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OBSERVATIONS

Are Attractive Men's Faces Masculine or Feminine? The Importance of Controlling Confounds in Face Stimuli

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Women's preferences for male masculinity are highly variable. Although many researchers explain this variability as reflecting systematic individual differences in how women resolve the tradeoff between the costs and benefits of choosing a masculine partner, others suggest that methodological differences between studies are responsible. A recent study found general femininity preferences for judgments of faces that were manipulated in sexual dimorphism of shape but general masculinity preferences for judgments of faces that were based on perceived masculinity. Using the original stimuli, we replicated these previous results but found equivalent general femininity preferences for both types of faces when nonface confounds in the stimuli (e.g. hairstyle) were eliminated through masking. We conclude that care must be taken to control potential confounds in stimuli and that the influence of nonface cues on preferences for facial masculinity deserves further study.

Keywords: faces, masculinity, femininity, attractiveness, methodology

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Although nonhuman female animals tend to show strong preferences for masculine male traits (Andersson, 1994), women's preferences for male masculinity are highly variable (DeBruine et al., 2006; Fink & Penton-Voak, 2002; Little, Jones, Penton-Voak, Burt, & Perrett, 2002; Rhodes, 2006). Some researchers have suggested that preferences for relatively feminine male faces are an artifact of the computer graphic manipulations used in some studies (Rennels, Bronstad, & Langlois, 2008; Rhodes, 2006), whereas others have suggested that variable attraction to masculinity reflects differences between groups in the resolution of a tradeoff between the benefits (e.g., greater genetic health) and the costs (lower investment in relationships and children) of choosing a masculine partner (e.g., Fink & Penton-Voak, 2002; Gangestad & Simpson, 2000; Little et al., 2002).

Studies that used computer-graphic methods to manipulate sexual dimorphism of two-dimensional shape in male face images have variously observed general preferences for masculinity (DeBruine et al., 2006; Feinberg, DeBruine, Jones, & Little, 2008; Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Little, Cohen, Jones, & Belsky, 2007; Little, Jones, DeBruine, & Feinberg, 2008), femininity (Little, Burt, Penton-Voak, & Perrett, 2001; Little et al., 2002; Penton-Voak et al., 1999, Penton-Voak et al., 2003; Perrett et al., 1998; Rhodes, Hickford, & Jeffery, 2000; Welling et al., 2007, Welling, Jones, & DeBruine, 2008, Study 1), and average levels of sexual dimorphism of face shape (Cornwell et al., 2004; Swaddle & Riersen, 2002; Welling et al., 2008, Study 2). Studies that correlated attractiveness ratings and masculinity ratings of unmanipulated male faces mostly observed general female preferences for masculinity (e.g. Cunningham, Barbee, & Pike, 1990; Koehler, Simmons, Rhodes, & Peters, 2004; Neave, Laing, Fink, & Manning, 2003; O'Toole, Price, Vetter, Bartlett, & Blanz, 1999), although some studies found no significant relationship between women's masculinity ratings and attractiveness ratings of male faces (Penton-Voak et al., 2001; Rhodes et al., 2003). Some researchers have concluded from the aforementioned studies that differences in findings for women's general preferences for male facial masculinity are explained by differences in the methods used to assess masculinity preferences (Rhodes, 2006).

As mentioned previously, differences among groups in masculinity preferences may also contribute to differences among studies in whether people prefer masculine or feminine characteristics in men's faces (Fink & Penton-Voak, 2002; Gangestad & Simpson, 2000; Little et al., 2001). Such a tradeoff account of women's preferences for masculine men (Gangestad & Simpson, 2000) is supported by evidence that men's masculine traits signal both positive and negative attributes. As men's facial masculinity is a cue of present, past, and even prenatal testosterone levels (Burriss, Little, & Nelson, 2007; Penton-Voak & Chen, 2004; Pound, Penton-Voak, & Surridge, 2009), it can also be used as a cue of other testosterone-related traits. Facial masculinity in human males is associated with a lower incidence of disease (Rhodes, Chan, Zebrowitz, & Simmons, 2003; Thornhill & Gangestad, 2006), supporting the hypothesis that male masculinity signals genetic

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(i.e., heritable) good health (Hamilton & Zuk, 1982). Although male masculinity is associated with health benefits, it is also associated with negative personality traits and behaviors. Masculine male faces are ascribed antisocial traits such as low warmth, low emotionality, dishonesty, low cooperativeness, and poor quality as a parent (Boothroyd, Jones, Burt, & Perrett, 2007; Perrett et al., 1998). Masculine men are also perceived to have more interest in short-term than long-term relationships (Kruger, 2006), and masculine men have more short-term, but not long-term, partners than feminine men (Rhodes, Simmons, & Peters, 2005). Additionally, high-testosterone men are less likely to marry, more likely to divorce, and have more marital problems than low-testosterone men (Booth & Dabbs, 1993). Men with higher testosterone are also less likely to feel a need to respond to infant cries than men with lower testosterone (Fleming, Corter, Stallings, & Steiner, 2002). Because human masculinity is associated with both benefits and costs, women may vary in the extent to which they prefer masculinity versus femininity in male faces (Fink & Penton-Voak, 2002; Gangestad & Simpson, 2000; Little et al., 2001). Men's preferences for male facial masculinity may be similarly variable, but this area has received little research.

