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Preferences for variation in masculinity in real male faces change across the menstrual cycle: Women prefer more masculine faces when they are more fertile

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ABSTRACT

In women cyclical shifts in preference have been documented for odour and certain physical and behavioral male traits. For example, women prefer more masculinised male faces when at peak fertility than at other times in their menstrual cycle. In previous studies, the face images used have all been manipulated using computer graphic techniques. Here, we examine variation in preferences for perceived masculinity in unmanipulated real male faces to address consistency with findings using manipulated masculinity in faces. We show that women prefer greater masculinity in male faces at times when their fertility is likely to be highest (during the follicular phase of their cycle) if they are in a current romantic relationship. These results indicate that women's preferences for perceived sexual dimorphism in real male faces follow a similar pattern as found for manipulated sexual dimorphism, suggesting that manipulated and real masculinity in male faces generate similar results in preference studies. Cyclical preferences could influence women to select a partner who possesses traits that may enhance her offspring's quality via an attraction to increased masculinity at times when conception is most likely, or serve to improve partner investment via an attraction to reduced masculinity when investment is important.

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1. Introduction

Research on facial attractiveness has used both real and computer graphic manipulated faces. In some areas, the results generated have differed depending on the technique used. Computer graphic studies which manipulate masculinity have tended to suggest that feminine male faces are attractive while studies of real faces using rated masculinity have usually demonstrated preferences for masculinity (see Rhodes, 2006). This has led Rhodes (2006) to suggest that real faces may reveal a truer picture of female preferences than computer manipulated images. One area that has received much attention is cyclic variation in attraction to masculine face traits. Generally such studies have used manipulated faces (Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999), and so it is important to examine whether the effects seen in these studies are also found using variation in masculinity amongst real faces. If similar effects are seen using both real and manipulated faces we can conclude that results of studies using the two image types are comparable. Below we briefly review the literature and reasoning behind studying cyclic preferences for masculinity.

Women differ in their preferences and one biological explanation for within-individual variation lies with hormonal changes across the menstrual cycle. Many studies have demonstrated that women's preferences for certain male traits change across the menstrual cycle. Increased preferences for facial masculinity (Frost, 1994; Johnston et al., 2001; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999), vocal masculinity (Feinberg et al., 2006; Puts, 2005), dominant behavior (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004), for taller men (Pawlowski & Jasienska, 2005) and for masculine body shapes (Little, Jones, & Burriss, 2007a) that coincide with the late follicular (i.e., fertile) menstrual cycle phase have been reported. Cyclic shifts are also seen for other mate choice relevant traits whereby fertile women generally rate men as more attractive (Danel & Pawlowski, 2006) and are more attracted to facial symmetry (Little, Jones, Burt, & Perrett, 2007b). Changes in preferences for masculine men are potentially adaptive. Human males bring two factors to a parenting relationship: investment in their partners and offspring, and potential heritable benefits (e.g., genes for high quality immune systems). Masculinity in males has long been thought to be an indicator of quality via classic handicap models (Folstad & Karter, 1992); as higher testosterone levels handicap the immune system (Kanda, Tsuchida, & Tamaki, 1996) and, therefore, only high quality males can afford to be masculine (Thornhill & Gangestad, 1999). The relationship between masculinity and quality is controversial and there are several lines of reason involved in why it might be preferred (Getty, 2002; Thornhill & Gangestad, 1999).

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While masculine faced men are healthier than their feminine faced counterparts (Rhodes, Chan, Zebrowitz, & Simmons, 2003; Thornhill & Gangestad, 2006), masculinity in a partner also carries a cost. Men with masculine faces have higher circulating testosterone levels (Penton-Voak & Chen, 2004) which are linked to marital instability and lower levels of attachment in relationships (Booth & Dabbs, 1993; Burnham et al., 2003). As might be expected then, masculine faces are seen as more dominant but not seen as possessing traits that would be desirable in a long-term partner (Boothroyd, Jones, Burt, & Perrett, 2007; Perrett et al., 1998). Thus, variation in preferences during the menstrual cycle may enable women to maximize the benefits of their mate preferences, potentially shifting priorities between heritable benefits to offspring and investment (Penton-Voak et al., 1999).

