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Original Article

A New Viewpoint on the Evolution of Sexually Dimorphic Human Faces

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Abstract: Human faces show marked sexual shape dimorphism, and this affects their attractiveness. Humans also show marked height dimorphism, which means that men typically view women's faces from slightly above and women typically view men's faces from slightly below. We tested the idea that this perspective difference may be the evolutionary origin of the face shape dimorphism by having males and females rate the masculinity/femininity and attractiveness of male and female faces that had been manipulated in pitch (forward or backward tilt), simulating viewing the face from slightly above or below. As predicted, tilting female faces upwards decreased their perceived femininity and attractiveness, whereas tilting them downwards increased their perceived femininity and attractiveness. Male faces tilted up were judged to be more masculine, and tilted down judged to be less masculine. This suggests that sexual selection may have embodied this viewpoint difference into the actual facial proportions of men and women.

Keywords: attractiveness, head tilt, sexual dimorphism

Introduction

Human facial attractiveness has been extensively studied from an evolutionary perspective (Gangestad and Scheyd, 2005; Rhodes, 2006). Much of this research has concluded that facial features that increase attractiveness serve as cues of biologically important variables. In the case of female faces, there is good agreement, both across laboratories and across cultures, that attractiveness is increased by signs of youth (Jones, 1995), symmetry (Rhodes, Proffitt, Grady, and Sumich, 1998; Thornhill and Gangestad, 1993) and averageness (Langois and Roggman, 1990) perhaps signaling health and femininity (Perrett, May, and Yoshikawa, 1994 - a proxy for fertility). Male attractiveness is generally increased by facial symmetry (Rhodes et al., 1998; Thornhill and Gangestad, 1993) and averageness (Langois and Roggman, 1990), but male masculinity does not universally confer greater attractiveness. More masculine faces are rated as more attractive by females for short-term relationships (Penton-Voak, Little, Jones, and Burt, 2003), at peak fertility in the menstrual cycle (Penton-Voak, Perrett, Castles, Kobayashi, Burt, Murray, and Minamisawa, 1999), by those with high self-rated attractiveness (Little, Burt, Penton-Voak, and Perrett, 2001), and in environments in which males make little contribution to childrearing (Penton-Voak, Jacobson, and Trivers, 2004).

An unanswered question is the evolutionary origin of the sexually dimorphic structural differences (i.e., the masculinity and femininity of faces) that serve as attractiveness cues. Male faces are, on average, longer- and wider-jawed, have relatively smaller top halves and eyes, and more prominent brow-ridges. Highly feminine faces, conversely, have relatively larger eyes and smaller brow ridges, smaller jaws and fuller lips (Weston, Friday, and Lio, 2007). These differences are driven proximally by growth of the male face during puberty, under the influence of testosterone. Humans also show considerable size dimorphism, with males on average 8% taller (Gray and Wolfe, 1980) and 15% heavier (Ruff, 2002) than females. Testosterone influences both the body size differences and the face-shape differences, but the proportional sex differences in face shape are not explicable simply in terms of overall size dimorphism, suggesting a role for sexual selection of the facial proportions themselves (Weston et al., 2007). Consistent with this idea, male common chimpanzee faces seem to have been sexually selected for width, rather than larger bottom halves, with extra width not accounted for by size dimorphism, whereas larger male lowland gorilla faces are entirely explicable in terms of size dimorphism (Weston et al., 2007; Weston, Friday, Johnstone, and Schrenk, 2004). On the other hand, all of the bipedal fossil hominins that have been examined (e.g., *Homo erectus, H. ergaster, Australopithecus africanus, Paranthropus robustus*) show similar or greater height dimorphism to that found in modern humans (Ruff, 2002), and they also show the same pattern of sexual shape dimorphism as modern human faces, with males having larger bottom halves and smaller top halves of faces than is predicted by size dimorphism alone (Weston et al., 2007).

The current study is designed to test the idea that the evolutionary origin of the shape dimorphism in human faces is the different viewpoints of male and female faces afforded by the height dimorphism. A face viewed from slightly above – the typical male perspective on female faces – appears to have a larger forehead, larger eyes and a smaller chin than one viewed from slightly below – the typical female perspective on male faces (see figure 1). We postulate that the way faces look from these different perspectives placed sexual selection pressure on males and/or females to develop faces that emphasized, exaggerated or just ossified the perceptual perspective differences, as a signal of masculinity and/or femininity. To test this idea we manipulated the pitch (forward or backward tilt) of 3D models of male and female faces and had both male and female observers make judgments of the masculinity/femininity and attractiveness of the faces.

