

Facial symmetry is positively associated with self-reported extraversion

Nicholas Pound^{a, b, *}, Ian S. Penton-Voak^c and William M. Brown^{a, b}

^a Centre for Cognition and Neuroimaging, Brunel University, Uxbridge, UB8 3PH, United Kingdom

^b Centre for Culture and Evolutionary Psychology, Brunel University, Uxbridge, UB8 3PH, United Kingdom

^c Department of Experimental Psychology, 8 Woodland Road, Bristol, BS8 1TN, United Kingdom

* Corresponding author. Address: Centre for Cognition and Neuroimaging, School of Social Sciences, Brunel University, Uxbridge, UB8 3PH, United Kingdom. Tel.: +44 1895 266311; fax: +44 1895 269724.

Post-print (final draft post-refereeing)

Published in Personality & Individual Differences, Volume 43, Issue 6, October 2007, Pages 1572–1582.

Received 28 January 2007; revised 13 April 2007; accepted 17 April 2007. Available online 11 June 2007.

Personality & Individual Differences <http://www.sciencedirect.com/science/journal/01918869>

This article: <http://dx.doi.org/10.1016/j.paid.2007.04.014>

Abstract

Fink et al. (2005) reported significant associations between facial symmetry and scores on some of the “big five” personality dimensions derived from self-report data. In particular, they identified a positive association between facial symmetry and extraversion, but negative associations between facial symmetry and both agreeableness and openness. Fink et al. (2005) used a measure of facial symmetry based on analysis of the central region of each face. In the present study we attempted to replicate these findings with a much larger sample ($N = 294$) and using a landmark-based measure of facial symmetry that includes peripheral regions of the face. In both sexes, we found a significant positive association between self-reported extraversion and facial symmetry but were unable to replicate any of the other previously reported associations. Nevertheless, the positive association between symmetry and extraversion provides further support for the idea that facial appearance could predict personality and therefore makes it possible for some personality attributions to be “data driven”, i.e. driven by properties of the target.

Keywords: Fluctuating asymmetry; Symmetry; Personality; Face; Extraversion; Big-five

1. Introduction

The idea that various aspects of facial appearance can provide reliable information about an individual’s personality has been popular for centuries, although studies conducted in the early 20th century demonstrated that psychological characteristics rarely correlate with measurements of individual facial features (e.g. Cleeton & Knight, 1924). Research since then has generally yielded similar negative results (for a review see Alley, 1988). However, despite the lack of scientific evidence beliefs that facial appearance can be a valid indicator of personality persist and are widespread. For example, Liggett (1974) reported that 90% of undergraduate students believed that the face is a valid guide to character, and in 2000 this figure was still approximately 75% (Hassin & Trope, 2000). Moreover, whatever people’s stated beliefs, people do routinely make inferences about personality traits in others based on facial appearance alone, spontaneously and without reflection or deliberation (Hassin and Trope, 2000; Todorov et al., 2005).

Notwithstanding earlier failures to demonstrate relationships between various specific facial features and certain personality attributes, recent research has suggested that there may in fact be some observable relationships between some aspects of facial appearance and personality. Studies using zero-acquaintance paradigms (for review see Kenny, Albright, Malloy, & Kashy, 1994) have demonstrated high levels of consensus among judges rating the personality of others based on appearance alone, and more accuracy than would be expected by chance (i.e. agreement between ratings and the self-ratings of targets). Consequently, it appears that consensus in personality attributes is, to some extent, “data-driven” with facial appearance being one important source of “data”.

In many “zero-acquaintance” studies, “thin slices” of behaviour are presented, providing multiple non-facial cues to personality, in addition to non-verbal behaviour (such as facial movements and expressions) that could form a basis for accurate personality judgement. Furthermore, even in studies of static facial photographs, non-facial cues such as clothing and hairstyle are also often visible. So observed relationships between rated and self-report personality could in part depend on non-facial aspects of appearance. However, using computer graphics techniques to construct composite faces made from individuals self-reporting high and low scores on each of the “big five” dimensions, Penton-Voak, Pound, Little, and Perrett (2006) found some evidence for accurate and specific perception of agreeableness and extraversion in both male and female faces. Specifically, when composite faces were rated by independent raters on the “big five” dimensions, ratings of extraversion were best able to discriminate between composites derived from individuals who scored high on a self-report measure of extraversion and composites derived from individuals who scored low on that measure.

