AD 658 [illegible]

Group Effectiveness Research Laboratory

DEPARTMENT OF PSYCHOLOGY · UNIVERSITY OF ILLINOIS · [illegible]BANA, ILL.

MULTIMODE FACTOR ANALYSIS OF INTERPERSONAL PERCEPTIONS

EARL E. DAVIS
AND
NADINE NATKER GROBSTEIN
UNIVERSITY OF ILLINOIS

TECHNICAL REPORT NO. 36
DECEMBER, 1966

Communication, Cooperation, and Negotiation in Culturally Heterogeneous Groups
Project Supported by the Advanced Research Projects Agency, ARPA Order No. 454
Under Office of Naval Research Contract NR 177-472, Nonr 1834(36)

FRED E. FIEDLER, LAWRENCE M. STOLUROW, AND HARRY C. TRIANDIS
Principal Investigators

DISTRIBUTION OF THIS
DOCUMENT IS UNLIMITED

D D C
SEP 20 1967
[illegible]

[illegible]

46

GROUP EFFECTIVENESS RESEARCH LABORATORY

DEPARTMENT OF PSYCHOLOGY

UNIVERSITY OF ILLINOIS

URBANA, ILLINOIS

Multimode Factor Analysis of Interpersonal Perceptions

Earl J. Davis

and

Nadine Natker Grobstein

University of Illinois

Technical Report No. 36

December, 1966

Communication, Cooperation and Negotiation
in Culturally Heterogeneous Groups

Project Supported by the

Advanced Research Projects Agency, ARPA Order No. 454
Under Office of Naval Research Contract NR 177-472, Nonr 1834(36)

Fred E. Fiedler, Lawrence M. Stolurow, and Harry C. Triandis
Principal Investigators

DISTRIBUTION OF THIS
DOCUMENT IS UNLIMITED

Multimode Factor Analysis of Interpersonal Perceptions

Earl E. Davis and Nadine Natker Grobstein

University of Illinois

ABSTRACT

Data resulting from the interpersonal perceptions of 88 students who were heterogeneous with respect to race and sex were subjected to a variety of analyses, including Tucker's three-mode factor analysis procedure. Ss responded on Semantic and Behavioral Differential scales to complex person stimuli designated in terms of race, sex, and other characteristics which formed a factorial design. The data were reduced to a two-way classification of scales-by-stimuli, using Ss' mean group responses, and conventional factor analyses of scales were performed. Analyses of variance were carried out to determine the relative weights of the stimulus factors in determining the responses of the various groups of Ss on the scale factors. Finally, the three modes of the data classified in terms of scales-by-stimuli-by-subjects were subjected to Tucker's three-mode factor analysis. After obtaining principal axis factors for the three modes, the scale and subject mode factors were rotated by Varimax and the stimulus mode factors were transformed by means of discriminant function analysis. Counter-rotations of the three modes yielded a core matrix linking the scale factors to the stimulus factors. Although not all of the subject types were clearly interpretable in the present study, this type of analysis, with some modifications, would appear to have great potential value in treating complex interpersonal perception data.

Multimode Factor Analysis of Interpersonal Perception[1]

Earl E. Davis[2] and Nadine Natkar Grobstein[3]

University of Illinois

INTRODUCTION

The present report describes the treatment by means of both conventional and multimode factor analytic techniques of data pertaining to the social perceptions of subjects who may be considered to be culturally heterogeneous with respect to each other. A group of people is usually said to be culturally heterogeneous when certain background characteristics of its members cause them to differ systematically with respect to their attitudes, values, norms of behavior, etc. The typical background characteristics which are thought of as being associated with such differences are national-geographic origin, language, religion, or similar ethnic characteristics. However, a broader view of culture would define any group as culturally heterogeneous to the extent that its members differed in any characteristics which would lead to or be associated with different ways of thinking about and evaluating relevant aspects of reality. Thus, a group may be considered culturally heterogeneous if its members differ with respect to any of a wide range of characteristics such as social class, occupation, sex, race, religion, age, degree of urbanization, etc. -- assuming that these differences are, in fact, related to different ways of thinking about and evaluating relevant aspects of reality.

