Aesthetic equivalence of three representations of the face

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To assess the aesthetic equivalence of different representations of the human face, attractiveness ratings were collected for sets of faces shown in front vs. profile view photographs (Study 1) and in outline silhouettes vs. profile photographs (Study 2). Both studies showed moderate correlations, and thus a degree of aesthetic equivalence, between the pairs of representations. However, significant interactions between mode of representation and stimulus person also showed that the representations are not equivalent for all individuals. These results suggest that attempts to develop metrics that predict physical attractiveness from the physical structure of the face should be based not on any single two-dimensional view, but either on multiple views or on three-dimensional representations.

There is considerable evidence that facial attractiveness has a powerful effect on people's judgments and behavior in a variety of social contexts (see Adams, 1977; Berscheid, 1980). Although progress has been made toward understanding the psychological impact of facial attractiveness, efforts to describe the physical relationships underlying its perception have met with limited success. The significance of the latter problem derives, in part, from the need to characterize the apparent physical attractiveness stereotype that has been demonstrated by social and developmental psychologists. In addition, a set of facial measurements for predicting perceived attractiveness would have significant practical value. For clinicians, notably orthodontists and plastic, oral, and maxillofacial surgeons, much of whose treatment is prompted by aesthetic concerns, a physical measure of facial attractiveness would contribute to development of more objective and reliable standards for patient assessment, treatment planning, and evaluation than do measures currently used.

One might assume that development of an aesthetic metric would be grounded in the three-dimensional structure of either the visible soft tissue (skin) or under-

lying hard tissue (bone and cartilage). However, practical problems entailed in the collection and analysis of three-dimensional data have led to the use of various two-dimensional representations of the human head, including front and profile perspectives in the forms of photographs, line drawings, or X-rays. Choice of facial perspective, however, could have a significant bearing on people's aesthetic judgments, since different parts of the face are presented or emphasized in each perspective. For example, a large, prognathic lower jaw might seem unremarkable from the front, and yet appear highly menacing and unattractive in profile. Conversely, serious facial asymmetries visible in the front view may not be revealed in either of the profile views when seen alone. Similarly, the lack of detail in a silhouette might make its perceived attractiveness differ from that of the corresponding profile photograph.

While there are plausible reasons to suppose a priori that different representations might not be equivalent, no empirical tests appear to have been reported. Such tests are essential for establishing the generality and clinical applicability of any aesthetic measure. Unless the front and profile views of faces are equally attractive, a metric that accurately predicts perceived attractiveness of the profile might, for instance, fail to predict attractiveness judgments of the front view. Such a result would seriously weaken the claim that the metric has captured a viable structural description of attractiveness and could lead to serious errors if used to plan orthodontic or surgical intervention.

To date, aesthetic metrics have been based on a great variety of two-dimensional representations, including front and profile X-rays, photographs, line drawings, and

silhouettes (for examples of this research, see Bowker & Meredith, 1959; Burstone, 1958; Cox & van der Linden, 1971; Lines, Lines, & Lines, 1978; Lucker, 1980; Peck & Peck, 1970; Ricketts, 1982).

STUDY 1

Method

Stimuli. Facial photographs were copied from the files of the Denver Child Research Council's longitudinal study of growth. For roughly 100 children, moderately well standardized black-and-white photographs, both front and profile, were taken every 1-2 years, from infancy through early adulthood. For each of 10 males and 10 females, all Caucasian, three pairs of front and profile photographs were selected, one pair at each of three ages. Only photographs of reasonable quality, showing neutral, relaxed expressions, were selected. In each pair, the front and profile views were shot at a single sitting. The ages at the three levels varied widely among the stimulus people. Median ages were, for the younger pairs, 4-0 (i.e., 4 years, 0 months), for the middle pairs, 9-0, and for the older pairs, 14-4. The photographs were masked to hide clothing and as much hair as possible and then recopied as 35-mm slides.

Subjects. One hundred and fifty-one U.A.L.R. undergraduates in introductory psychology classes participated for course credit.

Design. Each subject viewed both the front and profile views of all 20 stimulus persons in one age-level set. Faces were shown in blocks by view, so that half of the subjects saw all the profiles first and half saw all the front views first. Within each block, the faces were presented in one of two random orders, with the same order being used for both the front- and profile-view blocks. The same two orders were used across subjects for the three sets. There were a total of 12 groups: three sets by two random orders by two orders of the perspective (i.e., front view first or profile view first). At least 10 subjects were used in each group.

