The social-encoding benefit in face recognition is generalized to other-race faces

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Abstract

Faces are visual stimuli that covey rich social information. Previous experiments found better recognition for faces that were evaluated based on their social traits than on their perceptual features during encoding. Here we ask whether this *social-encoding benefit* in face recognition is also found for categories of faces that we have no previous social experience with, such as other-race faces. To answer this question, we first explored whether social and perceptual evaluations for other-race faces are consistent and valid, and if so, whether social evaluations during encoding improve recognition for other-race faces. Results show that social and perceptual evaluations of own- and other-race faces were valid. We also found high agreement in social and perceptual evaluations across individuals from different races. This indicates that evaluations of other-race faces are not random but meaningful. Furthermore, we found that social evaluations facilitated face recognition regardless of race, demonstrating a *social-encoding benefit* for both own- and other-race faces. Our findings highlight the role of social information in face recognition and show how it can be used to improve recognition of categories of faces that are hard to recognize due to lack of experience with them.

1. Introduction

It is well-established that face recognition is better for own-race than other-race faces (Anthony, Copper, & Mullen, 1992; Bothwell, Brigham, & Malpass, 1989; Meissner & Brigham, 2001). Furthermore, many studies have shown that recognition of familiar faces (those with whom we have significant experience) is superior to recognition of unfamiliar faces even for faces of our own race (for review see Johnston & Edmonds, 2009; Young & Burton, 2017). These findings indicate that face recognition is heavily influenced by experience and the information acquired about faces during our interaction with people. Notably, different types of information are usually acquired during face familiarization. First, perceptual experience is gained as faces are learned across different views, lighting, and facial expressions (Burton, Kramer, Ritchie, & Jenkins, 2016; Jenkins, White, Van Montfort, & Burton, 2011; Ritchie & Burton, 2017; Ritchie et al., 2015). The role of perceptual experience in face recognition has been investigated extensively in the literature. For example, recent studies highlight the importance of exposure to high variability of appearances of a face to learn and be able to recognize them (Burton et al., 2016; Jenkins et al., 2011; Ritchie & Burton, 2017; Ritchie et al., 2015). Accordingly, it has been suggested that the perceptual expertise we gain for faces is critical for face recognition.

While perceptual experience is a key factor in face recognition, it is not the only type of information acquired during face learning that improves recognition. Faces are typically associated with social and conceptual information, such as social attributes, and the social context in which they are learned. Previous studies found that associating faces with social information facilitates face recognition. For example, face recognition is better for faces associated with ingroup than outgroup information or for faces that participants expect to socially interact with (Bernstein, Young, & Hugenberg, 2007; Van Bavel & Cunningham, 2012; Wilson, See, Bernstein, Hugenberg, & Chartier, 2014). Another way in which social information was shown to improve face recognition is by evaluating faces during encoding based on personality traits (e.g. how intelligent/trustworthy a face looks) compared to evaluating faces based on their physical featural attributes (how wide/symmetric is the face?) (Courtois & Mueller, 1979; Mueller, Carlomusto, & Goldstein, 1978; Schwartz & Yovel, 2019b, 2019a; Winograd, 1976).

Previous findings show that humans assign social attributes to faces automatically once faces are seen. These evaluations are highly correlated among participants (Cogsdill, Todorov, Spelke, & Banaji, 2014; Zebrowitz et al., 2012) and are elicited following short exposures of less than 100 ms (Willis & Todorov, 2006). While these first-impression evaluations do not reflect the true personality of a person, they were found to predict many real-life outcomes, from winning in political elections (Todorov, Mandisodza, Goren, & Hall, 2005) to financial success (Rule & Ambady, 2011) and decisions about criminal sentencing (Zebrowitz & McDonald, 1991). Importantly, inferred trait evaluations are made based on the visual structure of faces, with specific features correlated with specific traits. For example, previous experiments revealed that increasing the distance between the eyes and eyebrows increased the perception of face trustworthiness, as the face was perceived as more baby-like (Oosterhof & Todorov, 2008). Thus, despite the fact that both social-trait evaluations and facial-feature evaluations depend on the visual appearance of the face, making social evaluations significantly improves recognition of faces relative to making perceptual evaluations during encoding (Courtois & Mueller, 1979; Mueller et al., 1978; Schwartz & Yovel, 2019b, 2019a).

In a recent study, Schwartz and Yovel (2019a) asked whether better recognition of socially evaluated than perceptually evaluated faces indeed reflects a social benefit or instead may be due to a perceptual cost, whereby perceptual evaluations interfere with face learning. To that end, they included a third condition in which participants learned faces passively and made no evaluations. Results showed better recognition of socially evaluated faces than perceptually evaluated or non-evaluated faces. Furthermore, perceptual evaluations did not improve recognition even relative to faces that were encoded with no evaluations. These findings indicate that better recognition for socially evaluated than perceptually evaluated faces reflects a social benefit rather than a perceptual cost.

Two hypotheses were proposed to account for this social benefit in face recognition. Winograd (1981) proposed that social evaluations lead to more elaborative feature processing, and attributed the social benefit to a perceptual effect. Others have suggested that the social benefit in face recognition is mediated by the social processing system that converts faces from perceptual to social representations (Bower & Karlin, 1974; Schwartz & Yovel, 2019b). A recent fMRI study that aimed to decide between the two hypotheses found that socially evaluated faces activated social brain areas during recognition more than perceptually learned faces did, whereas no difference was found in perceptual brain areas for the two types of evaluation (Shoham, Kliger, & Yovel, 2021).

These results support the idea that social evaluations convert faces from perceptual images to socially meaningful stimuli.

While these findings indicate a role for social processing mechanisms in face recognition, they raise the question of whether social evaluations could improve recognition also for categories of faces that we have no previous social interaction with, such as other-race faces. The “other-race effect” (ORE) is an extensively studied phenomenon, broadly discussed in the literature in terms of its causes, moderators, and influences (for review see Meissner & Brigham, 2001; Young, Hugenberg, Bernstein, & Sacco, 2012). This investigation led to a controversy regarding the role of experience in the ORE, with two leading approaches: the socio-cognitive hypothesis and the perceptual expertise hypothesis.

The perceptual expertise hypothesis argues that lack of perceptual experience with other-race faces relative to own-race faces accounts for the ORE. According to this hypothesis, perceptual experience shapes the face perception system by tuning to perceptual information that is useful for identification of categories of faces we have experience with, and therefore recognition of own-race faces is advantageous (Rossion & Michel, 2011; Wan, Crookes, Reynolds, Irons, & McKone, 2015). Accordingly, a reduction of ORE was found after massive perceptual training, indicating that perceptual experience has an important role in this effect (Hills & Lewis, 2006). Alternatively, socio-cognitive models suggest that the tendency to categorize other-race faces as one group, along with reduced motivation to individuate them, accounts for the ORE, while perceptual experience plays a lesser role. Therefore, socio-cognitive models predict better recognition of other-race faces when participants are motivated to recognize them

(Bernstein, Young, & Hugenberg, 2007; Hugenberg, Miller, & Claypool, 2007; Hugenberg et al., 2010). It was further found that informing participants about the existence of the ORE and increasing their motivation to discriminate between other-race faces could eliminate the ORE (Hugenberg et al., 2007). Studies have also shown that the ORE decreases during an individuation relative to a categorization task with other-race faces (Levin, 2000; Tanaka & Pierce, 2009). The role of individuation was assessed by associating faces with name labels. For example, assigning faces or objects to subordinate-level labels improved their later recognition (Gordon & Tanaka, 2011; Schwartz & Yovel, 2016; Tanaka, Curran, & Sheinberg, 2005, Yovel et al., 2012). Notably, this effect was also found for other-race faces, suggesting that individuation of face categories we have no prior experience with facilitates face recognition (McGugin, Tanaka, Lebrecht, Tarr, & Gauthier, 2011; Tanaka & Pierce, 2009). Thus, evidence shows that the ORE can be reduced under specific conditions, by mechanisms of individuation and motivation (but see Wan et al., 2015).

