How Social Group Affects Recognition for Learned and Unlearned Views of Learned Faces



Note. A view-specific group effect (left) indicates enhanced recognition of the learned view but no effect for unlearned views of the same person; a group main effect (center) indicates enhanced recognition of the person across learned and unlearned views; a view invariant group effect (right) indicates enhanced recognition of the person, and that recognition is generalized to unlearned views. See the online article for the color version of this figure.

the richer visual experience with familiar faces (Burton et al., 2016; Ritchie & Burton, 2017). But it could also be that people are more motivated to individuate familiar faces, and that motivation alone could produce view-invariant representation. If so, a view-invariant representation would emerge for ingroup and high-status faces more than for outgroup and low-status faces. This pattern would provide a particularly strong support for the notion that social information about the importance of an individual encourages representations that are useful for future interactions with the individual, in which we are likely to encounter them in a novel appearance.

Dissociating Sensitivity and Response Bias

Researchers who assess recognition performance usually use tasks that present participants with learned and unlearned stimuli and require a binary response (e.g., learned/unlearned; Hautus et al., 2021). The question of how to analyze such binary responses turns out to be quite difficult (Brady et al., 2023). Stimuli in those tasks are often presented under two, or more, conditions (e.g., ingroup vs. outgroup faces), and participants are expected to respond with a higher HR in the condition in which items are best remembered. However, higher HRs may likewise reflect a higher tendency to respond “learned” in that condition (i.e., a response bias). Researchers are typically interested in demonstrating differences in memory (sensitivity) across conditions, and as such, it is critical to provide evidence that the locus of the manipulation is memory, not bias. To this end, differences between conditions in HRs must be compared to differences in FARs. A difference in sensitivity can be inferred when HRs increase across conditions but FARs do not. However, changes (say, an increase) across conditions are often observed in both HRs and FARs, meaning that the participant tended to make more “learned” responses in one condition compared to the other. In this case, there could be either differences in both sensitivity and response bias or differences only in response bias.

Such bias might in fact occur for ingroup members in real life because people typically interact more frequently with ingroup than outgroup members, and, therefore, an ingroup face is more likely to have been seen before than an outgroup face. It is also more likely to happen for members of high- compared to low-status groups, as it is more adaptive not to miss powerful individuals. In a recognition task, participants might therefore indicate that they have seen the face of an ingroup member or a high-status individual (i.e., respond “learned”).

For these scenarios, the critical question is as follows: Given an increase in HRs in an experimental condition, what accompanying level of increase in FARs would be sufficiently small so to be able to attribute the changes in HRs and FARs to a mnemonic difference? In parallel, at what higher level of increase in FARs would the changes only reflect a change in bias (Brady et al., 2023)?

Measures of sensitivity were designed to balance HRs with FARs. Many proposals have been made on how to carry on this balancing act. Critically, the decision on how to balance HRs and FARs is entirely dependent on how the recognition data are distributed as a function of memory strength, that is, the data-generating model. Different measures assume different data-generating models. For example, the often used measure of d' (Tanner & Swets, 1954) is premised on the assumption that the distributions of memory strength for both targets (learned items) and lures (unlearned items) are continuous Gaussians in form and that they have equal variance. Other common measures are corrected Hit rate, HR–FAR, and its linear transformation, the percent of correct responses (Hautus et al., 2021). These measures assume the data-generating model to be a threshold process, representing an all-or-none information. The nature of the true data-generating model is a topic of hot debate (Mickes et al., 2007; Rouder et al., 2010; Wixted & Mickes, 2010).

Importantly, if the used measure is premised on the wrong data-generating model, then it may incorrectly index differences in sensitivity when, in fact, conditions only differ in bias. This conclusion was found when studies tested for statistical differences between conditions (with a *t* test; $\alpha = 5\%$) that did not differ in sensitivity but differed in bias. A good measure of sensitivity should not be affected by changes in bias, hence yielding erroneous significant results—Type I error rates—on only 5% of tests carried out. Yet, it turns out that for all common measures, including d' and corrected HR, Type I error rates were very high, frequently reaching levels of 100% for sample sizes of 60 or more. This was found both in simulation (Levi et al., 2024a) and in empirical (Levi et al., 2024b) studies of recognition memory that were designed so as to gauge the rate of Type I errors. Thus, past findings of face recognition that are based on these sensitivity measures can reflect real differences in sensitivity but could also reflect differences in bias. Unfortunately, there is no way to know.

The one exception to the rule is d_a (Simpson & Fitter, 1973). Like d', this measure assumes that the underlying distributions of targets and lures as a function of memory strength are Gaussian. Unlike d', it does not assume that these distributions have equal variance. This allows d_a to serve as a valid measure of sensitivity even if responses to targets are made within a wider or narrower range of memory strength compared to responses to lures. Importantly, there is compelling evidence that these distributions are Gaussian with unequal variance (R. Ratcliff et al., 1992). Fortunately, both simulations and behavioral studies suggest that d_a is not affected by changes in bias (Levi et al., 2024a, 2024b). In summary, among all measures, only d_a allows measured changes in sensitivity to be correctly interpreted as reflecting actual changes in sensitivity rather than changes in bias.

Thus, in Experiments 2 and 3, we chose measures that would validate that the effects of group information reflect better recognition of faces of significant groups and rule out the alternative effect of response bias. In both experiments, we look at HRs and FARs because if information about social group affects HRs but does not affect FAR (or affects FAR in the opposite direction), differences in sensitivity could be inferred. Additionally, we designed these experiments such that their results could be also analyzed by using d_a, which would act as a valid measure of sensitivity even in case ingroup (vs. outgroup) and high-status (vs. low-status) affiliation of faces increases both HRs and FARs. We also estimated response bias, as measured by C_a (Hautus et al., 2021).

The Present Experiments

We conducted three experiments. Experiment 1 replicated previous findings on social group and extended them to unlearned views of the learned persons. We predicted better recognition of ingroup members, compared to outgroup members, in both learned and unlearned views, supporting either the *group main effect* or *view-invariant group effect*. Experiment 2 was designed to replicate Experiment 1 and examine whether the effect stems from sensitivity, bias, or both. We estimated sensitivity by calculating d_a and by examining separately the effect of group membership on correctly recognizing learned persons as learned (HR) and incorrectly recognizing unlearned persons as learned (FAR). We expected to find a *group main effect*, as found in Experiment 1. We also expected that the difference would stem from better sensitivity to ingroup, compared to outgroup, members. We did not have a specific prediction regarding a response bias. In Experiment 3, we examined the effect of social status on face recognition for learned and unlearned views and estimated sensitivity and bias by using the same methods as in Experiment 2. We predicted better recognition of high-status, compared to low-status, individuals in both learned and unlearned views. As faces were learned from two different head views, giving participants more visual experience, we expected a *view-invariant group effect.* As in Experiment 2, we expected this difference to stem from better sensitivity and did not have a specific prediction regarding response bias.

Transparency and Openness

We report how we determined sample size, all data exclusions (if any), all manipulations, and all measures in the study, and we follow the Journal Article Reporting Standards for quantitative research in psychology (Appelbaum et al., 2018). All data and analysis codes are available at the Open Science Framework (https://osf.io/vum7q/?view_only=79fc94ad2f7b4f758a24822422248215; Trzewik et al., 2024). Materials (face images) were adapted from the Database of Moving Faces and People (O'Toole et al., 2005). Data were analyzed using R, Version 4.2.3 (R Core Team, 2023), and the packages rstatix, Version 0.7.2 (Kassambara, 2023), and ggplot2, Version 3.4.3 (Wickham, 2016). Experiment 1 was not preregistered. Experiment 2 was preregistered at https://aspredicted.org/gg6m-pvxd.pdf, and Experiment 3 was preregistered at https://aspredicted.org/vj5r-fxsz.pdf.

Experiment 1: Are Ingroup Faces Remembered Better Than Outgroup Faces in Both Learned and Unlearned Appearances?

The goal of Experiment 1 was to extend previous findings on the effect of group membership on face recognition (Bernstein et al., 2007; Ng et al., 2016; Van Bavel et al., 2008; Wilson et al., 2014; Young et al., 2010) to images of unlearned views of the learned persons. Specifically, we used the design of Bernstein et al. (2007; Experiment 2), who experimentally created two social groups based on the results of a bogus personality test. This manipulation created a novel, yet meaningful, group categorization that was presented as relevant for social interactions. Importantly, we presented at test multiple images of each learned person and examined whether the group effect would be apparent in both learned and unlearned views. We hypothesized that recognition of learned ingroup members will be better than recognition of learned outgroup members and examined whether the ingroup relative to outgroup advantage is view-specific, a group main effect, or stems from a view-invariant representation (see Figure 1).

