

# FACIAL ATTRACTIVENESS, SYMMETRY, AND PHYSICAL FITNESS IN YOUNG WOMEN

Johannes Hönekopp

*Technische Universität Chemnitz*

Tobias Bartholomé

*Westfälische Wilhelms-Universität*

Gregor Jansen

*Christoph Dornier Klinik*

---

This study explores the evolutionary-based hypothesis that facial attractiveness (a guiding force in mate selection) is a cue for physical fitness (presumably an important contributor to mate value in ancestral times). Since fluctuating asymmetry, a measure of developmental stability, is known to be a valid cue for fitness in several biological domains, we scrutinized facial asymmetry as a potential mediator between attractiveness and fitness. In our sample of young women, facial beauty indeed indicated physical fitness. The relationships that pertained to asymmetry were in the expected direction. However, a closer analysis revealed that facial asymmetry did not mediate the relationship between fitness and attractiveness. Unexpected problems regarding the measurement of facial asymmetry are discussed.

KEY WORDS: Facial attractiveness; Fluctuating asymmetry; Mate choice; Physical fitness

---

Received September 16, 2002; accepted January 26, 2003; revised version received March 11, 2003.

*Address all correspondence to Johannes Hönekopp, Technische Universität Chemnitz, Psychologisches Institut, Wilhelm-Raabe-Str. 43, D-09120 Chemnitz, Germany. Email: johannes.hoenekopp@phil.tu-chemnitz.de*

Copyright 2004 by Walter de Gruyter, Inc., New York  
Human Nature, Vol. 15, No. 2, pp. 147–167.

1045-6767/04/\$1.00+.10

Although standards of facial attractiveness have presumably varied over time (Grammer 1995: fig. 57), they are by no means arbitrary. Instead, different cultures share similar beauty standards (Langlois et al. 2000), and humans as young as newborns prefer to look at faces that adults judge to be attractive (e.g., Slater et al. 1998). Both types of findings strongly suggest that the perception of facial attractiveness has a stable, innate component. Where does it stem from? And why do people care about others' looks at all? Throughout the past decade, evolutionary-based ideas have offered answers to these questions (e.g., Symons 1995 Thornhill and Gangestad 1993). They all share two basic ideas: (1) Physical attractiveness stems from morphological characteristics that signal high mate value, and (2) Since the impression of physical attractiveness guides mate choice (Buss and Barnes 1986), the ability to regard the person who exhibits such traits as attractive is an adaptation that helps to choose mates with high mate value and thus to increase one's own fitness.

Meta-analytic evidence (Langlois et al. 2000) strongly supports the notion that physical attractiveness indicates qualities that are desirable in a mate: Other things being equal, physically attractive people have more occupational success, they are more popular, they enjoy better physical health, they have superior social skills, their mental health is better, and they are more intelligent (in decreasing order of estimated effect sizes).

To the best of our knowledge, a potential link between physical fitness and facial attractiveness has yet to be investigated. Although it seems reasonable to regard physical health and physical fitness as related (e.g., few seriously ill people are able to run and jump), we think it useful to differentiate between both concepts. Everyday experience suggests that two healthy people of the same age can differ greatly in physical strength, endurance, flexibility, and quickness. In the following section, we will argue that these differences have constituted a significant difference in female mate value throughout human history. If this is true, it seems likely that physical fitness is one more trait that is indicated by facial attractiveness in women, and we will present a study that addresses this issue.

### **WOMEN'S PHYSICAL FITNESS AS A COMPONENT OF THEIR MATE VALUE**

Human existence had been, and in many parts of the world still is, physically demanding. As recently as the nineteenth century, three quarters of the European population lived by farming (Priebe 1976). Even today's technically facilitated farming "is hard and physically demanding, especially for women" (Perkiö-Mäkelä 2000:15).

Thus, physically fit women could provide more resources and simultaneously more successfully avoid overexertion, which threatens health directly (e.g., Mackinnon 2000) and indirectly (Nordstrom et al. 2001; Pickett et al. 1995).

It seems conceivable that physically fit women have the additional advantage of coping more easily with the physical demands of pregnancy and birth. Although data on this topic are scarce, findings indicate that physically fit women experience shorter labor (Wong and McKenzie 1987) and face a lower risk of pregnancy-induced hypertension and cesarean sections (Hale and Mittelman 1991). Moreover, several epidemiological studies found negative relationships between physical demands during pregnancy and pregnancy outcome (see Hatch and Stein 1991 for a compilation). Naturally, physically fit women should be better prepared to meet such demands without showing these negative consequences.

Physically fit women can not only better care for their offspring but also bestow the advantage of physical fitness on their offspring because physical fitness has a strong heritable component (Maes et al. 1996).

Very likely, physically fit women are also better able to defend themselves and thus to prevent rape (Fischhoff 1992).

In sum, over the course of human history physically fit women could better and longer care for their offspring, they bestowed the advantage of physical fitness on their children, and, because of their assumed reduced risk of being raped, they granted higher paternity certainty to their mates. It seems reasonable that all this contributed positively to their mate value. Thus, physically fit women who developed traits that signaled this attribute should have had an evolutionary advantage, and likewise men should have benefited from regarding these signals as attractive. Therefore, it seems reasonable to assume that signals of physical fitness have evolved in women and that men have evolved a preference for them.

There is at least indirect evidence that such signals exist: Physical disability might be conceptualized as being largely the opposite of physical fitness. If men indeed strive for physically fit mates, physically disabled women should be regarded as less attractive. Although data on the attractiveness of visibly physically disabled people are scarce, there is some evidence for this assertion (Hahn 1990), and disabled women in general are less likely to marry or to have spouse-like partners (Fine and Asch 1988; Groce 1997), although "disabled persons have been regarded and treated more positively in modern times than in other eras" (Havranek 1991:15).

Since the face plays a dominant role in social interaction, and since facial attractiveness largely contributes to overall attractiveness (Alicke and Smith 1987; Furnham et al. 2001; Mehrabian and Blum 1997; Mueser et al. 1984), it is reasonable to assume that (some of) the cues that signal



women's physical fitness and that are likewise valued by men can be found in the face. The main purpose of our study is to investigate this proposed relationship between human female physical fitness and facial attractiveness.