Accurate judgements of personality based on facial appearance alone must depend on associations between aspects of facial appearance and personality attributes. That is, for judgements to be accurate faces must contain certain reliable and valid cues to an individual’s personality. These cues, however, need not be specific features but instead may be configural properties of faces (Hassin & Trope, 2000). One configural property that has recently been shown to be associated with personality attributes is facial fluctuating asymmetry (FA).

Small random deviations from perfect symmetry in normally bilateral traits are referred to as fluctuating asymmetry (FA). Low levels of FA are believed to be an indicator of developmental stability (Van Valen, 1962) – an organism’s ability to buffer against stressors such as pathogens, toxins, and mutations (Møller and Swaddle, 1997; Polak, 2003). Across taxa higher FA is associated with greater morbidity, reduced fecundity, and higher mortality (Møller and Swaddle, 1997 and Polak, 2003) and in humans symmetry is associated with attractiveness. For example, bodily FA is negatively associated with face (Gangestad, Thornhill, & Yeo, 1994), voice (Hughes, Harrison, & Gallup, 2002), and odour attractiveness (Thornhill & Gangestad, 1999a).

In the above studies, it could not have been bodily symmetry per se that was influencing attractiveness judgments, rather symmetry appears to be associated with attractive traits. In contrast, a number of studies have demonstrated that facial symmetry itself can influence attractiveness judgements (for reviews see Grammer et al., 2003; Thornhill and Gangestad, 1999b). There is, however, evidence that the relationship between symmetry and attractiveness persists even when cues to symmetry are removed by presenting just the right or left half of each face (Scheib, Gangestad, & Thornhill, 1999). This suggests that observed relationships between facial symmetry and attractiveness may arise because symmetry covaries with other attractive facial traits, rather than simply because symmetry itself is perceived as attractive.

Shackelford and Larsen (1997) investigated associations between facial FA and various personality measures. They reported a general tendency for facial FA to be associated with higher scores on self-report measures that are arguably indicators of psychological/emotional distress. However, evidence for relationships between facial FA and scores on the Eysenck Personality Questionnaire's self-report measures of the "big three" personality dimensions was somewhat equivocal. They did find a significant positive association between FA and extraversion for women, but in men they found a tendency for the opposite to be true. More recently, Fink, Neave, Manning, and Grammer (2005) reported significant associations between a measure of facial symmetry and scores on some of the "big five" personality dimensions derived from self-report data. In particular, they identified a positive association between facial symmetry and extraversion and negative associations between facial symmetry and both agreeableness and openness.

Of particular relevance to the possibility that facial symmetry may be related to personality attributes is a recent finding by Brown et al. (2005) of a positive association between perceived dance quality and body symmetry. It is likely that there are relationships between personality traits, such as extraversion, and the willingness and ability of individuals to engage in behaviours related to courtship, such as dance. Indeed, there is some evidence that individuals who dance are more extraverted than those who do not (Rust, 1969) and that degree of extraversion is related to the use of locomotor space in modern dance improvisations (Murray, 1982).

So there are a number of findings of positive associations between symmetry and socially desirable characteristics in individuals (e.g. facial attractiveness, olfactory attractiveness, auditory attractiveness, and dance quality). To the extent that extraversion can be considered a socially desirable trait, Fink et al.'s (2005) finding of a positive association between facial symmetry and extraversion is another example of such a relationship. However, Fink et al.'s (2005) other findings of negative associations between facial symmetry and both agreeableness and openness represent associations between symmetry and socially *undesirable* traits. This, however, is not inconsistent with some previous work indicating that body FA is negatively associated with aggression (Furlow, Gangestad, & Armijo-Prewitt, 1998), that body FA is positively associated with generosity of offers in an experimental economics game (Zaatari & Trivers, in press) and that among male offenders, psychopathic individuals have lower FA than non-psychopathic individuals (Lalumière, Harris, & Rice, 2001).