Rennels et al. (2008) recently compared preferences for masculinity in male faces that had been generated through two different methods: manipulated sexual dimorphism and ratings of perceived masculinity. Faces were manipulated in sexual dimorphism of face shape with computer-graphic methods that exaggerate the two-dimensional (2D) vector differences between average male and average female face shapes (sensu Perrett et al., 1998; Rhodes et al., 2000). Faces that had been rated as highly masculine or highly feminine were averaged to produce stimuli that differed in perceived masculinity. In a between-subjects study, Rennels et al. (2008) observed general preferences for femininity when judging the attractiveness of the faces manipulated in sexual dimorphism of 2D face shape but observed general preferences for masculinity when judging the attractiveness of composites of men who had been rated as either the most or least masculine from a large sample. They concluded that these different methods produce strikingly different patterns of preferences.

Although Rennels et al. (2008) stated that theirs was the first empirical study to directly compare preferences for manipulated and perceived masculinity, DeBruine et al. (2006), using a within-subject design, found that preferences for masculinity in male faces manipulated in sexual dimorphism of 2D face shape were highly correlated with preferences for perceived masculinity. Indeed, in addition to being highly correlated, both of these methods produced significant preferences for masculinity over femininity (DeBruine et al., 2006). In light of these earlier findings (DeBruine et al., 2006) and variation in preferences for masculinity in studies using identical methodologies (e.g. DeBruine et al., 2006; Welling et al., 2007, Welling et al., 2008), Rennels et al.'s suggestion that the sexual dimorphism and perceived masculinity methods produce strikingly different results appears somewhat premature.

One limitation of Rennels et al.'s (2008) study may have led to misleading results. Their face pairs differed not only in facial appearance but also in the nonface cue of hairstyle. This confound makes it impossible to determine whether participants preferred the masculine face in the perceived masculinity condition because they preferred the masculinity of its face or because they preferred its hair or other nonface cues. Although Rennels et al. (2008) claimed to have "resolved the debate about whether masculine or feminine male faces are more attractive" (p. 891), their study may simply have shown that averaging the hair of men who are perceived as feminine produces a less attractive result than averaging the hair of men who are perceived as masculine.

In light of this, we replicated Rennels et al.'s (2008) study using their original faces as well as these faces with nonface cues removed (i.e. masked). We also compared masculinity preferences for the original faces with the masked versions. In addition, we replicated the study a second time using a different set of male face images. Following the findings of DeBruine et al. (2006), we predicted that general masculinity preferences for male faces manipulated in sexual dimorphism of 2D shape will be similar to general masculinity preferences for perceived masculinity when nonface cues are removed. On the other hand, if Rennels et al.'s finding that sexual dimorphism and perceived masculinity methods produce strikingly different results is not attributable to their study design or uncontrolled stimuli, then we predict that we would replicate their results using both unmasked and masked faces.

Experiment 1: Replication of Rennels et al. (2008)

Method

Participants. Participants were 50 men and 50 women between the ages of 16 and 52 years (men: $M = 23.9$, $SD = 7.52$; women: $M = 26.9$, $SD = 8.22$). The study was conducted online, and participants were recruited by following links from various search engines and listings of online psychology experiments. Previous studies have demonstrated that online and laboratory studies of variation in face preferences produce equivalent patterns of results (e.g., Jones et al., 2007; Jones et al., 2005).

Stimuli. Stimuli were the six composite faces from Rennels et al. (2008). All images were grayscale, although it is not indicated whether the original study used grayscale or color images (Rennels et al., 2008). These faces comprised masculine, average, and feminine versions of male faces that had been manufactured with two different methods: perceived masculinity (termed *average biased* in Rennels et al., 2008) and sexual dimorphism (termed *dimorphically female transformed* in Rennels et al., 2008). Images were cropped from the stimulus figures in Rennels et al. (2008) and reduced in size to 400 × 400 pixels for computer display.

The perceived masculinity faces were an average of the 32 faces rated most masculine (the masculine face), an average of 16 masculine and 16 feminine faces (the average face), and an average of the 32 most feminine faces (the feminine face) from a set of 150 individual male faces (Rennels et al., 2008). Please note the differences in nonface cues, such as hairstyle, among the unmasked images (Figure 1).