Although peaks in sexual desire and activity have been reported at different stages across the menstrual cycle (Regan, 1996), some studies have reported that women with partners may be more likely to engage in extra-pair sexual activity at peak fertility (Baker & Bellis, 1995). Further evidence for possible extra-pair sexual behavior comes from studies showing that women at peak fertility are more likely to have sexual fantasies about men other than their primary partner (Gangestad, Thornhill, & Garver, 2002), express a greater interest in attending social gatherings where they might meet men at peak fertility (Haselton & Gangestad, 2006), and report being more committed to their partners during the luteal phase of the menstrual cycle and less committed in the late follicular phase (Jones et al., 2005). These studies suggest a possible mechanism whereby women may maximize their chances of becoming pregnant with the offspring of males chosen for extra-pair affairs. Such males may be selected for possessing superior or alternative genes to the woman's current partner.

As an alternative or perhaps complementary explanation for shifting preferences alterations in progesterone level have been associated with increased commitment to a partner, and increased preferences for less masculinized male faces during the luteal phase of the cycle. This may reflect an increase in the care and support that is available during hormonal profiles similar to those that characterize pregnancy (Jones et al., 2005). In this way, rather than acquiring direct benefits for offspring from masculine men, women instead maximize investment from feminine men when raised progesterone prepares the body for pregnancy (Jones et al., 2005).

Preferences for masculinity in faces have also been found to be moderated by other factors relating to potentially strategic choice. Already having a partner has also been shown to predict female face preferences. An increased preference for genetic fitness over signs of parental investment would be expected in extra-pair copulations when a woman has already acquired a long-term partner. Indeed, Little, Jones, Penton-Voak, Burt, and Perrett (2002) have shown that women who have partners prefer masculinity in faces more so than females without a current romantic partner. Another factor that influences preferences for facial masculinity is the type of relationship being looked for. Studies have shown that women tend to prefer more masculine faces when judging for a short-term than for a long-term relationship. Indeed, in a variety of studies cycle effects are often more likely seen when women judge for short-term relations (Gangestad & Thornhill, 2008). In a similar way to already having an investing partner, short-term relations minimise the need to value investment from partners.

The current study again examined preferences for sexual dimorphism in male faces across the menstrual cycle, but with a key difference. Previous studies of shifting face preferences for masculinity have used computer graphic manipulations of shape and colour (Johnston et al., 2001) or manipulations of shape alone (Johnston et al., 2001; Jones et al., 2005; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999). As noted earlier, Rhodes (2006) has suggested, however, that findings from studies using computer graphic methods to manipulate sexual dimorphism might reflect an artefact of the methods used to manufacture stimuli, and should thus be treated cautiously. Studies reporting associations between ratings of the masculinity and attractiveness of unmanipulated facial images may thus represent a more valid reflection of female mate preferences (Rhodes, 2006). The goal of this study is to address whether similar results are seen for preferences in real faces varying in perceived masculinity. Here, we examine attraction to perceptual masculinity in real unmanipulated faces by asking women to choose between faces rated as relatively more or less masculine. We predicted (following similar results for preferences for manipulated masculinity in male faces) that women would prefer more masculine real male faces when in the follicular phase of their cycle. We also predicted that menstrual cycle shifts may be greater for women with partners, again following findings from manipulated face and body preferences, and that there may be an interaction between fertility and partnership status if shifting preferences across the menstrual cycle serve to focus individuals on the quality of potential extra-pair partners.

