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Self-perceived attractiveness and masculinization predict women's sociosexuality

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Abstract

Women vary with respect to monogamous/polyandrous inclinations, as indexed by the Sociosexual Orientation Inventory (SOI). Possible sources of SOI variation include variation in perceptions relating to the utility of different mating tactics and variation in one's degree of masculinity/femininity, among other things. In three studies with undergraduate participants SOI, an index of self-perceived attractiveness and two measures of masculinization, namely scores on the Vandenberg Mental Rotation test (V-MRT) and 2D:4D digit ratios, were measured. Self-perceived attractiveness predicted SOI in the first study, but not in the second study. Right 2D:4D did predict SOI in the second study. In the third study, both self-perceived attractiveness and right 2D:4D predicted SOI, and so did V-MRT scores. However, the strongest single predictor of SOI in Study 3 was the reported amount spent on alcohol during the average month.
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The Sociosexual Orientation Inventory (SOI) measures willingness to engage in casual (uncommitted) sex (Simpson & Gangestad, 1991). Variation in this inclination may account for much variation in reproductive histories and may reflect alternative mating tactics. Buss and Schmitt (1993) have identified two main human mating tactics, long term and short term. The former refers to building exclusive, long-term mating relationships with an emphasis on large amounts of parental investment from both partners. The latter tactic refers to mating

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with a large number of short-term partners, with women in particular putting increased emphasis on choosing mates of high genetic quality. An unrestricted sociosexual orientation (high SOI score) is equated with a short-term mating tactic, and a restricted sociosexual orientation (low SOI score) is equated with a long-term mating tactic (Gangestad & Simpson, 2000). The intrasexual strategic variability revealed by variance in SOI scores begs two questions: what are the ultimate explanations that account for this variability and what are the proximate mechanisms that determine it?

Alternative mating tactics are often employed in service of a conditional mating strategy; that is, the tactic that an individual employs is contingent on its status (Gross, 1996). An important element of an individual's status is the relative quality of its conspecifics. Captive male *Panorpa* scorpion flies "upgrade" their mating tactics if a larger male is removed from their environments, suggesting that smaller males had been using suboptimal tactics to avoid competition with higher quality males (Thornhill, 1981). Møller and Thornhill (1998) have reported an association between parental care and extrapair paternity across 18 bird species in which attractive males engage in less parental care when extrapair paternity rates are high. Presumably the attractive males are spending more time and energy pursuing extrapair copulations to the detriment of their parental duties. The expected payoff of this tactic is contingent on a male's relative attractiveness. Attractive males can expect better returns on further mating effort than less attractive males can. A similar mechanism may be operating for human males, where fluctuating asymmetry negatively predicts SOI score (Gangestad & Simpson, 2000). Low fluctuating asymmetry is believed to be an indicator of genetic quality (Møller & Swaddle, 1997); men with "good" genes are more likely to pursue short-term tactics.

This facultative pattern may apply to human females as well. Short-term mating tactics may have greater utility for women with high mate value because they can extract more resources from short-term mates than women with low mate value can, or perhaps because their mates should be willing to accept a greater risk of being cuckolded. Low waist-to-hip ratios in women are attractive to men (Singh, 1993), and Mikach and Bailey (1999) found that women who report having had a relatively large number of sex partners (25–200) had lower waist-to-hip ratios than women with fewer sexual partners (0–10). Similarly, Reise and Wright (1996) found a positive correlation between a woman's SOI score and her propensity to describe herself as "attractive and good-looking." Reise and Wright's results support the idea that self-perceived attractiveness may be a proximate regulator of shifts in mating tactics. The studies discussed in this paper were, in part, performed to further test this idea.

1. Study 1

1.1. Methods

The participants were 37 women aged 18–30 years (mean age = 20, S.D. = 2.6) enrolled in a first-year psychology course during 2001 at McMaster University. They received course credit for their participation.

This study consisted of two tasks. In the first, the participant was shown a stimulus set of photographs depicting 20 women (all of European descent) presented successively and in random order. The stimulus set was chosen from facial photographs of undergraduate women taken at another Canadian university in 1996. All 20 photographs were taken under the same lighting conditions; each depicted a woman from the shoulders up wearing a black smock. The participant was asked to rate each face as more or less attractive than herself. The number of faces rated as less attractive than the participant was used as an index of the participant's self-perceived attractiveness; higher scores indicate higher self-perceived attractiveness. This "more-or-less" test is novel and makes use of direct comparison to provide a reference-based measure of self-perceived attractiveness. It may be more comparable across participants than a score obtained by simply asking participants to rate their own attractiveness on a scale.

