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Chapter 6

WHY ARE SYMMETRICAL FACES ATTRACTIVE?

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ABSTRACT

Many studies have reported that symmetrical faces are judged more attractive than relatively asymmetrical faces. As the attractiveness of facial symmetry appears to be stable across cultures it has been suggested that the attractiveness-symmetry relationship has a biological basis. Two accounts of the nature of this biological basis have been advanced. The perceptual bias account suggests that symmetry is found attractive as a by-product of the relative ease with which the perceptual system can process all symmetrical stimuli. By contrast, the good genes account notes that facial symmetry may act as an indicator of an individuals' ability to maintain good health and suggests that the attractiveness-symmetry relationship reflects psychological adaptations that have evolved to facilitate discrimination between potential mates on the basis of physical condition. Here we discuss empirical data relevant to many of the issues associated with both the good genes and perceptual bias explanations. Whilst the findings of the studies discussed here suggest that the attractiveness of facial symmetry is best explained by the good genes account, there is also evidence for a perceptual bias component to the attractiveness of symmetry.

WHY STUDY ATTRACTIVENESS?

Physical attractiveness influences many different aspects of human social interaction (see Feingold, 1995 for a review). For example, people preferentially mate with (Gangestad and Buss, 1993), date (Huston, 1973), associate with (Jacobson and Trivers, 2002), employ (Chiu and Babcock, 2002) and even vote for (Klein and Ohr, 2000) physically attractive individuals. Whilst both males and females claim in self-report that attractiveness is not of primary importance when choosing a partner (Buss, 1989), the single best predictor of satisfaction

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with a 'blind date' is facial attractiveness for both men and women (Walster et al, 1966). Furthermore, the physical attractiveness of both misbehaving children (Dion, 1972) and individuals appearing in court on charges such as burglary and fraud (Sigall and Ostgrove, 1975) has been found to influence others' perceptions of the seriousness of their misdemeanours. The influence of physical attractiveness is even apparent in aspects of human social interaction as fundamental as the bonding between mothers and infants (Hildebrandt and Fitzgerald, 1983). As it is clear that physical attractiveness is important for many aspects of everyday life many studies have investigated what physical characteristics are considered to be attractive.

Although the attractiveness of bodies has also been investigated (e.g. Singh, 1993; Tovée and Cornelissen, 1999; Yu and Shepard, 1998), most experimental research has focused on identifying attractive facial characteristics. This emphasis on the study of facial attractiveness is consistent with the claims that the face plays a central role in human social interactions (Bruce and Young, 1986) and is more important for judgements of the attractiveness of the "whole person" (i.e. the face and body presented together) than body attractiveness (Furnham et al., 2001).

What Facial Traits are Attractive?

Whilst aspects of colouration (Frost, 1994) and texture have also been investigated (Fink et al., 2001; Little and Hancock, in press), studies of facial attractiveness have predominantly investigated the attractiveness of aspects of facial shape. For example, averageness (also often called prototypicality) of facial shape positively influences judgements of attractiveness (Langlois et al., 1990, 1994; Little and Hancock, in press; Rhodes et al., 1999; 2001a). The findings of these studies have convinced some researchers that averageness is the critical determinant of facial attractiveness (e.g. Langlois et al., 1990). Grammer and Thornhill (1994) and Perrett et al. (1994), however, have disputed this claim, finding that the shapes of highly attractive faces were systematically different from average. As highly masculine or highly feminine faces are, by definition, systematically different from the average shape, potential relationships between facial attractiveness and the dimension masculinity-femininity have been investigated.

For both male and female faces there is evidence that a feminine shape, typified by larger eyes and more prominent cheekbones (Penton-Voak et al., 2001), is preferred (Perrett et al., 1998; Rhodes et al., 2000). Other studies, however, have suggested that male faces with a more masculine shape, typified by a wide lower face and a pronounced brow (Penton-Voak et al., 2001), are optimally attractive (Johnstone et al., 2001). Moreover, Cunningham et al. (1990) suggested that the relationship between masculinity-femininity and facial attractiveness might be more complex, finding that highly attractive male faces possessed both masculine traits such as wide jaws and feminine traits such as large eyes.

Symmetry-asymmetry is another dimension along which individual faces vary and that may influence facial attractiveness (Thornhill and Gangestad, 1999). Early studies that tested for a potential positive relationship between facial symmetry and attractiveness reported slight preferences for asymmetry (see Kowner, 2001 for a review of these studies). Perrett et al. (1998), however, noted that this early work was confounded with methodological issues. Whilst the link between masculinity-femininity and facial attractiveness remains

controversial, recent studies that have tested for a relationship between attractiveness and facial symmetry have yielded more consistent findings.

Is Symmetry a Characteristic of Attractive Faces?

A number of studies have tested for an attractiveness-symmetry relationship using photographs of real faces. These studies have typically used one of two techniques to assess facial symmetry: facial metric and perceptual techniques.

