Female preference for male faces changes cyclically: Further evidence

I.S. Penton-Voak, Ph.D.*, D.I. Perrett, Ph.D.

School of Psychology, University of St. Andrews, Fife, Scotland, United Kingdom

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Abstract

Research has failed to reach consensus on the characteristics of attractive male faces. Different studies have reported preferences for phenotypically average faces, and faces with both exaggerated and reduced sexual dimorphism. Recent studies demonstrate cyclic changes in female sexual behavior and preferences for odors and facial characteristics that may reflect conditional mating strategies. We employed computer graphic techniques to manipulate the “masculinity” or “femininity” of a composite male face by exaggerating or reducing the shape differences between female and male average faces. Five stimuli with varying levels of masculinity and femininity were presented in a national U.K. magazine, with a questionnaire. Female respondents in the follicular phase of their menstrual cycle \( n = 55 \) were significantly more likely to choose a masculine face than those in menses and luteal phases \( n = 84 \). This study provides further evidence that when conception is most likely, females prefer testosterone-related facial characteristics that may honestly advertise immunocompetence. © 2000 Elsevier Science Inc. All rights reserved.

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Male face shape may provide information on an individual’s hormonal status. Testosterone levels at puberty are thought to be linked to the amount of growth of male secondary sexual facial characteristics: brow ridges, jaw, lower face, and cheekbones (Thornhill and Gangestad, 1996, in press). Such features have been hypothesized to be attractive in male faces, as they may honestly advertise quality through the immunocompetence handicap (Folstad and Karter, 1992; Thornhill and Gangestad, 1996). Only individuals in good condition can bear the cost of exaggerated secondary sexual characteristics. Less fit individuals cannot develop such traits without disrupting developmental stability, a consequence manifested in fluctuating asymmetries (random variations from perfect symmetry) of bilateral traits (Møller and Thornhill, 1998). Preferences for exaggerated male characteristics have been noted in both avian and mammalian species (for review, see Andersson, 1994).

* Corresponding author. Tel: 01334 463058; Fax: 1334 463042; E-mail: ip@st-and.ac.uk.
In men, however, the evidence that such traits are attractive is equivocal. Scheib et al. (1999) found a positive relationship between attractiveness and two markers of facial masculinity (cheekbone prominence and jaw size). Cunningham et al. (1990) and Grammer and Thornhill (1994) used facial-metric measurements and found a female preference for large jaws in males. “Masculine” features, such as a large jaw and a prominent brow ridge, are reliably associated with ratings of dominance in photographic, indenti-kit, and composite stimuli (Berry and Brownlow, 1989; Berry and Wero, 1993; McArthur and Apatow, 1983–1984; McArthur and Berry, 1987; Perrett et al., 1998). Facial dominance appears to correlate with status in some human hierarchies (Mueller and Mazur, 1997), and facial dominance in adolescent males is associated with earlier age at first copulation (Mazur et al., 1994). Nonetheless, the relationship between facial dominance and attractiveness is unclear: some studies find a positive relationship (Keating, 1985) while others find the opposite (Berry and McArthur, 1985; McArthur and Apatow, 1983–1984; Perrett et al., 1998). The “multiple motives” model of male attractiveness suggests that optimally attractive male faces may have combinations of mature (or dominant) features and neotonous (or expressive) features (Cunningham et al., 1990).

Recent work on male facial attractiveness has manipulated the size of male facial characteristics in a holistic manner using computerized caricaturing techniques detailed in the following and elsewhere (Benson and Perrett, 1991; Perrett et al., 1994, 1998; Rowland and Perrett, 1995). To “masculinize” or “feminize” faces, the shape differences between average male and average female faces are exaggerated or reduced, using a male face shape as the starting point. For example, as female jaws are smaller than male jaws, a “feminized” male will have a smaller jaw than the average male, whereas a “masculinized” male face will have a larger jaw. Working from the assumption that female/male facial differences represent low/high androgen differences, this “feminization” or “masculinization” of an average male face should mimic the effects that raised or lowered testosterone levels would have during development (Perrett and Penton-Voak, 1999). Such stimuli are useful for testing whether female preferences for male traits are similar to widely reported patterns in other species (i.e., preferences for exaggerated male traits).