2. Methods

2.1. Participants

One hundred and fifty female participants (aged 17–40, mean age = 25.1, SD = 6.6) took part in the study. The study was administered over the internet and participants were volunteers selected for reporting to be heterosexual, not using oral or other hormonal contraception, being between 17 and 40 years of age, not being pregnant, having a regular cycle, and having a restricted range in their reported cycle date (less than 29 days, i.e., women were excluded if the did not report their days since menstruating as between 0 and 28). Of these 96 were classified low fertile (52 with partners, 44 without) and 54 high fertile (26 with partners, 28 without). Using a chi-square test fertility was not found to covary with partnership status ($\chi^2 = 0.50$, $p = .479$). See below for a description of how women were classified according to cycle phase/fertility.

2.2. Conception risk

Following previous studies of preferences (Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999), we used a standard 28-day model of the female menstrual cycle to divide women into high (women reporting days 6–14) and low (women reporting days 0–5 and 15–28) conception risk based on self-reports of the previous onset of menses. These groups correspond to the follicular phase and menses and the luteal phase respectively (e.g., Regan, 1996). To estimate fertility and to check whether our split captured differences in fertility we calculated conception risk for each individual based on their reported menstruation (counting from onset of previous menses) by using values reported in Wilcox, Dunson, Weinberg, Trussell, and Baird (2001). Wilcox et al. provide likelihood of conception from a single act of intercourse for each day of the menstrual cycle based on a study of 221 women who were attempting to conceive. The highest probability from this data is only 0.086. An independent samples *t*-test revealed our follicular/high fertility group (mean = 0.055, SD = 0.027) was predicted to have a higher conception risk than our luteal/low fertility group (mean = 0.020, SD = 0.027, $t_{148} = 7.64$, $p < .001$). We then had two measures of fertility, cycle phase (follicular versus luteal) and a linear measure of fertility based on conception risk. We note that our cycle phase split captures fertility but also offers insight into the hormonal profile of the responding women. By excluding individuals who reported menstruation as occurring 29 or more days ago, because these individuals do not fit a 28-day model, if

participants reported their menstruation accurately then using our classification days women would have to have regular cycles of 20 days or under in order to be misclassified by phase here.

2.3. Stimuli

Ten pairs of face images were created from 20 individual photographs of male faces. To find faces differing in perceived masculinity we had 83 male faces (mean age = 21.2, SD = 2.4) rated for masculinity. These images were taken under standardised lighting conditions and participants were asked to pose with a neutral expression. Participants were asked to remove spectacles and participants who were not white or who had conspicuous facial hair (beards, goatees, conspicuous stubble) were excluded from the sample by the first author. These images were masked to exclude hair and clothing and normalised on interpupillary distance to remove the effect of head distance from the camera. Images were rated by 14 individuals (6 female, 8 male, mean age = 28.6, SD = 8.11). Participants were asked to rate each image for masculinity on a scale of 1–7 (1 = low, 7 = high) and selecting a number moved on to the next trial. Image order was randomised for each participant. There was high agreement amongst the judges for ratings of masculinity (Cronbach's Alpha = .981) and between male and female judges (Pearson's correlation $r = .722$, $p < .001$) and so we computed an average masculinity score for each face by averaging scores across judges. To address whether masculinity was confounded by attractiveness here, the faces were rated by 12 women (mean age = 25.2, SD = 5.42) for attractiveness. Participants were asked to rate each image for attractiveness here in the same as above and again there was high agreement amongst the judges (Cronbach's Alpha = .831).

We then took the top 10 scoring and bottom 10 scoring faces to create our test. Images were paired so as to try to keep the difference in perceived masculinity between face pairs constant. To do this the most masculine face of the top 10 was paired with the most masculine face of the bottom 10. The mean score for the bottom 10 faces was 2.29 (SD = 0.19) and the mean for the top 10 faces was 4.05 (SD = 0.25). The mean difference between pairs was 1.76 (SD = 0.11) and this difference was significant (paired samples $t_9 = 52.25$, $p < .001$). For attractiveness ratings, the mean score for the bottom 10 masculine faces was 1.33 (SD = 0.85) and the mean for the top 10 faces was 1.92 (SD = 0.94). The mean difference between pairs was 0.58 (SD = 1.44) and this difference was not significant (paired samples $t_9 = 1.28$, $p = .231$). Our faces then largely captured facial masculinity differences and not attractiveness.