Using the facial metric technique, each face-image is first scaled and rotated to a standard interpupillary distance. A horizontal axis is then created that bisects both pupil centres. A vertical axis is set perpendicular to, and bisecting, the horizontal axis. Distances between the vertical axis and each of 12 bilaterally paired points (following an original study by Thornhill & Gangestad, 1994, see Figure 1) are measured parallel to the horizontal axis. These signed distances are then summed to calculate horizontal asymmetry (alternatively referred to as L - R asymmetry, Hume and Montgomerie, 2001). Vertical asymmetry can also be calculated using similar distance measurements. Calculating facial asymmetry using horizontal asymmetries only (in line with Grammer and Thornhill, 1994; Hume and Montgomerie, 2001; Rhodes et al., 2001b), rather than combining vertical and horizontal asymmetries, as other studies have done (e.g. Grammer and Thornhill, 1994; Scheib et al., 1999), may be most relevant to human perceivers as humans are primarily sensitive to horizontal asymmetries in complex biological images (Evans et al., 2000). It has been reported that facial metric techniques of this kind yield measurements of facial asymmetry that can be calculated with high repeatability (e.g. Hume and Montgomerie, 2001). Both studies that have calculated horizontal asymmetry (Hume and Montgomerie, 2001; Jones et al., 2001) and those that have combined horizontal and vertical asymmetries (Grammer and Thornhill, 1994; Scheib et al., 1999) have found that asymmetry was negatively correlated with ratings of the facial attractiveness of both males and females.

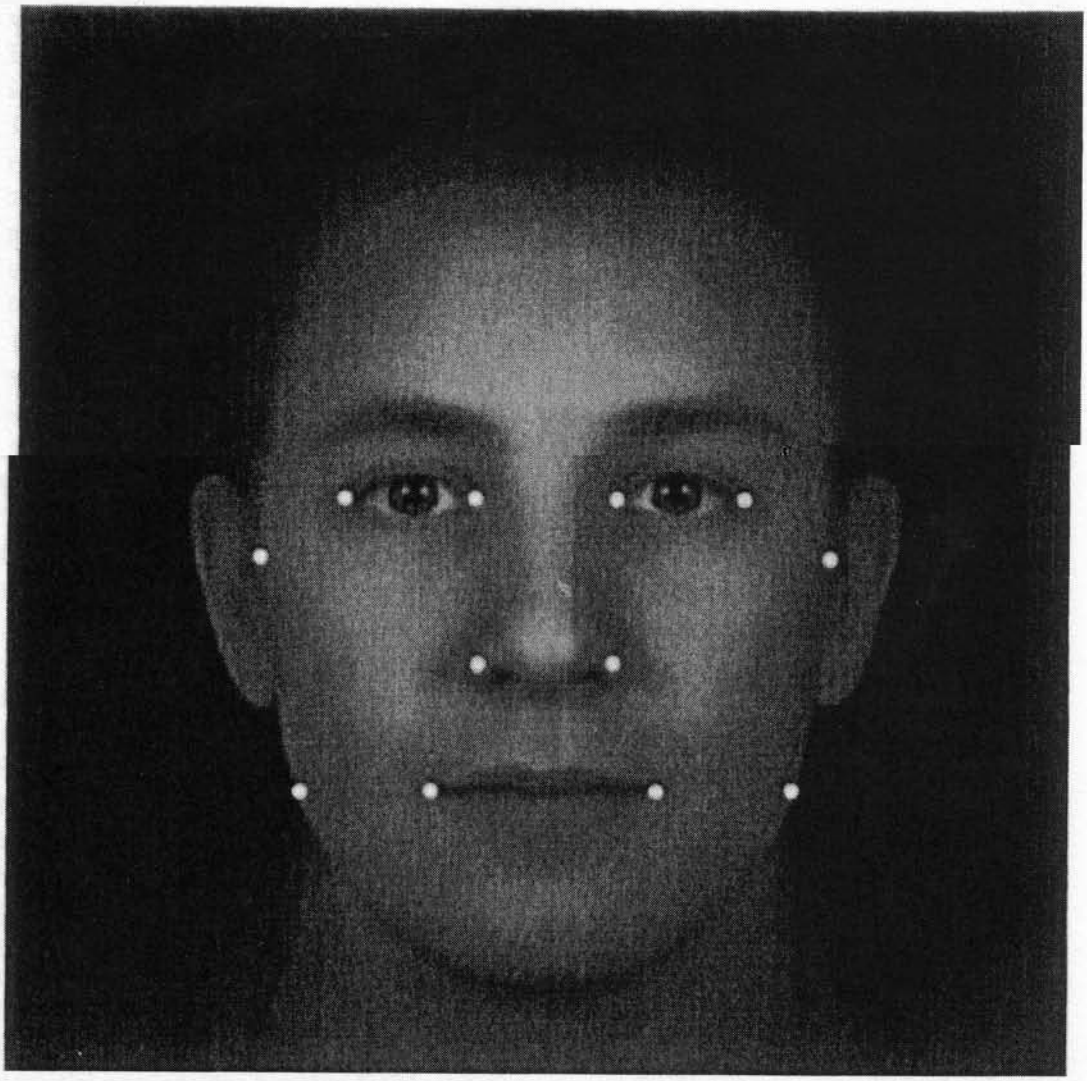
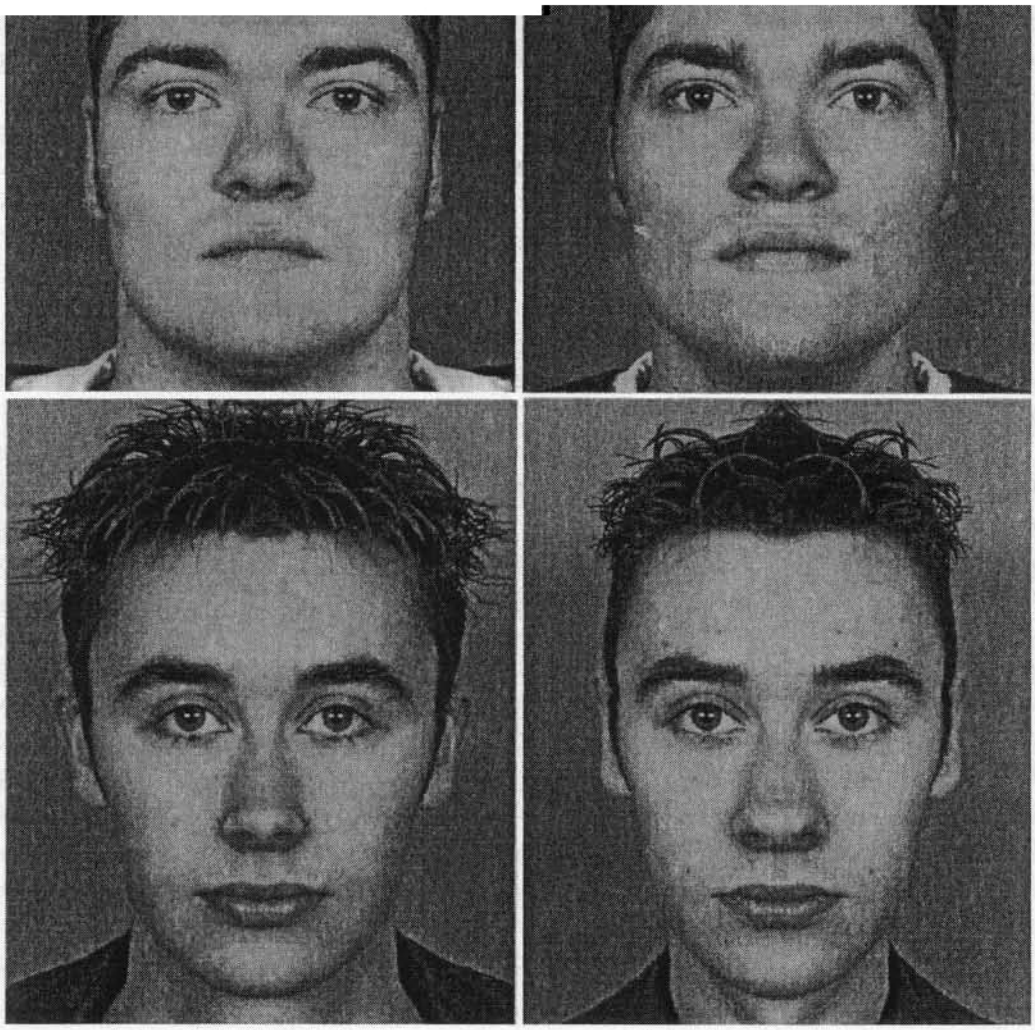


