CRITERIA OF FACIAL ATTRACTIVENESS IN FIVE POPULATIONS

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The theory of sexual selection suggests several possible explanations for the development of standards of physical attractiveness in humans. Asymmetry and departures from average proportions may be markers of the breakdown of developmental stability. Supernormal traits may present age- and sex-typical features in exaggerated form. Evidence from social psychology suggests that both average proportions and (in females) "neotenous" facial traits are indeed more attractive. Using facial photographs from three populations (United States, Brazil, Paraguayan Indians), rated by members of the same three populations, plus Russians and Venezuelan Indians, we show that age, average features, and (in females) feminine/neotenous features all play a role in facial attractiveness.

KEY WORDS: **Sexual selection; Physical attractiveness; Fluctuating asymmetry; Evolutionary psychology.**

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THEORY AND HYPOTHESES

Theory: Adaptive and Nonadaptive Mate Choice in Current Evolutionary Theory

Evolutionary biologists have produced a considerable body of theory and evidence regarding mate choice for physical characteristics in non-human animals, while social psychologists have begun to test alternative hypotheses of the criteria of facial attractiveness in different human populations. In this paper we discuss some current controversies about physical attractiveness in evolutionary theory and psychology, and we present some relevant results on standards of facial attractiveness from an ongoing study of the criteria and consequences of physical attractiveness in five human populations.

In 1871 Charles Darwin (1981) argued that the elaborate and brightly colored tail of the peacock, and similarly ornamental features in a host of other species, have evolved through sexual selection—that peacocks with elaborate tails have had more offspring, not because they enjoyed any advantage in the "struggle for existence," but because they were more often chosen as mates by the other sex. Most of Darwin's scientific contemporaries rejected his theory of sexual selection by mate choice; they were commonly skeptical that "lower" animals could have anything like an esthetic sense. The topic was also mostly neglected by the founders of the Modern Synthesis in the 1930s and 1940s (Cronin 1991). But the past twenty years or so have seen a full vindication of Darwin, and it is now almost universally accepted that elaborate secondary sexual characters are commonly the result of sexual selection by mate choice.

But Darwin did not offer any account of the origin or adaptive value of the preferences expressed in mate choice. Since his time, several processes have been proposed that might account for such preferences, but there is no consensus on which is likely to be most important. Facial attractiveness seems to present a special paradox for theories of sexual selection. Traits like body size and age may have direct consequences for survival and reproduction that make them relevant criteria for mate choice, but it is harder to imagine that subtle variations in facial morphology (at least among individuals of the same age) have strong direct fitness consequences. Below we will consider two possible theories that may circumvent this difficulty and may be particularly relevant to explaining standards of human facial attractiveness.

Canalization and Adaptive Mate Choice. Waddington (1957) argued that the development of adaptations is typically *canalized*—guided by negative feedback mechanisms adapted to keep development "on track" in spite of the possible perturbing influences of environmental insult and genetic load. But in the face of really powerful stresses, canalization is likely to break down, with several characteristic consequences, including *departures from average proportions* and *fluctuating asymmetry.*

Departures from average proportions. Where size is concerned, the optimum may be different from the average, if greater than average size reflects a developmental history of good nutrition and low energy drain from injury and parasites. But where shape is concerned, departures from the average often reflect maldevelopment. Deutsch (1987) reviews evidence that many psychiatric syndromes are associated with facial dysmorphology (see also Garn et al. 1985).

Fluctuating asymmetry. Developmental "noise" not only leads to differences between the features of affected individuals and those of average individuals, but also (in bilaterally symmetrical species) to random differences between features on the right and left sides of affected individuals (or fluctuating asymmetry) above and beyond biologically normal (or directional) asymmetry. In nonhuman organisms, inbreeding, elevated homozygosity, parasite load, undernutrition, and exposure to pollution are all associated with increased fluctuating asymmetry (Parsons 1990). In humans, fluctuating asymmetry correlates with inbreeding, premature birth, psychosis, and mental retardation (Livshits and Kobylianski 1991).

Both departures from average proportions and fluctuating asymmetry may reflect a history of environmental insult and genetic load, and forecast a future of reduced viability and fertility. Insofar as there are direct or indirect evolutionary advantages to choosing a healthy and fertile mate, selection will favor individuals who steer clear of mates that display departures from average proportions and fluctuating asymmetry. Koeslag (1990) reviews evidence for "koinophilia" (preference for average features), whereas Møller and Höglund (1991) and Thornhill (1992) provide evidence that scorpionlike and swallows look for symmetry in potential mates (see also Thornhill and Gangestad in this issue).

Sensory Bias and Nonadaptive Mate Choice. It seems likely that adaptations for complex perceptual discriminations will usually have nonadaptive biases built into them, and there is a growing interest in the possibility that some mate preferences are adaptive by-products rather than adaptations in their own right (Enquist and Arak 1993; Ryan et al. 1990;

Staddon 1975; ten Cate and Bateson 1989). Williams (1992) argues that preferences for exaggerated stimuli may be a nonadaptive by-product of *asymmetrical fitness functions*. (These functions have nothing to do with fluctuating asymmetry!) For example, if reproductively immature males have shorter tails than mature males, then a female preference for males with longer than average tails may be adaptive if it leads females to avoid matings with juveniles—better to err on the long side than on the short. But as a by-product, females may show a nonadaptive preference for mature males with long tails over mature males with short or average tails. Given heritable variation in male tail length, the result over time will be the evolution of exaggerated male tail length through female choice.