---

[1]This study was supported by ARPA Order No. 454, Contract Nr177-472, Nonr 1834(36) with the Advanced Research Projects Agency and the Office of Naval Research to study "Communication, Cooperation and Negotiation in Culturally Heterogeneous Groups" (F.E. Fiedler, L.M. Stolurow, and H.C. Triandis, Principal Investigators). The authors are indebted to Ping Koo for her expert aid in programming the analyses; to E. Thomanek and Mary Rudsinski for assistance in processing the data; and to H.C. Triandis and L.R. Tucker for their invaluable advice and patience.

[2]Now at the Graduate Faculty of the New School for Social Research.

[3]Now with the Department of Welfare of the City of Chicago.

In the present study subjects who differed with respect to race (Negro-white) and sex (male-female) responded to imaginary social stimuli which were designated in terms of various combinations of race, sex, and other characteristics. Whether the subjects' differences in race and sex mean that they constitute a "culturally heterogeneous" group, in the sense indicated above, is an empirical question, the determination of which was one of the purposes of this study. The criterion will be whether or not these differences are related to different ways of thinking about and evaluating relevant aspects of reality, and in particular to different interpersonal perceptions when the stimuli involved are described in terms of ethnic and other social characteristics which have been found to be important determinants of interpersonal perception in much previous research.

The responses along different dimensions, by subjects belonging to different categories, to stimuli designated by various combinations of socially relevant characteristics, constitute a three-way classification of data. The procedures of conventional factor analysis are applicable only to data which form a two-way classification, for example, to matrices of subjects by responses. The treatment of the present data matrix, which is a three-way classification of responses by stimuli by subjects, by means of conventional factor analytic procedures is only possible if the data are reduced in some way to a two-way classification. For example, semantic differential data are typically reduced to a concept by scale matrix, obtaining means of groups of subjects (Osgood, Suci, and Tannenbaum, 1957). The problems involved in reducing semantic differential data in this manner are discussed in detail by Osgood (1962). Behavioral differential data are also usually reduced to a two-way classification in the same manner (Triandis, 1964). Some of the methodological problems involved in factoring

semantic and behavioral differential responses obtained from members of different sub-cultures are discussed by Davis (1966).

The mathematical problems of the simultaneous analysis of all three modes of data which form a three-way classification and of examining the relationship among the corresponding factors has been solved by L. R. Tucker (1964b, 1965). A major purpose of the present study was to explore the application of three-mode factor analysis to data representing a three-way classification of responses by stimuli by subjects. The present data were collected earlier by the second author (Natker, 1964) and were first subjected to conventional factor analysis by reducing the data in the usual way. Also, analyses of variance were performed in order to examine the relative importance of various stimulus person characteristics in the determination of the variance on each factor. Some of these factor analytic and analysis of variance results will be presented here in order to familarize the reader with the data. Finally, the results of the three-mode factor analysis of the data will be presented and discussed.

METHOD

Subjects

A total of 88 undergraduate students at the University of Illinois (Urbana) were asked to fill out a questionnaire which required approximately one hour to complete. The Ss varied with respect to race and sex as follows: 25 Negro males, 21 Negro females, 21 white males, and 21 white females. The questionnaire was administered to the white Ss by a white experimenter of the same sex as themselves, and it was administered to the Negro Ss by a Negro experimenter of the same sex as themselves.

Questionnaire

The main part of the questionnaire was designed to obtain the Ss' ratings of a number of complex person stimuli on a set of twenty scales made up of

fifteen behavioral differential (BD) scales taken from Triandis (1964) and five semantic differential (SD) scales taken from Osgood et al. (1957).

The complex person stimuli were described at the top of each page in terms of the five stimulus factors of race, religion, skin color, sex, and occupation. The two levels of race (Negro-white), three levels of religion (Christian-Jewish-Moslem), two levels of skin color (dark-light), two levels of sex (male-female), and two levels of occupation (medical student-laborer) constituted a 2x3x2x2x2 factorial design. However, since this complete design would have required 48 stimulus persons and thus would have made the questionnaire too long, certain stimulus combinations were eliminated. Twenty-eight complex stimuli were retained, constituting two overlapping factorial designs. In a twenty-four cell design, race, skin color, sex, and religion were varied while status was kept constant; and in a sixteen-cell design, race, skin color, sex, and status were varied while religion was kept constant.

