The information conveyed by varying the dimensions of features in human outline faces

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Outline drawings of human faces were presented for rating as to a number of dichotomous attributes, while the dimensions of the four constituent features were varied systematically. It was found that people act in a regular and predictable fashion in attributing characteristics to certain of these features. When independently significant features appear in combination, there is a lawful increase in such characterizing responses. Subsidiary findings related to a halo effect between certain attributes, differential employment of some attributes, and a difference in overall strength of effect between certain features.

The human face is largely unique in its dual role of communication and identification. Variations in the relative positions of the various components or features assist both functions, both of which involve information transmission.

The question of facial identification relates particularly to problems of pattern recognition. Other aspects include the innateness/learning problem, stimulus importance and meaning, and part-whole configurations. For example, Hershenson et al (1967) studied the orienting response of human neonates to outline face drawings, both normal and scrambled.

The role of the face in communication, moreover, can be studied within two further contexts. Problems of person-perception proper occupy one field of study, while related to this are questions as to how we operate when attempting to judge a person's character from his features. These approaches overlap in, for example, the studies of Secord (1958). The face was seen to reflect or conceal emotional states, desires, feelings, and intentions. As a result, people tended to have certain judgmental stereotypes, relating features to character differences. Examples included bowed lips and conceit, thick lips and feminine sexuality, high foreheads and intelligence.

Similar studies were reviewed earlier by Sheldon and Tucker (1940), where in general no correlation was found between such judged traits and independent assessments. Nevertheless, prior to this, Brunswik and Reiter (1937) found consistencies in judgments of intelligence, age, and character when Ss viewed outline drawings of faces with alterations in the dimensions of certain features. Brooks and Hochberg (1960) looked at the effects of altering eye position on judgmental qualities such as cuteness. Similarly, Secord and Muthard (1955) examined the extent to which such factors as grooming, the wearing of glasses, and lip thickness affect the judgment of traits. The question remains of the extent to which such findings can carry over from schematic drawings to real-life situations (cf. Samuels, 1939).

Brunswik and Reiter (1937) in their study had varied eye-width, brow-height, and nose and mouth positions in their outline drawings of faces. Judgments were made for intelligence, mood, occupation, age, etc., using a non-English-speaking population. In view of the comparative inaccessibility of this pioneer study, the need to use more systematically varying stimuli, and possible alternative approaches in quantifying and comparing the data, a similar experiment was performed. It was hoped to be able to determine the extent to which human Ss could process various feature combinations in an informational sense. That is to say, if certain features were found independently to affect

judgments about attributes, what happened when they appeared in combination?

METHOD

Outline faces were constructed with systematically varying features, such that the eyes could be far apart or close together, high or low. The nose could be long or short and the mouth wide or narrow. Two extreme examples are given in Fig. 1. This provided a total of 16 possible combinations (2^4). In all cases the distance between the bottom of the nose and the mouth, and the top of the nose and the axis of the eyes was kept constant. Varied eye-height meant shifting all the features up or down the face and was in fact particularly reflected in forehead height. These stimuli were drawn from prepared templates onto cards, the vertical axis of the face measuring $4\frac{1}{4}$ in., the rest being to scale as shown in Fig. 1.

The Ss were 41 first-year psychology students, 27 males and 14 females. The cards were shuffled and arranged in a closed, hollow square upon a board. In the center of the board were written the seven dichotomous attributes or dimensions for judgment: male/female, young/old, happy/sad, stupid/clever, mean/generous, trustworthy/untrustworthy, wise/foolish. Each card had to be rated dichotomously for all seven attributes. The Ss were encouraged to start at any point on the square and work systematically around. It was considered important that all 16 examples continue to be present throughout so that a comparison could be made in each case against all other members of the ensemble. In Table 1 can be seen the scheme of the features and the card identification number.

The seven attributes for rating were chosen somewhat arbitrarily. Two attributes, age and sex, were thought to be the two most common objective dimensions whereby we categorize each other. The other five were thought to be frequently used judgments relating to personality characteristics. Despite their overt similarity, it was thought that the implied difference between stupid/clever and wise/foolish, in terms of intelligence vs knowledge, might prove of interest. It was considered probable that there would be further overlaps, or halo effects, between other attributes.