The measure of facial symmetry used by Fink et al. (2005) and also used previously (Fink, Manning, Neave, & Grammer, 2004) differed from the method used by other investigators (e.g. Penton-Voak et al., 2001; Scheib et al., 1999) and may be problematic. The symmetry assessment was based on a rectangular region of interest (ROI) defined by the left and right outer eye corners, the top of the brows, and the lower lip. Consequently, the symmetry measurements excluded peripheral regions of the face where important asymmetries in bone structure may be present. Additionally, the

symmetry measurement technique was based on the assessment of differences in grey values between the left and right sides of horizontal 1-pixel slices through the ROI. Such a technique is likely more susceptible to lighting asymmetries than landmark-based approaches used by (Scheib et al., 1999) and (Penton-Voak et al., 2001). Moreover, even relatively small asymmetric colouration blemishes could lead to substantial increases in the asymmetry index.

In the present study we attempted, using a significantly larger sample of males and females, to establish whether the findings of Fink et al. (2005) are replicable using a landmark-based measure of facial asymmetry that, unlike the method used by Fink et al. (2005) includes peripheral regions of the face and moreover is likely to be less vulnerable to lighting asymmetries. Fink et al. (2005) reported small to medium correlations between facial symmetry and personality scores. These included a medium correlation between facial symmetry and extraversion in women ($r = 0.31$; $p < 0.05$), a small correlation for the whole sample ($r = 0.21$; $p < 0.05$) but a non-significant association for the male sub-sample ($r = 0.21$; $p = 0.13$). However, a study with sample size of 50 males (like Fink et al's) will only have statistical power of 0.42 to detect a correlation of $r = 0.25$ (at $\alpha = 0.05$; two-tailed). In the present study, we use samples of approximately 150 males and 150 females which give power of 0.87 to detect correlations of this magnitude (at $\alpha = 0.05$; two-tailed) within each sex.

2. Methods

Participants were 146 male and 148 female volunteers who were students at the University of Stirling aged between 18 and 22 years old.

2.1. Personality measures

Each participant completed a 40-item self-report personality questionnaire (Botwin, Buss, & Shackelford, 1997). The questionnaire consisted of a series of adjective pairs with a 1–7 scale between the two anchors. The adjective pairs used in the questionnaire developed by Botwin et al. (1997) were drawn from the highest-loading pairs of adjectives from Goldberg's (1983) factor analysis of possible trait descriptors.

A confirmatory factor analysis (independently for each sex, varimax rotation, constrained to five factors) was used to generate scores on the 'big five' personality dimensions. For female participants, the five factors explained 46.3% of the variance in responses [agreeableness (8.8%), conscientiousness (9.7%), extraversion (10%), emotional stability (11.4%) and openness (6.4%)]. For male participants the five factors accounted for 39.9% of variance in the questionnaire responses [agreeableness (7.3%), conscientiousness (8.4%), extraversion (7.5%), emotional stability (9.6%) and openness (7.1%)]. These findings are similar to the results obtained by Botwin et al. (1997) who found that a five-factor solution accounted for 42% of the variance in responses

on the 40-items. Scores on each factor were standardized to create z -scores for each personality dimension.

2.2. Facial symmetry measures

Participants were photographed in a standing position, since head position is more replicable when subjects are standing rather than sitting (Stephan, Clement, Owen, Dobrostanski, & Owen, 2004). Photographs were taken from a distance of 1.5 m using a digital camera (Canon G1 Powershot) at a resolution of 1536×2048 pixels, with constant lateral illumination from two lamp units, in front of a neutral grey background. A grey smock covered participants' clothes.

A facial metric technique was used to assess the symmetry of individual faces, based on the procedure used by (Scheib et al., 1999) and (Penton-Voak et al., 2001). The x and y coordinates of 12 facial landmarks were delineated by a measurer blind to the experimental hypothesis. These corresponded to the following bilateral features on each face; the centre of the pupil, the endocanthion (medial corner of the eye), the exocanthion (lateral corner of the eye), the cheekbones (most outward projecting points on the face at or below the eyes), the alare (lateral edge of nose), the cheilion (lateral corner of the mouth), and the gonion approximation (the apex of the lower jaw).