Figure 1. Illustrating the facial-metric technique for assessing facial asymmetry: pairs of bilateral points used to calculate facial asymmetry. Distances between the vertical axis and each of 12 bilaterally paired points are measured parallel to the horizontal axis. These signed distances are then summed to calculate horizontal asymmetry. Vertical asymmetry can also be calculated using similar distance measurements.

With the perceptual measure of facial symmetry (Mealey et al., 1999), high symmetry is indicated by high ratings of the similarity between a left-left chimeric face (the original full-face photograph split down a central vertical axis and the left side of the face aligned with a mirror-reflected version of the left side of the face) and a right-right chimeric face (the original full-face photograph split down a central vertical axis and the right side of the face aligned with a mirror-reflected version of the right side of the face. Examples of left-left and right-right chimeric faces are shown in Figure 2. It has been reported that facial symmetry assessed using the facial metric and perceptual measures yielded estimates that were correlated (Penton-Voak et al., 2001). Studies that have tested the attractiveness-symmetry relationship using the perceptual assessment of facial symmetry have reported that symmetry



Left-left chimeric faces Right-right chimeric faces

Figure 2. Illustrating the perceptual technique for assessing facial symmetry: Left-left and right-right chimeric faces. High facial symmetry is indicated by high ratings of the similarity between the two images. The first pair of chimeric faces were derived from a symmetrical male face. The second pair were derived from a relatively asymmetrical male face.

Both the perceptual and facial metric techniques for assessing facial symmetry measure symmetry relative to a facial mid-line that is defined as bisecting the interpupillary distance. As the midline of the face is identified from a single pair of facial locations it may not reflect the true mid-line of the face (Swaddle, 1999). This may somewhat distort the measure of symmetry that is calculated (Swaddle, 1999). Recently, however, techniques have been developed that measure facial symmetry using edge detection algorithims (e.g. Scognamillo et al., 2001, see also Morrone and Burr, 1995). These algorithims do not rely on a facial midline defined as bisecting the interpupillary distance. Whilst assessments of facial symmetry using edge detection alogorithims and perceptual techniques yield positively correlated measures (Scognamillo et al., 2001), the attractiveness-symmetry relationship has not yet been investigated using these new techniques. Perhaps a more fundamental methodological issue for facial symmetry assessment, however, is the potentially confounding influence small head rotations may have on symmetry measures (see Penton-Voak et al., 2001). It is not known if this introduces noise or a systematic bias to the data. When assessing facial symmetry using either the facial metric or perceptual techniques the influence of small head rotations may be minimised by restricting the sample of faces to those that are approximately truly full-face images. Where head rotations are small in magnitude, however, this may not be possible as very small head rotations may not be identifiable but may still distort symmetry measures. The development of 3D scanning techniques (see O'Toole et al., 1999) that allow facial images to be rotated to the position of minimal asymmetry prior to symmetry measurement would allow researchers to control for the influence of small head rotations on symmetry measures.