Previous research has manipulated the height of the internal features of a face (as a rough proxy for pitch) and found that placement of the internal features influences attractiveness ratings in adults, but not infants (Geldart, Maurer, and Henderson, 1999), the influence changes with age (from 3 to 12 – Cooper, Geldart, Mondloch, and Maurer, 2006), and in adults it correlates with the rater’s height (Geldart, 2008). Collectively, this has been interpreted as an effect of experience from particular viewpoints influencing attractiveness judgments, since familiarity itself increases attractiveness, of faces specifically (Little, DeBruine, and Jones, 2005) and of stimuli generally via the Mere Exposure effect (Rhodes and Halberstadt, 2001), or as a preference for "baby" faces. Despite the hints provided by these findings, there is no published report that has examined the role of the sex of the face or the sex of the rater in this effect and there is no previous research that has examined the effect of a realistic manipulation of pitch.

Campbell, Wallace, and Benson (1996) found that averting the eyes downward (but not tilting the head) slowed sex judgments of both male and female faces, and reduced masculinity ratings of male faces, but did not affect femininity ratings of female faces. The authors attributed this finding to changes in the distance between the brow and the eye, a reliably sexually dimorphic feature. Averting the eyes downward increases this distance more for male faces than for female faces, making male faces appear more feminine and reducing the sexual dimorphism of the measure. No study has yet measured the effect of pitch on perceived masculinity/femininity by actually presenting images of faces at different tilts.

Mignault and Chauderi (2003) have examined the role of head pitch in facial-emotional signaling. Likening the bowing and raising of the head to the appeasement and dominance displays of many non-human animals, the authors demonstrated that upwardly tilted heads of both sexes were perceived as more dominant and as expressing superiority-related emotions, such as pride and disdain. Downwardly tilted heads, conversely, were perceived as expressing inferiority-related expressions such as guilt and shame. Given the positive relationship between dominance and masculinity of male faces (Neave, Laing, Fink, and Manning, 2003), the effect of head-tilt on perceived dominance is potentially relevant to the interpretation of the current data and we will consider this possibility further in the discussion section.

In the current study, participants completed two tasks designed to measure the perceived masculinity or femininity of faces, and to rate their attractiveness. The virtual viewpoint of the face was manipulated by importing photos of faces into a 3D face modeling program (FaceGen, Singular Inversions) and manipulating the portrayed pitch of the resulting model. Faces were depicted untilted (straight), tilted slightly upwards (up 1), further upwards (up 2), slightly downwards (down 1) and further downwards (down 2). Main, DeBruine, Little, and Jones (2010) have shown that faces are perceived as more attractive when viewed front-on (eyes straight ahead, looking at the viewer) than if viewed at a three-quarter perspective (eyes straight ahead, so not looking at the viewer) if the face is showing a happy expression or if it belongs to a physically attractive individual. For this reason, the stimuli in our study were all created with eye-gaze directed at the viewer.