Taking the available evidence together, Hugenberg, Young, Bernstein, and Sacco (2010) proposed the Categorization-Individuation Model (CIM), which highlights the common role of categorization, motivation, and perceptual experience in the ORE. This model suggests that viewing a face activates social categories, making perceivers notice category-diagnostic features. Then, motivation to individuate the faces can divert the viewer's attention to identity-diagnostic features, and so discrimination between faces in a specific group, category, or ethnic group could occur. When viewing faces, people are usually motivated to individuate own-race faces (which are their own group) rather than other-race faces. Thus, own-race faces signal that the target face is relevant for encoding, so viewers tend to notice identity-diagnostic features in these faces. In contrast, other-race faces signal that the face is socially irrelevant, and therefore engaging in categorical features is sufficient and there is no need to individuate the face. Finally, the CIM describes the role of experience in the ORE: greater experience can improve recognition of other-race faces, but it is more effective when the perceiver is motivated to individuate them (Hugenberg et al., 2010). Overall, these findings predict that increasing the social relevance of faces, regardless of race, can boost their later recognition. As previously mentioned, social evaluations of faces during encoding benefits face recognition, whereas perceptual evaluations do not (Schwartz & Yovel, 2019a, 2019b). However, thus far this effect was investigated for own-race faces with which participants have social experience. Consistent with the CIM, we predict that social evaluations may increase the social relevance of faces, and therefore enhance recognition also for other-race faces.

In the current study, we aimed to examine whether there is a *social-encoding benefit* for categories of faces that participants have no experience with, such as other-race faces. To that end, two experiments were conducted, with participants from two different ethnic groups – White and Asian – performing the same tasks. Asian face stimuli were own-race face stimuli for the Asian participants and other-race stimuli for the white participants, and vice versa with white face stimuli. In both Experiments 1 and 2, participants were asked to make social and perceptual evaluations about either own- or other-race faces. In Experiment 1, we first ensured that social and perceptual evaluations for other-race faces were valid, by testing whether the correlations between similar personality traits such as friendly and trustworthy were positive, and negative between opposite traits such as aggressive and friendly also for other race faces. We also examined whether judgments for the same faces were consistent across ethnic groups, by measuring the correlations for the same faces for each judgment across participants from different ethnic groups. Results show that social and perceptual evaluations for other-race faces were valid as well as consistent with own-race face judgments. This indicates that social evaluations of faces are meaningful. Then, in Experiment 2 we examined whether social evaluations facilitate face recognition of other-race faces, and whether this effect generalizes to other images of the learned identities, similar to previous findings with own-race faces (Schwartz & Yovel, 2019a).

2. Experiment 1

Experiment 1 aimed to determine whether perceptual and social evaluations are valid (correlated between related traits) and consistent across ethnic groups. To that end, Asian or White frontal face images (between subjects) were presented to the participants. Each face repeated five times throughout the experiment, and each time was preceded by the instruction for evaluation of one of five perceptual characteristics or five social attributes (within subject). Half of the faces were presented with social evaluations and the other half with perceptual evaluations. The identities that were presented with each type of evaluation were counterbalanced across participants, who were asked to rate each face according to each of the evaluations they were asked about.

2.1. Method and material

2.1.1. Participants

All White participants in the experiment were Israelis, and all the Asian participants were Chinese. Based on results of Zebrowitz, et al., (1993) that revealed an average of r~0.7 between social trait evaluations within and between other race faces, the sample size needed to reveal this effect with a power of 0.8 is n=13 (Erdfelder, FAul, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007). We still used a larger sample size in this experiment of 40-50 participants for each version of the experiment because we also examined the reliabilities and validity of perceptual evaluations across races and were not aware of previous studies that reported these data. This is also the sample size that was used in our previous studies that examine social and perceptual evaluations using the same paradigm (Schwartz & Yovel, 2019a, 2019b).

White participants: 88 undergraduate white students from Israel participated in this experiment; 44 were allocated to the other-race condition (36 females, age 18–33, M age = 22.89, SD = 2.45), and 44 to the own-race condition (34 females, age 19–32, M age = 23.07, SD = 2.21). All received course credit for participation. All White Israeli participants were recruited through a Tel-Aviv University online system, designed to enable students to register for experiments for course credit or payment.

Asian participants: 96 Asian Chinese participants participated in this experiment, of which 50 participants were randomly allocated to the other-race condition (27 females, age 18–28, M age = 22.10, SD = 2.84), and 46 to the own-race condition (29 females, age 17–29, M age = 21.43, SD = 2.51). Data from 7 participants were excluded from analysis – 5 participants pressed the wrong keys during rating and their results could not be analysed, and 2 participants were excluded due to technical issues that prevented them from viewing and rating all the identities in the experiment. All participants of Asian ethnicity were Chinese. They were recruited voluntarily using social media by completing a questionnaire on exposure to White face. Only participants who replied that they have not lived or travelled in Europe, Oceania, America, West Asia, North Africa or North India for longer than 2 months were further approached to complete the experiment

Notably, the exposure of people in China and Israel to faces of the other race is minimal. The populations in both countries are very homogeneous in terms of racial diversity, and the majority of people do not have the opportunity to socially interact with people from the other race in the education system or the workplace.

The experiment was approved by the institutional ethics committee of Tel Aviv University, and all participants signed an informed-consent document.

2.1.2. Stimuli

The white face stimuli were grayscale face photographs of 40 white young adult males, all taken from the Harvard Face Database (Duchaine & Nakayama, 2006). The Asian face stimuli were 40 Asian young adult males, taken from the Chinese Academy of Sciences (CAS) Pose, Expression, Accessories, and Lighting (PEAL) Large-Scale Chinese Face Database (Gao et al., 2008). All face stimuli in the experiment had no glasses, facial hair, long hair, or scars. All photos were centered and their backgrounds removed. The versions with Asian face stimuli served as own-race stimuli for Asian participants, and as other-race stimuli for white participants, and vice versa.

There were two separate versions of the experiment for each face race (own/other race) that were counterbalanced across participants. In the first version, out of 40 identities, 20 identities were assigned to the “social condition”, and the remaining 20 identities were assigned to the “perceptual condition”. In the second version, stimuli were switched, so that social-condition faces in version 1 were assigned to the perceptual condition in version 2, and vice versa.

2.1.3. Procedure

All participants performed the experiment online. The experiment was programmed with JavaScript. The procedure of the Asian and White versions of the experiment was identical and differed only in the face stimuli (Asian or White) that were presented: both versions included a 30-min rating phase during which participants were asked to rate 40 different face identities, based on either their social attributes or perceptual appearance. Each trial began with either a social or perceptual question/evaluation, which was presented on the screen for 3 seconds. This was followed by a 1-second inter-stimulus interval, and then a face was presented on the screen for 1 second. Following face presentation, a 1–7 scale appeared, and participants were asked to rate the face based on the question they were asked. This scale was presented until response (see Figure 1). Each identity was presented five times, each time following a different question according to the condition the identity was assigned to. The order of the trials was random, such that the five presentations of each identity did not appear sequentially, but in a random order throughout the experiment.

