Female reproductive strategy predicts preferences for sexually dimorphic male facial characteristics.

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Fhionna Moore, Miriam Law Smith, Clare Cassidy, David Perrett

Abstract

The aim of the current studies was to test an assumption that variation in female preferences for sexually dimorphic male facial characteristics reflects strategic optimisation of investment in offspring. A negative relationship was predicted between ideal number of children and preferences for masculine male face shapes, as the benefits of securing paternal investment should outweigh the benefits of securing good genes as the costs of raising offspring increase. In Study 1 desired number of children and preferences for masculine face shapes were compared in a sample of female students. In study 2, the prediction was tested in a sample with a wider age profile while controlling for relationship status. Preferences for explicit partner characteristics were also assessed. The prediction was supported: women who desired a higher number of children preferred more feminine male face shapes and ranked cues to investment of parental care over cues to immunocompetence in a partner more highly than those who desired fewer children. Results indicate that female mate preferences vary with reproductive strategy and support assumptions that preferences for feminine male faces reflect preferences for "good dads".

Keywords

reproductive strategies, mate preferences, sexual dimorphism, face preferences

Introduction

The aim of the current studies was to test an assumption of the "adaptive trade-off" model of variation in female preferences for sexually dimorphic male facial characteristics: that preferences are dependent upon requirements for direct investment of paternal care in offspring. Masculine male facial characteristics develop under the action of the immunosuppressant testosterone (Enlow 1990; Vanderschueren & Bouillon 1995; Penton-Voak & Chen 2004) so may provide an indicator of heritable immunocompetence (Penton-Voak et al. 1999; but see Roberts, Buchanen & Evans 2004). Males with masculine face shapes are perceived as cold, dishonest and less likely to make good parents (Perrett et al. 1998) and are perceived as more likely to pursue short-term relationships (Kruger 2006; Boothroyd et al. 2007) as well as reporting more short-term relationships (Rhodes, Simmons and Peters 2005) than males with feminine face shapes. Feminised male face shapes are associated with warmth, honesty and the likelihood of being a good parent (Perrett et al. 1998). As such, masculine and feminine male face shapes are associated with divergent costs and benefits: masculine faces may signal heritable benefits such as immunocompetence at the cost of decreased provisioning of paternal care, whereas feminine faces may signal greater paternal investment at the cost of lower immunocompetence (Gangestad & Simpson 2000; Fink & Penton-Voak 2002). It has been argued that variation in female preferences for sexual dimorphism in opposite sex faces results from a mate choice trade-off between indirect investment of "good genes" and direct investment of material resources and paternal care in offspring (e.g. Perrett et al. 1998; Gangestad & Simpson 2000; Little & Perrett 2002; Hill & Reeve 2004).

Consistent with the adaptive trade-off interpretation, many studies show that women generally prefer feminine male face shapes (Berry & McArthur 1985; Cunningham, Barbee & Pike 1990; Perrett et al. 1998; Penton-Voak et al. 1999; Rhodes et al. 2000). This makes sense given the high energetic costs of raising human offspring (Kaplan & Lancaster 2003). Indeed, female preferences for feminine male faces become more pronounced under hypothetical environmental stress, when securing a partner who is likely to invest should be of even greater importance (Little et al. 2007). Women prefer less feminine faces during the fertile phase of the menstrual cycle (Penton-Voak et al. 1999; Jones et al. 2008) and in the context of a short-term relationship (Scott et al. 2008). These findings have been interpreted as reflecting mixed mating strategies designed to secure reliable long-term partners who are willing to invest in offspring (i.e. men with feminine facial features), but to secure heritable qualities (i.e. from men with masculine facial features) when the chances of conception are high (e.g. Penton-Voak et al. 1999; Gangestad et al. 2004), or when investment of anything other than genes is unlikely (Little et al. 2002). An additional predictor of individual differences in female preferences is condition-dependence: women who consider themselves to be of high physical attractiveness prefer masculine male faces (Little et al. 2001; Penton-Voak et al. 2003; Little and Mannion, 2006).

