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The Eye Wants What the Heart Wants: Female Face Preferences Are Related to Partner Personality Preferences

DongWon Oh
New York University

Natalie Grant-Villegas
Columbia University

Alexander Todorov
Princeton University

Women prefer male faces with feminine shape and masculine reflectance. Here, we investigated the conceptual correlates of this preference, showing that it might reflect women's preferences for feminine (vs. masculine) personality in a partner. Young heterosexual women reported their preferences for personality traits in a partner and rated male faces—manipulated on masculinity/femininity—on stereotypically masculine (e.g., dominance) and feminine traits (e.g., warmth). Masculine shape and reflectance increased perceptions of masculine traits but had different effects on perceptions of feminine traits and attractiveness. While masculine shape decreased perceptions of both attractiveness and feminine traits, masculine reflectance increased perceptions of attractiveness and, to a weaker extent, perceptions of feminine traits. These findings are consistent with the idea that sex-dimorphic characteristics elicit personality trait judgments, which might in turn affect attractiveness. Importantly, participants found faces attractive to the extent that these faces elicited their preferred personality traits, regardless of gender typicality of the traits. In sum, women's preferences for male faces are associated with their preferences for personality traits.

Public Significance Statement
The study shows that women's preference for feminine (masculine) characteristics in male faces reflects their preference for typically feminine (masculine) personality traits in a partner. These results highlight conceptual rather than perceptual mechanisms (e.g., symmetry) of facial attraction, explaining the rich diversity in human attractiveness perception and mating choice.

Keywords: mate selection, attractiveness, social perception, faces, sexual dimorphism

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A large body of research emphasizes the high consensus in judgments of facial attractiveness across individuals (Cunningham, 1986; Langlois et al., 2000)—even including newborns (Langlois et al., 1987)—and across cultures (Apicella, Little, & Marlowe, 2007; Coetzee, Greeff, Stephen, & Perrett, 2014; Little, Apicella, & Marlowe, 2007). Symmetry (Little et al., 2007; Little, Jones, Waitt, et al., 2008; Scheib, Gangestad, & Thornhill, 1999), averageness (Apicella et al., 2007; Langlois & Roggman, 1990; Rhodes & Tremewan, 1996; but see DeBruine, Jones, Unger, Little, & Feinberg, 2007; Sofer et al., 2017; Sofer, Dotsch, Wigboldus, & Todorov, 2015), and sexual dimorphism in the face (i.e., feminine/masculine characteristics; Cunningham, Barbee, & Pike, 1990; Holzleitner et al., 2019; Nakamura & Watanabe, 2019; Perrett et al., 1998; Perrett, May, & Yoshikawa, 1994; Russell, 2003; Said & Todorov, 2011) have been implicated in judgments of facial attractiveness (for reviews, see Little, Jones, & DeBruine, 2011; Rhodes, 2006). These findings suggest that people find similar faces attractive and that those faces share common morphological properties, providing the basis for consensus in attractiveness judgments.

Recent findings, however, suggest that the view of a complete universal consensus is oversimplified (Hönekopp, 2006; Martinez, Funk, & Todorov, 2020; Xie, Flake, & Hehman, 2018). Prefer-

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DongWon Oh, Department of Psychology, New York University; Natalie Grant-Villegas, School of Nursing, Columbia University; Alexander Todorov, Department of Psychology, Princeton University.

Alexander Todorov is now at School of Business, University of Chicago.

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Correspondence concerning this article should be addressed to DongWon Oh, Department of Psychology, New York University, 6 Washington Place, New York, NY 10003. E-mail: dongwon.oh@nyu.edu

ences for attractive faces vary across cultures (Apicella et al., 2007; Scott et al., 2014; Zhang et al., 2019) and depend on various characteristics such as the rater's self-reported attractiveness, genetic propensity, and sexual orientation (Holzleitner & Perrett, 2017; Little, Burt, Penton-Voak, & Perrett, 2001; Zietsch, Lee, Sherlock, & Jern, 2015). Consistent with these findings, when the meaningful variance in attractiveness judgments is partitioned, shared preferences (i.e., consensus) explain about 50% of this variance at best (Hönekopp, 2006; Martinez et al., 2020). The remaining variance is explained by stable idiosyncratic preferences.

The unclear role of sexual dimorphism in male facial attractiveness further illustrates the complexity of attractiveness preferences. While some studies have found that masculine facial characteristics in male faces are perceived as attractive (Cunningham et al., 1990; DeBruine et al., 2006; Feinberg, DeBruine, Jones, & Little, 2008; Holzleitner & Perrett, 2017; Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Little, Cohen, Jones, & Belsky, 2006; Little, Jones, DeBruine, & Feinberg, 2008), others have found that feminine characteristics are perceived as attractive (Burriss, Marcinkowska, & Lyons, 2014; DeBruine, Jones, Smith, & Little, 2010; Little & Hancock, 2002; Penton-Voak et al., 1999; Perrett et al., 1998; Rhodes, Hickford, & Jeffery, 2000; Said & Todorov, 2011; Smith, Jones, & DeBruine, 2010; Welling, Jones, & DeBruine, 2008). Although it has been argued that women's preference for feminine male faces is a methodological byproduct of using composite facial images (e.g., obscuring the jawline; Rhodes, 2006), the results have been inconsistent across different methods (but see DeBruine et al., 2006) and even across data sets employing the same method (that is, studies have found masculinity preference despite using the composite method, e.g., Feinberg et al., 2008; Little, Cohen, et al., 2006). All in all, certain feminine facial characteristics appear to contribute to male facial attractiveness.

In an attempt to explain the inconsistency in female attraction to masculine versus feminine male faces, Said and Todorov (2011) built a statistical data-driven model of facial attractiveness. In this model, attractiveness varies according to a face's position in a multidimensional face space (O'Toole, 2011; Valentine, 1991), in which each face is a vector. This model predicted perceivers' attractiveness judgments of female ($r = .79$, $R^2 = .62$) and male faces ($r = .84$, $R^2 = .71$), outperforming alternative models based on face averageness, sexual dimorphism, or a combination of both. The multidimensional nature of the model allowed for separate analyses of the effects of sexual dimorphism in shape and reflectance cues—two main sources of face-based social judgments (Oh, Dotsch, & Todorov, 2019; Torrance, Wincenciak, Hahn, DeBruine, & Jones, 2014)—on attractiveness. Increasing the femininity of both shape and reflectance cues in female faces increased their attractiveness. However, increasing the masculinity of shape and reflectance cues in male faces led to opposite effects on their attractiveness; whereas masculine reflectance increased attractiveness, masculine shape decreased attractiveness. These findings are consistent with earlier work that restricted sex-dimorphic variation to either shape or reflectance cues. With respect to shape, Perrett et al. (1998) showed that feminine shape was attractive in male faces (see also Burriss et al., 2014; Rhodes et al., 2000; Smith et al., 2010). With respect to reflectance, Russell (2003) and Carrito et al. (2016) showed that masculine reflectance was attractive in male faces, consistent with research showing that men's faces were perceived as darker than women's faces of the same brightness (Carrito & Semin, 2019) and that men's names and personal items were more strongly associated with darker colors than women's (Semin, Palma, Acarturk, & Dziuba, 2018).

The objective of the current study is to explain the dissociation between shape and reflectance for male faces. One hypothesis is that the shape-reflectance dissociation stems from women's preferences for personality traits in male partners. Specifically, facial characteristics that lead to inferences of undesirable traits should decrease the attractiveness of male faces. In contrast, characteristics that lead to inferences of desirable traits should increase the attractiveness. In fact, facially masculine men are perceived as colder, more dishonest and violent, less cooperative, and less qualified to be a parent (Boothroyd, Jones, Burt, & Perrett, 2007; Johnston et al., 2001). In contrast, feminine facial characteristics, such as larger and more round eyes, a smaller chin, and fuller lips, including those in male faces, are perceived as implying traits such as warmth, honesty, cooperativeness, and quality as a parent (Berry & Zebrowitz McArthur, 1985; Friedman & Zebrowitz, 1992). Notably, these feminine facial characteristics associated with good personality qualities are all face shape information (as opposed to feminine reflectance information, e.g., lighter complexion, higher contrast across the face; Russell, 2009). Thus, feminine shape in male faces may lead to inferences of desirable traits and consequently may increase the attractiveness of these faces. In contrast, masculine shape may lead to inferences of undesirable traits and decrease the attractiveness of male faces. If women's attractiveness preferences for male faces reflect desired personality traits, we would also expect that masculine reflectance would not be associated with inferences of undesirable traits.

Personality traits matter in partner selection for women, who care less about their mates' appearances than men do (Buss, 1989; Buss & Barnes, 1986; Fletcher, Tither, O'Loughlin, Friesen, & Overall, 2004). Notably, the personality traits that heterosexual women view as desirable in mates align closely with traits that are stereotypically feminine (Buss, 1989; Buss & Barnes, 1986; Fletcher, Simpson, Thomas, & Giles, 1999; Fletcher et al., 2004; South Palomares, Sutherland, & Young, 2018); women are expected and perceived to possess communal personality traits, such as warmth and helpfulness, whereas men are expected and perceived to possess agentic personality traits, such as dominance and assertiveness (Costa, Terracciano, & McCrae, 2001; Eagly & Mladinic, 1989; Eagly & Steffen, 1984; Feingold, 1994; Oh, Buck, & Todorov, 2019; Oh, Dotsch, Porter, & Todorov, 2019; Oswald & Lindstedt, 2006; Schmitt, Realo, Voracek, & Allik, 2008; Sutherland et al., 2013; Williams, Satterwhite, & Best, 1999). On the other hand, while some stereotypically masculine traits (e.g., confidence, assertiveness; Fletcher et al., 1999) and facial appearances suggestive of such traits are considered desirable (Little, Burt, & Perrett, 2006; Oh, Buck, & Todorov, 2019), women view other masculine traits as undesirable (e.g., aggressiveness; Buss & Barnes, 1986; Fletcher et al., 1999). In sum, women seek many stereotypically feminine personality traits in their mates but few stereotypically masculine traits. If these "feminine" traits are mostly inferred from sexually dimorphic face shape cues and not from face reflectance cues, then women on average should prefer male face shape with feminine facial characteristics (e.g., larger eyes, smaller chins).

However, an even more general principle than "feminine personality preference → feminine face-shape preference" may exist. So far, we only considered preferences averaged across individuals—communal/feminine traits are *on average* preferred to agentic/masculine traits. However, given the wide individual differences in how people evaluate facial attractiveness (Hönekopp, 2006; Martinez et al., 2020; Xie et al., 2018), we would expect meaningful variation across women regarding sexually stereotypical personality traits; some (typical) individuals would prefer stereotypically feminine traits—warmth and helpfulness—to masculine ones—dominance and assertiveness—whereas other (atypical) individuals would prefer masculine to feminine traits. As a result, these two groups of individuals should show preferences for male faces suggestive of feminine and masculine personality, respectively. Regardless of this dissociation, both types of individuals' facial preferences could be explained by a general principle that female face preferences are correlated with partner personality preferences. This hypothesis is consistent with the findings of Little and colleagues (2006), who showed that faces were perceived as more attractive when they appeared to reflect the perceiver's desired personality traits in a partner.

In the present study, we first asked heterosexual women to rate the desirability of personality traits in a potential mate in a laboratory setting. We then asked them to rate male faces—parametrically manipulated on masculinity/femininity—on stereotypically masculine and feminine traits. Importantly, we independently manipulated the masculinity/femininity of shape and reflectance cues. We then asked the same participants (in-person participants) and a separate group of participants recruited online (online participants) to rate the attractiveness of the faces. Consistent with the prior literature (Buss, 1989; Buss & Barnes, 1986; Fletcher et al., 1999, 2004), we expected that participants would prefer feminine to masculine personality traits in a partner. More importantly, we expected to observe dissociation between the effects of shape and reflectance cues on both judgments of stereotypically feminine traits and attractiveness. Specifically, replicating prior work (Said & Todorov, 2011), women should perceive male faces with feminine shape but masculine reflectance as attractive. They should also perceive faces with feminine shape as possessing stereotypically feminine traits. On the other hand, given the positive relation between masculine reflectance and attractiveness, we did not expect to find a negative relation between masculine reflectance and judgments of stereotypically feminine traits. For judgments of stereotypically masculine traits, we expected that women should perceive faces with masculine shape and reflectance as possessing masculine traits.