The sexual dimorphism faces were an average of 32 randomly selected male faces (the average face) with shape warped toward (to manufacture the feminized face) or away from (to manufacture the masculinized face) an average female face (Rennels et al., 2008).

Masked versions of these stimuli were made by delineating the shape of the face around the chin and hairline and masking the background with gray (Figure 1).

Figure 1. The original, unmasked face stimuli (top row) and the masked versions of these same faces (bottom row) for Experiment 1. Faces were masculinized, average, and feminized faces manipulated in perceived masculinity (left group) or sexual dimorphism (right group).

Procedure. Participants viewed 12 pairs of faces in a random order and chose the more attractive face from each pair. The faces in each pair were from one of four conditions: unmasked perceived masculinity, masked perceived masculinity, unmasked sexual dimorphism, and masked sexual dimorphism. For each condition, three pairings were shown: masculine versus average, masculine versus feminine, and average versus feminine. This procedure is identical to that used by Rennels et al. (2008), apart from the addition of masked faces and the use of a within-subject design.

A within-subject design was used to control for potential sources of individual differences in masculinity preferences. For example, differences among individuals in their recent visual experience (Buckingham et al., 2006; Little, DeBruine, & Jones, 2005), hormonal status (Penton-Voak et al., 1999; Welling et al., 2007), own attractiveness (Little et al., 2001; Penton-Voak et al., 2003), and sex drive (Welling et al., 2008) are all associated with differences in masculinity preference. Indeed, strikingly different general masculinity preferences similar to those found by Rennels et al. (2008) have been found between different studies that used identical methods and even identical stimuli (e.g. DeBruine et al., 2006; Welling et al., 2008). Although random assignment of participants to conditions should be sufficient to eliminate large differences between groups, replicating Rennels et al.'s (2008) findings using a within-subject design would confirm that these results were not due to individual differences between groups.

Results and Discussion

Masculinity preferences in the four conditions (unmasked perceived masculinity, masked perceived masculinity, unmasked sexual dimorphism, and masked sexual dimorphism) were scored as the number of trials out of three (masculine–average, masculine–feminine, and average–feminine) that the more masculine face was chosen. Because these scores cannot be normally distributed, we used nonparametric analyses.

There were no significant differences between men's and women's preferences (Mann–Whitney U: all Zs $\leq$ 1.32, $p \geq .19$). Following Rennels et al. (2008), in further analyses we combined data from male and female participants.

Consistent with findings of the original study (Figure 2A), masculinity was preferred more in the perceived masculinity condition than in the sexual dimorphism condition when faces were

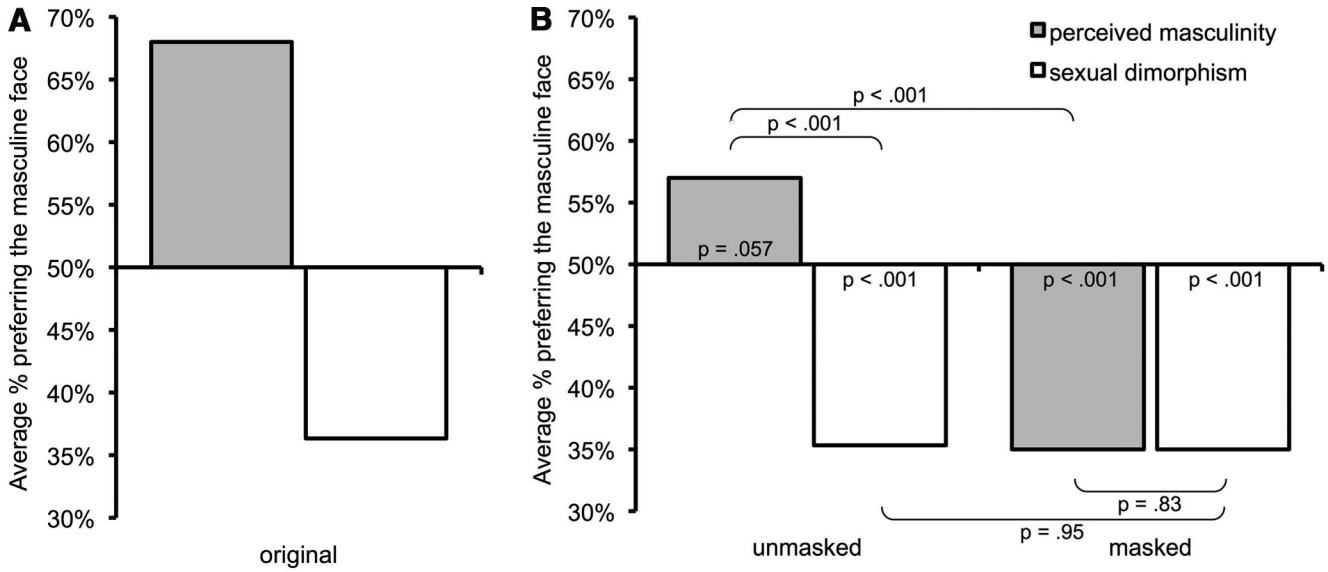

Figure 2. Average percentage of participants who preferred the more masculine face in (a) Experiment 1 of the original study (Rennels et al., 2008) and in (b) the unmasked and masked conditions in the present Experiment 1.

