Association of Digit Ratio (2D:4D) with Self-Reported Attractiveness in Men and Women

Evidence from the BBC Internet Survey

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Abstract. Prenatal testosterone (PT) may influence attractiveness such that high PT increases attractiveness in men. Here we are concerned with self-perceptions of attractiveness, rather than ratings of attractiveness by others. Our sample was 255,116 participants drawn from an Internet survey. We considered the relationship between self-reported attractiveness and the ratio of the length of the 2nd and 4th digits (digit ratio, 2D:4D), a putative negative correlate of PT. Participants reported ratings on their general attractiveness, and the attractiveness of their face, voice, and body. There were significant effects of sexual orientation on the ratings and we considered only heterosexuals in all subsequent analyses. We found that 2D:4D was negatively correlated with general, facial, and body attractiveness, with the strongest association for body attractiveness. There was no relationship for voice attractiveness. General, facial, and body attractiveness were negatively associated with age and positively related to height (a possible correlate of adult testosterone, AT). However, the 2D:4D relationships were independent of age and height. 2D:4D differs across ethnic groups, but a consideration of only white Caucasians gave essentially the same results. We conclude that (1) high PT, as measured by low 2D:4D, is associated with self-perception of high attractiveness in men and women, and (2) the relationships between height and attractiveness indicate that AT is also positively correlated to self-perceptions of attractiveness in men and women. Thus, high PT and AT may increase body esteem in both men and women.

Keywords: digit ratio, 2D:4D, prenatal testosterone, height, self-reported attractiveness

Introduction

Digit ratio, or the relative lengths of the 2nd (index) and fourth (ring) fingers (2D:4D), is a sexually dimorphic trait with lower 2D:4D in males compared to females (see Manning, 2002 for review). The dimorphism is found in the fetus (Malas, Dogan, Evcil, & Desdicioglu, in press) and in children (Manning, Scutt, Wilson, & Lewis-Jones, 1998; McIntyre, Ellison, Liebermann, Demerath, & Towne, 2005); is unaffected by puberty (Trivers, Manning, & Jacobson, 2006), and appears to be universal across ethnic groups (Manning, 2002). Evidence such as this does not include direct measurements of prenatal testosterone (PT), but its sex dependent pattern led Manning et al. (1998) to suggest that 2D:4D may be negatively correlated to PT and positively related to prenatal estrogen.

In males, low 2D:4D (high PT) has been reported to be related to female ratings of attractiveness. Thus, after social interaction with potential mates, men with low 2D:4D are rated by women as more attractive than men with high 2D:4D (Roney & Maestripieri, 2004). The link between 2D:4D and attractiveness in men may be behavioural rather than physical because low 2D:4D is associated with higher levels of courtship behaviour (Roney & Maestripieri, 2004), but not to attractiveness ratings of the face (Neave, Laing, Fink, & Manning, 2003). However, Saino, Roman, and Innocenti (in press) found that an increased 4th digit length in relation to the 2nd digit increased women's attractiveness ratings of men's hands. Therefore, links between low male 2D:4D and female ratings of attractiveness may be partly behavioural and partly physical. For women there is less evidence for associations between 2D:4D and men's ratings of attractiveness. However, Saino et al. (in press) did find that increasing the length of the 2nd digit in relation to the 4th led to an increase in men's ratings of the attractiveness of women's hands.

We are concerned here with self-perceptions of attractiveness. For men there are no published data concerning links between 2D:4D and self-ratings of attractiveness. For women there are two relevant and contradictory studies. Klump et al. (2006) have reported that women with low 2D:4D tend to have low scores on a measure of body dissatisfaction, weight preoccupation and binge eating (The Minnesota Eating Behavior Survey). This finding suggests that women with low 2D:4D are more satisfied with their

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body than women with high 2D:4D. However, Wade, Shanley, and Imm (2004) found some evidence that women with low 2D:4D rated themselves as less physically attractive than women with high 2D:4D, although 2D:4D did not relate to 15 other correlates of self-perceived attractiveness such as sexual attractiveness, physical condition, appearance of eyes, and self-esteem.

