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Original Article:

HOW DO GENDER, EMOTIONAL VALENCE, AND ATTRACTIVENESS AFFECT FACIAL RECOGNITION MEMORY?

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Abstract

Many studies have examined the effects of race, age, and gender on facial recognition memory. However, no previous study has specifically examined the role that gender identity plays on memory for gender-nonconforming faces. We designed our study to fill this gap and to examine the influence of emotional valence and attractiveness on facial recognition memory. In our study, young participants were tested using a facial recognition paradigm consisting of young and older faces of men and women, as well as faces of young gender-nonconforming adults. Our findings showed an own-gender bias when young participants viewed older faces, but not when they viewed young faces. This cross-age group own-gender bias has not been demonstrated in the past. We also found that women recalled more gender-nonconforming faces than men. This supports existing findings that women generally score higher than men in facial recognition tests, although women's recognition of gender-nonconforming faces has never previously been tested. To further understand our findings, we examined the roles that emotional valence and attractiveness ratings play in participants' facial recognition memory. Our findings suggest a significant but complex relationship among valence, attractiveness, and facial recognition memory for gender-nonconforming faces. We discussed these findings in relation to existing literature on emotional and facial recognition memory.

Keywords: facial recognition, memory, gender, valence, attractiveness

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INTRODUCTION

Faces convey an incredibly unique, complex, and diverse set of features that play a vital role in social interaction and communication. They communicate a vast amount of nuanced information, both verbal and nonverbal. The psychological literature shows that people have a perspicacity in differentiating between and recognizing people based on minute differences in facial features and expressions (Wilmer et al., 2012). Facial recognition has an immense impact on our daily lives – from one's ability to recognize intimate family members to identifying a suspect in eyewitness testimonies. Given its plenary importance in our quest to understand human cognition, the existing facial recognition memory literature is growing at a rapid rate.

Gender and facial recognition

While many studies have documented the effects of age, sex, and race on facial recognition (Hourihan et al., 2012), no previous study has examined the roles that age and gender identity play on the recognition of gender-nonconforming faces. It is well established that women usually remember faces more accurately than men (Lewin & Herlitz, 2002). Women have also been found to perceive subtle emotions more accurately compared to men (Hoffmann et al., 2010). These findings may be explained by experience (Lovén et al., 2011). For example, women have been found to engage in higher rates of eye contact with other women (Ashear & Snortum, 1973; Rennels & Davis, 2008) and younger people of all genders are usually exposed to more female faces than male faces (Connellan et al., 2000; Leeb & Rejskind, 2004). This early experience may be counteracted in boys as they age and interact more with peers of their own gender. However, a motivational account is also a possible explanation for the above findings. For example, Hills et al. (2018) found evidence against the experience-based account by manipulating encoding instructions (attractiveness vs. distinctiveness) and participants' sexual orientation. They found an own-gender bias when participants were encouraged to process faces for distinctiveness, but an other-gender bias when attractiveness instructions were used. Furthermore, participants were more likely to remember faces of the gender to which they are most sexually attracted. These findings support motivation as a possible mechanism of gender-based facial recognition memory.

Race, age, and facial recognition

Own-sex or own-gender bias research was borne out of an extensive research area on race-based facial memory. For example, the cross-race effect or own-race bias suggests that people are generally more likely to recognize faces of a race with which they have the most experience, typically their own identified racial group, e.g., Asian participants are better at recognizing Asian faces than Caucasian or Black faces and vice versa (Platz & Hosch, 1988; Meissner & Brigham, 2001).

Apart from race, own-age bias is also well-documented (Anastasi & Rhodes, 2005). This suggests that younger participants are better at recognizing younger faces and older participants have higher accuracy when recognizing older faces. In a meta-analysis that included 43 published studies, Rhodes and Anastasi (2012) concluded that the own-age bias is a robust effect because: 1) hit rates are consistently higher for own-age rather than other-age faces, 2) false alarms were reliably lower for own-age compared to other-age faces, 3) discriminability was higher for own-age faces than other-age faces, and these findings were found for children, young adults, and older adults.