Procedure. Subjects were informed that the study was concerned with facial beauty and that their task was to rate the physical attractiveness of the faces that would be projected onto a movie screen. They were given forms on which a series of 7-point scales was printed. The points on the scale were labeled from left to right as "extremely unattractive," "moderately unattractive," "slightly unattractive," and so on, to "extremely attractive." Before the ratings were collected, subjects were shown five faces as samples and questions about the instructions were answered. Slides were shown for about 8 sec each.

Results and Discussion

The ratings were scored as integers from 1 to 7, with 1 indicated the lowest rating of attractiveness and 7 the highest. Two analyses were performed: a repeated-measures analysis of variance, with perspective, age level, and stimulus person as factors, and calculation of the product-moment correlation coefficient between the mean ratings of the front and profile views across stimulus persons.

In the analysis of variance, there was no significant main effect (p > .05) of perspective. This suggests that there was no general difference in perceived attractiveness between profile and front views. The interaction between stimulus person and perspective (p < .001), however, indicated that relative attractiveness of the individual may have varied with perspective.

A significant three-way interaction was also found among perspective, age level, and stimulus person, thus

pointing toward differential effects of growth on various parts of the face. That is, growth might have produced changes in relative attractiveness of the two perspectives. Alternatively, it is possible that, in spite of the extensive efforts made to insure that pairs of photographs for each person at each age were comparable, slight variations in either the quality of photographs or expression are responsible for this interaction. Means for the two perspectives, by age-level set, are presented in Table 1.

The magnitude of the differences in attractiveness of the two perspectives can be seen in the scatterplot presented in Figure 1. Note that the differences range from profile more attractive, through near equality, to front view more attractive. Product-moment correlations provide another index of the equality of the attractiveness of the two perspectives. Computing the correlation over the means of all 66 pairs of faces gives r = .48 (p < .01). Thus, while the aesthetic equivalence of the front and profile views varies from person to person, there is a moderate linear relation between the perceived attractiveness of faces portrayed by these two views. The correlations within the age-level sets are,

Table 1
Mean Attractiveness Ratings

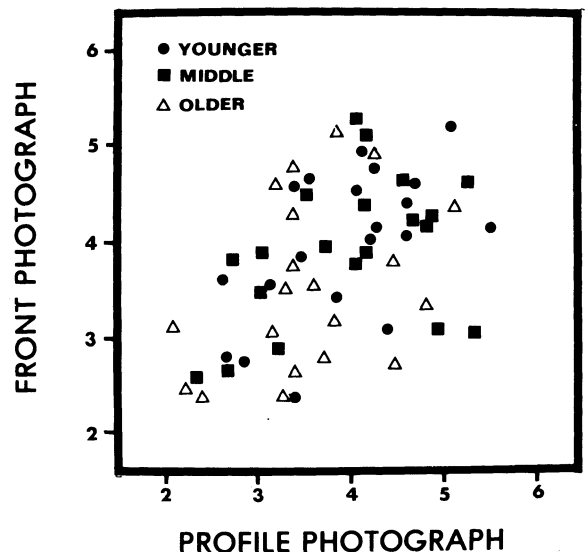| Representation	Age-Level Set			
	Younger	Middle	Older	Mean
Study 1				
Profile Photograph	3.93	3.96	3.60	3.83
Front Photograph	3.99	3.89	3.56	3.81
Mean	3.96	3.93	3.58	
Study 2				
Profile Photograph	3.78	3.40	3.36	3.51
Front Photograph	3.88	3.70	3.70	3.74
Mean	3.83	3.55	3.54	

Figure 1. Mean attractiveness ratings: Study 1.

from younger to older, .57, .40, and .43. With the reduced degrees of freedom, only the first is significant at the .05 level.

STUDY 2

Method

Stimuli. For each of 11 males and 11 females, three profile photographs were selected from the Denver collection. The criteria for selection were that the print quality be good, that the face show a relaxed neutral expression, and that the camera position appear to be nearly 90 deg from the direct front view. The last criterion was included to avoid distortion when the silhouette profile was made. This additional criterion meant that the stimulus people and ages did not entirely overlap those used in Study 1. About 50% of the profiles used in Study 1 were used again in Study 2. The median ages of the three age-level sets were 4-0, 8-7, 16-8.

As before, hair and clothes were masked and 35-mm slides were prepared. For each profile, the face was projected onto a screen and viewed following the profile contour was drawn from the hair line to the first few inches of the neck. The resulting line silhouettes were photographed to project as black lines on a white background at approximately the same size as the profile photographs.