Method

Participants

Thirty-one Tel-Aviv University students (13 females; $M_{\text{age}} = 26.43$, $SD = 5.46$) participated for either course credit or payment of 20 NIS (about $6). Sample size was determined based on previous experiments from our lab that used relatively similar tasks and used the same set of stimuli. Based on a sensitivity power analysis, this sample provided 80% power to detect an effect size of $\eta_p^2 = .10$ or greater in a repeated-measure analysis of variance (ANOVA) with a 5% false-positive rate.

Materials and Procedure

Participants signed the consent form, after which they completed a fictitious personality test. We used the test to define two fictitious personality types that the questionnaire ostensibly reveals. Sixteen statements, adjusted from Barnum profiles (Dickson & Kelly, 1985), were presented in a random order, accompanied by a scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). The statements in the questionnaire were designed to be vague and to elicit wide agreement while at the same time creating the sense that they reveal something important and deep about the responder (e.g., "I prefer a certain amount of change and variety in my everyday life," "I have a tendency to be critical of myself"). After completing the test, participants received false random feedback stating that they were either an "L" or "H" personality type and that people of that personality type usually interact with others who have the same personality type. They then completed the face recognition task, comprising three phases: learning, testing, and rating (see Figure 2). Forty faces of Caucasian young women were chosen for the task from the Human ID Database (O'Toole et al., 2005). By choosing only young Caucasian women, we minimized visual cues that might lead to alternative group categorizations or to the creation of "subgroups" according to gender, race, or age. For each face, there were five color images taken from five different views: front (0°), 22.5°, 45°, 67.5°, and profile (90°). The size of the face images was 200 × 200 pixels.

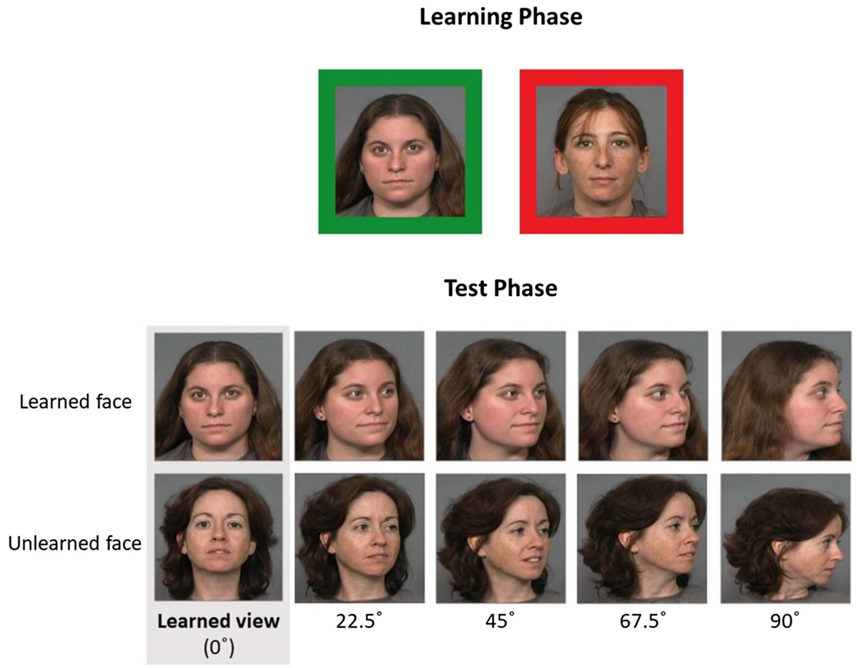
The learning phase included frontal view images of 20 different faces. Each image was presented for 3 s with an intertrial interval of 800 ms. Half of the images were presented with a red (or green) frame indicting the same personality type as the participant (ingroup faces), and the other half were presented with a green (or red) frame indicating the other personality type (outgroup faces). Each participant saw a unique, randomized order of the 20 faces, which was repeated three times.

The test phase presented images of the 20 learned faces and 20 unlearned faces. The faces assigned to learned and unlearned conditions were counterbalanced across participants. Images were presented one at a time for 3 s. Participants indicated whether that person appeared during the learning phase or not, irrespective of whether it belonged to an ingroup or an outgroup. Each face was presented five times from five different views: the learned, frontal view, and four unlearned views. The order of presentation of the different views was randomized for each participant.

In the final rating phase, frontal view images of the learned faces were presented again, and participants recalled the personality type of each face and rated a potential future interaction with that person by answering the question, "How easy would it be for you to make social contact with this woman?" on a 1 (*not at all*) to 5 (*extremely easy*) scale. Finally, participants were asked to recall their own personality type (whether they are "L type" or "H type") and to rate the extent to which they believed the personality characterization

Figure 2

An Illustration of the Experimental Design in Experiment 1



Note. In the learning phase, the green/red frame represents the personality type of the person (same as or different from the participant's personality). In the test phase, learned and unlearned faces were presented in a random order, from learned and unlearned views. See the online article for the color version of this figure.

they received on a 1 (*totally believed it*) to 4 (*did not believe it at all*) scale.

Data Analysis

Following previous studies, we computed HRs and FARs based on the responses obtained during the test phase. Note that unlearned persons were not separated to ingroup and outgroup, so there was a shared FAR for both group conditions. For the dependent measure, we computed ($\mathrm{HR}_{[\mathrm{group,\ view}]} - \mathrm{FAR}_{[\mathrm{view}]}$) for every combination of group and test face view conditions.

Results

Face Recognition Test

Figure 3 shows recognition level (HR–FAR) of the ingroup versus outgroup faces for the different face views. We conducted a repeated-measure ANOVA with group (ingroup, outgroup) and five test face views (0°, 22.5°, 45°, 67.5°, 90°) as within-participant variables.

First, we examined performance for only the frontal, learned view to check whether our findings replicate previous studies that presented the same image at learning and testing. Replicating previous research (Bernstein et al., 2007; Wilson et al., 2014), ingroup members were recognized better than outgroup members, $t(30) = 3.34$, $p = .002$, $\eta_p^2 = .27$.

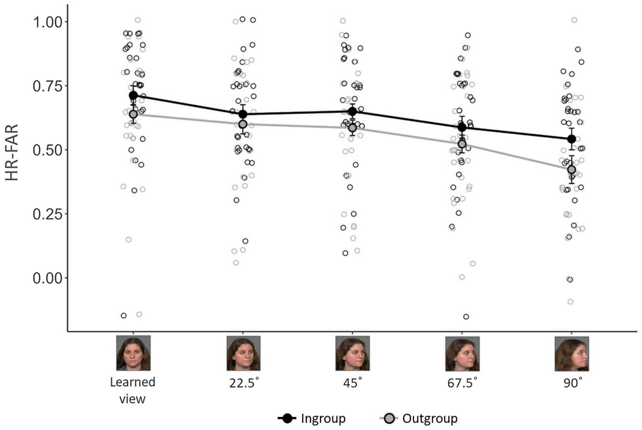
Then we examined the group effect across learned and unlearned views. There was a main effect of group, $F(1, 30) = 12.42$, $p = .001$, $\eta_p^2 = .29$, showing better recognition of ingroup, compared to outgroup, faces. There was also a main effect of test face view, $F(2.99, 89.79) = 15.54$, $p < .001$, $\eta_p^2 = .34$ (Greenhouse–Geiser sphericity correction). A significant linear trend of test face views, $t(120) = -7.62$, $p < .001$, showed, as expected, that recognition was lower the larger the difference in view angle from the learned view. There was no significant interaction between group and test face view, $F(4, 120) = 2.11$, $p = .084$, $\eta_p^2 = .07$. Thus, our findings are consistent with a group main effect for learned and unlearned views (Figure 1b).

Ease of Social Contact

We examined whether presenting faces as having the same (vs. different) personality type made participants expect future interactions with them to be easier. Consistent with the intent of our manipulation, a paired sample *t* test revealed that future social contact with members of the ingroup ($M = 3.17$, $SD = 0.64$) was rated as easier than social contact with members of the outgroup ($M = 2.87$, $SD = 0.57$), $t(30) = 2.30$, $p = .03$, Cohen's $d = 0.41$. As a part of the review process, we further examined whether rated ease of social contact was correlated with performance in the main task. We found a positive correlation with recognition of ingroup faces and no correlation with recognition of outgroup faces. This analysis is presented in the Supplemental Materials of this article.

