



Hormonal effects on women's facial masculinity preferences: The influence of pregnancy, post-partum, and hormonal contraceptive use



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ABSTRACT

Here, we investigate changes in women's facial masculinity preferences across pregnancy and the post-partum period. The majority of previous research demonstrating changes in women's masculinity preferences has examined the impact of hormonal variation across the female menstrual cycle. Hormonal changes experienced during pregnancy and the post-partum period, critical periods in women's reproductive life histories, are considerably more extreme than the variation that occurs across the menstrual cycle, suggesting that differences in preferences may also be displayed during these times. We find that women's preference for masculinity in men's faces, but not women's faces, decreases in the post-partum period relative to pregnancy. Furthermore, when compared to a sample of nulliparous control participants, post-partum participants showed different masculinity preferences compared with women who were using hormonal contraception, with the direction of this difference dependent upon the sex of the face assessed.

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1. Introduction

A large number of studies indicate that women's preference for masculinity in male faces is moderated by their menstrual cycle stage. For example, in the late follicular phase of the cycle, when oestrogen levels are relatively high and conception risk is highest, women have stronger preferences for facial masculinity than they do in the luteal phase of the cycle when oestrogen and conception risk are low (Little, Jones, & DeBruine, 2008; Little & Jones, 2012; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999). Increased attraction to masculinity during the late follicular phase has likewise been documented in women's ratings of male voices (Feinberg et al., 2006; Puts, 2005), bodies (Little, Jones, & Burriss, 2007), and masculine characteristics in point-light displays of biological motion (Provost, Troje, & Quinsey, 2008, but see also Peters, Simmons, & Rhodes, 2009). An increased preference for related traits, such as dominant behavioural displays (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004), personality traits associated with dominance (Lukaszewski & Roney, 2009), the odour of dominant men (Havlicek, Roberts, & Flegr, 2005), and men's height (Pawlowski & Jasienska, 2005), have also been shown to occur in the follicular phase of the cycle.

One possible explanation for shifts in judgements of masculinity and related traits across the menstrual cycle is that at mid-cycle, when conception risk is highest, cues to a man's condition or genetic quality are especially pertinent for women in order to make an adaptive mate choice. Masculine-faced men are thought to possess 'good genes' and to be healthier than relatively feminine-faced men (Thornhill & Gangestad, 2006), suggesting that a selective preference for masculinity when conception is possible could increase reproductive success. Indeed, masculinity has long been suggested to be an indicator of male quality (Folstad & Karter, 1992; Thornhill & Gangestad, 1999), although there is limited evidence for this proposition (e.g. Scott, Clark, Boothroyd, & Penton-Voak, 2013). Nonetheless, masculine faces are not associated with traits that are desirable in a long term partner, such as investment (Boothroyd, Jones, Burt, & Perrett, 2007), meaning that a general preference for masculinity, even if it does reflect underlying genetic quality, may not be desirable. As such, cycle-dependent changes in line with a woman's conception risk, or current reproductive condition, could carry adaptive benefits.

Irrespective of the logic for why such shifts occur, that cyclical changes in women's preferences for masculine traits occur suggests that within-individual variation in judgements, at least in part, are associated with hormonal variation. Indeed, existing work looking at other phases of hormonal transition across the female lifespan appears consistent with this idea. For example, circum-menopausal women show an increased preference for femininity in male and female faces relative to regularly cycling women

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(Jones, Vukovic, Little, Roberts, & DeBruine, 2011; Little et al., 2010; Vukovic et al., 2009). This finding may be explained by the reduced value placed on adaptive mate choice among circum-menopausal aged women. Specifically, circum-menopausal women may benefit less from choosing a masculine male partner since conception is no longer a relevant concern, and thus the advertised importance of genetic quality in men may be of diminished value. Moreover, increased preference for femininity in female faces may reflect lower levels of intrasexual competition, with women of this age achieving less from rival derogation relative to those of reproductive age. In other related work, Little et al. (2010) showed that post-pubescent girls had stronger preferences for masculinity in male faces than did younger peri-pubescent girls (see also Saxton, DeBruine, Jones, Little, & Roberts (2009), for similar results in both faces and voices). Together, these findings appear to suggest that attraction to masculinity is particularly high at times in which women are reproductively active. Advertisements of male quality may be most salient to women in the reproductive age group, particularly when fertile.