Studies using this computer graphic technique indicate that “feminized” male face shapes are preferred by university students in the U.K. and Japan (Perrett et al., 1998). This somewhat unexpected result is contrary to predictions from both “good genes” and “runaway” theories of sexual selection. These “feminized” face shapes, however, receive positive personality attributions (e.g., cooperative, honest, and good parent) that may be correlated with actual behavior. These preferences may be adaptive in humans. Such a correlation between facial characteristics and behavior may arise through behavioral confirmation processes, in which others’ stereotypical expectations (based, in this case, on facial appearance) may influence the face owner’s behavior (Berry and Brownlow, 1989; Berry and Wero, 1993). An alternative explanation is a hypothetical biological association between low testosterone, “feminine” features, and pro-social behavior (e.g., cooperation). Males with high testosterone report higher rates of marital instability, divorce, and domestic violence (Mazur and Booth, 1998). High testosterone also is thought to be associated with male facial growth, especially in the lower face and brow ridges. Masculine faces are associated with attributions of dominance (Keating, 1985; Perrett et al., 1998), and certain personality attributions made to pho-
tographed faces are thought to have limited accuracy (Borkenau and Liebler, 1992). In light of these findings, Perrett et al. (1998) argued that benefits of biparental care in humans may have led to preferences for faces that suggest likely investment in future offspring, rather than traditional markers of “good genes” (i.e., exaggerated male traits).

Accumulating evidence suggests that some aspects of female sexual preference and behavior change across the menstrual cycle with the probability of conception. Fitness benefits to offspring can only be realized if conception follows copulation, so females may be more attentive to phenotypic markers indicating “good genes” during the follicular phase of the menstrual cycle when conception is most likely (days 6–14; Baker and Bellis, 1995; Gangestad and Thornhill, 1998; Regan, 1996; Thornhill and Gangestad, 1999). Several studies report an increase in female sexual interest around ovulation, although many women experience peaks of sexual desire at other times (for review, see Regan, 1996). There seems to be no species-typical pattern of human female sexual behavior, which appears to be as influenced by social factors as much as by hormonal variables. Nonetheless, Baker and Bellis (1995) report that self-reported rates of extra-pair copulation peak around ovulation. Females prefer men with low levels of fluctuating asymmetry as extrapair copulation partners, supporting the idea that females act on preferences for men who demonstrate developmental stability (i.e., “high-quality” males) more at ovulation than at other times in the cycle (Thornhill and Gangestad, 1994). Female preferences for odor seem to have a cyclic component, with females being more responsive to males in general at ovulation: the odor of androstenone (a putative male pheromone) becomes more acceptable to females at midcycle (Grammer, 1993). Women also may make discriminations of male “quality” in the follicular phase of the menstrual cycle that they do not make at other times: females prefer the scent of males with low fluctuating asymmetry in this “high conception risk” phase, but not outside it (Gangestad and Thornhill, 1998; Rikowski and Grammer, 1999; Thornhill and Gangestad, 1999).

In the visual modality, females prefer darker photographs of male faces around ovulation (Frost, 1994). Skin color is sexually dimorphic within all races, with males having darker skin than females. A preference for darker skin at ovulation could be considered a preference for exaggeration of a male trait.

In two experiments using composite stimuli that had been “masculinized” and “feminized,” female university students in Japan and the U.K. showed an overall preference for slightly “feminized” male face shapes in a variety of mate choice contexts (e.g., short- or long-term relationships; Penton-Voak et al., 1999). In the follicular phase of the menstrual cycle, however, we hypothesized that preferences may shift somewhat toward more masculine stimuli. Facial masculinity may correlate with symmetry, as large secondary sexual traits have less fluctuating asymmetry than smaller traits in some birds, and possibly in humans (Möller and Hoglund, 1991; Scheib et al., 1999; Thornhill and Gangestad, 1996). A preference for more masculine face shapes when conception is most likely would be consistent with findings of cyclic preferences for the odor of symmetric men.

