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Facial Characteristics: Symmetry

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Synonyms

Fluctuating asymmetry; Lateralization

Definition

Facial symmetry refers to the bilateral symmetry of the face, the extent to which the left and right sides of the face exhibit identical, but reflected, morphology and movement.

Facial Characteristics: Symmetry

High facial symmetry is not itself a trait. Rather, it reflects the absence, or low levels, of asymmetry. Facial asymmetry may manifest in two distinct manners: fluctuating asymmetry and systematic lateralization. With divergent etiologies, these manifestations of facial asymmetry bring theoretically distinct implications for how facial asymmetry should impact judgments of attractiveness and personality, both of which are expected to influence mating decisions.

Fluctuating Asymmetry

Fluctuating asymmetry refers to morphological deviations from bilateral symmetry, whose distribution across any given population "fluctuates," meaning that it is randomly distributed with respect to direction magnitude about a mean of zero across individuals (Ludwig, 1932; Parsons, 1992). Fluctuating asymmetry is presumed to reflect accrued developmental perturbations arising from stress experienced during development (Palmer & Strobeck, 1986). Stressors can include nutritional deficiencies (Swaddle & Witter, 1994), disease (Thornhill & Møller, 1997), and parasite burdens (Møller, 1992). As such, the absence of fluctuating asymmetry putatively signals that an individual experienced a well-nourished development that was either free from serious disease and an excessive parasite burden, or only involved exposure to diseases and parasites for which the individual possesses a robust immune defense (also known as buffering capacity, see also Klingenberg & Nijhout, 1999). All of these are positive indicators of high adult mate quality, and so the absence of fluctuating asymmetry is theoretically predicted to lead to high perceived attractiveness, mate value, and ultimately to reproductive success (Gangestad et al., 1994).

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Systematic Lateralization of the Human Face

Lateralization refers to functional – as opposed to stochastic – morphological and behavioral asymmetries of the left and right sides of the body. Lateralities of morphology are ubiquitous across the Animal Kingdom (Klingenberg et al., 1998) and are typically associated with cerebral asymmetries and bilateral specialization of function (Frasnelli et al., 2012; Rogers, 2002). Morphological lateralization may manifest as either directional asymmetry or antisymmetry. Directional asymmetry occurs when the majority of individuals within a population exhibit left-right differences in the same direction for a given trait. Antisymmetry occurs when individuals exhibit functionally relevant lateralization, but with no overall population trend for one direction of lateralization to be more common than the other. Directional asymmetry, rather than antisymmetry, is the expected form of lateralization when social coordination of behavior is required (Vallortigara & Rogers, 2005), as is the case with human facial signaling. Lateralization may be structural (pertaining to left-right differences in morphology) or functional (left-right asymmetries of behavior). Human faces exhibit both structural and functional directional asymmetries.

The human face is structurally asymmetric. The overall patterns of asymmetry in the human face are complex. A left side chin deviation is reported across studies (Ferrario et al., 1993; Haraguchi et al., 2008). There may also be differences in asymmetry apparent across different regions of the face, with most asymmetry apparent in the lower face, and the least apparent in the upper face (Nur et al., 2016). Conflicting findings have also been reported. Studies on different populations using different methods to measure asymmetry have variously reported that the left (Ercan et al., 2008) or right (Haraguchi et al., 2008; Shah & Joshi, 1978) hemiface is significantly larger. Varying ages of the samples could help account for some disparities with studies on younger samples (often children) more likely to report a larger right hemiface, with the right hemiface size bias weakening with age in one such study (Haraguchi et al., 2008). It is also possible that some aspects of facial asymmetry constitute antisymmetry. Antisymmetrical features are lateralized to similar extents across individuals, but with no systematic pattern across the population in the observed direction of the asymmetry. Features presenting as antisymmetrical within a sample would thus not be identified as asymmetrical by any study focused only on sample-wide, biased mean deviations from symmetry (which is the focus of the majority of studies reporting on facial morphological asymmetry). Furthermore, nonrandom sampling (or even simple sampling error) could mean that antisymmetrical traits manifest predominantly in one direction or the other in any given sample. Soft tissue asymmetries can also compensate for underlying skeletal asymmetries (Nur et al., 2016) potentially accounting for differences in results based on skeletal scans compared to those based on facial photographs. The presence of systematic structural asymmetry in human faces is certain, but a definitive substantiation of the manifest patterns of human facial structural lateralization remains elusive.