unmasked (Wilcoxon signed-ranks: $Z = 4.87$, $p < .001$; see Figure 2B). However, there was no difference between masculinity preferences in the two conditions when the faces were masked ($Z = -0.21$, $p = .83$; Figure 2B).

As predicted, masculinity was preferred significantly more in the original, unmasked images than in the masked images in the perceived masculinity condition ($Z = 4.83$, $p < .001$), but not in the sexual dimorphism condition ($Z = 0.057$, $p = .95$). Binomial tests revealed a marginally significant preference for masculine faces in the unmasked perceived masculinity condition ($p = .057$) and significant preferences for femininity in masked perceived masculinity condition and both of the sexual dimorphism conditions (all ps $< .001$).

Although unmasked faces in the sexual dimorphism condition produced general masculinity preferences, whereas all other conditions produced general femininity preferences, masculinity preferences in all conditions were positively and significantly correlated (all ρs $\geq .24$, $p \leq .015$). Specifically, masculinity preferences for masked and unmasked faces were correlated in both the perceived masculinity condition ($\rho = .43$, $p < .001$) and the sexual dimorphism condition ($\rho = .43$, $p < .001$). Similarly, masculinity preferences for the perceived masculinity and sexual dimorphism conditions were correlated for both the unmasked faces ($\rho = .34$, $p = .001$) and the masked faces ($\rho = .43$, $p < .001$).

Here we predicted and found that masculinity preferences in the perceived masculinity condition were greater when nonface cues were present than when nonface cues were masked. Indeed, a general preference for masculinity in the unmasked perceived masculinity condition switched to a general preference for femininity when these same faces were masked. This result shows that nonface cues were confounded with facial masculinity in the perceived masculinity stimuli used by Rennels et al. (2008). We replicated their original results using unmasked stimuli and a within-subject design, confirming that their results were not due to their between-subjects design. However, when nonface cues were masked, there was no difference between masculinity preferences for faces made through the perceived masculinity method and the sexual dimorphism method. Thus, the results of Experiment 1 suggest that Rennels et al.'s results were an artifact of an uncontrolled variable in their stimuli and, consequently, their conclusion that sexual dimorphism and perceived masculinity methods produce strikingly different results is unfounded.

Experiment 2: Replication With a New Image Set

In Experiment 1, we showed that nonface cues were confounded with facial masculinity in the perceived masculinity stimuli used by Rennels et al. (2008). atatat-231.7(at)-236eerc15.1(used)1535464(is)-535.7464(ia5.7464(in)-337464(iss)-27464(it)-37464(iT*[(n464(ii)-33s[(n464(i

Figure 3. The unmasked face stimuli (top row) and the masked versions of these same faces (bottom row) for Study 2. Faces were masculinized, average, and feminized faces manipulated in perceived masculinity (left group) or sexual dimorphism (right group). A color version of this figure is available in the supplemental materials.

morphism, and masked sexual dimorphism. For each condition, three pairings were shown: masculine versus average, masculine versus feminine, and average versus feminine.

Results and Discussion

As in Experiment 1, masculinity preferences in the four conditions (unmasked perceived masculinity, masked perceived masculinity, unmasked sexual dimorphism, and masked sexual dimorphism) were scored as the number of trials out of three (masculine–average, masculine–feminine, and average–feminine) in which the more masculine face was chosen and analyzed with nonparametric analyses.

There were no significant differences between men's and women's preferences, although women preferred masculinity marginally more than men in the unmasked perceived masculinity condition ($Z = 1.85$, $p = .064$; for all others: $Z \leq 1.19$, $p \geq .23$). Following Rennels et al. (2008) and Experiment 1, in further analyses we combined data from male and female participants.

Consistent with Experiment 1, masculinity was preferred more in the perceived masculinity condition than in the sexual dimorphism condition when faces were unmasked, although this was only marginally significant (Wilcoxon signed-ranks: $Z = 1.80$, $p = .072$), and there was no difference between masculinity preferences in the two conditions when the faces were masked ($Z = 0.35$, $p = .73$; Figure 4).

