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Does sexual dimorphism in human faces signal health?

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Evolutionary psychologists suggest that a preference for sexually dimorphic traits in human faces is an adaptation for mate choice, because such traits reflect health during development. For male faces, this claim rests on the immunocompetence-handicap hypothesis, which states that the increased testosterone levels needed to develop large masculine traits stress the immune system. We examined whether masculine traits in adolescent male faces are associated with health during development, and also whether feminine traits in adolescent female faces signal health. Feminine traits are attractive, but it is less clear whether they should signal health. Rated masculinity in adolescent male faces correlated modestly with actual health, and was perceived as healthy, but not as attractive. Rated femininity in adolescent female faces did not correlate with actual health, although it was perceived as healthy and attractive. These results support the immunocompetence-handicap hypothesis for male faces in that masculine traits signalled health during adolescence. However, they suggest that any health-related evolutionary benefits obtained from preferences for attractive facial traits may be weak.

Keywords: sexual dimorphism; facial attractiveness; immunocompetence-handicap hypothesis

1. INTRODUCTION

Evolutionary psychologists propose that a preference for sexually dimorphic traits is an adaptation for finding healthy mates (Thornhill & Gangestad 1999; Fink & Penton-Voak 2002). Feminine traits are attractive in female faces and masculine traits can be attractive in male faces, particularly at the fertile point of the menstrual cycle (for a review, see Zebrowitz & Rhodes 2002). These traits have the potential to act as signals of health. Testosterone enables the development of secondary sexual traits in males, but suppresses the immune system (Grossman 1985; Alexander & Stimson 1988; Zuk *et al.* 1995; Peters 2000; but see Braude *et al.* 1999), making males more susceptible to parasitic infections than females (Folstad *et al.* 1989; Poulin 1996). In humans, testosterone may be linked to prostate cancer (Shaneyfelt *et al.* 2000). According to the immunocompetence-handicap hypothesis of Folstad & Karter (1992), the expression of secondary sexual traits reliably signals a male's health because only individuals in good health can withstand the immunosuppressive costs of trait expression. Where good health has a genetic basis, females could enhance the future health of their offspring by choosing males with exaggerated secondary sexual traits. Support for the immunocompetence-handicap hypothesis comes from many non-human animal studies that show a positive association between immunocompetence and secondary sexual trait expression (Møller *et al.* 1999).

The immunocompetence-handicap hypothesis was originally proposed for males. It is less clear whether feminine facial traits would signal health. First, the relationship between oestrogen and immunocompetence seems weaker than between testosterone and immunocompetence. In humans, oestrogen is linked to breast, endometrial and ovarian cancers (Service 1998) and long-term oestrogen replacement therapy increases the risk of these cancers (Zeil & Finkle 1975; Colditz *et al.* 1995; Rodriguez *et al.* 2001). Nevertheless, animal studies suggest that while suppressing cell-mediated immunity, oestrogen may enhance humoral immunity (Alexander & Stimson 1988). Second, feminine facial traits differ less from immature traits than do male traits, making them less costly to produce. Therefore feminine traits may be poorer signals of health than masculine traits.

The immunocompetence-handicap hypothesis predicts that the expression of secondary sexual traits should be negatively associated with parasite burden, because individuals with good heritable resistance to parasites can afford the immunosuppressive costs of secondary sexual trait expression. Recently, however, Getty (2002) pointed out that honest signalling theory can equally accommodate a positive relationship between parasite burden and secondary sexual trait expression if higher-quality individuals can tolerate more parasites (or poorer health) with less impact on their viability. Fifty-two per cent of published studies on non-human animals report positive associations between parasite burdens and secondary sexual trait expression (Møller *et al.* 1999). Currently, there is no general prediction for the relationship between health and trait expression (Getty 2002). This relationship will have to be determined empirically.

We investigated the relationship between health and sexual dimorphism in human faces. We asked whether masculine traits in male faces signal health, as the immunocompetence-handicap hypothesis predicts, and whether these traits are attractive. We also investigated whether feminine facial traits signal health, and whether they are attractive.

2. METHODS

Black and white, front-view photographs (12.5 cm × 10 cm) of 154 male and 156 female faces (used by Kalick *et al.* (1998) and Rhodes *et al.* (2001)) were taken from the Intergenerational Studies Archive, held at the Institute of Human Development, University of California, Berkeley, CA, USA. These individuals were born between 1920 and 1929 in California. A grey oval mask was placed over each face to minimize the influence of hairstyles on masculinity and femininity ratings.