Recent evidence supports the assumption that masculinity provides a cue to heritable quality (e.g. Little et al. 2008) and that there are reliable cues to potential willingness and ability to invest paternal care in the male face (Roney et al. 2006; Penton-Voak et al. 2007). There is no direct evidence, however, to support the assumption that variation in preferences results from requirements for investment in

offspring. In order to test this assumption, we investigated relationships between women's planned reproductive strategy and preferences for sexually dimorphic male facial characteristics. In addition, we investigated relationships between face preferences and explicit preferences for partner characteristics associated with heritable immunocompetence and direct paternal investment. In Study 1, we tested the prediction that female undergraduate students who desire more children will prefer a higher degree of feminisation in male face shapes than those who desire fewer children. Reproductive strategy was measured as ideal number of children (see Buss et al. 2000) and preferences for masculine male face shapes as attractiveness ratings for faces manipulated on sexual dimorphism. In Study 2, the prediction was tested in a sample from wider and socioeconomic status profiles via online tests. In addition, we investigated relationships between explicit preferences for partner characteristics and ideal number of children. Both studies controlled for a known positive relationship between self-rated attractiveness and preferences for masculine male face shapes (Little et al. 2001). Own age was also controlled for, as were career ambitions and education (as these may relate to onset of reproduction; Low, 2000, 2005).

Study 1

Methods

Participants

Eighty-eight female undergraduate students (age range = 18 to 23, mean = 19.91; S. D. = 1.34) were recruited from the University of St Andrews, Scotland. All participants indicated a heterosexual orientation.

Materials

Preference for masculinity in male faces was assessed using 6 interactive male face sequence trials (4 Caucasian, 1 African-Caribbean, and 1 East-Asian) which have been utilised in previous studies (Perrett et al. 1998; Penton-Voak et al. 1999). Participants manipulated each face along a masculinity/femininity face shape continuum by moving the mouse over the image (from 50% feminized to 50% masculinised in 24 steps of ~4.2%). For example endpoints of a trial, see Figure 1.

Figure 1.

A short questionnaire assessed participants' age, sexual orientation, self-rated attractiveness (1 to 7 scale where 1 = not at all attractive and 7 = extremely attractive), career and education ambitions (1 to 7 scale where 1 = not at all important and 7 = extremely important) and ideal number of children.

Procedure

Participants completed the questionnaire followed by the face preference test. The 6 face sequence trials were displayed in random order. Participants were asked to indicate when they had made the face most attractive on the masculinised-feminised continuum, by clicking the mouse. Preference for masculine male face shapes was calculated as the mean preference across the 6 trials.

Results

Preferences for male face shapes ranged from preferences for feminised to preferences for masculinised faces (range: –33.5% to 37.5%; mean = 1.5%, S. D. = 17.5%). Ideal number of children ranged from 0 to 6 (mean = 2.74, S. D. = 1.29). Ratings on self rated attractiveness, and importance of education and career ranged from 1 to 7 (self-rated attractiveness: mean = 4.25, S.D. = 1.05; importance of education: mean = 5.4, S.D. = 1.13; importance of career: mean = 5.78, S.D. = 1.19).

Ideal number of children, own age, self-rated attractiveness and career and education ambitions were entered as independent variables in a multiple linear regression model. Mean face preference scores were entered as the dependent variable. Tolerance to multicollinearity was high (all > 0.6). Adjusted R^2 was 0.03 (p for model = 0.2). Results are shown in Table 1.

Table 1.

Table 1 above shows that variation in preference for masculine male face shapes was predicted by ideal number of children (β = -0.24, p = 0.04): women who desired a greater number of children preferred more feminine male face shapes.

Discussion

Planned reproductive strategy predicted preferences for masculinity in male faces in a sample of undergraduate students. Women who desired greater numbers of children preferred more feminine male face shapes. The relationship supported the prediction that a larger ideal number of children would be associated with

increased importance of investment of paternal care over heritable benefits. The stimuli used in this study have been calibrated in previous studies, such that the feminised male faces are associated with warmth and the likelihood of making a good parent, and the masculinised faces are perceived as being more likely to be cold and dishonest (Perrett et al. 1998). Furthermore, the relationship between ideal number of children and face preferences cannot be attributed to career aspirations or self rated attractiveness (as these were controlled for in the model).

