

**Impact of Two Biological Signals, Fluctuating Asymmetry and Finger Length Ratios, on
Perceived Quality of Individuals**

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ABSTRACT

Although we tend to think that our behavior, including our attraction to individuals, is a result of experience, in fact a lot of our perceptions and reactions are influenced by innate biological mechanisms. An important factor in our perception of individuals' attractiveness is linked to those individuals' bilateral symmetry which is an indirect indicator of developmental stability and hence overall quality. Similarly, individuals' exposure to prenatal hormones can greatly influence their adult behavior. For my study I used two indirect markers to test the influence of symmetry (fluctuating asymmetry or FA) and of prenatal hormones (finger length, 2D:4D, ratios).

In part 1, male and female raters assessed female models for various qualities (attractiveness, femininity/masculinity, submissiveness/dominance, butch/femme, jealousy, and perceived sexual orientation). The results suggest that as model FA increased, raters' perception of mate quality decreased (i.e. more deviation from traits typically associated with male preferences in a female mate). Results were similar for male and female raters except for assessments of dominance; males' ratings increased with increasing FA but females' show no significant pattern. In part 2, male raters gave themselves ratings for various traits. The data revealed that males exposed to less testosterone prenatally (i.e., had higher 2D:4D ratios) tended to rate themselves as less masculine and less dominant, with lower tendencies towards jealousy. Although studies have identified the link between prenatal hormones and differences in these traits, my study is the first to show that men's self perceptions also reflect prenatal testosterone levels.

INTRODUCTION

Symmetry and Attractiveness

A number of studies indicate that symmetry is an important cue when assessing attractiveness²⁴. Symmetry is a reflection of developmental stability which is the ability of individual organisms to produce a specific phenotype under various environmental conditions as dictated by its genetic code²⁵.

Numerous studies indicate that developmental stability is associated with increased probability of survival as well as greater reproductive success²¹. For example, there is a negative correlation between symmetry and survivability in tent caterpillar moths¹⁸ and a positive correlation between symmetry and reproductive success has been documented in many species^{15, 17}. Males with higher symmetry also tend to have: deep, masculinized voices²²; masculine faces⁴; increased ambition, social status and financial wealth; desire for children; and a commitment to family⁴. Similarly, more symmetrical females exhibit features of youthfulness, health and physical attractiveness which indicate high fecundity and reproductive potential to potential mates⁴.

Given these correlations, symmetry is considered to be an honest signal of individual quality.

Perceptions of Attractiveness

Attractiveness is relative. This means that individuals adjust their perception of attractiveness depending on external influences or social settings. For example, an individual's perceived attractiveness is influenced by the relative attractiveness of those around them (i.e., by

the local competition^{6, 26}. Females exposed to attractive same-sex individuals decreased ratings of their own face and body attractiveness whereas upon exposure to unattractive “others” increased self-ratings of attractiveness¹³. This effect holds true regardless of whether individuals or photos of individuals are viewed^{11, 12}. Men, however, did not significantly alter their self-evaluations of attractiveness after exposure to more physically attractive men⁸.

Individuals’ assessment of others is also influenced by their self perception such that ‘likes attract’. Thought to be a strategy for efficient mate selection, individuals tend to find others that are similar in quality to themselves more attractive than those who differ greatly, be they more or less attractive. The relativistic hypothesis of ‘likes attract’ assumes that the degree of similarity of partners increases the stability of a long term relationship and thus has a positive influence on reproductive success¹.

Estimating Symmetry: FA

Most studies estimate symmetry using fluctuating asymmetry (FA). During development, the same genes control development of bilateral traits on the left and right side of the body, thus, the expression of the traits should be identical on both sides. While this exists under ideal conditions, developmental noise can disturb patterns of cell division, differentiation and growth causing subtle deviations¹⁴. FA is defined as the small, random deviations from symmetry that arise in otherwise bilaterally symmetrical traits as a consequence of developmental noise and developmental instability¹⁴. Therefore, FA can be used as indirect measure of developmental instability.