Fig. 1. Examples of two outline faces, one with eyes low, eyes wide, nose long, and mouth narrow, and the other with converse features.

Table 1
Summarized Schema of the Features of the 16 Different Stimulus Cards,
Together with Identification Number

1	Eyes High	Eyes Wide	Nose Short	Mouth Narrow
7	Eyes High	Eyes Wide	Nose Short	Mouth Wide
6	Eyes High	Eyes Wide	Nose Long	Mouth Narrow
15	Eyes High	Eyes Wide	Nose Long	Mouth Wide
10	Eyes High	Eyes Narrow	Nose Short	Mouth Narrow
9	Eyes High	Eyes Narrow	Nose Short	Mouth Wide
3	Eyes High	Eyes Narrow	Nose Long	Mouth Narrow
5	Eyes High	Eyes Narrow	Nose Long	Mouth Wide
8	Eyes Low	Eyes Wide	Nose Short	Mouth Narrow
12	Eyes Low	Eyes Wide	Nose Short	Mouth Wide
16	Eyes Low	Eyes Wide	Nose Long	Mouth Narrow
13	Eyes Low	Eyes Wide	Nose Long	Mouth Wide
14	Eyes Low	Eyes Narrow	Nose Short	Mouth Narrow
11	Eyes Low	Eyes Narrow	Nose Short	Mouth Wide
2	Eyes Low	Eyes Narrow	Nose Long	Mouth Narrow
4	Eyes Low	Eyes Narrow	Nose Long	Mouth Wide

RESULTS

Table 2 presents the totals, over the 16 stimulus cards and 41 Ss, for the seven attributes. Data for only one of each pair is provided as the pair taken together sums to 41. It can be seen that in no category is there an even distribution of scores; overall, there are more allocations to male than to female, more to young than to old, etc. There is, in fact, a descending order of imbalance from wisdom, through sex, stupidity, trustworthiness, happiness, and generosity, to age. Reference to the normal approximation to the binomial probability distribution indicates that all these imbalances are statistically significant at $p < .05$.

Table 3 presents the totaled raw scores of each of the two members of each feature pair when broken down by attribute. From these, the differences are calculated by subtraction. This figure is the same irrespective of whether it is calculated upon, say, total male scores or total female scores. An indication is also given when this difference between the two distributions of scores reaches significance. Use was made of the fact that when an expected and an obtained score in a binomial distribution differ by a certain number of standard deviations, the significance of that difference can readily be obtained by reference to a table of the probability integral.

It can be seen that eye-height, that is, forehead-height, contributes most, and eye-width least, to the Ss' perception of

attributes. Similarly, there is a descending order of magnitude, starting at happiness, passing through generosity, age, sex, trustworthiness, stupidity, and ending at wisdom, with the perceived attributes. Together, these two trends would imply that eye-height and happiness interact the most strongly and eye-width and wisdom the least. The negative sign in the differences can be made to disappear, as in Table 4, by reversing the polarity of either the feature or the attribute.

Consequently, in Table 4 are presented those difference scores which were found significant in Table 3, together with one attribute (stupid) which is presented for comparison, as none of its components were found significant. The difference scores are presented in three columns, labeled 8,8 cards, 4,4 cards, and 2,2 cards. In the first column, the total difference scores obtained from Table 3 are corrected for number of contributing cards. As single features are being individually compared, there were two sets of eight relevant cards, one set containing the particular feature (e.g., eyes high) and one set containing the converse (eyes low). Consequently, a difference score corrected for number of contributory cards is obtained by dividing the original score by 8.

Similarly, in the second column, the combined effect of two independently significant features is presented (e.g., eyes high together with nose short). The difference score is now derived from two sets of four cards, instead of eight. Consequently, a correction is applied by dividing the obtained total difference score by 4.