Study 1 had a number of limitations. Ideal number of children and preferences for male facial characteristics may be influenced by participants' relationship status. Women who are in a stable relationship may be more likely to be considering having children than single women. Additionally, partner characteristics associated with paternal care may be of less importance to single women who are looking to start a new relationship, the time span of which (and the prospects for having children) is unknown. A further limitation was the narrow age profile of the sample: women in their late teens/early twenties may not yet be seriously considering how many children they desire, or considering partners with the prospect of having children. To ensure that the relationship between ideal number of children and face preferences was not a spurious result in a young age group, or driven by single/attached females the prediction was tested in women from a wider age profile while controlling for relationship status (Study 2). In addition, to attempt to validate the conclusion that the relationship between ideal number of children and preferences for masculine male faces reflects preferences for cues to heritable quality versus cues to paternal investment, relationships between

reproductive strategy and explicit preferences for partner characteristics (i.e. preference rankings) were investigated.

Study 2

Method

Participants

Two hundred and twenty-four female participants were recruited through the laboratory website (age range = 18 to 35, mean = 24.35 years, S. D. = 5.01). All participants were residents of the UK and completed the online test on remote computers. Participants who indicated non-heterosexual orientation were not included in the current sample. Duplicate responses were detected using a random subject code allocated to participants at the start of the test and removed.

Materials

a. Stimuli

Four hundred and thirty-seven male and 496 female facial photographs were collected under standardised lighting with neutral expression (all faces were European Caucasian). Each image was aligned to a symmetrical image and normalised on inter-pupillary distance. Faces were presented in random order to 10 participants (mean age = 23.29 years, S. D. = 2.29; females n = 8) who estimated the age of each face. Mean perceived age was used to identify sets of 15 male and 15 female Caucasian faces at each 5-year interval from 20 to 50, such that the mean perceived age of each set was approximately the desired age.

One hundred and seventy-four predefined points were marked out on each face, providing a map of comparable features between faces (e.g. one point at the tip of the nose and at the inner corner of each eye). Composite faces containing the average shape of the faces in each set were generated by calculating the mean position of corresponding points and warping each face into this average face shape (for details of the averaging process see Benson & Perrett, 1993 and Tiddeman, Burt & Perrett 2001). Each composite was symmetrised by averaging with its mirror reflected image. This provided an average male and female face at 5-year intervals from 20 to 50.

A base face from each of the 7 age brackets was generated by averaging together 5-6 faces selected at random from each of the age brackets in the image set. Each base face was transformed in shape, 25% towards the age relevant composite female (i.e. the face was feminised) and 25% towards the composite male (i.e. the face was masculinised). This process was repeated for each 5-year age bracket, thus producing 7 face pairs differing in masculinity. The procedure for manipulating masculinity was equivalent to that used in Study 1 (see Tiddeman, Burt & Perrett 2001), has been used in many published studies of masculinity and has demonstrable validity (Debruine et al. in press). For an example face pair see Figure 2.

Figure 2

b. Questionnaire

Participants reported age, country of residence, ethnicity, relationship status (single, casual relationship, serious relationship – living apart, serious relationship – living together, married), sexual orientation and ideal number of children. They then indicated self-rated attractiveness and importance of career and education on 1 – 7 likert scales. Relationship status was recoded as a dummy variable (i.e. 0 = single or casual relationship; 1 = serious relationship or married).

Participants were asked to rank 13 partner characteristics in order of importance in a potential partner for a long-term relationship. Such a partner was defined as "someone you would be willing to commit to in a serious relationship and would consider marrying, or entering a relationship with on grounds similar to marriage". The 13 characteristics were in part taken from those used by Buss (1989) and included the target characteristics: putative cues to heritable immunocompetence (physical attractiveness and good health) and willingness and ability to invest paternal care (fondness of children and good parenting abilities). Mean scores of preference rankings for cues to immunocompetence and investment of paternal care were calculated. Relative preferences were then calculated as the mean preference for cues to heritable immunity subtracted from the mean preference for cues to direct investment of paternal care (such that a negative number represents a preference for cues to heritable immunity over direct investment of care and vice versa).