Unlike (Scheib et al., 1999) and (Penton-Voak et al., 2001), but similar to Fink et al. (2005) faces were standardized for size and orientation. The x – y coordinates of the facial landmarks were registered (rotated and scaled) using a Generalised Procrustes analysis, a best fit procedure that scales shapes and removes rotational differences (Goodall, 1991; Gower, 1975; Rohlf and Slice, 1990). The Generalised Procrustes analysis was carried out using Morphologika (Paul O'Higgins & Nicholas Jones, University of York).

Symmetry measurements were made from the Procrustes registered landmark positions. For each pair of bilateral facial landmarks, the mid-point of their separation in the x -axis was calculated. As in (Scheib et al., 1999) and (Penton-Voak et al., 2001), horizontal asymmetry was calculated as the sum of the differences in the x -axis between all mid-points. However, to control for trait size, when calculating the difference in the x -axis between the mid-points of two horizontal lines, this was computed as a percentage of the average length of the two horizontal lines (between the two relevant pairs of landmarks). The values were then standardized for each sex and the z -scores were used as the index of facial asymmetry in subsequent analyses.

2.3. Attractiveness measures

Photographs of half of the participants (73 males and 74 females) were selected randomly and presented individually to 17 raters (7 male and 10 female) who were students at The University of Bristol (aged 18–22). Raters were asked to rate each face for attractiveness on a scale from 1

(attractive) to 7 (unattractive). Reliability was high for attractiveness ratings of male (Cronbach's $\alpha = 0.85$) and female (Cronbach's $\alpha = 0.90$) faces. Consequently, a mean attractiveness score was calculated for each individual face.

3. Results

There were significant negative associations between facial asymmetry and self-reported extraversion for both male and female faces (Table 1). There were, however, no other significant associations between facial asymmetry and self-report personality dimensions in either males or females. In particular, there were no significant associations between facial symmetry and either self-reported agreeableness or openness to experience. The negative association ($r = -0.25$; $p < 0.005$) between facial asymmetry and self-reported extraversion in males (Fig. 1) was significant ($r = -0.20$; $p < 0.05$) even after the removal of an outlier with an asymmetry index score >4.0 . The negative association between facial asymmetry and self-reported extraversion in females is shown in Fig. 2.

Table 1. Zero-order correlations between facial asymmetry and scores on self-report personality dimension

	Correlation with facial asymmetry index		
	Total Sample (n=294)	Males (n=146)	Females (n=148)
Agreeableness	-.050 (.392)	.052 (.537)	-.146 (.077)
Conscientiousness	-.011(.851)	.027 (.748)	-.052 (.529)
Extraversion	-.210 (.000)***	-.248 (.003)**	-.198 (.016)*
Neuroticism	.032 (.588)	-.099 (.233)	.151 (.067)
Openness	-.044(.457)	-.046 (.585)	-.040 (.627)

* $p < .05$ two-tailed; ** $p < .01$ two-tailed, *** $p < .001$ two-tailed

Mean attractiveness ratings were not significantly associated with facial asymmetry for either male or female faces. Moreover, controlling for attractiveness partial correlations between facial asymmetry and self-reported extraversion remained significant for both male ($r = -0.27$; $p < 0.05$) and female ($r = -0.27$; $p < 0.05$) faces.