As in Experiment 1, masculinity was preferred significantly more in the original, unmasked images than in the masked images in the perceived masculinity condition ($Z = 3.63$, $p < .001$). In contrast to Study 1, this was also true in the sexual dimorphism condition ($Z = 2.59$, $p = .010$). Binomial tests revealed a significant preference for masculine faces in the unmasked perceived masculinity condition ($p = .021$) and no significant preferences for masculinity or femininity in masked perceived masculinity condition ($p = .76$) or either of the sexual dimorphism conditions (unmasked, $p = .48$; masked, $p = .27$).

As in Experiment 1, masculinity preferences in all conditions were positively and significantly correlated (all $\rho s \geq .24$, $p \leq .016$). Specifically, masculinity preferences for masked and unmasked faces were correlated in both the perceived masculinity condition ($\rho = .30$, $p = .002$) and the sexual dimorphism condition ($\rho = .46$, $p < .001$). Similarly, masculinity preferences for the perceived masculinity and sexual dimorphism conditions were correlated for both the unmasked faces ($\rho = .35$, $p < .001$) and the masked faces ($\rho = .32$, $p = .001$).

Here we show that, as in Experiment 1, masculinity was generally preferred only in the unmasked perceived masculinity condition. However, unlike Experiment 1, femininity was not generally preferred in the other three conditions. Also as in Experiment 1, masculinity was preferred more when nonface cues were present than when they were masked. Although this was only true for the perceived masculinity condition in Experiment 1, here we see this result for both the perceived masculinity and the sexual dimorphism conditions. Thus, nonface cues were confounded with facial masculinity in both types of our new stimuli. However, the effect of masking nonface cues was more pronounced for perceived masculinity stimuli than for sexual dimorphism stimuli in both Experiments 1 and 2 (see Appendix).

General Discussion

Rennels et al. (2008) found large differences between masculinity preferences assessed with two different methods to vary

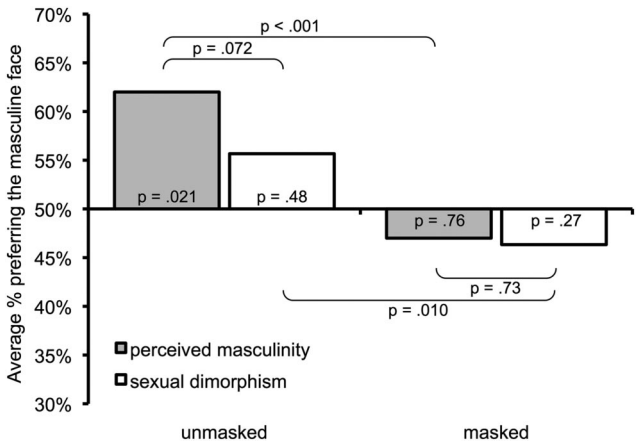

Figure 4. Average percentage of participants who preferred the more masculine face in the unmasked and masked conditions in Experiment 2.

masculinity in male faces. In their study, femininity was generally preferred when faces were manipulated in sexual dimorphism by exaggerating or de-emphasizing the 2D shape differences between an average male face and an average female face (Rennels et al., 2008). By contrast, masculinity was generally preferred when faces were composites of individual men who had been rated as highly masculine or highly feminine (Rennels et al., 2008). Rennels et al. concluded that these differences in masculinity preference were produced by the differences in methods used to produce the stimuli. They also suggested that differences among previous studies in general masculinity preferences are also explained by differences in the methodologies for generating masculine and feminine images. Additionally, they suggested that previous findings for individual differences in masculinity preferences, which have typically used the manipulated sexual dimorphism method to manufacture stimuli, should be treated with caution.

In our Experiment 1, using the same stimuli from Rennels et al.'s (2008) experiment, we replicated their main finding, demonstrating the same differences between masculinity preferences assessed using unmasked stimuli generated with the sexual dimorphism and perceived masculinity methods. Critically, however, these differences were no longer observed when nonface cues, such as hairstyle, were masked in the stimuli. In our Experiment 2, we generated a new set of stimuli, using methods almost identical to those of Rennels et al. (2008), and replicated the effects of manipulation technique and masking that were seen in Experiment 1. The new face set used in Experiment 2 also generated greater differences between preferences for masculinity in perceived masculinity and sexual dimorphism stimuli when faces were unmasked than when faces were masked. Collectively, these findings suggest that the different results for judgments of faces manipulated with the sexual dimorphism and perceived masculinity methods in Rennels et al.'s (2008) study are attributable to the effects of nonface cues and not a consequence of the different methods.

Differences in Stimuli Cause Differences in Results

Although our data support the conclusion that differences in stimuli can cause differences in results, they do not support Rennels et al.'s (2008) conclusion that the sexual dimorphism and perceived masculinity methods themselves produce these different results. Rather, our results support the idea that nonface cues such as hairstyle are confounded with gender and perceived facial masculinity and that these cues, either themselves or through interaction with facial cues, influence preferences.