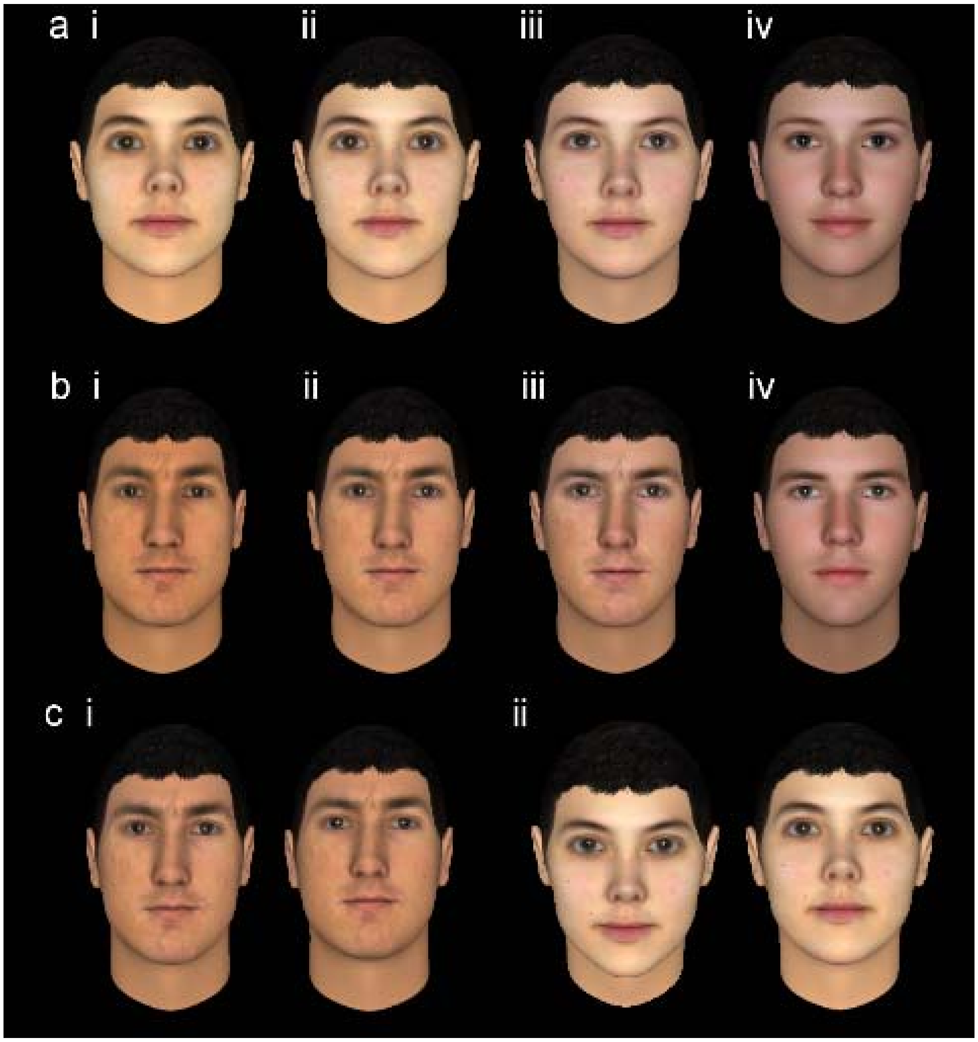
We predicted that if angle of view has been an important determinant of masculinity/femininity and attractiveness, then female faces will be judged more feminine and more attractive when tilted forwards (simulating viewing from above), and less feminine and less attractive when tilted backwards (simulating viewing from below). Male faces, conversely, will be judged more masculine when tilted backwards and less masculine when tilted forwards. Given the complex relationship between masculinity and attractiveness, we would not predict any straightforward relationship between pitch and attractiveness for male faces. In order to be sure that the results were not specific to a particular range of attractiveness, we manipulated the attractiveness of the imported faces by morphing faces towards or away from attractive average faces.

Since we are hypothesizing that sexual selection may have acted on face shape to make female faces, for example, most feminine when viewed from slightly above (the view males typically have of them), we are predicting that both sexes should rate female faces as more feminine when they are tilted downwards (with the converse arguments applying to male faces). If, on the other hand, changes in masculinity/femininity ratings as a function of pitch are the result of normative experience of viewing faces, we would predict to see those effects more pronounced in ratings provided by the opposite sex than ratings provided by the same sex.

Materials and Methods

Faces imported into FaceGen were from the Aberdeen set of the PICS database (http://pics.psych.stir.ac.uk/). Ages are not supplied with this dataset but they can be subjectively estimated to be in their twenties, possibly up to early thirties. We created models of 10 real male faces, 10 real female faces, 3 average male faces and 3 average female faces (each average face was created by morphing 8 Caucasian faces of the appropriate sex – in pilot data these averages were rated as highly attractive). We then made "attractive" and "unattractive" versions of the real faces by using FaceGen to morph the 3D model of each real face 50% towards an average of the average face models or 50% away from that average. This created 33 male and 33 female face models that varied in attractiveness. All face models were rendered with the same short black hair (see figure 1), and presented in color. Pitch of the face was manipulated in FaceGen (which produces rotatable 3D models of the imported faces) by shifting the eye gaze of the face to each of 25% and 50% of maximum upward gaze, and 25% and 50% of maximum downward gaze, and then adjusting the pitch of the face until the eyes gazed directly ahead. This resulted in five levels of pitch (up 1, up 2, straight, down 1 and down 2), corresponding to tilts in the range of ± 5-8° and ± 10-15° for the up/down 1 and up/down 2 stimuli respectively. Taking the mean height difference between the sexes to be 13cm, the minimum and maximum tilts employed represent the viewpoints of opposite sex faces at distances ranging from 1.5m to 0.5m, respectively. Given normal variation in height and possible movement of the head during conversation the total range of viewpoints in our study, -15° to +15°, likely corresponds closely to the actual perspectives of faces people have during normal conversation. Each of the face models was exported as a jpg (400x400 pixels at a resolution of 72 pixels per inch) at each pitch, resulting in a stimulus set of 165 female and 165 male faces.