A recent simulation by Enquist and Arak (1993) models the evolution of nonadaptive preferences as by-products of adaptation. The authors present a "neural network"—a simple computer model of a retina and nervous system—with a long-tailed shape representing a mate of the right species, with a short-tailed shape representing a mate of the wrong species, and with random shapes. They make small random changes in the network and save those versions of the network that respond strongly to the right shapes and weakly to the wrong ones. By reiterating this trial-and-error process in a simulation of natural selection they produce a network that distinguishes almost perfectly between mates of the right species (presented in a variety of orientations) and other stimuli. However, the network responds even more strongly to a few shapes—especially shapes that present the distinguishing features of the correct stimulus in an exaggerated form—than it does to the stimulus to which it was selected to respond! A further simulation shows that this nonadaptive sensory bias toward "supernormal stimuli" can persist and result in the evolution of exaggerated traits, even when these traits carry a moderate fitness cost.

Staddon (1975) notes that animals trained by reinforcement learning to show a response to a stimulus commonly show an even stronger response to a version of the stimulus that exaggerates its distinguishing features—a phenomenon called "peak shift"—and ten Cate and Bateson (1989) note an analogous phenomenon in the case of imprinting.

Hypotheses: The Young, the Average, and the Supernormal

Social psychologists and cultural anthropologists have often argued that human standards of physical attractiveness are culturally determined—that standards in different cultures have little or nothing in common, that one person's standards are acquired by imitation or by social reinforcement learning, and that standards can be understood only within the context of the whole system of meanings and values particular to a given culture (Hatfield 1986; Polhemus 1988). We do not argue that imitation, social learning, and symbolism are always unimportant in setting standards of physical attractiveness; however, several lines of evidence suggest that other things are going on.

Age. First, there seems to be little variation across populations in the relationship between age and attractiveness (Buss 1989; Symons 1979; Williams 1966). By way of comparison, consider how much variation there is in ideal fatness, with obesity favored in some societies and leanness in others (Brink 1989; Brown 1992). Yet in no society, to our knowledge, are physical markers of reproductive senility like dry, sagging, and wrinkled skin considered attractive. Probably signs of aging are universally considered sexually unattractive because throughout human evolutionary history individuals with an attraction to reproductively senescent mates left few surviving offspring.

Second, variation in perceived attractiveness *within* age classes may also depend in part on the operation of precultural psychological mechanisms. Discrimination between attractive and unattractive faces develops at a very young age. Langlois and her co-workers (Langlois et al. 1987) have shown that infants as young as two to three months of age, given a choice between looking at photographs of women's faces rated attractive by adults and women's faces rated unattractive, will spend more time looking at the attractive faces. Several mechanisms could account for this agreement in standards of facial attractiveness between adults and unenculturated infants.

Average Features and Symmetry. A number of studies suggest that faces with proportions especially close to average proportions are more attractive than most faces. Langlois and Roggman (1990) rely on computer graphics to produce composite faces that blend the features of a number of faces; these composite faces are rated more attractive than most of the original faces used to produce the composite. Benson and Perret (1992), using a more complex graphics system, show that the averageness effect results partly because the composite faces have smoother complexions, and partly because they have proportions close to average proportions. Other studies relying on measurements of faces also find that attractive faces are more average (Farkas and Munro 1987; Strzałko and Kaszycka 1992). All these studies suggest that the human mind may include a "face averaging device" which blends perceived faces to arrive at an ideal prototypical face (Symons 1979).

Some forthcoming work (see Thornhill and Gangestad in this issue) also suggests that symmetry is an important component of facial attractiveness.

Supernormal Stimuli. There is probably more to facial attractiveness than averageness. The same study by Langlois and colleagues which found that composite faces are more attractive than most of the faces that go into making the composites also found that a few individual faces are consistently rated more attractive than any composite (Alley and Cunningham 1991). Cunningham (1986) shows that photographs of female faces rated attractive in the United States have unusually large eyes, high cheekbones, narrow cheeks, and small noses, chins, and jaws. McArthur and Berry (1983), working in the United States, and Riedl (1990), working in Austria, both using computer systems normally used for police identification work, show that the ideal female face has a more "neotenous" (juvenile) appearance—larger eyes and more reduced vertical dimensions—than the average female face, whereas the ideal male face is closer to the average male face.

The interpretation of these results is problematic. Cunningham argues that men are attracted to women with large eyes, small noses, and small chins and jaws because these are juvenile traits. On the other hand, men are attracted to women with high cheekbones and narrow cheeks because these are mature traits. Cunningham gives no clear rationale why this particular combination of juvenile and mature traits is favored, rather than some other, or even the opposite, combination. It may be relevant that *all* the traits listed above are traits that distinguish female from male faces (Enlow 1990). Male faces undergo a more thorough remodeling during adolescence than female faces, with a great expansion of the nose, mid-face, brows, chin, and jaw, which reduces the apparent prominence of the eyes and cheekbones; many of the features that distinguish adult from juvenile faces also distinguish male from female faces.

Below we consider how facial attractiveness is related to age, fluctuating asymmetry, averageness, and exaggerated feminine/neotenous features in samples of five populations.

MATERIALS AND METHODS

Sampled Populations

We collected photographs of individuals of both sexes, together with interviews and anthropometric measurements of photographic subjects from three populations: undergraduates at the University of Michigan in

Ann Arbor; students at the Federal University of Bahia in Salvador, Brazil; and natives of several villages of Ache (or Guayaki) Indians in eastern Paraguay. We collected ratings of each set of photographs and conducted interviews with raters from a new sample of University of Michigan undergraduates; from middle and lower class adults in Salvador, Brazil; from natives of a different Ache village; from students at the Moscow Institute of the Humanities in Russia; and from Hiwi (or Cuiva) Indians in southern Venezuela. Data were collected by Doug Jones in the United States, Brazil, and Russia; by Kim Hill in Venezuela; and by both researchers in Paraguay. Data collection extended over several fieldwork sessions from 1990 to 1992.

