Research Article

ATTRACTIVE FACES ARE ONLY AVERAGE

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Abstract—*Scientists and philosophers have searched for centuries for a parsimonious answer to the question of what constitutes beauty We approached this problem from both an evolutionary and information-processing rationale and predicted that faces representing the average value of the population would be consistently judged as attractive To evaluate this hypothesis, we digitized samples of male and female faces, mathematically averaged them, and had adults judge the attractiveness of both the individual faces and the computer-generated composite images Both male (three samples) and female (three samples) composite faces were judged as more attractive than almost all the individual faces comprising the composites A strong linear trend also revealed that the composite faces became more attractive as more faces were entered These data showing that attractive faces are only average are consistent with evolutionary pressures that favor characteristics close to the mean of the population and with cognitive processes that favor prototypical category members*

What makes a face beautiful? The answer to this question has eluded scientists[1] and philosophers even though interest in the question has continued for centuries Research in social and developmental psychology, even without a conceptual definition of beauty or a specification of its stimulus dimensions, has nevertheless produced some of the most robust and widely replicated findings in the social and behavioral sciences Both children and adults respond more positively to attractive rather than unattractive individuals (see reviews by Berscheid & Walster, 1974, Langlois, 1986, Sorell & Nowak, 1981)

Until recently, most researchers interested in attractiveness effects have avoided investigating the stimulus dimensions of beauty, both because of the intractable nature of the problem and because of several well-entrenched assumptions about standards of beauty and preferences for attractiveness. For example, it has been assumed, at least since the publication of Darwin's *Descent of Man* (1871), that standards of beauty are culturally specific and that attempts to determine universal or underlying dimensions of beauty are futile It has also been widely held that standards of attractiveness are only gradually learned by children through exposure to the media and culture in which they live.

Both these assumptions, however, have been challenged by new data First, a number of recent cross-cultural investigations have demonstrated surprisingly high (e g , 66–93) inter-rater reliabilities in judgments of attractiveness (e g , Bernstein, Lin, & McClellan, 1982, Cunningham, 1986, Johnson, Dannenbring, Anderson, & Villa, 1983, Maret, 1983, Maret & Harling, 1985, Richardson, Goodman, Hastorf, & Dornbusch, 1961, Thakerar & Iwawaki, 1979, Weisfeld, Weisfeld, & Callaghan, 1984) The cross-cultural data suggest that ethnically diverse faces possess both distinct and similar structural features, these features seem to be perceived as attractive regardless of the racial and cultural background of the perceiver

Second, a number of recent studies of infants have demonstrated that when infants 3 to 6 months of age are shown pictures of adult-judged attractive and unattractive faces, they prefer attractive ones (Langlois, Roggman, Casey, Ritter, Rieser-Danner, & Jenkins, 1987, Langlois, Roggman, & Rieser-Danner, in press, Samuels & Ewy, 1985, Shapiro, Eppler, Haith, & Reis, 1987) Thus, even before any substantial exposure to cultural standards of beauty, young infants display behaviors that seem to be rudimentary versions of the judgments and preferences for attractive faces so prevalent in older children and adults

Taken together, the cross-cultural and infant data suggest that there may be universal stimulus dimensions of faces that infants, older children, and adults cross-culturally view as attractive The ability to detect these stimulus dimensions may be innate or acquired much earlier than previously believed Such findings thus compel a more intensified search for answers to the old question of what defines a beautiful face.

THE LENGTH OF NOSES

Most recent attempts to define beauty have taken a feature-measurement approach (Cunningham, 1986; Hildebrandt & Fitzgerald, 1979, Lucker, 1981) While some progress has been made in identifying facial measurements that predict attractiveness ratings, the findings have been contradictory both within and between studies (Cunningham, 1986; Farkas, Munro, & Kolar, 1987) Even if consistent results were to be obtained, the feature-measurement approach would not provide a parsimonious answer to the question of what makes a face attractive. Thousands of measurements of the face are possible (Farkas, 1981), although research so far has employed only a few of the many possible facial measures. Furthermore, even if we could accurately and reliably predict attractiveness judgments from feature measurements, we would still not know why the combination of certain measures are perceived as attractive by infants, children, and adults.