Behavioral data supports the existence of functionally relevant directional asymmetries. For the majority of facial expressions, the left side of the face is perceived to be more expressive than the right (Sackeim et al., 1978; Nicholls et al., 2004; reviewed by Lindell, 2013). The left side of the face is also prioritized in photographic and painted portraits (Conesa et al., 1995; McManus & Humphrey, 1973; Powell & Schirillo, 2009). Motives to display or conceal emotion also influence a person to preferentially display their left or right hemiface, respectively (Nicholls et al., 1999; Okubo & Oyama, 2022). Biased hemiface display may also be used to manipulate perceptions of trustworthiness (Okubo et al., 2018). Much like the underlying structural asymmetries, facial expression asymmetries are more complex than a simple left-side bias. Across different expressions, and different regions of the faces, the left and right hemiface are variously preferentially fixated (Thomas et al., 2014), suggesting that viewers extract a variety of information

asymmetrically from the face. Potential functional relationships between systematic structural facial asymmetries and expression lateralization remain unexplored.

Differentiating Fluctuating Asymmetry from Structural Facial Lateralization

Fluctuating asymmetry is theoretically presumed to be distributed randomly across the face and across the population, about a mean of zero. Antisymmetry would be distributed about a mean of zero but would manifest with systematic and opposing patterns of asymmetry about this mean. Directional asymmetry is systematically distributed across the population about nonzero means. This makes differentiating structural facial lateralization (which may include both directional asymmetry and antisymmetry components) from fluctuating asymmetry straight forward, at least logically. Geometric morphometric analyses can identify patterns of asymmetry repeatedly observed across a sample of specimens. Remaining observed asymmetries, not accounted for by these systematic patterns, may be presumed to represent fluctuating asymmetry (Klingenberg, 2015).

In practice, the majority of studies of human facial symmetry, especially older studies, have not attempted to differentiate between different types and sources of facial asymmetry or have not adopted appropriate methods to do so (Graham & Özener, 2016). Most of these studies have been concerned, theoretically, with the consequences of varying levels of fluctuating asymmetry on subjective impressions of face. These studies have tended to measure or manipulate overall facial asymmetry, with no attempt to differentiate fluctuating asymmetry from systematic structural lateralization. Such methods confound the effects of fluctuating asymmetry and structural lateralization on whatever dependent variables are being measured (typically, these are subjective impressions of attractiveness, health, or other variables theoretically related to fluctuating asymmetry as a signal of mate quality (Rhodes & Simmons, 2007; Swaddle & Cuthill, 1995). This is problematic because fluctuating asymmetry and structural lateralization could have opposing effects on subjective judgments of faces (see below).

A practical issue that arises when trying to isolate fluctuating asymmetry from other sources of asymmetry in natural face stimuli is that fluctuating asymmetry manifests much like measurement error – small, ostensibly random deviations distributed around a mean of zero (Rhodes & Simmons, 2007). Unless steps are taken to estimate potential measurement error (such as having the morphology of individual specimens independently delineated and estimating inter-researcher reliability), it is impossible to avoid attributing measurement error to estimates of fluctuating asymmetry. This is not a trivial concern because the magnitude of fluctuating asymmetry is typically a small proportion of trait size (Palmer & Strobeck, 2003) and measurement error when delineating the morphology of face specimens has been seen to be substantial in comparison to estimated fluctuating asymmetry (for example, Pound et al., 2014).

Facial Symmetry and Attractiveness

Facial symmetry is generally positively associated with facial attractiveness. In a seminal study, naturally varying facial asymmetry was negatively correlated with subjective judgments of the attractiveness of male and female faces, provided by opposite sex raters (Grammer & Thornhill, 1994). Numerous subsequent findings confirmed this observation (Hume & Montgomerie, 2001; Jones et al., 2001; Mealey et al., 1999, Rhodes et al., 1998, Scheib et al., 1999; and see also Rhodes & Simmons, 2007, for a meta-analysis reporting the same).

