Cognition 166 (2017) 130–138

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/COGNIT

Original Articles

Fertility affects asymmetry detection not symmetry preference in assessments of 3D facial attractiveness

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ARTICLE INFO

Article history:
Received 10 November 2016
Revised 19 May 2017
Accepted 23 May 2017
Available online 27 May 2017

Keywords:
Facial symmetry
Facial attractiveness
Menstrual cycle
Hormones
Mate choice

ABSTRACT

Consistent with theories from evolutionary psychology, facial symmetry correlates with attractiveness. Further, the preference for symmetrical faces appears to be affected by fertility in women. One limitation of previous research is that faces are often symmetrically lit front-views and so symmetry can be assessed using 2D pictorial information. Another limitation is that two-alternative-forced-choice (2afc) tasks are often used to assess symmetry preference and these cannot distinguish between differences in preference for symmetry and differences in ability of asymmetry detection. The current study used three tasks to assess the effects of facial symmetry: attractiveness ratings, 2afc preference and asymmetry detection. To break the link between 2D pictorial symmetry and facial symmetry, 3D computer generated heads were used with asymmetrical lighting and yaw rotation. Facial symmetry correlated with attractiveness even under more naturalistic viewing conditions. Path analysis indicates that the link between fertility and 2afc symmetry preference is mediated by asymmetry detection not increased preference for symmetry. The existing literature on symmetry preference and attractiveness is reinterpreted in terms of differences in asymmetry detection.

1. Introduction

Symmetry has for a long time been associated with attractiveness. According to Aristotle, "The chief forms of beauty are order, symmetry and definiteness" (*Metaphysica 13*). Darwin (1882) took the link between symmetry and beauty further and suggested that symmetry is a product of sexual selection. These speculations have continued and now there is a growing body of evidence that suggests that fluctuating asymmetry, which is measured as random bilateral deviations, (Van Valen, 1962) is related to attractiveness. The level of fluctuating asymmetries is thought to be an honest indicator of genetic quality. Amongst non-human animals, lower fluctuating asymmetry is associated with more successful mating (e.g. Manning & Chamberlain, 1993; Møller, 1992). In humans, lower levels of bodily fluctuating asymmetry are associated with a higher number of sexual partners (Thornhill & Gangestad, 1994). It would be likely, therefore, that fluctuating asymmetry in the human face would also be important in attractiveness and mating. This idea is underpinned by two premises. First, that facial symmetry can be detected in the natural viewing of faces. Second, that facial symmetry plays an important role in the mating process such that the size of the preference for symmetry changes between individuals and within individuals at different times. These two premises are evaluated here by looking at the detection and responses to symmetrical and asymmetrical faces.

1.1. Naturally occurring asymmetries

A number of studies have sought to assess the relationship between naturally occurring facial asymmetry and attractiveness. It has been demonstrated that where there is a high degree of asymmetry, for example as a result of chromosomal abnormality, this is associated with a decrease in attractiveness (see Thornhill & Møller, 1997). Studies that explore asymmetry at more typical (and non-pathological) levels have been mixed in their findings for the association between asymmetry and attractiveness. Some studies, usually assessing symmetry with 12 or 14 facial landmarks, have shown a positive relationship between attractiveness and symmetry (e.g., Hume & Montgomerie, 2001; Jones et al., 2001; Scheib, Gangestad, & Thornhill, 1999). More recent studies, that have used an assessment of asymmetry that employed more landmarks, have found a more limited correlations between asymmetry and attractiveness. One such study by Kaipainen et al. (2015) assessed the symmetry of 59 faces using 3D scans and found that attractiveness was not influenced by degree of symmetry. Another study by Farrera, Villaneuva, Quinto-Sánchez and

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http://dx.doi.org/10.1016/j.cognition.2017.05.034
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González-José (2014) used 28 facial landmarks on 565 faces to assess facial asymmetry. They found that the rated attractiveness of the faces did not significantly correlate with asymmetry of the faces.

Simmons, Rhodes, Peters, and Koehler (2004) found that faces showed both fluctuating asymmetry and directional asymmetry. Directional asymmetry is the asymmetry within a group of organisms such that one side is consistently different to the other. They found that fluctuating asymmetry was related to attractiveness whereas directional asymmetry was not. One potential problem with this demonstration of directional asymmetry was that 2D photos were used. If the head position possessed any rotation then this would have appeared as asymmetry. Further, if people are consistently inclined to present a particular side of their face then with would show up as directional asymmetry.

The research using natural images has been inconclusive as to whether symmetry is related to attractiveness. Photo-manipulation, however, has proved to be an invaluable tool in revealing the relationship.

1.2. Symmetry-enhanced faces

A variety of methods for changing the symmetry of a face have been used. Initial studies, that constructed a face from a half face and its mirror reverse, did not find a symmetry advantage (Langlois, Roggman, & Musselman, 1994). This was probably due to artefacts introduced by slight yaw rotation in the original image creating images unlike commonly encountered faces. Grammer and Thornhill (1994) found that blending faces together made for more symmetrical faces, which were more attractive beyond just their greater averageness. In other studies, symmetry was achieved by blending a whole face with its mirror reverse. Some of these show a link between symmetry and attractiveness (e.g., Rhodes, Proffitt, Grady, & Sumich, 1998) but not all (see Swaddle & Cuthill, 1995).