Figure 3

Recognition Level (HR–FAR) for Ingroup and Outgroup Faces on Each Test Face View in Experiment 1 Reveal a Main Effect of Group for Learned and Unlearned Views (See Figure 1b)



Note. Error bars represent the 95% within-participant confidence interval (Morey, 2008). HR–FAR = Hit rates−False Alarm rates. See the online article for the color version of this figure.

Memory for Own Group and the Learned Faces' Group

Of the participants, 83% correctly remembered their personality group (L/H). An exploratory analysis estimated memory for learned faces' group affiliation. A one-sample t test showed that when participants had to indicate the group membership of each learned face they performed significantly above chance ($M = 0.69$, $SD = 0.16$), $t(30) = 6.50$, $p < .001$, Cohen's $d = 1.17$. This was the same for both ingroup ($M = 0.70$, $SD = 0.19$) and outgroup faces ($M = 0.68$, $SD = 0.19$), $t(30) = 0.68$, $p = .50$, Cohen's $d = 0.12$.

Belief in the Manipulation

When asked whether they believed the bogus feedback about their personality type, 6.45% responded that they completely believed the feedback, 48.39% responded that they believed it but were not sure, 35.48% did not believe the feedback but were not sure, and 9.68% responded that they did not believe it at all. As a part of the review process, we further analyzed the effect of belief in the manipulation moderated performance in the main task. We found no effect of belief in the manipulation and no significant interactions with this factor, possibly due to the low variability of the responses on its scale. This exploratory analysis is presented in the Supplemental Materials of this article.

Discussion

Experiment 1 showed that ingroup members were recognized better than outgroup members for both the learned and unlearned views of the face. These results replicate findings by Wilson et al. (2014) and Bernstein et al. (2007) regarding learned views and extend them to unlearned views of the learned person. As expected, we also found that recognition level decreased as the angle difference between the learned and unlearned view increased (O'Toole et al., 1998). The benefit for recognition of ingroup members was similar across the different face views, supporting the *group main effect* hypothesis. This pattern is in line with the finding reported by Schwartz and Yovel (2019), who found that social judgment (compared to perceptual judgment) at encoding improved face recognition for both learned and unlearned views. This finding indicates that encoding a face as an ingroup member improves recognition of the person and not only recognition of the image. This improvement might be useful for interacting with that ingroup member in future encounters. The fact that participants anticipated greater ease of social interaction with ingroup members, as opposed to outgroup members, aligns with the possibility that the group membership prompts us to consider and prepare for potential encounters, even in the absence of any explicit indications of such encounters occurring.

A limitation of Experiment 1 as well as of some previous reports (Schwartz & Yovel, 2016, 2019; Van Bavel & Cunningham, 2012) is that the images presented at test were not assigned to groups, and therefore a common FAR was used for both ingroup and outgroup faces. In this situation, group differences in accuracy, which is operationalized as HR–FAR, can only reflect differences in HR and thus cannot distinguish between sensitivity and response bias (Levi et al., 2024a; Rotello et al., 2008). Specifically, it can be that ingroup faces induce both higher HRs and higher FARs than outgroup faces, indicating a response bias. Better sensitivity can be indicated only by higher HRs and the same or lower FARs when seeing ingroup, compared to outgroup, faces, or by using a bias-independent sensitivity measure. To address this ambiguity, in the following experiments, unlearned persons presented at test were also associated with a social group. This enabled us to examine the effect of group on learned and unlearned persons separately and conduct an analysis based on the d_a measure of sensitivity (Simpson & Fitter, 1973).

Experiment 2: The Effect of Group Membership on Face Recognition: Replication and Extension

Experiment 1 demonstrated better recognition of ingroup faces compared to outgroup faces for both learned and unlearned appearances. In Experiment 2, we sought to replicate Experiment 1 with an improved design and analyses that enable us to explore whether the effect stems from differences in sensitivity between groups or can only be attributed to differences in bias. Therefore, at test, both learned and unlearned faces were assigned to an ingroup or an outgroup. This was achieved by using picture frames of the same group-specific colors as during the learning phase. In this way, we could compute a separate FAR for each of the experimental conditions. In addition, participants indicated their level of confidence in learned/unlearned decision. This enabled us to compute the d_a measure to estimate sensitivity and C_a measure to estimate bias.

Method

We preregistered our hypotheses and analyses plan (https://aspredicted.org/gg6m-pvxd.pdf).

Participants

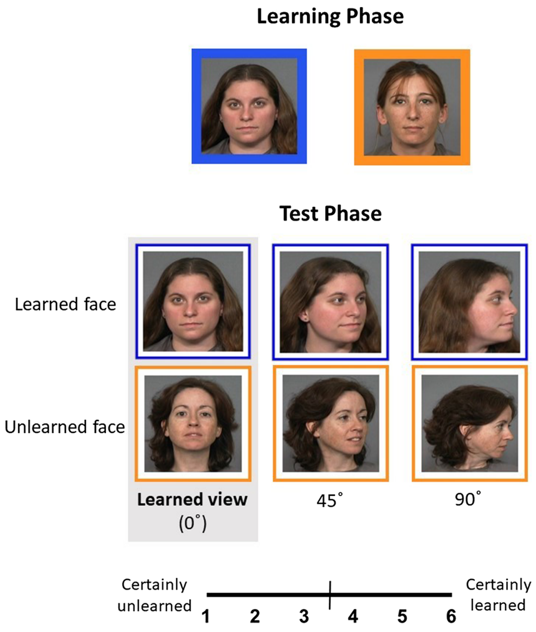
We planned to recruit 80 participants to achieve at least .85 power for an effect size of $\eta_p^2 = 0.07$. This effect size was estimated based on Experiment 1. Eighty-two students participated in a lab study for course credit. We excluded 11 participants whose performance level in the frontal view was not significantly above chance (see detailed explanation in the data analysis section), so we analyzed the data of 71 participants (55 females, $M_{\text{age}} = 23.93$, $SD = 5.81$). Based on a sensitivity power analysis, this sample provided 80% power to detect an effect size of $\eta_p^2 = .07$ or greater in a repeated-measure ANOVA with a 5% false-positive rate.

Materials and Procedure

The procedure was similar to Experiment 1, except the following changes: We chose 84 women faces from the Human ID Database (O'Toole et al., 2005), 42 faces per condition (*ingroup* and *outgroup*). For each face, there were three color images, taken from three views: a frontal view, 45° view, and 90° view; the images appeared with blue or orange frames, according to the experimental condition. The test phase used the same colors but a different frame style. Specifically, whereas at the learning phase, we used a single blue or orange frame, at test, we used a double, white and blue or white and orange frame (see Figure 4) in order to visually distinguish between the learning and test phases. Using blue and orange frames at test made it possible to assign all test faces to ingroup versus outgroup and thus separate between the FAR of ingroup and outgroup faces; the face recognition task included two learning–test sessions. It was made clear to the participants that each session presented a different set of faces; in each learning session, 28 faces were presented in frontal images, and the whole set was repeated three times; in each test session, 28 learned faces and 14 unlearned faces were presented; each face was presented in the test three times—once from each view (frontal, 45°, and 90°)—in a random order; to enable computation of d_a, participants responded on the following scale:1 (*certainly unlearned*), 2 (*probably unlearned*), 3 (*may be unlearned*), 4 (*may be learned*), 5 (*probably learned*), 6 (*certainly learned*).

Figure 4

An Illustration of the Experimental Design in Experiment 2



Note. In the learning phase, the blue/orange frame represents the personality type of the woman (same as or different from the participant's personality). In the test phase, learned and unlearned faces were presented in a random order, from learned and unlearned views. See the online article for the color version of this figure.

Data Analysis

Exclusions. We planned to exclude the data of participants whose performance in the frontal test view was equal to 0. Based on the results of a pilot experiment, we updated our exclusion criterion and excluded from the analysis participants who did not score significantly higher than chance level (0.5) in the frontal test view. According to a binominal test, the minimal rate of correct responses for inclusion in the analysis was 0.65. According to an a priori exclusion criterion, we excluded the responses that were faster than 200 ms or slower than 10,000 ms. We also planned to exclude participants based on their responses to catch trials, but as there were eventually no such trials in the task, this criterion became irrelevant.

Accuracy. For each experimental condition (Group × Test Face View), we calculated HR and FAR. HR is the proportion of test faces that were correctly identified as "learned faces" (response on the scale was between 4 and 6) out of all learned faces. FAR is the proportion of test faces that were incorrectly identified as "learned faces" (response on the scale was between 4 and 6) out of all unlearned faces. A pattern whereby HR is higher for ingroup than outgroup faces, while FAR is not higher (or even lower) would indicate enhanced sensitivity for ingroup than outgroup faces (the question of whether there is also a bias remains open in this case). A pattern whereby both HR and FAR are higher for ingroup faces makes it more difficult to decide whether there is a difference in sensitivity, as it could reflect either sensitivity or response bias (or both). In this case, a sensitivity difference could be reliably indicated by d_a, and a bias could be reliably indicated by C_a. This analysis was not preregistered.