Design and Procedure. The design and procedures used in Study 1 were repeated. Subjects rated the faces on the 7-point scale and viewed both the photographs and silhouettes of all 22 people at one age level. The two representations were blocked, and two random orders were used, as before. One hundred and fifty-six new introductory psychology students participated. There were at least 10 subjects in each of the 12 groups.

Results

In the analysis of variance, all main effects and interactions were significant at the .001 level, except for the Representation by Age interaction, which was significant at the .05 level. As in Study 1, the Representation by Stimulus Person interaction shows that the aesthetics of the two representations were not entirely equivalent across people. The scatterplot presented in Figure 2 shows that the aesthetic equivalence of the two representations varied widely among individuals. The differences were, however, generally not as large as those in Study 1. This can be seen both by comparing the two figures and by comparing correlation coefficients. The product-moment correlation coefficient over all 60 pairs was $r = .67$. For the age-level sets, from younger to older, the coefficients were .64, .74, and .68. These were all significant at the .01 level.

Since the silhouettes and profile photographs are variants of the same view, it is not surprising that they are aesthetically more similar than profile and front views. However, the profiles and their corresponding silhouettes are still not aesthetically identical. This suggests that the silhouette does not carry all the information for attractiveness available in a profile photograph. Eyes, cheeks, and so on, not visible in the silhouettes are likely to play a strong role in perceived attractiveness. For example, a particular shape of nose that might look unattractive in the silhouette could appear
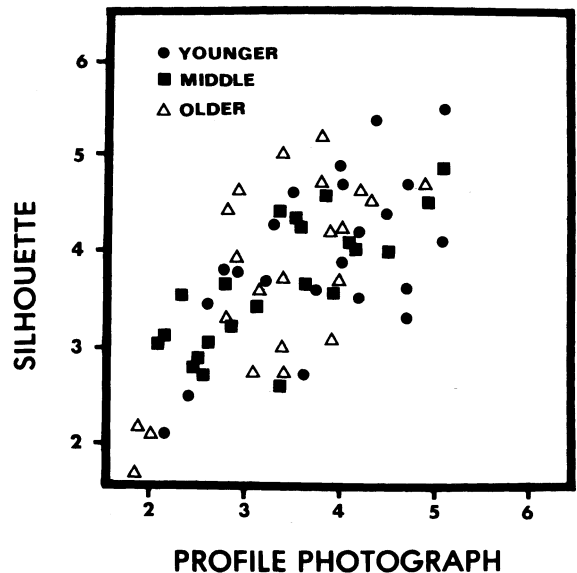

Figure 2. Mean attractiveness ratings: Study 2.

attractive given an appropriate configuration of eyes and cheeks.

In contrast to Study 1, a representation effect and a Representation by Age Level interaction were found. The relevant means are displayed in Table 1. The representation effect shows that silhouettes were typically seen as slightly more attractive than the photographs. The interaction shows that this difference appeared largely in the two older sets. Also note that the sample of photographic profiles in this study was, overall, slightly less attractive than the sample in Study 1.

GENERAL DISCUSSION

In both the comparisons of profile- and front-view photographs and of profile photographs with silhouettes, the aesthetic equivalence of the representations was only partial. The moderate linear relation between the attractiveness ratings in each pair of representations was accompanied by strong differences for numerous individuals. If our aesthetic judgment of another's face is determined by a wide variety of aspects of facial structure, the obtained results are just what would be expected. Different two-dimensional representations will provide information about different facial structures and will therefore be limited in their aesthetic equivalence. In the present studies, the profile and front views portrayed only partially overlapping sets of structures, and the silhouettes showed fewer structures than the corresponding profile photographs.

The values of the correlation coefficients show that there is a moderate overall aesthetic equivalence among the representations tested. However, the scatterplots show that for many individuals, the different representations are far from equivalent. It seems reasonable to suppose that the socially effective attractiveness of an individual comes from seeing the face in three dimensions and as it changes expression over time. The results of the present studies suggest that neither front or profile photographs nor profile silhouettes can serve as the basis for a physical metric that fully captures attractiveness. Whether or not use of multiple two-dimensional representations will suffice to solve the problem is unknown. It may be necessary to use

three-dimensional, perhaps even dynamic, representations to develop a general, clinically applicable set of measures linking the physical structure of the face with its perceived attractiveness.

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