Therefore, the associations between self-rated attractiveness and 2D:4D are not understood. The purpose of this work was to clarify such relationships. We controlled for age and height in our analyses. The former may be negatively related to perceptions of attractiveness as age-dependent changes affect such things as body shape. The latter has been suggested to be a marker for adult testosterone (AT; Vanderschueren & Boiullon, 1995), and AT may have activational effects (rather than the organizational effects of PT) on self-perceptions of attractiveness. In addition, we controlled for sexual orientation and ethnicity effects on both 2D:4D and attractiveness scores.

Methods

Participants were recruited from a BBC Internet study on cognitive and behavioural sex differences, hosted by the BBC Science and Nature Website (for details of the study see Peters et al., 2006). Data were collected between January and May 2005. The experiment took 30–40 min to complete and comprised questions about demographics, personality, social attitudes, and behaviours, along with cognitive tests and self-measurement of physical characteristics such as 2D:4D. There were six blocks, each taking between 3 and 6 min to complete.

The first questions in the study were sex (male/female) and age (drop-down menu 0–99 years) for which a value had to be entered in order to continue. Responses to all other questions were optional. Ethnicity appeared on the first page with sex and age, with a dropdown menu, from which participants could choose one of seven categories (Asian/Asian British, Black/Black British, Black other, Chinese, Middle/Near Eastern, Mixed ethnic, White).

In Part Two of the survey finger lengths were self-measured following the methodology reported by Manning et al. (1998). The instructions were as follows: "Hold your right hand in front of you. Look at where your ring finger joins the palm of your hand. Find the bottom crease. Go to the middle of this crease. Put the 0 of your ruler exactly on the middle of the bottom crease. Make sure the ruler runs straight up the middle of your finger. Measure to the tip of your finger (not your nail) in millimetres." Participants selected finger length in millimetres for left and right index and ring fingers using dropdown menus, with values between 10 and 100 mm in 1 mm increments. Participants were also asked to report their height in Part Two of the survey.

Following this, in Part Four there were four questions relating to self-perception of attractiveness.

– "In general, how physically attractive do you consider yourself to be?"
– "How attractive is your face?"
– "How attractive is your voice?"
– "How attractive is your body?"

The scoring options were on a scale of 1–7 (from *very unattractive* to *very attractive*). The questions were restricted to participants who reported that they were 18 years or older. Also in Part Four there was a question regarding sexual orientation. The question was restricted to participants who were "18 plus only" and was worded "What is your sexual orientation?" A drop-down menu provided the alternatives 1 = heterosexual (straight), 2 = homosexual (gay/lesbian), 3 = bisexual.

Results

There were 462,859 user IDs set up, and 255,116 people completed the entire study. Only the latter were included in the analysis reported here. All analyses were restricted to respondents who reported to be 18 years and older.

With regard to the 2D:4D data, there were extreme values varying from 0 to 10 in the complete data set. We excluded such unlikely values by considering a range from 0.80 to 1.20, which was consistent with values reported in large-scale experimenter-measured studies where measurements were made directly on the fingers rather than from photocopies of the hand (Manning et al., 1998; Manning, 2002). After these exclusions there were 201,865 participants (90,910 women) with a mean age (± *SD*) of 31.78 ± 11.08 years. The means for 2D:4D were right hand 0.988 ± 0.050 (201,865 participants) and left hand 0.988 ± 0.049. Digit ratio showed the expected sexual dimorphism with mean male 2D:4D lower than mean female 2D:4D (right hand; males n = 110,955, 0.984 ± .049, females n = 90,910, 0.994 ± .051, t = 44.04, p = .0001: left hand; males n = 110,955, 0.984 ± .048, females n = 90,910, 0.992 ± .049, t = 33.66, p = .0001).