In the United States, photographic subjects and raters were recruited in introductory anthropology and psychology courses, and by flyers posted around campus. In Brazil and Paraguay, photographic equipment was set up in public areas, and interested individuals were invited to participate. Raters in Brazil, Paraguay, Russia, and Venezuela were recruited in part by going from door to door, and in part by approaching potential raters in public places.

Photographic subjects and raters in the United States were largely of European ancestry. Although we also collected attractiveness ratings of and from Asian-Americans and African-Americans, in this paper we present data for European-Americans only, since a restricted sample provides a better test of some of our hypotheses. Brazilian subjects and raters overwhelmingly described themselves as being of mixed ancestry, mostly European and African, with some American Indian. In this paper we will use our Brazilian sample to test hypotheses about age, symmetry, averageness, and supernormal features, but there are additional complexities in the Brazilian situation that we can only touch on here (see the conclusion to the section on "Average Proportions" under Results). Russian raters were largely of Russian nationality, with some other nationalities of the former Soviet Union (Ukrainians, Jews, Germans, Central Asians) represented as well. Culturally, the Ache and the Hiwi are the most divergent populations in our study. Both groups were foragers, with dogs being the only domesticated animals. Neither group had peaceable contact with the outside world until the 1960s, and both continue to have relatively little contact on a day-to-day basis with outsiders, and little exposure to Western media.

Figures for age, sex, and number of subjects and raters are included in Table 1.

Photographs, Interviews, and Ratings

The senior author took photographs with a tripod-mounted Canon ES 750 camera and Agfa color film of subjects seated against a white back-

Table 1. Age and Facial Attractiveness

PHOTOGRAPHS *Raters (Male, Female)*		*PHOTOGRAPHS OF FEMALES*		*PHOTOGRAPHS OF MALES*
BRAZILIANS *n*		51		23
mean age		23.0		24.0
age s.d.		3.76		3.34
age range		17–34		19–32
	Correlation	*Regression Slope*	*Correlation*	*Regression Slope*
Brazilians (19,11)	−.38**	−.13**	−.40†	−.17†
U.S. Americans (12,20)	−.07	−.03	−.36†	−.15†
Russians (11,14)	−.22†	−.10†	−.10	−.04
Ache Indians (11,13)	−.18	−.07	−.17	−.07
Hiwi Indians (4,4)	−.10	−.05	−.54**	−.24**
U.S. AMERICANS *n*		52		31
mean age		20.1		21.3
age s.d.		1.38		2.84
age range		18–25		18–30
	Correlation	*Regression Slope*	*Correlation*	*Regression Slope*
Brazilians (20,23)	−.15	−.12	.13	.07
U.S. Americans (11,18)	−.12	−.13	.18	.12
Russians (12,14)	−.16	−.17	.20	.10
Ache Indians (20,21)	−.16	−.14	−.05	−.03
Hiwi Indians (0,0)	n.a.	n.a.	n.a.	n.a.
ACHE INDIANS *n*		41		42
mean age		29.1		31.7
age s.d.		10.54		12.96
age range		14–51		16–60
	Regression Slope		*Regression Slope*	
	Segregated	*Mixed*	*Segregated*	*Mixed*
Brazilians (17,16)	−.06	−.11**	−.07	−.09**
U.S. Americans (12,15)	−.04	n.a.	−.07	n.a.
Russians (12,12)	.04	−.05*	−.06	−.10**
Ache Indians (15,15)	−.14	−.15**	−.04	−.05*
Hiwi Indians (7,4)	−.13	n.a.	−.02	−.02

Note: Numbers in parentheses are number of raters that rated members of the opposite sex in that category. Correlation is Pearson product-moment; slope is slope of least-squares regression line. Negative correlations and regression slopes mean that attractiveness declines with age. See text for discussion of age-segregated and mixed Ache groups.

Significance (two-tailed): † $p < 0.1$

* $p < 0.05$

** $p < 0.01$

drop, with their heads at a fixed distance and carefully positioned using an angle-meter.

We got ratings of photographs by laying out nine photos in three rows in front of each rater and asking her, first, to sort each column by attractiveness, putting the most attractive face (Portuguese: *rosto mais bonito;* English: most attractive face; Russian: *samoe krasivoe litso;* Ache: *cha'a gatuvi* = best face; Hiwi: *wohune/pehenowa* = pretty/handsome face) at the top and the least attractive at the bottom, and second, to sort rows left to right by attractiveness. The result was to rank the photographs roughly from 1 to 9. For each rater we laid out 3 by 3 girds, selecting photos at random from a single population sample of the other sex, until we ran out. All but a few Ache and Hiwi, and all Brazilians, Americans, and Russians carried out the task without difficulties.

A much greater range of ages was represented among the Ache, and our format for rating the photographs differed; in order to provide some control for age effects, we divided both our male and female Ache photographs into four subgroups, roughly segregated by age, and carried out rankings within subgroups. We also carried out a small number of rankings mixing together Ache from different subgroups in order to carry out a separate assessment of the effects of age on attractiveness.

Although we did not explicitly ask raters to assess individuals in photographs as potential sexual or marital partners, many raters, especially Ache and Brazilians of both sexes, made spontaneous comments along these lines. Ongoing research in Brazil by the senior author will assess to what extent perceived attractiveness has real-life social consequences. (And see Gangestad, in this issue, for material on consequences of physical attractiveness in the United States.)

Measurement of Photographic Facial Landmarks

We scanned each of our photographs with an Apple Scanner connected to a Macintosh II. We began by taking x,y coordinates of 60 points on each face, but our tests of the face-averaging hypothesis are based on just 27 points—seven along the midline of the face and ten on either side—because remeasurement suggested that these 27 gave the most consistent results. The points we used are as follows: for the face, at the bottom of chin, junction of chin and lower lip, lower junctions of ear and cheek (right and left), lateralmost protrusion of cheekbone (both sides), and glabella; for the lips, bottom midpoint of lower vermilion, upper midpoint of lower vermilion (or lower midpoint of upper vermilion), upper midpoint of upper vermilion, lateralmost extensions (both right and left); for the nose, bottom midpoint of nasal septum, lateralmost extensions of nasal alae (both sides); for the eyes and eyebrows, upper and lower midlines of eyes, inside and outside corners of eyes, and innermost and outermost extensions of eyebrows (all three measured on both right and left sides).