When three features independently signify an attribute, their isolated corrected difference scores appear in the first column, their combined effects taken two at a time appear in the second, and their combined effects, taken all three together, appear in the third. By now, of course, there are only two cards which contain all three relevant features and two which contain their converse. Consequently, the total difference score for these two cards is corrected by dividing by 2. As the figures indicate, these two cards are the most powerful indicators of the particular feature as they contain all the relevant features together. There is no 1,1 card category in Table 3 as in no case was eye width found to indicate significantly any attribute.

Figure 2 graphs the averaged points obtained from each grouping in Table 4. Also given are the three theoretical plots which would be obtained were human Ss perfectly systematic in their responses to combinations of features. A theoretical 4,4 plot is calculated, even though none were found

Table 2
Raw Scores; for Each Attribute, only One of Each Complementary Pair is Given,
as Each Pair Sums to 41

Card	Male	Young	Happy	Stupid	Generous	Trustworthy	Wise
1	30	30	34	30	25	25	12
7	27	29	40	34	38	30	8
6	14	29	19	16	18	24	26
15	36	13	18	26	26	21	18
10	20	21	31	27	24	23	16
9	32	16	37	28	31	24	10
3	24	30	24	11	18	26	28
5	32	25	29	22	32	28	15
8	12	32	17	9	30	30	24
12	22	22	20	12	29	24	22
16	17	16	0	27	11	23	12
13	28	9	4	29	10	14	9
14	12	35	21	18	21	25	18
11	25	18	6	22	18	11	18
2	31	12	0	23	9	15	18
4	23	12	0	32	11	16	14
Sum	385	349	300	366	351	359	268
Complementary	271	307	356	290	305	297	388
Mean 328	Total 656

Fig. 2. Graph of possible and actual difference scores, corrected for number of stimulus exemplars, when two or more features together characterize an attribute.

empirically. These were calculated on the assumption that, for example, with three relevant features the following situation would obtain. When all three features were present together, all 41 Ss would assign the appropriate attribute to that card. When all three features were absent, that is, present in converse form, all 41 Ss would assign the converse of the attribute to that card. When two of the three features were present, and one was opposed, the score would be reduced by one-third, and so on, on a pro rata basis. This makes two assumptions. One is that all features would contribute equally, if at all, towards an attribute. Reference to Table 4 shows that this is not strictly true. The second assumption is that the population of scores would reflect the individual's level of uncertainty. That is to say, given the presence of two out of three features, an individual would be two-thirds tempted to opt for that particular attribute, and this would be reflected in

the total distribution of scores. The evidence from Fig. 2 strongly supports this view. The theoretical plot shows that every time the number of comparison cards is halved, the original corrected difference score as at 8.8 should be given a constant increment. This increment, equal to the original score at 8.8, is itself determined by the total number of features which can together characterize that attribute. The empirical data can be seen to follow this rule exactly. The only exceptions are a drop in the 2,2 figure for young, and the nonsignificant curve for stupid, which was merely provided for comparison. Thus, as the information in the stimulus increases through combination of relevant features, there is a corresponding linear increase to be seen in the corrected difference scores.

In Table 5 evidence can be seen of a strong "halo effect." It was considered possible that when a S had, for example, attributed "young" to a stimulus, this would tend to induce related judgments of "happy," "generous," etc., rather than "sad" and "mean." Consequently, the data from each S were analyzed for all 21 possible attribute-pairs into the number of instances of, for example, male/old, female/young vs male/young, female/old. In Table 5 both the observed scores and the expected chance scores are given, the latter obtained by calculation from the ratios given at the bottom of Table 2. In Table 5 only the data for half the combination are given, viz male/old, female/young, instead of also male/young, female/old. For the latter halves, data can be obtained by subtraction from 656. It can be seen that the score for the greater half has been given in each case, i.e., the score that indicates the direction of the halo effect. It is evident that the effect is quite strong; young is linked with happy, generous, trustworthy, and wise at a significant level. Young/clever just fails to reach significance. Happy is linked with generous and trustworthy, stupid with untrustworthy and foolish, generous with trustworthy, and trustworthy with wise.