### SYMMETRY AS A SIGNAL OF QUALITY

If indeed women's facial attractiveness signals, among other properties, physical fitness, one question remains: Which facial attributes indicate physical fitness and likewise appeal to men's taste? The absence of facial fluctuating asymmetry (FA) is an obvious candidate for this role. FA denotes a difference in the size of bilateral characters (like legs, paws, wings) that show a mean difference of zero in the population (i.e., on average, left legs are as long as right legs, etc.).

The absence of systematic differences is thought to indicate a symmetrical genetic design for these characters (van Valen 1962). However, ontogeny is susceptible to disruptions that can cause divergences of the actual body proportions from their genetic design. Thus, a high degree of FA in an individual indicates that it was somehow "damaged" (Hoyme 1994). Possible sources are genetic disturbances, toxics, and a high exposure to and/or a limited capacity to withstand parasites (see Thornhill and Møller 1997 for a review). Along the same line, Møller and Thornhill (1998) provide meta-analytic evidence that, in many species, body symmetry is a valid cue for mate value that is utilized in mate choice. Concerning humans, several studies indicate that facial symmetry is positively linked to facial attractiveness (Grammer and Thornhill 1994; Hume and Montgomerie 2001; Mealey et al. 1999; Rhodes et al. 1998; Scheib et al. 1999; Zebrowitz et al. 1996; but also see Fink et al. 2001; Rhodes et al. 2001; Rikowski and Grammer 1998; Shackelford and Larsen 1997; Swaddle and Cuthill 1995 for mixed or contradictory results). In our study, we will examine if the absence of facial asymmetry can (partly) explain the presumed relationship between physical fitness and facial attractiveness.

If symmetry is a valid cue for physical fitness, this relationship should not only hold for facial symmetry, but for body symmetry as well. Therefore, we also measured body symmetry, expecting a positive relationship between physical fitness and body symmetry.

### HYPOTHESES

In sum, our hypotheses are as follows: (1) There is a positive relationship between the physical fitness of women and the attractiveness of their faces

as perceived by men. (2) This relationship is (partly) mediated by the degree of facial asymmetry. The latter is expected to negatively correlate with physical fitness and facial attractiveness. (3) There will also be a negative relationship between physical fitness and body FA.

## METHOD

### Scrutinized Participants

Eighty-four women, most of them undergraduate students of psychology, participated in our study. They were required to be in good health at the time of the study. Of course, this restriction made it more difficult for us to demonstrate the proposed relationship between facial attractiveness and physical fitness. However, we regarded the health requirement as a necessary precaution. Without this, transient maladies (like a cold) that are likely to negatively affect physical fitness and facial attractiveness at least momentarily could have artificially inflated the sought-after relationship.

Most participants took part to fulfill departmental requirements that they participate in research outside the classroom. As an additional inducement, prizes, like movie vouchers, were raffled. Our participants had an unexpectedly large age range. Since aging negatively affects both of our key variables, facial attractiveness (e.g., Zebrowitz and Montepare 1992) and physical fitness (Nakamura et al. 1998), it was desirable to obtain a rather homogeneous sample with respect to age. Therefore, we excluded seven participants between ages 28 and 43 from all analyses. The remaining 77 women ranged from age 19 to 26 with a mean of 20.8 years ( $s.d. = 1.9$ ).

### Measuring Physical Fitness

Women's physical fitness was measured by means of the Haro fitness test (Haag 1981). This test consists of six different exercises, which can be conveniently performed in a small gym. The six routines consisted of running and crawling beneath an obstacle; sit ups; repeated jumps over a hurdle; push ups; repeatedly running over a short stretch, picking up a rope from the floor, running back and exchanging the rope for another one; and throwing a heavy ball repeatedly while lying on the belly. Each exercise lasted 30 seconds, and routines were separated by breaks of 120 seconds. Thus, the test required quickness, flexibility, dexterity, strength of different muscle groups, and endurance. Women performed alone or in groups of two or three. For each routine, rules of scoring are easy to apply.

To control for potential confounds, we asked the participants (a) how many cigarettes they smoke per week, (b) how many hours per week they

exercise, (c) how many hours per week they ride a bicycle as a means of transportation (which is very popular in Münster), and (d) body height and weight in order to compute body mass index. These questions were asked in conjunction with the administration of a health questionnaire (see below).

Relationships between facial attractiveness and health have recently been discussed (Kalick et al. 1998; Reis and Zaidel 2001; Rhodes et al. 2001; Shackelford and Larsen 1999). To ensure that our fitness test measured something other than health, participants were required to answer BL and BL', two parallel forms of a health screening instrument (Zerssen 1976) widely used in German clinical and epidemiological studies. Both self-rating scales measure actual health. Each of them consists of 24 items, which cover a wide variety of symptoms. On a four-point scale, participants indicated how much they suffered from each one (*strongly to not at all*). All 48 responses are summed into an overall score. We shall refer to this sum score as *health*. Participants filled out this questionnaire at the beginning of their second appointment (see below).

### Measuring Facial Attractiveness

At a second appointment, participants were photographed with a digital camera using a resolution of 1.1 million pixels. They were required to remove make-up and glasses. Participants wore a hair circlet to hold the hair away from the face. Pictures were taken from a distance of 1 meter. Light came from fluorescent tubes on the ceiling, which evenly illuminated both face halves. The women were instructed to face the camera frontally with a neutral facial expression. Beneath the camera was a mirror, fixed in the same plane as the camera, which enabled them to determine their exact orientation relative to the camera (by checking to see that the same amount of their ears was showing). Likewise, with the help of the display at the back of the camera, which contained a grid pattern, the photographer controlled participants' orientation.

To ensure that attractiveness raters did not know any of our participants, we collected attractiveness ratings from all 23 male employees (mean age 31.8 years, s.d. = 6.1) of a Bavarian industrial company. During single sessions, the portraits were presented on a 17" computer monitor using a resolution of 1024 × 768 pixels. Since some of the pictures showed unnatural colors, all had been previously reduced onto a 8-bit (256 shades) gray scale. Pictures were standardized to a height of 550 pixels and showed the full head, down to the upper cervical fold. Because all pictures had been taken in front of the same background, brightness could be standardized using the background as a yardstick. This ensured that interindividual differences in skin lightness, which presumably affect judgments of women's at-



tractiveness (Frost 1988), were accurately reproduced. In a first trial, each portrait was shown for four seconds to allow raters to form an evaluation standard. In the second trial, the pictures were presented in the same order and were rated on a seven-point scale ranging from *not attractive* (1) to *very attractive* (7). The presentation order was randomly determined for each rater.