We calculated distances between each point and all other points along the midline and/or on the same side of the face. We eliminated some of the distances involving the eyebrows, since remeasurement suggested that our eyebrow landmarks measured vertical position better than horizontal. We were left with 247 distances between landmarks for each face.

Statistics

We use two different indices to measure how much each face in our six population samples differs from the average face in that sample. Changing the size of a face without changing its shape will not change the value of either index. The first is a slightly modified version of the pattern variability index (PVI) of Garn, LaVelle, and Smith (Garn et al. 1985). For each of our six samples, and for each of our 247 log-transformed distances between facial landmarks, we calculate the median. Then, for each log-distance for each face, we calculate the difference from the sample median. Finally, for each face we calculate the standard deviation of the 247 differences. The higher the PVI, the more the face differs from the proportions of the median face in the sample. Thus, if all the measurements of a face are 10% larger than the median measurements in the population (1.1, 1.1, 1.1, . . .), the standard deviation of the logarithms of these measurements will be zero; the face is larger than average, but its *proportions* are those of the average face. But if one of the measurements is 10% larger than the median, one is 20% larger, one is 10% smaller, and so on (1.1, 1.2, 0.9, . . .), then the standard deviation of the logarithms of those measurements will be greater than zero, reflecting the difference in proportions between the face being measured and the average face.

The Euclidean Distance matrix index (EMDI) for each face is the logarithm of the ratio of the largest to the smallest differences from the sample median (Lele and Richtsmeier 1991). Again, if all the measurements of a face are 10% larger than average, then the logarithm of the ratio of the largest to the smallest of these differences will be $\log(1.1/1.1) = \log(1) = 0$, whereas if any two landmark distances differ from their medians by different percentages, the resulting EDMI will be greater than zero.

More measurement error is involved in the measurement of fluctuating asymmetry than in the measurement of averageness, since differences between the right and left side of one person's face are typically smaller than differences between two different faces. When we remeasured faces, measurement error was less than 20% for all of our 247 distance measurements, but more than 50% for most measurements of right/left distance differences. We selected just six measurements (from inside and outside corners of the eye to outside corner of lip, bottom midpoint of nasal septum, and chin) that seemed particularly reliable (measurement error less than 30%). For each measurement we subtracted left from right distances, divided by the mean of left and right, and subtracted the median left-right difference for that measurement and that sample (to correct for directional—i.e., nonfluctuating—asymmetry). Our index of fluctuating asymmetry (FA) is the average of these six numbers for each photograph.

To test the hypothesis that femininity/neoteny is a component of female facial attractiveness, we began by comparing median distances in male and female photographic samples. When we looked at the ratio of median female measurements to median male measurements in each of our three populations of photographic subjects, the distances between landmarks around the eyes and eyebrows consistently produced some of the highest ratios (typically > 1), while vertical distances along the midline of the face consistently produced some of the lowest (typically $<$ 0.9). In other words, the size of the eyes in relation to the height of the face strongly distinguishes between females and males. The same ratio also distinguishes juvenile from adult faces (Enlow 1990; Farkas and Munro 1987), although we can't show this with our data set. In this paper, we report the relation to attractiveness of the eye width to face height ratio (EW/FH)—the mean of right and left eye widths divided by the distance between the bottom of the chin and the glabella (the lower border of the forehead along the midline of the face, between the eyebrows).

In our analyses, we sometimes present pooled data. Pooling of samples was carried out by calculating *z*-scores within each sample, to allow for differences in sample means and standard deviations, and then pooling these scores to calculate correlations and significance levels. In a few cases, we summarize our results by presenting average correlations, but in these cases we do not attempt significance tests.

RESULTS

Effects of Age

Table 1 presents correlations between ages of photographic subjects and mean ratings of attractiveness for different combinations of photographic subjects and raters. Since the range of ages represented in our photographic samples differs, we also present slopes of least-squares regression lines to make it easier to compare different samples.

The photographic samples from the United States have the most limited age ranges (18 to 25 for females, 18 to 30 for males). Not surprisingly, the correlations between age and attractiveness in these samples are low. There is a greater range of ages in the Brazilian photographic sample (17–34, 19–32), and correlations with attractiveness are consistently (and in some cases significantly) negative for both sexes.

The format for the Ache photographic subjects (presented at the bottom of the tables) differs somewhat from that for the other two groups, since we have two sets of attractiveness ratings for each subject. The Ache photographs were divided into four subgroups, roughly segregated by age, and rankings reflect relative standing *within* a subgroup. The mixed rankings derive from all four groups combined and reflect standing relative to all other same-sex Ache in the sample. (See Materials and Methods for further discussion.) For the Ache we present two columns of regression slope coefficients for each sex. The first is based on calculating the regression of attractiveness within subgroups on age separately for each of four subgroups. Table 1 gives the average of the resulting slopes. The second column is based on calculating the regression of attractiveness on age for the mixed sample. The two different methods of estimating the effects of age on attractiveness among the Ache give generally similar results, although results from the mixed sample are consistently a little higher.