We applied sequential Holmes–Bonferroni correction for multiple comparisons to all of the effects that were included in the HR and FAR analyses.

Sensitivity and Bias. The data were further analyzed by using the d_a sensitivity measure, which Levi et al. (2024a, 2024b) have shown to be more valid measures of sensitivity and bias than most commonly used measures. We also used the C_a measure of bias.

Given that participants were able to make at test one of six possible judgments (1–6) for each face, we assume that responses could be given under five hypothetical decision criteria. A response of "1" would be given for items with mnemonic strength weaker than the lowest criterion (C_1). A response of "2" would be given for items with strength between the first (C_1) and second (C_2) criteria and so on; finally, a response of "6" would be given for items with stronger strength than the highest criterion (C_5; for further details, see Levi et al., 2022). We could therefore simulate five HRs and FARs pairs for different degrees of bias, as described in Figure 5.

Based on these five pairs, we created a Z-standardized receiver operating characteristic (zROC) curve. The slope of this curve (S) is an estimate of the ratio of the standard deviations of the lure and target distributions (R. Ratcliff et al., 1992). The mean value of S is equal to approximately 0.8 (Dougal & Rotello, 2007; Mickes et al., 2007; R. Ratcliff et al., 1992) and varies across participants. In Experiments 2 and 3 of this article, the mean estimates of S across participants were even smaller ($M = 0.65$ in Experiment 2 and $M = 0.71$ in Experiment 3; complete reports of these analyses are

Figure 5

Calculation of HR and FAR Pairs Simulating Different Levels of Decision Criteria at Test

Note. For the most liberal bias, all "1" responses (across all trials and across all participants) were considered as "unlearned" responses, and any responses between "2" and "6" were considered as "learned" responses. Thus, all learned items judged "2"–"6" constituted Hits, and all unlearned items judged "2"–"6" constituted FAs, resulting in the highest possible scores for both. For slightly less liberal bias, responses between "3" and "6" were considered as "learned," leading to fewer Hits and FAs. Different levels of bias were thus simulated, ending with the most conservative bias, wherein only "6" responses were considered as "learned." Then, for every level of bias, we transformed the raw Hits into Hit rates (HRs) by computing the percentage of Hits from the total number of learned items and transformed the raw FAs into FA rates (FARs) by computing the percentage of FAs from the total number of unlearned items within each respective bias category. Overall, five levels of bias could be simulated from our task, yielding five pairs of HRs and FARs. FA = False Alarm; FAR = False Alarm rate. See the online article for the color version of this figure.

presented in the Supplemental Materials). That S value provides evidence that the d' assumption of equal variances cannot be defended. Following Levi et al. (2024a, 2024b), rather than falsely assuming the identical ratio for every participant, we estimated the data-generating model for each participant and computed S for each participant. This value was then used for calculating the dependent measure d_a (Goshen-Gottstein & Levi, 2019; Simpson & Fitter, 1973; Equation 1). This measure represents the participant's recognition performance, weighted across the different possible criteria (HR_3 and FAR_3 stand for the performance according to the middle criterion, which calculated HR and FAR as in the accuracy analysis):

$$d_a = \sqrt{\frac{2}{1+S^2}} \times [Z(\mathrm{HR}_3) - S \times Z(\mathrm{FAR}_3)]. \tag{1}$$

This procedure was done separately for each of the six Group × Test-View conditions, resulting in six d_a scores. These scores were compared by using a repeated-measures ANOVA.

Response Bias. We conducted an exploratory, nonregistered analysis to estimate participants' response bias (i.e., their tendency to respond "learned" or "unlearned" at test regardless of memory strength). For this aim, we calculated C_a (Hautus et al., 2021) for each experimental condition. Like d_a, this measure is based on calculating HR and FAR under different decision criteria, which generates a zROC slope. We calculated it according to the following formula (HR_3 and FAR_3 stand for the performance according to the intermediate criterion, S stands for the zROC slope):

$$C_a = \frac{-\sqrt{2} \times S}{\sqrt{1+S^2} \times (1+S)} \times [Z(\mathrm{HR}_3) + Z(\mathrm{FAR}_3)]. \tag{2}$$

Higher values reflect a more conservative criterion (i.e., a tendency to respond "unlearned"). A significant effect on this measure indicates that the participants' responses at test were influenced by a response bias.

Additional Analyses. Following recommendations from the review process, we conducted two additional analyses. Both are presented in the Supplemental Materials of this article. First, we estimated performance in the main task using a mixed-model analysis with group and test view as fixed factors, and participant and face stimulus as random factors. Consistent with the ANOVA results, and in line with our expectations, in the HRs analysis there was a main effect of Group, a main effect of test view, and no interaction. In the FARs analysis there was a main effect of test view, but no effect of group, and no interaction.

We also conducted an exploratory analysis of participants' confidence levels. We found that they were higher for ingroup compared to outgroup members, for views that were closer to the learned one, and for learned compared to unlearned faces, with no significant interactions.

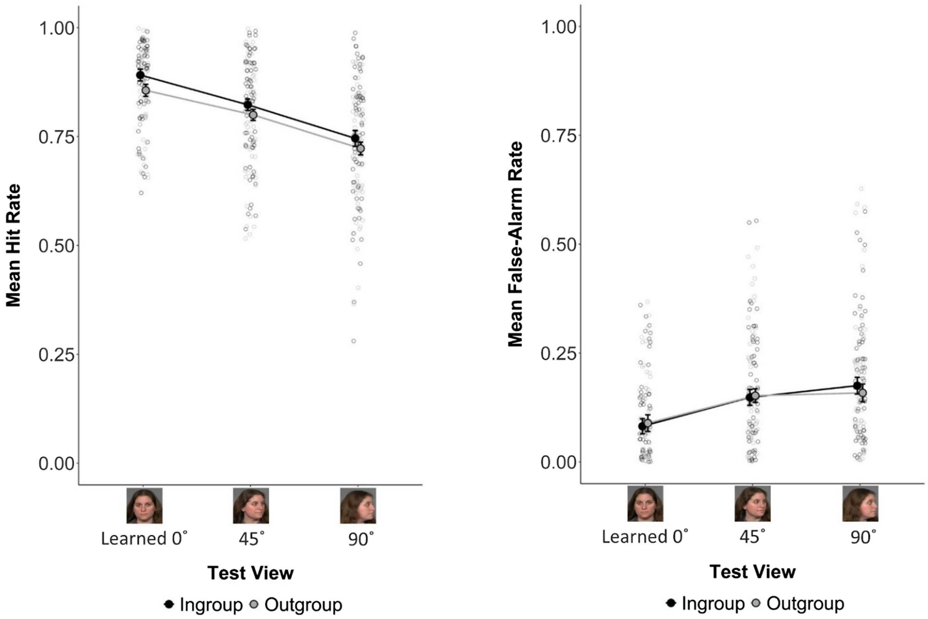
Results

Accuracy

Figure 6 shows the HR and FAR of the ingroup versus outgroup faces for the different head views. First, we analyzed the HR to examine differences in recognition of learned faces. We conducted a repeated-measures ANOVA with group (ingroup/outgroup) and test face view (frontal/45°/90°) as within-participant factors. In line with our predictions and the results of Experiment 1, recognition was better for ingroup faces than outgroup faces, $F(1, 70) = 10.60$, $p = .002$, $\eta_p^2 = .13$. We found better performance for the learned view than the unlearned views, $F(1.65, 115.6) = 155.48$, $p < .001$, $\eta_p^2 = .69$ (Greenhouse–Geiser sphericity correction). We found also that performance dropped as a function of the difference between the angle of the learned and unlearned head views, $t(140) = -17.62$,

Figure 6

Performance in Experiment 2 for Ingroup and Outgroup Members, Across Face Views in the Test Phase, as Measured by the Hit Rates (Right) and False Alarm Rates (Left)



Note. Error bars represent the 95% within-participant confidence interval (Morey, 2008). See the online article for the color version of this figure.

$p < .001$. Similar to Experiment 1, no interaction was found between the group and test face view, $F(2, 140) = 0.41$, $p = .66$, $\eta_p^2 < .01$.