Of course, factors other than symmetry determine facial beauty. Large eyes (e.g., Geldart et al. 1999), prominent cheekbones, and small chins, for example, seem to increase female attractiveness (Cunningham 1986; Cunningham et al. 1995). Therefore, any relationship between facial beauty and symmetry should become more prominent when the influence of other factors, like those mentioned here, is controlled. To enable control of non-symmetry influences we split the faces in our study vertically and gathered attractiveness ratings for both half faces as well (see also Scheib et al. 1999). Splitting faces, as well as measuring their symmetry (see below), requires that they be exactly upright. Thus, using Adobe Photoshop pictures were rotated until the authors agreed that an imagined line between the middle of the philtrum and the middle of the nasion was vertical. Splitting the faces into left and right halves was also conducted by agreement.

To gather attractiveness judgments of the half faces, we produced four booklets. Each page showed one face half (with stray hair and background removed); picture height was 16 cm. Each booklet contained one image of each participant and consisted of 50% right halves and 50% left halves. The image order was randomly determined for each booklet. Both facial halves of each participant occurred in the two booklets.

Twenty male visitors of Chemnitz University Library (ages 20 to 41 years, mean = 24.3, s.d. = 4.5) were paid €3 for rating the attractiveness of all face halves in one of the booklets. Raters used a seven-point scale that was anchored with the labels *not attractive* (1) and *very attractive* (7). Prior to rating, participants briefly looked at all items of the booklet to establish a stable internal standard for scale use.

### Measuring Facial Symmetry by Means of Facial Landmarks

To measure facial symmetry, upright rotated portraits were gauged using 12 facial landmarks adopted from Grammer and Thornhill (1994). Those points are shown in Figure 1. The positions of the facial landmarks were measured by each co-author independently on a computer screen.

We computed two asymmetry scores for each face, one measuring horizontal and one measuring vertical deviations from symmetry. The facial  $x$ -asymmetry score ( $fas_x$ ) made use of the  $x$ -differences of the 1–2, 3–4, 5–6, 7–8, 9–10, and 11–12 point pairs (see Figure 1). Perfect symmetry would be

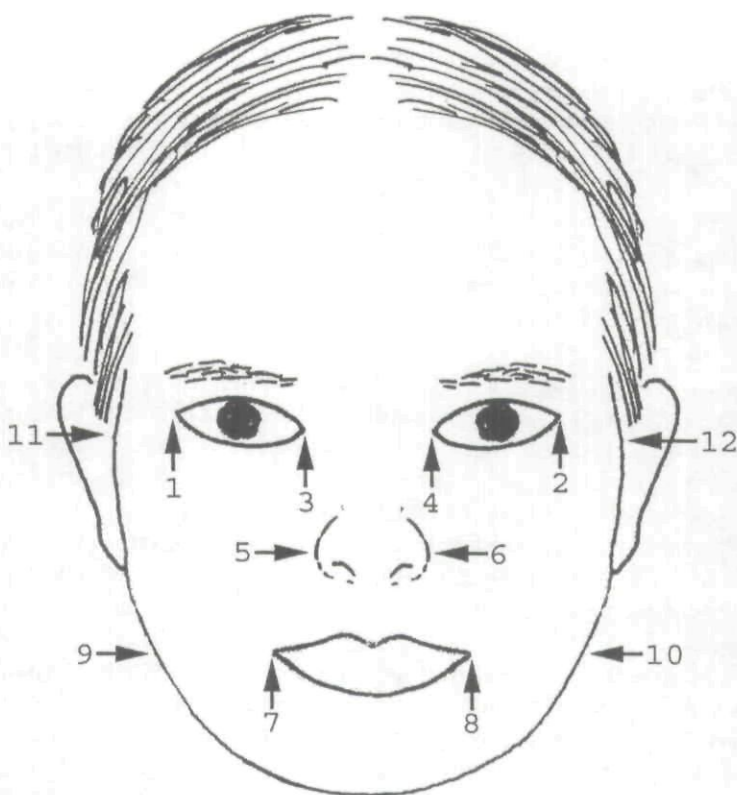


Figure 1. Facial landmarks that were used to gauge facial symmetry ( $fas_x$  and  $fas_y$ ).

indicated by all lines' midpoints lying on the same vertical. For each face, we computed the average  $x$ -position of the six lines' midpoints, and  $fas_x$  marked the sum of the six unsigned deviations from this average. Our second asymmetry score,  $fas_y$ , was computed for each face as the sum of the unsigned  $y$ -differences between the points 1–2, 3–4, 5–6, and 7–8. Using the difference 9–10 did not make sense because their  $y$ -coordinates were identical to those of the points 7 and 8; we excluded the 11–12 pair because we were not able to measure their  $y$ -coordinates reliably.

One possible source of unreliability might be due to different people obtaining different measures from the same photograph. To check for this possibility, all measures were taken independently by each co-author.

But there is also a second potential source of unreliability: Two pictures of the same person might show different results. Especially, any turn of the head that causes an oblique angle between face and camera should result in artificially high  $fas_x$  values. To control for this possibility the facial and



all body pictures (see below) of ten randomly selected participants were taken twice. The second set of pictures was taken immediately after the first set. The fact that very different body parts were photographed guaranteed that many changes of posture had taken place between each first and second shot.

### Measuring Facial Symmetry by Means of Chimeric Portraits

To the best of our knowledge, we are the first to examine differences between portraits of the same person as a potential source for measurement error. Having taken two pictures of ten participants, we wanted to capitalize on that opportunity to examine the between-picture reliability of another common method of facial symmetry measurement. In this approach an artificial right-right picture that consists of the original and the vertically mirrored right half of the face is made from each portrait. A left-left picture is constructed accordingly (see, e.g., Mealey et al. 1999 for details). Stronger asymmetry in the original face results in higher differences between its right-right and left-left picture. Thus, the rated similarity of the right-right and the left-left picture can be used to assess the symmetry of the original face.

We constructed a right-right and a left-left picture for each of the two portraits of the ten participants that had been photographed twice. Both chimeric faces of the same photograph were printed together on a sheet, with right and left positions counterbalanced. The height of each picture was approximately 11 cm. Four booklets were produced: two consisted of the ten right-right and left-left pairs that were constructed from the first shots, the other two comprised the chimeric pairs that were made from the second photographs. All booklets presented the ten sheets in a different random order. Forty-one participants (17 of them women) were recruited as raters in Chemnitz University Library; mean age was 26 years (s.d. = 6.4). Each participant worked on one booklet and rated the similarity of the two pictures in each pair using a seven-point scale with end-points labeled *rather dissimilar* and *very much alike*. The participants were instructed to base their ratings on the faces only and to ignore any differences in hairstyle, clothing, or background.