Studies examining either perceptual or facial-metric measured symmetry use photographs of real faces. By contrast, other studies have used computer graphic techniques to investigate the relationship between facial symmetry and attractiveness. It has been reported that faces that have been manipulated, using computer graphic techniques, to be more symmetrical are preferred to the original, relatively asymmetrical, images (Little et al., 2001; Perrett et al., 1999; Rhodes et al., 1998, 2001a). An example of the stimuli used by Perrett et al. (1999) and Little et al. (2001) is shown in Figure 3. As facial symmetry alone was varied in these studies, many researchers have concluded that symmetry not only predicts judgements of facial attractiveness but that symmetry also acts as a visual cue for judgements of the attractiveness of real faces (Little et al., 2001; Perrett et al., 1999; Rhodes et al., 1998, 2001a). For some, however, the link remains in debate (e.g. Penton-Voak et al., 2001; Scheib et al., 1999). We will return to this issue later in the manuscript.

Manipulated symmetrical image Original, relatively asymmetric image

Figure 3. Examples of stimuli used in Little et al. (2001) and Perrett et al. (1999). On the left is the manipulated, symmetrical version. On the right is the original, relatively asymmetrical version of the face. Note that both versions retain the colour and texture of the original image.

Why Is Facial Symmetry Attractive?

It has been suggested that judgements of physical attractiveness owe much to media promulgated preferences (Hogg and Graham, 1995; Katzmarzyk and Davis, 2001; Petrie et al., 1996). In other words, what we find attractive is "dictated" to us by exposure to media-generated and perpetuated ideals. For example, traits possessed by celebrities presented as attractive on film and television may increase the attractiveness of members of the public who also possess those traits. These ideals might be expected to be culture-specific. Judgements of facial attractiveness, however, appear to be stable across many diverse cultures, suggesting that some characteristics of attractive faces are universally attractive (Cunningham et al., 1995; Zebrowitz et al., 1993; Perrett et al., 1994, 1998; Rhodes et al., 2001a; for a meta-analytic review see Langlois et al., 2000). Many researchers have interpreted the existence of universally attractive traits as evidence that judgements of facial attractiveness have a biological basis (e.g. Morris, 1967; Perrett et al., 1998; Rhodes et al., 2001a). Facial symmetry appears to be a trait that is attractive across diverse cultures (Rhodes et al., 2001a), suggesting that the attractiveness of symmetry has a biological basis. Two explanations have been advanced as to the nature of this biological basis. These are often referred to as the good genes explanation and the perceptual bias explanation.

Good Genes Explanation

Many theorists (e.g. Miller and Todd, 1998; Thornhill and Gangestad, 1993, 1999) have suggested that fluctuating asymmetry (individual variation between left and right traits that tend to be symmetric at the population level, Ludwig, 1932; Van Valen, 1962) in humans is associated with developmental stability. Developmental stability is a direct measure of how well an individual's genome can resist disease and maintain normal development in the face

of environmental perturbation (Møller, 1990; Parsons, 1992). As developmental stability appears to be heritable (see Møller and Thornhill, 1997 for a review of the heritiability of developmental stability), preferences for individuals with low fluctuating asymmetry are potentially adaptive, since mate selection on the basis of markers of developmental stability will increase offspring viability (Wedekind, 1992). It has been suggested that the attractiveness of symmetrical faces reflects this adaptive preference for symmetrical individuals. In other words, symmetry may be associated with judgements of facial attractiveness because symmetry is a visual marker for qualities that are important within the context of mate selection (i.e. aspects of physical condition such as immunocompetence, fertility and physical fitness). Thus, the good genes explanation of the attractiveness-symmetry relationship suggests symmetry is attractive because it facilitates discrimination between potential mates on the basis of apparent quality. This good genes explanation of the attractiveness-symmetry relationship contrasts markedly with the perceptual bias explanation.

Perceptual Bias Explanation

In order to recognize a face as being a face (rather than, say, a car or a flower) the perceptual system may match a representation of the stimuli to internal prototypical representations (see Bruce and Green, 1990, pp. 381 – 391 for a discussion of this issue and alternative theories of object classification). Symmetrical faces closely match these prototypical representations because prototypical representations are necessarily symmetrical (Enquist et al., 2002). Prototypical representations will be symmetrical because random deviations from perfect symmetry in each individual face will "even out" as the prototype develops (see Alley and Cunningham, 1991 for a discussion of the symmetrical nature of prototypical representations). The perceptual bias explanation of the attractiveness-symmetry relationship suggests that symmetrical faces are found attractive because of the effect exposure to stimuli that closely resemble prototypes has on the human nervous system (Enquist et al., 2002). Thus, the perceptual bias explanation of the attractiveness of symmetry suggests that symmetrical faces are found attractive as a by-product of the ease (in terms of efficiency) with which the perceptual system can process symmetric stimuli (e.g. Bradbury and Vehrencamp, 1998; Enquist and Arak, 1998; Enquist and Ghirlanda, 1998; Enquist et al., 2002).

Testing the Good Genes and Perceptual Bias Explanations

Both the good genes and perceptual bias explanations of the attractiveness-symmetry relationship raise a number of questions about the nature of the link between attractiveness and facial symmetry. These issues arise from the difference in emphasis the two explanations place on the role of symmetry in attractiveness judgements. For example, the good genes explanation of the attractiveness-symmetry relationship emphasises the role of facial symmetry in mate choice while the perceptual bias account emphasises the benefits for the efficiency of the visual recognition system when processing all symmetric stimuli. The following sections of this manuscript discuss empirical data relevant to these issues.

DOES SYMMETRY REFLECT PHYSICAL CONDITION?