For populations in which potential mates span a range of ages from adolescence to reproductive senility, physical differences associated with age are probably the most important determinants of physical attractiveness for both sexes. Our Ache sample spans this range, and for this sample age is a much stronger predictor of attractiveness than any of the other variables we will consider. This topic deserves a much more extended treatment than we can give in this paper. For present purposes, age-related differences must be controlled before we can look at possible non-age-related criteria of physical attractiveness. This presents problems because our estimates of the slopes of regression lines have considerable margin for error and show a great deal of variability between photographic samples and raters. We approached this problem by calculating correlations in three ways: without controlling for age; controlling for age using the regression slopes presented in Table 1 for each combination of photographic subjects and raters (a Lilliefors test showed that none of the age and attractiveness distributions used in this regression were significantly different from a normal distribution); and controlling for age assuming first low (.05), then medium (.1), then high (.15) values for the regression slope across all combinations of photographic subjects and raters. With few exceptions (discussed below), our conclusions are quite robust in the face of different assumptions about the strength of the relationship between age and attractiveness. In all the tables that follow, we show correlations controlled for age using the regression slopes from the second assumption listed above.

Intergroup Comparisons

With age partialled out, how much do samples of different populations of raters agree in their judgments of physical attractiveness? Table 2 shows correlations in age-corrected ratings of physical attractiveness between samples of raters. (We use Pearson product-moment correlations because a Lilliefors test shows that the distributions of attractiveness ratings do not depart significantly from normality.) In the Western cluster, which consists of raters from Brazil, the United States, and Russia, there is very strong and significant agreement on standards of physical attractiveness for all population samples rated. The average correlation between members of the Western cluster is .64. The average correlation for the Indian cluster, consisting of Ache and Hiwi raters, is .42. Finally, even in the cross-cluster comparisons there seems to be some agreement, since a number of correlations are significantly positive and none are significantly negative. The average correlation across clusters is .13.

These results have some implications for hypotheses about criteria of facial attractiveness. First, standards of attractiveness vary across populations. This is certainly not news. Darwin (1981), Westermarck (1891), and Ellis (1942), relying on missionaries' and travelers' accounts, all reported such variation across populations, and modern ethnographers commonly second these reports (cf. Ford and Beach 1951). These results do not disprove the existence of specialized biological adaptations for assessing attractiveness, any more than linguistic variation disproves the existence of specialized biological adaptations for processing phonology and syntax. However, they do argue that theories of the psychology of attractiveness need to be tested across a range of cultures, if they are to have strong claims to be theories of *human*, and not merely industrial Western, psychology.

Second, shared culture probably cannot completely account for similarities in standards of physical attractiveness across populations. Shared culture might be responsible in part for similarities in standards of attractiveness within the Western cluster on Table 2. But it is hard to see how similarities between Ache and Hiwi Indian standards could have anything to do with shared culture; Ache and Hiwi cultures have been developing independently for many thousands of years. On the

Table 2. Age-Corrected Agreement about Facial Attractiveness across Populations

PHOTOGRAPHS	RATERS					RATERS				
	Western			*Indian*		*Western*			*Indian*	
Raters (Male,Female)	*Brazil*	*U.S.*	*Russia*	*Ache*	*Hiwi*	*Brazil*	*U.S.*	*Russia*	*Ache*	*Hiwi*
BRAZILIANS	Photographs of Females (n = 51)					Photographs of Males (n = 23)				
Brazilians (19,11)	***.98***					***.79***				
U.S. Students (12,20)	.68**	***.87***				.70**	***.94***			
Russians (11,14)	.68**	.79**	***.85***			.72**	.56*	***.85***		
Ache Indians (11,13)	.32*	−.07	.04	***.87***		.12	−.28	−.13	***.51***	
Hiwi Indians (4,4)	.25†	−.03	.08	.57**	***.71***	.33	.26	.40†	.21	***.58***
U.S. AMERICANS	Photographs of Females (n = 52)					Photographs of Males (n = 31)				
Brazilians (20,23)	***.78***					***.87***				
U.S. Americans (11,18)	.59**	***.86***				.44*	***.89***			
Russians (12,14)	.66**	.78**	***.82***			.71**	.64**	***.88***		
Ache Indians (20,21)	.15	.15	.19	***.90***		−.07	−.05	−.13	***.88***	
Hiwi Indians (0,0)	n.a.	n.a.	n.a.	n.a.	***n.a.***	n.a.	n.a.	n.a.	n.a.	***n.a.***
ACHE INDIANS	Photographs of Females (n = 41)					Photographs of Males (n = 42)				
Brazilians (17,16)	***.80***					***.87***				
U.S. Americans (12,15)	.65**	***.82***				.72**	***.92***			
Russians (12,12)	.68**	.71**	***.82***			.51**	.52**	***.89***		
Ache Indians (15,15)	.41**	.21	.19	***.76***		.24	.33*	.28†	***.79***	
Hiwi Indians (7,4)	.19	−.05	.02	.42**	***.72***	.28†	.17	.14	.50**	***.81***
POOLED CORRELATIONS	Photographs of Females (n = 144)					Photographs of Males (n = 96)				
Brazilians (56,50)										
U.S. Americans (35,53)	.63**					.60**				
Russians (35,40)	.66**	.75**				.65**	.57**			
Ache Indians (46,49)	.28**	.09	.13			.08	−.02	−.01		
Hiwi Indians (7,5)	.22**	−.04	.05	.50**		.31**	.22*	.28**	.34**	

Mean Correlations: West (Brazil, U.S., Russia) .64 Indians (Ache, Hiwi) .42 Combined .13

Note: Numbers in plain type are Pearson product-moment correlations between average ratings of attractiveness, with age partialled out. Numbers in ***boldface italics*** are Cronbach's alphas. See text and Table 1 for additional explanation.

Significance (two-tailed): † $p < 0.1$ * $p < 0.05$ ** $p < 0.01$

other hand, something like a Face Averaging Device (see Background and Theory) would make sense in this case; two physically similar groups like the Ache and Hiwi could have similar ideal composites even without culture contact. More complicated mechanisms—e.g., setting the ideal face equal to the average face subject to some transformation—would also work.