While it is obvious that menarche, the menstrual cycle and the transition to menopause are related to major shifts in women's hormonal profiles, much research remains in determining which hormone, or group of hormones, mediate these changes in judgements of masculinity. Work by Welling et al. (2007) has previously documented a positive association between women's salivary testosterone and preference for male facial masculinity. This finding is consistent with much of the literature outlined above. For example, while effects are mixed, some research suggests very moderate testosterone increases occur near to ovulation in the follicular phase of the cycle (e.g. Alexander, Sherwin, Bancroft, & Davidson, 1990; Dabbs, 1990; but see also: Schultheiss, Dargel, & Rohde, 2003; Welling et al., 2007) and indeed this is the time when women express enhanced masculinity preferences. Moreover, post-pubescent girls have higher levels of testosterone than peri-pubescent girls (e.g. Angold, Costello, Erkanli, & Worthman, 1999) and, while testosterone does not show a precipitous drop in the menopause, it does show a gradual age decline, meaning older women are likely to have lower levels of this hormone (Longcope, Franz, Morello, Baker, & Johnston, 1986; Zumof, Strain, Miller, & Israel, 1995). Therefore, the finding that testosterone positively relates to masculinity preferences is consistent with the pattern of results documented across these phases of female hormonal transition. Nonetheless, a range of other hormones, including oestrogen and progesterone, fluctuate across these reproductive life events. Thus, it is possible that several hormones, or interactions among hormones, underpin shifts in masculinity preferences that have been documented across the female lifespan.

The current experiment investigated the impact of pregnancy and the post-partum period on women's preferences for feminized versus masculinized versions of both same-sex and opposite-sex faces. If variation in testosterone or other ovarian hormones contributes to masculinity preferences, pregnancy and the post-partum period may reflect further life stages wherein women's preferences for this trait change. It is known that testosterone levels increase throughout pregnancy and then drop swiftly post-partum (e.g. Buckwalter et al., 1999; Leary, Boyne, Flett, Beilby, & James, 1991). Given the results of Welling et al. (2007), discussed above, this may suggest that women would exhibit decreased preference for masculinity post-partum relative to pregnancy. Moreover, Watkins (2012) showed that masculinity preferences relate to measures of reproductive interest or ambition, and, if this is the case, we might further expect pregnancy and the post-partum to be associated with lower masculinity preferences than those exhibited by non-pregnant women of reproductive age. Notably, regularly cycling women have been shown to prefer greater levels of masculinity than women who use hormonal contraception (e.g.

Jones et al., 2005; Little, Burriss, Petrie, Jones, & Roberts, 2013). Pre-existing differences between oral contraceptive users and regularly cycling women may result in divergent differences when these groups' preferences are compared to judgements made by pregnant and post-partum women. Thus, based on this previous research, we hypothesized that: (1) preferences for masculinity will be higher during pregnancy than post-partum; (2) preferences for masculinity during pregnancy and the post-partum period would differ from reports made by women using hormonal contraception or regularly cycling; (3) preferences for masculinity would be higher in regularly cycling women than those using hormonal contraception.

2. Methods

2.1. Participants

A total of 103 adult women took part in this research. Twenty-eight of these participants were pregnant women aged between 22 and 39 ($M = 30.89$, $SD = 5.17$). These participants were recruited from social networking sites for pregnant women and via announcements on the University of Stirling's online portal. Recruitment materials specified that we were looking for women who were currently pregnant and who would be willing to complete a questionnaire immediately and then again after the birth. This was critical to allow for a within-subjects assessment of variance in facial preferences. At the time of recruitment, participants were between weeks 13 and 31 of pregnancy ($M = 21.57$, $SD = 4.80$), the vast majority ($N = 26$) were in their second trimester. Seventeen women reported to be pregnant for the first time, while eleven reported that they had been pregnant previously.