### Measuring Body Symmetry

Following the method of Gangestad, Thornhill, and Yeo (1994), we compared the breadth of hands, wrists, elbows, feet, ankles, and ears, as well as the length of ears and of second and fifth fingers, to measure body asymmetry. Usually these sizes are measured with the help of a caliper; to do so is not easy because all these body parts consist of or are at least encased by soft tissue. Therefore, the pressure applied by the measurer in fitting the caliper to the body part highly influences the results. A pretest

showed us that we could gauge body part sizes more precisely from digital images on the computer screen. Therefore, all these measures were taken twice, independently by each co-author, from photographs. Pictures of fingers, wrists, elbows, and feet were taken with the help of a glass plate which was perpendicularly mounted on a table top, the plate being parallel to and facing the camera. Participants sat behind the plate and pressed the body parts to be photographed (e.g., the soles of the feet) against it. This guaranteed that left and right soles, hands, wrists, etc., were the same distance from and orthogonal to the camera. Photographers took care that right and left ears, as well as both ankles, were the same distance from and angle to the camera. Body pictures were taken together with the facial shots at the second appointment.

For each body part, we computed its asymmetry as  $|size_{left} - size_{right}| / (size_{left} + size_{right})^{-1}$ , thus following the recommendation of Palmer and Strobeck (1986). Examination of inter-rater correlations showed that we were not able to measure elbow breadths reliably ( $r = .07$ ). Therefore, we did not include this body part in our final measure of body asymmetry (*bas*), which summed the asymmetries of the remaining eight features. For these, acceptable inter-rater correlations could be obtained (lowest:  $r = .58$ , mean:  $r = .84$ ).

## RESULTS

### Reliability of Measures

Our inter-rater correlations for  $fas_x$  and  $fas_y$  were extremely high:  $r_{77} = .97$  and  $r_{77} = .95$ , respectively. We also examined reliability across the two pictures of the same person. For each of the two pictures there were two independent measures of  $fas_x$  and  $fas_y$ . These were first averaged for each picture and then correlated. For  $fas_y$  we obtained a between-picture correlation of  $r_{10} = .78$  ( $p = .004$ ; note that in line with our directional hypotheses we always test one-sided) and a mean of 21.7 pixels (s.d. = 12.7).

Surprisingly, for  $fas_x$  we found no relationship between the first and second picture of the same person:  $r_{10} = -.20$ . Closer inspection showed that this was mainly caused by great differences concerning the 9–10 and 11–12 point pairs (see Figure 1). These points are most remote from the face center and thus alter their position most when the head is turned. Therefore, it seems plausible that  $fas_x$  did not measure facial asymmetry but rather to what extent we had succeeded in orienting the face orthogonal to the camera—although we had taken great care to control head position. Therefore  $fas_x$  will not be discussed further.

The results on  $fas_x$  indicate that head turning causes severe problems. Would this affect asymmetry measurement by means of chimeric portraits? Remember that for each portrait of the same participant the simi-



larity of the respective r-r and l-l picture had been rated. Raters agreed about the similarity of the pairs (average Cronbach's  $\alpha = .86$ ). But when we computed the average similarity rating for each of the two portraits of the ten women, the correlation between the first and the second pictures' similarity ratings was  $r_{10} = -.12$ . This indicates that head turning negatively affects symmetry measurement via chimeric faces as well.

Inter-rater correlation for *bas* (mean = .257, s.d. = .091) was  $r_{77} = .99$  ( $p < .001$ ), and *bas* correlated between picture sets of the same person with  $r_{10} = .84$  ( $p = .001$ ).

All analyses concerning facial attractiveness will be based on averaged evaluations. Our averaged attractiveness ratings proved to be very reliable (full faces: Cronbach's  $\alpha = .91$ , with  $n = 23$  raters; half faces:  $\alpha = .87$ , with  $n = 20$  raters). Mean facial attractiveness was 3.2 (s.d. = .73) for full faces and 3.1 (s.d. = .69) for half faces (averaged across the ten left-half and the ten right-half judgments).

### Physical Fitness

The fitness test yielded six single exercise scores for each participant. The single scores were subjected to a principal component factor analysis. Only one factor with an eigenvalue greater than 1 was obtained; it explained 48% of the variance. All six exercise scores showed high, positive factor loadings between .56 (exercise 4) and .80 (exercise 1). Therefore, all six single scores were summed into an overall fitness score labeled *fit*. This score was subjected to an ANOVA to check whether performing exercises alone or in groups of two or three had had any impact. This was not the case ( $F_{2, 74} = .74$ ,  $p = .48$ ). Mean performance was 122.2 (s.d. = 15.9). We found no correlation between *fit* and *health* ( $r = -.01$ ). This confirmed our assumption that the Haro fitness test was not simply another measure of participants' health.

### Confounds

We examined age, smoking, exercising, riding a bike, BMI, and *health* as potential covariates of facial attractiveness and physical fitness. Only the relationship between weekly hours of exercising and *fit* proved to be significant ( $r_{77} = .27$ ,  $p = .008$ ). In the Results section, we will consider this by reporting all relationships involving *fit* as first order and partial correlations (controlling for hours of exercising).

### Facial Attractiveness, Symmetry, and Physical Fitness

We now turn to our key questions, the relationships between facial attractiveness, symmetry, and physical fitness. Does facial attractiveness signal physical fitness? In line with our main hypothesis, those women who were more physically fit had better-looking faces ( $r = .24$  [.23],  $p = .017$



[.021]—the figures in brackets relate to partial correlations, controlling for hours of exercising per week). Obviously, facial attractiveness can help to guide men's mate choice toward physically fit women, and therefore hypothesis 1 could be confirmed.