One stimulus combination that was of particular interest was that of "Negro-Moslem." In the introduction to the questionnaire, it was explained that each major religion had many subdivisions and examples of these were given. One of the examples included was that of the Black Muslims as a subdivision of the Moslem faith. It was the intent of the investigators that the Ss would associate the stimulus "Negro-Moslem" with the Black Muslims and rate the stimulus accordingly. In order to determine whether or not the Ss had knowledge of the Black Muslims, a section entitled "Current Events Test" was included in the questionnaire. This test contained twenty questions, five of them relating to the Black Muslims.

ANALYSES AND RESULTS

Factor Analysis of Scales

A conventional factor analysis of the twenty BD and SD scales was performed separately for each of the four groups of subjects. Summing over Ss and correlating over stimulus persons, a 20x20 correlation matrix of scales was obtained and factored. Using the criterion of Eigenvalues equal to or greater than one, three principal axis factors were extracted and rotated by the Varimax method. The factor structures of the scales were quite similar for the four samples. To the extent that there were differences, the Negro males tended to differ somewhat from the other three samples. However, in light of the similarity of the factor structures, and for purposes of comparability, the same scales were selected as representative of each of the three factors for all four groups. The criterion of selection was a factor loading of greater than .70 for at least three of the four groups; in most cases the criterion was met for all four groups.

Table 1 presents the Varimax rotated factor loadings of the twenty scales for all four samples; the highest loading scales are indicated by an asterisk. An inspection of the factor loadings of the BD scales on the first factor shows a clear emergence of the Formal Social Acceptance with Subordination Factor obtained by Triandis (1964) in his original study. In addition, all five SD scales loaded on this factor. This tendency for BD scales belonging to the Formal Social Acceptance Factor and SD scales belonging to the evaluative factor to load together on a common factor has been observed in numerous studies (Fishbein, 1964).

Table 2 presents the loadings for Factor II for all samples. An inspection of the highest loading scales on this factor makes the interpretation of Social Distance with Friendship Rejection quite clear. The tendency for Social Distance and Friendship Rejection, which had formed

Table 1

Varimax Rotated Factor Loadings of 20 BD and SD Scales for All Four Samples

Factor I: Social Acceptance with Subordination Plus Evaluation

	Scale	Sample			
		Negro Females	Negro Males	White Females	White Males
BD SCALES	1. Invite to my club	.48	.49	.48	.36
	*2. Admire the character of	.56	.87	.94	.79
	3. Exclude from my neighborhood	-.47	-.19	-.26	-.28
	4. Go out on a date with	.16	.01	.16	.01
	5. Accept as close kin by marriage	.16	.11	.03	.17
	6. Fall in love with	.11	.04	.12	.01
	7. Treat as an equal	.62	.50	.72	.61
	8. Accept as an intimate friend	.32	.33	.40	.35
	*9. Admire the ideas of	.79	.82	.92	.74
	*10. Treat as a subordinate	-.82	-.69	-.74	-.77
	11. Eat with	.32	.15	.35	.34
	*12. Elect to political office	.84	.83	.80	.70
	*13. Be commanded by	.81	.81	.92	.66
	14. Prohibit from voting	-.48	-.19	-.02	-.58
	15. Marry	.14	.01	.17	.02
SD SCALES	*16. Foolish-Wise	.92	.94	.98	.95
	*17. Weak-Strong	.87	.70	.86	.74
	*18. Bad-Good	.86	.90	.90	.77
	*19. Excitable-Calm	.83	.89	.91	.92
	*20. Dirty-Clean	.86	.91	.92	.86