In addition to the above hypotheses, we tested whether participants' trait judgments of male faces predict attractiveness judgments of the same faces, expecting that this would be the case for stereotypically feminine but not stereotypically masculine traits. Finally, we conducted two analyses to test the general principle that female face preferences are associated with partner personality preferences, regardless of whether they prefer feminine or masculine personality. The first analysis tested whether the relative rankings of individual participants' personality traits predicted the strength of the association between judgments of these traits and attractiveness judgments. Judgments of more highly ranked traits should be more strongly correlated to attractiveness judgments. The second analysis tested whether individual participants' masculine/femininity personality preference modulated the effect of face-based trait judgments on their attractiveness judgments. Judgments of preferred traits should be more predictive of attractiveness judgments.

Method

Participants

All participants gave informed consent. The study protocol had been approved by Princeton University's institutional review board. Two groups of participants participated in the study: in-person participants and online participants. In-person participants consisted of 46 Princeton University undergraduates. They participated for monetary reward and completed three sections: a demographic questionnaire, a personality preference questionnaire, and a face rating task. Data from three of the 46 in-person participants were excluded from analysis because they indicated that they were bisexual or declined to report their sexual orientation in the demographic questionnaire in the beginning of the experiment. The final sample consisted of 43 English-speaking young heterosexual women (18–23 years old, M age = 19.91, SD age = 1.49). Prior research employing a similar method (i.e., manipulation of gender-related facial cues, attractiveness ratings by human observers) found that the effect size is small to medium in linear models ($R^2 > .06$) and that a sample of $n = +20$ can afford power of 80% (Oh, Buck, et al., 2019).

Online participants were recruited from Amazon Mechanical Turk for additional analyses: 99 English-speaking women living in the United States. Data from 11 of the 99 online participants were excluded from analysis because they indicated that they were bisexual ($n = 3$) or their intrarater consistency was low ($n = 9$; see "Procedure" for details), with one participant being filtered by both exclusion criteria. The final sample from this participants group consisted of 88 English-speaking heterosexual women (18–69 years old, M age = 42.52, SD age = 11.74). Online participants completed an attractiveness rating task, which was part of the in-person face rating task that took place in the lab.

Stimuli

We created 75 synthetic male face images using FaceGen Software Development Kit (Singular Inversions, 2006). In FaceGen, each face is represented as a vector in a multidimensional space derived from 3D-laser scans of real human faces. We first created three initial faces by randomly sampling each dimension parameter from a normal distribution around the average male face in the FaceGen face space (Supplementary Figure 1). In a face space framework (O'Toole, 2011; Valentine, 1991), each dimension represents a holistic change that captures a large variation across individual human faces and is difficult to verbalize (Oosterhof & Todorov, 2008; Todorov & Oh, in press; Todorov & Oosterhof, 2011). We define the sex-dimorphic dimension as the dimension connecting the average male face and the average female face so that the dimension represents variation from facial masculinity (bigger value on the dimension) to facial femininity (smaller value on the dimension). As noted, the FaceGen model is derived from analyses of the variation of real faces. Thus, the sex-dimorphic dimension reflects actual differences in visual information be-

tween male and female faces (e.g., darker skin tone in men than women; Jablonski & Chaplin, 2000; Russell, 2009). The sex-dimorphic dimension has been validated (Said & Todorov, 2011).

Using the sex-dimorphic dimension, any novel face in the face space can be made to appear more masculine or more feminine. Importantly, in the FaceGen model, shape and reflectance (texture and pigmentation) information are represented separately. This allowed us to orthogonally manipulate the femininity/masculinity in shape and reflectance information of the initial three faces. Specifically, for each of the three face identifies, we manipulated the face on the sex-dimorphic shape dimension on five levels (−2, −1, 0, 1, 2 standard deviations; Figure 1a) and on the sex-dimorphic reflectance dimension on five levels (−2, −1, 0, 1, 2 standard deviations), resulting in 25 face images per identity (total of 75 images). The negative values on the sex-dimorphic dimension correspond to feminized versions of the initial faces, whereas the positive values correspond to masculinized versions of the initial faces. All face images were displayed in color and in a frontal view. The faces had resting expressions facing forward with the mouth closed and were presented with no additional visual cues, such as hair, clothes, or accessories.

Procedure

In-person participants (final $n = 43$) completed a self-paced experimental program on E-Prime 3 (Psychology Software Tools, 2016). The program consisted of three sections—a demographic questionnaire, a personality preference questionnaire, and a face rating task. The order of the sections was identical across participants. In the first section, participants were asked to report their gender, sexual orientation, and age. In the second section, a personality preference questionnaire, participants rated 19 traits according to their value in a mate. The questionnaire items included eight stereotypically feminine and eight stereotypically masculine psychological traits. The feminine traits were warmth, nurturance, gentleness, empathy, trustworthiness, helpfulness, vulnerability, and submissiveness. The masculine traits were dominance, competitiveness, self-confidence ("confidence" henceforward), courage, ambition, assertiveness, independence, and aggressiveness. The sexual stereotypicality of these trait words and their synonyms were previously validated (Eagly & Mladinic, 1989; Oh, Dotsch, et al., 2019; Spence, Helmreich, & Holahan, 1979). We added three additional traits (intelligence, funniness, and reflectiveness) because they are highly desirable in a partner (Fletcher et al., 1999) and we wanted to avoid participant expectancy effects given the sex stereotypicality of other traits. Each trait word appeared on the screen one at a time above the question, "How much do you value this trait in a mate?" The order of the trait words was randomized. Ratings were made on a 9-point scale ranging from 1 (*least valuable*) to 9 (*most valuable*). Each question remained on the screen until the participant provided a rating via key press. No face was presented in the questionnaire.

In the third section, a face rating task, participants viewed and rated face images. The task consisted of seven blocks. The first six blocks involved personality judgments of faces. Participants were asked to rate the extent to which each face reflected a certain personality trait using a 9-point scale ranging from 1 (*not at all*) to 9 (*extremely*). The six personality traits were three stereotypically feminine (warmth, nurturance, gentleness) and three stereotypically masculine traits (dominance, confidence, competitiveness). These traits were selected because of their importance in facial trait judgments (Oh, Dotsch, et al., 2019; Oosterhof & Todorov, 2008; Sutherland et al., 2013) and their gender stereotypicality (Costa et al., 2001; Eagly & Mladinic, 1989; Oh, Buck, & Todorov, 2019; Oh, Dotsch, et al., 2019). Each of the six blocks involved ratings of one personality trait. The six blocks were presented in random order for each participant. The last, seventh block involved attractiveness judgments of faces; participants were asked to rate the extent to which each face was attractive using a 9-point scale ranging from 1 (*extremely unattractive*) to 9 (*extremely attractive*). Each block presented all 75 faces. In each block, the face was displayed one at a time in the center of the screen above the question, "How [trait] is this person?" (e.g., "How warm is this person?"). Each face remained on the screen until the participant provided a rating via key press. A fixation point appeared in the center of the screen for 500 ms before the next face image appeared. In each block, the order of the faces was randomized. The nature of the manipulation of the face stimuli (e.g., sex-dimorphic variation) was not mentioned. Participants were encouraged to rate quickly based on their initial impression of each face. Interrater agreement was medium to high across traits (warmth: $\alpha = .88$, $M\ r_{\text{interrater}} = .16$; nurturance: $\alpha = .91$, $M\ r_{\text{interrater}} = .22$; gentleness: $\alpha = .98$, $M\ r_{\text{interrater}} = .21$; dominance: $\alpha = .86$, $M\ r_{\text{interrater}} = .12$; competitiveness: $\alpha = .81$, $M\ r_{\text{interrater}} = .08$; confidence: $\alpha = .78$, $M\ r_{\text{interrater}} = .09$; α = Cronbach's alpha; $M\ r_{\text{interrater}}$ = mean Pearson correlational coefficients for all pairs of raters' face ratings). Interrater agreement was high for attractiveness ($\alpha = .98$, $M\ r_{\text{interrater}} = .57$).

Online participants (final $n = 88$) completed an attractiveness judgment task, which was identical to the attractiveness task at the end of the in-person face rating task. Participants were asked to rate the extent to which each of 75 faces was attractive using a 9-point scale. Again, the nature of the manipulation of the face stimuli was not mentioned, and participants were encouraged to rate quickly based on their initial impression. To decrease the measurement error, each face was presented twice, and the attractiveness ratings were averaged across the two presentations per face for analysis. Intrarater consistency was assessed for each participant by correlating the two ratings of the same faces. Data from 11 of the 99 online participants were excluded from analysis because their intrarater consistency was lower than zero or they indicated that they were bisexual. This left us with data from 88 participants. The interrater agreement was high ($\alpha = .98$, $M\ r_{\text{interrater}} = .34$).

The attractiveness ratings of the online participants served two purposes. The first was to minimize a potential confound in the study design. One of the main hypotheses is that feminine traits judged from faces predict attractiveness better than masculine traits judged from faces. This kind of effect could have been partially inflated because of the order of tasks; our in-person participants first rated personality preferences, followed by the face rating task (including the attractiveness rating task). Judging what personality traits are desirable ("feminine" on average, according to our data and the previous literature) and undesirable ("masculine" on average) might have reminded the participants of what type of faces they found desirable, therefore attractive (i.e., faces with feminine characteristics, on average), and undesirable, therefore unattractive (i.e., faces with masculine characteristics, on average). Thus, arguably, the reminder of un/desirable personality traits embedded in the original study might have increased the predictive power of face-based feminine trait attributions on attractiveness. However, if we find a consistent effect using ratings of

