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Perceived health contributes to the attractiveness of facial symmetry, averageness, and sexual dimorphism

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Abstract. Symmetry, averageness, and sexual dimorphism (femininity in female faces, masculinity in male faces) are attractive in faces. Many have suggested that preferences for these traits may be adaptations for identifying healthy mates. If they are, then the traits should be honest indicators of health and their attractiveness should result from their healthy appearance. Much research has focused on whether these traits honestly signal health. Here we focused on whether the appeal of these traits results from their healthy appearance. Specifically, we tested whether the attractiveness of symmetry, averageness, and sexual dimorphism is reduced or eliminated when perceived health is controlled, in two large samples of Western faces and a large sample of Japanese faces. The appeal of symmetric faces was largely due to their healthy appearance, with most associations between symmetry and attractiveness eliminated when perceived health was controlled. A healthy appearance also contributed to the appeal of averageness and femininity in female faces and masculinity in male faces, although it did not fully explain their appeal. These results show that perceptions of attractiveness are sensitive to a healthy appearance, and are consistent with the hypothesis that preferences may be adaptations for mate choice.

1 Introduction

Face preferences are present early in development, before the opportunity to acquire cultural standards of beauty (Slater et al 1998) and are similar across diverse cultures (Langlois et al 2000; Rhodes et al 2001a, 2002). Therefore perceptions of attractiveness are not simply acquired from the prevailing culture, but are part of our evolutionary heritage (for discussions see Fink and Penton-Voak 2002; Symons 1979; Thornhill and Gangestad 1999).

Recent research on face preferences has been stimulated by the idea that perceptions of attractiveness may be adaptations for identifying high-quality mates, particularly healthy mates (for reviews see Etcoff 1999; Fink and Penton-Voak 2002; Gangestad and Scheyd 2005; Grammer et al 2003; Rhodes 2006; Rhodes and Simmons 2007; Symons 1979; Thornhill 2003; Thornhill and Gangestad 1993, 1999; Thornhill and Møller 1997). Healthy mates could provide direct benefits in the form of resources or parental care, indirect genetic benefits to offspring, such as heritable resistance to disease, or both (Andersson 1994).

On this adaptation account, attractive traits should be honest indicators of health. Averageness, symmetry, and sexual dimorphism are all attractive in faces (for recent reviews see Rhodes 2006; Rhodes and Zebrowitz 2002) and there are good theoretical reasons to think that they may signal real health (Rhodes 2006; Rhodes and Zebrowitz 2002; Thornhill and Gangestad 1999). Average and symmetric faces may reflect good resistance to pathogens, parasites, and other stressors during development (Gangestad and Buss 1993; Møller and Swaddle 1997; Thornhill and Gangestad 1993). Sexually dimorphic traits, particularly in males, are also hypothesised to signal real health.

According to the immunocompetence-handicap hypothesis, testosterone stresses the immune system, so that only healthy males can afford to create large male traits (Folstad and Karter 1992). Feminine traits could also be honest indicators of health, if high levels of female hormones stress the immune system, although the argument here is not as strong (see Rhodes et al 2003 for discussion).

Several meta-analyses and reviews have found links, albeit weak ones, between attractiveness and real health (Feingold 1992; Langlois et al 2000; Rhodes 2006). Attractiveness is also associated with hormonal markers of reproductive health in women (Law Smith et al 2006) and sperm quality in men (Soler et al 2003), which are important components of reproductive health. Positive associations have also been reported between real health and the attractive traits of averageness (Hoyme 1994; Zebrowitz and Rhodes 2004; Rhodes et al 2001b; Thornhill and Møller 1997), masculinity (Rhodes et al 2003), femininity (Law Smith et al 2006), and symmetry (for a recent review see Rhodes and Simmons 2007).

If perceptions of attractiveness are adaptations for identifying healthy mates, then perceptions of attractiveness should also be sensitive to cues to health (Thornhill and Gangestad 1999). Evidence that a healthy appearance looks attractive supports this hypothesis (Grammer and Thornhill 1994; Henderson and Anglin 2003; Jones et al 2001; Kalick et al 1998; Rhodes et al 2001a, 2003). Further support comes from the finding that the appeal of the attractive trait of facial symmetry is due to its healthy appearance. This was demonstrated by Jones and colleagues (2001) who showed that the correlation between facial symmetry and attractiveness is eliminated when perceived health is statistically controlled.