Figure 1. Examples of the stimuli as presented in: (a) & (b) the ratings tasks; (a)i, (a)ii, (a)iii & (a)iv examples of unattractive, real, attractive and average female faces and (b)i, (b)ii, (b)iii & (b)iv examples of unattractive, real, attractive and average male faces; (c) the forced-choice tasks, (c)i male stimuli, untilted on the left and tilted upwards (up 1) on the right; (c)ii female stimuli, untilted on the right and tilted downward (down 1) on the left



Data were collected using Superlab (Cedrus Corp.) controlled experiments on 20” iMac computers. Twenty-nine females (mean age 23.3y) and 10 males (mean age 27.2y) participated in the study. They were recruited from an intermediate-level undergraduate Evolutionary Psychology course, or were friends and colleagues of the researchers. Each participant first rated the attractiveness (from 1-9, 1:least, 5:average, 9:most) of all 165 faces of the opposite sex (task 1) and then, in a forced choice paradigm, chose the most attractive face (from these opposite sex faces) from two depictions of the same individual at different pitches (task 2). We used two tasks in order to maximize the generalizability of any effects we found, and to ensure that we had a measure that was somewhat like making spontaneous judgments of a particular face (task 1), and another measure that was sensitive enough to capture any effect of pitch that may be present (task 2), with the tradeoff that this is perhaps a less ecologically valid kind of judgment. For task 2 only the unmanipulated models derived from the real faces were used, and for each of the 10 identities (of each sex) 6 comparisons were made: straight versus each of the 4 tilted pitches, up 1 versus down 1 and up 2 versus down 2. Each of these comparisons was made twice (with each face presented once on the left and once on the right) resulting in a total of 120 forced choices.

Participants then completed these two tasks for the opposite sex faces again, but this time basing their decisions on femininity (of the female faces) or masculinity (of the male faces). Participants (except 1 male participant, who was interrupted part-way through testing and did not return to finish the task) then completed the same four tasks (attractiveness ratings and forced choices and masculinity/femininity ratings and forced choices) for the faces of their own sex. We chose to run the rating tasks in this order because we wanted to ensure, as much as was possible, that the attractiveness judgments were unaffected by prior masculinity or femininity judgments, and that they were initially made on members of the opposite sex, in order to encourage personal, subjective attractiveness ratings rather than making an abstract judgment of objective, socially-agreed upon attractiveness.

The research was approved by the Macquarie University Human Ethics Committee (protocol HE27FEB2009-R06286L&P), and informed consent was obtained from all participants.