Gender-nonconforming faces

Although we could examine gender using the traditional binary categorical approach, just like these past race- and age-based facial recognition studies, we attempted to contribute to the understanding of gender-based facial recognition memory by extending our investigation to faces of individuals who are gender-nonconforming or gender variant, i.e., individuals who do not identify as men or women. We are, therefore, conceptualizing gender on a continuum rather than binary categories. This is extremely important, as most standardized facial memory databases lack representation for gender minority subgroups, and thus, human recognition performance for faces along the gender continuum is currently not very well-understood. We aimed to fill this gap in the literature with the present study.

Valence and facial recognition

Aside from examining facial recognition memory performance, we were also interested in exploring the roles that emotional valence and attractiveness play in people's facial recognition memory. Many studies have documented an emotional enhancement effect, which posits that emotional information (both negative and positive) is remembered better than neutral information (Hamann et al., 1997; Heuer & Reisberg, 1990; Phelps et al., 1997). For example, participants may recall more emotional than neutral stimuli in a recall test (Hamann, 2001). They are also more likely to recall the source and the details of the emotional information rather than neutral information (Doerksen & Shimamura, 2001; Ochsner, 2000). When examining memory for faces, many studies have utilized face stimuli that display various emotions, e.g., happy, surprise, anger, and disgust. Past results have found that although older adults may exhibit a positivity effect in differentially processing positive faces better than negative faces, young adults do not usually show this pattern of results (see Mather & Carstensen, 2005 for a review). In fact, some studies have documented a negativity bias consistent with the rest of the memory literature, where young adults remember more negative emotion faces than positive ones (Grady et al., 2007). Our study is unique in that we asked our participants to rate neutral faces with a 5-point valence scale (0 = very negative, 5 = very positive), i.e., valence measure is subjective rather than objectively defined. This experimental manipulation allows us to take into account the personal relevance and meaningfulness of each face in our participants' memory performance.

Attractiveness and facial recognition

Past research has also examined the effect of attractiveness on facial recognition, even though attractiveness is difficult to define within theoretical models because it is not a changeable attribute of a face (Lindeberg et al., 2019). Research has shown that attractiveness ratings are somewhat universal among cultures, but do vary across different photographs of the same individual (Langlois et al., 2000; Jenkins et al., 2011). In general, attractive people are judged more positively than less attractive counterparts (Langlois et al., 2000). In relation to memory, Light et al. (1981) found that faces rated as more attractive are remembered at a lower rate than faces that are rated as less attractive. They explained this finding by proposing that more attractive faces are usually more uniform and more similar to one another, while less attractive faces are more distinct from each other. In a more recent study, Lin et al. (2016) found that young adults remembered both more attractive faces and less attractive faces better than moderately attractive faces. They also found likeability to partially mediate the linear relationship between memory and attractiveness. To extend these findings, we explored the effect that attractiveness has on facial recognition memory by gender.

The present study

The present study expands our understanding of the effect of gender on facial recognition by examining how young participants' gender affects their facial recognition memory for men, women, and gender-nonconforming faces. Based on past research findings, we hypothesized that women would recognize more faces overall, and would also be more likely than men to exhibit an own-gender bias. Women's overall superior facial recognition ability might also result in higher recognition rates of gender-nonconforming faces compared to men. Additionally, we hypothesized that faces that were rated with more extreme emotional valence (very negative and very positive) and attractiveness (very attractive and very unattractive) would result in the highest rates of recognition. We created a face database that consists of faces of young people who self-identify as non-binary and/or gender-nonconforming from the San Francisco Bay Area, as well as young and old male and female identified face stimuli taken from the Psychological Image Collection (University of Sterling, pics.stir.ac.uk) and the Face-Place Face Database Project (Tarr, 2011) databases. The goals of the present study were to add new dimensions to the existing research by examining the effects of gender, valence, and attractiveness on facial recognition, as well as to replicate the own-age bias finding that has been widely documented in the psychological literature.