The remaining 75 participants were nulliparous females recruited to serve as a control group of comparable age (range 22–42, $M = 29.88$, $SD = 5.01$). Our pregnant participants did not differ in age from our nulliparous control group ($t = .91$, $df = 101$, $p = .37$). Women in the control group were also recruited via the University of Stirling's online portal, but were simply asked to complete a single questionnaire at the time of recruitment. Of this sample of women, 42 were using hormonal contraception and 33 were regularly cycling. The study was administered over the Internet for both groups.

2.2. Procedure

At the time of recruitment, participants gave informed consent online, responded to a number of basic demographic questions, and provided information about their contraceptive use history. Pregnant participants also reported their stage of pregnancy (in weeks), and whether it was their first pregnancy or not.

Following these measures, twenty pairs of faces (10 male, 10 female), one masculine version and one feminine version, were presented (see below for more detail). Participants were asked to indicate which of the two faces was more attractive by clicking a button under the chosen face. We randomly presented the ten male and ten female face pairs in separate blocks, with the order of presentation of the images randomized. We also counterbalanced the side of presentation of the masculine vs feminine image. Note that our participants also completed a series of scales relating to sexual satisfaction which were not relevant to the aims of the current research.

Participants who indicated that they were pregnant at the time of recruitment also provided their contact details so that they could be re-contacted when we expected them to have given birth (based on reported stage of pregnancy) and would be approximately 12 weeks post-partum. On the post-partum questionnaire, we collected information about current contraceptive use or non-use, and confirmed the number of weeks post-partum each participant was ($M = 13.21$ weeks, $SD = 3.96$). Participants then recompleted the face pair rating task.

2.3. Stimuli

The facial stimuli were ten pairs of male, and ten pairs of female, composite facial images, one masculinized, one feminized. These composites were constructed from a set of 100 (50 male) facial photographs of individuals with a neutral expression, which were taken under standardized lighting conditions. Specifically, an average image comprising five randomly selected individual faces (of the same gender) was generated. This average face was then transformed on a sexual dimorphism dimension using linear differences between a composite of the 50 male faces and the 50 female faces, with transforms representing 50%± the difference between the two composites. This technique has been used in previous research (Benson & Perrett, 1992; Little, Cohen, Jones, & Belsky, 2006; Little et al., 2007; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999) and benefits from the fact that composite faces represent the average trait of the faces within them, meaning that there is a reduction in idiosyncratic differences between faces. The 20 image pairs were presented together in a random order.

3. Results

3.1. Preferences for male faces

We first computed the mean masculinity preference scores for the ten male and female face pairs for participants when pregnant and in the post-partum period. We coded the selection of the feminine face in each pair as ‘zero’ and the selection of the masculine face as ‘one’. Thus, participants were assigned an overall score ranging from zero to ten, with higher scores indicating a greater preference for masculine faces. We similarly calculated the masculinity preferences among our group of nulliparous participants. Paired *t*-tests indicated that women preferred higher rates of masculinity in male faces than in female faces, a difference which was significant both when participants were pregnant ($t = 4.67$, $df = 25$, $p < .001$) and in the post-partum phase ($t = 2.63$, $df = 25$, $p = .015$). Note that the sample for these analyses was somewhat reduced since there was missing data from 2 women’s judgments of the female faces. This difference was also noted among our control sample of nulliparous women who were regularly cycling ($t = 4.27$, $df = 32$, $p < .001$) and among those who were using hormonal contraception ($t = 9.88$, $df = 41$, $p < .001$). Non-parametric tests of these differences revealed similar and significant effects.

To test the impact of transitioning from pregnancy to the post-partum period on masculinity preferences, we conducted a linear-mixed model with reproductive state (pregnancy or post-partum) as the within-participant fixed factor and masculinity preference score obtained from the male faces as the dependent variable. The results of this test indicated a significant main effect of measurement time ($F = 7.63$, $p = .01$). Participants indicated a greater preference for masculine male faces during pregnancy ($M = 6.15$, $S.E. = .49$) relative to the post-partum phase ($M = 4.89$, $S.E. = .49$) (Fig. 1). We then tested the main effect of participant age by adding this variable as a covariate to the model. Age did not have a significant main effect ($F = .001$, $p = .98$) on the model, and the main effect of reproductive state remained significant ($F = 7.61$, $p = .01$). Since previous research indicates differences in masculinity preferences related to use of hormonal contraception (e.g. Jones et al., 2005; Little, Burriss, Petrie, Jones, & Roberts, 2013), we then re-ran this analysis adding whether or not the participant had begun to use hormonal contraception since the birth (yes/no, $N = 9$ had begun hormonal contraception) as a further fixed factor. In this model, the main effect of measurement time remained significant ($F = 7.01$, $p = .01$) and there was a main effect of contraceptive use in the post-partum phase ($F = 8.55$, $p = .01$), with women who used hormonal