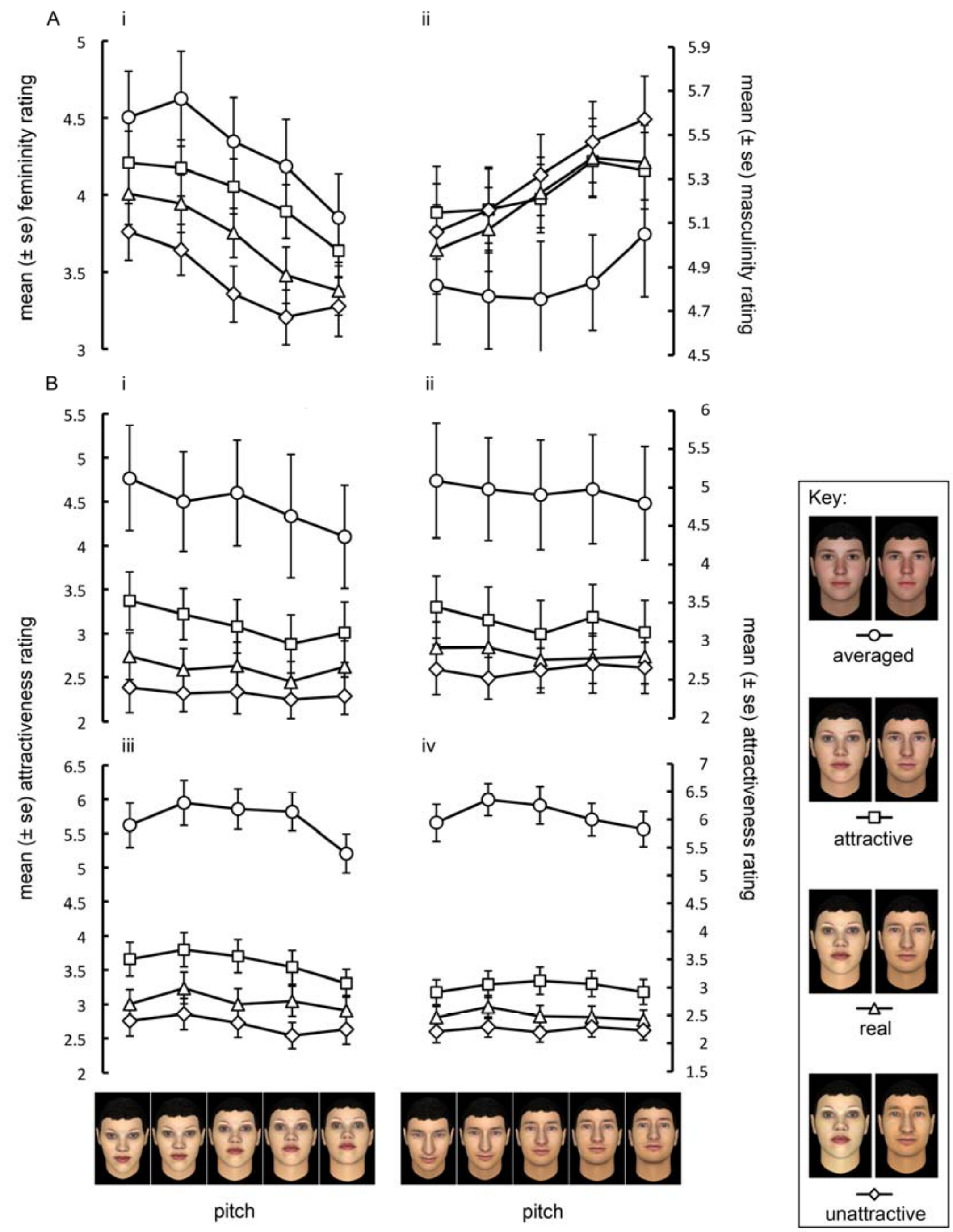
Results

The results clearly show that the pitch of the face directly influences its perceived masculinity/femininity, and that this translates into predictable attractiveness ratings, or attractiveness preferences. An upward tilted face is judged to be more masculine (or less feminine, in the case of female faces), and a downward tilted face is judged to be more feminine (or less masculine), in exactly the way our hypothesis predicts, and in the case of males rating female faces, this translates into systematic effects of pitch on attractiveness judgments.

Figure 2 a(i) shows the femininity ratings of the female faces (averaged across sex of rater, since this did not interact with any other variable) and a(ii) shows the masculinity ratings given to the male faces (again averaged across sex of rater). In both cases, a mixed factorial ANOVA revealed a significant main effect of the attractiveness manipulation (for female faces, $F(3,111) = 5.036$, $p = 0.003$, $\eta_\rho^2 = 0.120$, $\eta^2 = 0.075$; male faces, $F(3,108) = 3.13$, $p = 0.029$, $\eta_\rho^2 = 0.080$, $\eta^2 = 0.051$), indicating that the attractiveness manipulation affected masculinity/femininity (but note that the averaged female faces are rated as the most feminine, whereas the averaged male faces are rated as the least masculine). There was also a significant main effect of pitch (female faces, $F(4,148) = 11.657$, $p < 0.001$, $\eta_\rho^2 = 0.240$, $\eta^2 = 0.044$; male faces, $F(4,144) = 3.09$, $p = 0.018$, $\eta_\rho^2 = 0.079$, $\eta^2 = 0.013$), but no interaction between these variables, indicating that the pitch effect occurs equally across the attractiveness range we tested. In each case there was also a significant linear contrast for the main effect of pitch (female faces, $F(1,37) = 17.025$, $p < 0.001$, $\eta_\rho^2 = 0.315$; male faces, $F(1,36) = 4.22$, $p < 0.047$, $\eta_p^2 = 0.105$), which were in opposite directions – tilting the head downwards linearly increased the femininity ratings of female faces but linearly decreased the masculinity ratings of male faces. Female and males faces viewed from straight in front were judged to be intermediate in femininity and masculinity, respectively.