FA and Sexual Orientation

A recent study documented a significant difference in bilateral symmetry between homosexuals and heterosexuals⁹. This could influence homosexuals' use of symmetry for assessing mates in two ways. First, because the pool of potential mates has lower symmetry, gays and lesbians should, on average, rate less symmetrical individuals as more attractive than do heterosexuals. As well, homosexuals with a given level of symmetry should generally rate themselves as more attractive than will heterosexuals with similar symmetry (lower expectations of average symmetry).

Finger Length Ratios

Finger length ratios (FLRs), more specifically the ratio between the second and fourth finger length (2D:4D), is thought to be determined in utero by about the fourteenth week and remain stable between childhood and adulthood^{15, 16, 20}. FLRs reflect exposure to prenatal hormones with individuals exposed to more testosterone (relative to estrogen) exhibiting shorter index fingers than ring fingers^{7,10}. There is evidence that exposure to testosterone during critical periods of development is essential for masculinization of behavior and that exposure to prenatal estrogen points to a feminizing or demasculinizing effect²³. As a consequence, men's ratios tend to be significantly lower than are women's^{7,10}.

Predictions

The objectives of this study were to examine the link between developmental stability and perceived characteristics of attractiveness using fluctuating asymmetry to assess variations in how symmetry is utilized by individuals of different sexes and sexual orientations as well as to examine the effect of the link between prenatal hormones and developmental instability (using

2D:4D) on the perceived quality of potential male mates. This study also investigated the many different relationships between sexual orientation, sex typicality, mate quality and biological factors to determine if there were correlations between any of these factors.

It was expected that raters evaluation of the female models would reflect the models' developmental stability and hence that models with higher FA will be assigned qualities associated with less preferred mates. It is also expected that since lower 2D:4D ratios signify more prenatal testosterone; raters with lower ratios will assess themselves as more masculine and dominant.

METHODS

Data Collection

Homosexual and heterosexual volunteers were recruited in and around the American University campus during spring 2008. Raters signed an informed consent form and completed a brief survey. The survey included questions on sexual orientation, sexual history and sexual desires. It also asked raters to assess the perceived attractiveness, dominance, masculinity, jealousy, butchness and sexual orientation of themselves, models, and average gay and straight men and women.

Raters also assessed a series of female models (straight and lesbian) represented in 4.5x6 inches, color photos on neutral backgrounds. These images were forward facing faces showing neutral expressions with hair pulled back, no jewelry, with limited to no clothing showing. No information about the models (e.g., sexual orientation, FA estimates, etc) was provided to raters.

The models FA was determined using eight bilateral body traits (length of four fingers, width of wrist, elbow, knee and ankle) by established methods⁹ The raters also had their hands scanned using a portable scanner. Analysis of preliminary data indicated that there was very little measurement associated with using scanned images)

Before scanning, the crease between the palm and each finger on the raters' hands was marked with a fine point marker. Raters' hands were then placed flat and palm-side down on surface of the scanner and scanned into the computer. It was important to have each rater enter their rater number as the file name for the saved image of their hand so that their values finger length values could be combined with their survey data during analysis.

Each participant's finger lengths were measured (from the marked crease to the highest point on the tip of the finger) two times for each of the four fingers and averaged (to increase accuracy) using the software program JImage. The finger lengths were used to estimate the combined D2:D4 finger length ratios for the left and right hands $((2D_{\text{left}}/4D_{\text{left}}) + (2D_{\text{right}}/4D_{\text{right}}))$ and to calculate each individual's composite FA by summing $(L-R)/((L+R)/2)$ for each finger length (D2-D5).

Data Analysis

After all data collection was complete, each survey, FA and 2D:4D value was carefully entered into a database organized by the randomly assigned rater number. The database was reviewed for input error. Upon data entry, all statistical analysis was performed using Least Square Linear Regressions and ANOVA Estimate Models on SYSTAT Version 11 for Windows.