METHOD

Participants

Participants were 54 undergraduate students (aged 18-30) from Mills College, University of San Francisco, Stanford University, University of California, Berkeley, and the general San Francisco Bay Area. There were 22 men (*M* age = 22.18) and 32 women (*M* age = 20.55). See Table 1 for participant demographics and cognitive measure means and standard deviations. Overall, men scored significantly lower in the Bem femininity measure (as expected), but significantly higher in both digit span measures. Including both forward and backward digit span measures as covariates in our subsequent analyses did not alter the final results. Therefore, we reported the results from our original analyses without the covariates. Participants earned extra course credit or received a $10 Amazon gift card for their participation.

***Table 1*. Participants' Demographic & Cognitive Measures: Means and standard deviations**

Group	Bem Masculinity	Bem Femininity	BDI	MMSE	Digit Forward	Digit Backward
Women (n = 32)	4.70 (.65)	4.91 (.63)	13.1 (9.45)	28.85 (1.51)	11.26 (1.81)	7.81 (2.07)
Men (n = 22)	4.58 (1.45)	4.44* (.70)	9.38 (8.41)	29.30 (1.06)	12.48* (2.04)	9.43* (2.80)

*$p < .05$, significant difference between men and women

Materials

Faces for the encoding and recognition memory test phases were presented on a 15-inch computer screen. The encoding phase consisted of a racially-balanced set of 25 faces from the following categories: five young women, five young men, five older women, five older men, and five young gender-nonconforming individuals (Figure 1). Fourty young and old men and women faces of diverse ethnicities were carefully chosen from the Psychological Image Collection (University of Sterling, pics.stir.ac.uk, 20 faces) and the Face-Place Face Database Project (Tarr, 2011; 20 faces) databases. We then added photographs of ten young people (aged 18-30) who self-identified as non-binary and/or gender-nonconforming from the San Francisco Bay Area to our stimuli. They signed an informed consent about the use of their photos and were paid $60 each for their participation. The presented faces were cropped so as to include hair but not contain any background information. Two counterbalanced encoding lists were created and administered randomly to participants. The Mini-Mental State Exam (MMSE; Folstein et al., 1975) and the Digit Span Task (Wechsler, 1997) were used to assess general memory functioning. The set of faces presented in the recognition memory test included all the previously studied faces plus 25 new faces (a total of 50 faces) ordered randomly. After the recognition memory test, participants made a judgement about the perceived gender of each face (woman, man, or gender-nonconforming), emotional valence on a 1 to 7 scale (1 being the most negative and 7 being the most positive), and attractiveness on a scale from 1 to 7 (1 being very unattractive and 7 being very attractive). At the end of the experimental session, participants filled out the Bem Sex Role Inventory (BSRI; Pedhazur & Tetenbaum, 1979) to provide an understanding of participants' assessment of their own gender identity; and the Beck Depression Inventory (BDI; Beck et al., 1996), to ensure that our participants were equated on depression status.