Finally, in view of the possibility that the imbalance of the sexes among the Ss might have influenced the distribution of some of the scores, a comparison was made between the distributions of the male/female attribute among the male and female Ss. The average number of times female was used by the 14 female Ss proved to be 6.51. With the 27 male Ss, the figure was scarcely different at 6.66.

DISCUSSION

In general, it would seem that people act in a fairly regular and statistically predictable way in attributing characteristics

Table 3
Raw Differences and Their Significance, by Feature and Attribute. The Difference is the Same Irrespective of whether it is Calculated upon the One or the Other of the Complementary Pair which Comprise the Attribute.

	Male	Young	Happy	Stupid	Generous	Trustworthy	Wise	Mean Difference
Eyes High	215	193	232	194	212	201	133	regardless of sign 55.14
Eyes Low	170	156	68	172	139	158	135	
Difference	45*	37*	164**	22	73**	43*	2	
Nose Short	180	203	206	180	216	192	128	45.43
Nose Long	205	146	94	186	135	167	140	
Difference	-25	57**	112**	-6	81**	25	-12	
Mouth Narrow	160	205	146	161	156	191	154	40.00
Mouth Wide	225	144	154	205	195	168	114	
Difference	-65**	61**	-8	-44*	-39*	23	40*	
Eyes Wide	186	180	152	183	187	191	131	11.43
Eyes Narrow	199	169	148	183	164	168	137	
Difference	-13	11	4	0	23	23	-6	
Mean Difference Ignoring Sign	37	41.5	72	18	54	28.5	15	

* Significant at $p < .05$, by reference to the binomial probability distribution.

** Significant at $p < .01$.

Table 4
Differences, Corrected for Number of Characterizing Cards, for the Seven
Significantly and for One Nonsignificantly Characterized Attribute.

			8, 8 cards	4, 4 cards	2, 2 cards
Happy	(a)	Eyes High	20.50		
	(b)	Nose Short	14.00	(a)+(b) 34.5	
		Mean	17.25		
Generous	(a)	Eyes High	9.13	(a)+(b) 19.25	
	(b)	Nose Short	10.13	(a)+(c) 14.00	(a)+(b)+(c) 24.50
	(c)	Mouth Wide	4.88	(b)+(c) 15.00	
		Mean	8.05	Mean 16.08	
Young	(a)	Eyes High	4.13	(a)+(b) 11.75	
	(b)	Nose Short	7.13	(a)+(c) 12.25	(a)+(b)+(c) 15.00
	(c)	Mouth Narrow	7.63	(b)+(c) 14.75	
		Mean	6.30	Mean 12.98	
Male	(a)	Eyes High	5.63		
	(b)	Mouth Wide	8.13	(a)+(b) 13.75	
		Mean	6.88		
Wise		Mouth Narrow	5.00		
Stupid		Mouth Wide	5.50		
Trustworthy		Eyes High	5.38		
Stupid	(a)	Eyes High	2.75	(a)+(b) 2.75	
	(b)	Eyes Wide	0.00	(a)+(c) 3.50	(a)+(b)+(c) 1.00
	(c)	Nose Long	0.75	(b)+(c) 0.75	
		Mean	1.17	Mean 2.33	

to certain outline features. Happiness, generosity, and youth, either despite or because of their overlap in a halo effect, are seen to be characterized by a reduced forehead and short nose. Mouth-width appears to have a significant but differential effect. When independently significant features appear in combination, there is a lawful and predictable increase in characterizing responses. This approximates, though falls somewhat short from, the ideal response patterns were human Ss perfectly regular in processing information. Nevertheless, the empirical data was found to fit the theoretical curves remarkably closely. In both cases, the slope of the curves was found to be a function of two factors. One is the total number of features which together can characterize an attribute—the more there are, the lower the origin and the less steep the slope. Related to this is the point that the lower the characterizing value of any features taken singly, then again the lower the origin and the less steep the slope. Indeed, the more operative features there are, the less strongly will each one act in isolation, as there is a greater probability of competition arising from the co-presence of the converse of its fellows. Fundamentally, therefore, the operative strength of the feature determines the slope. This itself can be either the result of interaction with other features or simply the value Ss are found empirically to place upon it. Thus, the curve for stupid is found to be low and flat throughout.