Is this relationship (partly) mediated by facial symmetry? A prerequisite for this is that  $fas_y$  correlated negatively with physical fitness and facial attractiveness. This proved to be true. However, both relationships were weak and not statistically significant ( $r = -.18$  [-.14],  $p = .06$  [.11], and  $r_{77} = -.10$ ,  $p = .21$ , respectively). If facial symmetry had an impact on facial attractiveness, the relationship between the variables should increase when half-face attractiveness is controlled for. This was indeed the case; the correlation increased to  $r = -.19$  ( $df = 74$ ,  $p = .05$ ). If the relationship between physical fitness and facial attractiveness were mediated by facial symmetry, it should decline when symmetry is controlled for. This was hardly the case; the correlation only decreased from  $r = .24$  to  $r = .23$ . In sum, hypothesis 2 could only be partly supported. As expected, we did find a negative relationship between  $fas_y$  and facial attractiveness. However,  $fas_y$  cannot (even partly) account for the relationship between physical fitness and facial attractiveness.

As was predicted in hypothesis 3, physical fitness and  $bas$  correlated negatively. However, this relationship was marginal and far from statistical significance ( $r = -.03$  [-.03],  $p = .41$  [.39]).

The relationship between  $bas$  and facial attractiveness proved to be negative ( $r_{77} = -.24$ ,  $p = .02$ ), which is consistent with the view that both variables are indicators of mate value.

Although the question of whether health is signaled by facial attractiveness (Hume and Montgomerie 2001; Kalick et al. 1998; Shackelford and Larsen 1999) and symmetry (Rhodes et al. 2001) is not the target of this paper, these data are related here: As one would expect, *health* correlated positively with facial attractiveness and negatively with both asymmetry measures; however, these correlations were low and statistically non-significant ( $r = .17$ ,  $p = .08$ ;  $r = -.17$ ,  $p = .07$ ;  $r = -.14$ ,  $p = .11$ , for attractiveness,  $bas$ , and  $fas_y$ , respectively).

## GENERAL DISCUSSION

Physical attractiveness signals many attributes that relate to mate value, among them physical and mental health, popularity, and intelligence (Langlois et al. 2000). Investigating a sample of 77 women in their early and mid twenties, we could confirm the idea that facial attractiveness also indicates physical fitness, which proved to be independent from current health. Because we required participants to be in good health at the time

of the investigation, the obtained relationship could not originate from the transient influence of colds or other temporary illness.

That we found no relationship between current health and physical fitness seems counterintuitive at first. Indeed, we assume that such a relationship exists in the population of young women because many forms of illness already preclude normal physical activity. However, for the aforementioned reason, our sample was restricted to healthy women. And good health obviously allows for a broad range of athletic fitness. Remember, for example, your school days: Pupils with bad grades in sport were rarely valetudinarians.

There is evidence for both facial attractiveness and physical fitness to be fairly stable over time (Alley 1993; Campbell et al. 2001; Kemper et al. 2001; Pittenger et al. 1989; Sparacino 1980; Sussman et al. 1983), and the continuity of the latter seems to be largely independent of the individual level of physical activity. Therefore, we would expect that the obtained relationship between these variables holds in other age groups as well. Admittedly, we cannot be sure exactly which components of physical fitness have been most important to female mate value throughout human history. But the fact that our fitness test demanded a broad variety of abilities that are obviously highly intercorrelated (a factor analysis of the sub-tests yielded a one-factor solution) lets us feel optimistic that we were able to trace the relevant components of physical fitness.

Our main reason for examining women rather than men was that it was easier for us to recruit female participants. But we do not expect that the obtained relationship between physical fitness and facial attractiveness is restricted to women. Quite the contrary, at least three arguments can be brought forward supporting the view that the relationship is stronger for men. First, the human sexual dimorphism with regard to body height, weight, and strength indicates that physical fitness has been more important to men's than to women's fitness. Second, when humans subsisted as hunters and gatherers, hunting was predominantly men's task (Tooby and DeVore 1987), and it seems obvious that physical fitness is an integral constituent of hunting skill. Third, masculinity seems to promote male facial attractiveness (Cunningham et al. 1990; Dunkle and Francis 1996; Grammer and Thornhill 1994; Johnston and Oliver-Rodriguez 1997; Johnston et al. 2001; Keating 1985; Meerdink et al. 1990; Scheib et al. 1999; but also see Dunkle and Francis 1990; Penton-Voak et al. 1999; Perrett et al. 1998 for contradictory findings), and at the same time it is likely to indicate physical fitness. This is because masculine facial features (like thick brows and a large jaw) are probably influenced by testosterone, which is indicated by the fact that they undergo characteristic changes during puberty (Farkas 1988). Therefore, masculine male faces probably indicate a high testosterone level. Since testosterone stimulates muscle growth (Bhasin et al.



2001), masculine male faces should signal physical fitness as well. We hope to report on the relationship of male facial attractiveness and physical fitness in the near future.

We argued that facial symmetry may be an important cue for bridging the gap between females' physical fitness and males' judgment of their facial attractiveness. We could not confirm this view. Although facial vertical asymmetry correlated negatively with facial attractiveness when controlling for half-face attractiveness, and although it also tended to correlate negatively with physical fitness, both relationships were much too weak to explain the correlation between facial attractiveness and physical fitness. Moreover, the latter correlation was hardly affected when vertical facial asymmetry was controlled for. It seems unlikely that a different picture would have emerged if we had been able to measure facial horizontal asymmetry as well: There is no reason to expect that it could signal physical fitness better than vertical asymmetry. And, concerning the relationship between facial asymmetry and attractiveness,  $fas_y$  should be more important than  $fas_x$  because the human visual system is better tuned for the detection of vertical symmetry (Pashler 1990). Thus, our results indicate that facial symmetry may not be utilized as a cue for mate value (see also Scheib et al. 1999, and Jones et al. 2001, for similar accounts of this question).

As did several previous studies (e.g., Gangestad et al. 1994; Gangestad and Thornhill 1997; Hume and Montgomerie 2001; Rikowski and Grammer 1998; Thornhill and Gangestad 1993), we examined a potential link between body asymmetry and facial attractiveness. Unlike in those studies we were able to demonstrate a significant negative relationship between these variables ( $r = -.24$ ). This result is consistent with the view that body symmetry and facial attractiveness are both signals of "quality" (see also Thornhill and Grammer 1999, who discuss women's bodies and faces as a single "ornament"). However, the low magnitude of the relationship suggests either that body symmetry and facial attractiveness indicate different, only loosely related quality attributes, or else that at least one of the two is only a weak indicator of such attributes.