The social and perceptual questions were identical to those used by Schwartz and Yovel (2019a ,2019b). The five social questions were: “How intelligent/aggressive/dominant/ friendly/trustworthy is the following face?” The five perceptual questions were: “How symmetric/wide/round is the following face and how smooth/bright is the skin of the following face?”

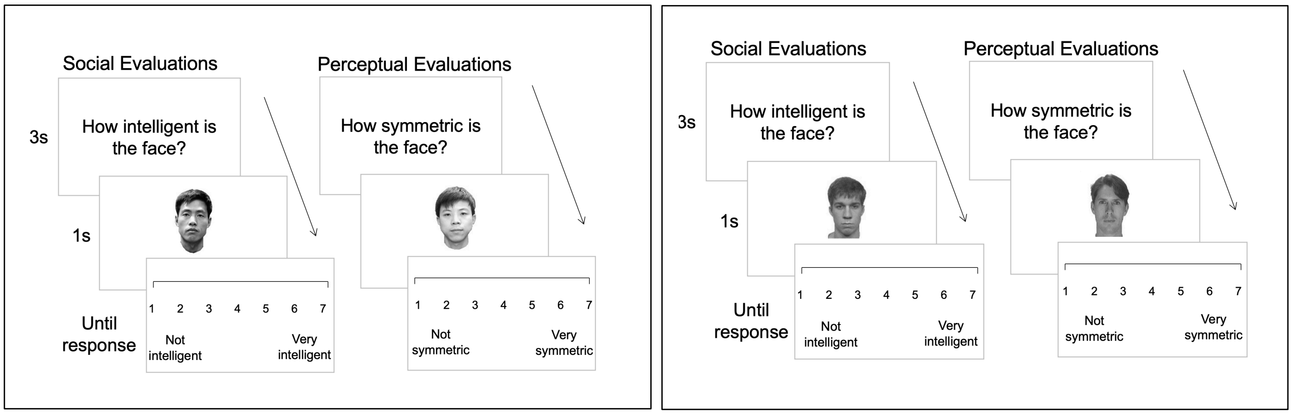
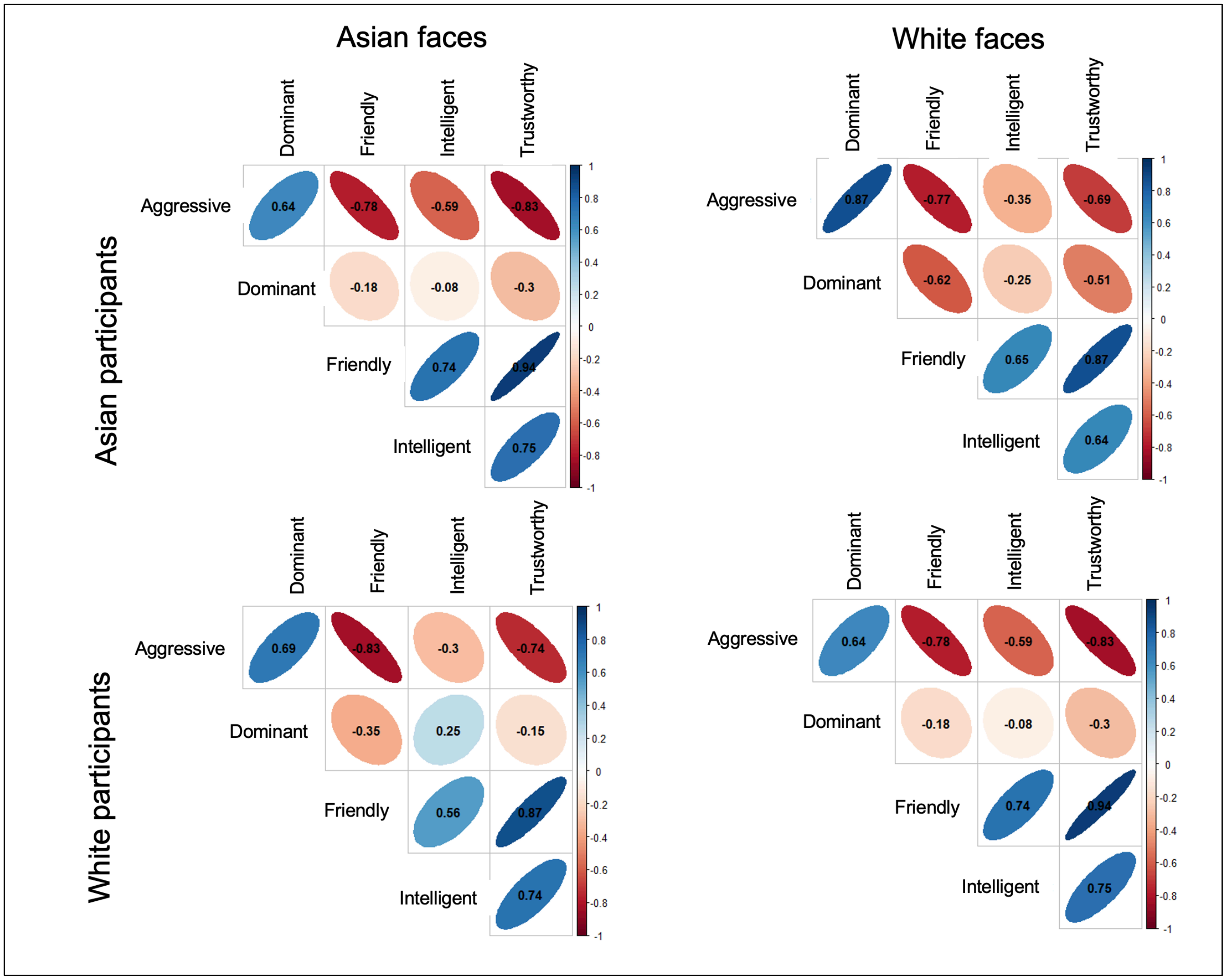


Figure 1: Design of Experiment 1: Face images of own- or other-race faces (a between-subjects factor) were presented in a random order. Participants rated identities based on either their social traits or perceptual characteristics. A total of 5 questions (perceptual/social) were asked about each identity.

2.2. Results

2.2.1. Validity

Validity was estimated based on the correlations between ratings of related social or perceptual characteristics. We averaged ratings for each identity and each one of the 10 evaluations across participants. Then we calculated the correlations among the ratings of every pair of questions for each evaluation type in each face stimulus. Correlations are shown in Figure 2.