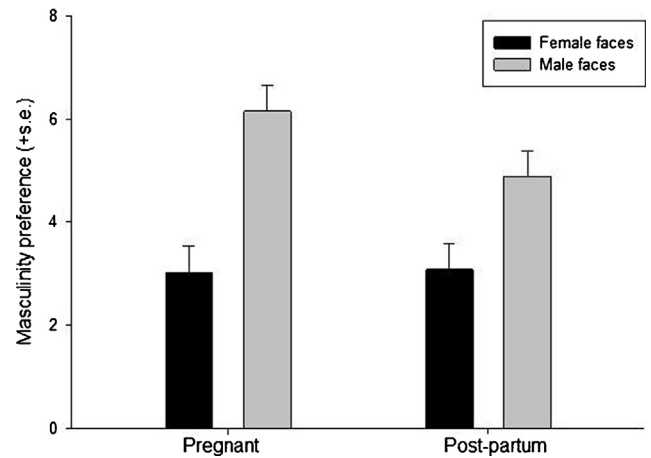


Fig. 1. Mean (+S.E.) masculinity preference scores for assessments of male faces. Participants preferred significantly higher levels of masculinity in male faces when pregnant, compared to the post-partum period.

contraception preferring higher levels of masculinity. However, the interaction between measurement time and contraceptive use was non-significant ($F = .44$, $p = .51$). Thus, irrespective of use or non-use of hormonal contraception in the post-partum phase, women preferred lower levels of masculinity in male faces at this time relative to pregnancy.

We then examined how male facial masculinity preferences during pregnancy and post-partum compared to preferences reported by our nulliparous control sample. Since some women in our nulliparous group were using hormonal contraception, we compared regularly cycling and hormonal contraceptive using women as distinct control groups. When pregnant, our participants gave scores that fell between those given by regularly cycling and contraceptive using control participants, but were not significantly different from either (Mean difference = 1.14, $S.E. = .74$, $p = .13$; Mean difference = $-.69$, $S.E. = .70$, $p = .33$). In contrast to previous work, women using hormonal contraceptives preferred higher levels of masculinity in male faces than women who were regularly cycling (mean difference = 1.83, $S.E. = .67$, $p < .01$). Women’s post-partum scores were significantly lower than those given by women who used hormonal contraception (mean difference = -1.94 , $S.E. = .70$, $p < .01$), but did not differ from women who were regularly cycling (mean difference = $-.11$, $S.E. = .74$, $p = .89$) (Fig. 2a).

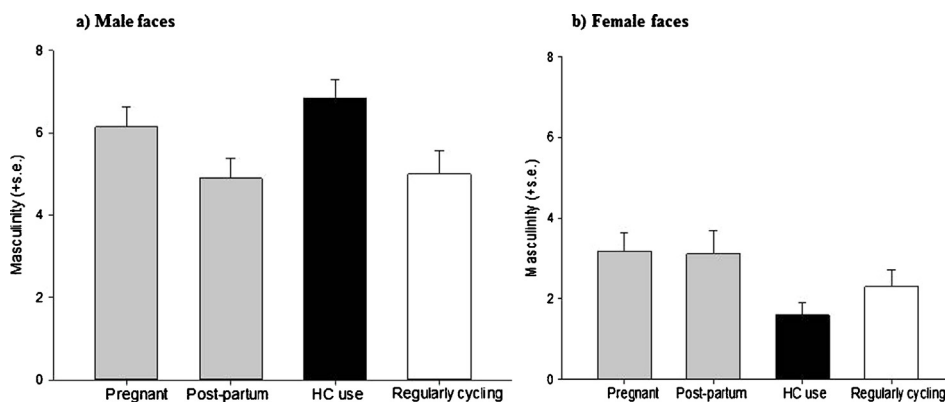


Fig. 2. Masculinity preference scores for assessments of (a) male faces and (b) female faces. Shading reflects distinct groups of participants; note that the grey bars are repeated measures from the same individuals. In assessing male faces, women using hormonal contraception showed a greater preference for masculinity than regularly cycling women or women in the post-partum. In assessing female faces, women using hormonal contraception and women who were regularly cycling showed a lower preference for masculinity than pregnant and post-partum women.