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1 The first psychologist to experimentally study beauty was probably Fechner in 1876 (Osborne, 1953)

Parsimony, Biology, and Cognition

A more parsimonious solution to defining beauty and explaining why certain facial configurations are perceived as attractive is suggested by two distinct fields of inquiry, evolutionary biology and cognitive psychology Darwin's theory of natural selection (1859), or at least modern day versions of it,[2] suggests that average values of many population features should be preferred to extreme values In the most ubiquitous form of natural selection, normalizing or stabilizing selection, evolutionary pressures operate against the extremes of the population, relative to those close to the mean (Barash, 1982, Dobzhansky, 1970) Thus, individuals with characteristics (especially some morphological features) that are close to the mean for the population should be less likely to carry harmful genetic mutations and, therefore, should be more preferred by conspecifics (Bumpas, 1899, Schmalhausen, 1949, Symons, 1979) The robust preference shown for attractive individuals has been puzzling in light of this evolutionary fact, given that more attractive individuals are at the extreme rather than in the middle of the distribution of attractiveness ratings

Results from a second domain of investigation, cognitive and developmental psychology, also converge on the suggestion that the average value of faces should be preferred It is well known that even young infants are capable of forming concepts and of abstracting prototypes from individual exemplars of a category (Cohen & Younger, 1983; Quinn & Eimas, 1986) A prototype can be defined as the central representation of a category, as possessing the average or mean value of the attributes of that category and as representing the averaged members of the class (Reed, 1972, Rosch, 1978, Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976, Rosch, Simpson, & Miller, 1976) After seeing several exemplars from a category, both infants and adults respond to an averaged representation of those exemplars as if it were familiar, that is, they show evidence of forming mental prototypes, and they rely on such abstracted prototypes to recognize new instances of the category (Quinn & Eimas, 1986, Rosch, 1978, Strauss, 1979)

For example, using schematic faces, Strauss demonstrated that even young infants recognized facial prototypes made from the averaged values of previously viewed facial features rather than from the most frequently viewed features Infants responded to a prototype or averaged face as highly familiar even though they had never seen it before Others have also shown that infants will average features from various kinds of visual stimuli to form prototypes (Bomba & Siqueland, 1983, Younger, 1985, Younger & Gotlieb, 1988)

Thus, evidence exists demonstrating that the average value of members of a class of objects is often prototypical, that infants are capable of forming prototypes by averaging features, and that infants assign prototypes special status by recognizing prototypical category members even when they have not seen them before To the extent that a face is a good example or prototype and is thus easily recognized as a face, infants may show more interest in it than a less prototypical face. These facts imply an explanation for studies showing that infants prefer attractive faces Perhaps an attractive face is attractive simply because it is prototypical

If attractive faces are attractive because they represent a prototype or an average of a face, then a prototype created by averaging several faces would be expected to be attractive Such an attractive "average" face would be consistent with both evolutionary and cognitive theory and would help explain why young infants and adults from diverse cultures prefer attractive faces Considerable progress may be made in both defining facial beauty and in understanding the broad preferences for a beautiful face if it can be shown that faces representing the average value of the population are judged as attractive

COMPUTER FACES

To evaluate whether the "average" face is more attractive than the individual faces used to create them, we digitized individual faces, averaged them, and had adults rate the physical attractiveness both of the individual faces and the averaged composite images We predicted that these average faces would be attractive, that this effect would generalize across different sets of both composite faces and raters, and that composite faces would be more attractive than the mean level of attractiveness of the individual faces used to create them

To test these hypotheses, we photographed male and female undergraduate students from a standard distance in a full-front view of the face and neck Background and lighting were identical across subjects Subjects were asked to pose with a "pleasant but neutral, closed mouth expression " Clothing was draped with a solid light-colored cloth to eliminate all variation in appearance Subjects wearing glasses or earrings were asked to remove them Males with facial hair were not included in the population of faces

The population of facial photographs included a pool of 336 males (including 26 Hispanics and 21 Asians) and a pool of 214 females (including 24 Hispanics and 18 Asians) From each pool, a sample of 96 faces was randomly selected without replacement and randomly divided into three sets of 32 faces from which three composites were created No face was included in more than one composite set

Each face was digitized by scanning the photograph with a video lens interfaced with a computer Using a zoom lens and "joystick" markers, faces were adjusted for size and position by matching the location of the eye pupils and the middle of the lip line across all faces A 512 × 512 matrix of numeric gray values then represented each facial image By arithmetically averaging those matrices, a series of achromatic composite facial images was created For each set, composites were created at five levels of averaging. two faces, four faces, eight faces, sixteen faces, and thirty-two faces