There was high inter-rater reliability for the ratings of femininity given to female faces ($\alpha_{\text{Cronbach's}} = 0.883$, $n = 39$) and lower inter-rater reliability for the ratings of masculinity given to male faces ($\alpha_{\text{Cronbach's}} = 0.660$, $n = 38$). Further investigation of the between-participant correlations for the ratings of masculinity revealed that correlations amongst all male raters and 23 of the female raters were strongly positive ($\alpha_{\text{Cronbach's}} = 0.898$, $n = 32$) while the remaining six female raters agreed with each other ($\alpha_{\text{Cronbach's}} = 0.929$, $n = 6$) but correlated strongly negatively with the other raters, meaning that they were reliably rating the more downward tilted faces as less, rather than more, masculine. To investigate whether this represented a reliable individual difference between participants, we examined the data from the forced-choice task of these six participants. For five of the six participants their forced-choice data were *not* consistent with their rating data; in the forced choice paradigm these five participants all rated the more downward tilted faces as more masculine on the majority of trials (80%, 83%, 87%, 92%, 92%, respectively). Only the sixth participant's forced choice data were consistent with their rating data, choosing the more downward tilted face as more masculine on only 27% of trials. The inconsistency led us to suspect that (at least five of) these six participants may have failed to follow the instructions during the masculinity rating task and may, in fact, have been rating the attractiveness of these faces, an arguably more automatic conscious judgment to make. To test this hypothesis we correlated all female participants' masculinity ratings (mean for each pitch of each face type) with their attractiveness ratings of the male faces. The results supported our hypothesis. There were strong positive correlations between the masculinity and attractiveness ratings given by the group of six female raters (r = 0.812, 0.830, 0.844, 0.862, 0.910, 0.959, respectively, all ps < 0.001). The remaining 23 female raters showed a range of correlation strengths between their masculinity and attractiveness ratings. Using Pearson correlations with uncorrected alphas, six participants showed a strong negative correlation (all rs = -0.800 or stronger, all ps < 0.001), three showed a weaker negative correlation (rs between -0.5 and -0.65, all ps < 0.05), thirteen showed no significant relationship ($p > 0.05$) and the remaining one showed a strong positive correlation ($r = 0.805$, $p < 0.05$). Not surprisingly, when these r-values were converted to z' values and subjected to an independent samples t-test, the six female participants that had originally given masculinity ratings opposite to what had been predicted and opposite to the other participants showed a significantly stronger, more positive relationship between their masculinity and attractiveness ratings (mean $r = 0.870$) than the other 23 female participants (mean $r = -0.289$), $t(23.07) = 8.841$, $p < 0.001$ (degrees of freedom adjusted for violation of assumption of homogeneity of variances).

Figure 2. Mean ratings for averaged, attractive, real and unattractive female and male faces (on a scale of 1-9, least-most) as a function of pitch of: (a)i femininity & (a)ii masculinity as rated by all participants; (b)i & (b)ii attractiveness as rated by male participants; (b)iii & (b)iv attractiveness as rated by female participants



Note: Error bars represent ±1 standard error of the mean.