The good genes account of the attractiveness-symmetry relationship suggests that facial symmetry is a marker for the physical condition of an individual. Tests for relationships between physical health and either facial attractiveness (Kalick et al., 1998) or facial symmetry (Rhodes et al., 2001b) have, however, found no significant associations. Though Shackelford and Larsen (1999) found weak associations between facial attractiveness and physical health, these results were not replicated across their two samples and the validity of the self-report health measures they used has been questioned (Rhodes et al., 2001b). Hume and Montgomerie (2001) have also reported associations between facial attractiveness and past health problems, though again this finding was reliant on self-reported measures of physical health. Enquist et al. (2002) have suggested that the failure to demonstrate that either facial symmetry or attractiveness reliably signal physical condition undermines the plausibility of the good genes explanation of the attractiveness-symmetry relationship.

The good genes explanation, however, makes a claim concerning how mate selection, at a point in human history prior to the introduction of modern medicine, has shaped psychological adaptations that mediate current mate preferences. Consequently, associations between actual health in modern humans and either facial attractiveness or facial symmetry are not necessarily predicted by the good genes explanation of the attractiveness-symmetry relationship. Thus, it would appear that critics of the good genes explanation of the attractiveness-symmetry relationship have overstated the importance of demonstrating the existence of links between physical condition and facial symmetry in modern humans.

This issue aside, the general medical health investigated by Kalick et al. (1998), Shackelford and Larsen (1999), Rhodes et al. (2001b) and Hume and Montgomerie (2001) need not necessarily be the aspects of mate quality signalled by symmetry. For example, it has been suggested that physical strength and fighting ability may have been important aspects of mate quality in ancestral males, as strong males who could fight well would have been better able to compete for and retain resources (Furlow et al., 1998; Manning and Taylor, 2001). Indeed, males with symmetrical bodies are more likely to have both engaged in and won physical confrontations with other males than those with relatively asymmetric bodies (Furlow et al., 1998). Potential relationships between male facial symmetry and variables such as fighting ability and physical strength have not been tested, however. Body symmetry also seems to be correlated with fertility (Manning et al., 1997, 1998) and intelligence (Furlow et al., 1997) in modern humans. Although Zebrowitz et al. (2002) found that facial symmetry was correlated with intelligence quotient (IQ), researchers testing for relationships between aspects of mate quality and facial symmetry have typically overlooked variables such as intelligence and fertility.

DOES FACIAL SYMMETRY LOOK HEALTHY?

Although it is unclear whether or not facial symmetry signals actual physical health, there is evidence that symmetrical faces do *look* particularly healthy. Rhodes et al. (2001b), Grammer and Thornhill (1994), Penton-Voak et al. (2001) and Jones et al. (2001) found that facial symmetry was positively associated with ratings of the apparent health of an individual made when viewing full-face photographs. These findings are consistent with the good genes

explanation of the attractiveness-symmetry relationship as this suggests that symmetry is attractive because it looks healthy (Grammer and Thornhill, 1994; Jones et al., 2001). By contrast, the perceptual bias account might predict that the relationship between facial symmetry and judgments of apparent health simply reflects an "attractiveness halo" where positive attributes (e.g. extraversion, stability, good health) are automatically ascribed to good looking, symmetrical individuals (see Feingold, 1992; Langlois et al., 2000 for meta-analytic reviews of research on attractiveness halo effects).

Jones et al. (2001) investigated the nature of the inter-relationship between facial symmetry, attractiveness and apparent health using a partial correlation design. Jones et al. (2001), found that judgments of apparent health mediated the attractiveness-symmetry relationship and that the link between perceived health and facial symmetry remained when controlling for the influence of attractiveness. These findings suggest that symmetry is attractive because it looks healthy and negate the view that the perceived health-symmetry relationship reflects a psychological halo effect. Thus, the nature of the inter-relationship between attractiveness, symmetry and apparent health supports the good genes account of the attractiveness-symmetry relationship and is evidence against the perceptual bias explanation.

Is Facial Symmetry Attractive Independent of Prototypicality?

The perceptual bias explanation of the attractiveness-symmetry relationship suggests that symmetrical faces are attractive because they closely resemble internal prototypical representations of faces (Enquist et al., 2002). Indeed, prototypical faces generated using computer graphic techniques (see Benson and Perrett, 1992, 1993; Rowland and Perrett, 1995) tend to be highly symmetrical (Alley and Cunningham, 1991). There is evidence, however, that facial symmetry is attractive independently of prototypicality.

Many researchers have suggested that reverse-scored distinctiveness ratings reflect facial prototypicality (e.g. Rhodes et al., 1999; Wickham et al., 2000). In other words, these researchers suggest that faces judged to be highly distinctive are both non-prototypical and non-average. In studies that have used this technique to assess facial prototypicality, distinctiveness is normally defined as the ease with which that person could be picked out from a crowd. Consistent with the suggestion that prototypical faces are highly symmetrical, Rhodes et al. (1999) found that facial symmetry was associated with reverse-scored ratings of facial distinctiveness (i.e. prototypicality). Rhodes et al. (1999) also found that both reverse-scored distinctiveness and symmetry positively influenced judgements of facial attractiveness independently of one another. This latter finding suggests that the relationship between symmetry and facial attractiveness is not mediated by prototypicality as the perceptual bias account suggests.