In sum, we obtained evidence that female facial attractiveness signals physical fitness. Relationships between physical attractiveness and traits tend to be moderate; compared with other findings in this field, the obtained relationship of  $r = .24$  is rather high (see Langlois et al. 2000: Table 8). Although  $fas_y$ , as predicted, negatively correlated with physical fitness and with attractiveness, we found no evidence that the relationship between physical fitness and facial attractiveness was mediated by facial symmetry. Future research is needed to show which cues tie physical fitness (and other attributes that pertain to mate value) to the judgment of facial attractiveness.



## Measuring Facial Symmetry

Much to our surprise, neither the measurement of horizontal facial asymmetry nor the asymmetry measurement via chimeric faces provided results that were reliable across different pictures of the same person. This probably resulted from head turning, although we had taken great care to control head position. While there is an easy remedy for head tilting (namely rotating the pictures accordingly) there is no counter measure for head turning after the picture was taken.

Several authors have reported statistically significant negative correlations between facial asymmetry and facial attractiveness (Grammer and Thornhill 1994; Hume and Montgomerie 2001; Jones et al. 2001; Mealey et al. 1999). Many factors could account for these results; here we only mention three. First, our reliability estimates are quite vague, owing to our small sample size (which was motivated by our erroneous belief that we would obtain high reliabilities between pictures); for example, the upper bound of the 95% confidence interval for the reliability of the chimera-comparison measure is  $r = .62$ . If this were the true reliability, substantial correlations between this symmetry measure and facial attractiveness might be obtained. Second, other researchers could simply have made better photographs. However, considering our own care in this regard, and taking into consideration the setting of other studies (in Mealey et al.'s 1999 study, none of the participants' faces was oriented perpendicular to the camera), we doubt this very much. Third, the reported correlations might represent an artifact inasmuch as people might more favorably evaluate those faces that are oriented exactly perpendicular to the camera.

Future studies must show which, if any, of these accounts is correct. Certainly, our results do not prove that facial asymmetry cannot be assessed by measuring horizontal asymmetry or by comparing chimeric faces. But they should caution researchers that taking the facial photograph is a crucial part of the measurement which has not received due attention, and that the reliability of any facial asymmetry measure is not guaranteed unless it is demonstrated that two pictures of the same person yield similar results.

We would like to thank two anonymous reviewers, Sonja Fischer, Wolfgang Hell, Sandra Hopps, Gabriele Jansen, Ute Lausmann, Frank Renkewitz, Udo Rudolph, and Peter Sedlmeier for their valuable help.

Johannes Hönekopp graduated in 1996 from Westfälische Wilhelms-Universität Münster with a degree in psychology and earned a Ph.D. from the University of Paderborn in 2001 with a thesis about decision making under uncertainty. In 1999–2001 he was a research assistant at WWU Münster. Since 2001 he has been a

research assistant at Technische Universität Chemnitz. He is the head of a DFG-funded project on facial attractiveness and sex hormones.

Tobias Bartholomé is a researcher at Westfälische Wilhelms-Universität in Münster, Germany. He received his diploma in psychology in 2001 with a thesis on the perception of facial attractiveness. In his Ph.D. work he focuses on the effects of new media on the acquisition and use of robust and flexible conceptual knowledge. His current research interests encompass perception of facial attractiveness, knowledge acquisition through learning with multiple representations, development and evaluation of interactive learning environments, as well as help-seeking within interactive learning environments.

Gregor Jansen studied philosophy and psychology at Westfälische Wilhelms-Universität Münster. He received his diploma in psychology in 2001 with a thesis on the perception of facial attractiveness. Since then he has been working as a clinical psychologist at Christoph-Dornier-Klinik für Psychotherapie and at Niedersächsisches Landeskrankenhaus Osnabrück.

## REFERENCES

- Alicke, M. D., and R. H. Smith  
1987 Judgment of Physical Attractiveness: The Role of Faces and Bodies. *Personality and Social Psychology Bulletin* 12:381–389.
- Alley, T. R.  
1993 The Developmental Stability of Facial Attractiveness: New Longitudinal Data and a Review. *Merrill-Palmer Quarterly* 39:265–278.
- Bhasin, S., L. Woodhouse, and T. W. Storer  
2001 Proof of the Effect of Testosterone on Skeletal Muscle. *Journal of Endocrinology* 170:27–38.
- Buss, D. M., and M. Barnes  
1986 Preferences in Human Mate Selection. *Journal of Personality and Social Psychology* 50:559–570.
- Campbell, P. T., P. T. Katzmarzyk, R. M. Malina, D. C. Rao, L. Pérusse, and C. Bouchard  
2001 Prediction of Physical Activity and Physical Work Capacity (PWC150) in Young Adulthood from Childhood and Adolescence with Consideration of Parental Measures. *American Journal of Human Biology* 13:190–196.
- Cunningham, M. R.  
1986 Measuring the Physical in Physical Attractiveness: Quasi-experiments on the Sociobiology of Female Facial Beauty. *Journal of Personality and Social Psychology* 50:925–935.
- Cunningham, M. R., A. P. Barbee, and C. L. Pike  
1990 What Do Women Want? Facialmetric Assessment of Multiple Motives in the Perception of Male Facial Physical Attractiveness. *Journal of Personality and Social Psychology* 59:61–72.