These composites were then contrast enhanced to clarify the image Initially, each image was "smoothed," meaning that each pixel in the matrix was adjusted to the average value of the pixels immediately surrounding it so that any double edges creating by averaging were minimized "Extra" edges occasionally remained in the composites with eight or fewer faces and were removed from the image. Subsequently, the gray value

2. Darwin himself did not believe there were either common cross-cultural preferences for beauty or common underlying dimensions of beauty

difference between each pixel and its surrounding area was doubled so that the resulting smoothed edges were sharpened. Contrast was also enhanced by increasing the range of gray values, similarly to the way the contrast adjustment on a standard television affects the image. The individual faces were smoothed and contrast enhanced in the same manner as the composites to create photographically similar images. The composite and individual faces were then photographed by a matrix camera with direct input from the computer screen (See Figure 1).

Each set of individual faces and its corresponding composites were rated for physical attractiveness by a minimum of 65 (range = 65–80) males and females enrolled in undergraduate psychology classes. Three hundred raters participated; some raters evaluated more than one set of faces. The slides of the individual and composite faces from each set were projected in random order and were shown for 10 seconds each. Raters scored each facial image on a 1 to 5 scale ranging from 1 = very unattractive to 5 = very attractive. The raters were told that the photographs were taken from a television screen, to ignore any reduction of photographic quality caused by the TV image, and to judge only the physical attractiveness of faces.

Reliability of the attractiveness ratings was assessed separately for each set of images using coefficient alpha and ranged from .90 to .98. Separate estimates of reliability for male and female raters ranged from .90 for one group of 23 male raters to .98 for one group of 46 female raters. Only three raters from the total of 300 were eliminated from the data set because of low inter-rater correlations with the rest of the raters.

Composite Faces

For each facial image, all ratings were averaged to produce a mean attractiveness score. Table 1 shows the means and standard deviations for each set of individual faces and for each level of the composites. The mean attractiveness scores of the 32- and 16-face male and female composite faces are one standard deviation or more above the mean for the individual male and female faces. Differences in attractiveness scores among levels of the composites were evaluated using analysis of variance (ANOVA) with sex and level of composite as factors. A significant effect for the number of faces entered into the composite was obtained, $F(4, 25) = 3.16, p = .03$, but there were no significant effects for sex or for the interaction between sex and composite level. The main effect for composite level was followed up by a test of linearity, which revealed a strong linear effect of increasing attractiveness as more faces were entered into the composite, $F(1, 25) = 10.43, p = .004$.

Individual vs. Composite Faces

The individual faces were compared to the composites in three ways for each sex. First, individual faces were compared