In Experiment 1, we found that a general masculinity preference for the unmasked perceived masculinity images switched to a general femininity preference when these images were masked. We found no difference between judgments of the unmasked and masked sexual dimorphism images, suggesting that such nonface confounds may be particularly problematic for stimuli produced from ratings of perceived masculinity. Because hairstyle and other nonface cues are likely to influence masculinity ratings, stimuli made with perceived masculinity ratings will be more affected by these confounds than stimuli made with the objective shape differences between average male and female faces.

Additionally, even when ratings of individual faces were made from images with hair and clothing masked, as in Experiment 2, masculinity was preferred more in the unmasked composite images than in the masked composite images. Thus, masculinity of face and of nonface cues, such as hairstyle, appear to be confounded in most faces, not just in Rennels et al.'s (2008) sample. However, in Experiment 2, masculinity was also preferred more in the unmasked sexual dimorphism images than in the masked versions. The sexual dimorphism method only alters the shape of the hairstyle to the extent that the skull shape of men and women differ. Thus, this finding suggests that nonface cues can interact with facial attractiveness. That is, nonface cues may influence perceptions of facial attractiveness, even when they are kept relatively stable, as in the sexual dimorphism method.

A potential alternative interpretation of our findings is that the presence or absence of hairstyle itself affects masculinity preferences. In other words, preferences for masculinity in faces with hair may be systematically higher than preferences for masculinity in faces without hair. Although this is consistent with our finding from Experiment 2 that preferences for masculinity differ between masked and unmasked sexual dimorphism stimuli in which the hair and nonface cues are kept relatively stable, this is inconsistent with the finding from Experiment 1 that masculinity preferences are nearly identical between masked and unmasked sexual dimorphism stimuli. Thus, the effects of the presence or absence of hairstyle cues and type of hairstyle (e.g. short, masculine hair vs. longer, feminine hair) remain an interesting and engaging topic for future research. For example, further studies may compare masculinity preferences for identical faces with masculine hair, feminine hair, and masked hair. Additionally, the effects of hair may also interact with the masculinity of the face. Further studies in which hairstyle and facial cues are independently manipulated may provide important insights into these issues.

Implications for Face Perception Research

In recent years, many studies have demonstrated systematic variation in masculinity preferences. For example, women's preferences for masculinity in men's faces are greater around ovulation than during other phases of the menstrual cycle (see Jones et al., 2008, for a review). Additionally, women who consider themselves to be particularly attractive; are rated as particularly attractive by others; and who have a body shape that is associated with health, fertility, and attractiveness demonstrate stronger preferences for masculinity in men's faces (Little et al., 2001; Little & Mannion, 2006; Penton-Voak et al., 2003). Women in cultures that are characterized by high pathogen load and low paternal investment also prefer masculinity in men's faces more than women in other cultures do (Penton-Voak, Jacobson, & Trivers, 2004). These findings are consistent with facultative mate preferences whereby a variety of factors affect the relative costs and benefits associated with choosing a masculine partner (see Fink & Penton-Voak, 2002; Gangestad & Simpson, 2000; Jones et al., 2008; Little et al., 2001, for comprehensive reviews). Because the majority of these studies used the sexual dimorphism method to generate masculine and feminine face stimuli, Rennels et al. (2008) concluded that these findings should be treated cautiously until they are replicated using perceived masculinity. Our findings demonstrating that the perceived masculinity and sexual dimorphism methods produce identical results, provided care is taken to control for non-face cues, suggests that Rennels, Bronstad and Langlois' (2008) concerns are unwarranted based on current data. Indeed, many of these findings for individual differences in the strength of preferences

for masculinity in men's faces have been replicated using perceived masculinity (e.g. Little, Jones & DeBruine, 2008) and have been shown to occur for variation in preferences for masculinity in other domains, such as judgments of vocal attractiveness (Vukovic et al., 2008) and video clips of male behavior (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004). That predictable variation in masculinity preference can be seen with different types of visual and auditory stimuli casts strong doubts that similar variability in preferences for facial masculinity, whether defined structurally or perceptually, can be fully accounted for by recourse to methodological issues.

Additionally, the significant positive correlations between masculinity preferences assessed with stimuli generated by the sexual dimorphism and perceived masculinity methods that we observed in both experiments demonstrate that women who show particularly strong masculinity preferences for faces manipulated with the sexual dimorphism method also show particularly strong masculinity preferences for faces manipulated with the perceived masculinity method. These correlated preferences complement those reported by DeBruine et al. (2006) for judgments of faces manipulated in masculinity with comparable methods and correlated preferences for male masculinity in different domains (Cornwell et al., 2004; Feinberg et al., 2008).