Thirty-seven students (19 male, 18 female, aged from 17 to 40 years, mean of 22.3 years) from the University of Western Australia rated male faces for masculinity and female faces for femininity (seven-point scales). We used ratings because humans can make fine discriminations between faces, and because measurements of facial sexual dimorphism made on photographs appear to lack validity. For example, measurements of masculinity in various studies show inconsistent associations with symmetry (Scheib *et al.* 1999; Penton-Voak *et al.* 2001).

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Table 1. Pearson product-moment correlations of masculinity (male faces) and femininity (female faces) with actual health, perceived health and attractiveness.
(Partial correlations controlling attractiveness are shown in parentheses. For female faces, all correlations also control for the presence of artificially enhanced feminine traits, as assessed by two independent judges (plucked eyebrows, 81% agreement; lipstick, 86% agreement).)

rating	*n*	actual health	perceived health	attractiveness
masculinity	154	0.17* (0.17*)	0.37*** (0.40***)	0.11
femininity	156	−0.01 (0.08)	0.50*** (0.26**)	0.53***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Faces were presented individually on a computer screen and remained visible until a rating was made using keyboard number keys 1–7. Faces were presented in random order, but blocked by sex. Order of sex was counterbalanced across participants. One female rater was dropped because her ratings correlated negatively with those of all other raters, suggesting that she had used the scale in reverse. Inter-rater reliability was high for masculinity (Cronbach $\alpha = 0.92$) and femininity (Cronbach $\alpha = 0.94$) ratings, with good agreement between male and female raters for both male ($r = 0.85$, $n = 154$, $p < 0.0001$) and female faces ($r = 0.90$, $n = 156$, $p < 0.0001$). A single masculinity or femininity rating was calculated for each face by averaging across participants' ratings (masculinity: mean of 4.4, s.d. = 0.6, range of 2.4–5.9; femininity: mean of 3.5, s.d. = 0.8, range of 1.4–5.5). Reliable attractiveness (mean of 3.2, s.d. = 0.7, range of 1.3–5.4) and perceived health ratings (mean of 4.3, s.d. = 0.8; range of 1.5–6.2) were taken from Zebrowitz *et al.* (1993) and Kalick *et al.* (1998), respectively.

Annual health scores (1, no illness, to 5, serious illness), based on detailed medical examinations and health histories, were averaged across ages 11 to 18 to reflect health during puberty and adolescence, when development is strongly influenced by sex hormones (mean of 3.5, s.d. = 0.5, range of 1.5–4.8). These individuals were developing before vaccinations and antibiotics were used, so their health scores should reflect heritable resistance to disease.

3. RESULTS AND DISCUSSION

Table 1 shows Pearson product-moment correlations of masculinity (male faces) and femininity (female faces) with actual health, perceived health and attractiveness. All variables were normally distributed. Masculinity correlated modestly, but significantly, with actual health during adolescence, supporting the immunocompetence-handicap hypothesis. This result also supports claims that a shift in female preferences towards masculinized faces during the fertile phase of the menstrual cycle may be adaptive because it would target high-quality mates (Perrett *et al.* 1998; Penton-Voak *et al.* 1999; Johnston *et al.* 2001). Masculinity was also perceived as healthy, suggesting that people correctly interpret masculine traits as signs of health.

Masculinity correlated positively, but not significantly, with attractiveness (cf. Swaddle & Reierson 2002). This correlation may have been stronger if women had been tested when fertile (e.g. Penton-Voak & Perrett 2000). Male faces that were rated as healthy (correctly or incorrectly) did, however, look attractive ($r = 0.68$, $p < 0.0001$). The masculinity ratings had divergent validity because the association of masculinity ratings with health (both actual and perceived) remained significant when attractiveness was controlled (table 1), and because attractiveness did not correlate with masculinity (table 1) or health in male faces ($r = 0.00$, n.s.). They also showed convergent validity because they correlated highly with perceived dominance ($r = 0.53$, $p < 0.0001$; L. A. Zebrowitz, unpublished data).

Femininity correlated with attractiveness, but not actual health (table 1), indicating that not all attractive facial traits signal health. Feminine traits may of course signal other aspects of mate quality, such as reproductive potential (Thornhill & Gangestad 1999). Femininity did correlate with perceived health (table 1), and this correlation remained significant (albeit smaller) when attractiveness was controlled, so the healthy appearance of feminine faces is not solely an attractiveness halo effect.

Across many studies, feminine faces are attractive (Zebrowitz & Rhodes 2002), even though they are no healthier than their less feminine peers. The tendency to perceive masculine male faces as attractive is weaker and less consistent, although the present results indicate that these men are in fact healthier. Other attractive facial traits also show inconsistent associations with health, with averageness showing a moderate association, and symmetry showing little association (e.g. Rhodes *et al.* 2001). Therefore, any health-related evolutionary benefits obtained from our preferences for attractive facial traits are likely to be weak.

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