Next, we analyzed the FAR to examine differences in the ability to reject unlearned faces. We conducted a repeated-measures ANOVA with group (ingroup/outgroup) and test face view (frontal/45°/90°) as within-participant factors. There was no effect of group, $F(1, 70) = 0.28$, $p = .60$, $\eta_p^2 < .01$. An effect of test face view, $F(2, 140) = 30.94$, $p < .001$, $\eta_p^2 = .31$, showed fewer False Alarms in the learned view, compared to the unlearned 45° and 90° views. There was no interaction between group and test face view, $F(2, 140) = 1.11$, $p = .33$, $\eta_p^2 = .02$.

Sensitivity

We conducted a repeated-measures ANOVA on the d_a scores with group (ingroup/outgroup) and test face view (frontal/45°/90°) as within-participant factors. Descriptive statistics are presented in Table 1. Sensitivity was higher for ingroup than outgroup faces, $F(1, 70) = 6.75$, $p = .004$, $\eta_p^2 = .10$, and higher for the learned view than the unlearned views, $F(2, 140) = 157.04$, $p < .001$, $\eta_p^2 = .67$. There was no significant interaction between group and test face view, $F(2, 140) = 1.86$, $p = .159$, $\eta_p^2 = .02$.

Response Bias

We conducted a repeated-measures ANOVA on the C_a scores with group (ingroup/outgroup) and test face view (frontal/45°/90°) as within-participant factors. Descriptive statistics are presented in Table 2. The results showed a more conservative criterion when responding to outgroup than ingroup faces, $F(1, 70) = 8.86$, $p = .004$, $\eta_p^2 = .10$. Namely, participants tended to respond that an outgroup member was not learned before more than an ingroup member. We also found a significant main effect of test face view, showing a more conservative criterion when responding to the unlearned views than the learned view, $F(2, 140) = 11.66$, $p < .001$, $\eta_p^2 = .13$. There was no significant interaction between group and test face view, $F(2, 140) = 1.24$, $p = .293$, $\eta_p^2 = .02$.

Ease of Social Contact

The average rating was calculated for each participant under each group condition (ingroup/outgroup). As expected, a paired sample *t* test showed that future social contact with members of the ingroup was rated as easier ($M = 2.95$, $SD = 0.53$) than with outgroup faces ($M = 2.75$, $SD = 0.57$), $t(68) = 4.31$, $p < .001$, Cohen's $d = 0.52$. As a part of the review process, we further analyzed whether rated ease of social contact was correlated with sensitivity and bias in the main task. We found that ease of social contact was marginally correlated with recognition accuracy of ingroup but not outgroup faces, as measured by d_a. Higher ease of contact was also related to a more conservative decision criterion (i.e., a tendency to respond "unlearned") to outgroup but not ingroup faces, as measured by C_a. This exploratory analysis is presented in the Supplemental Materials of this article.

Manipulation Checks

Group Affiliation. Among all participants, 95.00% recalled correctly their feedback in the bogus personality test (Type H or L, and tendency to associate with others with a similar personality

Table 1
Descriptive Statistics of d_a Scores in Experiment 2

	Frontal view (0°)				45° view				90° view			
		95% CI				95% CI				95% CI		
Group	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*
Ingroup	2.57	2.66	2.47	0.44	2.03	2.11	1.95	0.40	1.60	1.69	1.51	0.45
Outgroup	2.32	2.40	2.24	0.37	1.87	1.96	1.79	0.40	1.52	1.60	1.44	0.38

Note. $N = 62$; CI = confidence interval of the mean; *UL* = upper limit; *LL* = lower limit.

type), and 98.75% recalled correctly the frame color that represented their personality type (blue or orange).

Recognition of Faces' Group Affiliation. The percent of correct group recognition was calculated for each participant under each group condition (ingroup/outgroup). We conducted an exploratory analysis to examine whether group recognition was different between the two groups. A paired-sample *t* test showed no difference in group recognition for ingroup ($M = 0.66$, $SD = 0.15$) and outgroup faces ($M = 0.66$, $SD = 0.17$), $t(68) = -0.03$, $p = .98$, Cohen's $d = -0.01$.

Belief in the Manipulation. When asked whether they believed the bogus feedback about their personality type, 23.75% responded that they believed the feedback, 31.75% responded that they did not believe the feedback, and 45.00% responded that they were not sure. As a part of the review process, we further analyzed the effect of belief in the manipulation moderated performance in the main task. We found that the group effect was significant across all views for participants who believed the manipulation. There was no group effect for participants who were not sure whether to believe the manipulation or not. Surprisingly, participants who did not believe the manipulation still showed an effect of group, albeit only in the learned view. We present this exploratory analysis and discuss it in the Supplemental Materials of this article.

Discussion

As in Experiment 1, our findings show that ingroup members were recognized more accurately than outgroup members. This was the case for both the learned views, replicating the results of Wilson et al. (2014), and for unlearned views, showing that the memory advantage for ingroup members extends beyond the learned appearance. Importantly, an effect of group membership was found for HRs but not FARs. Namely, group affected recognition of learned persons but did not affect rejection of unlearned persons. This indicates that there is better sensitivity to faces of ingroup members compared to outgroup members, confirming that the higher performance for ingroup members is not solely due to a tendency to judge any person of the ingroup as learned. This conclusion was also supported by the results of the d_a analysis.

In addition to the differences in sensitivity, the results of the C_a analysis demonstrated that there were differences in response bias between ingroup and outgroup faces. Specifically, participants tended to indicate that outgroup members, more than ingroup members, were not seen during learning. The existence of bias further highlights the importance of employing bias-free sensitivity measures to accurately interpret differences in recognition performance across groups.

As expected, recognition was better with test views that were more similar to the learned view, consistent with previous studies that examined recognition of faces from different views at learning and testing (O'Toole et al., 1998). This was the case for both the recognition of learned persons and the rejection of unlearned persons. Most importantly, the recognition accuracy advantage of ingroup relative to outgroup faces was evident across all test views, both learned and unlearned, supporting the hypothesis of a *group main effect*. Taken together, these results are consistent with the notion that ingroup faces, compared to outgroup faces, are encoded more accurately and in a manner that affords better recognition of a novel appearance of the same face. This is advantageous because members of the ingroup, compared to the outgroup, are more likely to be encountered, and such encounters would likely involve seeing them in a novel appearance.

Experiment 3: The Effect of Social Status on Face Recognition

Experiments 1 and 2 manipulated group membership of target faces as ingroup versus outgroup. The goal of Experiment 3 was to extend these findings to another social group manipulation, namely high- versus low-status groups. Past research suggested that participants recognized better faces of individuals that were presented as having high compared to low social status (e.g.,

Table 2
Descriptive Statistics of C_a Scores in Experiment 2

	Frontal view (0°)				45° view				90° view			
		95% CI				95% CI				95% CI		
Group	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*
Ingroup	0.03	0.07	–0.02	0.21	0.06	0.10	0.02	0.19	0.13	0.18	0.09	0.24
Outgroup	0.13	0.18	0.08	0.24	0.10	0.13	0.07	0.16	0.23	0.28	0.19	0.21

Note. $N = 62$; CI = confidence interval of the mean; *UL* = upper limit; *LL* = lower limit.

"doctor" vs. "mechanic"; N. J. Ratcliff et al., 2011). In these experiments, the recognition task presented the same images that were presented at learning, and therefore, it is unclear if the advantage of high-status (vs. low-status) faces extends to other, unlearned images of the same person.

We used "physicians" as the high-status group and "cleaners" as the low-status group (Fiske et al., 2002; Imhoff et al., 2013; N. J. Ratcliff et al., 2011) and predicted that high-status individuals would be recognized better than low-status individuals in both the learned views and the unlearned view. Additionally, results of Experiments 1 and 2 revealed no evidence for the generation of a view-invariant representation for ingroup faces. It is possible that extrapolation to unlearned views is more challenging when faces are learned from only one view, which, in addition, is fairly distant in head view angle from the unlearned views (Honig et al., 2022). Therefore, in this experiment, participants learned faces from two views (frontal and 45°) and were tested on an intermediate unlearned view (22°), which may enable interpolation between learned and unlearned views. We examined whether high-status faces would generate a view-invariant representation relative to low-status faces. Such representation would be manifested in a smaller difference between learned and unlearned views for high-status faces compared to low-status faces (Figure 1C).

As in this experiment groups were familiar to the participants, we added exploratory preregistered analyses that examined whether differences in the meaning of high- and low-status groups for the participants would affect recognition performance. First, we estimated participants' socioeconomic status and examined whether participants of higher status would demonstrate a larger effect of social group (i.e., a larger difference between recognition of high- and low-status individuals) than participants of low socioeconomic status. Second, we estimated participants' social dominance orientation (SDO; Pratto et al., 1994), which is their preference for hierarchy among social groups. We examined whether participants higher in SDO would demonstrate a larger effect of social group than participants of low socioeconomic status.

