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Attractiveness, body size, masculine sex roles and 2D:4D ratios in men

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ABSTRACT

Several studies have examined men's attractiveness in relation to the index-to-ring-finger (2D:4D) ratio, which may be linked to prenatal androgen levels. These studies have yielded conflicting results and have not controlled for related characteristics (i.e., body size and masculine personality/sex role). The present study again examined this relation and attempted to address these limitations. Participants were 273 men recruited at university. The men were assessed for physical attractiveness (both self-perceived and other-rated), body size (height, BMI), 2D:4D ratios and masculine personality/sex roles. Results showed that masculine personality/sex role and height predicted men's attractiveness. Results also indicated that a low (more masculine) 2D:4D ratio in the right hand was related to men's attractiveness. This relationship occurred controlling for body size and personality/sex roles, along with relevant demographics. The findings suggest that women may be partially attracted to men because of their relative level of prenatal androgen exposure; and that features of physical attractiveness in men are, at least partly, androgen-based markers of fitness detectable by women.

1. Introduction

A number of lines of evidence support a linkage between the index-to-ring-finger (2D:4D) ratio and prenatal androgens. First, male fetuses have higher exposure to androgens (e.g., testosterone) prenatally than do female fetuses, and men have lower 2D:4D ratios than women (Manning, 2002). Second, Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, and Manning (2004) showed that high fetal testosterone levels and low fetal estrogen levels predicted a low 2D:4D ratio in children assessed two years later. Third, children exposed to high prenatal androgens resulting from congenital adrenal hyperplasia (CAH) have lower 2D:4D ratios than controls (Brown, Hines, Fane, & Breedlove, 2002). Fourth, research using animal models (e.g., rats) indicates that 2D:4D of the forefeet is lower after exposure to prenatal testosterone (Talarovicová, Krsková, & Blazeková, 2009). Additional evidence supporting such a linkage can be found in Manning, Churchill, and Peters (2007).

The relationships between digit ratio and androgen-linked characteristics are stronger in the right hand than in the left. For example, research indicates that a low 2D:4D ratio of the right hand correlates more strongly with such characteristics as sperm count, testosterone concentrations, and athleticism than a low 2D:4D ratio of the left hand (e.g., Manning, Scutt, Wilson, & Lewis-Jones, 1998). This may not be surprising, as male forms of sex dimorphic traits are typically more pronounced on the right side of the body (Lutchmaya et al., 2004). Thus, the digits of the right hand may be more androgen-sensitive than those of the left hand.

Investigators have examined men's physical attractiveness and 2D:4D (e.g., Neave, Laing, Fink, & Manning, 2003; Russell, 2006). Such a relationship is interesting because, if reliable, it suggests that women are (partially) attracted to men because of their relative level of prenatal androgen exposure; and that features of physical attractiveness in men are prenatal androgen-based markers of fitness (e.g., sperm quality; dominance/competitiveness) detectable by women.

However, the available evidence is conflicting about whether a more masculine (lower) 2D:4D ratio is indeed related to men's attractiveness. This relationship has been examined indirectly through sex dimorphic (e.g., dominant/masculine) facial features in men, as these features are sometimes rated as attractive by women (e.g., Waynforth, Delwadia, & Camm, 2005). Two studies (Fink, Grammer, Manning, & Neave, 2004; Neave et al., 2003) have yielded the predicted relationship, but two others have not (see, Burriss, Little, & Nelson, 2007; Koehler, Rhodes, & Simmons, 2004). The 2D:4D/attractiveness relationship also has been examined more directly by self-rated and/or other-rated attractiveness (Manning & Quinton, 2007; Neave et al., 2003; Roney & Maestripieri, 2004; Russell, 2006). Two studies (Manning & Quinton, 2007; Roney & Maestripieri, 2004) yielded the expected correlation, while two did not. Thus, more research is needed to establish if a reliable relationship does exist between physical attractiveness and 2D:4D in men.