RESULTS

Fluctuating Asymmetry and Perceived Quality of Individuals

Perceived Model Character	Trend with Increasing Model FA	Rater Populations with Significant Correlations
Attractiveness	Decreased	All: Men, Women; Individually: Str Men, Str Women
Submissiveness	Decreased	All: Men; Individually: Str Men, Gay Women
‘Femme’ score*	Decreased	All: Men, Women; Individually: Str Men, Str Women, Gay Men, Gay Women
Femininity	Decreased	All: Men, Women; Individually: Str Men, Str Women, Gay Men, Gay Women
Sexual Orientation	Decreased (toward gay)	All: Men, Women; Individually: Str Men, Str Women, Gay Men, Gay Women
Jealousy	NS	

*butch/femme includes the idea of a masculine/feminine appearance and also aspects of speech, body movement, dress, career preferences and leisure activities (dependent of sexual orientation); significant correlations: $P \leq 0.05$ and $R \geq 0.10$

Table 1: Influence of Model FA on Perceived Quality

Results presented in Table 1 are reported for ‘Rater Populations’ for which there was a significant relationship between ratings and FA scores. “All” indicates comparisons with all individuals of a given sex, regardless of sexual orientation; “Individual” indicates results for specific subgroups (by rater sex and sexual orientation). Comparisons for ‘Femme’ score (butch/femme scale), Femininity (masculinity/femininity scale), and Sexual Orientation (straight/gay scale) showed significant correlations for all subgroups; significant negative correlations with model FA were observed only among some subgroups for attractiveness and submissiveness ratings. Negative correlations observed between model FA and raters’ estimates of various characteristics are consistent with lower quality individuals being assigned lower ratings for other preferred traits.