- Cunningham, M. R., A. R. Roberts, A. P. Barbee, P. B. Druen, and C.-H. Wu  
1995 "Their Ideas of Beauty Are, on the Whole, the Same as Ours": Consistency and Variability in the Cross-Cultural Perception of Female Physical Attractiveness. *Journal of Personality and Social Psychology* 68:261-279.
- Dunkle, J. H., and P. L. Francis  
1990 The Role of Facial Masculinity/Femininity in the Attribution of Homosexuality. *Sex Roles* 23:157-167.  
1996 "Physical Attractiveness Stereotype" and the Attribution of Homosexuality Revisited. *Journal of Homosexuality* 30:13-29.
- Farkas, L.  
1988 Age- and Sex-Related Changes in Facial Proportions. In *Anthropometric Facial Proportions in Medicine*, L. G. Farkas and I. R. Munro, eds. Pp. 29-56. Springfield: Charles C. Thomas.
- Fine, M., and A. Asch  
1988 *Women with Disabilities: Essays in Psychology, Culture, and Politics*. Philadelphia: Temple University Press.
- Fink, B., K. Grammer, and R. Thornhill  
2001 Human (*Homo sapiens*) Facial Attractiveness in Relation to Skin Texture and Color. *Journal of Comparative Psychology* 115:92-99.
- Fischhoff, B.  
1992 Giving Advice: Decision Theory Perspectives on Sexual Assault. *American Psychologist* 47:577-588.
- Frost, P.  
1988 Human Skin Color: A Possible Relationship between Its Sexual Dimorphism and Its Social Perception. *Perspectives in Biology and Medicine* 32:38-58.
- Furnham, A., M. Lavancy, and A. McClelland  
2001 Waist to Hip Ratio and Facial Attractiveness: A Pilot Study. *Personality and Individual Differences* 30:491-502.
- Gangestad, S. W., R. Thornhill, and R. A. Yeo  
1994 Facial Attractiveness, Developmental Stability, and Fluctuating Asymmetry. *Ethology and Sociobiology* 15:73-85.
- Gangestad, S. W., and R. Thornhill  
1997 The Evolutionary Psychology of Extrapair Sex: The Role of Fluctuating Asymmetry. *Evolution and Human Behavior* 18:69-88.
- Geldart, S., D. Maurer, and K. Carney  
1999 Effects of Eye Size on Adults' Aesthetic Ratings of Faces and 5-Month-Olds' Looking Times. *Perception* 28:361-374.
- Grammer, K.  
1995 *Signale der Liebe. Die Biologischen Gesetze der Partnerschaft*. München: Deutscher Taschenbuch.
- Grammer, K., and R. Thornhill  
1994 Human (*Homo sapiens*) Facial Attractiveness and Sexual Selection: The Role of Symmetry and Averageness. *Journal of Comparative Psychology* 108: 233-242.
- Groce, N. E.  
1997 Women with Disabilities in the Developing World. *Journal of Disability Policy Studies* 8:178-193.



Haag, H.

1981 *Fitness Tests*. Schorndorf: Hofmann.

Hahn, H.

1990 The Social Component of Sexuality and Disability: Some Problems and Proposals. In *Perspectives on Disability*, M. Nagler, ed. Pp. 343–351. Palo Alto: Health Markets Research.

Hale, R. W., and R. A. Mittelmark

1991 Pregnancy in the Elite and Professional Athlete: A Stepwise Clinical Approach. In *Exercise in Pregnancy*, R. A. Mittelmark, R. A. Wiswell, and B. L. Drinkwater, eds. Pp. 231–238. Baltimore: Williams and Wilkins.

Hatch, M. C., and Z. A. Stein

1991 Work and Exercise during Pregnancy: Epidemiological Studies. In *Exercise in Pregnancy*, R. A. Mittelmark, R. A. Wiswell, and B. L. Drinkwater, eds. Pp. 279–286. Baltimore: Williams and Wilkins.

Havranek, J. E.

1991 The Social and Individual Costs of Negative Attitudes Towards Persons with Physical Disabilities. *Journal of Applied Rehabilitation Counseling* 22:15–21.

Hoyme, H. E.

1994 Minor Anomalies: Diagnostic Clues to Aberrant Human Morphogenesis. In *Developmental Instability: Its Origins and Evolutionary Implications*, T. A. Markow, ed. Pp. 309–317. Dordrecht: Kluwer.

Hume, D. K., and R. Montgomerie

2001 Facial Attractiveness Signals Different Aspects of "Quality" in Women and Men. *Evolution and Human Behavior* 22:93–112.

Johnston, V. S., and J. C. Oliver-Rodriguez

1997 Facial Beauty and the Late Positive Component of Event-Related Potentials. *Journal of Sex Research* 34:188–198.

Johnston, V. S., R. Hagel, M. Franklin, B. Fink, and K. Grammer

2001 Male Facial Attractiveness. Evidence for Hormone-Mediated Adaptive Design. *Evolution and Human Behavior* 22:251–267.

Jones, B. C., A. C. Little, I. S. Penton-Voak, B. P. Tiddeman, D. M. Burt, and D. I. Perrett

2001 Facial Symmetry and Judgments of Apparent Health. Support for a "Good Genes" Explanation of the Attractiveness-Symmetry Relationship. *Evolution and Human Behavior* 22:417–429.

Kalick, S. M., L. A. Zebrowitz, J. H. Langlois, and R. M. Johnson

1998 Does Human Facial Attractiveness Honestly Advertise Health? Longitudinal Data on an Evolutionary Question. *Psychological Science* 9:8–13.

Keating, C. F.

1985 Gender and Physiognomy of Dominance and Attractiveness. *Social Psychology Quarterly* 48:61–70.

Kemper, H. C. G., W. de Vente, W. van Mechelen, and J. W. R. Twisk

2001 Adolescent Motor Skill and Performance: Is Physical Activity in Adolescence Related to Adult Physical Fitness? *American Journal of Human Biology* 13:180–189.

Langlois, J. H., L. Kalakanis, A. J. Rubenstein, A. Larson, M. Hallam, and M. Smoot

2000 Maxims or Myths of Beauty? A Meta-analytic and Theoretical Review. *Psychological Bulletin* 126:390–423.

Mackinnon, L. T.

2000 Overtraining Effects on Immunity and Performance in Athletes. *Immunology and Cell Biology* 78:502-509.

Maes, H. H., G. P. Beunen, R. F. Vlietinck, M. C. Neale, M. Thomis, B. Vandeneuynde, R. Lysens, J. Simons, C. Derom, and R. Derom

1996 Inheritance of Physical Fitness in 10-yr-old Twins and Their Parents. *Medicine and Science in Sports and Exercises* 28:1479-1491.

Mealey, L., R. Bridgstock, and G. C. Townsend

1999 Symmetry and Perceived Facial Attractiveness: A Monozygotic Co-twin Comparison. *Journal of Personality and Social Psychology* 76:151-158.

Meerdink, J. E., C. P. Garbin, and D. W. Leger

1990 Cross-gender Perceptions of Facial Attributes and Their Relation to Attractiveness: Do We See Them Differently Than They See Us? *Perception and Psychophysics* 48:227-233.

Mehrabian, A., and J. S. Blum

1997 Physical Appearance, Attractiveness, and the Mediating Role of Emotions. *Current Psychology: Developmental, Learning, Personality, Social* 16:20-42.

Møller, A. P., and R. Thornhill

1998 Bilateral Symmetry and Sexual Selection: A Meta-analysis. *American Naturalist* 151:174-192.

Mueser, K. T., B. S. Grau, S. Sussman, and A. J. Rosen

1984 You're Only as Pretty as You Feel: Facial Expression as a Determinant of Physical Attractiveness. *Journal of Personality and Social Psychology* 46:469-478.