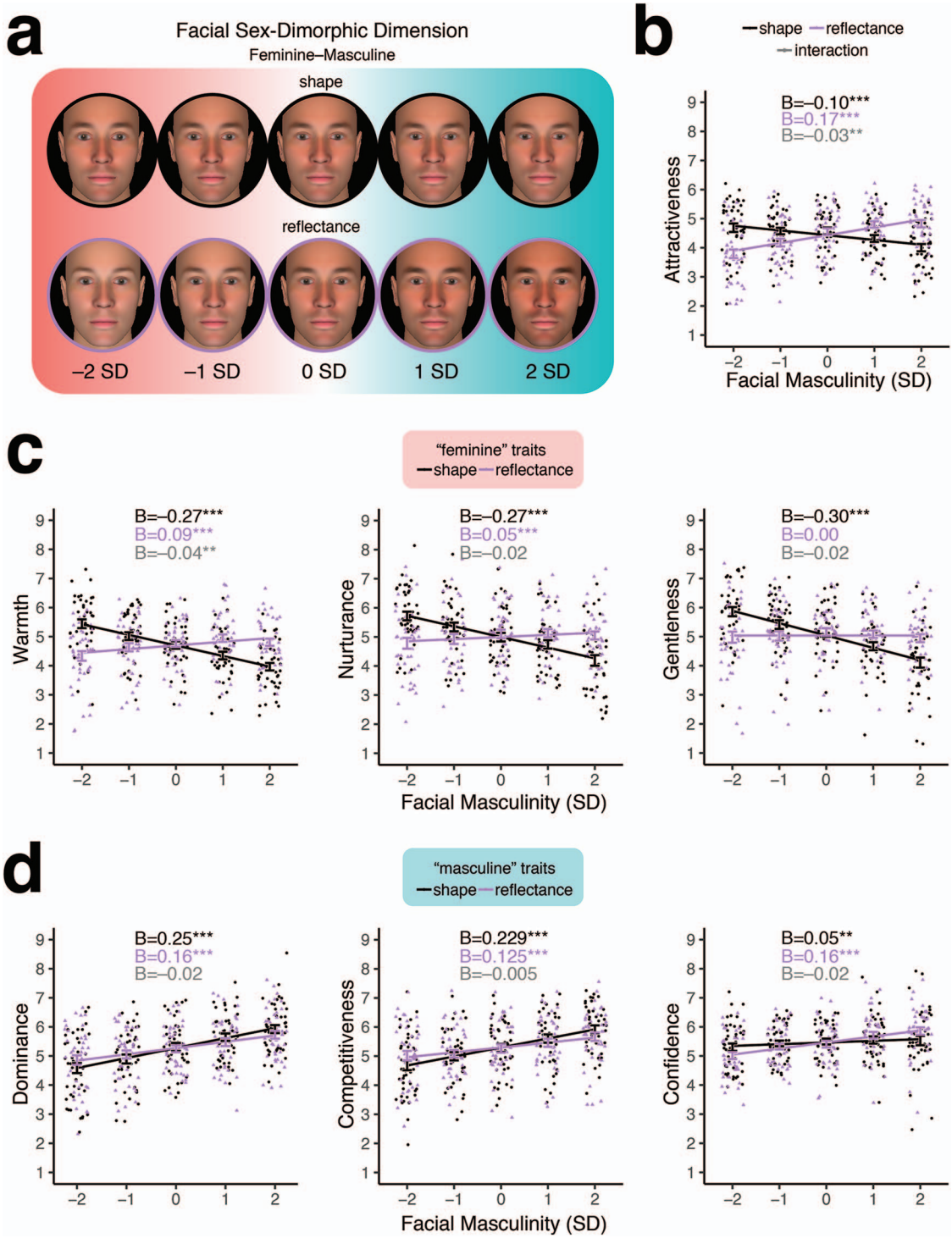

Figure 1. Sex-dimorphic manipulations (Panel a) and mean attractiveness and personality trait ratings as a function of the manipulation level (Panels b–d). A sample face identity and its variants along the empirically derived sex-dimorphic shape (top) and reflectance dimension (bottom; Panel a). Mean ratings of attractiveness (Panel b) and stereotypically feminine (Panel c) and stereotypically masculine traits of faces (Panel d) manipulated on sexual dimorphism ($M \pm SE$). For visualization purposes, dots represent participants' mean ratings averaged across face stimuli at each manipulation level. Actual analyses were conducted via multilevel regressions, considering all individual face ratings and the hierarchical structure of the data. Statistical significances were tested via the Satterthwaite approximation. B = multilevel regression coefficient. $^{**}p < .01$. $^{***}p < .001$. See the online article for the color version of this figure.

independent raters in the absence of personality ratings (preceding attractiveness ratings), it will refute the idea that the correlation between women's preferences for feminine faces and personality preferences is due to an order effect.

The second purpose of using independent attractiveness ratings was to diversify the pool of our raters, not limiting it only to young university students. Young women prefer young men as their partners (Buunk, Dijkstra, Kenrick, & Warntjes, 2001; Kenrick & Keefe, 1992), and young appearance is positively correlated with facial femininity (and negatively with facial masculinity). One of the main hypotheses is that women prefer men with feminine personality traits and faces. A finding supporting this hypothesis would be trivial if our participants' young age was the only reason behind their preference for feminine traits and appearance in men. Thus, it is important to test our hypothesis with older participants, who do not necessarily find younger-looking (thus more feminine-looking) faces attractive. The online participants were significantly older than the in-person participants ($M \pm SD = 42.52 \pm 11.74$ vs. 19.91 ± 1.49 years old, respectively), $t(92.45) = 17.81$, 95% CI [20.11, 25.16], $p < .001$. If we find a consistent effect using much older participants' attractiveness ratings, it will refute the idea that the correlation between women's preference for feminine faces and personality preferences is due to participants' young age.

Results

Personality Preferences

To identify participants' relative preferences for personality traits, we averaged the preference ratings across participants for each trait. In-person participants' data were used for this part of the analysis. As we expected, the most desired traits were stereotypically feminine traits (Figure 2a; see Supplementary Table 1 for the results in numbers). The top five traits included four stereotypically feminine personality traits (trustworthiness: $M = 8.70$, $SD = 0.60$; empathy: $M = 8.23$, $SD = 0.84$; warmth: $M = 7.86$, $SD = 1.26$; helpfulness: $M = 7.67$, $SD = 1.23$) and intelligence ($M = 7.35$, $SD = 1.46$). That being said, several stereotypically masculine

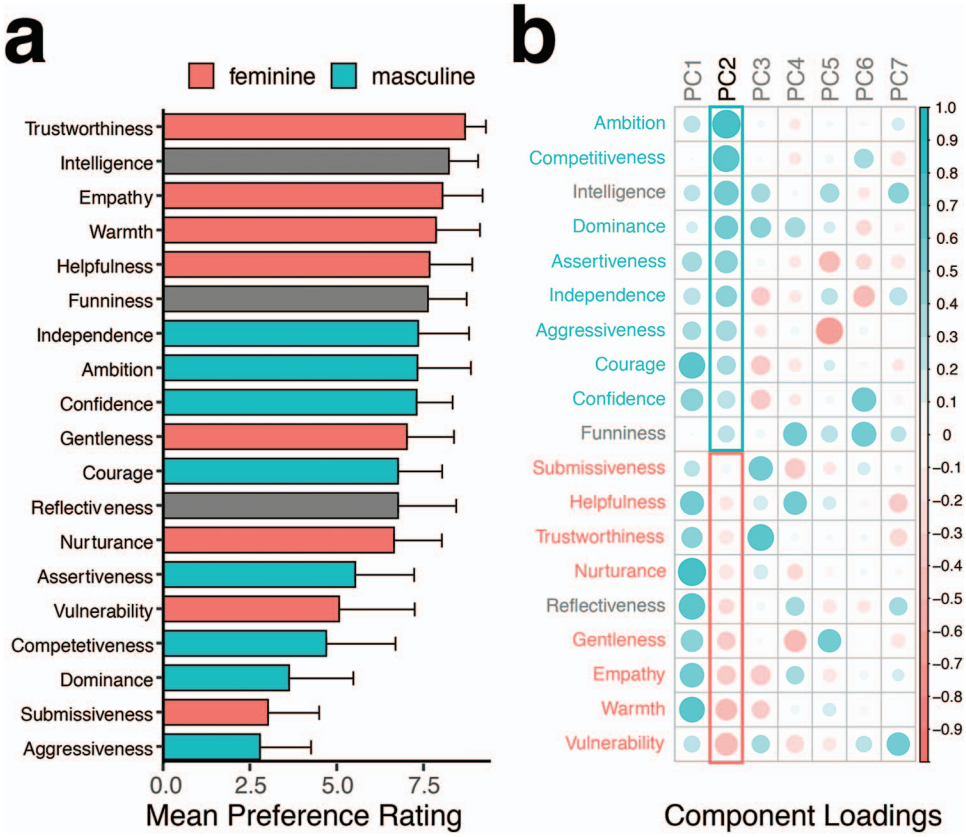

Figure 2. Personality trait preference ratings (Panel a) and principal component analysis loadings of the trait preference ratings (Panel b). Mean ratings of trait preferences averaged across participants ($M \pm SD$; Panel a). The color of the bars represents the gender stereotypicality of each trait, predetermined by the authors based on previous research. Loading strengths of trait preferences on the principal components (Panel b). The second component (PC2) represents the level of participant's preference for masculine-feminine personality traits in a partner. Only components with eigenvalue > 1 are presented. The color of the trait names represents the gender stereotypicality of each trait, predetermined by the authors. The size and the color intensity of the circles represent the loading strength as indicated in the color bar. PC = principal component. See the online article for the color version of this figure.

personality traits received high ratings, such as independence ($M = 7.35$, $SD = 1.46$), confidence ($M = 7.33$, $SD = 1.54$), and ambition ($M = 7.30$, $SD = 1.04$), while several (unambiguously negative) stereotypically feminine traits received low ratings, such as vulnerability ($M = 5.07$, $SD = 2.18$) and submissiveness ($M = 3.02$, $SD = 1.47$). In sum, on average, our female participants desired feminine personality traits more than masculine personality traits in a partner.

We conducted a principal component analysis (PCA) on the preference ratings to explore how preferences for the 19 personality traits were related to each other and find out whether the correlational structure in the ratings reflected a preference for stereotypically masculine versus feminine personality traits. Out of the first seven components (eigenvalue > 1; see Supplementary Figure 2 for the scree plot; see Supplementary Figure 3 for the traits' loadings on the first two principal components), only the second principal component (PC2) was loaded on positively by stereotypically masculine and negatively by stereotypically feminine personality traits (Figure 2b; see Supplementary Table 1 for the loadings in numbers). This result suggests that PC2 represented the participants' general preference for masculine (vs. feminine) personality traits. Somewhat unexpectedly, but consistent with research on stereotypes (Bennett, 1996; Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972; Tiedemann, 2002), the PCA solution suggested that funniness ($M = 7.63$, $SD = 1.11$) and intelligence ($M = 8.23$, $SD = 0.84$) were considered masculine traits, loading positively on PC2, while reflectiveness ($M = 6.77$, $SD = 1.67$) was considered a feminine trait, loading negatively on PC2 (Figure 2b).

The Effects of Shape and Reflectance on Attractiveness and Personality Attributions

To assess the effects of sex-dimorphic facial shape and reflectance on judgments of personality traits and attractiveness, we fitted a multilevel linear model predicting judgment ratings of each trait from the sex-dimorphic shape and reflectance manipulation levels (-2, -1, 0, 1, 2 standard deviations; see Supplementary Figures 4–10 for mean ratings of each trait as a function of the sex-dimorphic manipulation levels) and their interaction using lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017) in the R environment (R Core Team, 2018). To take into account the multilevel structure of the data (facial sex-dimorphism levels nested in face identities and participants), in each model, random intercepts across participants and face identities were allowed. More complex models failed to converge. For consistency in interpretation, the same model structure was used across all ratings. All trait ratings and attractiveness ratings were normalized to Z scores before model fitting. We report the unstandardized coefficients (B) and the standard errors (SE) of fixed effects. Degrees of freedom and p values were computed via the Satterthwaite approximation. Both in-person and online data were used for this part of the analysis.

Attractiveness. Consistent with Said and Todorov (2011), we found a dissociation between the effects of sexual dimorphism of shape and reflectance on attractiveness; attractiveness ratings decreased as facial shape became more masculine (less feminine; $B = -0.10$, $SE = 0.01$, 95% CI [-0.124, -0.079], $t = -8.90$, $p < .001$; Figure 1b) but increased as facial reflectance became more masculine (less feminine; $B = 0.17$, $SE = 0.01$, 95% CI [0.146, 0.191], $t = 14.73$, $p < .001$). This pattern was reflected in a significant interaction between shape and reflectance sex-dimorphic information ($B = -0.03$, $SE = 0.01$, 95% CI [-0.06, -0.01], $t = -2.92$, $p = .004$). In sum, sex-dimorphic shape and reflectance information had differential effects on attractiveness.

We repeated this analysis using the attractiveness ratings of the independent online raters ($n = 88$; see "Method" for details). The independently acquired attractiveness ratings of the 75 faces were highly similar to the ratings of the in-person participants, $r = .94$, $t(73) = 24.57$, 95% CI [.91, .96], $p < .001$. We used multilevel models with the same structure as in the original analyses; random intercepts across participants and face identities were allowed. Consistent with the original analysis, attractiveness ratings decreased as facial shape became more masculine (less feminine; $B = -0.09$, $SE = 0.01$, 95% CI [-0.10, -0.07], $t = -10.71$, $p < .001$; Supplementary Figure 11) and increased as facial reflectance became more masculine ($B = 0.02$, $SE = 0.01$, 95% CI [0.00, 0.03], $t = 2.05$, $p = .040$). We did not observe the interaction between shape and reflectance ($B = 0.00$, $SE = 0.01$, 95% CI [-0.02, 0.02], $t = 0.03$, $p = .976$). In sum, across the two participant samples, feminine shape and masculine reflectance in male faces contributed to increased attractiveness.