It was noticeable that a very considerable overlap existed between the attributes wise/foolish and clever/stupid, both in terms of the halo effect, and the fact that mouth-width was found to be a significant—the only significant—distinguishing feature in both cases. It was considered a priori likely that there would be this overlap, despite possible conceptual differences. It is difficult, however, to see why there should be this stereotypical linking of mouth-width with wisdom and cleverness. Conversely, the almost universal folk connection between these two attributes and brow-height was completely unsupported. Just as eye-width was found to be completely neutral throughout, eye-height had no effect upon judged intellectual ability. It is of course possible, with eye-width, that its complete lack of characterization was a result of insufficiently drawn differentiation between the two extremes.

A similar lack of confirmation of a popularly held

stereotype was the nonsignificance, and trend relationship only, between trustworthiness and eye-width. The narrow-eyed figure was seen as only marginally less trustworthy than its converse. In fact, the only significant indicator of trustworthiness was eye-height. Stimuli with small brows were seen as just significantly more trustworthy than those with large ones.

A descending order of importance was found, from eye-height down to eye-width, in degree to which they tended to characterize certain attributes. Brunswik and Reiter (1937) found in their study that mouth-width was the most important single feature, while in the present study, though it tied top with eye-height for the greatest number of associated

Table 5
Halo Effects. Observed and Expected Scores for each Pair of Attributes.

	Expected	Observed	
Male Old, Female Young	324	366	**
Male Happy, Female Sad	323	330	N.S.
Male Stupid, Female Clever	335	359	N.S.
Male Generous, Female Mean	332	335	N.S.
Male Untrustworthy, Female Trustworthy	322	343	N.S.
Male Foolish, Female Wise	338	343	N.S.
Young Happy, Old Sad	326	403	**
Young Clever, Old Stupid	326	349	N.S.
Young Generous, Old Mean	329	367	**
Young Trustworthy, Old Untrustworthy	330	369	**
Young Wise, Old Foolish	324	354	*
Happy Clever, Sad Stupid	331	333	N.S.
Happy Generous, Sad Mean	326	437	**
Happy Trustworthy, Sad Untrustworthy	325	405	**
Happy Wise, Sad Foolish	333	334	N.S.
Stupid Mean, Clever Generous	325	339	N.S.
Stupid Untrustworthy, Clever Trustworthy	324	364	**
Stupid Foolish, Clever Wise	335	492	**
Generous Trustworthy, Mean Untrustworthy	330	443	**
Generous Foolish, Mean Wise	332	337	N.S.
Trustworthy Wise, Untrustworthy Foolish	322	350	*

* Difference (d) O-E is significant at $p < .05$ when $d > 25$.

** It is significant at $p < .01$ when $d > 33$, by reference to the normal approximation to the binomial probability distribution.

significant differences, it came third in the scale of overall mean differences. Certainly the mouth is likely to be one of the most decisive facial features in determining our judgments in view of its mobility and use in both verbal and expressive communication.

There is a further problem as to why certain attributes were over-employed with under-employment of their converses. Thus a significant majority of cards were seen representing foolish males who were trustworthy, sad, and generous, in that order of strength. It is possible that a S population consisting of entirely young, student, and predominantly male persons accounts for this. A comparison using a sample drawn from an entirely different population would be worthwhile. Nevertheless, analysis showed that the male and female Ss did not differ in their allocation ratios of the male and female categories where it might be expected that they would be most likely to differ.

With one exception, the halo effect was seen to link together all those attributes likely to be considered good, as separate from all the potentially bad ones. Thus, young, happy, generous, trustworthy, wise, and clever all tended in varying degrees to go together. The one exception, and a highly significant one, linked male with old and female with young. As a further check against the possibility of artifacts arising from the difference in sexes among the Ss, values for male/old, female/young vs male/young, female/old were computed for both male and female Ss. No significant

difference was found, a ratio of 1.27 being obtained with the females and one of 1.31 with the males. Consequently, it must be concluded that both sexes saw male and old, and female and young as going together.

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NOTE

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