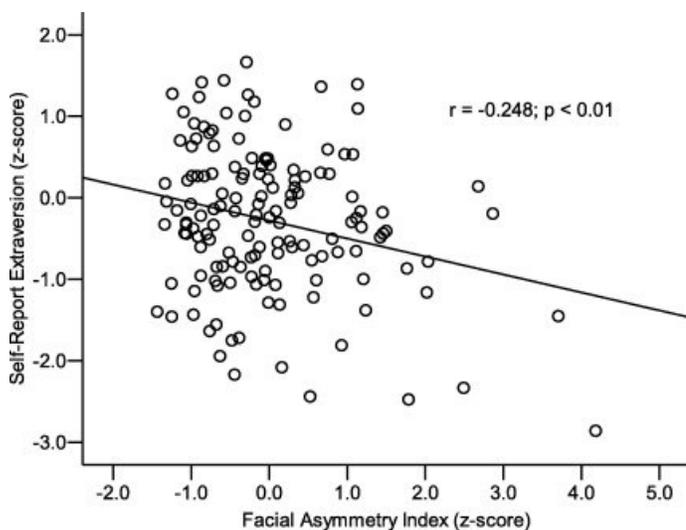


Fig. 1. Negative association between facial asymmetry and self-reported extraversion for males (n = 146).

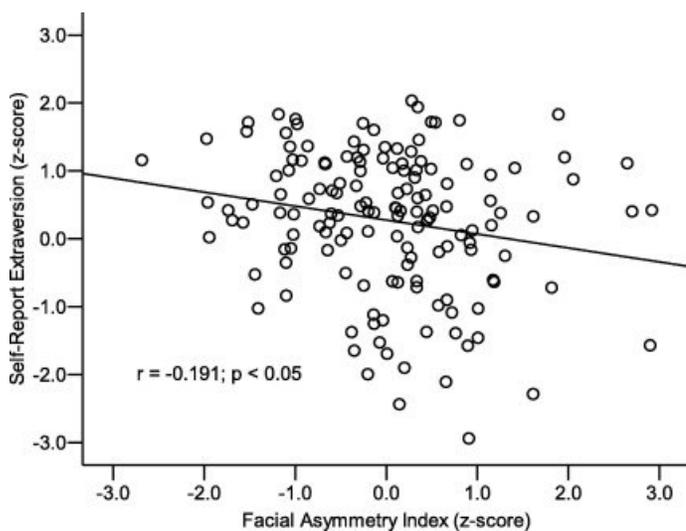


Fig. 2. Negative association between facial asymmetry and self-reported extraversion for females (n = 148).

4. Discussion

In the present study we replicated Fink et al.'s (2005) finding of a positive association between facial symmetry and self-reported extraversion. We were, however, unable to replicate Fink et al.'s (2005) findings of negative associations between facial symmetry and self-reported agreeableness and openness to experience. The present study employed a landmark-based measure of facial asymmetry that is likely to be less affected by asymmetric lighting than the method used by Fink et al. (2005). Moreover, the landmark-based method incorporated measurements of peripheral regions of the face that were excluded from the region of interest (ROI) used in the previous study. This is important since many of the peripheral facial regions excluded from the analyses carried out by Fink et al. (2005) likely also have an important role in face perception, and are possible sites for significant asymmetries in facial structure (e.g. cheekbones and apex of jaw). Although the configuration of internal facial features is most important for the recognition of familiar faces, more peripheral features (e.g. jaw-line, chin and forehead) are important for the identification of unfamiliar faces (Ellis, Shepherd, & Davies, 1979) and for the identification of familiar faces by children (Campbell, Walker, & Baron-Cohen, 1995).

The findings of the present study suggest that the positive association between facial symmetry and self-reported extraversion reported by Fink et al. (2005) is robust and generalisable. Fink et al reported such an association for females, and their total sample but not for males. In the present study, however, we additionally found a significant association for males. The reason for this discrepancy is likely that a sample of 146 males (as used in the present study) has significantly greater power to detect such small-to-medium associations than does a sample of 50 males (as used by Fink et al.). As noted previously, a sample of 50 males will only have statistical power of 0.42 to detect a correlation of $r = 0.25$ (at $\alpha = 0.05$; two-tailed) while a sample of 146 males will have power of 0.87 to detect an association of this magnitude.

With regard to the failure to replicate Fink et al.'s (2005) findings of negative associations between facial symmetry and self-reported openness to experience in men and women, it should be noted that the present study sample sizes had power in excess of 0.99 for detecting associations of the magnitude reported by Fink et al. Additionally, with regard to the failure to replicate Fink et al.'s (2005) finding of a negative association between self-reported agreeableness and symmetry for the total sample it should be noted that the present study had a power in excess of 0.99 for detecting such an association. This suggests that, although we cannot dismiss these previously reported findings completely, they may be of limited generalisability.