Trait judgments. The effects of sexual dimorphism of shape and reflectance on ratings of stereotypically feminine traits were consistent with the idea that feminine facial characteristics result in feminine trait judgments (Figure 1c). Ratings of warmth, nurturance, and gentleness judgments decreased as facial shape became more masculine ($B = -0.27$, $SE = 0.02$, 95% CI [-0.30, -0.24], $t = -17.92$, $p < .001$; $B = -0.27$, $SE = 0.01$, 95% CI [-0.29, -0.24], $t = -18.94$, $p < .001$; $B = -0.30$, $SE = 0.01$, 95% CI [-0.33, -0.27], $t = -20.83$, $p < .001$; respectively). The effects of reflectance were more complex. While gentleness ratings were not affected by reflectance ($B = 0.00$, 95% CI [-0.03, 0.03], $t = -0.01$, $p = .994$), warmth and nurturance ratings increased as facial reflectance became more masculine ($B = 0.09$, $SE = 0.02$, 95% CI [0.06, 0.12], $t = 6.22$, $p < .001$; $B = 0.05$, $SE = 0.01$, 95% CI [0.03, 0.08], $t = 3.80$, $p < .001$; respectively; Figure 1c). We observed a Shape × Reflectance interaction on warmth ratings ($B = -0.04$, $SE = 0.02$, 95% CI [-0.07, -0.01], $t = -2.63$, $p = .008$) but not on nurturance ($B = -0.02$, $SE = 0.01$, 95% CI [-0.05, 0.01], $t = -1.47$, $p = .141$) and gentleness ratings ($B = -0.02$, $SE = 0.01$, 95% CI [-0.05, 0.00], $t = -1.70$, $p = .089$).

The effects of sexual dimorphism on ratings of stereotypically masculine traits were consistent with the idea that masculine facial characteristics result in masculine trait judgments (Figure 1d). Ratings of dominance, competence, and confidence judgments increased as both facial shape ($B = 0.25$, $SE = 0.02$, 95% CI [0.22, 0.28], $t = 16.26$, $p < .001$; $B = 0.23$, $SE = 0.02$, 95% CI [0.20, 0.26], $t = 14.98$, $p < .001$; $B = 0.05$, $SE = 0.02$, 95% CI [0.01, 0.08], $t = 2.77$, $p = .006$; respectively) and reflectance became more masculine ($B = 0.16$, $SE = 0.02$, 95% CI [0.13, 0.19], $t = 10.26$, $p < .001$; $B = 0.13$, $SE = 0.02$, 95% CI [0.10, 0.16], $t = 8.14$, $p < .001$; $B = 0.16$, $SE = 0.02$, 95% CI [0.13, 0.19], $t = 9.90$, $p < .001$; respectively). None of the interaction effects were significant ($B = -0.02$, $SE = 0.02$, 95% CI [-0.05, 0.01], $t = -1.41$, $p = .157$; $B = -.01$, $SE = 0.02$, 95% CI [-0.04, 0.03], $t = -0.33$, $p = .738$; $B = -0.02$, $SE = 0.02$, 95% CI [-0.05, 0.01], $t = -1.29$, $p = .196$; respectively; see Figure 1).

In sum, emphasizing feminine and masculine shape characteristics on the face strengthened judgments of stereotypically feminine and masculine traits, respectively. Masculine shape cues decreased perceptions not only of feminine traits but also of attractiveness. In contrast, masculine reflectance cues increased perceptions of attractiveness and, to a smaller extent, perceptions of feminine traits. Both masculine shape and reflectance cues increased perceptions of masculine traits.

Relations Between Trait Ratings and Attractiveness Ratings

To determine whether personality trait ratings of a face predicted facial attractiveness, we fitted multilevel linear models using each of the stereotypically feminine (warmth, nurturance, gentleness) and masculine trait ratings (dominance, competitiveness, confidence) to predict attractiveness ratings. In each of the six models, random slopes across participants and face identities were allowed. Any model that was more complex than the final model prevented model convergence. For consistency in interpretation, the same model structure was used across all traits. All trait ratings and attractiveness ratings were normalized to Z scores before model fitting. Both in-person and online data were used for this part of the analysis.

Ratings of all three stereotypically feminine traits—warmth, nurturance, and gentleness (Figure 3; $B = 0.39$, $SE = 0.06$, 95% CI [0.27, 0.51], $t = 6.45$, $p < .001$; $B = 0.44$, $SE = 0.06$, 95% CI [0.33, 0.55], $t = 7.78$, $p < .001$; $B = 0.45$, $SE = 0.06$, 95% CI [0.34, 0.57], $t = 7.64$, $p < .001$; respectively)—and one stereotypically masculine trait—confidence—positively predicted ratings of attractiveness ($B = 0.30$, $SE = 0.06$, 95% CI [0.18, 0.42], $t = 4.77$, $p < .001$). On the contrary, ratings of dominance and competitiveness did not ($B = 0.01$, $SE = 0.08$, 95% CI [−0.14, 0.17], $t = 0.18$, $p = .859$; $B = 0.08$, $SE = 0.10$, 95% CI [−0.11, 0.27], $t = 0.80$, $p = .451$; respectively).

We conducted two additional analyses of the same nature without considering the hierarchical structure of the data and found consistent results with the multilevel analyses. For each of the six personality traits, we calculated a Pearson correlational coefficient between the trait and attractiveness ratings of the faces. For each analysis, the mean trait ratings were averaged either across participants (face-level analysis) or faces (participant-level analysis). At the face level, all trait ratings were positively correlated with attractiveness ratings, but more strongly for ratings of the stereotypically feminine traits, warmth: $r = .70$, $t(73) = 8.35$, 95% CI [.56, .80], $p < .001$; nurturance: $r = .80$, $t(73) = 11.23$, 95% CI [.69, .87], $p < .001$; gentleness: $r = .72$, $t(73) = 8.74$, 95% CI [.58, .81], $p < .001$, than ratings of the stereotypically masculine traits, dominance: $r = .28$, $t(73) = 2.47$, 95% CI [.05, .47], $p = .016$; competitiveness: $r = .32$, $t(73) = 2.87$, 95% CI [.10, .51], $p = .005$; confidence: $r = .76$, $t(73) = 9.91$, 95% CI [.64, .84], $p < .001$ (Figure 3). At the participant level, only ratings of the stereotypically feminine traits were significantly positively correlated with attractiveness ratings, warmth: $r = .53$, $t(41) = 3.96$, 95% CI [.27, .71], $p < .001$; nurturance: $r = .46$, $t(41) = 3.30$, 95% CI [.18, .67], $p = .002$; gentleness: $r = .47$, $t(41) = 3.43$, 95% CI [.20, .68], $p = .001$, versus dominance: $r = .24$, $t(41) = 1.57$, 95% CI [–.07, .50], $p = .123$; competitiveness: $r = .14$, $t(41) = 0.88$, 95% CI [–.17, .42], $p = .385$; confidence: $r = .17$, $t(41) = 1.09$, 95% CI [–.14, .45], $p = .280$. In sum, facial judgments of feminine traits predicted attractiveness more strongly than did facial judgments of masculine traits.

We repeated the analyses using the attractiveness ratings of the independent online raters ($n = 88$; see "Method" for details). Consistent with our original analyses, we fitted multilevel effects

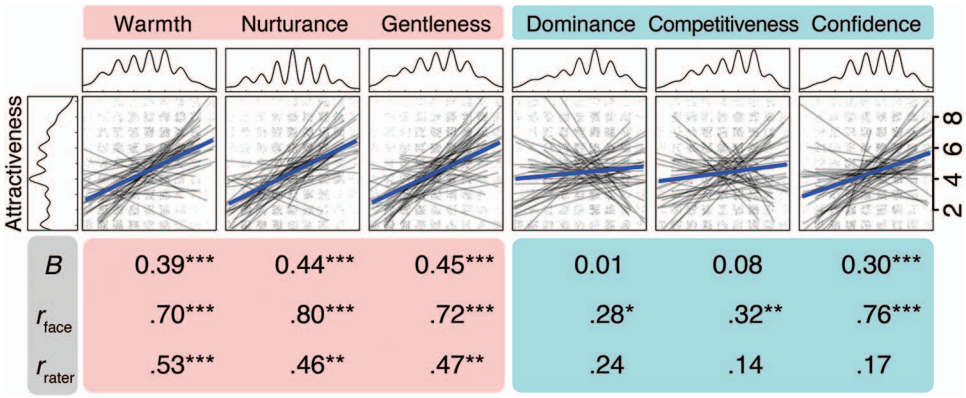

Figure 3. Relationship between facial trait judgments and attractiveness. Face-based judgments of stereotypically feminine traits (left) are more strongly and positively related to attractiveness judgments than judgments of stereotypically masculine traits (right). Raw attractiveness ratings are displayed as a function of trait ratings. The distribution curve of each measure is shown in the leftmost panel and at the top panels. The thin lines represent the linear fit for each participant, and the thick line represents the average linear fit. Actual analyses were conducted via multilevel regressions using all individual data points and Pearson correlations using mean data points (averaged across either participants or faces). For each multilevel regression, the coefficient's statistical significance (B) was tested via the Satterthwaite approximation. B = multilevel regression coefficient; r_{face} = Pearson correlational coefficient at the level of faces; r_{rater} = Pearson correlational coefficient at the level of raters. * $p < .05$. ** $p < .01$. *** $p < .001$. See the online article for the color version of this figure.

linear models predicting attractiveness ratings from each of the six face-based judgments. As in the original models, random slopes across face identities were allowed. Random slopes across participants were not included because this time, the data set was not nested by participant. We used the mean attractiveness ratings of individual face stimuli, averaged across raters.

The analyses yielded results consistent with the original results. Ratings of attractiveness were positively predicted by face-based judgments of all stereotypically feminine traits—warmth, nurturance, and gentleness ($B = 0.23$, $SE = 0.03$, 95% CI [0.18, 0.28], $t = 8.61$, $p = .001$; $B = 0.28$, $SE = 0.04$, 95% CI [0.20, 0.36], $t = 6.49$, $p = .021$; $B = 0.25$, $SE = 0.04$, 95% CI [0.17, 0.33], $t = 6.33$, $p = .023$; respectively)—but not by judgments of any of the stereotypically masculine traits—dominance, competitiveness, or confidence ($B = -0.13$, $SE = 0.07$, 95% CI [−0.27, 0.00], $t = -1.98$, $p = .188$; $B = -0.16$, $SE = 0.08$, 95% CI [−0.31, −0.01], $t = -2.06$, $p = .182$; $B = 0.06$, $SE = 0.05$, 95% CI [−0.05, 0.16], $t = 1.08$, $p = .354$; respectively). In sum, all face-based feminine trait judgments positively predicted attractiveness, whereas none of the masculine trait judgments predicted attractiveness.

As in our original analyses, we also ran Pearson correlational analyses between each of six trait judgments and attractiveness judgments at the level of the faces. Ratings of warmth, nurturance, and gentleness were positively correlated with attractiveness, $r = .66$, $t(73) = 7.58$, 95% CI [.51, .77], $p < .001$; $r = .78$, $t(73) = 10.51$, 95% CI [.67, .85], $p < .001$; $r = .70$, $t(73) = 8.48$, 95% CI [.57, .80], $p < .001$; respectively. Ratings of dominance, competitiveness, and confidence were also correlated with attractiveness, although in general, the relationships were weaker, $r = .25$, $t(73) = 2.16$, 95% CI [.02, .45], $p = .034$; $r = .23$, $t(73) = 2.02$, 95% CI [.00, .43], $p = .047$; $r = .68$, $t(73) = 7.88$, 95% CI [.53, .78], $p < .001$; respectively. Taken together, in the absence of the potential confounding factors of the study order and participant age, we found that feminine trait judgments were more strongly related to facial attractiveness than were masculine trait judgments.