2.4. Procedure

A questionnaire was first administered addressing age, whether they had a partner (yes/no), hormonal contraceptive use, days since last menstruation, pregnancy status, and sexuality. Participants were then presented with the 10 forced-choice paired image trials (choosing between relatively more masculine or feminine faces). Participants were asked to select the face they found most attractive. The trials were presented in random order with the side each face was presented on also randomized.

3. Results

Proportion of masculine faces chosen was calculated for each participant by taking the number of masculine faces picked from the pairs (from 0 to 10 out of the 10 pairs) and multiplying by 100 to represent a percentage.

A one-sample t-test against no preference (50%, no preference) revealed that overall women preferred more masculine male faces (mean = 60.0%, SD = 17.3, $t_{149} = 7.12$, $p < .001$). Splitting by cycle phase revealed both groups preferred masculine faces (follicular, mean = 64.4%, SD = 15.6, $t_{53} = 6.64$, $p < .001$, luteal, mean = 57.6%, SD = 17.6, $t_{95} = 4.23$, $p < .001$).

A univariate ANOVA with partner (yes/no) and cycle phase (follicular/luteal) as between-participant factors and age as a covariate revealed a significant effect of cycle phase ($F_{4,145} = 5.30$, $p = .023$) and a significant interaction between cycle phase and partner ($F_{4,145} = 4.35$, $p = .039$). There was no overall significant effect of age ($F_{4,145} = 0.24$, $p = .627$) or partner ($F_{4,145} = 1.96$, $p = .164$),The interaction between cycle phase and partner can be seen in Fig. 1 and indicates that women preferred more masculine faces in the follicular phase than in the luteal phase only when they had a partner. Splitting the sample on partner confirmed a significant effect of fertility for women with a partner ($F_{2,75} = 9.00$, $p = .002$) but not for those without a partner ($F_{2,69} = 0.04$, $p = .845$).

We also examined linear fertility estimated from published measures of conception risk (see methods for calculation) by running a univariate ANOVA with partner (yes/no) as a between-participant factor and entering linear fertility as a covariate. Following the effects seen above, a custom model revealed a significant interaction between fertility and partner ($F_{3,146} = 3.60$, $p = .030$). Splitting the sample on partner Pearson correlations revealed that fertility was significantly positively correlated with preference for face masculinity for women with a partner ($r = .298$, $p = .002$) but not for those without a partner ($r = .014$, $p = .905$).

4. Discussion

The current study demonstrates that female preferences for perceived masculinity in real male faces change across the menstrual cycle and that women with partners show the greatest change across the cycle. Women preferred more masculine male faces when they were in the late follicular, fertile phase of the menstrual cycle though this effect here was seen only for choices when women already had a partner. We also found a linear estimate of conception risk to be positively correlated with preferences for masculinity. The effects we see appear likely to be driven by hormonal changes across the cycle, which are closely tied to fertility, such as changes in progesterone or oestrogen. Testosterone also fluctuates over women's menstrual cycles and has been associated with increased preferences for facial masculinity in a manner independent of fluctuations in progesterone (Welling et al., 2007). While we do not directly measure hormones here, the link between masculinity preferences and hormonal profile remains a fruitful area for future research. We also note that while we follow a previous method in determining cycle phase there are other ways of calculating phase and estimating fertility. The

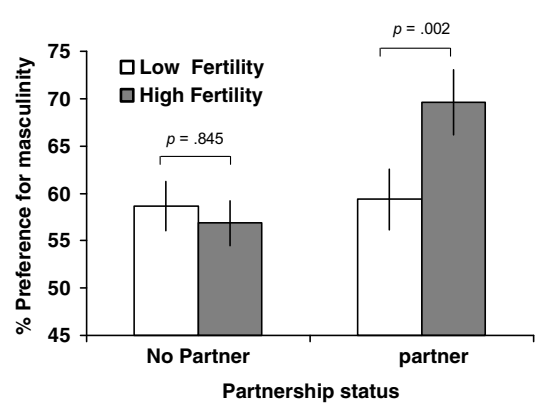

Fig. 1. %Preferences for facial masculinity (±1SE of mean) by cycle phase noted as fertility (high/low) and partner (yes/no).

utility and evolutionary relevance of each of these methods remains a topic for future research.