The finding that a configural aspect of facial appearance (i.e., symmetry) is associated with self-reported extraversion is interesting in light of Kenny et al.'s (1994) conclusion that perception of extraversion operates differently to perception of other personality attributes. In their meta-analysis of zero-acquaintance studies, Kenny et al. (1994) found particularly high levels of

consensus and stability over time for ratings of extraversion, indicating that these judgements were being driven by target-based characteristics. Consequently, there appears to be some convergence here between the literature on consensus in personality judgements and the research on accuracy in personality judgements. Consensus is highest for extraversion, a dimension for which there is evidence of accurate perception (Penton-Voak et al., 2006) and that has now been shown to be reliably associated with a configural aspect of facial appearance.

Associations between facial appearance and personality attributes could depend on a number of possible mechanisms. An association between extraversion and facial symmetry could arise if they have a common cause such as if developmental stability leads to both the expression of a symmetrical facial phenotype and an extraverted personality. Alternatively, the development an extraverted personality may follow directly from the expression of a symmetrical facial phenotype if personality development is partially contingent upon interactions with others (whose behaviour towards an individual may be influenced by facial appearance). Given that associations exist between perceived attractiveness and facial symmetry, attractiveness could mediate such a process since attractive individuals are likely to be treated differently. Since extraversion as a behavioural strategy is likely to have costs as well as benefits (Nettle, 2006), pursuing such a strategy may only be viable in situations where an individual is widely perceived as attractive. Consequently, facultative adjustment by an individual of their behavioural strategy in response to feedback about their perceived attractiveness could be functional.

In the present study, however, we found no evidence of an association between facial symmetry and attractiveness and therefore no evidence that the observed relationships between facial symmetry and personality are mediated by individual differences in attractiveness. We were, of course, only able to measure the current perceived attractiveness of participants and not their attractiveness during relevant periods of development when some personality traits may become established. So we cannot completely rule out the possibility that individuals with more symmetrical faces may, as a consequence of being more attractive, develop extravert personality traits after experiencing more rewarding social interactions during development.

Self-fulfilling prophecy effects provide a more specific way in which personality development may be affected by interactions with others whose behaviour towards an individual may be influenced by facial appearance. These could arise where individuals with facial characteristics typically believed to be associated with a particular personality trait are treated in such a way as to encourage them to adopt that personality trait. Explanations that postulate self-fulfilling prophecy mechanisms as the source of an association between facial symmetry and self-report personality, depend on symmetrical individuals being perceived as different to asymmetric individuals and thus being subject to differential treatment. For a small sample of female faces, Fink, Neave, Manning, and Grammer (2006) reported positive associations between facial symmetry and perceived

attractiveness and some personality attributes such as “sociability”, “intelligence”, “liveliness”, and “self-confidence”. However, it is important to note that such associations may arise if perceived attractiveness covaries with other facial traits that drive personality attributions rather than because symmetry itself drives these attributions directly. As noted previously, the relationship between facial symmetry and perceived attractiveness may arise because of associations between symmetry and other facial traits, rather than because symmetry itself is perceived as attractive (Scheib et al., 1999).

In addition to self-fulfilling prophecy processes, other mechanisms have been proposed to explain apparent associations between configural aspects of faces and self-reported personality (Zebrowitz & Collins, 1997). One such possibility is that there are direct links between physiology and personality. For example, there is evidence that facial appearance indicates current endocrine status, with male circulating testosterone being correlated with both ratings of masculinity (Penton-Voak & Chen, 2004) and expressive behaviours such as smiling (Dabbs, 1997). These findings raise the possibility of accurate perception of personality attributes based on facial appearance given that, in males, high levels of circulating testosterone are associated with low scores on self-reported pro-social personality characteristics (Harris, Rushton, Hampson, & Jackson, 1996), with marital dissatisfaction and poor father–child relationships (Julian & McKenry, 1989), with low scores on a measure of “spousal investment” (Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002), and are related to antisocial behaviour (Dabbs, 1993).