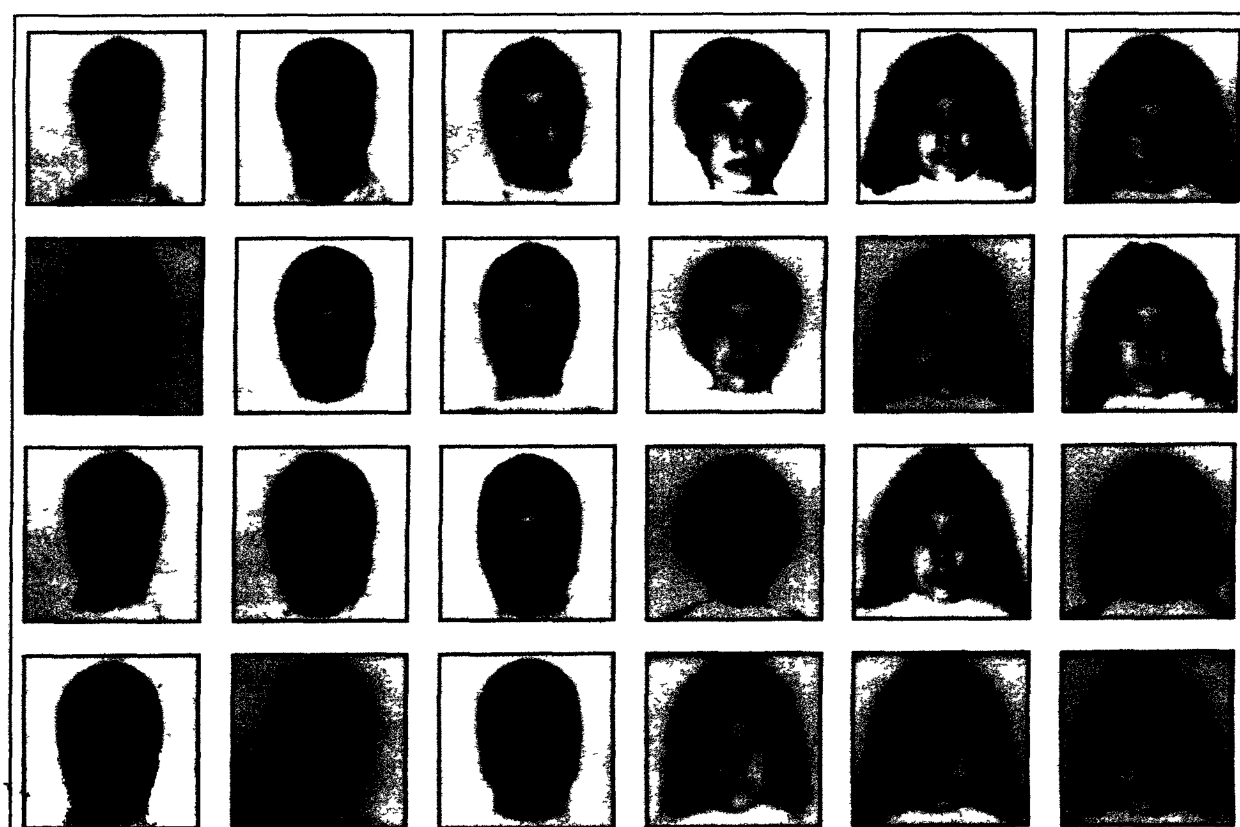

Fig. 1. Composite faces. Faces from left to right represent the six different composite sets. Faces from top to bottom represent composite levels of four faces, eight faces, sixteen faces, and thirty-two faces.

Table 1. *Attractiveness ratings for individual and composite faces*

	n	Mean	*SD*
Male Faces			
Individual Faces			
Set 1	32	2 60	53
Set 2	32	2.51	.54
Set 3	32	2 42	48
Sets 1–3	96	2 51	52
Composite Faces			
2-face level	3	2 34	12
4-face level	3	2 45	61
8-face level	3	2 75	57
16-face level	3	3 31	17
32-face level	3	3 27	08
Female Faces			
Individual Faces			
Set 1	32	2 38	67
Set 2	32	2 48	63
Set 3	32	2 42	66
Sets 1–3	96	2 43	64
Composite Faces			
2-face level	3	2 87	49
4-face level	3	2 84	77
8-face level	3	3 03	34
16-face level	3	3 06	18
32-face level	3	3 25	07

to the composites using an analysis of variance with a single factor with six levels the individual face level and each of the five levels of composites (2, 4, 8, 16, 32) This overall test was followed by planned comparisons between the composites at each level of averaging and the individual faces that were averaged into the composite 32 faces from each of the three sets ($n = 96$) were compared to the three 32-face composites, 16 faces from each of the three sets ($n = 48$) were compared to the three 16-face composites, and so on Two sample t tests with separate variance estimates were used for these planned comparisons because of differences in the variance and sample size between the individual faces and the composites Finally, within rater, paired t tests were used to compare raters' judgments of the 32-face composites with their ratings of all the individual faces.

Male Faces

The attractiveness scores of the 96 individual male faces ranged from 1 8 to 3 8 with a mean of 2 51 ($SD =$ 52) The ANOVA comparing images of individual male faces with 2-, 4-, 8-, 16-, and 32-face images revealed a significant effect of the number of faces, $F(5, 93) = 2\ 90, p = .017$ The planned comparisons showed that the 32- and 16-face composites were rated as significantly more attractive than their corresponding individual male faces ($t = 10\ 60, p = .0001$; $t = 7.24, p = .001$, for the 32- and 16-face composites, respectively). The composites made of eight or fewer faces, however, did not differ significantly from their individual faces.