Asian faces
White faces
Asian participants
White participants
Aggressive
Dominant
Friendly
Intelligent
Trustworthy

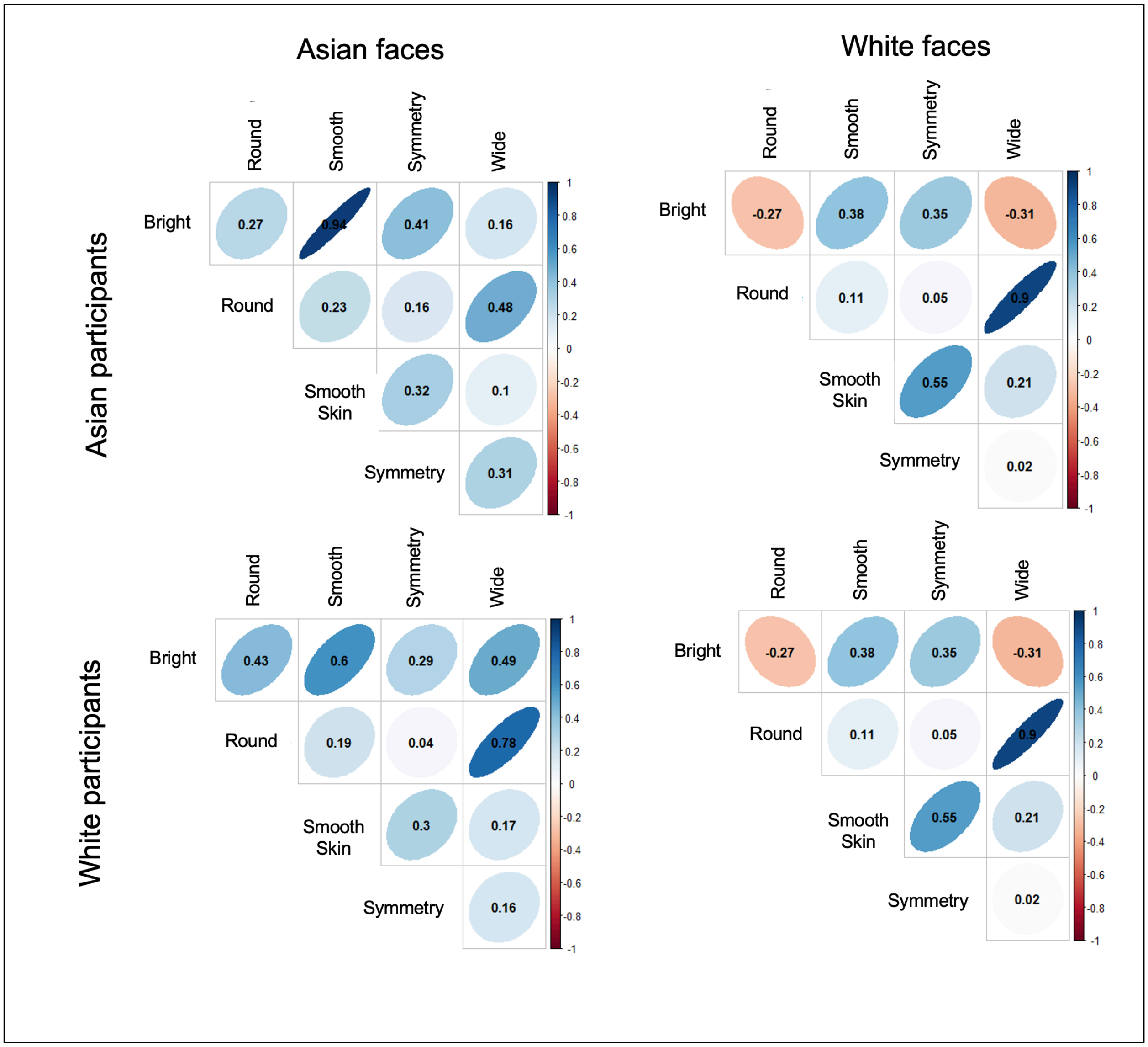


Figure 2: Validity: Correlations between the ratings of each pair of questions for each evaluation type in each race. The upper four correlation matrices show social evaluations and the lower four correlation matrices show perceptual evaluations. Overall findings are very similar across own and other race faces.

To assess the relationship between ratings across face race, we first transformed the correlations to Fisher's Z scores. Then we performed a simple regression on Fisher's Z values to evaluate correlations between races in each evaluation type. We found highly significant correlation for both Asian and White participants for the validity of their ratings for own- and other-race faces in social evaluations: Asians' correlation ($F_{(1,8)} = 411.8$, $p < 0.001$, $R^2 = 0.98$); White participants' correlation ($F_{(1,8)} = 110.79$, $p < 0.001$, $R^2 = 0.93$). For perceptual evaluations, a significant correlation between validity score of races was found for the Asian participants ($F_{(1,8)} = 7.1$, $p = 0.029$, $R^2 = 0.47$), and a marginally significant correlation was found for the White participants ($F_{(1,8)} = 4.50$, $p = 0.067$, $R^2 = 0.36$).

2.2.2. Cross-race social and perceptual rating agreement

We then assessed whether participants from different races agree on the social and perceptual rating of their own- and other-race faces. Cross-race agreement was assessed by measuring the correlations between ratings of participants from different races (i.e., do Asians and White participants rate the faces similarly?). To calculate this measure, we averaged the ratings for each identity for each evaluation across participants in each race. Then we correlated the ratings of Asians and white participants for each evaluation separately. All correlations were statically significant (ranging between $R^2 = 0.11$–0.90, $t(38) = 2.21$–18.48, $p = 0.03$–0.001), indicating that Asian and white participants evaluated own- and other-race faces similarly. Results are reported in Table 1 and Figure 3.

Table 1: Cross-race rating agreement

	Asian Faces				
	Intelligent	Friendly	Aggressive	Dominant	Trustworthy
r	0.34	0.75	0.71	0.61	0.69
p-value	0.03	<.001	<.001	<.001	<.001
	White Faces				
	Intelligent	Friendly	Aggressive	Dominant	Trustworthy
r	0.80	0.85	0.79	0.77	0.75
p-value	<.001	<.001	<.001	<.001	<.001

	Asian Faces				
	Symmetric	Skin smooth	Face width	Bright skin	Face round
r	0.79	0.85	0.81	0.72	0.91
p-value	<.001	<.001	<.001	<.001	<.001
	White Faces				
	Symmetric	Skin smooth	Face width	Bright skin	Face round
r	0.77	0.71	0.95	0.40	0.95
p-value	<.001	<.001	<.001	<.001	<.001