Method

We preregistered our hypotheses and analyses plan (https://aspredicted.org/gg6m-pvxd.pdf) and the augmentation of the data (https://aspredicted.org/wyth-f8nd.pdf).

Participants

A total of 110 Tel-Aviv University students completed the experiment for course credit. We initially planned to recruit 50 participants to achieve at least .95 power for an effect size of $\eta_p^2 = 0.20$. This effect size was estimated based on pilot experiments. Thirteen of them were excluded from the analysis because their performance was not significantly above chance level for the frontal view faces. A post hoc power analysis indicated that this sample size was too small for detecting the actual effect size of $\eta_p^2 = 0.10$. Therefore, we recalculated the required sample size for achieving at least .85 power for the updated effect size, which was 86 (including the existing sample). Considering potential dropout, we recruited additional 60 participants and preregistered a post hoc analysis for augmented data (Sagarin et al., 2014). Of this sample of participants, 21 participants were excluded because their performance was not significantly above the chance level. Analysis was performed on data from 76 participants (70 females, $M_{\text{age}} = 23.14$, $SD = 3.65$). Based on a sensitivity power analysis, this sample provided 80% power to detect an effect size of $\eta_p^2 = .06$ or greater in a repeated-measure ANOVA with a 5% false-positive rate.

Materials and Procedure

The experiment was performed by using Testable (Rezlescu et al., 2020), a platform for running online experiments. The procedure was similar to Experiment 1, except the following changes: There was no personality test; social group was manipulated by presenting the face images with one of two labels: a physician (*high-status condition*) or a cleaner (*low-status condition*; see Figure 7); we chose 80 women faces from the Human ID Database (O'Toole et al., 2005). For each face, there were three color images, taken from three views: a frontal view, 22.5° view, and 45° view; in the learning phase, participants were presented with 40 faces. Each face was presented in two views sequentially: first, the frontal view, then the 45° view. Each image was presented for 3 s; in the test phase, 40 learned ("learned") faces and 40 unlearned ("unlearned") faces were presented; each face was presented in the test three times—once from each view (frontal, 22.5°, and 45°)—in a random order; all the images were presented at test with a blue frame to visually distinguish between the learning and test phases, and the test question "Was this physician (cleaner) presented in the learning?" Learned faces appeared with the occupation that was assigned to them in the learning phase. Half of the unlearned faces were assigned to one of these occupations and the other half to the other occupation. The assignment of occupations to faces was counterbalanced across participants; at the end of the experiment, participants reported their socioeconomic status on a scale between 1 ("much below average") and 6 ("much above average") and filled the SDO scale (Pratto et al., 1994).

Data Analysis

Exclusions. As in Experiment 2, we excluded from the analysis participants who did not score significantly higher than chance level (0.5) in the frontal test view. To reiterate, according to a binominal test, the minimal rate of correct responses for inclusion in the analysis was 0.65. We also excluded responses that were faster than 200 ms or slower than 10,000 ms. Both exclusion criteria were preregistered.

Measures. Similar to Experiment 2, for each experimental condition (Social Status × Test Face View), we estimated accuracy by calculating separately HR and FAR and estimated sensitivity by calculating d_a, and response bias by calculating C_a.

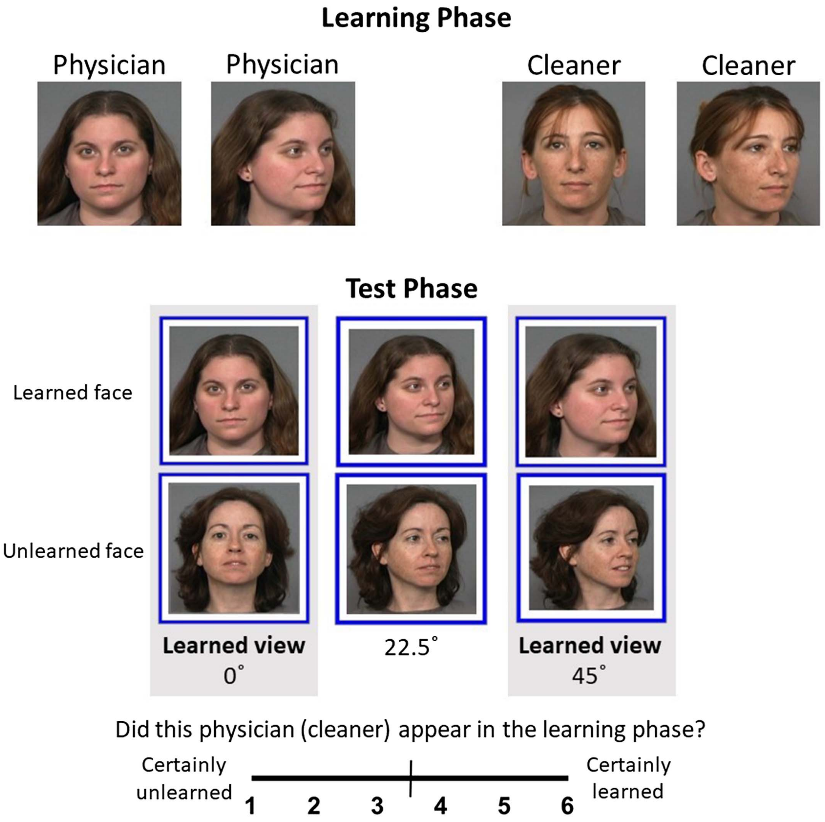
We applied sequential Holmes–Bonferroni correction for multiple comparisons to all of the effects that were included in the HR and FAR analyses.

Additional Analyses. We preregistered two exploratory analyses examining the correlation between performance in the main task and participants' reported socioeconomic status and with their SDO scores.

We also conducted two nonregistered exploratory analyses of the data. Both are presented in detail in the Supplemental Materials of this article. First, we estimated performance in the main task using a mixed-model analysis with social status and test view as fixed factors and participant and face stimulus as random factors.

Figure 7

An Illustration of the Experimental Design in Experiment 3



Note. In the learning phase, faces were presented with occupation labels, first in a frontal image and then in a 45° view image, and the participants were asked to memorize the faces and the occupations in order to recognize them later in the test. In the test phase, the learned and unlearned persons were presented in the learned views and in an unlearned view (22°), with a question that reminded their occupation. See the online article for the color version of this figure.

Consistent with the ANOVA results, in the HRs analysis, there was a main effect of social status, a marginal effect of test view, and no interaction. In the FARs analysis, there was a main effect of test view but no effect of social status nor an interaction.

Second, we examined whether participants' confidence levels were affected by social status. Confidence was higher for high- compared to low-status individuals and for learned compared to unlearned faces. There was no effect of view nor significant interactions.

Results

Accuracy

Figure 8 shows the HR and FAR for the two social status conditions and the three different test face views. First, we examined recognition of learned faces. We conducted a repeated-measures ANOVA on the HR with social status (high/low) and test face view (frontal/22°/45°) as within-participant factors. Results showed a higher HR for high-status faces than low-status faces across all face views, $F(1, 75) = 8.69$, $p = .004$, $\eta_p^2 = .10$, $p_{\text{augmented}} = (.05, .05)$. There was a main effect of test face view, $F(1.71, 128.28) = 4.90$, $p = .01$, $\eta_p^2 = .06$, $p_{\text{augmented}} = (.05, .06)$. As in Experiments 1 and 2, we found no interaction, $F(1.84, 137.72) = 0.49$, $p = .59$, $\eta_p^2 < .01$, $p_{\text{augmented}} = (.58, .60)$.