Theoretically, fluctuating asymmetry is an indicator of developmental instability and thus of low mate quality, and so high levels of facial fluctuating asymmetry are expected to negatively impact perceived facial attractiveness. Asymmetry arising from structural lateralization of the face is not expected, theoretically, to negatively impact perceived attractiveness. In fact, it may positively impact attractiveness (Sulikowski, 2016; see also

Swaddle & Cuthill, 1995). The majority of studies reporting relationships between facial asymmetry and attractiveness, however, have not differentiated between fluctuating asymmetry, and structural lateralization of the face. Many studies (for example, Grammer & Thornhill, 1994; Hume & Montgomerie, 2001; Jones et al., 2001; Scheib et al., 1999) relied on objective measurements of overall facial asymmetry, which would combine asymmetry arising from these two sources. Subjective judgments of facial asymmetry do not necessarily correlate strongly with objective measures of the same (Scheib et al., 1999); however, Simmons et al. (2004) demonstrated that subjective judgments of facial asymmetry estimate the amount of fluctuating asymmetry present in faces more accurately than the amount of structural lateralization present. Hence, studies reporting correlations between perceived facial attractiveness and perceived (rather than measured) facial asymmetry (such as Rhodes et al., 1998) likely provide more accurate estimates of the size of the association between fluctuating asymmetry and facial attractiveness. Indeed, such effect sizes are larger when facial symmetry is perceived than when it is measured (Rhodes & Simmons, 2007).

Naturally occurring correlations between facial symmetry and perceived attractiveness are not sufficient to establish that facial asymmetry, per se, impacts perceived attractiveness. The relationship between facial asymmetry and attractiveness has also been confirmed experimentally, via controlled manipulations of the amount of overall asymmetry present in faces (Perrett et al., 1999; Rhodes et al., 2001). Such studies do confirm a direct causal relationship between facial asymmetry and perceived attractiveness, whereby decreases in the amount of asymmetry present result in increased perceived attractiveness. But this does not preclude the possibility that facial traits impacting perceived attractiveness covary with facial asymmetry, and contribute to the observed correlational relationships between facial asymmetry and perceived attractiveness. Attractiveness judgments of vertical half-faces (which, by definition, contain no direct illustration of the whole face's levels of asymmetry) correlate with the asymmetry measurements derived from the whole face (Scheib et al., 1999). This same study reported that facial masculinity, indexed by cheek-bone prominence and lower facial length, correlated with both symmetry and attractiveness, suggesting that aspects of facial morphology hypothesized to indicate mate quality (Foo et al., 2020) may covary with symmetry, and may contribute to the relationship between facial symmetry and attractiveness.

Preferences for low levels of fluctuating facial asymmetry may increase in high pathogen environments. This is commensurate with low levels of fluctuating asymmetry providing a reliable cue of disease resistance and immune-competence. Naturally occurring individual differences in disease concerns correlate positively with preferences for symmetric faces, but not with preferences for symmetry in other objects (Young et al., 2011). Reported preferences for symmetric faces are also larger following conceptual priming for infectious diseases (Young et al., 2011), and the effect may be larger, or even restricted to, opposite sex faces (Ainsworth & Maner, 2019).

Facial Symmetry and Health

As an index of developmental instability, fluctuating asymmetry is expected to be associated with poorer developmental and adult health outcomes. High facial symmetry, signaling an absence of fluctuating asymmetry, would therefore be expected to correlate with health metrics and to be subjectively perceived as healthy. Empirically, both postulates are supported, albeit with a greater weight of evidence supporting the latter. Studies investigating the relationship between facial fluctuating asymmetry and actual and perceived health have tended to be hampered by the same methodological issues (accurately measuring and manipulating fluctuating asymmetry, as opposed to overall facial asymmetry) as those investigating the impact of asymmetry on perceived attractiveness.