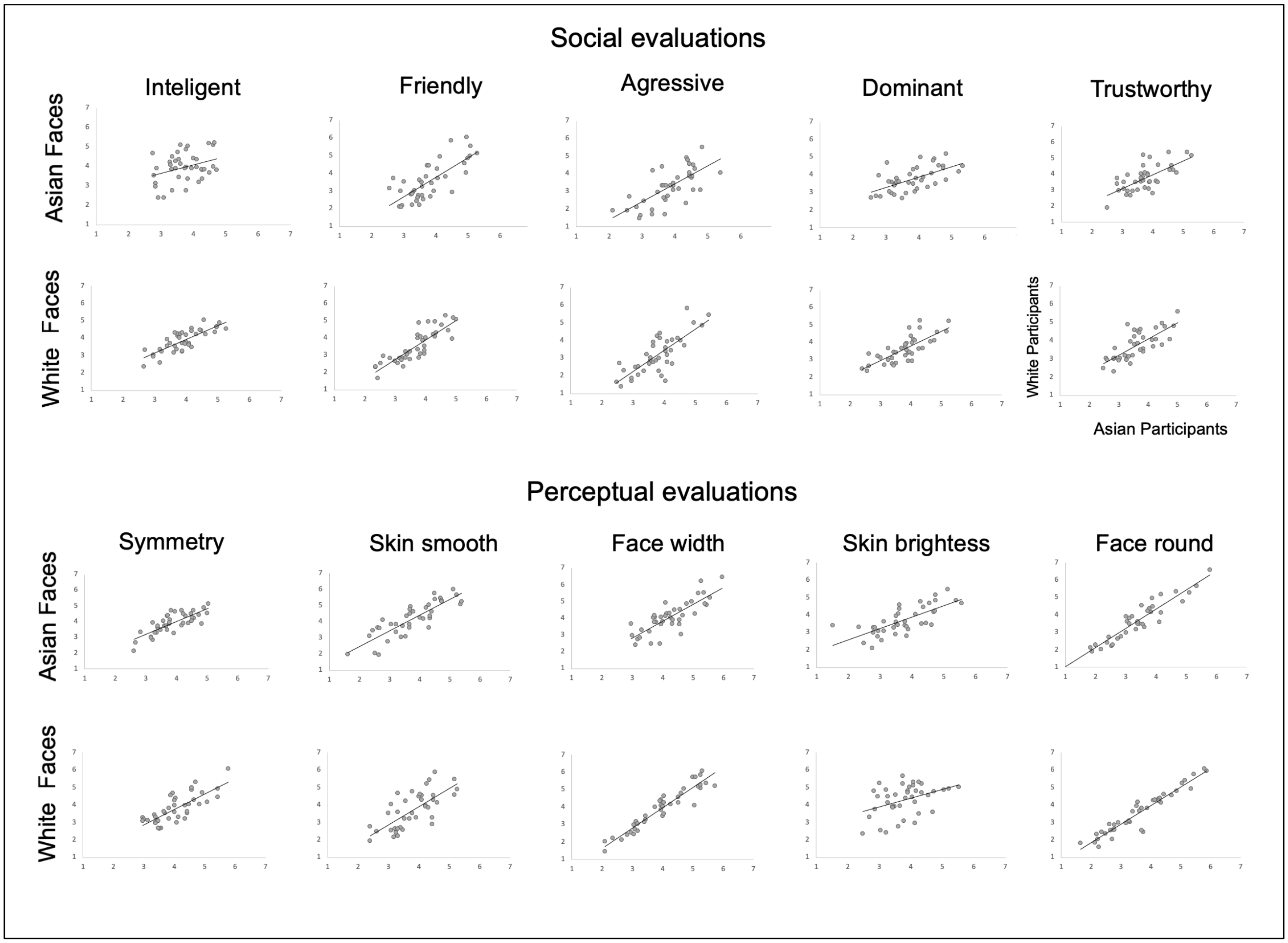


Figure 3: Scatterplots show the relationship between the ratings of Asian (x-axis) and White (y-axis) participants. Each dot is a different face. There was a very high agreement for all social and perceptual evaluations between individuals from different races.

2.3. Discussion

Our findings show that social evaluations of own- and other-race faces are valid and consistent across own- and other-race raters. The pattern of correlations of related social/perceptual evaluations were similar for own- and other-race faces. In addition, there was agreement among participants from different races about their social and perceptual evaluations. These results indicate that social evaluations are based on similar appearance criteria (e.g., faces that express positive valence are trustworthy) and are applied similarly to faces from other races despite lack of experience. These findings are consistent with a previous study that demonstrated equally high consensus between subjects about personality traits (such as honesty, submissiveness, naivety, etc.) of own- and other-race faces (Zebrowitz, Montepare, & Lee, 1993). These results therefore show that social evaluations of other-race faces are not random but are consistent with ratings of own-race faces. This suggests that social evaluations during encoding may benefit recognition of faces of other races.

3. Experiment 2

The goal of Experiment 2 was to assess whether social evaluations during encoding improve face recognition for other-race faces. Our previous study showed that *the social-encoding benefit* is found not only for the learned faces but also extends to unlearned views of the learned identities. Thus, in the current study we adopted the same experimental design used by Schwartz and Yovel (2019a) with own-race faces to apply to other-race faces. Faces were presented in the study with social, perceptual, or no evaluations in a frontal view. The same frontal-view faces as well as two unlearned views (30 and 60 degrees) were presented. This paradigm enables us to assess the effect of social information, by comparing socially evaluated faces to perceptually and non-evaluated faces as well as assess whether the social benefit is generalized also to unlearned views of the learned identities.

3.1. Method and material

3.1.1. Participants

We performed power analysis to determine the sample size needed to obtain the effect size of the social encoding benefit that was reported in previous studies that used the same paradigm: across different experiments that tested a social encoding benefit with a repeated measures ANOVA, the effect size ranged between η^2p = 0.6 in the standard designs (Schwartz & Yovel, 2019b, Experiment 1&2), η^2p = 0.32 (Schwartz & Yovel, 2019a, Experiment 2) η^2p = 0.24 (Schwartz & Yovel, 2019b, Experiment 4) and η^2p = 0.15 in the multi-view design (Schwartz & Yovel, 2019a, Experiment 1). For a power of 0.8 with an average effect size of η^2p = 0.33 for 3 group repeated measure ANOVA, the sample size required is less than 10 participants (Erdfelder et al., 2009; Faul et al., 2007). We still included a sample size that is similar to our previous studies that included 30–50 participants for a single race group (Schwartz & Yovel, 2019a, 2019b). Because ANOVAs in the current experiment included additional main effects and interactions of ethnic group and the race of the face stimuli, we collected data from 40-50 participants per each race group.

One hundred and three ethnically white Israeli undergraduate students participated in the experiment. All white Israeli participants were recruited using the Tel-Aviv University online system designed to enable undergrad students to register for experiments for course credit or payment. Prior to the experiment, participants were asked whether they had lived in or travelled to East Asia for longer than 2 months and if they were personally familiar with an Asian individual(s). Participants who answered “yes” were assigned to the own-race condition. Overall, 51 participants were allocated to the other-race condition (34 females, age 19–29, M age = 23.18, SD = 2.08), and 52 to the own-race condition (46 females, age 20–36, M age = 23.29, SD = 2.48). All participants received course credit in return for taking part, were native Hebrew speakers, and reported normal or corrected to normal vision.

One hundred and sixty-one Asian individuals participated in the experiments. All participants of Asian (Chinese) ethnicity, and were recruited voluntarily on the Internet by finishing a questionnaire on Caucasian face exposure. Only participants who replied that they have not lived or travelled to Europe, Oceania, America, West Asia, North Africa or North India for longer than 2 months were further approached to complete the experiment. From the total of 161 participants, 89 participants were randomly allocated to the other-race condition (75 females, age 17–29, M age = 22.11, SD = 2.54), and 71 to the own-race condition (57 females, age 18-28, M age = 22.05, SD = 2.27). Five participants were excluded from analysis: 3 due to technical errors in data acquisition during the recognition phase of the experiment, and 2 participants who recognized all the test faces as "new", resulting in a total of 156 participants. Note that the difference in sample size between the two groups was due to technical issues that prevented several participants from completing the online tasks. The same recruitment procedure that is explained in Study 1 was also used in Study 2. None of the Asian participants reported that they had travelled to countries with a majority white population for longer than 2 months. Only 2 participants reported high familiarity with a white person. The experiment was approved by the institutional ethics committee of Tel Aviv University, and all participants gave informed consent to take part in the study.

3.1.2. Stimuli

The stimuli were identical to those used in Experiment 1. Experiment 2 featured two separate versions – one with Asian face stimuli, and one with white face stimuli. The Asian face stimuli served as own-race stimuli for Asian participants, and as other-race stimuli for white participants, and vice versa.