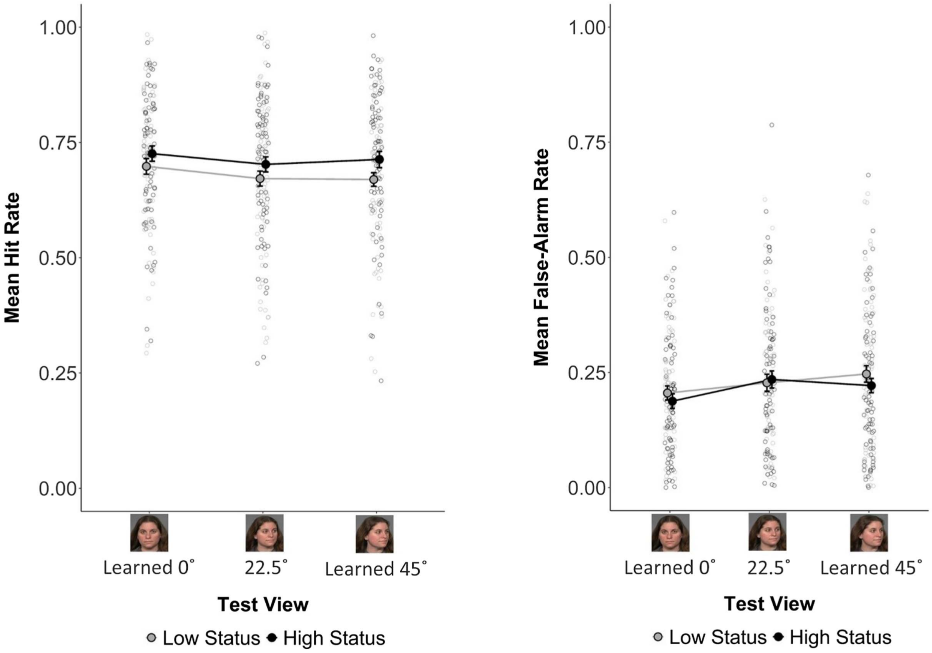
We then examined FAR in a repeated-measures ANOVA with social status (high/low) and test face view (frontal/22°/45°) as within-participant factors. There was no effect of social status, $F(1, 75) = 1.15$, $p = .28$, $\eta_p^2 = .01$, $p_{\text{augmented}} = (.28, .30)$. There was a main effect of test face view, $F(2, 150) = 10.66$, $p < .001$, $\eta_p^2 = .12$, $p_{\text{augmented}} = (.05, .05)$, and no interaction, $F(2, 150) = 1.68$, $p = .19$, $\eta_p^2 = .02$, $p_{\text{augmented}} = (.09, .21)$.

Sensitivity

Four participants selected two or less confidence levels in the response scale for the test faces and were excluded from the analysis. The analysis included 72 participants ($M_{\text{age}} = 23.18$, $SD = 3.73$; 66 females). Descriptive statistics are presented in Table 3. Recognition was better for high-status than low-status faces, $F(1, 71) = 10.27$, $p = .002$, $\eta_p^2 = .12$. There was a significant main effect of test

Figure 8

Performance in Experiment 3 for High-Status and Low-Status Faces, Across Face Views in the Test Phase, as Measured by the Hit Rates (Right) and False Alarm Rate (Left)



Note. Error bars represent the 95% within-participant confidence interval (Morey, 2008). See the online article for the color version of this figure.

face view, $F(2, 142) = 14.60$, $p < .001$, $\eta_p^2 = .15$. There was no interaction between the social status and test face view, $F(2, 142) = 1.81$, $p = .168$, $\eta_p^2 = .02$.

Response Bias

Descriptive statistics are presented in Table 4. There were no effects of social status, $F(1, 71) = 1.33$, $p = .253$, $\eta_p^2 = .01$, and test view, $F(2, 142) = 0.60$, $p = .549$, $\eta_p^2 < .01$, and there was no interaction between them, $F(2, 142) = 0.47$, $p = .629$, $\eta_p^2 < .01$.

Correlations of Sensitivity and Response Bias With Participants' Socioeconomic Status and SDO

Among the 72 participants who were included in the sensitivity and bias analyses of the main task, 16 did not complete the socioeconomic status and SDO questionnaires, which followed the main task. Thus, these two analyses included 56 participants ($M_{\text{age}} = 23.29$, $SD = 4.16$; 51 females).

First, we investigated whether participants' socioeconomic status correlated with any effect of social group on either sensitivity or response bias. To that end, we calculated the average d_a and C_a for high- and low-status faces for each participant and computed the difference between the scores of high-status and low-status individuals ($d_{a\ \text{high}} - d_{a\ \text{low}}$; $C_{a\ \text{high}} - C_{a\ \text{low}}$). A Spearman's rank correlation between these measures and participants' socioeconomic status was not significant: for d_a, $r(54) = -.02$, $p = .580$; for C_a, $r(54) = -.11$, $p = .400$.

Second, we examined whether participants higher in SDO (Pratto et al., 1994) would be more accurate and/or more biased in recognizing high- versus low-status individuals. Spearman's rank correlation indicated that higher SDO scores predicted a greater

Table 3

Descriptive Statistics of d_a Scores in Experiment 3

	Frontal view (0°)				22° view				45° view			
		95% CI				95% CI				95% CI		
Group	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*
Low status	1.34	1.43	1.26	0.34	1.20	1.29	1.10	0.38	1.14	1.22	1.05	0.34
High status	1.51	1.61	1.42	0.38	1.28	1.35	1.20	0.30	1.36	1.46	1.27	0.38

Note. $N = 72$; CI = confidence interval of the mean; *UL* = upper limit; *LL* = lower limit.

Table 4
Descriptive Statistics of C_a Scores in Experiment 3

	Frontal view (0°)				22° view				45° view			
		95% CI				95% CI				95% CI		
Group	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*	*M*	*UL*	*LL*	*SD*
Low status	0.16	0.21	0.11	0.20	0.16	0.22	0.11	0.22	0.15	0.20	0.10	0.20
High status	0.15	0.21	0.10	0.21	0.11	0.17	0.05	0.24	0.12	0.16	0.07	0.19

Note. $N = 72$; CI = confidence interval of the mean; *UL* = upper limit; *LL* = lower limit.

difference in response bias (C_a scores) between high-status and low-status individuals (specifically showing a more conservative bias when responding to low-, compared to high-status, faces), $r(54) = -.26$, $p = .049$. There was no correlation with the difference in d_a scores, $r(54) = -.11$, $p = .400$.

Discussion

Our results show that high-status faces were recognized better than low-status faces. This was evident in both learned views, replicating the results of N. J. Ratcliff et al. (2011), and in unlearned views, showing for the first time that learning a face as a member of a high-status group affects its recognition in an unlearned appearance. As in Experiment 2, the difference between the groups emerged in HR but not in FAR, a pattern that indicates a better sensitivity for members of high-, compared to low-status, groups. This conclusion was further supported by the results of the d_a analysis.

The results of the C_a analysis indicated that there were no differences in bias when responding to high- and low-status individuals. SDO predicted differential bias against low-status individuals. Specifically, individuals higher in SDO tend to indicate that low-status faces (more than high-status faces) were not seen before. Notably, we did not find any indication of worse memory for low-status (compared to high-status) faces on part of people high in SDO, only a tendency to respond “have not seen this person” at test.

In contrast to our expectations, we did not find evidence for a more view-invariant representation of high-status faces relative to low-status faces, which would have manifested in a smaller drop in performance for unlearned test view in the high-status group compared to the low-status group. The pattern we found supports, once again, the *group main effect* hypothesis, according to which the effect of group status generalizes to unlearned views, but recognition in those unlearned views is impaired relative to learned views to a similar extent for both high- and low-status faces.

These results are consistent with the suggestion of N. J. Ratcliff et al. (2011) of an attentional and processing bias toward high-status faces that exists because powerful people might be useful for goal fulfillment, access to resources, and social inclusion. Our results suggest an important extension to this logic, namely, that anticipating high-status individuals to be more significant in future interactions should manifest in better recognition not only for a specific appearance of a person but also for unlearned appearances.

Unlike Experiments 1 and 2, the group manipulation in Experiment 3 was based on two familiar social groups—physicians and cleaners, and therefore knowledge and stereotypes regarding those groups, beyond their social status, might have affected memory. For example, cleaners are often expected to be women, and physicians are often expected to be men (Kennison & Trofe, 2003). It is still possible, then, that physicians were remembered better than cleaners because their group affiliation was more surprising, thus driving more attention during encoding. This concern could be resolved in future studies by using a different manipulation of social status or by using faces of both genders as stimuli. Let us emphasize, however, that the influence of expectancy violations on subsequent memory is unclear, as there are inconsistent findings regarding the direction (improving or impairing memory performance) and the nature of this effect as linear versus nonlinear (for a review, see Reggev, 2024).

General Discussion

We examined whether group affiliation and group status affect recognition of faces beyond the specific appearances presented at learning. Three experiments showed that group information that suggests more social importance, namely ingroup (vs. outgroup) membership and high (vs. low) status, enhances recognition of learned faces in both learned and unlearned views. In Experiments 1 and 2, ingroup members were recognized better than outgroup members. In Experiment 3, high-status individuals were recognized better than low-status individuals.