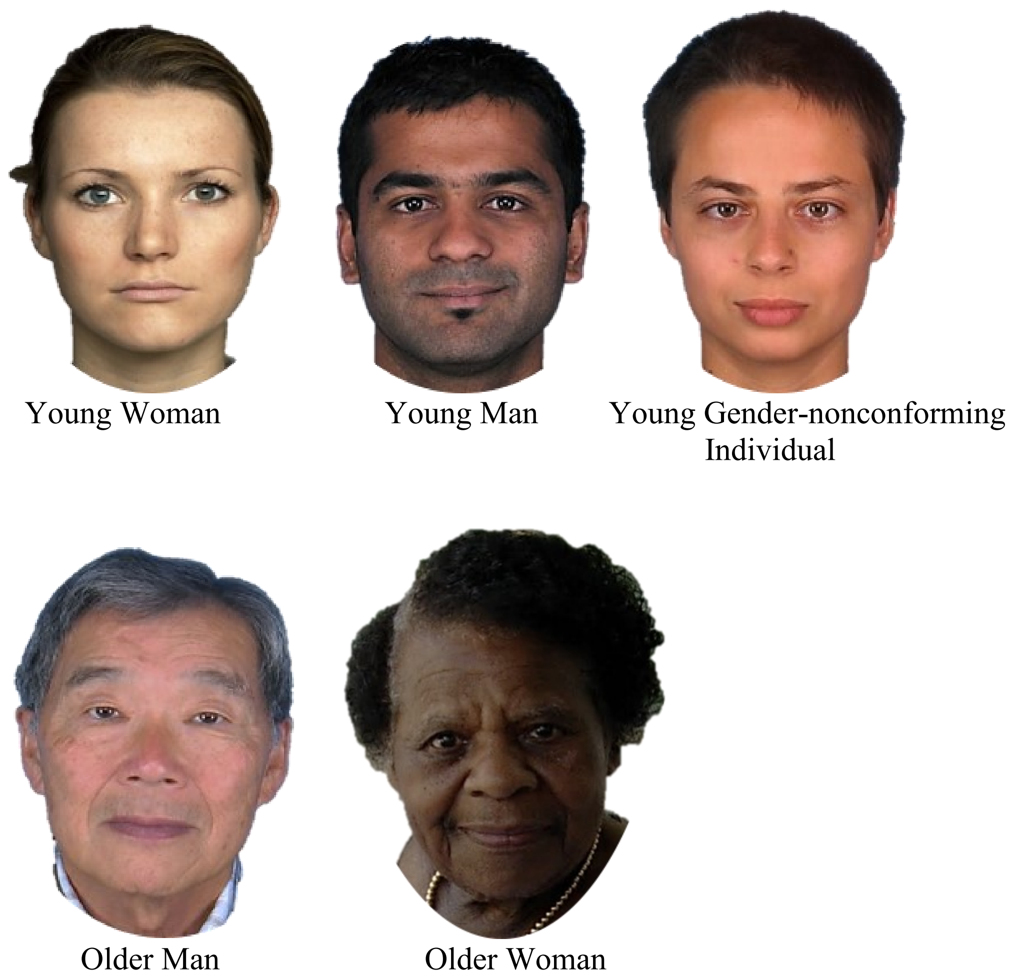

Figure 1. Samples of stimuli used in the facial recognition memory task

Procedure

Participants were first asked to give consent and then completed a general information and demographics questionnaire. They were also asked if they felt capable of performing a basic computer task and were able to visually perceive information presented on a screen. After the completion of these preliminary steps, participants were shown the encoding list of 25 faces on a 15-inch computer screen, at a rate of 3 sec per face and a 3-sec blank screen in between each face. Participants were instructed to pay close attention to the presented faces and be prepared for a subsequent memory test. Following the encoding phase, participants were administered the MMSE (Folstein et al., 1975) and the Digit Span Task (Wechsler, 1997). Then, participants took the facial recognition memory test where faces were presented in a random order. They were asked to give verbal yes or no responses affirming or denying if they recognized each face on the computer screen. This information was manually recorded by the experimenter on paper. After the test phase, participants rated all of the faces shown in the test list for perceived gender, emotional valence, and attractiveness. Participants recorded their responses by circling their chosen responses on an answer sheet. Finally, they completed the BSRI (Pedhazur & Tetenbaum, 1979) and the BDI (Beck et al., 1996) while the experimenter waited outside of the room to reduce bias and encourage honest responses. Each experimental session lasted around 45 minutes.