In the present research, a new test of this relationship was conducted. We also included potentially related characteristics: body

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size (e.g., height, BMI) and masculine personality/sex role. Body size, particularly elevated height, is important because it is often perceived as attractive by women (e.g., Nettle, 2002). There also may be a small negative relationship between height and 2D:4D (Hurd & van Anders, 2007; Tester & Campbell, 2007). Of the two studies yielding significant associations between 2D:4D and physical attractiveness, the Roney and Maestripieri (2004) study demonstrated the strongest relationship. However, this study did not assess body size, and the other study (Manning & Quinton, 2007) did not control for it. Thus, new research is needed to establish if an association between 2D:4D and attractiveness occurs independent of body size. Masculine personality/sex roles are also important as they too may relate to men's attractiveness (e.g., Sadalla, Kenrick, & Vershure, 1987). Masculine personality/sex role characteristics and 2D:4D ratios have also been related (e.g., Bailey & Hurd, 2005; McIntyre et al., 2007), although inconsistently (e.g., Lippa, 2006). No study examining 2D:4D and physical attractiveness has, to our knowledge, included masculine personality/sex roles. Thus, new research is needed to establish if an association between 2D:4D and attractiveness occurs independent of personality/sex role characteristics. In summary, 2D:4D ratio's relationship to men's attractiveness is important to assess within the context of both body size and personality/sex roles.

2. Method

2.1. Participants

Participants were 273 men aged 16.8–51.3 (M = 21.4 years), recruited through advertisements posted at a Canadian university (Brock), and on a psychology research website at the same university.

2.2. Measurement of demographics and predictor variables

2.2.1. Demographics

Age, income (1 = "under $5000" to 12 = "$100,000 or more"), education (1 = "less than grade 9" to 8 = "Doctorate, currently attending or completed degree"), and ethnicity/race (1 = "White," 2 = "Black," 3 = "Asian," and 4 = "other") were assessed. In this study, "Asian" referred to East Asian (e.g., Chinese). Along with providing basic sample information, these variables are important because some may act as confounds, and thus, were controlled for in the main analyses. For example, 2D:4D ratios vary with ethnicity (e.g., Manning, 2002).

2.2.2. Self-perceived attractiveness

Participants rated themselves on physical attractiveness, sexual appeal, and how a stranger would rate their physical attractiveness on a 7-point scale (i.e., 1 = "well below average" to 7 = "well above average"). Cronbach's Alpha for these three self-ratings was .912.

2.2.3. Other-rated attractiveness

Self-perceived attractiveness correlates well with other-rated attractiveness (Weeden & Sabini, 2007). Self-ratings also may capture unique variation in real/objective attractiveness that other-rated attractiveness does not capture, particularly if assessed as a static or one-time rating (for a discussion, see Weeden & Sabini, 2007), but they also may capture psychological variation beyond real/objective attractiveness, such as self-esteem and narcissism (e.g., Critelli, Ee, & Gabriel, 1994). Thus, to assess attractiveness more fully, the participants were rated on attractiveness by two heterosexual female researchers. The first rater assessed the entire sample. The second female rater rated a subset of men (147 of 273). The two ratings were independently (i.e., blindly) assessed and used a 7-point scale (i.e., 1 = "well below average" to 7 = "well above average"). The two raters were blind to the hypothesis (i.e., that 2D:4D would relate to men's attractiveness).

The correlation between the two raters was r = 0.505, p < 0.001, indicating a fairly large (but not complete) degree of overlap in the raters' assessments of the men. The aggregate (i.e., mean) of the three self-perceived attractiveness ratings correlated .313 (p < .001) with the first rater's assessment and .227 (p < .01) with the second rater's assessment of the men's attractiveness. Three additional aggregate measures of attractiveness were formed by (1) averaging the first rater and second rater's assessments (sub-sample; n = 147); (2) averaging the mean of the self-ratings with the first rater's assessment (full sample); and (3) averaging the mean of the self-ratings with the first rater and the second rater's assessment (sub-sample; n = 147).