Nakamura, E., T. Moritani, and A. Kanetaka

1998 Further Evaluation of Physical Fitness Age Versus Physiological Age in Women. *European Journal of Applied Physiology and Occupational Physiology* 78:195-200.

Nordstrom, D. L., C. Zwerling, A. M. Stromquist, L. F. Burmeister, and J. A. Merchant

2001 Epidemiology of Unintentional Adult Injury in a Rural Population. *Journal of Trauma Injury, Infection and Critical Care* 51:758-766.

Palmer, A. R., and C. Strobeck

1986 Fluctuating Asymmetry: Measurement, Analysis, Patterns. *Annual Review of Ecology and Systematics* 17:392-421.

Pashler, H.

1990 Coordinate Frame for Symmetry Detection and Object Recognition. *Journal of Experimental Psychology: Human Perception and Performance* 16:150-163.

Penton-Voak, I., D. I. Perrett, D. L. Castles, T. Kobayashi, D. M. Burt, L. K. Murray, and R. Minamisawa

1999 Menstrual Cycle Alters Face Preference. *Nature* 399:741-742.

Perkiö-Mäkelä, M. M.

2000 Finnish Farmers' Self-reported Morbidity, Work Ability, and Functional Capacity. *Annals of Agricultural and Environmental Medicine* 7:11-16.

Perrett, D. I., K. J. Lee, I. Penton-Voak, D. Rowland, S. Yoshikawa, D. M. Burt, S. P. Henzi, D. L. Castles, and S. Akamatsu

1998 Effects of Sexual Dimorphism on Sexual Attractiveness. *Nature* 394:884-887.

- Pickett, W., R. J. Brison, H. Niezgoda, and M. L. Chipman  
1995 Nonfatal Farm Injuries in Ontario: A Population-Based Survey. *Accident Analysis and Prevention* 27:425-433.
- Pittenger, J. B., L. S. Mark, and D. F. Johnson  
1989 Longitudinal Stability of Facial Attractiveness. *Bulletin of the Psychonomic Society* 27:171-174.
- Priebe, H.  
1976 The Changing Role of Agriculture, 1920-1970. In *The Fontana Economic History of Europe, Part Two: The 20<sup>th</sup> Century*, T. A. Markow, ed. Pp. 403-442. London: Collins.
- Reis, V. A., and D. W. Zaidel  
2001 Functional Asymmetry in the Human Face: Perception of Health in the Left and Right Sides of the Face. *Laterality* 6:225-231.
- Rhodes, G., F. Proffitt, J. M. Grady, and A. Sumich  
1998 Facial Symmetry and the Perception of Beauty. *Psychonomic Bulletin and Review* 5:659-669.
- Rhodes, G., L. A. Zebrowitz, A. Clark, S. M. Kalick, A. Hightower, and R. McKay  
2001 Do Facial Averageness and Symmetry Signal Health? *Evolution and Human Behavior* 22:31-46.
- Rikowski, A., and D. Grammer  
1998 Human Body Odour, Symmetry and Attractiveness. *Proceedings of the Royal Society London B* 266:869-874.
- Scheib, J. E., S. W. Gangestad, and R. Thornhill  
1999 Facial Attractiveness, Symmetry and Cues of Good Genes. *Proceedings of the Royal Society London B* 266:1913-1917.
- Shackelford, T. K., and R. J. Larsen  
1997 Facial Asymmetry as an Indicator of Psychological, Emotional, and Physiological Distress. *Journal of Personality and Social Psychology* 72:456-466.  
1999 Facial Attractiveness and Physical Health. *Evolution and Human Behavior* 20:71-76.
- Slater, A., C. von der Schulenburg, E. Brown, M. Badenoch, G. Butterworth, S. Parsons, and C. Samuels  
1998 Newborn Infants Prefer Attractive Faces. *Infant Behavior and Development* 21:345-354.
- Sparacino, J.  
1980 Physical Attractiveness and Occupational Prestige among Male College Graduates. *Psychological Reports* 47:1275-1280.
- Sussman, S., K. T. Mueser, B. W. Grau, and P. R. Yarnold  
1983 Stability of Females' Facial Attractiveness during Childhood. *Journal of Personality and Social Psychology* 44:1231-1233.
- Swaddle, J. P., and I. C. Cuthill  
1995 Asymmetry and Human Facial Attractiveness: Symmetry May Not Always Be Beautiful. *Proceedings of the Royal Society London B* 261:111-116.
- Symons, D.  
1995 Beauty Is in the Adaptations of the Beholder: The Evolutionary Psychology of Human Female Sexual Attractiveness. In *Sexual Nature, Sexual Culture*,



- P. R. Abramson and S. D. Pinkerton, eds. Pp. 80-118. Chicago: University of Chicago Press.
- Thornhill, R., and S. W. Gangestad  
1993 Human Facial Beauty: Averageness, Symmetry, and Parasite Resistance. *Human Nature* 4:237-269.
- Thornhill, R., and K. Grammer  
1999 The Body and Face of Woman: One Ornament That Signals Quality? *Evolution and Human Behavior* 20:105-120.
- Thornhill, R., and A. P. Møller  
1997 Developmental Stability, Disease and Medicine. *Biological Review* 72: 497-548.
- Tooby, J., and I. DeVore  
1987 The Reconstruction of Hominid Behavioral Evolution through Strategic Modeling. In *The Evolution of Human Behavior*, W. G. Kinzey, ed. Pp. 183-237. New York: State University of New York Press.
- van Valen, L.  
1962 A Study of Fluctuating Asymmetry. *Evolution* 16:125-142.
- Wong, S. C., and D. C. McKenzie  
1987 Cardiorespiratory Fitness during Pregnancy and Its Effect on Outcome. *International Journal of Sports Medicine* 8:79-83.
- Zebrowitz, L. A., and J. M. Montepare  
1992 Impressions of Babyfaced Individuals across the Life Span. *Developmental Psychology* 28:1143-1152.
- Zebrowitz, L. A., L. Voinescu, and M. A. Collins  
1996 "Wide-eyed" and "Crooked-faced": Determinants of Perceived and Real Honesty across the Life Span. *Personality and Social Psychology Bulletin* 22: 1258-1269.
- Zerssen, D.  
1976 *Beschwerden Liste (B-L)*. Weinheim: Beltz Testgesellschaft.

Copyright of Human Nature is the property of Transaction Publishers and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.