The within-rater analyses revealed that of the 96 individual male faces, only three were judged as significantly more attractive than their corresponding composite, about what would be expected by chance By comparison, 80 of the individual male faces were rated as significantly less attractive than the composite

Female Faces

The attractiveness scores of the 96 individual female faces ranged from 1 20 to 4.05, with a mean of 2 43 ($SD =$ 64), similar to the mean of the males The results for the analyses of the female faces were similar to the results for the male faces There was a significant overall effect of the number of faces in each image revealed by the ANOVA, $F(5, 93) = 2\ 38, p =$ 043 The planned comparisons showed that the 32- and 16-face composites were rated as significantly more attractive than their corresponding individual female faces, but that the other composites did not differ significantly from their individual faces ($t = 10\ 46, p =$ 0001, $t = 4\ 83, p =$ 005, for the 32- and 16-face composites, respectively)

Again, the raters' attractiveness judgments for each individual female face were compared to their ratings of the 32-face composites Of the 96 individual female faces, only 4 were rated as significantly more attractive than the composites, whereas 75 were judged as significantly less attractive

DISCUSSION

Galton's Meat-Eaters

In the 1800s, a number of articles and commentaries were published on composite portraits created by Galton and Stoddard in which they superimposed photographic exposures of faces (Galton, 1878, 1883, Stoddard, 1886, 1887) The apparent purpose of these composite portraits was to create graphic representations of types of faces Galton enjoyed creating composites of criminals, meat-eaters, vegetarians, and tuberculosis patients Stoddard created composites of the 1883, 1884, and 1886 senior classes of Smith College and of members of the National Academy of Sciences Although both Galton and Stoddard noted that the composites were "better looking" than their individual components because "the special villainous irregularities in the latter have disappeared" (Galton, 1878, p 135), their observations were not pursued systematically until now The data provided here offer empirical evidence that composite faces, at least those of a group of predominantly Caucasian males and females, are indeed attractive and are rated as more attractive than are the individual faces comprising the composite

Mathematical Averages

The computerized technique of mathematically averaging faces provides several advantages over the photographic method of Galton and Stoddard. First, the images are precisely averaged rather than superimposed by hand based on only roughly equivalent units of time exposure Second, our technique allowed us to standardize lighting and contrast and to perform precise image enhancement procedures on all of the faces equivalently Finally, the random selection procedure ensured that faces were included in the composite in an unbiased fashion Thus, some of the composites were begun with an unattractive face, some with an attractive face, some composites had more unattractive than attractive faces, others had the reverse The mean attractiveness ratings of the 16- and 32-face composites indicated that the attractiveness of the individual faces in these composites was not an important determinant of the attractiveness of the composite As Stoddard (1887) discovered, neither was the order in which the faces were entered and averaged.[3]

Despite the technical advantages of a computerized technique over the timed multiple-exposure photography of the last century, we do not presume to have simulated the human mind Our digitized images, even at 262,144 pixels per image, do not approach the quality of an image of a face viewed live, and our technique only approximates the averaging process that is assumed to occur when humans form mental prototypes Nevertheless, by using image-processing techniques and by collecting objective and reliable ratings of attractiveness, we have empirically demonstrated that average faces are perceived as attractive We replicated this finding in two populations, male and female young adults, and in three separate samples from each population using several analytic approaches Our results demonstrating this robust effect confirm the subjective impressions of those who, in the last century, have viewed composite faces and commented on their striking attractiveness At the same time, our results will surprise contemporary researchers who have not considered an attractive face to be average

The attractiveness scores of the composites indicated that faces attain both average values and high attractiveness ratings when 8 to 16 faces are combined into a composite image Likewise, the variability of the attractiveness ratings of the 16- and 32-face composites was lower than that for most of the other composites and those of all of the individual faces These statistical findings are mirrored by observation. Inspection of the composites reveals that the 16- and 32-face composites look very similar to each other, both within and between same-sex composite sets That this similarity should hold between composite sets is especially interesting given that no individual face appeared in more than one set Thus, the averaging procedure, in addition to producing attractive faces, also seems to produce a typical face Other research is consistent with this finding Faces rated as more attractive are also rated as more typical and less unusual, in turn, faces rated as attractive and typical are rated as more similar to each other than to other faces (Light, Hollander, & Kayra-Stuart, 1981)

The typicalness and "averageness" of attractive faces helps to explain why they are preferred Faces may be preferred by infants and adults alike if they are perceived as prototypes of a face; that is, as more *facelike*. Unattractive faces, because of their minor distortions (e.g , malocclusions, etc), may be perceived as less facelike or as less typical of human faces In the study presented here, although we have not shown that attractive faces are perceived as prototypes, we have demonstrated that prototype faces are perceived as attractive Conceptually, averaging the gray values of digitized images of faces creates a prototype by definition (Reed, 1972, Rosch, Simpson, & Miller, 1976, Wittgenstein, 1953) Methodologically, averaging matrices of pixels to create prototypes from exemplars is the inverse of procedures used in previous research to create category exemplars from prototypes, such as random distortions of prototype dot patterns (Bomba & Siqueland, 1983, Posner & Keele, 1968) This method of creating a prototype by averaging facial images is also similar to creating a schematic prototype by averaging facial features (Strauss, 1979)