In our sample of 201,865 participants there were 189,211 (83,311 women) who reported their height (in meters). Mean height was 1.732 ± 0.103 m, and, as expected, height was sexually dimorphic with men reporting higher values (men 1.793 ± 0.078 m, women 1.654 ± 0.076 m, p = .0001). A number of studies have shown sex differences in height of between .13 to .15 m, and our data (male-female height = .139 m) falls within this range.

For general attractiveness there were self-ratings from 199,142 participants (89,641 women) with a mean of 4.35 ± 1.33, and for self-ratings of attractiveness of the face from 200,051 participants (90,008 women) with a mean of 4.61 ± 1.34. Attractiveness of the voice was self-rated by 199,923 (89,941 women) with a mean score of 4.31 ± 1.43, and body attractiveness by 199,929 (89,956 women) with a mean score of 4.024 ± 1.46.

We used 2 × 3 ANOVAs (male, female × heterosexual,

Table 1. Correlations (*r*; product-moment correlation coefficient) between 2D:4D and self-reported ratings of general attractiveness and attractiveness of the face, voice, and body

	General attractiveness *r*	Facial attractiveness *r*	Voice attractiveness *r*	Body attractiveness *r*
Males	*n* = 98461	*n* = 98940	*n* = 98885	*n* = 98879
Right 2D:4D	–0.036***	–0.023***	–0.003	–0.041***
Left 2D:4D	–0.043***	–0.027***	–0.004	–0.044***
Females	*n* = 80576	*n* = 80900	*n* = 80838	*n* = 80858
Right 2D:4D	–0.037***	–0.017***	0.003	–0.044***
Left 2D:4D	–0.031***	–0.013***	0.001	–0.036***

*$p < .05$; **$p < .01$; ***$p < .001$

homosexual, and bisexual) to consider the relationships between self-reported attractiveness and sex and sexual orientation. With regard to general attractiveness we found a nonsignificant main effect for sex, $F(1, 198{,}120) = 0.99$, $p = .32$, but a significant main effect for sexual orientation, $F(2, 198{,}120) = 31.12$, $p = .0001$. There was a significant interaction, $F(2, 198{,}120) = 53.50$, $p = .0001$. The latter reflected a pattern in which homosexual males rated themselves more attractive than did heterosexual males (homosexual males 4.39 ± 1.33, heterosexual males 4.31 ± 1.32, Fisher's PLSD, $p = .0001$), but homosexual females rated themselves less attractive than did heterosexual females (homosexual females, 4.17 ± 1.38, heterosexual females 4.40 ± 1.33, Fisher's PLSD, $p = .0001$). Similar patterns of a nonsignificant effect of sex but significant main effects for sexual orientation and their interaction were found for attractiveness of the voice and the body. For the face there was a reversal of this pattern with a significant main effect for sex, with females self-rating their faces as more attractive than did males, $F(1, 199{,}018) = 34.67$, $p = .0001$, but not for sexual orientation, $F(2, 199{,}018) = 2.48$, $p = .08$. However, there was a significant interaction, $F(2, 199{,}018) = 84.55$, $p = .0001$, in which there was a pattern that was similar to that of attractiveness in general and for the voice and body. That is, homosexual males self-rated their faces as more attractive than did heterosexual males (homosexual males 4.73 ± 1.33, heterosexual males 4.52 ± 1.33, Fisher's PLSD, $p = .0001$), but homosexual females rated their faces less attractive than did heterosexual females (homosexual females, 4.51 ± 1.39, heterosexual females 4.71 ± 1.33, Fisher's PLSD, $p = .0001$). These effects of sex and sexual orientation on self-ratings of attractiveness are quite complex. However, we are concerned here with relationships between 2D:4D and self-perceptions of attractiveness. Therefore, we considered only heterosexuals in subsequent analyses.

2D:4D was significantly negatively correlated with general attractiveness, and attractiveness of the face and body (Table 1). The relationships were found for both males and females and were strongest for 2D:4D and self-reported body attractiveness (Figure 1). There were no significant relationships between 2D:4D and self-reported attractiveness of the voice.