Highly symmetrical faces are perceived as healthy (Fink et al., 2006; Grammer & Thornhill,

1994; Jones et al., 2001; Rhodes et al., 2001). Grammer and Thornhill (1994) first reported that women rating men's faces judged more symmetrical faces to be healthier. The same correlation, though, was not significant for men rating women's faces. Jones et al. (2001) extended these findings reporting that perceived health of both male and female faces correlates with measured asymmetry. The correlations persist after controlling for perceived attractiveness, ruling out explanations based on simple halo-effects (Švegar, 2016). Further, the impacts of asymmetry on perceived health were larger for opposite-sex, compared to same-sex, ratings of faces. This directly implicates facial symmetry as playing a role in mate-value judgments. Rhodes et al. (2001) and Dykiert et al. (2012) also reported positive relationships between perceived health and facial symmetry. Both of these studies estimated facial symmetry based on subjective ratings, in contrast to the earlier studies of Grammer and Thornhill (1994) and Jones et al. (2001) who relied upon objective measures of facial symmetry. As previously explained, subjective judgments of facial symmetry tend to better estimate the amount of fluctuating asymmetry present in faces (to which viewers are especially sensitive, Simmons et al., 2004) than objective measures of overall asymmetry, which necessarily reflect a combination of fluctuating asymmetry and structural laterality. Therefore, even though none of the aforementioned studies attempted to correlate objective estimates of fluctuating asymmetry (as distinct from overall asymmetry), with perceived health, Rhodes et al. (2001) and Dykiert et al. (2012) provide the strongest evidence linking fluctuating asymmetry with lower perceived healthiness.

The evidence linking fluctuating asymmetry to actual, rather than perceived, health is more equivocal. Shackelford and Larsen (1997) reported positive correlations between objectively measured overall facial asymmetry and indicators of poor psychological health in men, though not in women. They did not observe relationships between facial asymmetry and the frequency with which a variety of common health complaints were experienced in a test period of 1 month, for either men or women. Hönekopp et al. (2004) reported no significant relationship between objectively measured facial asymmetry and either laboratory tests of physical fitness, or self-reported health in young women, although the former approached significance. Similarly, Rhodes et al. (2001) reported a relationship approaching significance between measured overall facial asymmetry at adolescence and adult health in women, though not in men. Since none of these studies differentiated fluctuating asymmetry from overall asymmetry, they are all limited in the extent to which they can speak to the specific relationship between fluctuating facial asymmetry and health markers of developmental instability.

A recent meta-analysis (Švegar, 2016) reported a robust association between facial asymmetry and health outcomes, but the meta-analysis was not restricted to humans, with several of the larger reported effect sizes involving the nonhuman primates. A larger meta-analysis restricted to humans, but not restricted to faces (Van Dongen & Gangestad, 2011), concluded that there was a robust but small effect between fluctuating asymmetry across the human face, body, and dentition, and health outcomes attributable to developmental instability. The analysis did not observe differences in the strength of this relationship between body asymmetry, facial asymmetry, and asymmetry of dentition, but it also lacked the power to test reliably for such differences.

One more recent study did attempt to statistically isolate fluctuating asymmetry from overall facial asymmetry. Pound et al. (2014) used geometric morphometrics to estimate the levels of fluctuating asymmetry (as distinct from overall asymmetry) present in three-dimensional facial scans of 15-year-old boys and girls. Estimates of fluctuating asymmetry correlated with IQ and birth weight as would be expected if fluctuating asymmetry were an indicator of developmental instability. It did not, however, correlate with three parent-reported measures of childhood health including the number of childhood infections reported (from a list of common childhood infections including measles, chicken pox, mumps, rubella, etc.), the average number of