Here we sought to determine whether a healthy appearance explains the appeal of attractive traits more generally. Specifically, we tested whether the attractive traits of facial symmetry, averageness, and sexual dimorphism (femininity in female faces, masculinity in male faces) look healthy, and whether their appeal is eliminated, or significantly reduced,[(1)] when perceived health is statistically controlled. If we find that a healthy appearance explains the appeal of these diverse traits, it would offer a unified account of their appeal that is consistent with the idea that perceptions of attractiveness are adaptations for mate choice.

We sought to increase the generalisability of our results by using both Western and non-Western faces and participants and by using diverse samples of faces. Some of the samples contained faces whose symmetry and/or averageness had been artificially manipulated and some contained only natural, undistorted faces. We can be confident that any findings which replicate across these diverse samples are not due to peculiarities of computer-manipulated images.

Following many other studies we used ratings of symmetry, averageness, and sexual dimorphism as our trait measures (see Rhodes 2006 for a review). Ratings were used in preference to measurements because of the acute sensitivity of the human visual system to individual differences in these traits, which exceeds that of current measurement methods. The latter rely on a limited number of landmark points that only partially capture a face's structure and capture nothing of its fattiness or skin quality (see Rhodes et al 2005 for further discussion). Ratings of symmetry and averageness covary with physical manipulations of these traits (eg Rhodes et al 1998; Rhodes and Tremewan 1996), validating their use as trait measures. Importantly, symmetry ratings are sensitive to fluctuating asymmetries, which are theoretically linked to developmental stability and genetic quality, but not to directional asymmetries (Simmons et al 2004). Finally, perceptions of traits, reflected in ratings, affect reproductive behaviour (Rhodes et al 2005). Each trait was rated by different raters to ensure independent measures.

[(1)] Controlling health might reduce, rather than eliminate, the appeal of these traits, because health is not the only component of mate quality to which perceptions of attractiveness might be sensitive.

Attractiveness and perceived health were also rated by different raters. The Western and Japanese faces in samples one and two were rated by own-race raters and sample three, which consisted largely of Western faces, was rated by Western raters.

2 Method

2.1 *Stimuli*

2.1.1 *Sample 1.* This was a set of Western faces taken from Rhodes et al (1999). It consisted of 292 (146 male) faces constructed from 48 (24 male) young adult, Caucasian faces, displaying neutral expressions, and photographed under symmetric lighting conditions. There were six versions of each face: the original face, a low-average version, a high-average version, and perfectly symmetric versions of each of these. The low-average version was a 50% caricature, made by exaggerating (by 50%) the spatial differences between the face and an average composite face of the same sex, created by blending all 24 same-sex faces. The high-average version was a 50% anticaricature made by reducing (by 50%) all the spatial differences between the face and the average composite. The perfectly symmetric versions were made by blending each image with its mirror image. The images were made in Gryphon's Morph^{TM} with standard procedures (see Rhodes et al 1999 for details). The set also contained the male and female average, together with their perfectly symmetric versions. The images were black-and-white and measured approximately 10.0 cm $\times$ 12.5 cm. All faces were displayed in oval masks that hid the outer hairline, but left the face contour and inner hairline visible.

2.1.2 *Sample 2.* This was a set of 292 faces constructed in the same way as sample 1, except that the faces were Japanese and were depicted in colour. It was taken from Rhodes et al (2001a). The images measured approximately 7.5 cm $\times$ 8.0 cm.

2.1.3 *Sample 3.* This set consisted of undistorted, front-view, colour photographs of 134 male (99 Caucasian, 29 Asian, 6 other) and 163 female (125 Caucasian, 32 Asian, 6 other) faces of young adults (aged 17 to 25 years), recruited primarily from the University of Western Australia. These individuals were part of a larger sample (with a wider age range) described in Rhodes et al (2005). The photographs were taken under uniform, symmetric lighting, from a fixed distance (190 cm), and were rotated so that both pupil centres were located on the same y-coordinate. All faces displayed a neutral expression. A black oval mask was placed over each face, leaving the inner hairline and face outline visible, but hiding most of the hair. Inner dimensions of the mask were approximately 8.5 cm $\times$ 11.5 cm.