These results extend previous findings that demonstrated that ingroup members (Bernstein et al., 2007; Ng et al., 2016; Wilson et al., 2014; Young et al., 2010) and high-status individuals (N. J. Ratcliff et al., 2011) were recognized better in a same-image task. We demonstrated that these effects are not restricted to the specific appearance that has been learned but also extend to unlearned appearances of the same person. This pattern of results suggests that group information might affect how a person’s face is encoded rather than only the encoding of the specific image that is presented at learning. It was not possible to draw this conclusion based on previous face recognition studies, which showed the exact same image at learning and at test.

We also examined whether and how group information and test face view interacted. Our results consistently found only two main effects, with no interaction: Learned views were remembered better than unlearned views, and the effect of social group did not differ between learned and unlearned views of a person. Schwartz and Yovel (2019) found a similar pattern, whereby when participants provided social evaluations (compared to perceptual judgments) at learning, they improved in recognizing both learned and unlearned views of a face. Our results demonstrate a similar pattern with ingroup versus outgroup faces and with high versus low-status groups. Importantly, we showed that ingroup (vs. outgroup) faces and high-status (vs. low-status) faces only showed higher HR but no difference in FAR, a pattern that indicates increased sensitivity. Consistent with this conclusion, we found that a bias-free measure of sensitivity also shows significant differences in recognition between members of socially important group.

Our findings regarding differences in sensitivity do not rule out differences in response bias. In fact, in Experiment 2, group affiliation affected bias, such that participants tended to respond “unlearned” more often to outgroup, compared to ingroup, members. While we did not observe differential bias between high- and low-status individuals in Experiment 3, we did find that SDO predicted differential, status-dependent bias. Specifically, higher SDO predicted a higher tendency to say “I have not seen this person before” about low- than high-status individuals. These findings suggest that group information might not only affect sensitivity but also response bias. They therefore underscore the importance of using measuring methods that differentiate between these two aspects of performance in recognition tasks.

While the present study does not delve into the mechanisms through which the encoding of ingroup and high-status faces is improved, the literature provides some possible explanations. One explanation may be differences in the allocation of attention to these faces. For instance, in a study by Kawakami et al. (2014), participants gazed longer at the eye regions when looking at the faces of ingroup members compared to outgroup members. This difference was observed when group categorization was based on either race or a novel category introduced in the experiment. Importantly, longer gaze at the eye regions predicted better performance in a same-image recognition test and also predicted which faces participants preferred as coworkers (Kawakami et al., 2014).

Another explanation might be differences in early stages of face perception and processing. For example, group context can lead to different categorization of the same visual input, as in a study by Freeman et al. (2011), where participants were more likely to categorize faces’ skin tone as “black” when they were presented as individuals of lower, rather than higher, social status. Such different categorization might consequently affect processing style. This was demonstrated by Michel et al. (2007), who found that racially ambiguous faces were processed more holistically when they were learned in a context of the same race as the participants, as opposed to a different race. Similarly, Hugenberg and Corneille (2009) found that same-race faces were processed more holistically when presented as students of the same university as the participants, as opposed to a different university. In addition, event-related potential studies (Cassidy et al., 2014; Gamond et al., 2017; Zheng & Segalowitz, 2014) demonstrated that learning faces as ingroup members, compared to outgroup members, influences the N170 component (which signifies early structural face encoding), even though there were no visual differences between the images of the two groups. These studies demonstrate a number of processes in face perception that might be sensitive to information about group affiliation. When the same faces are processed differently (e.g., when they are encoded more deeply or more holistically in a specific group context), they might also be encoded differently in memory.

We speculate that the group effect found in this study stems mainly from a higher relevance of some groups compared to others for important future social interactions. Both group manipulations that we used can be viewed as affecting anticipated future relevance. In Experiments 1 and 2, groups were created based on a novel category, but this category was presented as reflecting a deep (though somewhat vague) personality characteristic and as being relevant to the participants’ social environment, as we told participants that family and friends typically share the same personality type. In Experiment 3, we presented faces of individuals that were said to be members of two well-known social groups, which confer differential social status and differential relevance for the participants’ life.

If the effect of group on accuracy of recognition had been a result of mere categorization as ingroup versus outgroup, it should be evident even within the confines of the “minimal group paradigm” (Tajfel et al., 1971; for a review, see Otten, 2016), where groups are formed based on a category that is both new and nonconsequential to the participants (e.g., a tendency to over- or underestimate numbers of dots). Past research (Van Bavel et al., 2008) has shown that such manipulation affects reaction time but not accuracy in a same-image recognition test. This might suggest that without a clear implication for the likelihood and/or importance of future encounters, group categorization is not enough for enhancing recognition.

In addition, there is evidence that group membership does not affect the accuracy of face recognition when it is decoupled from the expectation of future interaction. For instance, Wilson et al. (2014) demonstrated that when ingroup and outgroup are expected to be encountered equally frequently, the difference between recognition of ingroup and outgroup faces in a same-image task diminishes.

In this study, we examined only effects of conceptual group information (i.e., group labels) on face recognition, but our theorizing extends also to other types of group information that imply higher (vs. lower) likelihood and importance of future encounters with the person, including information that can be deduced from visual appearance. For example, if one interacts frequently with individuals from East Asia, the typical facial phenotype of individuals from East Asia might signify higher likelihood of future encounters and consequently lead to better recognition of their faces. Notably, visually cued group membership could affect recognition of faces also because there are differences in visual experience with the groups’ facial phenotypes (Chiroro & Valentine, 1995). Past studies that unconfounded these two factors showed that when different phenotypes did not signify different importance of future interaction (e.g., a classmate of a different race than ours), then differences in recognition accuracy between the (visually distinct) groups were moderated (Hehman et al., 2010; Shriver et al., 2008).

The present study compared between the recognition accuracy of faces of members of different social groups. However, its experimental design did not present a control group in which the faces had no labels of group membership or social status. It is thus unclear whether the effect of social group stems from an advantage of ingroup and high-status faces, a disadvantage of outgroup and low-status faces, or both. To answer this question, future studies need to add a neutral, unlabeled condition and also examine what group affiliation participants tend to assume “by default” in the absence of explicit information.

In all of the experiments in the present study, we examined generalization by testing recognition across different head views while keeping other visual features (e.g., lighting, camera setting) constant. However, when recognizing others in real life, there are many more variations in the way the faces look, such as hairstyle, makeup, facial expression, and more (Ritchie & Burton, 2017). It is indeed useful to examine generalization of face recognition across different levels of a single variable (in our experiments, it was angle of view), as this variable can be easily controlled and systematically manipulated. Yet, an experimental design that would examine generalization across more natural variations, similar to how faces vary in real life, can provide further insights about the social variables that might enhance generalization of learned faces to novel appearances.

Another limitation of our study was the homogeneity of our stimuli set, which consisted solely of young Caucasian women across all experiments. The reason for this choice was to remove potential confounds related to group categorization based on visual cues such as race, gender, and age. However, it also limits the generalizability of our results. For instance, it is possible that the effect of occupation labels would have been weaker if the groups had a more diverse composition. Another possibility is that for some participants, all identities were considered as outgroup members (e.g., participants of other ethnicities than the targets'), and therefore the ingroup versus outgroup manipulation in Experiments 1 and 2 was weaker than for other participants. Future research could address these questions by choosing other sets of faces or more diverse faces as stimuli. For further elaboration on the limitations of this study, see Table 5.

In conclusion, our findings show that information about group affiliation and social status affects recognition not only of the learned appearances but also of the unlearned appearances of the same person. We suggest that this is because a person's social group signifies the likelihood of an important future interaction with that person. For example, ingroup members are seen more often than outgroup members (Wilson et al., 2014), and interactions with high-status individuals might be more important for us than interactions with low-status individuals (N. J. Ratcliff et al., 2011). As the appearance of the same face can change across different occasions, it is likely that such faces would be encoded in a way that affords their recognition not only in the learned appearance but also in unlearned appearances.

Table 5
Limitations

Limitation description and meaning
• All participants in the present study were Israeli undergraduate students. In addition, the vast majority of participants (about 78% of the total sample) identified themselves as women. As the main interest of this study is the effect of group membership, the social groups of the participants might be a factor in obtaining similar results.
• The present study examined group effects when learning faces from one or two still images. Learning faces in a more ecological setting, such as face-to-face encounters or video recordings, might produce different results.
• The present study examines the group effect on face recognition within a relatively short time period. It should be considered that long-term effects on face recognition might manifest differently.
• Learning faces in a social context is often a continual process, involving multiple exposures to each face on different occasions, and might include feedback. As the present study focused on learning in a single encounter, the results might not be relevant to learning faces from multiple exposures.

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