Infants may prefer attractive or prototypical faces because prototypes are easier to classify as a face Faces are such an important class of visual stimuli for humans, and the perception of faceness in infancy is a critical part of the development of social responsiveness If humans have evolved to respond to facial configurations for the purpose of extracting relevant social information (e g , McArthur & Baron, 1983), both infants and adults may respond most strongly to the most facelike or prototypic stimuli in the environment Because of the importance of the information conveyed by faces for social interaction, humans should therefore have built-in or early developing preferences for them

Beauty Detectors

The ability of both infants and adults to abstract a prototype by averaging features will not come as a surprise to some biologically oriented theorists Symons (1979), for example, has proposed an innate mechanism that detects the population mean of anatomical features In the case of faces, this proposed "beauty-detecting" mechanism averages observed faces, selection pressures are assumed to favor built-in preferences for these average faces over preferences for faces more distant from the mean Perhaps because of the difficulty of shifting perspectives from ratings of attractiveness to the dimension of faces themselves, however, the field of study concerned with facial attractiveness and its effects on social relations and social behavior has failed to pursue Symons' proposal until now.

Although the nomenclature of the evolutionary and cognitive perspectives is quite different, these perspectives offer more similarity than difference in the predictions made for prototypic or averaged faces and the tendency of infants and adults from diverse cultures to notice and prefer them. The data provided here do not, however, allow us to choose between evolutionary theory, which suggests that preferences for attractive faces are innate, and cognitive theory, which suggests that preferences for attractive faces are acquired early in life through exposure to category exemplars.[4] Indeed, it may be that the mechanism

3 We did not systematically test variations of order However that the attractiveness of the composites is unrelated to the attractiveness of the faces entered at the beginning of the averaging process is obvious from the nearly identical attractiveness ratings and appearance of the 32-face composites within each gender, compared to the wide range of attractiveness of the first four faces entered into each composite set and from the four-face composites

4. The ability to categorize is the innate component from this perspective (Cohen, 1988). Unfortunately, the innate versus early acquired distinction cannot be investigated in infants at birth because of the immature status of the visual system (Banks & Salapatek, 1983)

by which such preferences would become built-in is an inevitable outcome of the categorical abstraction of social stimuli. In any case, both the evolutionary and cognitive developmental perspectives bring coherence to the cross-cultural and infant data when the metric of average faceness rather than attractiveness ratings is designated for study

In their seminal review of physical attractiveness effects, Berscheid and Walster (1974) concluded that there was no answer to the question of what constitutes beauty Nor could Berscheid and Walster discern a foreseeable answer to this question. The data provided here suggest that attractive faces are those that represent the central tendency or the averaged members of the category of faces Such a definition of attractiveness is parsimonious and fits with both evolutionary and cognitive theory Certain limitations, however, should be noted in these data Our composites were created by averaging the faces of young, university students from the southwest Although it is quite unlikely that the faces of these undergraduates differ in any meaningful way from those in other geographical areas of the United States, generality should be ensured by making composites of faces from different geographical locations. Composites of faces from other cultures should also be evaluated Although a composite of 32 Asian faces will surely look different than that of a Caucasian composite face, we would predict that such an Asian composite face would, nevertheless, be judged as very attractive by both Asian and non-Asian raters

We also acknowledge that a sample of movie stars might be rated as more attractive than our composites It may be the case that although averageness is a necessary and critical element of attractiveness, other elements may also be important in influencing judgments of attractiveness However, whether the digitized versions of faces of movie stars are more attractive in some absolute sense or are merely rated as more attractive because of their exposure and familiarity to raters (e g , Harrison, 1969; Zajonc, 1968) is unclear and will need to be resolved by future research. Finally, we make no claim that our analysis applies to aesthetics in general, although average faces may be quite attractive, average (i e , composited) art is not at all likely to be attractive and, in fact, hardly seems to be a useful construct.

We end by noting that the topic of physical attractiveness and its effects on social behaviors and relationships has been described as "undemocratic" (Aronson, 1969) Social scientists may be less disturbed by studying the effects of attractiveness knowing that attractive faces, in fact, are only average

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