Table 2 also presents Cronbach's alphas for each combination of rater and photographic sample. (See diagonal matrix elements in italic boldface.) These values set a lower bound to the reliability of our attractiveness ratings. Thus the error in rating j is less than or equal to $1 - \alpha_j$. Since $\alpha > 0$ for all attractiveness ratings, correlations of attractiveness with other variables in this and other tables underestimate the true correlations.

Average Proportions

Do raters perceive faces as especially attractive when these faces have proportions especially close to average proportions (with "average" meaning average for the population from which raters are drawn)? We have used a version of Garn, LaVelle, and Smith's pattern variability index (PVI) and a Euclidean Distance matrix index (EDMI), derived from Lele and Richtsmeier (see above), to determine how closely the proportions of each face in our sample correspond to average proportions. Table 3 shows the correlations of log PVI and log EDMI with age-corrected attractiveness. (We take the logarithms of our indices to correct for significant right skewness, as measured by a Lilliefors test for normality. We get virtually identical results using the original values of the indices. Log PVI and log EDMI are strongly and significantly correlated with each other for all photographic samples: average $r = .8$, range $= .66–.87$.) Negative correlations in Table 3 mean that deviant faces are less attractive.

According to the face averaging hypothesis, we expect raters to be particularly attracted to faces especially close to the average in their own populations. The shaded areas indicate cases in which raters are rating members of their own population. For the pooled sample we pooled data within these boxes only.

Table 3 provides strong support for the face averaging hypothesis only for ratings of Ache photographs, although trends for other photographic samples are generally in the right direction. (Positive correlations for some of the ratings carried out by Hiwi women probably reflect the very small number of raters.) Neither of our indices of difference in facial proportions is consistently a better predictor than the other.

Table 3. Nonaverage Features and Facial Attractiveness

PHOTOGRAPHS Raters (Male,Female)	PHOTOGRAPHS OF FEMALES PVI	EDMI	PHOTOGRAPHS OF MALES PVI	EDMI
BRAZILIANS	(n = 51)		(n = 23)	
average	.033	.29	.037	.30
s.d.	.008	.10	.007	.10
Brazilians (19,11)	−.16	−.18	−.23	−.26
U.S. Americans (12,20)	.01	−.02	−.31†	−.19
Russians (11,14)	−.19†	−.15	.01	−.04
Ache Indians (11,13)	−.10	.00	.08	−.04
Hiwi Indians (4,4)	−.10	.04	.18	.11
U.S. AMERICANS	(n = 52)		(n = 31)	
average	.034	.31	.034	.29
s.d.	.008	.14	.008	.10
Brazilians (20,23)	−.11†	−.21†	−.24	−.16
U.S. Americans (11,18)	−.07	−.18	−.19	.06
Russians (12,14)	−.12	−.25*	−.28	.00
Ache Indians (20,21)	−.04	−.06	−.31*	−.45*
Hiwi Indians (0,0)	n.a.	n.a.	n.a.	n.a.
ACHE INDIANS	(n = 41)		(n = 42)	
average	.036	.30	.036	.32
s.d.	.010	.10	.010	.13
Brazilians (17,16)	−.27*	−.34*	−.19	−.17
U.S. Americans (12,15)	−.15	−.16	−.25*	−.28*
Russians (12,12)	−.23†	−.19	−.33*	−.39**
Ache Indians (15,15)	−.37**	−.43**	−.28*	−.26*
Hiwi Indians (7,4)	−.45**	−.36**	.25	.14
Pooled Ratings	(n = 144)		(n = 96)	
(Brazil, U.S., Ache)	−0.18*	−0.25**	−0.23*	−0.14†

Note: Numbers are Pearson product-moment correlations between average ratings of attractiveness and logarithms of two indexes of deviation from average proportions, with age partialled out. PVA is pattern variability index; EDMI is Euclidean Distance matrix index. Negative correlations mean that attractiveness declines with deviations from average proportions. Shaded areas mark raters who rated members of their own populations; these ratings were pooled to generate the ratings shown at the bottom of the table.

Significance (one-tailed): † $p < 0.1$ * $p < 0.05$ ** $p < 0.01$

Why should the averageness effect be so much stronger for the Ache than for the other groups in our sample? And why are even non-Indian raters sometimes attracted to Ache faces close to average Ache proportions? Part of the answer may be that departures from average proportions are correlated with age for the Ache (r = .27, .27, .37, .14 for PVI and EDMI for males and females, respectively), so our estimate of the effect of nonaverage features on physical attractiveness is sensitive to our assumptions about the effects of age on attractiveness. (See "Effects of Age" above; this is the only finding in this paper that is greatly affected by our assumptions about the attractiveness-age regression.) Also, although the variability of Ache faces is about the same as that for the other groups (judging by averages and standard deviations of PVI and EDMI), the causes of variability are probably different. The range of ages is much greater in the Ache sample than in the others; conditions of life have been much harder for the Ache; and the Ache are probably more genetically homogeneous than our other samples. It is possible that departures from average features resulting from aging and a hard life detract more from attractiveness than departures resulting from genetic heterogeneity in modern multi-ethnic societies. Correcting for age can remove some of these effects, but (if people age at different rates) not all of them.

Brazil may be something of a special case. In Table 3, where Brazilians are rating Brazilians, the correlations of attractiveness with PVI and EDMI for females and males are −.16, −.18, −.23, and −.26, respectively. Suppose we recalculate our indices using measurements of U.S. American rather than Brazilian faces as our standard. In other words, suppose we measure how much each Brazilian face differs from the average American face, rather than from the average Brazilian face. The corresponding correlations with attractiveness in this case are consistently stronger (−.21, −.26, −.26, and −.33). Brazilians seem to be evaluating Brazilian faces more by how closely they match U.S. proportions than by how closely they match Brazilian proportions! This probably reflects both the influence of North American and European media, and a local class structure in which the rich are disproportionately European in ancestry and appearance and the poor are disproportionately African. Hoetink (1967) suggests that in racially stratified societies the standard of physical attractiveness (the "somatic norm image") will be weighted toward the physical appearance of the dominant group (cf. Franklin 1968; Russell et al. 1992); we hope to give this topic a more extended treatment in future publications.