2.2.4. 2D:4D

The lengths of the ring and index fingers on both the right and left hands were measured directly using a Vernier caliper, to the nearest 0.01 mm. Direct measures are argued to be superior to indirect methods (scans/photocopies) because the latter may lead to distortions in 2D:4D ratios (Manning, Fink, Neave, & Caswell, 2005). As suggested by Manning (2002), the lengths of the digits were measured on the underside (or palm surface) of the hand from the lowest crease (closest to the palm) of the finger to the tip. Only creases extending at least halfway across the width of the finger were used in this measurement. Prior to measurement, participants were asked by the first rater (first female researcher mentioned above) to place their hand palm-up on the desk, and to stretch their fingers to ensure that the area being measured was as flat and smooth as possible. In a subset of the men (i.e., 148 cases), a second rater (second female researcher mentioned above) was also used to measure digit lengths. The two raters independently assessed the figure-lengths (i.e., "blindly"). The correlations between the two raters for the four digits ranged from r = 0.935 to 0.957. When the ratios themselves were constructed (i.e., 2D/4D), the correlation between raters was r = 0.760, p < 0.001 for the right hand; for left hand 2D:4D, it was r = 0.750, p < 0.001. These correlations (i.e., repeatabilities) for the direct measurement of finger lengths and the derived ratios are very similar to Manning et al. (2005). Given the degree of correspondence between the raters, and that the second rater only rated a subset of participants, only the first rater's ratings of finger lengths were used in the present study.

2.2.5. Height and weight

Each participant was assessed for height (using a stadiometer) and weight (using a Tanita digital scale). Participants were asked to remove shoes and hats prior to measurement. Body mass index (BMI) was calculated by multiplying each participant's weight (in pounds) by 704.5, and dividing the product by his squared height (in inches).

2.2.6. Masculine/feminine personality/sex roles

Six scales measuring various aspects of masculine personality/sex roles were included. Participants completed the extended version of the personal attributes questionnaire (EPAQ; Spence, Helmreich, & Stapp, 1973), with some items removed due to unreliability (McCreary, personal communication, August, 2005). The final version consisted of 24 items in total, measuring three personal attributes relating to (1) agency (focus on self), (2) communion (focus on others), and (3) unmitigated agency (extreme focus on the self to the exclusion of others). Participants were asked to indicate the degree to which each item describes what kind of person they are on a 5-point scale (i.e., A = "not at all independent" to E = "very independent"). Cronbach's Alphas for these scales in this study were .698, .708, and .667, respectively.

Table 1
Means and standard deviations for the measures.

Measures	*M*	SD
Right hand 2D4D	0.97	0.03
Left hand 2D4D	0.97	0.04
Age	21.47	3.81
Height	177.62	6.60
BMI	25.48	4.00
Occupational preferences	76.76	10.11
CMNI total score	133.97	23.96
Agency	3.69	0.58
Communion	3.84	0.52
Agency (unmitigated)	2.72	0.57
Communion (unmitigated)	25.33	5.44
Physical attractiveness – rater 1	4.10	1.29
Physical attractiveness – rater 2	3.74	1.62
Inter-rater average of physical attractiveness	3.88	1.28
Self-reported physical attractiveness average	4.69	0.92
Physical attractiveness total 1	4.40	0.90
Physical attractiveness total 2	4.16	0.99

Note: Physical attractiveness total 1 = sum of rater 1 and self-reported rating; and physical attractiveness total 2 = sum of rater 1, rater 2, and self-reported rating.

Given that several EPAQ items were unreliable, participants completed the (4) unmitigated communion scale (Korabik & McCreary, 2000), which measures an extreme focus on others to the exclusion of the self (i.e., a traditional feminine quality). They rated the degree to which each of the eight items described them on a 5-point scale (1 = "not at all like me" to 5 = "very much like me"). An example is "I place the needs of others above my own." Cronbach's Alpha for this scale in this study was .752.

Additionally, participants completed (5) the conformity to male role norms scale (CMNI; Mahalik et al., 2003). This scale contains 94 items answered on a 4-point Likert scale, and is designed to measure attitudes, behaviors and cognitions reflecting both conformity to, and non-conformity to, eleven masculine normative messages (i.e., winning, emotional control, risk-taking, violence, power over women, dominance, playboy, self-reliance, primacy of work, disdain for homosexuals, and pursuit of status). The CMNI total score is the sum of all 94 items, with higher scores reflecting greater conformity to the identified masculine norm. An example item is "It is best to keep your emotions hidden." Cronbach's Alpha for this scale was .922.