Procedure

The questionnaire and ranking of partner characteristics were followed by the face preference test. Face pairs were presented with a forced – choice paradigm.

Participants indicated which face they preferred and the strength of their preference from face pairs differing in masculinity on a 0 - 7 scale displayed below the images (0 = strongly prefer feminine, 1 = prefer feminine, 2 = slightly prefer feminine, 3 = guess feminine, 4 = guess masculine, 5 = slightly prefer masculine, 6 = prefer masculine, 7 = strongly prefer masculine). The order in which pairs were displayed, and the side each face was displayed on, were fully randomised. Masculinity preference was calculated as the mean preference for the 7 face pairs: preference of less than 3.5 indicates a preference for feminine male faces, preference of greater than 3.5 indicates a preference for masculine male faces and a preference of 3.5 indicates no preference.

Results

Face preferences ranged from preferences for feminine male face shapes to preferences for masculine male face shapes (range 1.43 – 5.14, mean = 3.4, S. D. = 0.75). Ideal number of children ranged from 0 to 9 (mean = 2.22; S. D. = 1.18).

Ideal number of children, self-rated attractiveness, relationship status, own age and importance of career and education were entered as independent variables in 2 multiple regression models. Preference for masculinity in male faces was entered as the dependent variable in the first model (Adjusted R^2 = 0.003) and preferences for direct paternal investment versus indirect heritable benefits were entered as the dependent variable in the second model (Adjusted R^2 = 0.08; for full results, see Table 1). Ideal number of children predicted variation in preferences for masculinity in male faces (β = -0.19, p = 0.02) and in preferences for cues to paternal investment over cues to immunocompetence (β = 0.26, p = 0.001). Higher

ideal numbers of children were associated with preferences for increased feminisation of male faces and preference rankings for cues to investment of paternal care over cues to immunocompetence.

Mediation analysis was conducted to determine whether preferences for masculinity in male faces and preference rankings for cues to investment of paternal care over cues to immunocompetence covaried. When preference rankings for cues to investment of paternal care over immununocompetence were added as a predictor in the model (with masculinity preferences as the dependent variable), the relationship between ideal number of children and masculinity preference lost significance ($\beta = -0.16$, $p = 0.06$). Therefore, the relationship between ideal number of children and masculinity preference in this model can be attributed to relative preferences for cues to paternal investment versus cues to immunocompetence.

Discussion

The results of Study 2 provided additional support for the prediction. The negative relationship between ideal number of children and preferences for masculinity in male faces of Study 1 was replicated, this time in a sample with a wider demographic profile. Furthermore, there was a positive relationship between ideal number of children and preferences for partner characteristics associated with investment of paternal care in offspring over those associated with heritable immunity. Mediation analysis confirmed that the relationship between ideal number of children and preferences for masculinity in male faces can be attributed to preferences for cues to paternal investment versus cues to immunocompetence. This provides support for the adaptive trade-off interpretation of variation in female

face preferences: when women anticipate having a larger number of children they express preferences for cues to investment of care over cues to heritable benefits, both in male faces and in stated partner characteristics.

General Discussion

We predicted that women who desired larger numbers of children would prefer cues to direct investment of parental care over cues of indirect heritable qualities (manifested as a preference for feminine face shapes) due to increased anticipated costs of raising larger numbers of offspring. By so doing, we aimed to test an assumption of the "strategic trade-off" explanation of female face preferences: that preferences for sexual dimorphism in male faces reflect strategic attempts to optimise investment in offspring. The results of both studies supported the prediction: there were negative relationships between ideal number of children and preferences for masculinised male face shapes. We interpreted these results as a shift in female preferences from cues to heritable quality to cues to willingness and ability to invest parental care with increasing anticipated reproductive costs. This interpretation was supported by a positive relationship between ideal number of children and preferences for partner characteristics relating to paternal care over those relating to immunocompetence (Study 2), and by demonstration of the mediating role of relative preference for cues to paternal care over cues to immunocompetence on the relationship between ideal number of children and masculinity preference. Our results demonstrated that anticipated costs of raising offspring predict variation in preferences, providing support for the theory that women's preferences for sexual dimorphism in male faces are strategic attempts to optimise individual reproductive success.