Finger Length Ratios and Perceived Quality of Individuals

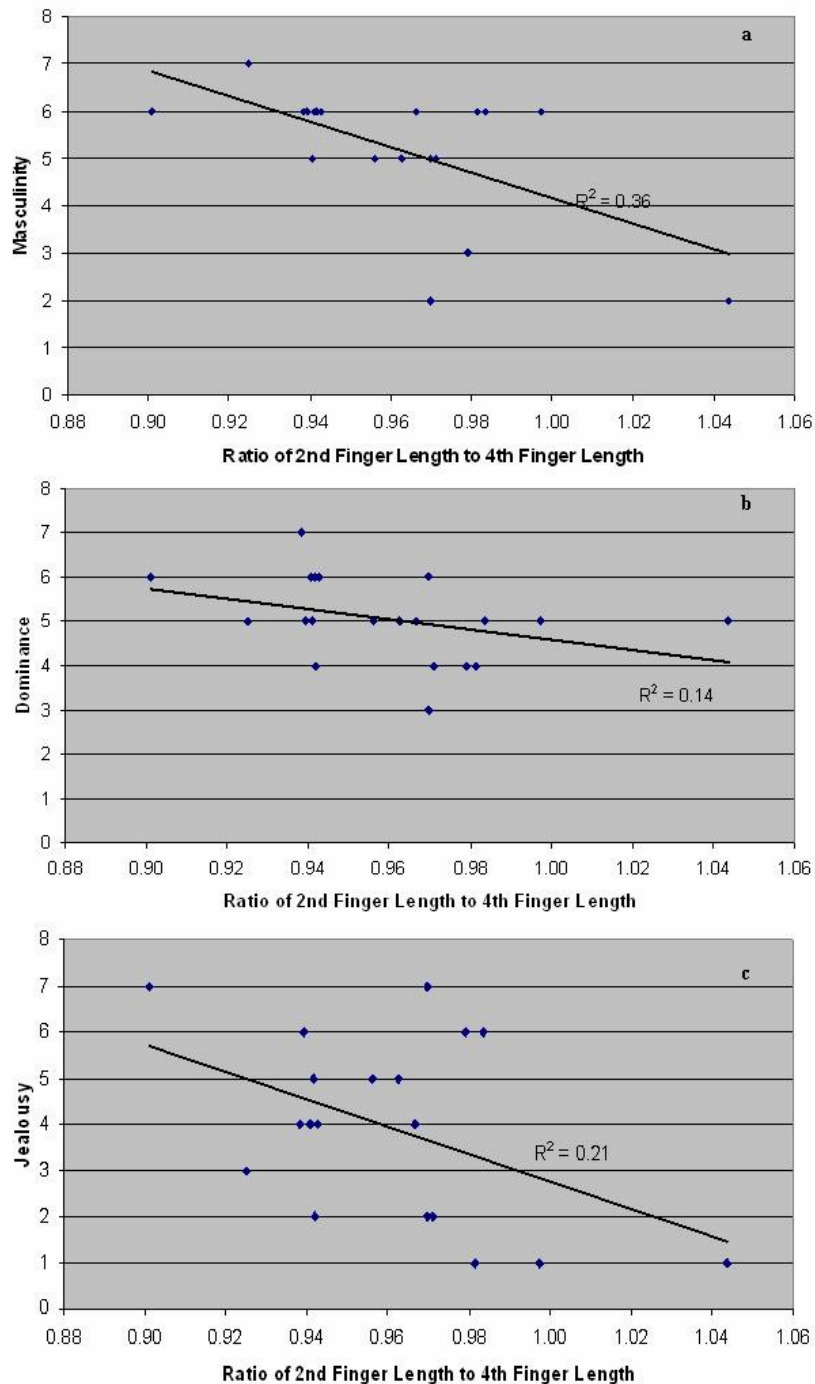


Figure 1: Relationships between self-perception of male individuals' qualities [(a) masculinity, (b) dominance and (c) jealousy] and 2D:4D finger length ratios

Figure 1 illustrates the significant negative correlations between raters' measured FLRs and their self-rated levels of masculinity and dominance suggest that higher levels of prenatal testosterone are associated with increased masculinity and dominance in males. The negative correlation between jealousy and FLRs further suggests that the tendency towards jealousy (mate guarding) increases with increasing male quality.