Participants completed Simpson and Gangestad's (1991) seven-item SOI scale as the second task in this study. Item 4 of the SOI scale ("How often do you fantasize about having sex with someone other than your current dating partner?") assumes a current romantic relationship, thus excluding many participants. Indeed, Item 4 was skipped more often than any other item. Using factor analysis, Item 4 had the smallest communality and the smallest loading on the first principal component of any of the seven items by a large margin. Therefore, SOI score was calculated by Simpson and Gangestad's suggested formula, but excluding Item 4. This same method was also used in Studies 2 and 3.

The correlation between self-perceived attractiveness and SOI score was calculated. A nonparametric statistic was used because of the small sample size and apparently nonnormal distribution of the SOI scores.

1.2. Results

Self-perceived attractiveness scores ranged from 7 to 20 (mean = 13.5, S.D. = 3.7). SOI scores ranged from 6 to 56 (mean = 21.7, S.D. = 14.9).

There was a significant positive correlation between self-perceived attractiveness and SOI score (Spearman's rho = 0.397, $P = .02$, $n = 34$).

2. Study 2

Additional factors affecting SOI variance in women may have little to do with a conditional mating strategy. Men have generally been found to have less restricted sociosexual orientations than women, and short-term mating tactics are more characteristic of males than females (Buss & Schmitt, 1993; Simpson & Gangestad, 1991). Women with higher SOI scores could therefore be thought of as possessing a more malelike sociosexual orientation. These women may have been exposed to more malelike developmental conditions than women with lower SOI scores. Using self-report and interviewer-rated measures of masculinity, Mikach and Bailey (1999) found that women who reported having a high number of sexual partners were more masculine than those who reported a "normal"

number. It may also be possible to obtain a physical measure of developmental masculinization. The 2D:4D ratio (the length of the second digit, or index finger, divided by the length of the fourth digit, or ring finger) is prenatally determined and has been linked to concentrations of steroidal hormones in the uterine environment, with low 2D:4D ratios indicating high testosterone and low estrogen levels, and high 2D:4D ratios indicating low testosterone and high estrogen levels (Manning, 2002). The 2D:4D ratio is sexually dimorphic in many populations, with males having lower ratios (Manning, 2002). If high levels of testosterone in the prenatal environment have a masculinizing effect on a woman's mating psychology, this effect may manifest itself in a negative correlation between 2D:4D ratio and women's SOI scores.

2.1. Methods

The participants were 36 women aged 18–27 (mean age = 20, S.D.=1.7) enrolled in a first-year psychology course during the spring of 2002 at McMaster University. They received course credit for their participation.

Participants completed the same two tasks described for Study 1, then participants' hands were photographed for the purposes of measuring 2D:4D ratios, and their faces were photographed so that they could be rated for attractiveness by third-party raters. We took a photograph of the bottom of each hand while it rested palm up on top of a flat wooden board. A sheet of graph paper (squares 1×1 cm) was taped to the board to provide a scale reference. The camera pointed downward from a tripod mount at a distance of about 1 m above this surface.

Scion Image was used to measure the lengths (mm) of the second and fourth digits on each hand. The digits were measured from the tip of each finger to the center of the basal crease where the finger meets the hand. 2D:4D ratios for each hand were calculated by dividing the length of the second digit by the length of the fourth digit. Each hand was measured twice to establish repeatability.

Permission to take facial photographs for the purposes of having them rated was obtained (or refused) before the participants started the first task (six women declined to have their faces photographed). Photographs were taken with participants standing in front of a white background. These photographs depicted the participants from the midtorso up, displaying a neutral facial expression. These were later reduced and cropped to match the depictions of the women in the stimulus set. The participants' faces were rated for attractiveness along a 7-point scale by 87 independent undergraduate raters (48 male and 39 female) ranging in age from 18 to 24.