Finally, we employed the occupational preferences scale (e.g., Lippa, 2005). Research has shown that there are sex differences in preferences for occupations (Lippa, 2005). This scale includes a list of 40 occupations. Participants indicate how much they would like to do each kind of work on a 5-point scale (e.g., "I would like to be a children's author;" 1 = "strongly disagree" to 5 = "strongly agree"). Items referring to "feminine" occupations (Cronbach's Alpha = .836) were reverse-scored and then combined with the "masculine" occupations (Cronbach's Alpha = .832) to produce a total score (i.e., a high score corresponded to more masculine occupational preferences).

2.3. Procedure

Participants were assessed in groups of 5–15. Measures used in the present study were included as part of a larger study on personality and sexual preferences (Fawcett, 2006). While questionnaires were being completed, participants were summoned individually to a corner of the room to be assessed for height, weight and digit ratio by the first rater. At this time too, the second rater assessed the finger lengths and physical attractiveness for the subset of participants she measured. The first rater assessed physical attractiveness at the end of the study. After completing the physical measurements, participants returned to their desks to complete the questionnaire. When finished with the questionnaire, the men were offered either research credit (28 men) or $20 (245 men) for their participation. Participants received a detailed debriefing before leaving. Questionnaires took approximately 30 min to complete. The methods were approved by the Research Ethics at Brock University in Canada (Fawcett, 2006).

3. Results

The participants were 83.7% White, 2.6% Black, 6.3% Asian, and 7.4% belonged to other ethnic groups (for the remaining analyses, ethnicity/race was coded as 1 = "White" and 2 = "non-White"). The means for the 2D:4D ratios for the full sample was .972 for right hand; .967 for left hand. For Whites only, the means were .973 and .969, respectively. These ratios were similar to those reported by Manning and his colleagues for direct measurement using calipers (i.e., see Table 2; Manning et al., 2005, pp. 97–98). For more information on descriptive statistics of the sample (see Table 1).

Table 2 shows the relationship among the predictors. A high (more feminine) 2D:4D ratio related to one aspect of masculine/feminine personality/sex roles, i.e., unmitigated communion. A low (more masculine) 2D:4D ratio did not significantly predict height, although the correlations for the left and right hand were in this direction. Also, not surprisingly, the measures of masculine

Table 2
Correlations among predictors.

	Right hand 2D4D	Left hand 2D4D	Age	Height	BMI	Occupational preferences	CMNI total score	Agency	Communion	Agency (unmitigated)	Communion (unmitigated)
Right hand 2D4D	1	.644***	.109	−.023	.097	.005	−.128	−.035	.099	−.107	.133*
Left hand 2D4D		1	.007	−.083	.085	.105	−.058	.007	−.006	.002	.149*
Age			1	−.033	.144*	−.073	−.189**	−.048	−.061	.018	.017
Height				1	−.181**	.058	.008	.038	−.048	−.021	−.099
BMI					1	.029	−.049	.080	.091	−.080	.095
Occupational preferences						1	.358***	.106	−.145*	.076	.026
CMNI total score							1	.313***	−.289***	.436***	−.275***
Agency								1	.110	.114	−.099
Communion									1	−.381***	.511***
Agency (unmitigated)										1	−.259***
Communion (unmitigated)											1

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

Table 3
Correlations between predictors and attractiveness.

	Physical attractiveness – rater 1	Physical attractiveness – rater 2	Inter-rater average of physical attractiveness	Self-reported physical attractiveness average	Physical attractiveness total 1	Physical attractiveness total 2
Right hand 2D4D	−.170**	−.222**	−.200*	−.123*	−.181**	−.229**
Left hand 2D4D	−.146*	−.108	−.115	−.039	−.119	−.091
Age	−.275***	−.066	−.218**	−.067	−.222***	−.198*
Height	.275***	.105	.176*	.109	.244***	.180*
BMI	−.093	−.069	−.082	−.049	−.078	−.066
Occupational preferences	−.020	.098	.094	.023	−.009	.111
CMNI total score	.112	.188*	.196*	.281***	.216**	.271**
Agency	.126*	.052	.070	.247***	.215***	.128
Communion	−.067	−.189*	−.175*	.060	−.013	−.143
Agency (unmitigated)	.034	.109	.083	.174**	.116	.103
Communion (unmitigated)	−.136*	−.207**	−.205*	−.076	−.129*	−.196*

Note: Physical attractiveness total 1 = sum of rater 1 and self-reported ratings; and physical attractiveness total 2 = sum of rater 1, rater 2, and self-reported ratings.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

personality/sex role were related to one another (e.g., agency and CMNI total).