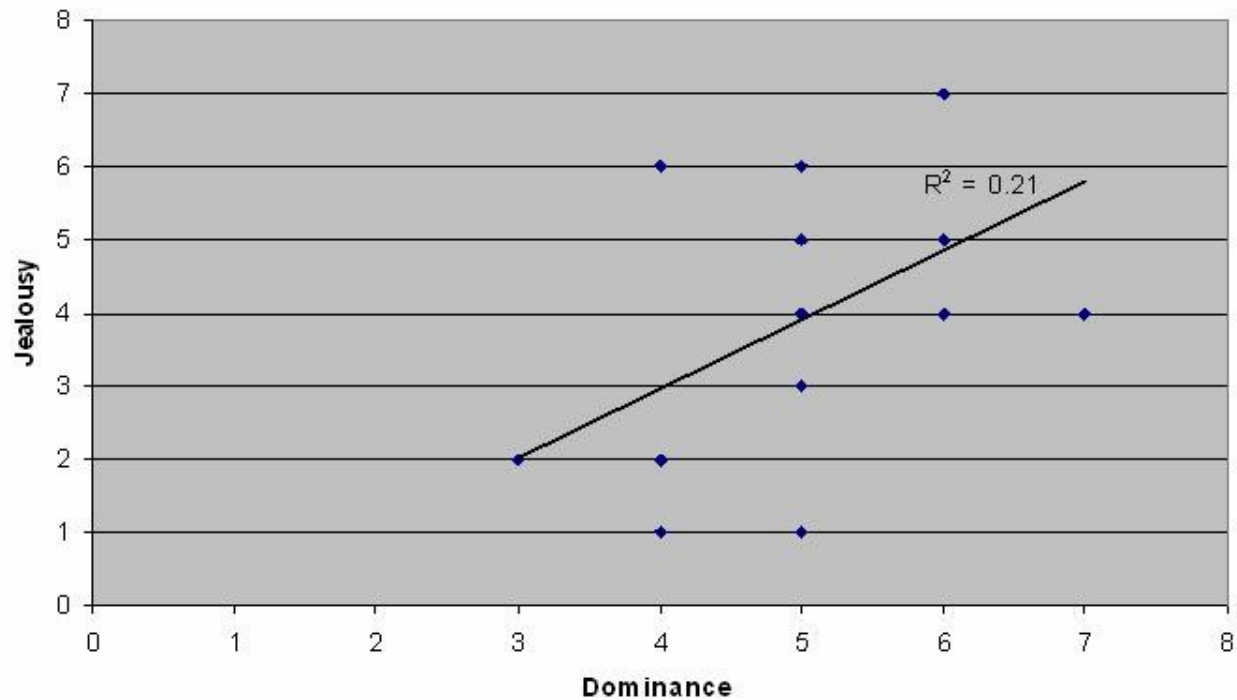


Figure 2: Positive Correlation between males' self-perception of jealousy and dominance

Results shown in Figure 2 support trends from the previous graphs, that men of higher quality (as indicated by self-perceived levels of masculinity and dominance) are more likely to rate themselves as highly jealous.

Sex-Typicality and Perceived Quality of Individuals

Figure 3 illustrates the positive correlations between models' sex typicality and raters' perceptions of mate quality. Values given by female raters are in the left plots and values given by male raters are in the right plots. Each linear relationship shows the increase in ratings (perceptions of better mate quality) between sex-atypical and sex-typical models. The typicality of the models was determined by a panel of participants.