* Scales which describe this factor

Table 2

Varimax Rotated Factor Loadings of 20 BD and SD Scales for All Four Samples

Factor II. Social Distance with Friendship Rejection

	Scale	Sample			
		Negro Females	Negro Males	White Females	White Males
BD SCALES	*1. Invite to my club	-.83	-.76	-.86	-.88
	2. Admire the character of	-.70	-.08	-.20	-.49
	*3. Exclude from my neighborhood	.77	.82	.90	.92
	4. Go out on a date with	-.21	-.12	-.21	-.29
	*5. Accept as close kin by marriage	-.93	-.86	-.93	-.92
	6. Fall in love with	-.07	-.14	-.26	-.24
	7. Treat as an equal	-.68	-.55	-.60	-.72
	*8. Accept as an intimate friend	-.90	-.79	-.88	-.88
	9. Admire the ideas of	-.54	-.45	-.32	-.61
	10. Treat as a subordinate	.32	.29	.55	.56
	*11. Eat with	-.83	-.38	-.87	-.88
	12. Elect to political office	-.22	-.38	-.34	-.52
	13. Be commanded by	-.45	-.33	-.18	-.57
	14. Prohibit from voting	.36	.04	.47	.59
	15. Marry	-.06	-.12	-.27	-.27
SD SCALES	16. Foolish-Wise	-.14	-.17	-.10	-.23
	17. Weak-Strong	-.31	-.43	-.09	-.21
	18. Bad-Good	-.38	-.32	-.23	-.47
	19. Excitable-Calm	-.41	-.24	-.15	-.05
	20. Dirty-Clean	-.33	-.22	-.27	-.35

* Scales which describe this factor

separate factors in the original Triandis (1964) study, to merge has been demonstrated in previous studies (e.g., Davis and Triandis, 1965).

Finally, Table 3 presents the loadings for Factor III which is clearly interpretable as a Marital Acceptance Factor and is the same Marital Factor as the one obtained in the Triandis (1964) study.

Analyses of Variance

The highest loading items on each of the three factors were summed together to yield a composite score. Thus, a factor composite score was computed for each complex stimulus. These scores were used in the computation of analyses of variance.

The twenty-eight stimulus persons presented in the questionnaire constituted two overlapping factorial designs. We will consider first the sixteen-cell design, in which skin color, occupational status, race, and sex were varied while religion was kept constant. Table 4 presents the results of the analysis of variance in terms of the percent variance accounted for by the four stimulus factors and their interactions in the sixteen-cell design for Scale Factor I, for all four samples. The results obtained from the four samples are strikingly similar. For Factor I--Social Acceptance with Subordination plus Evaluation--occupation was by far the most important determinant for all four groups; race was second in significance, though least so for Negro males. Both Negro and white males considered sex of some significance on this factor. As a separate stimulus factor, skin color played almost no role for most of the Ss, except for white females for whom it was of small but slight significance ($p < .05$--in all cases the third and fourth order interactions were pooled as an error term on the basis of which the F ratios were computed).

Table 3

Varimax Rotated Factor Loadings of 20 BD and SD Scales for All Four Samples

Factor III: Marital Acceptance

	Scale	Sample			
		Negro Females	Negro Males	White Females	White Males
BD SCALES	1. Invite to my club	.12	.06	.11	.26
	2. Admire the character of	.15	.16	.02	.27
	3. Exclude from my neighborhood	-.32	-.00	-.26	-.22
	*4. Go out on a date with	.96	.98	.94	.95
	5. Accept as close kin by marriage	.22	.23	.29	.32
	*6. Fall in love with	.98	.98	.95	.96
	7. Treat as an equal	.14	.09	.02	.09
	8. Accept as an intimate friend	.05	.14	.05	.30
	9. Admire the ideas of	.07	.07	/01	.20
	10. Treat as a subordinate	-.04	-.25	-.11	-.11
	11. Eat with	.08	.08	.18	.25
	12. Elect to political office	.25	.24	.37	.39
	13. Be commanded by	.27	.26	.20	.36
	14. Prohibit from voting	-.24	-.37	-.31	-.04
SD SCALES	*15. Marry	.97	.98	.93	.95
	16. Foolish-Wise	.01	.01	.05	.03
	17. Weak-Strong	.26	.50	.37	.41
	18. Bad-Good	.03	.06	.06	.37
	19. Excitable-Calm	.17	.30	.20	.33
	20. Dirty-Clean	.03	.13	.01	.32