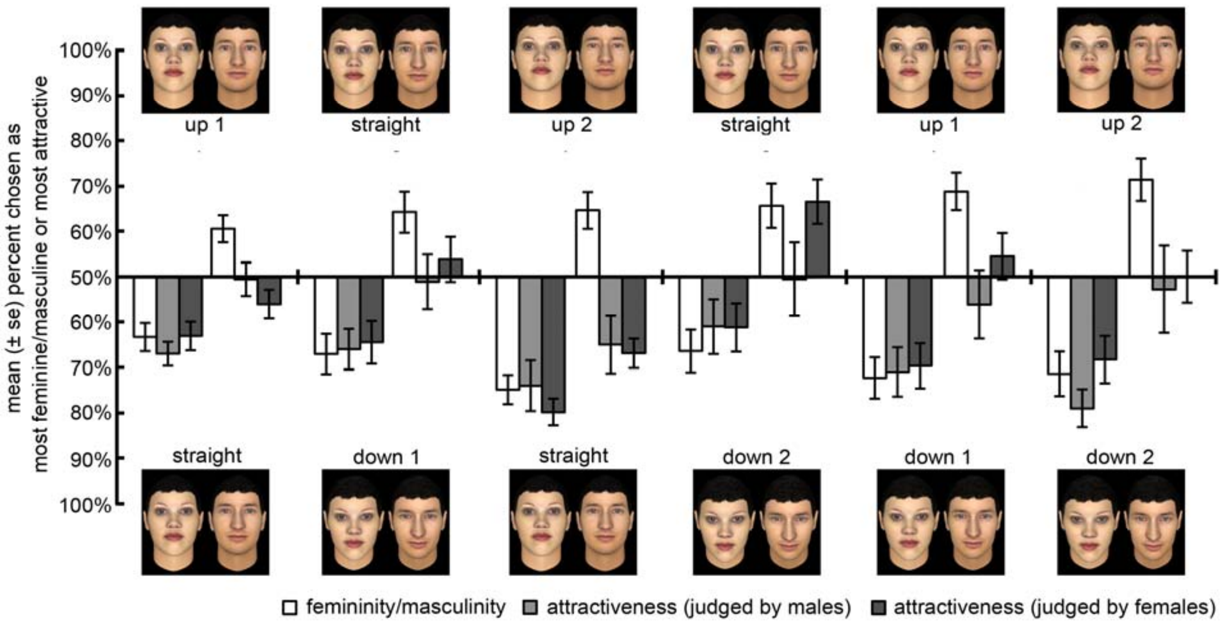
Figure 2 b shows the attractiveness ratings given by males to female faces (i) and to male faces (ii), and by females to female faces (iii) and to male faces (iv). These are plotted separately for male and female raters because we predicted that male and female attractiveness judgments would be differentially affected by the pitch manipulation. The analysis of the ratings of female face attractiveness (judged by both male and female raters) revealed a significant main effect of the attractiveness manipulation, $F(3,111) = 88.089$, $p < 0.001$, $\eta_\rho^2 = 0.704$, $\eta^2 = 0.595$, and a main effect of pitch, $F(4,148) = 5.818$, $p < 0.001$, $\eta_\rho^2 = 0.136$, $\eta^2 = 0.008$, as well as a significant attractiveness x pitch interaction, $F(12,444) = 2.073$, $p = 0.018$, $\eta_\rho^2 = 0.053$, $\eta^2 = 0.004$, indicating that the effect of pitch was larger for some levels of attractiveness, possibly because of a floor effect in attractiveness ratings for the less attractive faces. There were also some nearly significant interactions between rater sex and the attractiveness manipulation, $F(3,111) = 2.676$, $p = 0.051$, $\eta_\rho^2 = 0.067$, $\eta^2 = 0.018$, and between rater sex and pitch, $F(4,148) = 2.132$, $p = 0.080$, $\eta_\rho^2 = 0.054$, $\eta^2 = 0.003$, providing some evidence that male and female raters were affected in different ways by the attractiveness and pitch manipulations. Overall, as for the femininity judgments, there was a significant linear contrast effect for the pitch manipulation, $F(1,37) = 9.849$, $p = 0.003$, $\eta_\rho^2 = 0.210$, indicating that attractiveness linearly decreased as the upward tilt of the female faces increased. Consistent with the rater sex x pitch interaction approaching significance, this effect appears to be somewhat larger for male raters. Inter-rater reliability of the attractiveness ratings given to female faces was high for both male raters ($\alpha_{\text{Cronbach's}} = 0.927$, $n = 10$) and female raters ($\alpha_{\text{Cronbach's}} = 0.988$, $n = 29$) and all raters combined ($\alpha_{\text{Cronbach's}} = 0.989$, $n = 39$).

The analysis of the attractiveness ratings of the male faces produced predictably more complex results, since there is a much less straightforward relationship between masculinity and attractiveness (of male faces) than there is between femininity and attractiveness (of female faces). In this analysis (including both male and female raters) there was a significant main effect of the attractiveness manipulation, $F(3,108) = 125.26$, $p < 0.001$, $\eta_\rho^2 = 0.777$, $\eta^2 = 0.680$, which interacted with the sex of the rater, $F(3,108) = 8.235$, $p < 0.001$, $\eta_\rho^2 = 0.186$, $\eta^2 = 0.045$. Overall, there was no main effect of pitch, indicating that the tilt of the male faces did not affect attractiveness, but the interaction between pitch and sex of rater approached significance, $F(4,144) = 2.367$, $p = 0.056$, $\eta_\rho^2 = 0.052$, $\eta^2 = 0.001$. This may be because there is a hint of a pitch effect for male raters, with downward tilted (less masculine) faces being rated as more attractive by the males, whereas female ratings were essentially unaffected by pitch. This is not surprising since the attractiveness of facial masculinity for female raters depends on a number of variables that we did not control. Inter-rater reliability of the attractiveness ratings given to male faces was high for both male raters ($\alpha_{\text{Cronbach's}} = 0.941$, $n = 9$) and female raters ($\alpha_{\text{Cronbach's}} = 0.993$, $n = 29$) and all raters combined ($\alpha_{\text{Cronbach's}} = 0.993$, $n = 38$).