RESULTS

Hit and false alarm rates were calculated for participants' recognition of each type of face (Table 2). To give a comprehensive view of participants' overall recognition performance, we conducted final analyses on corrected recognition scores by subtracting false alarms from hits in each category (Figure 2). We also conducted post-hoc t-tests with Bonferroni correction to further examine any significant interactions. A mixed factor 2 (Participant gender: men, women) x 5 (Face category: young women, young men, older women, older men, and young gender-nonconforming) ANOVA revealed a significant gender x face category two-way interaction, $F(4, 200) = 4.77$, $p < .002$, $\eta^2 = .087$. Post-hoc t-tests showed that women recognized older women's faces at a significantly higher rate than men participants, *M*s = .84 vs. .67, $t(52) = 2.34$, $p < .025$. Men, however, showed superior facial recognition of older men's faces compared to women participants, *M*s = .66 vs. .46, $t(52) = 2.27$, $p < .025$. To our knowledge, this is the first time a cross-age-group own-gender bias has been demonstrated in the memory literature.

***Table 1*. Hits and false alarms rates for men and women participants in facial recognition task**

Group		Young women	Young men	Gender-nonconforming	Older women	Older men
Women	Hits	.81 (.22)	.68 (.17)	.91 (.16)	.91 (.14)	.82 (.21)
	FAs	.11 (.16)	.15 (.15)	.06 (.12)	.08 (.11)	.36 (.28)
Men	Hits	.82 (.20)	.75 (.19)	.83 (.18)	.84 (.17)	.84 (.19)
	FAs	.05 (.11)	.11 (.13)	.12 (.16)	.16 (.22)	.17* (.15)

*$p < .05$, significant difference between men and women

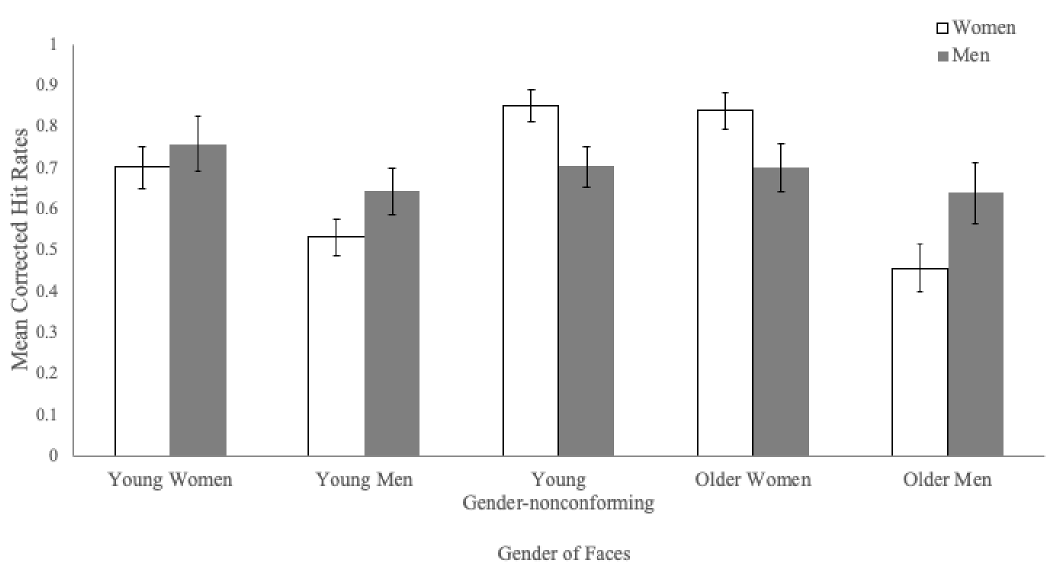

***Figure 2*. Participants' corrected recognition for men, women, and gender-nonconforming faces (error bars represent standard errors)**

Post-hoc t-tests also revealed that women participants recognized significantly more gender-nonconforming faces than men participants, *M*s = .85 vs. .70, $t(52) = 2.23$, $p = .03$ (based on Bonferroni correction significance level of $p < .025$). This finding is unique in that gender-nonconforming faces have not been used in past paradigms. However, it is in line with previous findings that documented women's overall superior facial recognition memory when compared to men's performance (e.g., Herlitz & Yonker, 2002; Hill et al., 1995). Both men and women participants recognized more young women than young men faces, $t(21) = 2.83$, $p < .01$, $t(31) = 3.17$, $p < .004$, respectively.