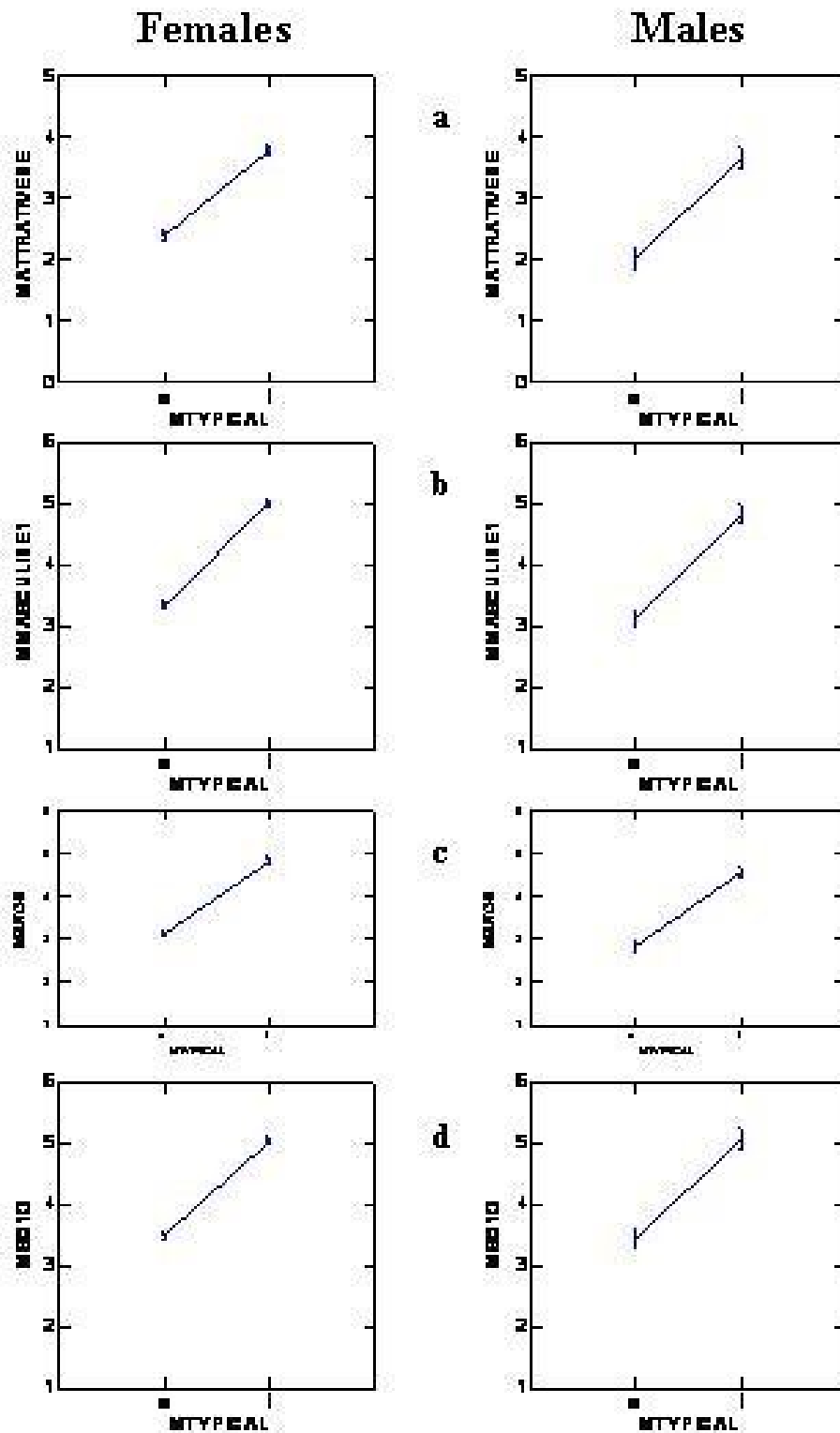


Figure 3: Relationships between female models' typicality and a) attractiveness, b) femininity, c) femmeness, and d) sexual orientation, as perceived by female and male raters

DISCUSSION

This study investigated a number of different factors regarding the role of biological signals on the perceived mate quality of individuals. The surveys were very extensive in order to include many different variables for comparison. Significant correlations were found between both fluctuating asymmetry and finger length ratios and the perceived quality of individuals.

As expected, female models' FA (an indirect marker of developmental instability and hence individual quality) was strongly correlated with raters' assessment of various quality-based characteristics (as summarized in Table 1). A negative correlation was evident between model FA and rater-assessed levels of models' attractiveness, submissiveness, femininity, placement on a butch/femme scale ('femme' score) and sexual orientation; there was no significant relationship for estimates of models' jealousy. Raters were not aware of the models' FA values when assigning ratings, which imply that the facial symmetry was a cue for overall mate quality.

Ratings assigned by men, particularly straight men, consistently reflected a significant negative correlation with model FA. Female raters' assigned similar scores for all traits except submissiveness. When investigated at the individual level (by rater sex and sexual orientation), neither straight women nor gay men's ratings suggested this negative correlation between model FA and submissiveness indicating that they do not perceive dominance to be a negative quality in women. In comparison, the two groups that actually seek female partners (the gay women and straight men) showed a negative correlation, indicating that dominance in female partners is a negative quality.

The tendency to assign a non-heterosexual sexual orientation to female models that were less symmetrical is consistent with data that indicate that gays and lesbians do in fact exhibit

higher levels of asymmetry⁹. It is interesting therefore, that the correlation between FA levels and attractiveness ratings was driven by straight rather than gay raters (nonsignificant relationships for gay men and women). The difference between straight and gay raters may be due to different expectations for symmetry among gays or, instead, the trend may be the same for both groups but less evident among gay raters due to smaller sample sizes.

The role of the sex typicality of the models in influencing the perceived mate quality was directly observed in Figure 3. Each of the models was assessed as either sex typical or sex atypical by a panel of random judges. Using these assignments, ANOVA estimates were used to illustrate that the atypical female models were assessed as lower quality mates (for attractiveness, masculine/feminine and butch/femme) for both male and female raters. The atypical models were also given lower ratings on the gay/straight scale, shifting them toward the gay side. These results are consistent with the relationship between FA and observed sex-typicality, suggesting that less symmetrical individuals are perceived to be more atypical and this lower quality mates.