Overall, women found masculine faces more attractive than feminine faces and so the cyclic shift in preferences can be said to favour masculine faces. In previous studies shifts have been relative. For example, early work demonstrated that women preferred feminine face shapes and at high fertility preferences were still for more feminine faces but the faces chosen were relatively masculinised (Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999). While our absolute preferences differ from those found in Penton-Voak et al. (1999), it is the shift in preference that is important here. Our work is comparable despite the differences in absolute preferences for masculinity, but also help refute any suggestion that women are choosing more randomly at high fertility and regressing towards a mean of no preference (see also Johnston et al., 2001). Previous studies have also shown that cycle effects on attraction to masculinity are generally stronger when women judge for short-term relations (Gangestad & Thornhill, 2008). While we did not address this variable in this study, we can conclude cycle affects general attractiveness judgements. The pattern of previous data suggests our pattern of data might have been stronger if women were asked to judge for a short-term context.

The observed change in preferences for perceived masculine male faces during the menstrual cycle is in line with previous work examining menstrual cycle effects on preferences for manipulated facial masculinity (Johnston et al., 2001; Jones et al., 2005; Penton-Voak and Perrett, 2000; Penton-Voak et al., 1999; Welling et al., 2007). Our images use a different methodology to define sexual dimorphism as that used in previous studies of face preference and suggest that changes in preference for masculinity across the cycle are not an artefact of face manipulation procedures. While it has been noted that studies using manipulated sexual dimorphism should be treated cautiously (Rhodes, 2006) our data show the same effects that are seen in real faces differing in perceived masculinity as are seen in the computer manipulated studies. As similar effects are seen using both real and manipulated faces we suggest that results of studies using the two image types can be directly compared in the sense that they appear to tap the same underlying notion of facial masculinity.

Women preferred masculine faces at peak fertility here only when in a relationship, and this suggests that facial masculinity may be more highly valued under circumstances where the potential to pass traits to offspring is high and where parental investment is secured. As women have sexual fantasies about men other than their partners (Gangestad et al., 2002) and are less committed to their partners (Jones et al., 2005) at peak fertility, women may maximize their chances of becoming pregnant with the offspring of males chosen for extra-pair affairs, though we note that we did not address short or long-term relationships in this study. Functionally, shifting preferences may then lead to maximising the likelihood that offspring inherit strong immune systems via good genes from fathers (Penton-Voak and Perrett, 2000) or promote strategies to associate with more investing individuals when not at peak fertility (Jones et al., 2005).

Between-participant data is not ideal to study a within-participant effect, though here we note our effects are consistent with findings from carefully controlled within-participants studies. There are also several different methods for dividing participants according to their cycle and here we use one common method of classification based on allocation to groups and self-report data as well as a linear estimate of conception risk. We note that any errors in the allocation to group or estimate, such as inaccurate reporting from the participants, would be most likely to decrease the chance of finding a significant effect here. While factors not measured here such as relationship length or error in reporting of cycle days may be important, these factors would not bias the results, adding only noise to the data and hence only reduce the chance of finding a significant effect of menstrual cycle.

In summary, the current study suggest that the menstrual cycle has an important impact on real face preferences, with women preferring more masculine faces at peak fertility. We suggest that ideas of evolved mechanisms promoting attention to biologically relevant traits at peak fertility may provide a parsimonious explanation for the observed results. Hormonal changes associated with phases of the menstrual cycle likely provide the mechanism for these differences in preference. That we replicate a finding previously seen using computer manipulated faces using real faces would suggest that both types of face generate comparable results and both can then be used to usefully measure preferences for masculinity.

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