Next, participants' valence rating for each face was examined with a 2 (Participant gender) x 5 (Face category) ANOVA (Figure 3). We found a significant two-way interaction between gender x face category, $F(4, 196) = 4.14$, $p < .004$, $\eta^2 = .08$. When men and women participants' ratings were examined separately, we found that women rated older men and gender-nonconforming faces significantly more negatively than all other categories, all *t*'s > 1.56, *p*'s < .001. Men participants showed a similar pattern of ratings, all *t*'s > 2.80, *p*'s < .025, although their ratings for older women and gender-nonconforming faces were not statistically different.

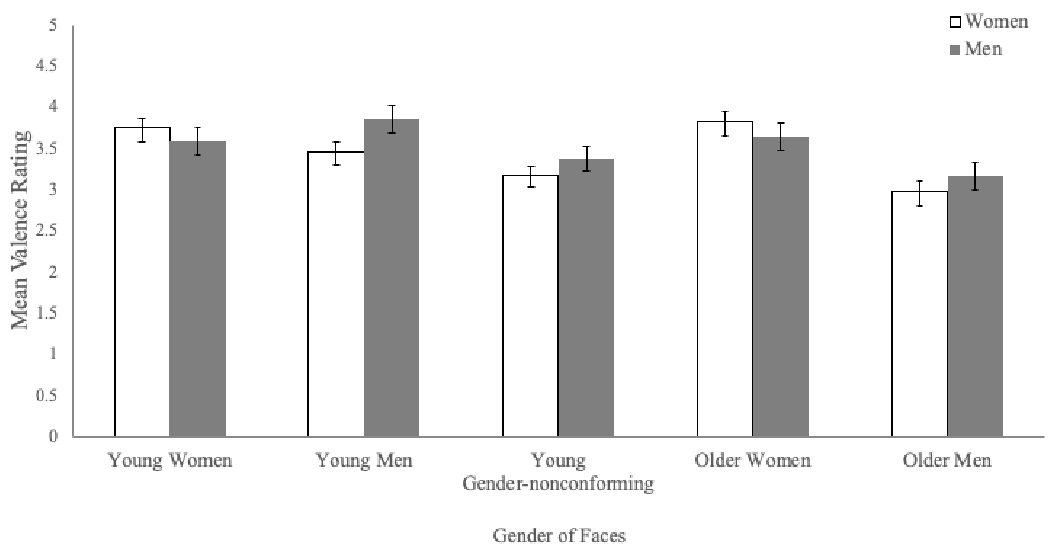

Figure 3. Participants' valence ratings for men, women, and gender-nonconforming faces (error bars represent standard errors)

We also examined participants' attractiveness ratings for faces used in the test phase (Figure 4). A mixed factor 2 (Gender) x 5 (Face category) ANOVA showed a significant attractiveness x gender two-way interaction, $F(4, 196) = 4.07$, $p < .004$, $\eta^2 = .08$. Further post-hoc t-tests showed that women participants rated young women faces as significantly more attractive than all other faces except for young men faces, all *t*'s > 2.10, *p*'s < .002. Men participants showed similar results, all *t*'s > 4.49, *p*'s < .01, and their ratings for young men and young women faces also did not differ significantly. Women participants rated older men and gender-nonconforming faces as significantly lower in attractiveness, all *t*'s > 5.12, *p*'s < .01. Men participants showed the same pattern of results, all *t*'s > 2.24, *p*'s < .01, except for a non-significant difference between older men, older women, and gender-nonconforming faces.