Fluctuating Asymmetry

Table 4 presents data on the relationship between facial fluctuating asymmetry and facial attractiveness. The results are unimpressive. Among all our samples of raters, only Russian women show a really significant attraction to faces with low FA. These results differ from

Table 4. Fluctuating Asymmetry and Facial Attractiveness

PHOTOGRAPHS *Raters (Male,Female)*		*PHOTOGRAPHS OF FEMALES*	*PHOTOGRAPHS OF MALES*
BRAZILIANS	*n*	51	23
	average FA	.0053	.0052
	s.d. FA	.0031	.0036
Brazilians (19,11)		−.15	−.22
U.S. Americans (12,20)		−.08	−.27
Russians (11,14)		−.25*	.07
Ache Indians (11,13)		.14	.08
Hiwi Indians (4,4)		−.03	.26
U.S. AMERICANS	*n*	52	31
	average FA	.0059	.0052
	s.d. FA	.0036	.0021
Brazilians (20,23)		.07	−.12
U.S. Americans (11,18)		−.01	.07
Russians (12,14)		−.10	−.23
Ache Indians (20,21)		−.07	−.03
Hiwi Indians (0,0)		n.a.	n.a.
ACHE INDIANS	*n*	41	42
	average FA	.0052	.0071
	s.d. FA	.0020	.0038
Brazilians (17,16)		−.07	−.04
U.S. Americans (12,15)		−.09	−.10
Russians (12,12)		−.23†	.03
Ache Indians (15,15)		.03	−.12
Hiwi Indians (7,4)		−.03	.05
POOLED SAMPLES	*n*	145	96
Brazilians (56,50)		−.05	−.11
U.S. Americans (35,53)		−.06	−.09
Russians (35,40)		−.19*	−.04
Ache Indians (46,49)		.03	−.04
Hiwi Indians (7,5)		−.02	.12

Note: Numbers are Pearson product-moment correlations between average ratings of attractiveness and logarithms of a measure of fluctuating asymmetry (FA), with age partialled out. Negative correlations mean that attractiveness declines with increasing asymmetry.

Significance (one-tailed): † $p < .01$
* $p < 0.05$

forthcoming results discussed by Thornhill and Gangestad in this issue, although measurement error in FA (discussed above) may weaken our test.

FA is weakly correlated with PVI and EDMI (pooled r = .11, .22 for females; .05, .09 for males). Controlling for PVI and EDMI slightly lowers the correlations of FA with attractiveness, but controlling for FA has virtually no effect on the correlation of PVI and EDMI with attractiveness. FA is not significantly correlated with age among the Ache.

Supernormal Stimuli

As discussed above, recent research and theory suggest that preferences for exaggerated, or "supernormal," stimuli may sometimes be adaptive by-products rather than adaptations in their own right. Selection for choosing a mate of the right species, sex, and age may lead incidentally to nonadaptive biases in mate choice among those individuals who fall *within* the "right" species, sex, and age class.

Table 5 presents correlations between a measure of femininity/neoteny of facial features—the eye width to face height ratio—and ratings of attractiveness. In ratings of both Brazilian and U.S. females a high EW/FH ratio (an exaggerated feminine/neotenous feature) is consistently and often strongly and significantly correlated with attractiveness. No such correlation is present for ratings of Ache females. In spite of the anomalous results for ratings of Ache females (discussed below), pooling results for different populations of photographic subjects shows that men in every population of raters give women higher ratings for attractiveness when they have a higher EW/FH.

There is no strong or consistent effect of EW/FH on female assessments of male attractiveness. Correlations of EW/FH with PVI and EDMI are weak and inconsistent. Correlation of EW/FH with age among the Ache is −.16 for females and −.52 for males.

DISCUSSION

To summarize, we find strong support for the hypothesis that increased age is associated with declining facial attractiveness for adults of both sexes, at least in samples that span a wide range of ages. We find strong support with our Ache photographic samples and weak support with other photographic samples for the hypothesis that facial proportions close to the population average are associated with increased attractiveness. We find little support for the hypothesis that increased fluctuating asymmetry in facial proportions is associated with declining physical

Table 5. Eye Width to Face Height Ratio and Facial Attractiveness

PHOTOGRAPHS *Raters (Male,Female)*		*PHOTOGRAPHS OF FEMALES*	*PHOTOGRAPHS OF MALES*
BRAZILIANS	*n*	49	20
	average EW/FH	.21	.18
	EW/FH s.d.	.014	.018
Brazilians (19,11)		.39**	.05
U.S. Americans (12,20)		.19	.16
Russians (11,14)		.31*	.45*
Ache Indians (11,13)		.43**	.09
Hiwi Indians (4,4)		.26†	.42†
U.S. AMERICANS	*n*	51	31
	average EW/FH	.23	.20
	s.d. EW/FH	.018	.013
Brazilians (20,23)		.23†	.00
U.S. Americans (11,18)		.34*	−.03
Russians (12,14)		.25†	.07
Ache Indians (20,21)		.37**	−.11
Hiwi Indians (0,0)		n.a.	n.a.
ACHE INDIANS	*n*	41	36
	average EW/FH	.19	.18
	s.d. EW/FH	.013	.013
Brazilians (17,16)		−.12	.22
U.S. Americans (12,15)		−.10	.18
Russians (12,12)		−.21	.00
Ache Indians (15,15)		.02	.15
Hiwi Indians (7,4)		.18	−.44**
POOLED SAMPLES	*n*	145	96
Brazilians (56,50)		.18*	.11
U.S. Americans (35,53)		.16*	.11
Russians (35,40)		.13†	.13
Ache Indians (46,49)		.29**	.05
Hiwi Indians (7,5)		.22*	−.14

Note: Numbers are Pearson product-moment correlations between average ratings of attractiveness and logarithms of a measure of fluctuating asymmetry (FA), with age partialled out. Negative correlations mean that attractiveness declines with increasing asymmetry.