Predicting the Relation Between Trait Ratings and Attractiveness From Personality Preferences

To test the hypothesis that preferences for personality traits predict the relationship between the facial perception of these traits and facial attractiveness, we conducted two separate analyses: rank correlation and multilevel linear models. Individuals who value warmth, for example, should be more likely to perceive faces that appear to reflect warmth as attractive than individuals who do not value warmth (Figure 4a; Little, Burt, & Perrett, 2006). Individuals who value dominance, on the other hand, should be more likely to perceive faces that appear to reflect dominance as attractive than individuals who do not value dominance. In-person participants' data were used for this part of the analysis.

In our first analysis, we calculated Spearman's rank-order correlations between the individual participants' trait preference ranking (the *x*-axis in Figure 4b and 4c) and the Pearson correlation coefficient ranking between their trait and attractiveness ratings (the *y*-axis in Figure 4b and 4c). We used ranks of the variables, instead of the raw rating values, to take into account the individual participants' ranking patterns (e.g., some rated almost all traits desirable, whereas some rated only a few traits desirable). The participant-level Spearman's ρs were converted to Fisher's *Z* scores and submitted to a one-sample *t* test, tested against the null hypothesis that there is no correlation between the personality preference and the trait-attractiveness-judgment relationship. For any given participant (regardless of what traits she preferred), a positive correlation between the rankings of personality-trait preferences and the rankings of the correlation strength between trait judgments and attractiveness judgments would mean that she finds a face eliciting their preferred trait attractive (a positive slope in Figure 4b). Indeed, we found a positive relationship between the personality trait preferences and the correlations between trait and attractiveness judgments, $M_\rho = .31$, $SD_\rho = .53$, $M_Z = .43$; $t(42) = 3.80$, 95% CI [.20, .67], $p < .001$ (Figure 4b). In sum, individuals' relative preferences for personality traits predicted the strength of the relationship between their facial judgments of the traits and their perceptions of attractiveness.

In our second analysis, we further assessed the relationship between individuals' personality trait preferences and facial attractiveness, using the ratings of traits and attractiveness of each participant (rather than the rankings of traits and attractiveness). We tested whether the degree to which participants' trait judgments of faces (the *x*-axis in Figure 5a and 5b) predicted attractiveness (the *y*-axis in Figure 5a and 5b) varied depending on whether a participant preferred masculine or feminine traits (color in Figure 5a and 5b). Specifically, using multilevel linear models, we tested for the interaction effect between personality-trait preferences (preference for masculine vs. feminine traits) and the slope of trait judgments (masculine vs. feminine) predicting attractiveness. To quantify the degree to which each participant preferred masculine versus feminine personality, we used as an index the PC2 scores from the PCA on the 19 personality preference ratings (i.e., individual participants' PC2 scores; Figure 2b; see Supplementary Table 1 for the PC loadings; see "Personality Preferences" for details). The component score represented to what extent each participant liked masculine (vs. feminine) traits in a partner (i.e., smaller value = stronger femininity preference, bigger value = stronger masculinity preference).

To quantify the degree to which each face elicited feminine or masculine personality trait judgments, we calculated two simple composite scores: facial femininity—the mean across the three feminine trait ratings (warm, nurturing, gentle)—and facial masculinity—the mean across the three masculine trait ratings (dominant, competitive, confident). Facial femininity and masculinity were computed separately because all feminine trait ratings were positively correlated to one another, and so were all masculine traits (see Supplementary Figure 12 for the correlations across all six trait judgments from faces).

We then predicted participant-specific attractiveness ratings of faces from personality preference and facial femininity/masculinity, using multilevel linear effects models (see Figure 5). Variables were normalized to *Z* scores before model fitting, and random intercepts across participants were allowed. First, we found significant main effects of both facial femininity ($B = 0.54$, $SE = 0.02$, 95% CI [0.50, 0.57], $t = 33.23$, $p < .001$; Figure 5a) and masculinity ($B = 0.21$, $SE = 0.02$, 95% CI [0.18, 0.24], $t = 11.90$, $p < .001$; Figure 5b), indicating that both femininity and masculinity judgments from faces positively predicted the attractiveness of the faces. This result is consistent with the positive relationship between individual face-based trait judgments and attractiveness,

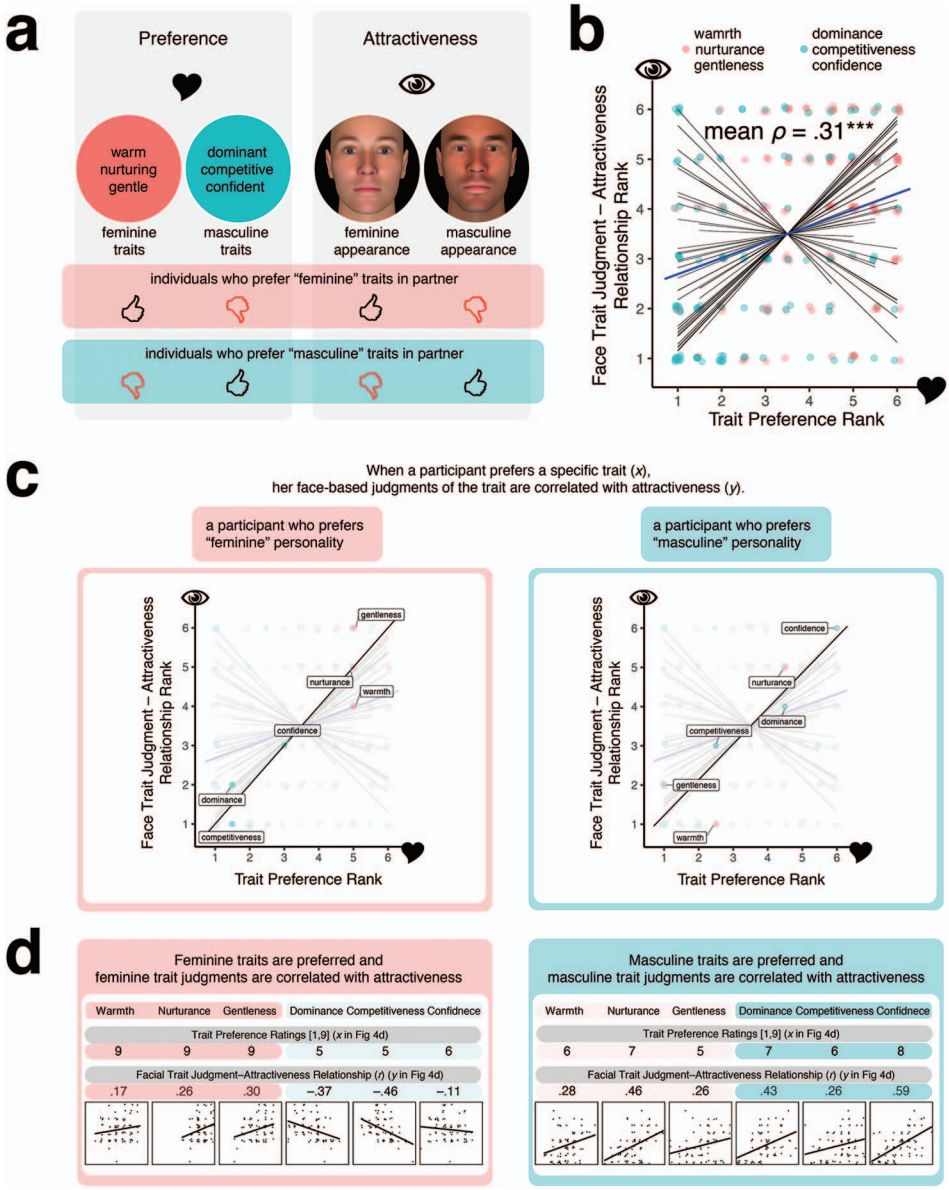

Figure 4. Relationship between personality trait preferences and the face-based trait judgment-attractiveness correlation. If an individual prefers stereotypically feminine traits in a partner (Panel a), then their trait preference should result in a stronger relationship between face-based judgments of feminine (vs. masculine) traits and attraction toward faces with feminine (vs. masculine) characteristics (the left plot in Panels c and d; higher ranks in Panels b–d mean stronger preference [*x*-axis] and stronger judgment-attractiveness relationship [*y*-axis] for illustrative purposes). On the other hand, if an individual prefers stereotypically masculine traits in a partner (Panel a), then their trait preference should result in a stronger relationship between masculine traits and attraction toward faces with masculine characteristics (the right plot in Panels c and d). Irrespective of the direction of the personality preference (Panel a), however, individuals' personality preference was reflected in their facial preference (Panels c, d), as revealed by the overall positive relationship between trait preference rank and trait judgment-attractiveness relationship (Panel b). For illustration purposes, the relationship between trait preferences and trait judgment-attractiveness correlation is displayed for two sample participants with low and high levels of masculinity trait preference (Panels c and d) derived from their sex-dimorphism personality preference component scores (participant PC2 score; see "Results" for details). In Panel c, the *x* and *y* coordinates represent the two sample participants' trait preference ranking (the original values are shown at the top in Panel d) and the ranking of the correlations between their facial trait judgments and attractiveness (the original values are shown at the bottom in Panel d and the scatterplots below them), respectively. ρ = Spearman correlational coefficient. *** $p < .001$. See the online article for the color version of this figure.

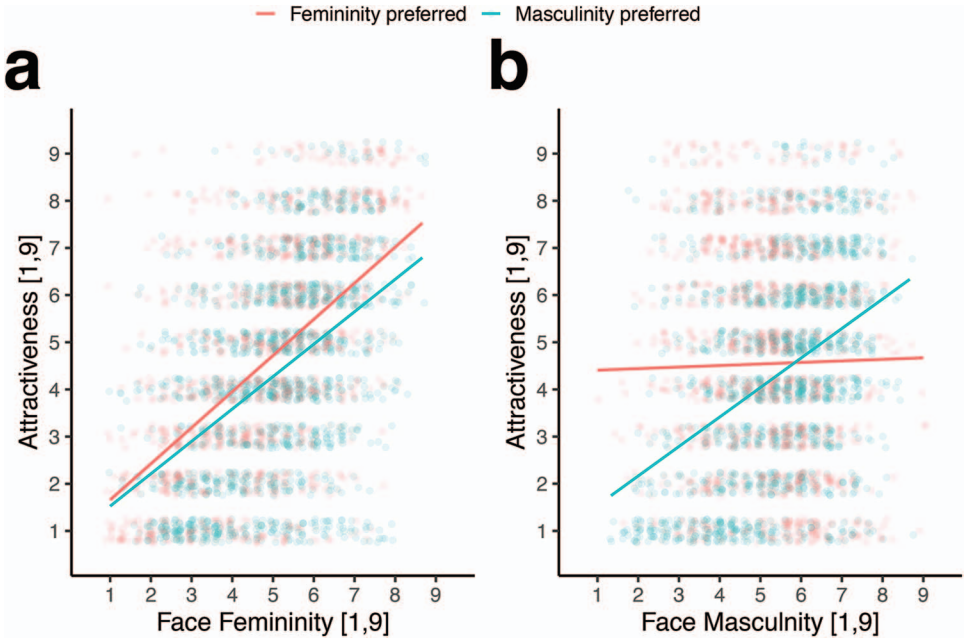

Figure 5. Attractiveness judgments as a function of face-based trait judgments and participants' trait preferences. Face femininity and masculinity (*x*-axis) is the participant-specific composite score of judgments of femininity (warmth, nurturance, gentleness; Panel a) and masculinity (dominance, competitiveness, confidence; Panel b). Trait Judgments × Personality Preference interaction was significant for masculinity ($B = 0.13$, $SE = 0.02$, 95% CI [0.09, 0.16], $t = 7.26$, $p < .001$; Satterthwaite approximation; Panel b) but not femininity ($B = -0.02$, $SE = 0.02$, 95% CI [−0.06, 0.01], $t = -1.29$, $p = .197$). Each point represents a face ($n = 75$ for each participant), and the lines represent the linear fit of each category of participants. For visualization and interpretability, participants are categorized into two groups here ("femininity preferred" and "masculinity preferred"); in the actual analyses, personality preference was continuous, not categorical, preserving differences across individual participants. The actual analyses were conducted via multilevel regressions, considering the hierarchical structure of the data. See the online article for the color version of this figure.

observed across traits—both stereotypically feminine and masculine—without considering the participant personality preference (see Figure 3).