The second task, plotted in Figure 3, was perhaps a more sensitive measure of the effect of pitch, since it forced participants to pick the most masculine/feminine or most attractive face out of two that differed only in terms of pitch. As Figure 3 illustrates, for every forced choice (up 1 vs. straight, for example) female faces tilted more downwards are always chosen as more feminine (every $t > 3.48$, every $p < 0.001$, smallest Cohen's $d = 0.558$), and male faces tilted more upwards are always chosen as more masculine (every $t >$

3.1, every $p < 0.004$, smallest Cohen's $d = 0.503$). As with the rating data, the male and female preferences of attractiveness perfectly track femininity for female faces (the face judged to be most feminine is also rated most attractive (every $t > 2.64$, every $p < 0.013$, smallest Cohen's $d = 0.423$), but the pattern for male faces is more complex, with no consistent preference for more upward tilted (more masculine) or more downward tilted (less masculine) faces.

Figure 3. Mean percent preference of pitch of female and male faces in a 2 forced-choice task



Note: White bars show the female face judged most feminine and the male face judged most masculine for each pair. Light grey bars show the face judged most attractive by females and dark grey bars show the face picked as most attractive by males. Error bars represent ±1 standard error of the mean.

Discussion

These data provide the first evidence that the pitch of a face affects its perceived masculinity/femininity. Pitch also affects perceived attractiveness. The changes in perceived attractiveness are consistent with these effects being direct consequences of the changes in masculinity/femininity induced by different pitches. The typical male perspective on a female face (viewed from above) increases its femininity and attractiveness, and the typical female perspective on a male face (viewed from below) increases its masculinity, which will affect its attractiveness in different ways for different raters. This cannot be a simple consequence of familiarity, or norm-based coding of either attractiveness or masculinity/femininity. Previous studies have demonstrated that familiarity can increase both attractiveness and liking ratings (Little, DeBruine, and Jones, 2005; Rhodes and Halberstadt, 2001), and that attractiveness is at least partly defined by proximity to what is considered average in a face (Langois and Roggman, 1990). Since the average view that an average person has of own-sex faces is from straight-on (considering only the pitch axis of viewpoint) an experiential or norm-based coding account of the data would predict own-sex ratings of attractiveness and masculinity/femininity to peak at the 'straight-on' category of pitch. Our data are not consistent with this explanation since participants of both sexes also judged female faces to be more feminine and more attractive when tilted forwards, and less feminine and less attractive when tilted backwards, and judged male faces tilted backwards as more masculine, and male faces tilted forwards as less masculine.

The pitch effect on masculinity/femininity and on female attractiveness that we have discovered raises the possibility that the viewpoint difference afforded by the height dimorphism in bipedal hominins (including modern humans) could have provided divergent sexual selection pressures that resulted in selection for male and female faces that embodied or exaggerated these perspective differences in their typical proportions. If this is true, then it not only provides a new perspective on the evolution of sexual dimorphism in human faces, it would also be the first instance, so far as we are aware, of a communicative signal evolving through a process similar to sensory exploitation (Endler and Basolo, 1998; Ryan, 1998), in which a signal evolves to take advantage of an existing perceptual sensitivity, but where the signal is, in this case, exploiting a habitual perspective difference rather than a peripheral sensory sensitivity difference.

An alternative, though not necessarily competing, perspective on the evolution of masculinity and femininity signals in human faces involves the relationship between dominance and head-tilt. As suggested by Mignault and Chauderi (2003), a parallel may be able to be drawn between the dominance/appeasement displays of non-humans animals (which often involve stretching/rearing to increase perceived size or crouching/bowing to decrease perceived size) and the position of human heads during interactions. Human faces tilted up are rated as more dominant compared to faces tilted down (Mignault and Chauderi, 2003), and masculinized male and female faces are rated as more dominant than feminized faces when gaze is directed at the viewer (Main, Jones, and Debruine, 2009). To these relationships between pitch and dominance and between masculinity and dominance, the current study can add a direct relationship between pitch and masculinity of male faces, pitch and femininity of females and pitch and attractiveness of female faces. Taken together, these findings suggest the likely importance of dominance in the evolution and/or perception of facial signals of masculinity and femininity. Since the obvious opportunities individuals have to adjust the tilt of their head during interactions, it seems likely that signals of masculinity/femininity and dominance are closely interrelated in real world scenarios. Similarly, the selection pressures that resulted in the patterns of sexual dimorphism of human faces may have involved differences in the relative importance of dominance signals to the two sexes. Given the obvious viewpoint difference afforded by differences in height, we do not think hypotheses about dominance ought to replace the hypotheses about height in considering the evolutionary origins of human face sexual dimorphism. Rather, we suggest that both ideas are consistent with the available evidence and that the relative importance of and/or interactions between the two perspectives requires further investigation.

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