2.2 *Ratings*

Ratings of symmetry, averageness,[(2)] sexual dimorphism, attractiveness, and perceived health were made by independent groups of raters. For each face in each sample, a mean rating for each trait was obtained by averaging across raters for that face and trait, with a minimum of 24 (12 male) and a maximum of 36 (18 male) raters (details below). Ratings from male and female raters were combined (cf Jones et al 2001) because they showed good agreement. Male–female correlations ranged from 0.73 to 0.98 for the five traits in sample 1 [mean (M) = 0.89, SD = 0.08, $N = 5$), from 0.80 to 0.96 in sample 2 (M = 0.87, SD = 0.06, $N = 5$), and from 0.61 to 0.87 in sample 3 (M = 0.74, SD = 0.07, $N = 5$). Cronbach coefficient alphas for these mean ratings showed acceptable reliability for all traits (sample 1: M = 0.95, SD = 0.03, range = 0.89–0.98, $N = 5$; sample 2: M = 0.93, SD = 0.03, range = 0.90–0.98, $N = 5$; sample 3: M = 0.83, SD = 0.10, range = 0.61–0.94, $N = 5$).

[(2)] Participants actually rated distinctiveness, which was reverse scored to provide a measure of averageness. This avoids the possible misinterpretation of 'averageness' to mean 'pretty average' as in 'not very attractive'.

2.2.1 *Sample 1.* Ratings of attractiveness, distinctiveness, and symmetry ($N = 18$ raters of each sex per scale) were taken from Rhodes et al (1999). Distinctiveness ratings were reverse scored to give a measure of averageness. Ratings of health ($N = 12$ raters of each sex) were taken from Rhodes et al (2001b). Ratings of sexual dimorphism (masculinity for male faces, femininity for female faces) ($N = 12$ raters of each sex) were obtained from additional young-adult Western raters recruited from the University of Western Australia. The images were presented individually on a computer screen in random order and remained visible until the rating was made using the number keys on the keyboard. All ratings were made on 7-point scales (1 = low, 7 = high).

2.2.2 *Sample 2.* Ratings of attractiveness ($N = 16$ raters of each sex) and averageness (reverse-scored distinctiveness) ($N = 12$ raters of each sex) were taken from Rhodes et al (2001a). Ratings of health, symmetry, and sexual dimorphism were obtained from young Japanese adults ($N = 11-16$ raters of each sex per scale), recruited from universities in the Kyoto region. The images were presented individually on the computer screen in random order and remained visible until the rating was made by using the number keys on the keyboard (0 labelled as 10). All ratings were made on 10-point scales (1 = low, 10 = high). After rating the faces, 85 participants (39 females) completed a contact questionnaire to assess their level of contact with Western faces. Results showed that they had little personal contact with Westerners (M = 1.5 Westerners known personally, SD = 2.7; M = 1.4 interactions with Westerners in a month, SD = 4.7), although they had some exposure to Western media (M = 6.1 h of Western TV per month, SD = 4.3; M = 0.4 Western magazines read per month, SD = 1.2).

2.2.3 *Sample 3.* Ratings of attractiveness, averageness (reverse-scored distinctiveness), symmetry, and sexual dimorphism were taken from Rhodes et al (2005) ($N = 12$ raters of each sex per scale). Ratings of health were obtained from young-adult Western raters ($N = 12$ raters of each sex) recruited from the University of Western Australia. All ratings were made on 7-point scales.

3 Results

We used Pearson product–moment correlations to examine the associations between variables. Inspection of the normal probability plots of residuals showed no violation of the assumptions of the linear model. Bonferroni correction was used in assessing the significance of individual associations. Standard meta-analytic procedures (χ^2-tests—Rosenthal 1991, page 73) were used to determine whether associations between attractiveness and each trait varied across the three samples. To test whether partial correlations were significantly lower than zero-order correlations, we used a test developed by Steiger (1980). The null hypothesis for this test is that $\rho_{ab} = \rho_{cd}$. In the present case ρ_{ab} is the raw correlation between the two variables of interest and ρ_{cd} represents the partial correlation; that is, it is the correlation between the residuals obtained for the two variables of interest after removing the effects of the third variable.

Symmetry, averageness, and femininity (in female faces) correlated positively with attractiveness in all three samples (table 1). There was significant heterogeneity in the effect sizes for averageness ($\chi^2_2 = 27.13$, $p < 0.0001$, female faces; $\chi^2_2 = 83.78$, $p < 0.0001$, male faces), with larger associations in samples 1 and 2, where averageness was manipulated, than in sample 3, where it was not. This finding is consistent with the results of a recent meta-analysis which showed that effect sizes are larger when averageness is experimentally manipulated than when normal, undistorted faces are used (Rhodes 2006). There was also significant heterogeneity in the effect sizes for femininity ($\chi^2_2 = 16.83$, $p < 0.0003$) and masculinity ($\chi^2_2 = 49.23$, $p < 0.0001$), but not symmetry ($\chi^2_2 = 3.20$, $p = 0.202$, female faces; $\chi^2_2 = 3.03$, $p = 0.220$, male faces).