3.2. Judgments of female faces

Next, we re-ran the same tests described above, this time testing changes in preferences for masculinity in women's faces. The results of the linear-mixed model testing within-person shifts in masculinity preference from pregnancy to the post-partum phase indicated that there was no significant effect of measurement time on masculinity judgement ($F = .009, p = .92$). When participant age was added as covariate to the model it remained non-significant ($F = .01, p = .92$) and age did not have a main effect ($F = .46, p = .50$). Moreover, when we split the model based on women's hormonal contraceptive use status in the post-partum phase, the models were non-significant (non-users: $F = 1.05, p = .35$, Hormonal contraceptive users: $F = .87, p = .36$). Taken together, these results suggest that between-individual judgements of masculinity in female faces do not vary significantly across the transition from pregnancy to the post-partum (Fig. 1).

When we examined how pregnant and post-partum attractiveness judgements for masculinity in female faces differed from our control group of nulliparous women's scores, we found that pregnant women judged higher levels of masculinity as more attractive than women who were using hormonal contraception (mean difference = 1.60, S.E. = .59, $p < .01$). The difference between our pregnant participants judgements and that of the regularly cycling control group was non-significant (mean difference = .89, S.E. = .63, $p = .16$). Similarly, post-partum scores were significantly higher than scores given by hormonal contraceptive users (mean difference = 1.52, S.E. = .60, $p = .01$), but did not differ from women who were regularly cycling (mean difference = .81, S.E. = .63, $p = .20$). There was no difference in preferences between our control group of nulliparous women using hormonal contraception and nulliparous regularly cycling women (mean difference = $-.71$, S.E. = .55, $p = .20$) (See Fig. 2b).

4. Discussion

The current study demonstrated a prospective shift in preference for masculinity in male faces from pregnancy to the post-partum phase measured within-subjects. Specifically, participants preferred relatively less masculine male faces in the weeks following birth compared to while they were pregnant. This finding is consistent with the idea that masculinity preferences for male faces are higher when testosterone levels are higher (Welling et al., 2007). In contrast, preferences for masculinity in female faces were unchanged between the two measurement times. That shifts in preferences for masculinity are specific to judgments of male faces appears to suggest that effects of hormonal variation between the two measurement times impacts partner preferences specifically, rather than reflecting changes in general face preferences. When one considers the high demands associated with rearing newborns (e.g. Clutton-Brock, 1991), reduced attraction to mating relevant cues in the post-partum phase may be considered as an adaptive means to promote maternal investment. Moreover, femininity in male faces reflects cues to pro-social behaviour (Watkins, DeBruine, Little, & Jones, 2012), suggesting it may additionally be adaptive for women with young infants, a time when investment is important, to prefer men displaying lower levels of masculinity since this may suggest they are likely to be more investing.

Our participants' masculinity judgements when pregnant and in the post-partum phase were also compared with a control sample of nulliparous women's judgments. We found that when judging male faces, women in the post-partum period preferred lower levels of masculinity than our hormonal contraceptive group. However, the reverse occurred when these same women judged the attractiveness of female faces: our post-partum group preferred

significantly higher levels of masculinity in female faces than our hormonal contraceptive using group. This result appears to suggest that endocrine changes associated with the post-partum phase influence facial masculinity preferences distinctly for the assessments of male and female stimuli. Again, this finding may suggest that indicators of male quality, or cues to rival females in the environment, are less salient or desired given the demands associated with motherhood.