Second, and more importantly for the current investigation, we found the Facial Masculinity × Personality Preference interaction effect on attractiveness ($B = 0.13$, $SE = 0.02$, 95% CI [0.09, 0.16], $t = 7.26$, $p < .001$; Figure 5b), indicating that the positive effect of masculine trait judgments on attractiveness was stronger among those who preferred a masculine personality than among those who preferred a feminine personality. We did not observe the Facial Femininity × Personality Preference interaction, although the effect was in the expected direction ($B = -0.02$, $SE = 0.02$, 95% CI [−0.06, 0.01], $t = -1.29$, $p = .197$; Figure 5a). That is, on average, the positive effect of feminine trait judgments on attractiveness was stronger among those who preferred a feminine personality than among those who preferred a masculine personality, although the difference did not reach significance (see Supplementary Figure 13 for the results for individual personality traits).

Across two analytic approaches (i.e., rank correlations, multilevel regressions), we found that participants who preferred a feminine personality preferred faces with characteristics suggesting feminine traits, whereas participants who preferred a masculine personality preferred faces with characteristics suggesting masculine traits. In sum, individuals' personality preferences predicted what type of facial judgments predicted their perceptions of attractiveness of faces. In other words, when a person prefers a specific trait such as dominance, faces that appear dominant are likely to appear attractive to them.

Discussion

Physical attractiveness affects real life. Attractive individuals not only enjoy positive general person impressions (e.g., Dion, Berscheid, & Walster, 1972; Landy & Sigall, 1974; for reviews, see Eagly, Ashmore, Makhijani, & Longo, 1991; Langlois et al., 2000) but also receive favorable treatments in various domains of life; they earn higher salaries (Frieze, Olson, & Russell, 1991), are more likely to get hired (Hosoda, Stone-Romero, & Coats, 2003), receive more lenient criminal sentences (Stewart, 1985), and are more likely to be voted for in elections (Banducci, Karp, Thrasher, & Rallings, 2008). The attractiveness of faces has been the focus of particular interest over the years (e.g., Landy & Sigall, 1974) because faces naturally attract human attention and are imbued with social meaning (Todorov, 2017).

The vast majority of research on facial attractiveness has been focused on *perceptual* factors (e.g., symmetry, averageness, sex dimorphism), which in principle should be universal across per-

ceivers. On the other hand, *conceptual* factors in facial attractiveness (i.e., conceptual correlates of attractiveness perceptions, measured from human observers, e.g., personality preference), which vary across perceivers, have been understudied (but see Holzleitner & Perrett, 2017; Little, Burt, & Perrett, 2006). Here, we tested how individual personality preferences for a partner affect both trait judgments and attractiveness of faces parametrically manipulated on sex-dimorphic characteristics, as well as the relationship between facial trait judgments and attractiveness.

We asked heterosexual female adults to report what personality traits they preferred in a partner and rate male faces on stereotypically masculine and feminine traits and on attractiveness. We found that (a) women overall prefer stereotypically feminine personality traits in male mates; (b) increasing the masculinity of shape information in male faces decreases both judgments of stereotypically feminine traits and attractiveness but (c) increasing the masculinity of reflectance information in male faces increases attractiveness and, unexpectedly, judgments of some stereotypically feminine traits; (d) increasing the masculinity of both shape and reflectance information increases judgments of stereotypically masculine traits; (e) judgments of desirable feminine traits in faces predict the attractiveness of these faces; and (f) variation in preferences for different personality traits predicts what kind of faces individuals find attractive.

With regard to the first finding, we found that stereotypically feminine traits, such as warmth, received higher desirability ratings, while stereotypically masculine traits, such as dominance, received lower ratings. Consistent with participants' overall preference for stereotypically feminine personality traits, the multilevel regressions found that individual participants' attractiveness judgments were positively predicted by individual perceptions of feminine traits in faces such as warmth, nurturance, and gentleness but not by perceptions of stereotypically masculine traits such as competitiveness and dominance (except for confidence). A separate set of multilevel regressions revealed that increasing the femininity of facial shape increased facial attractiveness, consistent with previous research (Perrett et al., 1998; Said & Todorov, 2011), whereas increasing the femininity of facial reflectance decreased facial attractiveness. The difference between the effects of facial shape and reflectance in men's facial attractiveness is consistent with previous research (Carrito et al., 2016; Said & Todorov, 2011; Torrance et al., 2014).

The preference for feminine traits and the differential effects of shape and reflectance cues on attractiveness judgments suggest that impressions of feminine traits are conveyed via feminine facial shape but not feminine facial reflectance. In fact, we found that facial shape strongly influenced judgments of feminine traits—warmth, nurturance, and gentleness; increasing the femininity of facial shape increased the perception of feminine traits in male faces. On the other hand, sex-dimorphic facial reflectance had a smaller effect on judgments of these feminine traits than did facial shape. Both shape and reflectance had significant effects on judgments of all three masculine traits investigated here; increasing the masculinity of both shape and reflectance increased the perception of dominance, competitiveness, and confidence.

Consistent with previous research (e.g., Carrito et al., 2016; Russell, 2003; Said & Todorov, 2011), we found that increasing the masculinity of facial reflectance increased facial attractiveness. This may be because masculine facial reflectance (e.g., darker complexion, lower contrast across the face) is a cue for gender categorization (Jablonski & Chaplin, 2000; Oh, Buck, & Todorov, 2019; Russell, 2003, 2009) and conveys positive impressions, such as judgments of competence and confidence, which are stereotypically masculine traits (Oh, Buck, & Todorov, 2019). Indeed, in our data, individual participants' face-based judgments of confidence (in addition to those of warmth, nurturance, and gentleness) positively predicted facial attractiveness. Similarly, a recent data-driven model of face-based trait judgments revealed that in male faces, darker skin tone within the range of Caucasian faces resulted in more positive impressions (Oh, Dotsch, et al., 2019). Consistent with the positive relationship between confidence judgments and attractiveness, in the personality preference ratings, several masculine traits were perceived as positive, including confidence and independence, whereas several feminine traits were perceived as negative, including vulnerability and submissiveness. However, on average, women appear to value feminine/communal traits over masculine/agentic traits in mates even when both types of traits are positive. All in all, facial attractiveness was predicted by female raters' judgments of feminine traits, which were mainly conveyed by feminine shape information.

With regard to the last main finding, using multiple approaches, we examined how individuals' personality preferences are related to what faces they find attractive. First, using Spearman rank correlations, we found a positive correlation between individuals' personality-trait preference ranking and the extent to which perceptions of these personality traits in faces were correlated with perceptions of attractiveness. Second, using multilevel regressions, we found a modulatory effect of individual participants' personality preferences on the effect of the personality trait judgments on attractiveness, especially in the case of judgments of masculine traits.

In our second analyses (multilevel regressions), the effect of facial femininity on attractiveness, unlike that of facial masculinity, did not vary across those who prefer feminine and masculine traits. This makes sense in light of the average personality preferences in women. Given the generally high desirability of feminine traits (according to our data and previous research), even women who prefer masculine traits in a man would not dislike feminine traits, such as warmth. That is, both those who prefer femininity and those who prefer masculinity value feminine traits. To the extent that these feminine traits are sought equally by those who prefer feminine traits and those who prefer masculine traits, it would be difficult to detect an interaction between facial dimorphism and personality preferences. This was indeed the case for facial femininity (Figure 5a). This logic extends to highly desirable masculine traits. Confidence, the most preferred masculine trait, showed the smallest interaction (Supplementary Figure 13f) among the masculine traits. As many feminine traits, confidence is likely equally sought by those who prefer feminine traits and those who prefer masculine traits.

Taken together, our results show that individuals who highly value a personality trait, such as dominance, are likely to perceive faces that appear to possess the trait as attractive. This general principle, together with the specific findings of femininity preferences, can explain the contributions of shared and idiosyncratic face preferences; on average, women prefer a feminine personality and feminine face shape in men. This pattern of preferences would explain shared preferences in previous models that partitioned the

variance in facial-attractiveness judgments (< ~50%; specific findings; Hönekopp, 2006; Martinez et al., 2020). The remaining variance would be explained by idiosyncratic preferences, which should vary to the extent that individual raters have different personality preferences (a general principle).

The relative homogeneity of our participant sample in sexual orientation may limit the generalizability of the findings. However, the present work focused on how personality preferences of straight female adults in an industrialized society covary with their attractiveness perceptions of men. While the conclusions of this work may not be applicable to a larger, more diverse population, future work can extend the present work by including samples that are diverse with respect to demographic domains.

The external validity of the current results may suffer if perception of synthetic faces significantly differs from perception of real human faces. Indeed, artificial face images are processed differently from real-life images; they are less memorable (Balas & Pacella, 2015), are less affected by face expertise (evidenced by less pronounced own-race effect; Balas & Nelson, 2010; Crookes et al., 2015), and are perceived as less trustworthy than real faces (Balas & Pacella, 2017). However, research employing both real-life and synthetic faces often finds similar patterns of social perceptions across the two types of images (Balas, Tupa, & Pacella, 2018; Oh, Buck, & Todorov, 2019; Oh, Dotsch, et al., 2019; Oosterhof & Todorov, 2008). Further, studies of social judgments conducted by different research groups using real-life and synthetic faces often find consistent results (e.g., between Oh et al., 2019; Torrance et al., 2014). While manipulation of real-life face images is possible (e.g., Blanz & Vetter, 1999; Karras et al., 2019; O'Toole, Price, Vetter, Bartlett, & Blanz, 1999; Russell, Biederman, Nederhouser, & Sinha, 2007), the use of multidimensional-space-based synthetic faces allows for a large amount of control over numerous stimuli, including statistically precise manipulations and a separate control of the shape and reflectance information (Todorov & Oh, in press).

While we empirically selected traits that are valued by women based on gender (e.g., Costa et al., 2001; Eagly & Mladinic, 1989; Oswald & Lindstedt, 2006) and relationship research (e.g., Fletcher et al., 1999; South Palomares et al., 2018), our personality preference questionnaire may not have involved enough traits to fully and accurately reflect personality preferences of women. Limited numbers of personality traits were rated on desirability (19 total) and faces (six total). It is possible that the stereotypically feminine personality traits that were included here were generally more positive than the stereotypically masculine traits, or that potentially, positive stereotypically masculine nonpersonality traits were excluded—for example, status and resources (Fletcher et al., 1999). Thus, the selected traits may not have been fully representative of the characteristics commonly associated with femininity/masculinity and valued by women in a relationship. However, it should be noted that (a) even unambiguously highly desirable masculine traits (e.g., independence, ambition, confidence) were rated lower than highly desirable feminine traits (e.g., trustworthiness; Figure 1), (b) even facial judgments of a desirable masculine trait (i.e., confidence) were worse at predicting attractiveness than facial judgments of less-valued feminine traits (e.g., nurturance, gentleness; Figure 3), and (c) women's preference for feminine/communal personality traits in male mates is consistent with existing theories of partner preferences (Buss & Barnes, 1986; Fletcher et al., 2004).

In conclusion, the present study shows that women desire communal (stereotypically feminine) personality traits in male mates. Feminine facial shape results in feminine trait judgments and in turn is associated with perceptions of attractiveness. In general, the desirability of personality traits is related to how strong trait judgments from faces predict attractiveness. The more desirable the trait, the stronger the correlation between judgments of that trait and attractiveness. This principle explains a variety of attractiveness preferences—individuals who desire a trait prefers faces that evoke impressions of the trait.