Table 3 shows the relations between the predictors and attractiveness. Age was negatively related to attractiveness. Second, men who were taller were more attractive than those who were shorter. Also, right hand 2D:4D ratio related to all of the attractiveness ratings, including aggregates of the various ratings of attractiveness. Thus, as predicted, a low (more masculine) 2D:4D pattern was related to a higher degree of attractiveness. A low (more masculine) left hand 2D:4D was not, although in the predicted direction, significantly related to attractiveness, except for one rating (first rater). In addition, most of the attractiveness ratings correlated with one measure of a masculine personality/sex role (i.e., CMNI), and were negatively related to one measure of feminine personality/sex role (i.e., unmitigated communion).

Given the association between attractiveness and 2D:4D occurred primarily for the right hand, when assessing predictors of attractiveness within a multivariate context, we only used right hand 2D:4D. Thus, we examined the relationship between right hand 2D:4D ratio and attractiveness controlling for age, ethnicity/race, body size (height and BMI), and masculinity personality/sex roles in two linear regressions, one with the aggregate rating of the first rater and the self-rating (i.e., full sample) and one with mean rating of the first rater, second rater, and the self-rating (subsample) as the dependent variables. As shown in Tables 4 and 5, age (negatively) and height (positively) significantly predicted men's attractiveness in both analyses. In the analysis with the full sample (Table 4), agency, CMNI, and masculine occupational preferences (negatively) predicted attractiveness. In the analysis with the sub-sample (Table 5), CMNI (positively) predicted attractiveness. Most relevant to the present investigation, however, a low (more masculine) right hand 2D:4D ratio remained a significant predictor of men's attractiveness in both analyses (Tables 4 and 5).

4. Discussion

We replicated relationships found in previous studies. First, taller men were more physically attractive than shorter men (e.g., Nettle, 2002). Second, age was negatively associated with attractiveness (e.g., Manning & Quinton, 2007). Third, attractiveness related to some aspects of masculine personality/sex roles (e.g., Sadalla et al., 1987). Finally, there was evidence that personality/sex role characteristics related to 2D:4D (e.g., Bailey & Hurd, 2005), yet, to our knowledge, the specific personality/sex role characteristics demonstrating these relationships in the present study (e.g., unmitigated communion) have not been examined previously. Although in the predicted direction, we did not replicate a significant relationship between height and (low) 2D:4D ratio observed in a recent study (Tester & Campbell, 2007). This relationship is likely very small and may require very large samples, along with direct measures of digit ratios, to demonstrate it reliably.

We showed that, as predicted, a low 2D:4D ratio in the right hand was related to men's attractiveness. This relationship occurred with three independent assessments of men's attractiveness (their own, and two female raters' assessments). This relationship also occurred controlling for demographics, personal-

Table 4
Multiple regression predicting attraction (physical attractiveness total 1: sum of rater 1 and self-report ratings).

Predictor	*B*	Standard error	Beta	*P*
Age	−.040	.014	−.181	.005
Ethnicity/race	−.244	.155	−.102	.116
Height	.033	.009	.244	.000
BMI	−.009	.014	−.041	.525
Right hand 2D4D	−4.359	1.707	−.158	.011
Occupational preferences	−.012	.006	−.135	.044
CMNI total score	.006	.003	.172	.030
Agency	.208	.102	.133	.043
Communion	.112	.133	.065	.401
Agency (unmitigated)	.052	.112	.033	.643
Communion (unmitigated)	−.009	.012	−.055	.448

Table 5
Multiple regression predicting attractiveness (physical attractiveness total 2; sum of two raters and self-reported attractiveness).