The second biological signal observed in relation to perceived quality of individuals was finger length ratios (FLRs; 2D:4D, averaged across both hands). Due to the timing of developmental processes, lower ratios reflect relatively higher prenatal exposure to testosterone versus estrogen in amniotic fluid. Previous research has investigated FLRs, testosterone and perceived male dominance. While my study only asked raters to assess photographs of female models, other studies have reported that women tend to prefer more masculinized male faces, as they may consider testosterone markers to be an honest indication of good health (thus, good mate quality). More pronounced facial testosterone markers, however, may be associated with negative personality traits (such as aggression). These findings suggest that high levels of prenatal testosterone serve to ‘organize’ male facial features to reflect dominance and masculine

characteristics but that physical attractiveness is not directly related to these increased androgen levels. Thus, female preference for more physically attractive males may be an adaptive compromise between positive attributes associated with higher than average testosterone and the negative attributes associated with more extreme masculinization¹⁹.

While this study did not ask raters to directly assess photographs of males, raters were asked to mentally picture themselves as well as an average gay and straight man and woman to assess each individual's mate quality. Figure 1 illustrates the negative correlation that was observed between measured 2D:4D ratios and their self-perceived levels of a) masculinity, b) dominance, and c) jealousy for straight male raters. The R^2 values indicated that the correlation between 2D:4D and masculinity had the strongest relationship, followed by jealousy and dominance, respectively. The FLR data was consistent with results from other studies that determined that 2D:4D ratios are indirect markers of prenatal testosterone^{7, 20} and that higher exposure is linked to observable differences in men's behavior. This study, however, was the first to determine that men's self assessment of masculinity and dominance accurately reflected their exposure to prenatal hormones.

These results, as illustrated in Figure 2, also indicate that higher quality males (relatively high scores for masculinity and dominance) are more likely to be jealous (a form of mate guarding). In males, jealousy revolves around the issue of uncertainty of paternity. Studies of sexual jealousy provide direct evidence that jealousy is a psychological mechanism for solving the paternity problem and reducing the likelihood of unfaithful mates¹. Mate guarding by males has been reported to be greatest when their female partners are near their ovulation, as extra-marital flirting has been known to increase during this time¹⁰, providing further evidence. This

positive correlation between jealousy and dominance (Figure 3) suggests that prenatal hormones may relate to this evolutionary mechanism of 'mate guarding.'

This study was successful in showing the impact of the two biological signals, fluctuating asymmetry and finger length ratios, on the perceived mate quality of individuals. Though both of these signals have been shown to influence overall perceptions of mate quality, there was no significant correlation between FA and FLRs, suggesting that these biological signals are controlled by separate mechanisms. With the use of a much larger population size in future research, more correlations may be both independently or dependently observed between FA and FLRs and perceptions of overall mate quality.