References

Apicella, C. L., Little, A. C., & Marlowe, F. W. (2007). Facial averageness and attractiveness in an isolated population of hunter-gatherers. *Perception, 36,* 1813–1820. http://dx.doi.org/10.1068/p5601

Balas, B., & Nelson, C. A. (2010). The role of face shape and pigmentation in other-race face perception: An electrophysiological study. *Neuropsychologia, 48,* 498–506. http://dx.doi.org/10.1016/j.neuropsychologia.2009.10.007

Balas, B., & Pacella, J. (2015). Artificial faces are harder to remember. *Computers in Human Behavior, 52,* 331–337. http://dx.doi.org/10.1016/j.chb.2015.06.018

Balas, B., & Pacella, J. (2017). Trustworthiness perception is disrupted in artificial faces. *Computers in Human Behavior, 77,* 240–248. http://dx.doi.org/10.1016/j.chb.2017.08.045

Balas, B., Tupa, L., & Pacella, J. (2018). Measuring social variables in real and artificial faces. *Computers in Human Behavior, 88,* 236–243. http://dx.doi.org/10.1016/j.chb.2018.07.013

Banducci, S. A., Karp, J. A., Thrasher, M., & Rallings, C. (2008). Ballot photographs as cues in low-information elections. *Political Psychology, 29,* 903–917. http://dx.doi.org/10.1111/j.1467-9221.2008.00672.x

Bennett, M. (1996). Men's and women's self-estimates of intelligence. *The Journal of Social Psychology, 136,* 411–412. http://dx.doi.org/10.1080/00224545.1996.9714021

Berry, D. S., & Zebrowitz McArthur, L. (1985). Some components and consequences of a babyface. *Journal of Personality and Social Psychology, 48,* 312–323. http://dx.doi.org/10.1037/0022-3514.48.2.312

Blanz, V., & Vetter, T. (1999). A morphable model for the synthesis of 3D faces. Proceedings of the 26th Annual Conference on Computer Graphics and Interactive Techniques, *19,* 187–194. http://dx.doi.org/10.1145/311535.311556

Boothroyd, L. G., Jones, B. C., Burt, D. M., & Perrett, D. I. (2007). Partner characteristics associated with masculinity, health and maturity in male faces. *Personality and Individual Differences, 43,* 1161–1173. http://dx.doi.org/10.1016/j.paid.2007.03.008

Broverman, I. K., Vogel, S. R., Broverman, D. M., Clarkson, F. E., & Rosenkrantz, P. S. (1972). Sex-role stereotypes: A current appraisal. *Journal of Social Issues, 28,* 59–78. http://dx.doi.org/10.1111/j.1540-4560.1972.tb00018.x

Burriss, R. P., Marcinkowska, U. M., & Lyons, M. T. (2014). Gaze properties of women judging the attractiveness of masculine and feminine male faces. *Evolutionary Psychology, 12,* 19–35. http://dx.doi.org/10.1177/147470491401200102

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12,* 1–14. http://dx.doi.org/10.1017/S0140525X00023992

Buss, D. M., & Barnes, M. (1986). Preferences in human mate selection. *Journal of Personality and Social Psychology, 50,* 559–570. http://dx.doi.org/10.1037/0022-3514.50.3.559

Buunk, B. P., Dijkstra, P., Kenrick, D. T., & Warntjes, A. (2001). Age preferences for mates as related to gender, own age, and involvement level. *Evolution and Human Behavior, 22,* 241–250. http://dx.doi.org/10.1016/S1090-5138(01)00065-4

Carrito, M. L., Santos, I. M. B., Lefevre, C. E., Whitehead, R. D., Silva, C. F., & Perrett, D. I. (2016). The role of sexually dimorphic skin colour and shape in attractiveness of male faces. *Evolution and Human Behavior, 37,* 125–133. http://dx.doi.org/10.1016/j.evolhumbehav.2015.09.006

Carrito, M. L., & Semin, G. R. (2019). When we don't know what we know - Sex and skin color. *Cognition, 191,* 103972. http://dx.doi.org/10.1016/j.cognition.2019.05.009

Coetzee, V., Greeff, J. M., Stephen, I. D., & Perrett, D. I. (2014). Cross-cultural agreement in facial attractiveness preferences: The role of ethnicity and gender. *PLoS ONE, 9*(7), e99629. http://dx.doi.org/10.1371/journal.pone.0099629

Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Personality and Social Psychology, 81,* 322–331. http://dx.doi.org/10.1037/0022-3514.81.2.322

Crookes, K., Ewing, L., Gildenhuys, J. D., Kloth, N., Hayward, W. G., Oxner, M., . . . Rhodes, G. (2015). How well do computer-generated faces tap face expertise? *PLoS ONE, 10*(11), e0141353. http://dx.doi.org/10.1371/journal.pone.0141353

Cunningham, M. R. (1986). Measuring the physical in physical attractiveness: Quasi-experiments on the sociobiology of female facial beauty. *Journal of Personality and Social Psychology, 50,* 925–935. http://dx.doi.org/10.1037/0022-3514.50.5.925

Cunningham, M. R., Barbee, A. P., & Pike, C. L. (1990). What do women want? Facialmetric assessment of multiple motives in the perception of male facial physical attractiveness. *Journal of Personality and Social Psychology, 59,* 61–72. http://dx.doi.org/10.1037/0022-3514.59.1.61

DeBruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., . . . Tiddeman, B. P. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings Biological Sciences, 273,* 1355–1360. http://dx.doi.org/10.1098/rspb.2005.3445

DeBruine, L. M., Jones, B. C., Smith, F. G., & Little, A. C. (2010). Are attractive men's faces masculine or feminine? The importance of controlling confounds in face stimuli. *Journal of Experimental Psychology: Human Perception and Performance, 36,* 751–758. http://dx.doi.org/10.1037/a0016457

DeBruine, L. M., Jones, B. C., Unger, L., Little, A. C., & Feinberg, D. R. (2007). Dissociating averageness and attractiveness: Attractive faces are not always average. *Journal of Experimental Psychology: Human Perception and Performance, 33,* 1420–1430. http://dx.doi.org/10.1037/0096-1523.33.6.1420

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of Personality and Social Psychology, 24,* 285–290. http://dx.doi.org/10.1037/h0033731

Eagly, A. H., Ashmore, R. D., Makhijani, M. G., & Longo, L. C. (1991). What is beautiful is good, but . . .: A meta-analytic review of research on the physical attractiveness stereotype. *Psychological Bulletin, 110,* 109–128. http://dx.doi.org/10.1037/0033-2909.110.1.109

Eagly, A. H., & Mladinic, A. (1989). Gender stereotypes and attitudes toward women and men. *Personality and Social Psychology Bulletin, 15,* 543–558. http://dx.doi.org/10.1177/0146167289154008

Eagly, A. H., & Steffen, V. J. (1984). Gender stereotypes stem from the distribution of women and men into social roles. *Journal of Personality and Social Psychology, 46,* 735–754. http://dx.doi.org/10.1037/0022-3514.46.4.735

Feinberg, D. R., DeBruine, L. M., Jones, B. C., & Little, A. C. (2008). Correlated preferences for men's facial and vocal masculinity. *Evolution and Human Behavior, 29,* 233–241. http://dx.doi.org/10.1016/j.evolhumbehav.2007.12.008

Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin, 116,* 429–456. http://dx.doi.org/10.1037/0033-2909.116.3.429

Fletcher, G. J. O., Simpson, J. A., Thomas, G., & Giles, L. (1999). Ideals in intimate relationships. *Journal of Personality and Social Psychology, 76,* 72–89. http://dx.doi.org/10.1037/0022-3514.76.1.72

Fletcher, G. J. O., Tither, J. M., O'Loughlin, C., Friesen, M., & Overall, N. (2004). Warm and homely or cold and beautiful? Sex differences in trading off traits in mate selection. *Personality and Social Psychology Bulletin, 30,* 659–672. http://dx.doi.org/10.1177/0146167203262847

Friedman, H., & Zebrowitz, L. A. (1992). The contribution of typical sex differences in facial maturity to sex role stereotypes. *Personality and Social Psychology Bulletin, 18,* 430–438. http://dx.doi.org/10.1177/0146167292184006

Frieze, I. H., Olson, J. E., & Russell, J. (1991). Attractiveness and income for men and women in management. *Journal of Applied Social Psychology, 21,* 1039–1057. http://dx.doi.org/10.1111/j.1559-1816.1991.tb00458.x

Holzleitner, I. J., Lee, A. J., Hahn, A. C., Kandrik, M., Bovet, J., Renoult, J. P., . . . Jones, B. C. (2019). Comparing theory-driven and data-driven attractiveness models using images of real women's faces. *Journal of Experimental Psychology: Human Perception and Performance, 45,* 1589–1595. http://dx.doi.org/10.1037/xhp0000685

Holzleitner, I. J., & Perrett, D. I. (2017). Women's preferences for men's facial masculinity: Trade-off accounts revisited. *Adaptive Human Behavior and Physiology, 3,* 304–320. http://dx.doi.org/10.1007/s40750-017-0070-3

Hönekopp, J. (2006). Once more: Is beauty in the eye of the beholder? Relative contributions of private and shared taste to judgments of facial attractiveness. *Journal of Experimental Psychology: Human Perception and Performance, 32,* 199–209. http://dx.doi.org/10.1037/0096-1523.32.2.199

Hosoda, M., Stone-Romero, E. F., & Coats, G. (2003). The effects of physical attractiveness on job-related outcomes: A meta-analysis of experimental studies. *Personnel Psychology, 56,* 431–462. http://dx.doi.org/10.1111/j.1744-6570.2003.tb00157.x

Jablonski, N. G., & Chaplin, G. (2000). The evolution of human skin coloration. *Journal of Human Evolution, 39,* 57–106. http://dx.doi.org/10.1006/jhev.2000.0403

Johnston, V. S., Hagel, R., Franklin, M., Fink, B., & Grammer, K. (2001). Male facial attractiveness: Evidence for hormone-mediated adaptive design. *Evolution and Human Behavior, 22,* 251–267. http://dx.doi.org/10.1016/S1090-5138(01)00066-6

Karras, T., Laine, S., Aittala, M., Hellsten, J., Lehtinen, J., & Aila, T. (2019). *Analyzing and improving the image quality of StyleGAN*. arXiv. Retrieved from https://arxiv.org/abs/1912.04958v2

Kenrick, D. T., & Keefe, R. C. (1992). Age preferences in mates reflect sex differences in human reproductive strategies. *Behavioral and Brain Sciences, 15,* 75–91. http://dx.doi.org/10.1017/S0140525X00067595

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software, 82,* 1–26. http://dx.doi.org/10.18637/jss.v082.i13

Landy, D., & Sigall, H. (1974). Beauty is talent: Task evaluation as a function of the performer's physical attractiveness. *Journal of Personality and Social Psychology, 29,* 299–304. http://dx.doi.org/10.1037/h0036018

Langlois, J. H., Kalakanis, L., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological Bulletin, 126,* 390–423. http://dx.doi.org/10.1037/0033-2909.126.3.390

Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science, 1,* 115–121. http://dx.doi.org/10.1111/j.1467-9280.1990.tb00079.x

Langlois, J. H., Roggman, L. A., Casey, R. J., Ritter, J. M., Rieser-Danner, L. A., & Jenkins, V. Y. (1987). Infant preferences for attractive faces: Rudiments of a stereotype? *Developmental Psychology, 23,* 363–369. http://dx.doi.org/10.1037/0012-1649.23.3.363

Little, A. C., Apicella, C. L., & Marlowe, F. W. (2007). Preferences for symmetry in human faces in two cultures: Data from the U. K. and the Hadza, an isolated group of hunter-gatherers. *Proceedings Biological Sciences, 274,* 3113–3117. http://dx.doi.org/10.1098/rspb.2007.0895