Cyclic shifts in preferences for male face shapes may be influenced by the context of relationship sought by a woman. In a sample of U.K. undergraduates, women choosing male face shapes suitable for a “long-term partner” showed no cyclic change in preferences; women asked to select male face shapes for a “short-term sexual partner,” however, did show cyclic shifts in preferences (Penton-Voak et al., 1999). Furthermore, in a sample of female Japanese
undergraduates, trends indicated that women who had partners showed a larger shift toward preferring masculinity at times of high conception risk and preferred more masculine faces overall than women without partners (Penton-Voak et al., 1999).

These shifting preferences for male face shapes may reflect complex, context-specific mate choice strategies of women. In situations when likely paternal investment is low and conception risk is high (short-term relationships or possibly extra-pair copulations during the follicular phase of the menstrual cycle), relatively masculine face shapes are preferred, possibly to obtain heritable genetic benefits in offspring suggested by facial testosterone markers. At other times, faces indicating lower testosterone are preferred, perhaps because they are indicative of pro-social personality traits that are associated with paternal investment (Penton-Voak et al., 1999; Perrett et al., 1998). This finding adds a temporal dimension to “multiple motives” theories of facial attractiveness (Cunningham et al., 1990): faces indicating different qualities (i.e., dominance or warmth) may vary in attractiveness across the menstrual cycle with chance of conception.

Much previous facial attractiveness research has concentrated on university undergraduate populations. The current study investigates the presence of cyclic shifts in response to male face shapes in a self-selected, nonundergraduate population, through a questionnaire published in Tomorrow’s World magazine (a monthly general interest science title published by the BBC). Replication with a more diverse subject group is desirable and would demonstrate a robust finding.

1. Methods

1.1. Stimuli

Forty female and 21 male second-year undergraduate students (mean age 20 years) were photographed on 35-mm film (Fuji Provia, 200 ASA). All individuals photographed were Caucasian. Sitters were asked to remove facial jewelry (ear and nose rings) and to push their hair back from their foreheads, using bands provided if necessary. Subjects sat on a stool facing the camera 2 meters from the tripod in front of a blue background. The height of the stool was adjusted so that the sitter could see his or her own eyes in a narrow mirror mounted directly above the camera lens, without looking up or down. This ensured that the direction of gaze and angle of head were equivalent for all individuals photographed. Subjects were asked to assume a neutral expression with a closed mouth and open eyes; two shots of each individual were taken. Diffused lighting from two flashguns was used to prevent shadows falling on the sitter’s face.

The films were developed and transferred to Kodak photo-CD for easy conversion to computer format. Kodak gray cards were used to ensure standardized hue, lightness, and saturation between films during developing.

The “best” of two images (in terms of neutrality of expression and head position) of each individual photographed was selected and converted to computer format at cd scale 4 (1024 × 1536 pixels). These images were delineated by marking 174 feature points on the image indicating the position of eyes, mouth, etc. (Fig. 1A). The choice of these points has been described previously (Benson and Perrett, 1991; Rowland and Perrett, 1995). The delineation software ran on a Silicon Graphics Maximum Impact workstation with 24-bit color.
Fig. 1. (Top panel) Male and female composites constructed from 21 males and 40 females. The delineation points used to calculate male/female shape differences are marked on the female face. (Bottom panel) The 50% feminized and 50% masculinized composite images, constructed from 21 Caucasian males, mean age 20 years.
To create an “average” male face, the mean XY position of each delineated feature point was calculated to generate shape information. “Average” color was generated by rendering color information from each individual into this average shape, and calculating mean red-green-blue (RGB) color values across the face set for each pixel location. To avoid possible confounding effects of facial hair on color information, males with beards were not photographed for use in the construction of the male average. Male and female averages, and the delineation points, are shown in Fig. 1A.