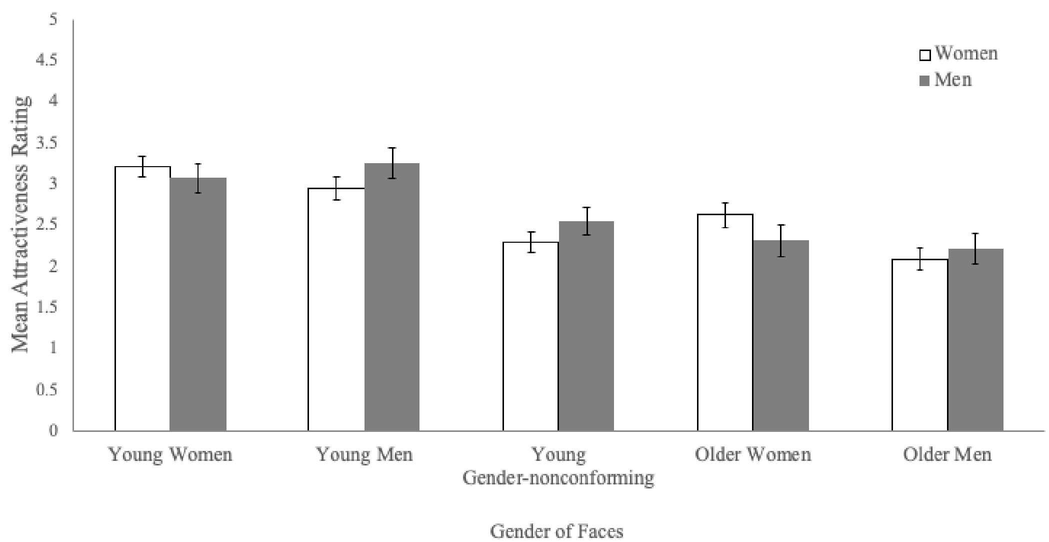

Figure 4. Participants' attractiveness ratings for men, women, and gender-nonconforming faces (error bars represent standard errors)

Multiple regression analyses were performed to examine whether valence and attractiveness ratings predicted men and women's corrected hit rates for faces. The only significant results we observed were for the gender-nonconforming faces. For men participants, valence significantly, negatively predicted corrected hit rates, *b* = -.33, *t*(18) = -2.17, *p* < .05, and attractiveness marginally predicted corrected hit rates, *b* = .17, *t*(18) = 1.98, *p* = .06. For women participants, attractiveness also marginally predicted corrected hit rates, *b* = .11, *t*(29) = 1.86, *p* = .07.

DISCUSSION

Many past studies have shown that women exhibit enhanced facial recognition when compared to men, with own-gender bias being reliably found in most paradigms (e.g., Herlitz & Lovén, 2013; Lovén et al., 2011). On the other hand, results for men have been mixed – the own-gender bias was observed only in certain paradigms. These findings suggest that gender-based face recognition is a complex mechanism that likely depends on both perceptual expertise, experience, and motivation (Hills et al., 2018). In line with the literature, we found that young women remembered more faces than young men overall (Herlitz & Lovén, 2013). However, our results revealed an own-gender bias for both young men and women participants tested with older faces, i.e., young women recognized more older women faces, and young men recognized more older men faces. No past studies have shown an own-gender bias across age groups as such. Our study allowed for a concise examination of own-gender bias because, when young adults were asked to recognize older faces, own-age bias was eliminated. Furthermore, young adults might be less likely to consider older adults as potential mates, and thus, our design also potentially decreased motivational and sexual factors that could influence memory.

Next, we found that both men and women participants recognized more young women faces. This finding corroborates the existing literature on the early socialization with women and better memory for women faces in early ages for both genders (Connellan et al., 2000; Leeb & Rejskind, 2004). However, these past studies have found this effect to slowly dissipate as boys start to interact with peers of their own gender as they mature. However, a motivational account could pose several possible explanations for these findings. Both men and women participants rated young women faces high on attractiveness. It is also possible that our men participants were more motivated to remember women's faces due to sexual motivation. Our men group was predominantly heterosexual (n = 16) and although we did not use the attraction scale until after their recognition task was completed, participants' memory strategy could still have been influenced by their sexual preference. Hills et al. (2018) conducted four experiments to illustrate the importance of motivation, specifically sexual motivation, over the role of experience in gender-based facial recognition. When attractiveness ratings were used instead of distinctiveness ratings, participants were more likely to show an other-gender, rather than own-gender bias, in face recognition. Homosexual participants were also more likely to show an own-gender bias compared to straight participants. Hills et al. (2018) explains that participants will use the expert perceptual system to assist in memory when they are motivated to process other-gender faces deeply. Therefore, we will test a larger sample of non-heterosexual men participants to further examine this finding. We also found that women recognized more gender-nonconforming faces than men. This finding is consistent with the well-documented literature on sex differences in face memory (e.g., Herlitz & Yonker, 2002; Hill et al., 1995).