REFERENCES

- ¹Bereczkei, T. & Csanaky, A. (1996). Mate choice, marital success and reproduction in a modern society. *Ethnology and Sociobiology*, 17:1, 17-35
- ²Buss, D.M. (1994). *The Evolution of Desire Strategies of Human Mating*. BasicBooks; New York.
- ³Buston, P.M. & Emlen, S. T. (2003). Cognitive processes underlying human mate choice: the relationship between self-perception and mate preference in Western Society. *PNAS Early Edition*. 1-6.
- ⁴Gangestad, S. W., Bennett, K., Thornhill, R. (2001). A latent variable model of Developmental instability in relation to men's sexual behavior. *Proceedings of the Royal Society of London*, 268, 1677-1684.
- ⁵Garn, S.M., Burdi, A.R., Babler, W.J. and Stinson, S. (1975) Early prenatal attainment of adult metacarpal-phalangeal rankings and proportions. *American Journal of Physical Anthropology*, 43, 327–332.
- ⁶Geiselman, R.E., Haight, N.A., & Kimata, L.G. (1984) Context effects on the perceived physical attractiveness of faces. *Journal of Experimental Social Psychology*, 20:5, 409-424.
- ⁷George, R. (1930). Human finger types. *Anatomical Record*, 46, 199–204.
- ⁸Gutierrez, S.E., Kenrick, D.T., & Partch, J.J. (1999). Beauty, Dominance, and the Mating Game: Contrast Effects in Self-Assessment Reflect Gender Differences in Mate Selection. *Personality and Social Psychology Bulletin*, 25:9, 1126-1134.
- ⁹Hall, P. A. & Schaeff, C. M. (2008). Fluctuating asymmetry and sexual orientation in men and women. *Archives of Sexual Behavior*. 37:1, 150-157.
- ¹⁰Haselton, M.G. & Gangestad, S.W. (2006). Conditional expression of women's desires and men's mate guarding across the ovulatory cycle. *Hormones and Behavior*, 49, 509-518.
- ¹¹Kenrick, D.T. & Gutierrez, S.E. (1980). Contrast effect and judgments of physical attractiveness, *Journal of Applied Social Psychology*, 38, 131-140.
- ¹²Kenrick, D.T., Gutierrez, S.E. & Goldberg, L.L. (1989). Influence of popular erotica on judgments of strangers and mates. *Journal of Applied Social Psychology*, 25, 159-167
- ¹³Little, A.C., & Mannion, H. (2006). Viewing attractive or unattractive same-sex individuals changes self-rated attractiveness and face preferences in women. *Animal Behaviour*, 72, 981-987.

- ¹⁴Ludwig, W. (1932). *Das Rechts-Links problem im tierreich und beim menschen*. Springer, Inc.: Berlin, Germany
- ¹⁵Manning, J.T. & Chamberlain, A.T. (1994). Sibling competition and sperm competitiveness: an answer to 'Why so many sperms?' and the recombination/sperm number correlation. *Proceedings of the Royal Society of London*. 256: 177–182.
- ¹⁶Manning, J.T., Scutt, D., Wilson, J. and Lewis-Jones, D.I., 1998. The ratio of 2nd to 4th digit length: a predictor of sperm numbers and levels of testosterone, LH and oestrogen. *Human Reproduction*, 13, 3000–3004.
- ¹⁷Møller, A. P., & Swaddle, J. P. (1997). *Asymmetry, developmental stability, and evolution*. Oxford University Press, London, UK.
- ¹⁸Naugler, C.T. and Leech, S.M. (1994). Fluctuating Asymmetry and survival ability in the forest tent caterpillar moth *Malacosoma disstria*: implications for pest management. *Entomologia Experimentalis et Applicata*, 70:3, 295-298.
- ¹⁹Neave, N., Laing, S., Fink, B., & Manning, J.T. (2003). Second to fourth digit ration, testosterone and perceived male dominance. *Proceedings of the Royal Society of London*, 270:1529, 2167 2172.
- ²⁰Phelps, V.R. (1952) Relative index finger length as a sex-influenced trait in man. *American Journal of Human Genetics*, 4, 72–89
- ²¹Polak, M., ed. (2003). *Developmental Instability: Causes and Consequences*. Oxford University Press. London, UK.
- ²²Putz, D., Gaulin, S., Sporter, R., McBurney, D. (2004). Sex hormones and finger length What does 2D:4D indicate? *Evolution and Human Behavior*, 25, 182-199
- ²³Reinisch, J.M. and Sanders, S.A., 1984. Prenatal gonadal steroidal influences on gender-related behavior. *Progress in Brain Research*, 61, 407–416.
- ²⁴Swaddle, J. P. & Cuthill. I. C. (1995). Asymmetry and human facial attractiveness: symmetry may not always be beautiful. *Proceedings of the Royal Society of London*, 261, 111-116.
- ²⁵Waddington, C. H. (1942). Canalization of development and the inheritance of acquired characters. *Nature*, 150, 563-566.
- ²⁶Wedell, D.H., Parducci, A., & Geiselman. (1987) R.E. A formal analysis of physical attractiveness: Successive contrast and simultaneous assimilation. *Journal of Experimental Social Psychology*. 23:3, 230-249.