Correlations were calculated between SOI score and self-perceived attractiveness, third-party ratings of attractiveness and the 2D:4D ratios, and also between third-party ratings of attractiveness and self-perceived attractiveness. Nonparametric statistics were used for correlations involving SOI because of the small sample size and apparently nonnormal distribution of the SOI scores. Left 2D:4D and right 2D:4D ratios were analyzed as separate variables, partly out of convention and partly because of evidence that masculinization is expressed more strongly in the right hand (Manning, 2002).

2.2. Results

A list of the variables, their ranges, means, and standard deviations is provided in Table 1.

There was no statistically significant correlation between self-perceived attractiveness and SOI score (Spearman's rho = −0.06, $P = .743$, $n = 32$), and no correlation between third-party ratings of attractiveness and SOI score (Spearman's rho = −0.167, $P = .395$, $n = 28$). However, there was a significant negative correlation between SOI score and right 2D:4D (Spearman's rho = −0.470, $P = .009$, $n = 30$), but the correlation between SOI score and left 2D:4D failed to reach significance (Spearman's rho = −0.321, $P = .078$, $n = 29$).

The first and second measures of left 2D:4D had a high intraclass correlation coefficient ($r_1 = .98$), as did the first and second measures of right 2D:4D ($r_1 = .91$). Repeated measures ANOVA analyses showed that variation in 2D:4D due to measurement error was low compared to variation in 2D:4D between individuals (left 2D:4D: $F = 46.98$, $P < .0001$; right 2D:4D: $F = 11.07$, $P < .0001$).

Self-perceived attractiveness and third-party ratings of attractiveness were significantly correlated with each other ($r = .585$, $P = .001$, $n = 30$), as were right 2D:4D and left 2D:4D ($r = .607$, $P < .001$, $n = 33$).

3. Study 3

Spatial rotation tasks offer another index of cognitive masculinization. Males are better at spatial rotation than females (Vandenburg & Kuse, 1978), and spatial rotation ability is thought to be linked to both adult and prenatal testosterone levels (Kimura, 1999). Some of the evidence cementing the link with prenatal testosterone comes from studies of womb-mates. Because women with twin brothers are likely to have been exposed to higher levels of prenatal testosterone than women with twin sisters, a comparison between these groups constitutes a test of whether an ability is affected by the hormones present during this early stage of development, and women with twin brothers indeed perform better on spatial rotation tasks than women with twin sisters (Cole-Harding, Morstad, and Wilson, 1988). Another line of evidence is provided by studies of girls diagnosed with congenital adrenal hyperplasia (CAH). People afflicted with CAH have enlarged adrenal glands that produce an overabundance of androgens. Girls with this disease have enhanced spatial ability compared

Table 1
The variables used in Study 2, their ranges, means and standard deviations

Variable	Range (min–max)	Mean±S.D.
SOI	6–68	25.41±15.76
Self-perceived attractiveness	0–20	13.37±4.83
Mean third-party attractiveness rating	1.87–4.84	3.03±0.92
Left 2D:4D	0.88–1.04	0.97±0.044
Right 2D:4D	0.89–1.02	0.96±0.031

to girls without it (Hampson, Rovet, and Altmann, 1998), implying that the high androgen dosage has a masculinizing effect on the girls' brains.

If the variance in mating tactics observed between women is partially attributable to the masculinizing effect of prenatal testosterone, women's SOI scores should be predicted by spatial rotation ability as well as by 2D:4D ratio.

3.1. Methods

The participants were 75 women of European descent aged 17–24 (mean age = 20, S.D.=3.6) who were enrolled in a first-year psychology course at McMaster University. They received course credit for their participation. Female research assistants were responsible for all interactions with the participants.

Each participant completed four tasks. The first task was identical to that described in Study 1. The second task was a spatial rotation task. Participants were given 10 min to complete 20 items of the Vandenberg Mental Rotation task (V-MRT) (Vandenburg & Kuse, 1978).

Following the spatial rotation task was a questionnaire that included the SOI items and a question asking the participant, "Are you on hormonal contraception?" It also included a section in which they were asked to estimate how much money they spend for various expense categories (such as alcohol, food, rent, clothes, cosmetics, etc.) over the course of an average month, in order to explore the possibility that SOI score might be related to expenditure on categories related to mate value (such as hair care, athletic expenses, clothing, etc.).