Conclusions

Our findings cast doubt on Rennels et al.'s (2008) conclusions that sexual dimorphism versus perceived masculinity methodologies lead to different results for masculinity preferences and that, consequently, findings from previous studies using the sexual dimorphism method to manufacture stimuli should be treated extremely cautiously. By contrast, our findings emphasize the importance of considering the influence of nonface cues in studies that intend to make conclusions about facial masculinity, particularly when stimuli are manipulated using perceived masculinity, which may capture characteristics other than facial cues. Furthermore, our findings suggest that the influence of hairstyle and nonface cues on face perception and preferences is an important and potentially fruitful area for future study. Finally, we present novel evidence that differences in computer graphic methods are unlikely to fully explain differences among studies in masculinity preferences and that such differences are more parsimoniously explained by well-established and systematic individual differences in masculinity preferences.

References

Andersson, M. (1994). *Sexual selection.* Princeton, NJ: Princeton University Press.

Booth, A., & Dabbs, J. (1993). Testosterone and men's marriages. *Social Forces, 72,* 463–477.

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.

Buckingham, G., DeBruine, L. M., Little, A. C., Welling, L. L. M., Conway, C. A., Tiddeman, B. P., & Jones, B. C. (2006). Visual adaptation to masculine and feminine faces influences generalized preferences and perceptions of trustworthiness. *Evolution and Human Behavior, 27,* 381–389.

Burriss, R. P., Little, A. C., & Nelson, E. (2007). 2D:4D and sexually dimorphic facial characteristics. *Archives of Sexual Behavior, 36,* 377–384.

Cornwell, R. E., Boothroyd, L. G., Burt, D. M., Feinberg, D. R., Jones, B. C., Little, A. C., et al. (2004). Concordant preferences for opposite-sex signals? Human pheromones and facial characteristics. *Proceedings of the Royal Society of London B, 271,* 635–640.

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.

DeBruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., et al. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings of the Royal Society of London B, 273,* 1355–1360.

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.

Fink, B., & Penton-Voak, I. S. (2002). Evolutionary psychology of facial attractiveness. *Current Directions in Psychological Science, 11,* 154–158.

Fleming, A. S., Corter, C., Stallings, J., & Steiner, M. (2002). Testosterone and prolactin are associated with emotional responses to infant cries in new fathers. *Hormones and Behavior, 42,* 399–413.

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23,* 573–644.

Gangestad, S. W., Simpson, J. A., Cousins, A. J., Garver-Apgar, C. E., & Christensen, P. N. (2004). Women's preferences for male behavioral displays change across the menstrual cycle. *Psychological Science, 15,* 203–207.

Hamilton, W. D., & M. Zuk. (1982). Heritable true fitness and bright birds: A role for parasites? *Science, 218,* 384–387.

Johnston, V. S., Hagel, R., Franklin, M., Fink, B., & Grammer, K. (2001). Male facial attractiveness: Evidence for a hormone-mediated adaptive design. *Evolution and Human Behavior, 22,* 251–267.

Jones, B. C., DeBruine, L. M., Little, A. C., Conway, C. A., Welling, L. L. M., & Smith, F. G. (2007). Sensation seeking and men's face preferences. *Evolution and Human Behavior, 28,* 439–446.

Jones, B. C., DeBruine, L. M., Perrett, D. I., Little, A. C., Feinberg, D. R., & Law Smith, M. J. (2008). Effects of menstrual cycle phase on face preferences. *Archives of Sexual Behavior, 37,* 78–84.

Jones, B. C., Little, A. C., Boothroyd, L. G., DeBruine, L. M., Feinberg, D. R., Law Smith, M. J., et al. (2005). Commitment to relationships and preferences for femininity and apparent health in faces are strongest on days of the menstrual cycle when progesterone level is high. *Hormones and Behavior, 48,* 283–290.

Koehler, N., Simmons, L. W., Rhodes, G., & Peters, M. (2004). The relationship between sexual dimorphism in human faces and fluctuating asymmetry. *Proceedings of the Royal Society of London B, 271,* S233–S236.

Kruger, D. J. (2006). Male facial masculinity influences attributions of personality and reproductive strategy. *Personal Relationships, 13,* 451–463.

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 of the Royal Society of London B, 268,* 39–44.

Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2007). Human preferences for facial masculinity change with relationship type and environmental harshness. *Behavioral Ecology and Sociobiology, 61,* 967–973.

Little, A. C., DeBruine, L. M., & Jones, B. C. (2005). Sex-contingent face aftereffects suggest distinct neural populations code male and female faces. *Proceedings of the Royal Society of London B, 272,* 2283–2287.

Little, A. C., Jones, B. C., & DeBruine, L. M. (2008). Preferences for variation in masculinity in real male faces change across the menstrual cycle. *Personality and Individual Differences, 45,* 478–482.

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.

Little, A. C., Jones, B. C., Penton-Voak, I. S., Burt, D. M., & Perrett, D. I.