Significance (one-tailed for females; two-tailed for males):

† $p < .01$

* $p < 0.05$

** $p < 0.01$

attractiveness (although measurement error may have weakened our test). We find support in ratings of Brazilian and U.S. females, but not in ratings of males or Ache females, for the hypothesis that exaggerated feminine/neotenous traits are particularly attractive.

How strong are our results? Not very, if we measure them as a percentage of variance explained (r^2). This is probably due in part to error variance in average attractiveness ratings (see above discussion of within-sample reliability as measured by Cronbach's alphas) and other variables. Our method of ranking photographs, our use of photographic rather than direct facial measurements, and attenuation of the range of attractiveness owing to the reluctance of unattractive individuals to participate are all possible sources of noise in our data.

But there is another way to gauge the strength of the effects of averageness, fluctuating asymmetry, and femininity/neoteny on attractiveness; we can compare them with the effects of age. For Ache females, one year's decline in physical attractiveness corresponds roughly to a .1 "point" decline in average attractiveness. (This is an average figure for all reproductive age females; obviously the slope may vary as a function of age. The figure would be a bit lower for Ache males. We cite figures for Ache because they have the widest age range.) One standard deviation (s.d.) in attractiveness averages around 1.5 points. A correlation of .34 between the eye width to face height ratio and attractiveness (the figure for U.S. males rating U.S. females) means that a 1 s.d. decrease in EW/FH corresponds to a .34 s.d. decrease in attractiveness, i.e., about .5 points or 5 years' worth. In other words, for a rough estimate of the "years' worth" of attractiveness corresponding to a 1 s.d. decrease in the relevant variable, multiply the correlation coefficients in Tables 3, 4, and 5 by 15. The exact numbers should not be taken to heart, but using attractiveness-year-equivalents as a benchmark may give more of an intuitive handle on the approximate magnitudes of the effects involved.

Adaptive Preferences or Adaptive By-products?

The effects of age on facial attractiveness are familiar and expected, and they probably have a direct adaptive explanation. The effects (or lack thereof) of symmetry, averageness, and neoteny/femininity are less commonsensical and may have some bearing on the theoretical dispute about the extent to which mating preferences are adaptations or by-products of adaptation. We began this paper by comparing two theories of the origins of standards of physical attractiveness that seemed especially relevant to facial attractiveness. One of these theories, that attractive features are markers of developmental homeostasis, was partly supported for our face samples—with positive but mostly insignificant results for fluctuating asymmetry, and both positive and significant results for averageness. However, our analysis also shows that departures from average proportions increase with increasing age in the one group, the Ache, that has a large range of ages, so it is possible that departures from average proportions seem unattractive as much because they are signs of aging as because they are signs of non-age-related genetic or epigenetic load. (It would be interesting to know whether the composite facial images of Langlois and colleagues and of Benson and Perret look younger than the individual faces that went into the composite.)

Our results are also consistent with the arguments of Williams (1992) and Enquist and Arak (1993) that selection for choosing a mate of a particular sex and age class may lead to a nonadaptive sensory bias for supernormal stimuli *within* sex and age classes. We find no evidence in our data set that EW/FH has any relationship to such variables as age at menarche, stature, or feminine body proportions (waist to hip ratio), which have arguably been relevant to fitness in our evolutionary past (see Singh, this issue); thus there may be no adaptive advantage for males to prefer feminine/neotenous features over and above the advantages of choosing mates of a particular sex and age. More research, looking at more variables, will be needed to settle whether facial femininity, masculinity, and neoteny are associated with components of mate value other than age. (See Thornhill and Gangestad in this issue on exaggerated facial proportions as possible markers of immunocompetence.)

Femininity, Neoteny, Averageness, and Aging

We noted above that many of the same features (including a high EW/FH) distinguish both juvenile from adult faces and female from male faces, which suggests two different explanations of why these features seem attractive. The explanation offered by Cunningham (1986), McArthur and Berry (1983), and Riedl (1990)—that it is neoteny or juvenility that makes facial features attractive—faces the difficulty that skeletal growth slows down greatly by early adulthood. A high eye width to face height ratio distinguishes juveniles from adults more effectively than it distinguishes young adults from old ones (Behrents 1985; Enlow 1990). It may be that EW/FH is most important in determining physical attractiveness among females in adolescence and early adulthood. For younger females, the most important cues may be puberty-related changes in body shape, while for older females (and older males) changes in soft tissue—wrinkles and sagging skin—may be more important age cues than changes in hard tissue. This difference could explain why we found no effect of EW/FH, but a strong effect of nonaverage facial proportions, on the attractiveness of Ache women (and men), who were older on average than our non-Ache samples. In other words, there may be an interaction with age in the effects of averageness and femininity/neoteny on facial attractiveness—although our current data set is too small to test this possibility properly.

The other interpretation is that attractive female facial features are exaggerated sex-typical features. The two interpretations are not mutually exclusive. Simultaneous selection for sex of mate (female) and age of mate (young but reproductively mature) could jointly result in an incidental preference for feminine/neotenous traits *within* a single sex and age class. (Where female standards of male attractiveness are concerned, simultaneous selection for sex of mate and age of mate might give more complicated and ambiguous results.) Our research suggests the importance of "supernormal" features in facial attractiveness in real populations, but further research, perhaps using artificial stimuli, will be needed to bring out the more subtle features of the "ideal" face in different populations.

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