To generate male faces with exaggerated or reduced levels of shape dimorphism, male and female averages were aligned on a point midway along a horizontal line between the eyes of both prototypes. To construct “feminized” male face shapes, each feature point on the male face was moved a prescribed distance along a vector toward its correspondent point on the aligned female average. Two feminized male face shapes were generated (representing 30% and 50% of the vector differences between male and female face shapes). Two “masculinized” face shapes were constructed by exaggerating the vector differences between points on the male and female averages by 30% and 50%. Identical color information from the average face then was warped into the feminized and masculinized faces. Manipulating male-female differences exaggerates differences in hairstyle (e.g., feminizing increases hair length). This sexual dimorphism reflects fashion more than anatomy, so stimuli were masked around the outline of the face to prevent such cues influencing attractiveness judgments (Fig. 1B).

1.2. Subjects and procedures

The five stimuli (50% and 30% masculinized; the average; and 50% and 30% feminized) were printed in full color in the Tomorrow's World magazine. A short accompanying questionnaire asked respondents which of the five stimuli they considered “most attractive” and requested details of age, oral contraception use, pregnancy, and number of days since the onset of previous menses. Subjects returned the questionnaire to a freepost (prepaid postage) address. Subjects who failed to complete details of their menstrual cycle or who reported more than 28 days since the beginning of their last cycle were excluded from the analysis, leaving 178 completed questionnaires.

As cyclic odor preferences have not been found in women using oral contraception, women reporting pill use were excluded from the initial analysis \( (n = 39) \). Following Gangestad and Thornhill (1998), a standard 28-day model of the female menstrual cycle was used to assign the 139 remaining female respondents (mean age 30.7 years, range 14–50) to one of two groups based on their chance of conception. This was estimated from the number of days since the onset of the participants’ last menses: “high conception risk” (the follicular phase, days 6–14) or “low conception risk” (days 0–5 and 15–28, menses and the luteal phase; Baker and Bellis, 1995; Regan, 1996).

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1Three women reported more than 28 days since the onset of last menses. One of these (65 days) was excluded due to the possibility of pregnancy or ovarian dysfunction. Two others (31 and 35 days, respectively) were excluded due to the possibility of misclassification. Including these subjects as “low risk” had no effect on the pattern of results or their statistical significance.
2. Results

Figure 2 shows the percentage of subjects who selected each face in the low and high conception risk groups. Responses in the high \((n = 55)\) and low \((n = 84)\) conception risk groups were not normally distributed (one-sample Kolmogorov-Smirnov \(Z = 2.10\) and \(2.07\), respectively; \(p < .001\) in both cases), so nonparametric tests were used in all analyses. A Chi-square test demonstrated that the high conception risk group were not selecting faces at random \((\chi^2 = 11.45, 4 df, p = .022)\). Inspection of Fig. 2 shows a clear preference for 30% masculinized faces in this group. Despite the apparent preference for 30% feminized faces shown in Fig. 2, the low risk group showed no significant preference for any of the five stimuli \((\chi^2 = 3.024, 4 df, NS)\).

A Mann-Whitney test indicated that women in the high conception risk group were significantly more likely to choose a masculine face than those in the low conception risk group \((U = 1798, Z = -2.255, p = .024, \text{Fig. 2})\). This indicates a cyclic preference for male face shape. If subjects responded with equal likelihood across the menstrual cycle, we would expect approximately 45 in the “high risk” group and 94 in the “low risk” group from the number of cycle days represented by each group. The “high risk” group, with 55 members, was slightly but not significantly overrepresented \((\chi^2 = 3.513, 1 df, p = .061)\).

A separate analysis of subjects using oral contraception \((n = 39)\), using the same time periods for classification, did not reveal a cyclic preference \((U = 127, Z = -1.28, NS)\) although sample size was low \((\text{days 6–14}, n = 13; \text{days 1–5 and 15–28}, n = 26)\). Participant age had no significant correlation with attractiveness judgments for either the pill and nonpill groups combined, \((r_{rho} = .043, n = 179, NS)\) or the separate nonpill groups (high risk, \(r_{rho} = .004, n = 55, NS\); low risk \(r_{rho} = 0.063, n = 84, NS)\).