* Scales which describe this factor

Table 4

Analysis of Variance

16 Cell Design

Factor I: Social Acceptance with Subordination Plus Evaluation

Source	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=21)
Skin Color (SC)	0.73	0.03	1.27*	0.33
Occupation (O)	73.33*	90.01**	85.18**	68.23**
Race (Ra)	24.07**	4.75**	9.89**	24.17**
Sex (S)	0.06	2.04*	0.08	4.97**
Interactions:				
SC x O	0.04	0.02	0.06	0.01
SC x Ra	0.14	0.21	0.51	0.14
SC x S	0.06	1.31*	0.00	0.12
O x Ra	0.68	0.13	1.49*	1.05*
O x S	0.00	0.47	0.00	0.07
Ra x S	0.18	0.15	0.86	0.40

* $p < .05$

** $p < .01$

Table 5 presents the results of the analysis of variance for Factor II--Social Distance with Friendship Rejection. Here, as might be expected on the basis of past studies (Triandis and Triandis, 1960; Triandis and Triandis, 1962; Triandis, Davis and Takezawa, 1965; Triandis and Davis, 1965), race is by far the most important determinant, with occupation of secondary importance. It is interesting to note, however, that race is of greater importance for white Ss than for Negro Ss. Of the four groups, it is most important for the white males and least important for the Negro males. It is also interesting to note that for both Negro and white females sex is a small but significant determinant of Social Distance with Friendship Rejection.

Table 6 presents the results of the analysis of variance for Factor III--Marital Acceptance. Sex is, of course, the most important determinant of this factor for all four groups. However, in the case of this factor the differences between the four samples become most striking. For white Ss, both males and females, sex accounts for roughly 40% of the variance, whereas race plus the race by sex interaction accounts for more than 50% of the variance. For Negro Ss race is relatively much less important, although it is somewhat more important for Negro females than for Negro males. For the latter group, race accounts for less than one percent of the variance.

Analyses of variance were also performed for all three factors and for all four samples in the second parallel design with 24 cells. Here, skin color, religion, race, and sex were varied while occupational status was held constant.

Table 7 presents the analysis of variance results for Factor I for this design. Again, the results for the four samples were roughly comparable, although once more Negro males stand apart in attributing relatively least importance to race. For all four samples, religion, in the absence of occupational status, accounts for the largest percent of variance. Race is

Table 5

Analysis of Variance

16 Cell Design

Factor II: Social Distance with Friendship Rejection

	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=21)
Skin Color (SC)	0.04	3.68	3.12**	0.51
Occupation (O)	14.55**	26.51**	9.02**	5.33**
Race (Ra)	78.19**	57.33**	85.33**	93.03**
Sex (S)	3.42**	2.00	1.50**	0.07
Interactions:				
SC x O	0.06	0.06	0.04	0.32
SC x Ra	0.07	0.14	0.64**	0.12
SC x S	0.13	0.00	0.00	0.15
O x Ra	0.06	0.00	0.00	0.00
O x S	1.05*	0.22	0.10*	0.05
Ra x S	1.71*	3.81	0.16*	0.20

* $p < .05$

** $p < .01$

Table 6

Analysis of Variance

16 Cell Design

Factor III: Marital Acceptance

Source	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=21)
Skin Color (SC)	0.00	0.00	1.80	0.06
Occupation (O)	4.98**	0.23*	1.75	0.29
Race (Ra)	18.29**	0.66**	26.27**	27.90**
Sex (S)	64.58**	98.21**	39.34**	44.33**
Interactions:				
SC x O	0.05	0.00	0.02	0.01
SC x Ra	0.00	0.01	1.22	0.08
SC x S	0.04	0.01	1.09	0.06
O x Ra	1.55*	0.00	0.64	0.19
O x S	1.77*	0.13*	1.35	0.17
Ra x S	8.18**	0.66**	24.82**	26.59**