Age also showed significant correlations with self-reported attractiveness. For general attractiveness, and attractiveness of the face and body there were significant negative associations with age (Table 2). For age and voice attractiveness the associations were positive. Correlations between height and self-reported attractiveness were all positive and significant (Table 2).

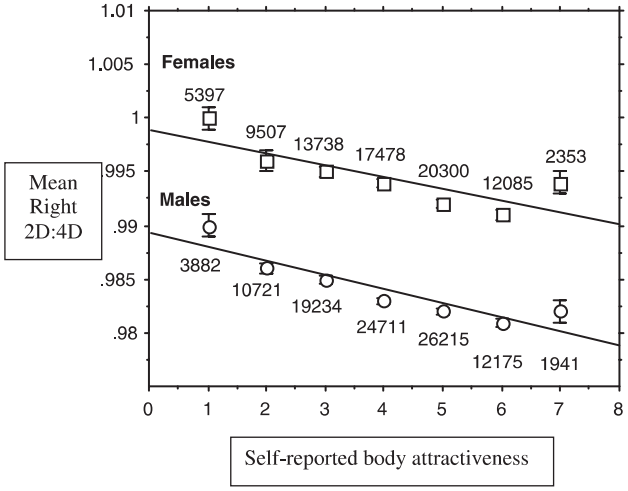

Figure 1. The relationship between right hand 2D:4D and self-reported body attractiveness scores (1 = *very unattractive* to 7 = *very attractive*) in heterosexual men (*n* = 98979) and heterosexual women (*n* = 80858). Sample sizes are given for each point on the body attractiveness scale.

Multiple regression analyses showed that for general attractiveness and attractiveness of the face and voice there were independent negative relationships for 2D:4D and age, and positive relationships for height. These associations were found in both men and women (Table 3). With regard to 2D:4D, the strongest association continued to be with body attractiveness. For voice attractiveness there were no significant correlations with 2D:4D, but significant positive correlations with age and height.

It is known that 2D:4D is dependent on ethnicity (Manning, 2002). Restricting our analysis to the most numerous group, i.e., White heterosexuals, we found essentially the same relationships between 2D:4D and attractiveness. For example, multiple regression analyses with independent vari-

Table 2. Correlations (*r*; product-moment correlation coefficient) between age and height, and self-reported ratings of general attractiveness, attractiveness of the face, voice, and body

	General attractiveness *r*	Facial attractiveness *r*	Voice attractiveness *r*	Body attractiveness *r*
Age				
Males	–0.50***	–0.064***	0.048***	–0.036***
Females	–0.078***	–0.081***	0.077***	–0.098***
Height				
Males	0.068***	0.053***	0.067***	0.051***
Females	0.038***	0.037***	0.017***	0.038***

*$p < .05$; **$p < .01$; ***$p < .001$

Table 3. Multiple regression analyses with associations (standardized partial regression coefficients) between independent variables right 2D:4D, age and height and dependent variables general attractiveness, and attractiveness of the face, voice, and body

	General attractiveness *St. reg. coeff.*	Facial attractiveness *St. reg. coeff.*	Voice attractiveness *St. reg. coeff.*	Body attractiveness *St. reg. coeff.*
Males	*n* = 94378	*n* = 94853	*n* = 94796	*n* = 94796
Right 2D:4D	–0.034***	–0.021***	–0.004	–0.040***
Age	–0.048***	–0.062***	0.052***	–0.034***
Height	0.065***	0.049***	0.071***	0.049***
Females	*n* = 74250	*n* = 74564	*n* = 74509	*n* = 74509
Right 2D:4D	–0.036***	–0.017***	0.002	–0.042***
Age	–0.074***	–0.078***	0.084***	–0.095***
Height	0.033***	0.033***	0.020***	0.033***

*$p < .05$; **$p < .01$; ***$p < .001$

ables right 2D:4D, age, and height, and dependent variables general, face, and body attractiveness gave significant negative relationships for both men and women (standardized partial regression coefficients; men, general attractiveness –0.036, face –0.024, body –0.042; women, general attractiveness –0.035, face –0.016, body –0.041; all with $p = .0001$).