An alternative prediction for the current investigation could have been derived from the life history tradeoff between number of offspring and investment in each. Resources invested in one offspring cannot be invested in another (i.e. the quantity/quality tradeoff: Lack, 1947; Blurton Jones 1986; Hill & Hurtado 1996). It has been proposed that humans evolved the ability to assess the effects of their investment on the future success of offspring, and optimise their investment in offspring accordingly (Kaplan 1996). If the desire for larger numbers of children is indicative of a "quantity" strategy, and thus lower parental investment in each child, females who want more children may have been expected to prefer partners who signal indirect heritable benefits such as immunocompetence, over men who are willing to invest in offspring (i.e. prefer masculine face shapes). While there is evidence that humans optimise number of children (e.g. Borgerhoff Mulder 2000), evidence that larger numbers of children are associated with decreased investment in offspring is unclear. Some studies have shown that larger numbers of offspring are associated with lower offspring survival rates (e.g. Hill & Kaplan 1988), but survival of Kipsigis and Ache children to age 5 relates positively to number of siblings (Borgerhoff Mulder 1998). Additionally, the unusually high costs of raising human offspring imply that larger numbers of children may not be associated with decreased investment overall. The results of the current investigation suggest this to be the case; women who desired a greater number of children preferred cues to investment of paternal care over cues to immunocompetence. Therefore, our studies yielded no evidence that a desire for a greater number of children resulted in decreased anticipation for investment overall.

The results of both studies demonstrate that women's partner preferences shift with anticipated demands for parental investment. We focussed on preferences for paternal care, but it may also be the case that women who desire a greater number of children anticipate the need for acquisition of greater material resources (e.g. wealth). Interestingly, there was no relationship between ideal number of children and preference rankings for "good financial prospects" in a partner when it was entered as the dependent variable in the model ($p = 0.9$). This suggests that the results yielded in the current studies represent preferences for investment of care rather than material resources. It is also possible that women who desire a greater number of children may anticipate the need to acquire resources for themselves. We attempted to control for this by inclusion of career ambition in analyses, and as such can conclude that the relationships between ideal number of children and partner preferences exist beyond women's anticipated independent resource provision. An alternative source of resources and support may come from kin (e.g. Sear et al. 2003; Newson et al. 2005). The current study did not include measures of kin support and future research could investigate the impact of this on relationships between reproductive strategy and partner preferences.

The relationship between ideal number of children and face preferences existed across two sets of male face stimuli, two participant age profiles (student age and 18 to 35), and while own age, self-rated attractiveness, relationship status and career aspirations were controlled for. This suggests that reproductive strategy predicts face preferences independently of the covariates included here. It is possible, however, that one or more variables underlie both reproductive strategy and face preferences, which we have not assessed in this study. Furthermore, while

we attempted to access women from a range of ages and backgrounds, the samples were still limited to women from the UK who were either university students or chose to participate in an online study. As such, our samples may have been self-selecting and not representative of cultural or socio-economic background. It would be interesting to test predictions across societies, and to investigate potential underlying causes of variation in ideal number of children, and the relationships of these to partner preferences.

Given the high costs of raising human offspring and the lack of evidence for decreased overall investment by parents of larger numbers of children, our results seem intuitive. The importance of cues to paternal care (both in male faces and in preference rankings of partner characteristics) shifted in response to requirements for raising offspring. Women who desire a large number of children would suffer greater costs of the reduced paternal care associated with masculine male faces than women who desire fewer children. Similarly, women who desire fewer offspring suffer lower costs of reduced paternal care and can afford to reap the benefits of a partner who can provide indirect benefits such as immunocompetence. Our results lend support to a strategic trade-off in female preferences for sexually dimorphic male facial characteristics so as to optimise investment in reproduction.