The last component of the study involved photographing the participants' hands for the purposes of measuring 2D:4D ratios, and their faces so that they could be rated for attractiveness by third-party raters. For the hand photographs, participants were directed to place their hands (one at a time) on top of a pane of antireflective glass with their whole hand making contact with the glass and their fingers spread. Their hands were covered with a sheet of paper to minimize glare from overhead lights. One photograph of each hand was taken with a digital camera positioned underneath the hand at a lens distance of 46 cm. The resulting images were uploaded to a personal computer where 2D:4D ratios were measured and recorded using a custom-made program. Reference points for measurements and calculation methods were as in Study 2. Each hand was measured twice to establish repeatability.

Table 2
The variables used in Study 3, their ranges, means and standard deviations

Variable	Range (min.–max.)	Mean±S.D.
SOI	6–78	26.30±17.61
Self-perceived attractiveness	5–20	15.35±3.60
Mean third-party attractiveness rating	1.86–5.41	3.45±0.83
Left 2D:4D	0.904–1.058	0.979±0.028
Right 2D:4D	0.921–1.069	0.973±0.029
V-MRT (raw score)	9–39	26.49±5.97
Alcohol expenditure ($/month)	0–250	44.86±44.44

Permission to take face photographs for the purposes of rating them was obtained (or refused) only after the first three components of the study were complete (35 women declined to have their faces photographed). Face photographs were taken and manipulated as in Study 2. The participants' faces were rated for attractiveness along a 7-point scale by 22 independent raters (11 male and 11 female) ranging in age from 21 to 39 years.

All statistical analyses were performed using SPSS 10. Parametric statistics were used because the sample size was adequate, and because the distribution of SOI scores more closely approximated a normal distribution.

3.2. Results

A list of the variables, their ranges, means, and standard deviations is provided in Table 2.

The first and second measures of left 2D:4D had a high intraclass correlation coefficient ($r_1 = .93$), as did the first and second measures of right 2D:4D ($r_1 = .97$). Repeated measures ANOVA analyses showed that variation in 2D:4D due to measurement error was low compared to variation in 2D:4D between individuals (left 2D:4D: $F = 14.16$, $P < .0001$; right 2D:4D: $F = 29.11$, $P < .0001$).

A multiple regression analysis was performed with SOI score as the dependent variable and self-perceived attractiveness, left 2D:4D, right 2D:4D and raw V-MRT score as the predictor variables (Table 3, Model I). The overall model is significant [$F(4,63) = 5.44$, $P = .001$, $R^2 = .257$].

Alcohol expenditure was the only expense category that correlated with SOI ($r = .50$, $P < .001$, two-tailed, $n = 72$). Because of the strength of this correlation I ran another multiple regression with SOI score as the dependent variable and self-perceived attractiveness, left 2D:4D, right 2D:4D, raw V-MRT score, and monthly expenditure on alcohol as the predictor variables (Table 3, Model II). This model is also significant [$F(5,61) = 10.85$, $P < .001$, $R^2 = .471$].

None of the significant predictors of SOI were significantly correlated with each other. Left 2D:4D and right 2D:4D were significantly correlated with each other ($r = .5$, $P < .001$, two-tailed, $n = 70$). Surprisingly, V-MRT scores were not significantly correlated with either left

Table 3
Two multiple regression models with SOI as the dependent variable

	Model I			Model II		
Predictor variables	β	t	p	β	t	p
Self-perceived attractiveness	.259	2.370	.021	.235	2.501	.015
V-MRT	.397	3.564	.001	.337	3.492	.001
Left 2D:4D	.135	1.052	.297	.169	1.531	.131
Right 2D:4D	−.254	−2.036	.046	−.274	−2.564	.013
Alcohol expenditure	–	–	–	.464	4.9	<.001

In Model I, self-perceived attractiveness, V-MRT score, left 2D:4D, and right 2D:4D are the predictors. Model II uses these four predictors as well as a fifth: average monthly expenditure on alcohol.

2D:4D ($r=-.22$, $P=.065$, two-tailed, $n=70$) or right 2D:4D ($r=-.06$, $P=.608$, two-tailed, $n=70$).