(2002). Partnership status and the temporal context of relationships influence human female preferences for sexual dimorphism in male face shape. *Proceedings of the Royal Society of London B, 269,* 1095–1103.

Little, A. C., & Mannion, H. (2006). Viewing attractive or unattractive same-sex individuals changes self-rated attractiveness and face preferences in women. *Animal Behaviour, 72,* 981–987.

Neave, N., Laing, S., Fink, B., & Manning, J. T. (2003). Second to fourth digit ratio, testosterone, and perceived male dominance. *Proceedings of the Royal Society of London B, 270,* 2167–2172.

O'Toole, A. J., Price, T., Vetter, T., Bartlett, J., & 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.

Penton-Voak, I. S., & Chen, J. Y. (2004). High salivary testosterone is linked to masculine male facial appearance in humans. *Evolution and Human Behavior, 25,* 229–241.

Penton-Voak, I. S., Jacobson, A., & Trivers, R. (2004). Populational differences in attractiveness judgements of male and female faces: Comparing British and Jamaican samples. *Evolution and Human Behavior, 25,* 355–370.

Penton-Voak, I. S., Jones, B. C., Little, A. C., Baker, S., Tiddeman, B., Burt, D. M., & Perrett, D. I. (2001). Symmetry, sexual dimorphism in facial proportions and male facial attractiveness. *Proceedings of the Royal Society of London B, 268,* 1617–1623.

Penton-Voak, I. S., Little, A. C., Jones, B. C., Burt, D. M., Tiddeman, B. P., & Perrett, D. I. (2003). Female condition influences preferences for sexual dimorphism in faces of male humans (*Homo sapiens*). *Journal of Comparative Psychology, 117,* 264–271.

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.

Perrett, D. I., Lee, K., Penton-Voak, I. S., Rowland, D., Yoshikawa, S., Burt, D. M., et al. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394,* 884–887.

Pound, N., Penton-Voak, I. S., & Surridge, A. K. (2009). Testosterone responses to competition in men are related to facial masculinity. *Proceedings of the Royal Society of London B, 276,* 153–159.

Rennels, J. L., Bronstad, P. M., & Langlois, J. H. (2008). Are attractive men's faces masculine or feminine? The importance of type of facial stimuli. *Journal of Experimental Psychology: Human Perception and Performance, 34,* 884–893.

Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology, 57,* 199–226.

Rhodes, G., Chan, J., Zebrowitz, L. A., & Simmons, L. W. (2003). Does sexual dimorphism in human faces signal health? *Proceedings of the Royal Society of London B, 270,* S93–S95.

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.

Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behaviour: Does attractiveness enhance mating success? *Evolution and Human Behavior, 26,* 186–201.

Swaddle, J. P., & Riersen, G. W. (2002). Testosterone increases perceived dominance but not attractiveness in human males. *Proceedings of the Royal Society of London B, 269,* 2285–2289.

Thornhill, R., & Gangestad, S. W. (2006). Facial sexual dimorphism, developmental stability, and susceptibility to disease in men and women. *Evolution and Human Behavior, 27,* 131–144.

Tiddeman, B. P., Perrett, D. I., & Burt, D. M. (2001). Prototyping and transforming facial textures for perception research. *IEEE Computer Graphics and Applications, 21,* 42–50.

Vukovic, J., Feinberg, D. R., Jones, B. C., DeBruine, L. M., Welling, L. L. M., Little, A. C., & Smith, F. G. (2008). Self-rated attractiveness predicts individual differences in women's preferences for masculine men's voices. *Personality and Individual Differences, 45,* 451–456.

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.

Welling, L. L. M., Jones, B. C., DeBruine, L. M., Conway, C. A., Law Smith, M. J., Little, A. C., et al. (2007). Raised salivary testosterone in women is associated with increased attraction to masculine faces. *Hormones and Behavior, 52,* 156–161.

Appendix

Percentage of Participants Choosing the More Masculine Face for Each Type of Pair in the Original Study (Experiment 1; Rennels, Bronstad, & Langlois, 2008) and in the Unmasked and Masked Conditions in the Present Experiments 1 and 2

		Perceived masculinity			Sexual dimorphism		
Experiment	Masking	Masculine-average	Masculine-feminine	Average-feminine	Masculine-average	Masculine-feminine	Average-feminine
Rennels et al. (2008)	Unmasked	71	73	60	36	38	35
Present study							
Experiment 1	Unmasked	52	56	63	21	26	59
Experiment 1	Masked	34*	27*	44*	23	30	52
Experiment 2	Unmasked	53	59	74	44	61	62
Experiment 2	Masked	32*	48	61*	53	43*	43*

Note. Percentages that are significantly different from chance (50%) are underlined. Percentages for masked conditions that are significantly different from unmasked conditions are indicated by asterisks.

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