Although some researchers have suggested that perceptual ratings do not necessarily reflect biological properties (Evans et al., 2000; Meyer and Quong, 1999; Scheib et al., 1999), and therefore reverse-scored ratings of distinctiveness may not reflect actual prototypicality, Little and Hancock (in press) found that distinctiveness ratings did reflect manipulations of the prototypicality of computer graphic faces (see Benson and Perrett, 1993 for methods for manipulating the prototypicality of computer graphic faces). That Bruce et al. (1994) found that an objective measure of prototypicality derived from measurements of facial proportions

was significantly correlated with reverse-scored distinctiveness ratings also supports the claim that distinctiveness ratings reflect actual facial prototypicality. Thus, the findings of Rhodes et al. (1999) are problematic for the perceptual bias account of the attractiveness-symmetry relationship as they are evidence against the claim that the attractiveness of symmetry simply reflects the prototypicality of symmetrical faces.

Is There an Opposite-Sex Bias in Strength of Preferences for Facial Symmetry?

Comparing attractiveness judgements under opposite- and own-sex conditions is an example of a manipulation of viewing context that is common in studies of facial attractiveness. The perceptual bias account would not predict the occurrence of an opposite-sex bias in sensitivity to symmetry when judging facial attractiveness as the efficiency gains that the visual recognition system enjoys when processing symmetrical stimuli will be equivalent regardless of viewing context. In other words, the perceptual bias explanation suggests that the attractiveness of symmetry is context-invariant. By contrast, if the attractiveness of symmetrical faces reflects adaptations facilitating discrimination between potential mates on the basis of apparent physical condition, as the good genes explanation suggests, then an opposite-sex bias in sensitivity to symmetry when judging facial attractiveness might be expected.

Consistent with this good genes prediction, a number of studies have reported opposite-sex biases in sensitivity to symmetry when judging facial attractiveness. Little et al. (2001) found that female judgments of male facial attractiveness (opposite-sex judgments) were more sensitive to symmetry than female judgments of the attractiveness of female faces (own-sex judgments). Penton-Voak et al. (2001) also reported that the relationship between symmetry and female judgments of male facial attractiveness (opposite-sex judgments) was stronger than that between symmetry and male judgments of the facial attractiveness of other males (own-sex judgments). In a similar vein, Jones et al. (2001) reported an opposite-sex bias in sensitivity to facial symmetry when judging the apparent health of individuals when viewing full-face photographs. As judgments of apparent health appear to mediate the attractiveness-symmetry relationship (Jones et al., 2001), presumably this opposite-sex bias in sensitivity to facial symmetry when judging apparent health underpins the opposite-sex biases reported by Penton-Voak et al. (2001) and Little et al. (2001).

These opposite-sex biases in sensitivity to facial symmetry (context-specific effects) cannot be explained by a purely perceptual bias account that suggests the attractiveness of symmetry is context-invariant. That there is an opposite-sex bias in sensitivity to facial symmetry when judging attractiveness and perceived health is, however, consistent with the claim that the processing of symmetry by the perceptual system is an adaptation facilitating discrimination between potential mates on the basis of apparent physical condition. Whilst perceptual bias may interact with perceiver motivation to facilitate context-sensitive perceptual bias, in the case of opposite-sex biases in sensitivity to symmetry this motivation would appear to have an adaptive basis.

Are Preferences for Facial Symmetry Condition-Dependent?

There is evidence that mate choices in non-human species often reflect the condition of the perceiver as much as they reflect the condition of the perceived. For example, female three-spined sticklebacks that are in good physical condition have a stronger preference for high quality males than female sticklebacks in relatively poor physical condition (Bakker et al., 1999). In an effort to test for analogous condition-dependent mate preferences in human females, Little et al. (2001) investigated the influence of self-rated attractiveness (thought by Little et al. to be a measure of female mate quality) on the strength of female preferences for symmetry in male faces. That self-rated female attractiveness has been found to be highly correlated with other's ratings of female facial attractiveness (Penton-Voak et al., in prep) supports the idea that self-rated attractiveness is a measure of female mate quality. Little et al. (2001) found that females who rated themselves as highly attractive had a stronger preference for male facial symmetry than females who rated themselves as relatively less attractive.

Little et al. (2001) explained this finding by noting that high quality females may be better able to retain high quality, and presumably highly symmetrical, males as long-term mates. Poorer quality females would lose out on male investment if they were to mate with, but not be able to retain, high quality males. High quality females may be able to maximize the available investment. Indeed, there is evidence that in many species, including humans, high quality males are less likely to invest in both relationships and offspring than relatively poorer quality males (see Gangestad and Simpson, 2000 for a review). Little et al. (2001) suggested that poorer quality females might have adaptive preferences for males that they are able to retain and that this is reflected in their relatively weak preference for symmetrical male faces.

As the perceptual bias account of the attractiveness-symmetry relationship suggests that preferences for symmetry occur independently of context, it cannot accommodate the finding that female preferences for symmetry in male faces are, to some extent, condition-dependent. By contrast, condition-dependent preferences for symmetry are consistent with the good genes explanation of the attractiveness-symmetry relationship as this emphasizes the role of symmetry in determining mate preferences. Thus, condition-dependent preferences for facial symmetry support the good genes explanation of the attractiveness-symmetry relationship and are problematic for the perceptual bias account.

Is Symmetry Attractive in Mate Choice-Irrelevant Stimuli?

If preferences for facial symmetry reflect adaptations facilitating discrimination between potential mates on the basis of cues to physical condition, as the good genes account suggests, then preferences for characteristics thought to be cues to good genes might only occur when judging the attractiveness of mate choice-relevant stimuli such as faces (Halberstadt and Rhodes, 2000). Preferences for symmetry have been observed, however, when judging the attractiveness of many types of objects (Rensch, 1963) and decorative art (Gombrich, 1984). These preferences serve no obvious purpose (within the context of mate selection) and are

consistent with the context-invariant nature of the perceptual bias explanation of the attractiveness of symmetry. By contrast, that symmetry is attractive in mate choice-irrelevant stimuli is problematic for the good genes explanation of the attractiveness-symmetry relationship[1].