Student's t tests revealed that women who reported that they were taking hormonal contraception ($n=34$) performed better on the V-MRT (mean V-MRT score±S.D.= 28.12±5.81, mean SOI score±S.D.=35.56±19.26) ($t=2.383$, $P=.02$, $df=73$) and had higher SOI scores ($t=4.836$, $P<.001$, $df=71$) than women who reported that they were not taking hormonal contraception ($n=39$) (mean V-MRT score±S.D.=24.87±5.8, mean SOI score-±S.D.=17.43±10.78). Controlling for reported use of hormonal contraception via partial correlation left a significant correlation between SOI and V-MRT ($r=.26$, $P=.029$, two-tailed, $n=70$). Self-perceived attractiveness was also higher in the group of women who reported that they were using hormonal contraception ($t=2.654$, $P=.01$, $df=73$) but third-party ratings of attractiveness were not ($t=0.985$, $P=.33$, $df=39$) (contraceptive users: mean self-perceived attractiveness±S.D.=16.47±3.15, mean third-party ratings±S.D.=3.56 ± 0.75; nonusers: mean self-perceived attractiveness±S.D.=14.31±3.74, mean third-party ratings±S.D.= 3.31±0.93).

Third-party ratings of attractiveness were not correlated with self-perceived attractiveness ($r=-.15$, $P=.34$, two-tailed, $n=41$) nor with SOI ($r=-.01$, $P=.97$, two-tailed, $n=41$). Student's t tests reveal no difference in SOI score or self-perceived attractiveness between those participants who agreed to have their pictures taken (mean SOI score±S.D.=28.51±19.86, mean self-perceived attractiveness±S.D.=15.46±3.46) and those who did not (mean SOI score±S.D.=23.47±14.03, mean self-perceived attractiveness±S.D.=15.21±3.80) ($t=1.270$, $P=.208$, $df=73$ and $t=0.307$, $P=.76$, $df=75$, respectively).

4. Discussion

These three studies provide some support for the hypothesis that a woman's SOI is partially governed by a facultative adjustment of mating tactics and, likewise, some support for the hypothesis that SOI is partially determined by prenatal androgen levels.

Self-perceived attractiveness was a significant positive predictor of SOI score in Studies 1 and 3. This finding is consistent with the hypothesis that women's mating strategy is facultatively linked to their self-perceived mate value: Women who perceive themselves as more attractive score higher on the SOI scale. However, in Study 3, neither self-perceived attractiveness nor SOI score was correlated with third-party ratings of attractiveness. Together, these two negative findings suggest that the higher SOI scores of self-perceived attractive women are not a result of their greater sexual opportunity (through being propositioned more often, or having their own advances accepted more often). In contrast, behaving in a sociosexually unrestricted manner may lead to self-perceptions of attractiveness, thus reversing the causal chain implied by the proposed conditional strategy.

Although self and third-party ratings of attractiveness were highly correlated in Study 2, the lack of such a relationship in Study 3 is problematic for the conditional-strategy hypothesis, because this strategy relies on accurate assessment of one's own mate value. Similarly, the lack of correlation between third-party ratings of attractiveness and SOI

score, found in Studies 2 and 3, is problematic because other's perceptions of mate value should inform mating tactics if the conditional strategy is to be functional. On the other hand, the discrepancy between participants' self-perceptions and those of third-party raters might arise because the rating tasks were not identical. The participants made judgments based on a single, static representation of each of the stimulus faces and a whole lifetime of experience with their own images. The third-party raters were simply exposed to the photographs taken on the day of the experiment. Therefore, the participants may have simply had access to more favorable representations of themselves than the third-party raters did.

This possibility would not explain the observed null relationship between SOI and third-party attractiveness ratings. Although participants were rating their own attractiveness relative to facial photographs, their self-perceived attractiveness scores may have incorporated other elements of mate value (e.g., personality, intelligence, attractiveness of body). Mikach and Bailey's (1999) finding that waist-to-hip ratio is lower in women with many partners suggests a connection between SOI and nonfacial components of mate value.