In summary, the present study has replicated Fink et al.’s (2005) finding of a negative association between facial asymmetry and self-reported extraversion. Moreover, this replication involved a substantially larger sample of participants, and a different measure of facial asymmetry that is likely to be less influenced by lighting asymmetries and includes peripheral regions of the face.

References

- Alley, T. R. (1988). Physiognomy and social perception. In T. R. Alley (Ed.), *Social and applied aspects of perceiving faces* (pp 167-186). Hillsdale, NJ: Erlbaum
- Botwin, M. D., Buss, D. M., & Shackelford, T. K. (1997). Personality and mate preferences: Five factors in mate selection and marital satisfaction. *Journal of Personality*, **65**, 107–136.
- Brown, W.M., Cronk, L., Grochow, K., Jacobson, A., Liu, K., Popović, Z., & Trivers, R. (2005). Dance reveals symmetry especially in young men. *Nature*, **438**, 1148-1150.
- Campbell, R., Walker, J., & Baron-Cohen, S. (1995). The development of differential use of inner and outer face features in familiar face identification. *Journal of Experimental Child Psychology*, **59**, 196–210.
- Cleeton, G. U., & Knight, F. B. (1924). Validity of character judgement based on external criteria. *Journal of Applied Psychology*, **8**, 215-231.
- Dabbs, J. M. (1993). Salivary testosterone measurements in behavioral-studies. *Annals of the New York Academy of Sciences*, **694**, 177-183.
- Dabbs, J. M. (1997). Testosterone, smiling, and facial appearance. *Journal of Nonverbal Behavior*, **21**, 45-55.
- Ellis, H. D., Shepherd, J. W., & Davies, G. M. (1979). Identification of familiar and unfamiliar faces from internal and external features: Some implications for theories of face recognition. *Perception*, **8**, 431-439.
- Fink, B., Manning, J. T., Neave, N., & Grammer, K. (2004). Second to fourth digit ratio and facial asymmetry. *Evolution & Human Behavior*, **25**, 125–132.
- Fink, B., Neave, N., Manning, J.T., & Grammer, K. (2005). Facial Symmetry and the 'Big-Five' Personality Factors. *Personality & Individual Differences*, **39**, 523-529.
- Fink, B., Neave, N., Manning, J.T. & Grammer, K. (2006). Facial symmetry and judgements of attractiveness, health and personality. *Personality & Individual Differences*, **41**, 491-499.
- Furlow, B. F., Gangestad, S. W., & Armijo-Prewitt, T. (1998). Fluctuating asymmetry and human violence. *Proceedings of the Royal Society of London B*, **265**, 1-6.
- Gangestad, S. W., Thornhill, R., & Yeo, R. A. (1994). Facial attractiveness, developmental stability, and fluctuating asymmetry. *Ethology & Sociobiology*, **15**, 73–85.
- Goldberg, L. R. (1983, June). *The magical number five, plus or minus two: Some considerations on the dimensionality of personality descriptors*. Paper presented at the Gerontology Research Center, National Institute on Aging/National Institutes of Health, Baltimore.