symptoms parents reported their children experiencing per year from a set list (including diarrhea, vomiting, stomach ache, rash, etc.), and the proportion of years (from age 2–14) in which parents reported their child experiencing health problems. Although the paper included a sample size of several thousands, strong conclusions regarding the relationship between adolescent facial fluctuating asymmetry and prior childhood health should be avoided. The estimated error of measurement was up to a third of the magnitude of estimated fluctuating asymmetry suggesting that fluctuating estimates may comprise non-negligible amounts of noise (although correlations are observed between fluctuating asymmetry and birth weight and IQ, respectively, and the reported sex difference with boys exhibiting higher fluctuating asymmetry than girls do, Claes et al., 2012, bolster confidence in the fluctuating asymmetry estimates). The measures of childhood health, however, are less convincing. Many of the common childhood infections surveyed were (and are) vaccine preventable for the tested cohort. Therefore, a substantial proportion of variance in this measure would be accounted for by whether or not the child had received the recommended childhood vaccinations. Similarly, the measure of symptoms involved a sum of binary responses as to whether a specific symptom had been experienced or not over the last 12 months, which provides an indicator of the variety of symptoms experienced, but not necessarily their frequency or severity. The proportion of years in which health problems were experienced potentially provides a rough indicator of frequency of health problems but does not capture either severity or cause (and would therefore include health problems arising from accidents and injury unrelated to immunocompetence and developmental instability). Therefore, although highly influential, Pound et al.'s (2014) study does not strongly refute the theory that fluctuating facial asymmetry, as an index of developmental instability, can reliably signal health in a manner relevant to judgments of mate quality.

Facial Symmetry and Personality

Facial symmetry is related to a variety of personality traits. Facial symmetry influences personality attributes made toward faces and is also correlated with a number of actual personality attributes as measured by self-report. Traits positively associated with symmetry include perseverance, impulsivity, and jealousy (Shackelford & Larsen, 1997); assertiveness (in men, Borráz-León & Cerda-Molina, 2015); narcissism (Borraz-Leon et al., 2019); and extraversion (Fink et al., 2005; Pound et al., 2007), while those negatively correlated with symmetry include superiority and self-admiration (in men, Shackelford & Larsen, 1997) and fear (in women, Shackelford & Larsen, 1997). A comprehensive assessment of the relationships between facial symmetry and personality (Holtzman et al., 2011) suggested that high levels of facial symmetry may reliably signal socially aversive personality types. Traits which correlated positively with facial symmetry included impression-management, aggression, angry hostility, self-consciousness, anxiety, and depression. Traits which correlated negatively with facial symmetry included empathy, calmness, amicability, even-temperedness, responsibility, and trust.

Attributions of personality to unfamiliar faces are influenced by facial symmetry. More symmetrical faces are perceived to be more sociable, lively, self-confident, and balanced, as well as less anxious (Fink et al., 2006). They are also observed to be more agreeable and conscientious (Shackelford & Larsen, 1997), and more intelligent (Fink et al., 2006; Shackelford & Larsen, 1997). The perceptions of intelligence (an individual difference trait more than a personality trait per se) align with the reports of Pound et al. (2014) linking intelligence to low levels of fluctuating asymmetry. The remaining personality judgments of highly symmetrical faces, however, stand in stark contrast to observed relationships between facial asymmetry and actual (self-reported) personality traits. Observed relationships between facial asymmetry and personality overwhelmingly point to socially undesirable

traits being higher in more symmetrical faces, whereas subjective impressions attribute desirable qualities to highly symmetric faces. One empirical resolution to this contradiction is the halo-effect, whereby highly symmetric faces are perceived to be more attractive and as direct result of this, other positive traits are attributed to them (although attributions of health toward more attractive faces are unlikely to be due to an attractiveness halo-effect, Jones et al., 2001). A possible theoretical resolution is that people make positive attributions of individuals perceived to be high mate value, as a strategy for guiding their own mate choices toward high mate value partners. Said another way, there is widespread selection pressure on individuals to positively evaluate high mate value prospective partners. In turn, such a bias could lead high mate value individuals to adopt a more selfish social strategy. This is because the cost-benefit trade-offs of selfish versus prosocial behavior may have a more selfish optimum for individuals whose prosociality is presumed and does not need to be actively signaled.

Cross-References

- ▶ Facial Characteristics: Big Five Personality Traits
- ▶ Facial Characteristics: Perceptions and Inferences
- ▶ Fluctuating Asymmetry

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