Spatial ability and right 2D:4D were also significant predictors of SOI. Higher V-MRT scores in Study 3 and lower right 2D:4D in Studies 2 and 3 were both associated with higher SOI scores. Together, these findings support the hypothesis that prenatal testosterone levels affect adult mating tactics, with high prenatal testosterone leading to "malelike" short-term mating tactics. Hormonal contraception could confound the apparent association between the V-MRT and SOI scores in Study 3. Women's scores on mental rotation tasks vary over the menstrual cycle: Women at low-estrogen phases (i.e., menstrual and follicular) perform better than women who are at high-estrogen phases (i.e., luteal) (Hampson, 1990a,1990b; Hampson & Kimura, 1988; Hausmann, et al., 2000). Because of the induced hormonal profile, women who are using hormonal contraception perform like women at the menstrual and follicular phases (Hampson, 1990c; McCormick & Teillon, 2001). Thus, women using hormonal contraception would be expected to perform better on average than women who are cycling naturally simply because some proportion of the latter group would be at high-estrogen phases of their cycles (Hampson, personal communication). This predicted association was observed in Study 3. Moreover, socio-sexually unrestricted women may be more likely to use hormonal contraception than more restricted women; the hormonal contraceptive users in this study did have higher SOI scores. Thus, it is possible that the association between V-MRT and SOI scores observed in the multiple regression was driven by a shared association with hormonal contraception. Nevertheless, a partial-correlation approach revealed a significant relationship between SOI and V-MRT after controlling for contraceptive use.

In both Studies 2 and 3, right 2D:4D ratio predicted SOI score significantly but left 2D:4D ratio did not, although this discrepancy was more marked in Study 3. This finding is not necessarily incongruent with the prenatal testosterone hypothesis. Tanner (1990) suggested that androgens act to enhance the development of sexually dimorphic traits on the right side of the body. Kimura (1994) found that men with bigger right testes and women with bigger right breasts score better on male-advantage tasks (including tasks involving spatial ability), whereas men with bigger left testes and women with bigger left breasts score better on

female-advantage tasks. Therefore, right 2D:4D might be expected to predict the effects of early developmental masculinization better than left 2D:4D.

One problem with this interpretation is that neither left 2D:4D nor right 2D:4D predicted V-MRT scores in Study 3. This finding seems surprising because 2D:4D ratio and spatial ability are both believed to be associated with prenatal androgen levels, and therefore an association between these traits would be expected. The finding of a null association between these traits is not new (see Coolican & Peters, 2003; Manning, 2002), but does not seem to have been adequately explained.

In Study 3, self-perceived attractiveness was not correlated with V-MRT score or 2D:4D ratio (left or right), indicating that these variables were all independent predictors of a woman's promiscuity. This suggests that any attractiveness-contingent effects on mating tactics operate independently of prenatal hormone influences that might masculinize a woman's mating psychology. Whereas the conditional-strategy account supports an adaptive explanation for some of the SOI variation among women, it seems possible that some of this variation is simply a by-product of (unexplained) variation in prenatal hormone levels.

Alcohol is an evolutionarily novel substance with pharmacological effects that have been linked to sexually unrestricted behaviour (e.g., Corcoran & Thomas, 1991; Leigh & Schafer, 1993; Luster & Small, 1994; Temple & Leigh, 1992). In Study 3, average monthly expenditure on alcohol was a strong positive predictor of SOI score. Even this relatively crude assay of alcohol consumption appears to explain more of the variation in SOI than self-perceived attractiveness or either measure of developmental masculinization. Study 3's multiple regression Model I, which includes the theoretically derived predictor variables of self-perceived attractiveness, 2D:4D ratio, and mental rotation score, explains about 26% of the variance in SOI scores. However, by adding monthly alcohol expenditure to these predictor variables, Model II explains about 47% of SOI variance.

Large as it is, this effect is not easy to interpret. Sociosexual variability in women (and possibly in men) may be artificially increased by variation in exposure to alcohol. On the other hand, alcohol expenditure may be related to a willingness to seek situations where promiscuous behavior is elevated, either because of the pharmacological effects of alcohol or because of the social contexts where alcohol is consumed, or both. This finding deserves further study.

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References

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: an evolutionary perspective on human mating. *Psychological Review*, *100*, 204–232.

Cole-Harding, S., Morstad, A. L., & Wilson, J. R. (1988). Spatial ability in members of opposite sex twin pairs. *Behavior Genetics*, *18*, 710.