The method of increasing asymmetry employed by Grammer and Thornhill (1994), Kowner (1996) and Rhodes et al. (1998) all involved the blending of faces with its mirror image. This method has the effect of making any asymmetries in the lighting conditions also more symmetrical. This can clearly be seen in second example of Fig. 1 in Rhodes et al. In that example, the starting face is lit slightly from the left-hand side. The resulting symmetrical face appears to be lit centrally. This method of generation of stimuli, therefore, confounds facial symmetry with symmetry of lighting conditions. Any observed preference for the symmetrical faces could, feasibly, be a preference for the symmetrical lighting conditions.

An alternative method of creating symmetrical faces is to average the facial structure from the left and right hand side of the face while keeping the original texture map. This is the method that was developed by Perrett et al. (1999) and employed by Little and Jones (2006) and Little, Jones, Burt, and Perrett (2007) amongst others. The resulting symmetrical faces, therefore, retained their texture based asymmetries. Any asymmetry in lighting conditions will remain in the symmetrical face. Any yaw rotation that is present in the original face, however, will be removed by this process meaning that the symmetrical face will always appear to be frontally oriented whereas the original face many have slight yaw rotations. Given that the original facial images were constructed under carefully controlled conditions, this potential yaw effect is likely to be minimal. Experiments that increase facial symmetry in this way, such as those mentioned above, consistently show an attractiveness preference for symmetrical faces over asymmetrical faces.

All of the methods described here for testing the effect of symmetry on attractiveness using photo-manipulated images confound 2D pictorial symmetry with 3D facial symmetry. The symmetrical face also occurs in a symmetrical image. An object can have 3D symmetry but produce an image that is asymmetrical – imagine a perfectly symmetrical face that is rotated away from the viewer. That face would have 3D symmetry but the projected image would not have 2D symmetry. It is not clear, therefore, whether the preference for symmetry is a preference for the symmetrical 2D image or the 3D symmetrical face. This confound has important theoretical implications. If the evolutionary explanation for the attractiveness preference for symmetry is to be meaningful then it is necessary that the preference is expressed for the 3D facial properties and not the 2D properties of the visual stimuli. Social interactions do not occur with heads exactly facing each other and with symmetrical lighting and so it is, firstly, important that symmetry can be extracted from more natural conditions. Secondly, it is important that this 3D symmetry relates to preference

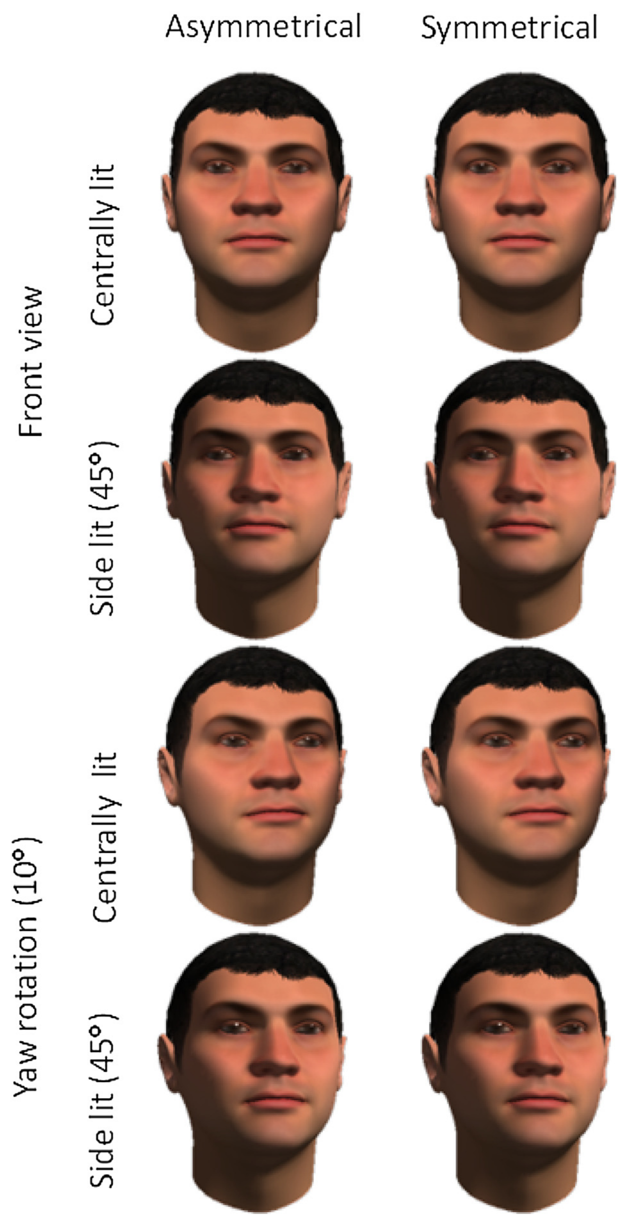

Fig. 1. An example of the set of stimuli used in the three tasks. The left hand faces show the typically asymmetrical faces whereas the right hand faces have 3D symmetry. The top four images are front views whereas the bottom four faces are rotated by 10 degrees. The first and the third row are lit from the centre whereas the second and fourth rows are lit from the side. Color versions are available online.