In both versions of the experiment (with either Asian or white face stimuli), from the pool of 40 identities, 24 identities were randomly assigned to the learning phase. These identities were randomly assigned to one of the three conditions: social evaluations, perceptual evaluations, or no evaluations. The remaining 16 identities were novel faces that appeared only in the recognition phase of the experiment as new, unlearned identities. Three face views of each identity were presented: frontal (learned view), and 30° and 60° novel face views.

3.1.3. Procedure

All participants performed the experiment online. The experiment was programmed using JavaScript. Both versions had an identical procedure and differed only in the face stimuli (Asians or White) that were presented; and both versions included a 20-minute learning phase during which participants were asked to learn 24 face identities for a later recognition test, while making social, perceptual, or no evaluations about them. The learning phase was immediately followed by a 7-minute old/new face-recognition phase, presenting the learned identities from the learned or unlearned views, as well as new, unfamiliar identities. All face identities were presented from learned and novel views.

Figure 4 shows the design of the experiment, which includes a learning phase and a recognition phase.

3.1.3.1. Learning phase

During the learning phase of the experiment, participants were asked to learn a total of 24 different identities. Of the 24 identities that were randomly assigned to each participant to be learned, 8 identities were assigned to the social condition and participants were asked to rate them based on their inferred personality traits; 8 identities were assigned to the perceptual condition and participants were asked to rate them based on their perceptual appearance; and the remaining 8 identities were assigned to the control, no-evaluation condition, and the participants were asked to passively view and memorize them.

Face stimuli were presented in mini blocks by identity throughout the learning phase, with each identity repeating five times sequentially, each time following a different question (in the social or perceptual condition) or a blank screen in the control no-questions condition. The presentation order of the identities and conditions was random for each participant.

In the social and perceptual conditions, each trial began with either a social or perceptual question from a set of five questions. Each question appeared on the screen for 3 seconds, followed by a 1 second inter-stimulus interval, after which the face was presented for 1 second. Following the face offset, a scale of 1–7 appeared on the screen, and the participants were asked to rate the relevant face on that scale based on the question asked. Each identity was presented five times, once following each of the five different questions. The order of the five questions on each mini-block was random. The five social questions were “How intelligent/dominant/trustworthy/friendly/aggressive does the face look?” The perceptual questions were “How symmetric/round/wide is the face?" and "How smooth/bright is the skin of the face?” In the no-evaluation condition, each trial began with a blank screen presented for 3 seconds, followed by the face presented for 1 second, followed by a blank screen presented again for 1 second.

3.1.3.2. Recognition phase

Participants performed an “old-new task” in which the 24 learned identities along with 16 novel identities were presented, each in three views throughout the recognition phase. Faces were presented sequentially in blocks by view: first, all identities were shown from a 60° view, then from a 30° view, and finally from a frontal view. All face images appeared for 1 s.

Participants were asked to determine for each face image whether the face identity was presented during the learning phase of the experiment, or whether it was a novel, unlearned identity. They were instructed to indicate “new” for identities that did not appear in the learning phase, and “old” for identities that appeared during the learning phase, even if they were presented in a 30° or 60° view that did not appear during the learning phase.

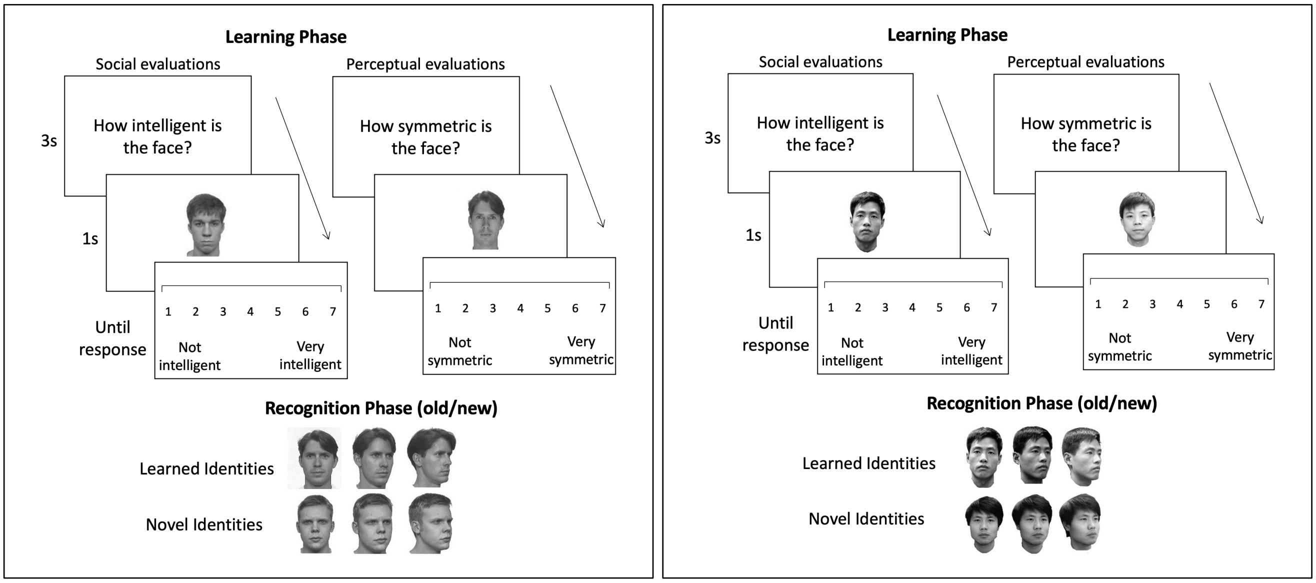


Figure 4: Design of Experiment 2: Face images of own- or other-race faces (a between-subjects factor) were presented during the learning phase. During the recognition phase, old and new faces were presented from the learned frontal view or unlearned views and participants were asked to make an old/new decision for each face.

3.2. Data analysis

Trials in which the response times were shorter than 200 msec or longer than 10 seconds were excluded from the analysis. We computed the Hit rate (HR) and False Alarm rate (FAR) during the old/new recognition task. Correct “old” responses for the learned identities were classified as Hits, and incorrect “old” responses for new identities were classified as False Alarms. The dependent measure was [HR-FAR], which was separately calculated for the social, perceptual, and the no-evaluation condition for each of the three test face views (60°, 30°, frontal). Note that the FAR is similar for the three evaluation conditions within each view.

3.3. Results

We performed a mixed ANOVA on HR-FAR with Condition (Social, Perceptual, No Evaluation) and Test face view (frontal, 30°, 60°,) as within-subject factors, and Face Race (Own race, Other race) and Race of participants (Asian, White) as between-subject factors.