Discussion

We have the following results: 2D:4D, a putative marker for PT, was negatively related to self-reported ratings for general, facial, and body attractiveness. There were no relationships between 2D:4D and self-perceptions of attractiveness of the voice. The correlations were significant for both men and women. These relationships suggest that high PT is associated with high self-ratings for attractiveness. Perhaps surprisingly, this is the case for women as well as men. Height showed positive correlations with attractiveness for both men and women. As height is a positive marker for AT, this suggests that high adult levels of testosterone are also related to high self-perceptions of attractiveness in men and women. These associations were independent of each other and independent of age.

Internet surveys have advantages and disadvantages. In this instance the principal advantage is the very large sample size. The drawbacks include a lack of control over recruitment such that participants had to have access to the Internet, and were disproportionately made up of white Caucasians from Europe and North America. Also measurement error was almost certainly very large. The effect sizes are small in this study but we do not know whether this is because they are in reality small, or whether they are considerably reduced by random measurement error. However, a very large sample makes up in some ways for a lack of rigor in sampling and measurement. Thus, if effects are real they are likely to show as weak but have low *p* values. This is the pattern that we found.

Our results suggest that PT and AT may have independent positive effects on body esteem in women and men. However, how strong is the position that 2D:4D is a negative correlate of PT? At present, indirect and direct evidence for a link between 2D:4D and PT is accumulating. Thus, digit ratio shows sex differences with lower mean 2D:4D in males compared to females (Manning et al., 1998; Manning, 2002). It appears that the sexual dimorphism arose early in the evolution of land vertebrates because it has been found in nonhuman primates, rodents, and birds (Brown, Hines, Fane, & Breedlove, 2002; Burley & Foster, 2004; Roney, Whitham, Leoni, Bellem, & Wielebnowski, 2004). The sex difference arises *in utero* (Malas et al., 2006), the strength of the dimorphism in infants is strongly related to the sex difference in adults (McIntyre et al., 2005), and 2D:4D of young children is strongly correlated with their 2D:4D after a number of years of growth (Trivers et

al., 2005). *In utero* twin effects have been noted for 2D:4D such that female members of twins discordant for sex have lower mean 2D:4D than in same-sex twins (Van Anders, Vernon, & Wilbur, 2006). More direct evidence for a 2D:4D/PT link is that 2D:4D is lower in children with congenital adrenal hyperplasia (CAH), a condition in which high prenatal testosterone is produced, than in controls (Okten, Kalyoncu, & Yaris, 2002; Brown, Finn et al., 2002; but see Buck, Williams, Hughes, & Acerini, 2003). In addition, 2D:4D is positively correlated with testosterone insensitivity (Manning, Bundred, Newton, & Flanagan, 2003), and negatively correlated with the testosterone:estrogen ratio obtained from amniocentesis (i.e., hormonal measurements obtained from the amniotic fluid of the fetus; Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004).

Our finding that PT and AT both have positive effects on body self-esteem may have implications for our understanding of female disordered-eating patterns. High 2D:4D has been found to correlate with high scores from the Minnesota Eating Behavior Survey (Klump et al., in press). Markers of low levels of testosterone and high levels of estrogen such as waist-to-hip ratio are related to high male ratings of female physical attractiveness (for review see Wade et al., 2004). It may be that there are discrepancies between women's own perceptions of attractiveness and that of men's perceptions of women's attractiveness such that the former is dependent on testosterone and the latter dependent on estrogen.

In conclusion, we have found that a potential marker for high PT (low 2D:4D) is related to high self-reported ratings for general, facial, and body attractiveness in men and women. In addition, a potential correlate of AT (height) is also related to similar self-perceptions of attractiveness. We suggest that testosterone has positive organizational and activational effects on body esteem in both men and women.

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