A recent study by Little (in prep) investigated the relationship between symmetry and the attractiveness of both inverted and upright (i.e. non-inverted) face images. Upright faces "enjoy a type of configural processing that is abolished when faces are shown inverted" (O'Donnell and Bruce, 2001, p756). This causes inverted faces to be treated as non-faces by the perceptual system (see Leder and Bruce, 1998 for a discussion of this issue). Inverted faces are therefore an example of mate choice-*irrelevant* stimuli while upright faces are an example of mate choice-*relevant* stimuli. The good genes account would not necessarily predict that symmetry would be associated with attractiveness when judging inverted faces (i.e. mate choice-irrelevant stimuli) but would predict that symmetry would be associated with attractiveness in upright faces (i.e. mate choice-relevant stimuli). By contrast, inversion of faces should not affect the attractiveness-symmetry relationship if the attractiveness of symmetry is context-invariant as the perceptual bias account suggests.

Little (in prep) found that symmetry influenced the attractiveness of both inverted and upright faces. Preferences for symmetry were significantly more pronounced, however, when judging the attractiveness of the upright faces than when judging the attractiveness of the inverted faces. Thus, symmetry appears to be more important for attractiveness judgments of mate choice-*relevant* stimuli (the upright face images) than for attractiveness judgments of mate choice-*irrelevant* stimuli (the inverted face images). This is consistent with the good genes account of the attractiveness-symmetry relationship. That both inverted and upright symmetrical faces were judged highly attractive, however, indicates that the attractiveness of facial symmetry also has a perceptual bias component.

Correlates of Symmetry and Facial Attractiveness: Is Symmetry a Visual Cue for Judgements of Facial Attractiveness?

It has been reported that faces that have been manipulated, using computer graphic techniques, to be more symmetrical are preferred to the original, relatively asymmetrical, images (Little et al., 2001; Perrett et al., 1999; Rhodes et al., 1998, 2001a). As facial symmetry alone was varied in these studies, many researchers have concluded that symmetry not only predicts judgements of facial attractiveness but that symmetry also acts as a visual cue for judgements of the attractiveness of real faces (Little et al., 2001; Perrett et al., 1999; Rhodes et al., 1998, 2001a). The findings of a number of recent studies raise doubts about this interpretation, however.

When participants were asked to rate the symmetry of 2D images of real faces, these perceptual judgements did not correlate with symmetry measurements (Scheib et al., 1999). This finding suggests that symmetry may not be a viable visual cue for judgments of facial attractiveness as it would appear that participants cannot accurately detect asymmetries in real

[1] Preferences for symmetry in mate choice-irrelevant stimuli may be due to an over-generalisation of preferences for symmetry in mate choice-relevant stimuli, however.

faces. Bruyer and Craps (1985) also found that participants were poor at detecting facial asymmetries in 2D face images. Whilst asymmetry detection when viewing 3D face images has never been tested, the findings of Scheib et al. (1999) and Bruyer and Craps (1985) suggest that the magnitude of asymmetries that occur in the human face are simply too small to be easily detected. Thus, Scheib et al. (1999) suggested that it may be correlates of symmetry that are the critical visual cues for judgements of the attractiveness of real faces.

If symmetry is not a visual cue for judgements of facial attractiveness, this would be problematic for the perceptual bias explanation of the attractiveness-symmetry relationship. The perceptual bias account suggests that symmetry is attractive because of processing gains resulting from the perception of symmetry. If symmetry is not a visual cue for judgements of facial attractiveness and is not perceived in real faces, then there is no opportunity for these processing gains to occur. In other words, the perceptual bias account suggests that symmetry predicts judgements of attractiveness precisely because it is a visual cue for judgements of facial attractiveness. By contrast, for many researchers the existence of attractive correlates of symmetry is a specific prediction of the good genes account, as aspects of physical appearance as diverse as visible skin condition (Fink et al., 2001; Jones et al., in prep; Symons, 1979), trait size (Grammer and Thornhill, 1999), body and face shapes (Thornhill and Grammer, 1999), in addition to symmetry (Thornhill and Gangestad, 1999), are thought to signal mate quality and therefore might be expected to co-vary (see Scheib et al., 1999; Swaddle, 1999 and Thornhill and Grammer, 1999 for recent discussions of this issue). Furthermore, attractive correlates of symmetry have been found in non-visual modalities. For example, symmetrical males have both a more attractive scent (Rikowski and Grammer, 1999) and more attractive voices (Feinberg and Jacobson, 2001; Hughes et al., 2002) than relatively asymmetric males. Consistent with the suggestion that correlates of symmetry are visual cues for judgements of the attractiveness of real faces, several recent studies (Jones et al., in prep; Scheib et al., 1999; Penton-Voak et al., 2001) have demonstrated the existence of facial characteristics that co-vary with, but that are attractive independently of, symmetry.

Scheib et al. (1999) reported that facial symmetry predicted judgements of the attractiveness of male faces regardless of whether faces were presented as full-face images or presented as half-faces (i.e. full-face images split down a central vertical axis and either the left or right half masked). As the visibility of cues to symmetry is reduced in half-faces[2], Scheib et al. concluded that (i) there are additional cues to attractiveness that co-vary with facial symmetry, (ii) that these co-variates are visible in half-faces and (iii) that these co-variates are sufficient to determine judgements of male facial attractiveness independently of facial symmetry. Penton-Voak et al. (2001) also found evidence for co-variates of symmetry predicting male facial attractiveness when cues to symmetry were not visible.