Table 1. Pearson product – moment correlations between variables.

	Attractiveness	Averageness	Symmetry	Femininity/ Masculinity	Perceived health
Female faces					
Sample 1, Western faces ($N = 146$)					
averageness	0.66*	1.00			
symmetry	0.43*	0.28*	1.00		
femininity	0.86*	0.45*	0.39*	1.00	
perceived health	0.89*	0.63*	0.39*	0.76*	1.00
Sample 2, Japanese faces ($N = 146$)					
averageness	0.67*	1.00			
symmetry	0.37*	0.19	1.00		
femininity	0.73*	0.41*	0.27*	1.00	
perceived health	0.79*	0.52*	0.35*	0.71*	1.00
Sample 3, Western and Asian faces ($N = 163$)					
averageness	0.28*	1.00			
symmetry	0.53*	0.20	1.00		
femininity	0.88*	0.18	0.45*	1.00	
perceived health	0.85*	0.28*	0.46*	0.77*	1.00
Male faces					
Sample 1, Western faces ($N = 146$)					
averageness	0.89*	1.00			
symmetry	0.43*	0.36*	1.00		
masculinity	−0.25*	−0.25*	−0.28*	1.00	
perceived health	0.88*	0.79*	0.47*	−0.19	1.00
Sample 2, Japanese faces ($N = 146$)					
averageness	0.58*	1.00			
symmetry	0.26*	0.12	1.00		
masculinity	−0.17	−0.22	−0.23*	1.00	
perceived health	0.72*	0.19	0.23*	0.06	1.00
Sample 3, Western and Asian faces ($N = 134$)					
averageness	0.34*	1.00			
symmetry	0.40*	0.23	1.00		
masculinity	0.48*	0.07	0.11	1.00	
perceived health	0.72*	0.26*	0.38*	0.39*	1.00

Note. * Significant with Bonferroni corrected $p = 0.005$ (10 comparisons).

Masculinity showed inconsistent associations with attractiveness. It was unattractive in the samples containing computer-manipulated faces (samples 1 and 2), but was attractive for normal, undistorted faces (sample 3). This pattern exactly matches that obtained in a recent meta-analysis (Rhodes 2006). In summary, these results confirm that symmetry, averageness, and sexual dimorphism are attractive, as expected.

Before examining the contribution of perceived health to the appeal of these traits, we confirmed that perceived health was indeed attractive (see table 1), albeit with some heterogeneity across samples ($\chi^2_2 = 8.82$, $p < 0.02$, female faces; $\chi^2_2 = 20.58$, $p < 0.0001$, male faces). We could now assess whether symmetry, averageness, and sexual dimorphism did in fact look healthy, and whether this healthy appearance contributes to their appeal. We present the results for each trait separately.

3.1 *Symmetry*

Symmetry was positively and significantly associated with perceived health for male and female faces in all three samples (table 1). In all but one case the associations between symmetry and attractiveness were significantly reduced when perceived health was controlled (table 2), indicating that a healthy appearance contributes to the appeal

Table 2. Zero-order correlations of symmetry, averageness, and sexual dimorphism (femininity in female faces, masculinity in male faces) with attractiveness and partial correlations of each trait with attractiveness, controlling health; p values in the final column indicate whether controlling perceived health significantly reduced the association of each trait with attractiveness.

Trait	Face sex	Sample	N	Zero-order correlation with attractiveness[a] (from table 1)	Partial correlation controlling perceived health[b]	Significance of reduction due to controlling health (one-tailed p values)[b]
Symmetry	female	1	146	0.43*	0.20	0.002
		2	146	0.37*	0.17	0.002
		3	163	0.53*	0.29*	0.001
	male	1	146	0.43*	0.03	0.001
		2	146	0.26*	0.14	0.03 (ns with Bonferroni)
		3	134	0.40*	0.19	0.001
Averageness	female	1	146	0.66*	0.28*	0.001
		2	146	0.67*	0.49*	0.001
		3	163	0.28*	0.08	0.004
	male	1	146	0.89*	0.68*	0.001
		2	146	0.58*	0.66*	No reduction
		3	134	0.34*	0.23*	0.04 (ns with Bonferroni)
Femininity	female	1	146	0.86*	0.61*	0.001
		2	146	0.73*	0.39*	0.001
		3	163	0.88*	0.66*	0.001
Masculinity	male	1	146	−0.25*	−0.17	na—trait not attractive
		2	146	−0.17	−0.31*	na—trait not attractive
		3	134	0.48*	0.31*	0.002

* Significant with Bonferroni correction for multiple comparisons.
[a] Bonferroni corrected $p = 0.005$ (10 comparisons—from table 1).
[b] Bonferroni corrected $p = 0.0125$ (4 comparisons).

of facial symmetry. Indeed, only one of the six partial correlations remained significant (female faces, sample 3), suggesting that a healthy appearance largely explains the appeal of symmetry. These results replicate Jones et al's (2001) findings for Western faces and extend them to Japanese faces.