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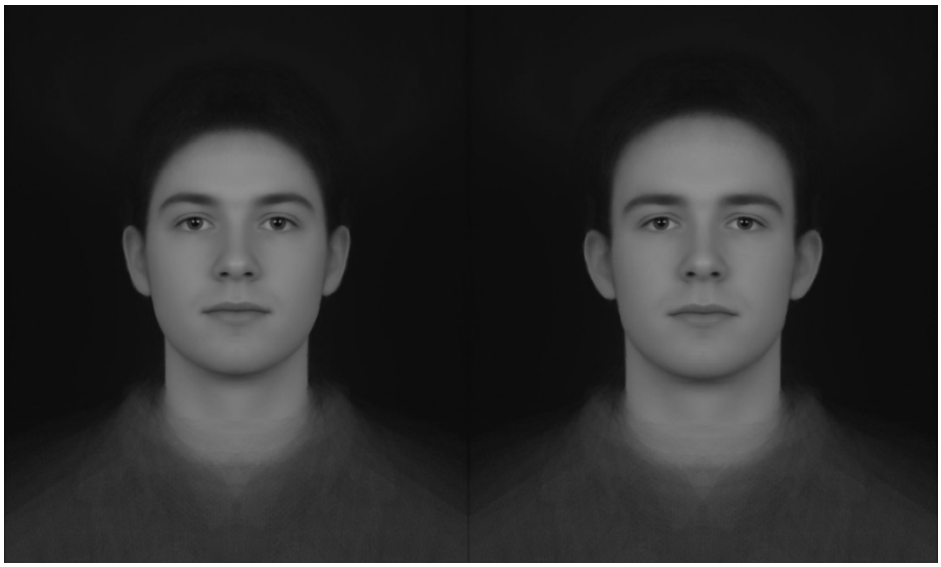

Figure 1. End points of an interactive sequence trial used to assess female preferences for sexually dimorphic male face shapes from 50% feminised (left) to 50% masculinised (right).

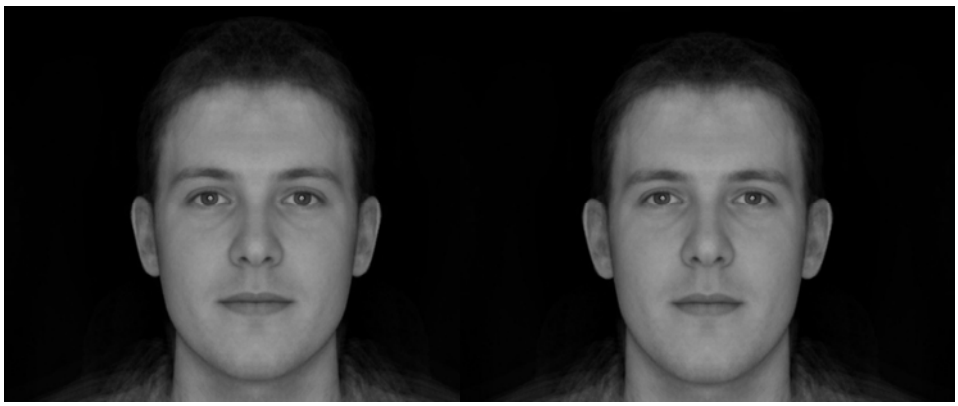

Figure 2. Male face pair (age = 25) with 25% feminised (left) and 25% masculinised male face shapes used to assess female preferences for sexually dimorphic male face shapes.

Table 1. Standardised β values for predictor variables in multiple linear regression models with (a) mean preference for masculinity in male faces and (b) preference rankings for cues to paternal care over cues to immunocompetence as the dependent variables

	Study 1 (a)	Study 2 (a)	Study 2 (b)
Ideal number of children	-.24*	-.19*	.26**
Own age	-0.003	.02	-.05
Self-rated attractiveness	0.19	-.05	.03
Importance of education	.1	.00001	-.09
Importance of career	-.1	-.06	-.12
Relationship status	NA	-.07	.12

* $p < 0.05$, ** $p < 0.005$