Penton-Voak et al. (2001) reported that a composite face (see Rowland and Perrett, 1995) representing the mean shape and colour of a sample of males with highly symmetrical faces, was judged as more attractive than a composite face that represented a sample of males with less symmetrical faces. Thus, symmetry of the individual faces (i.e. those contributing to the composites) predicted the attractiveness of the composite faces. As composite faces are likely to be of equivalent high symmetry (Alley and Cunningham, 1991), Penton-Voak et al.

[2] Some cues to symmetry may be visible in half-faces, however. A highly asymmetric face may break down into half faces with either atypically narrow central facial features (i.e. nose and mouth) or atypically wide central facial features. These deviations from "averageness" in the half-face may inform the viewer of how symmetrical the full-face is.

concluded that correlates of facial symmetry that are attractive to females must have remained visible in the composite faces. The composite faces used by Penton-Voak et al. (2001) are shown in Figure 4.

Mean facial shape of symmetric males Mean facial shape of asymmetric males

Figure 4. Composite faces in the mean shape of a sample of males with highly symmetrical faces (left) and males with relatively asymmetric faces (right) from Penton-Voak et al. (2001).

Scheib et al. (1999) proposed that facial masculinity might co-vary with, and determine attractiveness independently of, symmetry. This relationship might be anticipated, as both masculinity and symmetry are theoretically associated with immunocompetence and, as a consequence, may be attractive to females (Thornhill and Gangestad, 1999). Consistent with this prediction, Scheib et al. (1999) reported a positive association between facial symmetry and a composite masculinity index derived from the shape of facial characteristics thought to be male sex-typical traits (cheekbone prominence and face length relative to lower face length). Penton-Voak et al. (2001) disputed this link between facial masculinity and symmetry, finding that cheekbones were more prominent in a female sample than a male sample. A masculinity index derived from measurements of facial characteristics, first identified as being sexually dimorphic, was not associated with symmetry in male faces (Penton-Voak et al., 2001). Furthermore, the relationship between masculinity and attractiveness in male faces is somewhat disputed (see Penton-Voak and Perrett, 2001 for a review). Perrett et al. (1998), for example, found female preferences for male faces with a feminine shape, while other studies have found that masculine facial characteristics are attractive to females (e.g. Johnston et al., 2001).

Penton-Voak et al. were unable to ascertain what cues co-vary with symmetry but posited that apparent healthiness of facial skin might be one such characteristic (see also Symons, 1979). Jones et al. (in prep) reported that facial symmetry was associated with judgements of

the apparent health of the facial skin of males. Furthermore, Jones et al. (in prep) found that an average facial shape with the representative colour and texture of a sample of symmetrical male faces (see Tiddeman et al., 2001 for methods for calculating average colour and texture for a sample of faces) was judged more attractive and healthier looking than the same average facial shape with the representative colour and texture of a sample of relatively asymmetrical male faces. These findings suggest that visible condition of facial skin is a correlate of facial symmetry that is attractive independently of facial shape.

CONCLUSIONS

The findings discussed here suggest that both good genes and perceptual bias mechanisms underpin preferences for symmetry in the human face. Both condition-dependent variations in the strength of preferences for symmetry (Little et al., 2001) and opposite-sex biases in sensitivity to symmetry (Jones et al., 2001; Little et al., 2001; Penton-Voak et al., 2001) demonstrate that symmetry preferences are not context-invariant, as the perceptual bias explanation claims. By contrast, these context-specific findings are consistent with the good genes account as they emphasise the role of symmetry in mate choice decisions.

Further support for the good genes explanation of the attractiveness-symmetry relationship comes from tests of the nature of the inter-relationship between judgments of apparent health, attractiveness and facial symmetry. That the link between attractiveness and facial symmetry is mediated by judgements of apparent health (Jones et al., 2001) is a specific prediction of the good genes account. The perceptual bias explanation of the attractiveness-symmetry relationship, on the other hand, would predict that the link between apparent health and symmetry is due to an attractiveness halo effect. That symmetrical stimuli are preferred when judging the attractiveness of mate choice-irrelevant stimuli (e.g. inverted faces), however, albeit to a lesser extent than when judging the attractiveness of mate choice-relevant stimuli (e.g. upright faces), suggests that the attractiveness of symmetry also has a perceptual bias component (Little, in prep).

Although the attractiveness of facial symmetry appears to predominantly reflect adaptations for discriminating between potential mates on the basis of cues to apparent physical condition, perhaps a more fundamental issue is whether or not symmetry is a visual cue for judgements of physical attractiveness. At present the evidence is equivocal. Studies that have reported that manipulations of facial symmetry alone were sufficient to influence attractiveness judgements suggest that symmetry is a visual cue for judgements of facial attractiveness (Little et al., 2001; Perrett et al., 1999; Rhodes et al., 1998). Other studies have reported that symmetry predicted judgements of facial attractiveness even when the influence of facial symmetry was removed (Penton-Voak et al., 2001; Scheib et al., 1999), suggesting that correlates of symmetry are visual cues for judgements of facial attractiveness. It remains to be seen whether symmetry or correlates of symmetry have primacy when judging facial attractiveness. Given that attractiveness of both scent (Rikowski and Grammer, 1999) and voices (Feinberg and Jacobson, 2001; Hughes et al., 2002) are correlated with symmetry, a perceptual system may have evolved that uses both symmetry and correlates of symmetry that occur across multiple modalities to assess the quality of potential mates. Such a system would arguably increase the reliability of mate quality appraisals by reducing the likely impact of signalling errors.

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