Little, A. C., Burt, D. M., Penton-Voak, I. S., & Perrett, D. I. (2001). Self-perceived attractiveness influences human female preferences for sexual dimorphism and symmetry in male faces. *Proceedings Biological Sciences, 268,* 39–44. http://dx.doi.org/10.1098/rspb.2000.1327

Little, A. C., Burt, D. M., & Perrett, D. I. (2006). What is good is beautiful: Face preference reflects desired personality. *Personality and Individual Differences, 41,* 1107–1118. http://dx.doi.org/10.1016/j.paid.2006.04.015

Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2006). Human preferences for facial masculinity change with relationship type and environmental harshness. *Behavioral Ecology and Sociobiology, 61,* 967–973. http://dx.doi.org/10.1007/s00265-006-0325-7

Little, A. C., & Hancock, P. J. B. (2002). The role of masculinity and distinctiveness in judgments of human male facial attractiveness. *British Journal of Psychology, 93,* 451–464. http://dx.doi.org/10.1348/000712602761381349

Little, A. C., Jones, B. C., & DeBruine, L. M. (2011). Facial attractiveness: Evolutionary based research. *Philosophical Transactions of the Royal Society of London Series B: Biological Sciences, 366,* 1638–1659. http://dx.doi.org/10.1098/rstb.2010.0404

Little, A. C., Jones, B. C., DeBruine, L. M., & Feinberg, D. R. (2008). Symmetry and sexual dimorphism in human faces: Interrelated preferences suggest both signal quality. *Behavioral Ecology, 19,* 902–908. http://dx.doi.org/10.1093/beheco/arn049

Little, A. C., Jones, B. C., Waitt, C., Tiddeman, B. P., Feinberg, D. R., Perrett, D. I., . . . Marlowe, F. W. (2008). Symmetry is related to sexual dimorphism in faces: Data across culture and species. *PLoS ONE, 3*(5), e2106. http://dx.doi.org/10.1371/journal.pone.0002106

Martinez, J. E., Funk, F., & Todorov, A. (2020). Quantifying idiosyncratic and shared contributions to judgment. *Behavior Research Methods*. Advance online publication. http://dx.doi.org/10.3758/s13428-019-01323-0

Nakamura, K., & Watanabe, K. (2019). Data-driven mathematical model of East-Asian facial attractiveness: The relative contributions of shape and reflectance to attractiveness judgements. *Royal Society Open Science, 6,* 182189. http://dx.doi.org/10.1098/rsos.182189

Oh, D., Buck, E. A., & Todorov, A. (2019). Revealing hidden gender biases in competence impressions of faces. *Psychological Science, 30,* 65–79. http://dx.doi.org/10.1177/0956797618813092

Oh, D., Dotsch, R., Porter, J., & Todorov, A. (2019). Gender biases in impressions from faces: Empirical studies and computational models. *Journal of Experimental Psychology: General, 149,* 323–342. http://dx.doi.org/10.1037/xge0000638

Oh, D., Dotsch, R., & Todorov, A. (2019). Contributions of shape and reflectance information to social judgments from faces. *Vision Research, 165,* 131–142. http://dx.doi.org/10.1016/j.visres.2019.10.010

Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation. *Proceedings of the National Academy of Sciences of the United States of America, 105,* 11087–11092. http://dx.doi.org/10.1073/pnas.0805664105

Oswald, D. L., & Lindstedt, K. (2006). The content and function of gender self-stereotypes: An exploratory investigation. *Sex Roles: A Journal of Research, 54*(7–8), 447–458. http://dx.doi.org/10.1007/s11199-006-9026-y

O'Toole, A. J. (2011). Cognitive and computational approaches to face recognition. In G. Rhodes, A. Calder, M. Johnson, & J. V. Haxby (Eds.), *Oxford handbook of face perception* (pp. 15–30). New York, NY: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780199559053.013.0002

O'Toole, A. J., Price, T., Vetter, T., Bartlett, J. C., & Blanz, V. (1999). 3D shape and 2D surface textures of human faces: The role of "averages" in attractiveness and age. *Image and Vision Computing, 18,* 9–19. http://dx.doi.org/10.1016/S0262-8856(99)00012-8

Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., & Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399,* 741–742. http://dx.doi.org/10.1038/21557

Perrett, D. I., Lee, K. J., Penton-Voak, I., Rowland, D., Yoshikawa, S., Burt, D. M., . . . Akamatsu, S. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394,* 884–887. http://dx.doi.org/10.1038/29772

Perrett, D. I., May, K. A., & Yoshikawa, S. (1994). Facial shape and judgements of female attractiveness. *Nature, 368,* 239–242. http://dx.doi.org/10.1038/368239a0

Psychology Software Tools. (2016). E-Prime 3.0 [Computer software]. Retrieved from https://www.pstnet.com

R Core Team. (2018). R: A language and environment for statistical computing [Computer software]. Retrieved from https://www.R-project.org

Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology, 57,* 199–226. http://dx.doi.org/10.1146/annurev.psych.57.102904.190208

Rhodes, G., Hickford, C., & Jeffery, L. (2000). Sex-typicality and attractiveness: Are supermale and superfemale faces super-attractive? *British Journal of Psychology, 91,* 125–140. http://dx.doi.org/10.1348/000712600161718

Rhodes, G., & Tremewan, T. (1996). Averageness, exaggeration, and facial attractiveness. *Psychological Science, 7,* 105–110. http://dx.doi.org/10.1111/j.1467-9280.1996.tb00338.x

Russell, R. (2003). Sex, beauty, and the relative luminance of facial features. *Perception, 32,* 1093–1107. http://dx.doi.org/10.1068/p5101

Russell, R. (2009). A sex difference in facial contrast and its exaggeration by cosmetics. *Perception, 38,* 1211–1219. http://dx.doi.org/10.1068/p6331

Russell, R., Biederman, I., Nederhouser, M., & Sinha, P. (2007). The utility of surface reflectance for the recognition of upright and inverted faces. *Vision Research, 47,* 157–165. http://dx.doi.org/10.1016/j.visres.2006.11.002

Said, C. P., & Todorov, A. (2011). A statistical model of facial attractiveness. *Psychological Science, 22,* 1183–1190. http://dx.doi.org/10.1177/0956797611419169

Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings Biological Sciences, 266,* 1913–1917. http://dx.doi.org/10.1098/rspb.1999.0866

Schmitt, D. P., Realo, A., Voracek, M., & Allik, J. (2008). Why can't a man be more like a woman? Sex differences in Big Five personality traits across 55 cultures. *Journal of Personality and Social Psychology, 94,* 168–182. http://dx.doi.org/10.1037/0022-3514.94.1.168

Scott, I. M. L., Clark, A. P., Josephson, S. C., Boyette, A. H., Cuthill, I. C., Fried, R. L., . . . Penton-Voak, I. S. (2014). Human preferences for sexually dimorphic faces may be evolutionarily novel. *Proceedings of the National Academy of Sciences of the United States of America, 111,* 14388–14393. http://dx.doi.org/10.1073/pnas.1409643111

Semin, G. R., Palma, T., Acarturk, C., & Dziuba, A. (2018). Gender is not simply a matter of black and white, or is it? *Philosophical Transactions of the Royal Society B: Biological Sciences, 373,* 1752. http://dx.doi.org/10.1098/rstb.2017.0126

Singular Inversions. (2006). FaceGen Software Development Kit [Computer software]. Retrieved from https://facegen.com/sdk.htm

Smith, F. G., Jones, B. C., & DeBruine, L. M. (2010). Individual differences in empathizing and systemizing predict variation in face preferences. *Personality and Individual Differences, 49,* 655–658. http://dx.doi.org/10.1016/j.paid.2010.05.023

Sofer, C., Dotsch, R., Oikawa, M., Oikawa, H., Wigboldus, D. H. J., & Todorov, A. (2017). For your local eyes only: Culture-specific face typicality influences perceptions of trustworthiness. *Perception, 46,* 914–928. http://dx.doi.org/10.1177/0301006617691786

Sofer, C., Dotsch, R., Wigboldus, D. H. J., & Todorov, A. (2015). What is typical is good: The influence of face typicality on perceived trustworthiness. *Psychological Science, 26,* 39–47. http://dx.doi.org/10.1177/0956797614554955

South Palomares, J. K., Sutherland, C. A. M., & Young, A. W. (2018). Facial first impressions and partner preference models: Comparable or distinct underlying structures? *British Journal of Psychology, 109,* 538–563. http://dx.doi.org/10.1111/bjop.12286

Spence, J. T., Helmreich, R. L., & Holahan, C. K. (1979). Negative and positive components of psychological masculinity and femininity and their relationships to self-reports of neurotic and acting out behaviors. *Journal of Personality and Social Psychology, 37,* 1673–1682. http://dx.doi.org/10.1037/0022-3514.37.10.1673

Stewart, J. E., II. (1985). Appearance and punishment: The attraction-leniency effect in the courtroom. *The Journal of Social Psychology, 125,* 373–378. http://dx.doi.org/10.1080/00224545.1985.9922900

Sutherland, C. A. M., Oldmeadow, J. A., Santos, I. M., Towler, J., Michael Burt, D., & Young, A. W. (2013). Social inferences from faces: Ambient images generate a three-dimensional model. *Cognition, 127,* 105–118. http://dx.doi.org/10.1016/j.cognition.2012.12.001

Tiedemann, J. (2002). Teachers' gender stereotypes as determinants of teacher perceptions in elementary school mathematics. *Educational Studies in Mathematics, 50,* 49–62. http://dx.doi.org/10.1023/A:1020518104346

Todorov, A. (2017). *Face value: The irresistible influence of first impressions*. Princeton, NJ: Princeton University Press.

Todorov, A., & Oh, D. (in press). The structure and perceptual basis of social judgments from faces. In B. Gawronski (Ed.), *Advances in experimental social psychology* (Vol. 62). Cambridge, MA: Academic Press.

Todorov, A., & Oosterhof, N. (2011). Modeling social perception of faces. *IEEE Signal Processing Magazine, 28,* 117–122. http://dx.doi.org/10.1109/MSP.2010.940006

Torrance, J. S., Wincenciak, J., Hahn, A. C., DeBruine, L. M., & Jones, B. C. (2014). The relative contributions of facial shape and surface information to perceptions of attractiveness and dominance. *PLoS ONE, 9,* e104415. http://dx.doi.org/10.1371/journal.pone.0104415

Valentine, T. (1991). A unified account of the effects of distinctiveness, inversion, and race in face recognition. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 43,* 161–204. http://dx.doi.org/10.1080/14640749108400966

Welling, L. L. M., Jones, B. C., & DeBruine, L. M. (2008). Sex drive is positively associated with women's preferences for sexual dimorphism in men's and women's faces. *Personality and Individual Differences, 44,* 161–170. http://dx.doi.org/10.1016/j.paid.2007.07.026

Williams, J. E., Satterwhite, R. C., & Best, D. L. (1999). Pancultural gender stereotypes revisited: The five factor model. *Sex Roles: A Journal of Research, 40*(7–8), 513–525. http://dx.doi.org/10.1023/A:1018831928829

Xie, S. Y., Flake, J. K., & Hehman, E. (2018). Perceiver and target characteristics contribute to impression formation differently across race and gender. *Journal of Personality and Social Psychology, 117,* 364–385. http://dx.doi.org/10.1037/pspi0000160

Zhang, L., Holzleitner, I. J., Lee, A. J., Wang, H., Han, C., Fasolt, V., . . . Jones, B. C. (2019). A data-driven test for cross-cultural differences in face preferences. *Perception, 48,* 487–499. http://dx.doi.org/10.1177/0301006619849382

Zietsch, B. P., Lee, A. J., Sherlock, J. M., & Jern, P. (2015). Variation in women's preferences regarding male facial masculinity is better explained by genetic differences than by previously identified context-dependent effects. *Psychological Science, 26,* 1440–1448. http://dx.doi.org/10.1177/0956797615591770

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