* $p < .05$

** $p < .01$

Table 7

Analysis of Variance

24 Cell Design

Factor I: Social Acceptance with Subordination Plus Evaluation

Source	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=21)
Skin Color (SC)	0.01	0.22	2.00*	0.32
Religion (Re)	44.71**	52.47**	62.94**	49.58**
Race (Ra)	34.54**	7.75*	13.65**	29.98**
Sex (S)	0.16	7.09*	7.04**	16.08**
Interactions:				
SC x Re	2.11**	1.28	1.24	0.07
SC x Ra	0.07	1.12	4.50**	0.24
SC x S	0.09	5.93*	0.02	0.03
Re x Ra	15.13**	4.87	1.63	1.77**
Re x S	0.77	12.21*	1.64	0.28
Ra x S	0.12	0.16	1.87	0.05

* $p < .05$

** $p < .01$

second in importance, although least so for Negro males. Sex is also of some importance for all samples, except for Negro females. Once again, skin color is of no significance except in the case of white females.

Table 8 shows the results for Factor II--Social Distance with Friendship Rejection. Once again race is the major determinant of Social Distance for most subjects, with the exception of Negro males, for whom religion is of greater significance. An inspection of the various cells in the tables of sums, which were used as input for the analyses of variance, reveals that this relatively greater percent variance accounted for by religion for Negro males is based largely on rejection of the stimulus combination "Negro-Moslem" (Black Muslims). It was also the case that, of the four samples of Ss, the Negro males were most informed concerning the Black Muslims, and were thus able to associate this stimulus combination with this group. It is thus apparent that for this particular sample of Negro males (middle to upper-middle class University students) the Black Muslims had no appeal. For all four groups, religion was a significant determinant of Social Distance, both as a primary source and in the religion by race interaction. It is also of interest to note again that for white females, and to a lesser extent for white males, skin color was of some significance.

Table 9 shows the results for Factor III--Marital Acceptance--which are similar to those of the other design. Again, although sex is, of course, the primary determinant, race is of some significance, although least so for Negro males.

Three-mode Factor Analysis

The above results, obtained by reducing the data to a two-way classification, allows some comparisons among groups of subjects based on group means. By collapsing the data to a scale-by-stimulus matrix it was possible to factor the scales separately for the four groups of Ss and to

Table 8

Analysis of Variance

24 Cell Design

Factor II: Social Distance with Friendship Rejection

Source	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=25)
Skin Color	0.04	0.45	3.22**	0.98**
Religion (Re)	17.92**	29.73**	14.38**	14.73**
Race (Ra)	70.82**	22.46**	70.53**	76.32**
Sex (S)	1.29*	9.98*	2.79**	0.10
Interactions:				
SC x Re	0.32	4.66	0.09	0.21
SC x Ra	0.06	0.02	0.34	0.11
SC x S	0.09	0.06	0.00	0.17
Re x Ra	7.15**	19.23*	7.39**	6.34**
Re x S	0.39	2.06	0.17	0.11
Ra x S	0.07	0.41	0.38	0.60**

* $p < .05$

** $p < .01$

Table 9

Analysis of Variance

24 Cell Design

Factor II: Marital Acceptance

Source	% Variance			
	Negro Females (N=21)	Negro Males (N=25)	White Females (N=21)	White Males (N=21)
Skin Color (SC)	0.00	0.00	1.44	0.11
Religion (Re)	2.41**	0.23*	5.26*	1.50**
Race (Ra)	21.00**	0.42**	19.53**	22.04**
Sex (S)	66.96**	98.56**	45.27**	54.23**
Interactions:				
SC x Re	0.09	0.00	0.08	0.00
SC x Ra	0.01	0.00	0.50	0.03
SC x S	0.02	0.02	0.86	0.18
Re x Ra	0.96*	0.04	2.62	1.94**
Re x S	1.38*	0.27*	5.97*	2.84**
Ra x S	5.93**	0.24*	13.19**	13.31**

* $p < .05$

** $p < .01$

inspect the similarities and differences in the obtained factor structures. For the purposes of the original study, the similarities in factor structures were great enough to assume a common factor structure of scales and use the same composite scoring procedure for all four samples. However, some differences in the factor structures could also be observed. Tucker (1951) and Wrigley and Neuhaus (1955) have presented somewhat more systematic techniques for comparing sets of factors than mere inspection. The procedures for computing the coefficient of congruence to measure the degree of factorial similarity between two sets of factor coefficients are described by Harman (1960). These procedures are illustrated by Davis (1966) on the basis of data similar to those in the present study. However, these techniques are unsatisfactory for a number of reasons, not the least of which is the lack of an acceptable mathematical procedure for determining the significance of the coefficients of congruence which are thus obtained.