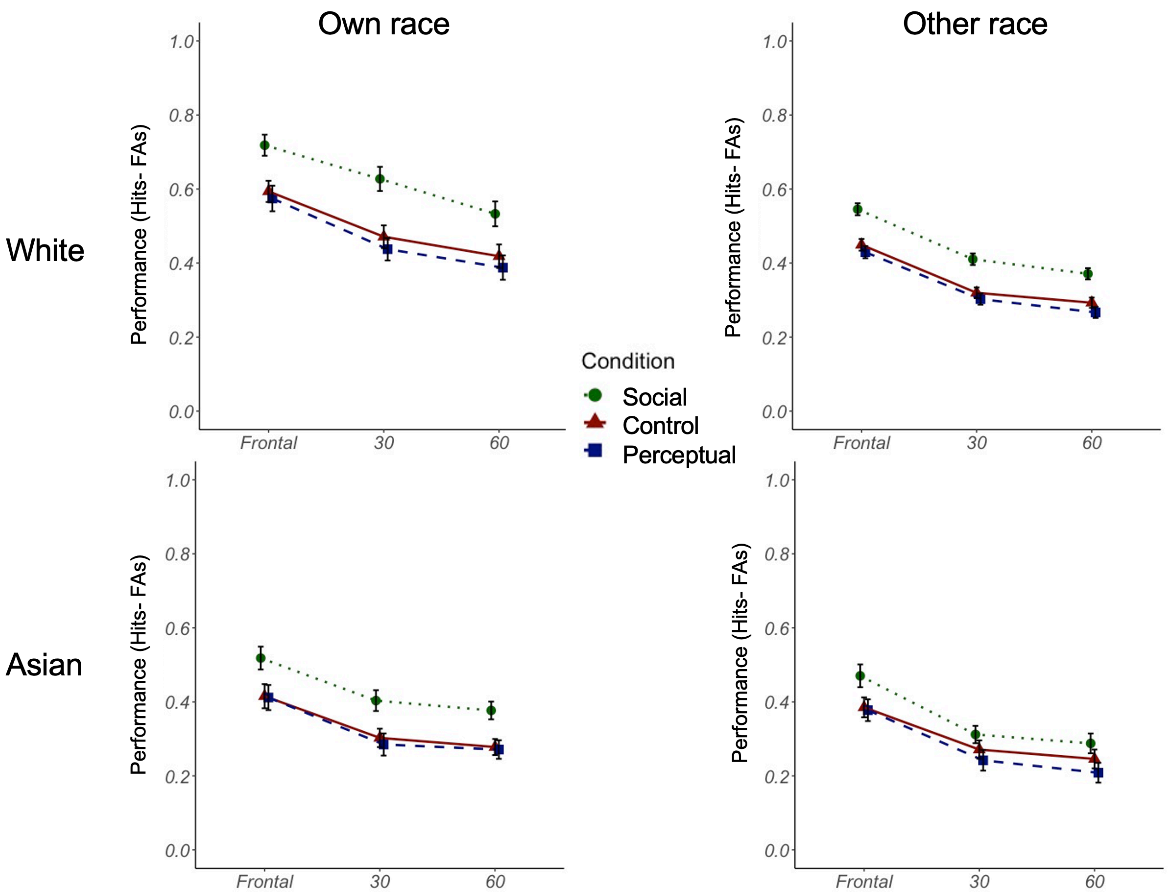


Figure 5: Performance of White (top) and Asian (bottom) participants on a face-recognition task for faces that were evaluated based on social traits, perceptual features, or no evaluation (control) for own-race (left) and other-race (right) faces. A social benefit in face recognition if shown for both own- and other-race faces.

We first report the between subject effects of Face Race and Participants race beyond the effects of Condition and View. A main effect of Face Race was found ($F(1, 255) = 36.97$, $p < 0.001$, $\eta^2p = 0.13$), indicating better recognition of own-race than other-race faces. The interaction of Face Race and Participant Race was significant ($F(1, 255)$

= 11.39, $p < 0.001$, $\eta^2 p = 0.04$), indicating a larger other race effect in White participants ($t(255) = 6.1$, $p < .001$) than in Asian participants ($t(255) = 2.14$, $p = .03$).

A significant main effect of Condition was found ($F(2, 510) = 57.839$, $p < 0.001$, $\eta^2 p = 0.19$), indicating better recognition of the socially evaluated faces than perceptually evaluated faces ($t(257) = 9.9$, $p < 0.001$, Cohen's d = 0.62) or non-evaluated faces ($t(257) = 7.91$, $p < 0.001$, Cohen's d = 0.49), and no significant difference between perceptually evaluated and no evaluation faces ($t(257) = -1.9$, $p = 0.17$, Cohen's d = 0.12), replicating previous findings (Schwartz & Yovel, 2019a, 2019b). Additionally, a significant main effect of Test face view was found ($F(2, 510) = 105.293$, $p < 0.001$, $\eta^2 p = 0.292$), resulting from better recognition of the frontal learned view than the 30° unlearned view ($t(257) = 11.39$, $p < 0.001$, Cohen's d = 0.71) and the 60° unlearned view ($t(257) = 13.43$, $p < 0.001$, Cohen's d = 0.84), and better recognition of the 30° view than the 60° view ($p = 0.011$, Cohen's d = 0.18). Similar to previous findings, there was no interaction between Condition and View ($F(4, 1020) = .27$, $p > 0.89$, $\eta^2 p = 0.001$), indicating a similar social benefit for all face views. We found no significant interactions with participants' race and thus no evidence for different patterns of results for White and Asian participants. A marginally significant interaction between Condition and Face Race was found ($F(2, 514) = 2.68 = 0.07$, $\eta^2 p = 0.01$). To evaluate whether the social-evaluation advantage was evident for both own- and other-race faces, a follow-up analysis examined the recognition of own- and other-race faces separately.

Own-Race Task – A significant main effect of Condition was found ($F(2, 240) = 44.42$, $p < 0.001$, $\eta^2 p = 0.27$), indicating better recognition of socially learned faces than perceptually learned faces ($t(120) = 8.06$, $p = 0.001$, Cohen's $d = 0.73$) and control faces ($t(120) = 7.26$, $p = 0.001$, Cohen's $d = 0.66$).

Other-Race Task – A significant main effect of Condition was found ($F(2, 270) = 17.69$, $p < 0.001$, $\eta^2 p = 0.12$), indicating better recognition of socially learned faces than perceptually learned faces ($t(135) = 6.03$, $p = 0.001$, Cohen's $d = 0.52$) and control faces ($t(135)$, $= 4.19$, $p = 0.001$, Cohen's $d = 0.36$).

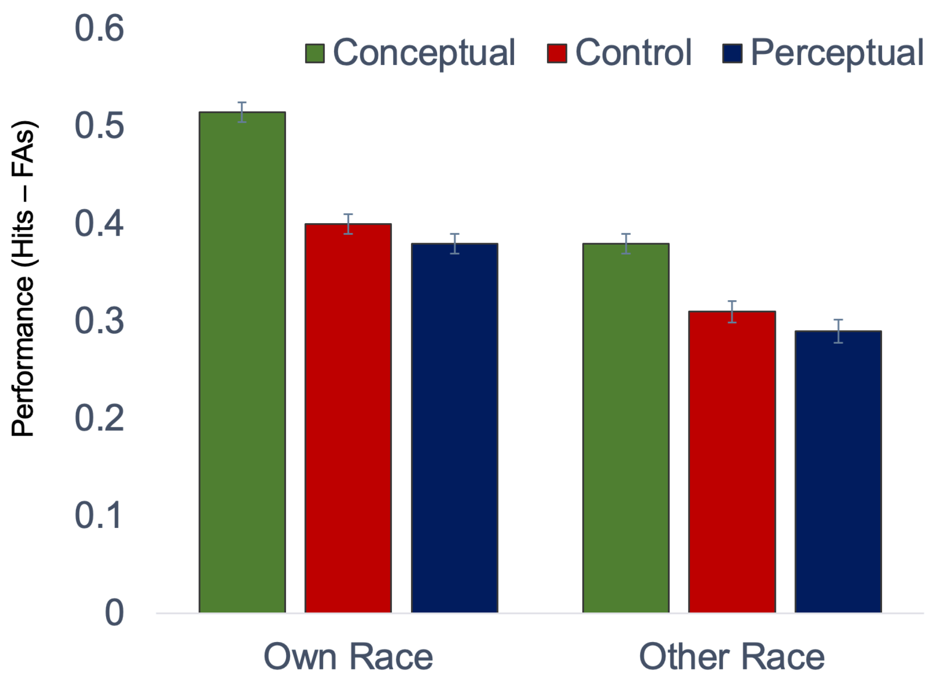


Figure 6: Performance for own and other race faces averaged across head views and participants country of origin show that performance for other race faces encoded conceptually eliminate the other race effect relative to own race faces encoded perceptually or without evaluations.