Coolican, J., & Peters, W. (2003). Sexual dimorphism in the 2D/4D ratio and its relation to mental rotation performance. *Evolution and Human Behavior*, *24*, 153–230.

Corcoran, K. J., & Thomas, L. R. (1991). The influence of observed alcohol consumption on perceptions of initiation of sexual activity in a college dating situation. *Journal of Applied Social Psychology*, *21*, 500–507.

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: trade-offs and strategic pluralism. *Behavioural and Brain Sciences*, *23*, 573–644.

Gross, M. R. (1996). Alternative reproductive strategies and tactics: diversity within sexes. *Trends in Ecology and Evolution*, *11*, 92–98.

Hampson, E. (1990a). Estrogen-related variations in human spatial and articulatory–motor skills. *Psychoneuroendocrinology*, *15*, 97–111.

Hampson, E. (1990b). Variations in sex-related cognitive abilities across the menstrual cycle. *Brain and Cognition*, *14*, 26–43.

Hampson, E. (1990c). Influence of gonadal hormones on cognitive function in women. *Clinical Neuropharmacology*, *13*, 522–523.

Hampson, E., & Kimura, D. (1988). Reciprocal effects of hormonal fluctuations on human motor and perceptual–spatial skills. *Behavioral Neuroscience*, *102*, 456–459.

Hampson, E., Rovet, J. F., & Altmann, D. (1998). Spatial reasoning in children with congenital adrenal hyperplasia due to 21-hydroxylase deficiency. *Developmental Neuropsychology*, *14*, 299–320.

Hausmann, M., Slabbekoorn, D., Van Goozen, S. H. M., Cohen-Kettenis, P. T., & Güntürkün, O. (2000). Sex hormones affect spatial abilities during the menstrual cycle. *Behavioral Neuroscience*, *114*, 1245–1250.

Kimura, D. (1994). Body asymmetry and intellectual pattern. *Personality and Individual Differences*, *19*, 471–478.

Kimura, D. (1999). *Sex and cognition*. Cambridge, MA: MIT Press.

Leigh, B. C., & Schafer, J. C. (1993). Heavy drinking occasions and the occurrence of sexual activity. *Psychology of Addictive Behaviors*, *7*, 197–200.

Luster, T., & Small, S. A. (1994). Factors associated with sexual risk-taking behaviors among adolescents. *Journal of Marriage and the Family*, *56*, 622–632.

Manning, J. T. (2002). *Digit ratio: a pointer to fertility, behavior, and health*. New Brunswick, NJ: Rutgers University Press.

McCormick, C. M., & Teillon, S. M. (2001). Menstrual cycle variation in spatial ability: relation to salivary cortisol levels. *Hormones and Behavior*, *39*, 29–38.

Mikach, S. M., & Bailey, J. M. (1999). What distinguishes women with unusually high numbers of sex partners? *Evolution and Human Behaviour*, *20*, 141–150.

Møller, A. P., & Swaddle, J. P. (1997). *Asymmetry, developmental stability, and evolution*. Oxford: Oxford University Press.

Møller, A. P., & Thornhill, R. (1998). Male parental care, differential parental investment by females, and sexual selection. *Animal Behaviour*, *55*, 1507–1515.

Reise, S. K., & Wright, T. M. (1996). Personality traits, cluster B personality disorders, and sociosexuality. *Journal of Research in Personality*, *30*, 128–136.

Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology*, *60*, 870–883.

Singh, D. (1993). Adaptive significance of female physical attractiveness: role of waist-to-hip ratio. *Journal of Personality and Social Psychology*, *65*, 293–307.

Tanner, J. M. (1990). *Foetus into man: physical growth from conception to maturity*. Cambridge, MA: Harvard University Press.

Temple, M. T., & Leigh, B. C. (1992). Alcohol consumption and unsafe sexual behavior in discrete events. *Journal of Sex Research*, *29*, 207–219.

Thornhill, R. (1981). *Panorpa* (Mecoptera: Panorpidae) scorpionflies: systems for understanding resource-defense polygyny and alternative male reproductive efforts. *Annual Review of Ecology and Systematics*, *12*, 355–386.

Vandenberg, S. G., & Kuse, A. R. (1978). Mental rotations, a group test of three-dimensional spatial visualization. *Perceptual and Motor Skills*, *47*, 599–604.