3.2 *Averageness*

Average faces generally looked healthy. Averageness correlated significantly with perceived health in all cases (table 1), except for Japanese male faces, where the positive association did not survive Bonferroni correction. Controlling perceived health significantly reduced the associations between averageness and attractiveness for female faces in all three samples, suggesting that a healthy appearance contributes to their appeal (table 2). However, two of the partial correlations remained substantial and significant, suggesting that it does not fully explain the appeal of average female faces. For male faces, controlling perceived health significantly reduced the associations between averageness and attractiveness in only one of the three samples, and the partial correlations remained substantial and significant (table 2). These results suggest that a healthy appearance contributes little to the appeal of average male faces.

3.3 *Sexual dimorphism*

Feminine faces looked healthy, with perceived health correlating strongly and significantly with femininity in all three samples (table 1). The healthy appearance of feminine faces contributed to, but did not fully explain, their appeal: controlling perceived health significantly reduced, but did not eliminate, the associations between femininity and attractiveness (table 2). As noted above, masculinity was only attractive for normal

(unmanipulated) male faces (sample 3). These masculine faces also looked healthy (table 2), and controlling perceived health significantly reduced, but did not eliminate, their appeal. These results suggest that a healthy appearance contributes to, but does not fully explain, the appeal of femininity in female faces and masculinity (when it is attractive) in male faces.

4 Discussion

Our results show that perceptions of attractiveness are sensitive to a healthy appearance, consistent with the hypothesis that they are adaptations for identifying healthy mates. The attractive traits of symmetry, averageness, and sexual dimorphism all looked healthy, and in most cases, their appeal was significantly reduced or eliminated when perceived health was controlled statistically. Similar results were obtained for Western and Japanese faces, consistent with recent meta-analyses showing that preferences generalise across ethnicity (Langlois et al 2000; Rhodes 2006).

The appeal of symmetric faces was due largely to their healthy appearance, with most of the associations between symmetry and attractiveness eliminated when perceived health was controlled statistically. This result corroborates Jones et al's (2001) findings for Western[3] faces and generalises them to Japanese faces. We used symmetry ratings, whereas Jones et al (2004) used symmetry measurements (following Grammer and Thornhill's 1994 method), but the same results were obtained in both cases.

A healthy appearance also contributed to the appeal of averageness, although the effect was clearer for female than for male faces. For female faces, controlling perceived health consistently reduced the appeal of averageness in all three samples. For male faces, controlling perceived health reduced the appeal of average male faces only in one of the three samples. For both male and female faces, averageness remained attractive after controlling perceived health. Therefore other factors must also contribute to the appeal of average faces. A likely candidate is subjective familiarity, and associated perceptual fluency, which contributes to the appeal of average exemplars in a variety of categories (Halberstadt 2006; Halberstadt and Rhodes 2000, 2003; Halberstadt et al 2003; Winkielman et al 2006).

Feminine female faces looked healthy, replicating Law Smith et al's (2006) recent findings for Western faces and extending them to Japanese faces. Masculine male faces also looked healthy, at least for normal, undistorted faces. In both cases a healthy appearance contributed to the appeal of these faces, providing further evidence that perceptions of attractiveness are sensitive to a healthy facial appearance. As for averageness, a healthy appearance did not fully explain the appeal of these traits. What other factors might contribute to the appeal of sexually dimorphic traits could be investigated in the future. For example, feminine traits in female faces might be perceived (rightly or wrongly) as indicators of good parenting potential, and masculine traits in male faces might be perceived (rightly or wrongly) as indicating good resource acquisition potential.

In summary, we have shown that a healthy appearance contributes to the appeal of a diverse set of attractive traits. Given that these attractive traits provide some information about real health (see section 1) and that perceptions of health are not entirely illusory (Kalick et al 1998; Zebrowitz and Rhodes 2004), the present results are consistent with the idea that face preferences are adaptations for identifying healthy mates. More generally, they show that perceptions of attractiveness are sensitive to a healthy appearance.

[3] Jones et al (2004) do not specify the ethnicity of their participants, but we assume that most of them would have been Caucasian, given that the research was conducted at St Andrews University.

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