An examination of participants' valence ratings revealed a significant two-way interaction between gender and attractiveness, which was mainly driven by the difference in men and women participants' valence ratings to older women's faces. Interestingly, women participants remembered significantly more older women faces than men participants, thereby demonstrating an own-gender bias across age groups. Women participants also showed a significantly higher recognition rate of gender-nonconforming faces, and yet their valence ratings for these faces were significantly lower than for other faces, with the exception of older men faces. For men participants, valence negatively predicted facial recognition performance. These findings corroborate results from other emotional memory paradigms that posit an emotional enhancement effect wherein emotional information, especially negative information, is recalled better than neutral information (Hamann, 2001). Face memory studies have also documented better memory for negative faces in young adults, although the face stimuli used in these past studies actually displayed emotions such as happy, surprise, anger, disgust (Grady et al., 2007). Our study is the first to have participants rate neutral faces for emotion using a 5-point valence scale, which means the valence ratings were subjective and reflected the impression each face had on our participants.

We observed similar patterns of results in attractiveness ratings. Of particular interest is the finding of women participants' low attractiveness ratings but superior recognition memory for gender-nonconforming faces. This finding extends Light et al.'s (1981) findings where faces that were rated as less attractive were remembered better because they are considered more distinctive than attractive faces. It is very possible that participants found gender non-conforming faces more distinctive due to certain features, thus, we aim to further elucidate the factor of distinctiveness in facial recognition memory performance. However, the overall picture was made more complicated when we found that attractiveness marginally positivity predicted recognition memory performance of gender-nonconforming faces for both men and women participants. This suggests that there is a trend for more attractive faces to be recognized better. This finding is in line with results reported by Lin et al. (2016), where young adults remembered both less attractive and more attractive faces better, although only memory for more attractive faces was partially mediated by likeability ratings. Lin et al. (2019) tested facial recognition memory with a database that included young and older faces, and found that memory for young, not older, faces was affected by attractiveness ratings. Thus, when different factors such as age, gender, and sexuality were combined, it is very possible that participants' ratings of attractiveness were influenced by the participants' own identity and sexual motivation, and therefore, subsequently affecting memory. Future studies will allow us to further explore the complex relationship between sexual identity, attractiveness, and facial recognition memory.

Taken together, our findings extend the current understanding of human memory beyond the gender binary and shed light on the roles that gender, age, emotional valence, and attractiveness can play on facial recognition memory. This study of facial recognition beyond the gender binary is important not only because this area of research is still in its infancy, but more importantly, because there is consensus in the social science literature that broader knowledge based on gender identity is needed to understand people's and society's beliefs and actions toward people of different self-identified gender identities. Our study is also unique in that we were able to carefully tease apart the contribution of age (objective factor), as well as emotional valence and attractiveness (both subjective factors) in one experimental design. In real-life settings, these factors interact with one another in complex ways; therefore, we are eager to design future experiments to further examine the underlying contribution of each factor to facial recognition memory. We will also examine the effect of sexual orientation on gender based facial recognition by testing more participants of various sexual orientations. Finally, perhaps the most important extension to the present study would be to test a group of non-binary/gender-nonconforming participants to explore the effect of participant gender non-conformity on age-related facial recognition memory. It is a logical next step to explore whether the own-gender bias would extend to gender identities along the gender continuum, other than men and women.

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