- Goodall, C. R., (1991). Procrustes methods and the statistical analysis of shape (with discussion), *Journal of the Royal Statistical Society B*, **53**, 285-340
- Gower, J. C. (1975). Generalised Procrustes analysis. *Psychometrika*, **40**, 33–50
- Grammer, K., Fink, B., Møller, A. P., & Thornhill, R. (2003). Darwinian aesthetics: Sexual selection and the biology of beauty. *Biological Reviews*, **78**, 385–407.
- Gray, P. B., Kahlenberg, S. M., Barrett, E. S., Lipson, S. F., & Ellison, P. T. (2002). Marriage and fatherhood are associated with lower testosterone in males. *Evolution and Human Behavior*, **23**, 193–201.
- Harris, J. A., Rushton, J. P., Hampson, E., & Jackson, D. N. (1996). Salivary testosterone and self-report aggressive and pro-social personality characteristics in men and women. *Aggressive Behavior*, **22**, 321–331
- Hassin, R., & Trope, Y. (2000). Facing faces: Studies on the cognitive aspects of physiognomy. *Journal of Personality & Social Psychology*, **78**, 837-852.
- Hughes, S. M., Harrison, M. A., & Gallup, G. G. (2002). The sound of symmetry: voice as a marker of developmental instability. *Evolution & Human Behavior*, **23**, 173–180.
- Julian, T., & McKenry, P. C. (1989). Relationship of testosterone to men's family functioning at mid-life: A research note. *Aggressive Behavior*, **15**, 281-289.
- Kenny, D. A., Albright, L., Malloy, T. E., & Kashy, D. A. (1994). Consensus in interpersonal perception: Acquaintance and the big five. *Psychological Bulletin*, **116**, 245-258.
- Lalumière, M. L., Harris, G. T., & Rice, M. E. (2001). Psychopathy and developmental instability. *Evolution & Human Behavior*, **22**, 75-92.
- Liggett, J. (1974). *The Human Face*. Stein and Day, New York
- Møller, A. P. & Swaddle, J. P. (1997). *Developmental Stability & Evolution*. Oxford Univ. Press, Oxford.
- Murray, P. A. (1982). Extraversion-introversion and the use of locomotor space in modern dance. (P.E.D. Dissertation, University of Indiana, 1982). *Dissertation Abstracts International*, **43**(4-A), 1080.
- Nettle, D. (2006). The evolution of personality variation in humans and other animals. *American Psychologist*, **61**, 622-631.
- Penton-Voak, I. S., & Chen, J. Y. (2004). High salivary testosterone is linked to masculine male facial appearance in humans. *Evolution & Human Behavior*, **25**, 229-241.
- Penton-Voak, I. S., Jones, B. C., Little, A. C., Baker, S., Tiddeman, B., Burt, D. M., & Perrett, D. I. (2001). Symmetry, sexual dimorphism in facial proportions and male facial attractiveness. *Proceedings of the Royal Society of London B*, **268**, 1617–1623.

- Penton-Voak, I.S., Pound, N., Little, A.C., & Perrett, D.I. (2006). Personality judgments from natural and composite facial images: more evidence for a 'kernel of truth' in social perception. *Social Cognition*, **24**, 490-524.
- Polak, M. (2003). *Developmental Instability: Causes and Consequences*. Oxford Univ. Press, New York.
- Rohlf, F., & Slice, D. E. (1990). Extensions of the Procrustes method for the optimal superimposition of landmarks. *Systematic Zoology*, **39**, 40–59.
- Rust, F. (1969). *Dance in Society: The Sociology of Culture*. Routledge and Kegan Paul Ltd.
- Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society of London B*, **266**, 1913–1917.
- Shackelford, T. K., & Larsen, R. J. (1997). Facial asymmetry as an indicator of psychological, emotional, and physiological distress. *Journal of Personality & Social Psychology*, **72**, 456-466.
- Stephan, C. N., Clement, J. G., Owen, C. D., Dobrostanski, T., & Owen, A. (2004). A new rig for standardized craniofacial photography put to the test. *Plastic and Reconstructive Surgery*, **113**, 827–833.
- Thornhill, R., & Gangestad, S. (1999a). The scent of symmetry: A human sex pheromone that signals fitness? *Evolution & Human Behavior*, **20**, 175–201.
- Thornhill, R., & Gangestad, S. W. (1999b). Facial attractiveness. *Trends in Cognitive Sciences*, **3**, 452–460.
- Todorov, A., Mandisodza, A. N., Goren, A., & Hall, C. C. (2005). Inferences of competence from faces predict election outcomes. *Science*, **308**, 1623-1626.
- Van Valen, L. (1962). A study of fluctuating asymmetry. *Evolution* **16**, 125–142.
- Zaatari, D., & Trivers, R. (*in press*). Degree of fluctuating asymmetry and behavior in the ultimatum game. *Evolution & Human Behavior*
- Zebrowitz, L. A., & Collins, M. A. (1997). Accurate social perception at zero acquaintance: The affordances of a Gibsonian approach. *Personality & Social Psychology Review*, **1**, 204-223.