We performed further post hoc analyses to assess whether social evaluations of other race faces eliminated the other race effect. This was done by first comparing recognition level for social evaluation condition only in own and other race faces. Social evaluations improved recognition for both own and other race faces and therefore performance was better for own than other race faces for this comparison ($t(257)=6.32$, $p < 0.001$, Cohen's $d = 0.62$). We then also compared recognition level for social evaluations of other race faces to the no evaluation condition $t(257) = 1.26$, $p = 1$, Cohen's $d = 0.12$) or the perceptual evaluation condition of own race faces ($t(257) = 0.45$, $p = 1$, Cohen's $d = 0.04$). We found no advantage for own than other race faces across these conditions. Thus, social evaluations of other race faces eliminate the other race effect when compared to performance of own race faces that are encoded in a default mode with no evaluations or even when they are evaluated perceptually during encoding (Figure 6).

3.4. Discussion

Our findings reveal better face recognition following social than perceptual evaluations or no evaluations. This effect was found for both own- and other-race faces following social than perceptual encoding (Figure 5). These results replicate previous findings (Schwartz & Yovel, 2019a, 2019b) showing a social-evaluation benefit for own-race faces, and further extend the effect to other-race faces. Interestingly, social evaluations for other-race faces improved recognition at the level of own-race faces that were encoded with no evaluation, which is the default mode of encoding in old-new recognition tasks. The same benefit for socially evaluated other race faces was also found when it was compared to perceptually evaluated own race faces. Thus, social evaluation of other race faces eliminates the other race effect when it is compared to the default, no evaluation encoding of own race faces and remarkably even when own race faces are evaluated perceptually. Moreover, the lack of previous experience with other race faces did not limit the encoding-evaluation benefit of other-race faces solely to the learned view, but was generalized to the new, unlearned views as well. Thus, similar to findings with own-race faces, the social benefit for face recognition was similar across all face views. Taken together, our results indicate that social evaluations induce a recognition benefit that is generalized to faces we have no experience with, supporting the notion that conceptual encoding increases the social relevance of the learned faces and contributes to better recognition (Schwartz & Yovel, 2019b; Shoham et al., 2021).

4. General discussion

The current study examined whether social evaluations lead to recognition benefit for categories of faces we have little experience with, such as other-race faces. To that end, we first examined whether Asian and White participants make valid and consistent social or perceptual evaluations for own- or other-race faces (Experiment 1). Results showed that social and perceptual evaluations were similarly valid and consistent for own- and other-race faces. These findings indicated that social evaluations made for other-race faces are not random but meaningful. We then examined if these evaluations would also facilitate face recognition. In Experiment 2, participants were asked to study faces while making social, perceptual, or no evaluations about them. We found that social evaluations enhanced recognition similarly for both own- and other-race faces. In fact, social evaluations for other race faces during encoding eliminate the other race effect when compared to own race faces evaluated perceptually or encoded with no evaluations.

The contribution of perceptual information to face recognition has been studied extensively, as faces have long been mainly regarded as perceptual, visual stimuli

(Burton et al., 2016; Jenkins et al., 2011; Kramer, Jenkins, Young, & Burton, 2017; Tanaka & Farah, 1993). Meanwhile, other studies have shown that associating faces with conceptual/social information (such as a name, occupation, or social attributes) during encoding (Gordon & Tanaka, 2011; Schwartz & Yovel, 2016, 2019b) or learning them in a social context (Hugenberg et al., 2010; Van Bavel & Cunningham, 2012; Wilson et al., 2014) improves face recognition. The paradigm used in the current study enabled us to assess the contribution of both perceptual and social information to face recognition. We found that social relevance as well as perceptual similarity contribute to face recognition, through complementary, independent mechanisms (see also Schwartz & Yovel, 2019b). In particular, we note that face recognition was better for the head view that was presented during the study (learning) phase, and recognition decreased as the angle difference between study and test faces decreased. These findings are consistent with a view specificity effect that was reported for both face and object recognition (O'Toole, Edelman, & Bülthoff, 1998; Tarr, 1995; Tarr & Gauthier, 1998). Nevertheless, social processing during encoding can increase performance for unlearned views to the level of the learned view that is encoded with no evaluation (Figure 5). Furthermore, the benefit of social information was similar for learned and unlearned views.

Our results also show that social evaluations are equally valid and consistent for own- and other-race faces. These results are in alignment with a previous work by Zebrowitz et al. (1993), who found that for White, African-American, and Korean participants, cross-race evaluations were as reliable as within-race evaluations. It is important to point out that even if social evaluations of other-race faces are valid and consistent, it does not necessarily mean that these evaluations are valid depictions of the individual. Instead, we suggest that in an absence of social experience with other-race faces, it is possible that this consensus is due to generalization of social inferences from own- to other-race faces, and that this generalization is a mechanism that allows us to socially interact with face categories we have no previous experience with. Notably, as we see from the results of the perceptual evaluations, consensus on evaluations alone does not lead to better recognition. Our results indicate that only social evaluations are beneficial and facilitate face recognition.

Our findings that associating social meaning with faces facilitates recognition of other-race faces is also relevant to the debate regarding the role of perceptual expertise and social/conceptual information in the ORE (Crookes & Rhodes, 2017; Rhodes, Lie, Ewing, Evangelista, & Tanaka, 2010; Tullis, Benjamin, & Liu, 2014). Because experience with faces is typically both perceptual and conceptual, it is hard to assess their contribution separately. To assess the pure contribution of perceptual information, a previous study examined recognition of newborn faces among neonatology nurses, a unique population who have massive perceptual experience with newborn faces but no conceptual/social interaction with them. Findings showed that neonatology nurses do not recognize newborn faces better than a control group of participants who have hardly any experience with newborn faces. These findings suggest that perceptual information alone does not contribute to face recognition. However, individuation training with participants who had no previous experience with newborn faces significantly improved face recognition for the learned as well as novel newborn faces (Yovel et al., 2012). These findings are consistent with the current study showing that perceptual information alone does not contribute to face recognition, unless it is encoded in a socially meaningful manner.

In conclusion, our findings show that social evaluations are valid and consistent for both own- and other-race faces and are therefore independent of previous experience with other-race faces. We also found that although both social and perceptual evaluations showed high consistency across races, only social evaluations induced a face recognition benefit. This effect is not limited to the learned face images but is generalized to novel views. Our findings are consistent with the CIM, which argues that social motivation enhances face recognition. Thus, our study stresses the role of social information in face recognition as a way to enhance recognition of face categories we have no prior experience with. This reflects generalization of social evaluations from own- to other-race faces, potentially enabling social interaction with novel categories of faces.

Word Count: 6377

Figure legends: 218

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