Finally, our results indicated that women who were using hormonal contraception preferred greater levels of masculinity in male faces compared to women who were regularly cycling, but this difference was not evident for judgments of female faces. This finding is in contrast to previous work on this topic; however, it should be noted that the between-subjects comparison used herein is not as powerful as the existing within-person tests showing the opposite outcome (Little et al., 2013). One factor which may also contribute to our conflicting result is that we did not account for the cycle phase among our regularly cycling women. Moreover, our participants that were taking hormonal contraception were not necessarily using the same formulation, giving rise to the possibility that different formulations have different effects, or effects of differing magnitude (e.g. Cobey, Pollet, Roberts, & Buunk, 2011; Welling, Puts, Roberts, Little, & Burriss, 2012), which could complicate the comparison made. Naturally, it is also possible that differences in masculinity preferences observed between users and non-users are the product of baseline differences (e.g. in reproductive ambition or relationship status) between the groups which were not measured here. Indeed, previous research by Watkins (2012) indicates that partnered women's reproductive ambition predicts their masculinity preference in male faces. Nonetheless, if users and non-users of contraception do differ in their preferences, one implication of this is that if a woman's current contraceptive use does not match use at the initiation of one's relationship, women may be relatively less attracted to their partner since their partner preferences are subtly altered (Roberts et al., 2014; Roberts, Cobey, Klapilová, & Havlíček, 2013).

Previous research suggests that the transition to parenthood is associated with a decrease in baseline testosterone levels (Berg & Wynne-Edwards, 2001; Gettler, McDade, Feranil, & Kuzawa, 2011; Kuzawa, Gettler, Huang, & McDade, 2010). Although this finding may be less robust in women than men (e.g. Pollet, Cobey, & van der Meij, 2013), it raises the possibility that physiological changes associated with investment in children, rather than physiological changes associated with the post-partum transition itself, could be the mechanism influencing women's masculinity judgements. Furthermore, it raises the intriguing possibility that changes in judgements of masculinity may occur in women's male partners during their transition to fatherhood. Future work which includes women's male partners and considers how men's judgments alter during this time would be of interest: if similar changes occur in men's judgments of women's faces, this would lend support to our interpretation that the changes we report here may be associated with parental investment, underpinned by shifts in levels of testosterone, or other hormones such as prolactin, oestrogen or progesterone.

An important point of discussion to consider is that there is a great deal of individual variation in masculinity preferences. Notably, while preferences for masculinity in male faces were higher in pregnancy than post-partum, pregnant women did not display a particularly strong overall masculinity preference. This is in line with previous research suggesting that, while women tend to prefer masculinity in male partners in some studies, preferences for masculinity varies between studies (DeBruine et al., 2010; Feinberg, DeBruine, Jones, & Little, 2008).

The current study adds to the literature by documenting additional relevant phases of hormonal transition across the female

lifespan, namely pregnancy and the post-partum phase, that influence women's facial judgements. This work benefited from the use of a within-subjects design to test the impact of transitioning from pregnancy to the post-partum phase, and the consideration of these preferences relative to two control groups. Furthermore, the use of both male and female facial stimuli allows for conclusions to be drawn with respect to the specificity versus generality of the finding (i.e. is it a mating-relevant shift or a general shift in face preference?). As noted, one limitation of the current work is that we did not account for the cycle stage of our nulliparous control group of regularly cycling women. However, given that we detected significant differences between groups in our comparisons of pregnant women, post-partum women, and the control groups, more subtle within-individual variation may be less relevant. It is also worth acknowledging that the control groups in our study, namely those women who were regularly cycling or using hormonal contraception, completed the facial rating task on just one occasion. In contrast, our experimental group completed the task twice: once during pregnancy and then again during the post-partum phase. While we feel it is unlikely, it is possible that there is a design confound in that we did not conduct a second measure among our control participants, and we were unable to randomize the order of the two naturally occurring phases in our experimental group. Furthermore, since previous work has shown that a woman's combined oral contraceptive pill dosage can also impact mating psychology (Cobey et al., 2011; Welling et al., 2012), future work could also consider preferences of women on different types and formulations of hormonal contraception. Examining the hormone, or group of hormones, responsible for the shifts documented here will certainly be a fruitful area for further research. Testosterone appears to be an obvious hormonal candidate (Welling et al., 2007); however, other hormones that are known to change post-partum (e.g., oestrogen, progesterone, prolactin, oxytocin), or interactions of these hormones, should also be incorporated in future studies.

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