Predictor	*B*	Standard error	Beta	*P*
Age	−.061	.030	−.188	.049
Ethnicity/race	−.127	.274	−.044	.643
Height	.037	.015	.231	.017
BMI	.000	.025	.000	.992
Right hand 2D4D	−7.319	2.834	−.240	.011
Occupational preferences	−.008	.010	−.084	.407
CMNI total score	.010	.004	.228	.036
Agency	.065	.168	.037	.700
Communion	−.177	.227	−.090	.438
Agency (unmitigated)	−.142	.194	−.078	.467
Communion (unmitigated)	−.012	.018	−.063	.527

ity/sex roles, and body size. These results suggest that women may be attracted to men because of their relative level of prenatal androgen exposure, and that features of physical attractiveness in men are, at least partly, prenatal androgen-based markers of fitness (e.g., sperm quality; dominance/competitiveness) detectable by women.

The previous research was conflicted on whether a significant relationship between 2D:4D ratio and attractiveness exists in men (cf., Roney & Maestripieri, 2004). Why would the present study be able to detect a relationship when many of previous studies have not? One reason is that, if the true relationship between 2D:4D and attractiveness is small, it may not be detectable in studies that had relatively small power. Indeed, the effect in the present study was relatively small (e.g., correlations ranged from .136 to .253), and the power to detect small effects exceeded both Neave et al. (2003) and Russell (2006), which had sample sizes of less than 70 participants (c.f., Roney & Maestripieri, 2004). The assessment of the main constructs (2D:4D; attractiveness) may have also been improved in the present study relative to previous research examining this issue. All but one previous study used indirect measures (scans/photocopies) of 2D:4D. As mentioned, such indirect measures have been argued to cause distortions in 2D:4D (Manning et al., 2005). The other published study examining this issue (Manning & Quinton, 2007) did employ direct measures, but participants measured their fingers themselves. In our study, a trained rater measured all participants, and this is likely superior (e.g., increased consistency) to self-report. We also used three independent assessments of men's attractiveness, whereas most previous studies used one method, and/or static, two-dimensional assessments (e.g., photographs). Interestingly, the strongest relationship between attractiveness and 2D:4D occurred when the three assessments of attractiveness were averaged. This is not surprising because an average of three independent assessments of a construct is usually more reliable than one assessment (e.g., Epstein, 1983). It also is not surprising that Roney and Maestripieri (2004) found a relatively strong relationship between 2D:4D and attractiveness, which, like the present study, included direct, other-rated attractiveness assessments. Perhaps direct, other-rated assessments are the best method of assessing physical attractiveness because they provide a three-dimensional assessment of a person in real-time.

A more fundamental question, however, is: Why is the 2D:4D/attractiveness relationship small in the first place? One reason is that 2D:4D is likely an imprecise indicator of prenatal androgen exposure. Other factors (e.g., genetics, ethnicity, latitude) likely contribute to digit ratios (see, Manning, 2002). Second, even if 2D:4D ratios were perfectly correlated with level of prenatal androgens, evidence suggests that masculine features (via, for example, prenatal androgen exposure) are not the only element in men's attractiveness. Facial symmetry is an additional feature that increases attractiveness, and symmetry and masculinity may be partially independent attributes affecting the overall attractiveness ratings of men's faces (e.g., Penton-Voak et al., 2001). There is also evidence that a lower (more masculine) 2D:4D relationship is associated with higher facial asymmetry in men (Fink et al., 2004). Thus, the 2D:4D relation to men's attractiveness may occur primarily via an androgenization effect on the masculinity of men's faces, and not because of (and even in spite of), its potentially negative effect on symmetry. Note that we expect that our findings reflect primarily facial (vs. body or personality) masculinity as the 2D:4D relationship with attractiveness was still significant after controlling for body size and masculine personality/sex role.

The inconsistent relationship between 2D:4D and ratings of men's attractiveness may also reflect variations in women's ovulatory status. Women find masculine bodies and faces most attractive when they are ovulating (e.g., Little, Jones, & Burriss, 2007). If so, female raters who are ovulating may assess low (more masculine) 2D:4D men as attractive, but female raters who are not ovulating may not rate low 2D:4D men as particularly attractive because they are using other cues in their assessment. Thus, stronger results may occur if women's ovulatory status was controlled (e.g., only having female raters who are ovulating). Future research should continue to examine men's attractiveness (masculine features; symmetry) and their 2D:4D ratios, but also assess the female raters' ovulatory status.

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