3. Discussion

These data provide further evidence that women are attracted to relatively exaggerated male traits when conception following coitus is most likely \((\text{days 6–14 of the follicular...})\).
phase) and not at other times of the menstrual cycle. The absence of a marked preference for any of the faces in the low conception risk group (menses and luteal phases) is consistent with the finding by Gangestad and Thornhill (1998) finding that women discriminate between the scent of symmetric and less symmetric men during the follicular phase, but not at other times.

Despite the apparent preference for feminized faces shown in Fig. 2, no significant overall preference for “feminized” male faces was found in this study, contrary to previous work (Perrett et al., 1998; Penton-Voak et al., 1999). There are several possible reasons for this failure to replicate. Although the difference just failed to reach significance, more subjects responded in the follicular phase than would be expected by chance. Women may have been more likely to respond to a study on male attractiveness in the follicular phase than other phases due to an increase in sexual interest, or possibly because it is easier to remember the date of onset of the previous menses when the event is relatively recent. As women who were in the “high risk” group were more likely to prefer a masculinized face, the overall preference would be shifted slightly toward masculinity due to this over-representation. Second, unlike previous studies reported by Perrett et al. (1994, 1998), the age of the participants was not linked to the age of the faces that comprised the composite. As “masculinized” faces are rated as older than “feminized” faces (Perrett et al., 1998), the older women in the current sample may have been slightly biased toward masculinity. This was not apparent from the data: age did not correlate with the masculinity of faces chosen. Finally, the average face employed in this study was constructed from different source faces than the faces reported in the Perrett et al. (1998) study.

Although levels of absolute masculinity/femininity preferred in this study do not directly replicate the levels found in previous studies, the pattern of responses replicates the findings of Penton-Voak et al (1999). In fact, the shift toward masculinity in this study is greater than that reported previously. If the shifts in preferences reflect cyclic hormonal changes, the lower incidence of anovulatory cycles in the slightly older sample employed in this study (mean age 30.7 years) may be related to the larger observed shifts (Baker, 1997).

Some methodological points suggest caution before drawing firm conclusions from these data. First, the task of the participants in this experiment (to judge which of the five faces is “most attractive”) may be a little ambiguous and could possibly be interpreted in a variety of different ways (e.g., attractive for a short-term partner, or attractive for a long-term partner). Our earlier work shows that such manipulations can influence attractiveness judgments, with larger cyclic preference changes taking place in subjects asked to select short-term partners (Penton-Voak et al., 1999). Nonetheless, a cyclic shift is still present in the data. Varying interpretations of the question might introduce “noise” that might mask an effect, but would seem unlikely to generate a false-positive result. Additionally, the reliability of self-reports of menstrual cycle phase is disputed (Bean et al., 1979, but see Baker et al., 1998), and many normally cycling women do not have a 28-day cycle. A study employing hormonal assays to ascertain cycle phase would be an improvement over this study, but it is difficult to see how our methodology could introduce a systematic bias to the results rather than noise. In addition, self-selected questionnaire respondents may not be representative of the population at large, although it seems unlikely that this alone could account for the findings. Cyclic preferences are demonstrated in the current experiment using a questionnaire methodology, as well as in laboratory based, within-subjects experiments (Penton-Voak et al., 1999), indicating that the findings are robust.
In summary, we found more evidence for cyclic changes in preferences for male face shapes, indicating that women exhibit preferences for biologically relevant aspects of facial structure that may signal heritable genetic characteristics when conception is likely. The results are consistent with a growing body of research indicating other cyclic preferences relevant to mate choice. Menstrual phase may be one variable that contributes to the difficulty of defining what females find attractive in male faces. Female sexual interest has a peak at ovulation, and preferences for men honestly advertising immunocompetence as short-term consorts or extra-pair partners may be adaptive at this time. The current study adds to data from previous experiments suggesting that cyclic preferences reflect conditional mate choice strategies (Gangestad and Thornhill, 1998; Penton-Voak et al., 1999; Rikowski and Grammer, 1999; Thornhill and Gangestad, 1999). Depending on likely future investment and current reproductive status, women may “trade off” advantages of heritable genetic quality in offspring against direct phenotypic benefits (paternal investment) when choosing sexual partners.

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