Once a common factor structure of scales for the four groups of subjects had been assumed, it was possible to make further comparisons of similarities and differences between the four groups with respect to the stimulus factors as determinants of the analyses of variance, as illustrated above. Such similarities and differences are interesting and could be explained on the basis of any number of hypotheses concerning the nature of the four groups of Ss employed. However, the classification of the subjects into four groups according to race and sex was arbitrary. The Ss, although roughly homogeneous with respect to certain background variables, obviously differed with respect to numerous other variables, such as religion, childhood experiences, personality traits, etc. Any one of these other characteristics could have been used as a basis for dividing the Ss into groups, and corresponding comparisons of factor structures of scales and analyses of variance results could have been made. However, this procedure is extremely tedious since there are theoretically a very

large number of variables on the basis of which the Ss could be grouped into categories. The three-mode factor analysis procedure allows for an empirical grouping of the Ss.

As used here, the term "mode" was first employed by Tucker to denote "a set of indices by which data might be classified" (1964b, p. 112). The present data, which constitute a three-way classification of scales by stimuli by subjects, is amenable to the three-mode factor analytic technique developed by Tucker (1964, 1965).

The mathematical procedures involved in three-mode factor analysis have been described in some detail by Tucker (1964b, 1965) and Levin (1965) and will not be described in detail here.

In the present data, the identifying classification for mode 1 will be considered to be the scales on which the subjects rated the stimuli. For purposes of simplicity, we will consider here only the fifteen behavioral differential scales. Mode 2 will be considered as the stimuli which were rated by the subjects. Up to this point, these two modes could be considered as a usual two-dimensional matrix described by a two-way classification of data in terms of scales by stimuli. However, instead of collapsing the subjects' responses to group means, we will consider the individuals who made the responses as mode 3. The rows of this matrix may be taken, then, to represent conceptualized or idealized individuals.

The procedure for factor analyzing this three-dimensional matrix has been described by Tucker (1965a, p. 2) as one "by which allowance can be made for errors of measurement and other influences that affect the measures for each particular combination of variables in mode 1 and mode 2." In discussing the relationship between the three modes, as expressed in the core matrix, Tucker (ibid) further states: "This raises a problem analogous to the communality problem in traditional factor analysis and results in an indeterminancy of the entries in the mode 3 factor matrix. This is analogous

to the factor score problem. The three-factor matrices are tied together by a small core box which gives the relations among the three types of idealized entities." Thus, we will describe the results of the three-mode factor analysis of the present data in terms of the factor matrix for mode 1 (scales), the factor matrix for mode 2 (stimuli), and finally, the core box, showing the relationship between the three modes of scales, stimuli, and subjects.

Mode 1. The Scale Factor Matrix

This first mode deals with the subjects' responses on the 15 behavioral differential scales. Since in the foregoing analyses the five semantic differential scales loaded together with the first major factor of BD scales, we decided to deal only with the BD scales here. This was both to simplify the data and reduce the size of the matrices.

The input data consisted of the matrix of covariances of the subjects' responses to the fifteen BD scales. Five principal axis factors were extracted by the principle components method. An inspection of the characteristic roots showed that there were clearly only three factors which accounted for a significant percent of variance. Accordingly, a factor solution consisting of three Varimax rotated factors was obtained. The factor loadings of the fifteen social variables on the three Varimax rotated factors are presented in Table 10. Since raw covariances were used as input, instead of standard scores, these loadings are in unstandarized form.

An inspection of the factor loadings in Table 10 shows that most of the high loading items are on the first factor. This factor accounts for approximately 60 percent of the rotated variance. The highest loading items on this factor are "would eat with," "would not exclude from my neighborhood," "would treat as an equal," "would elect to political office," and "would accept as intimate friend." Clearly, this is a generalized

Table 10

Mode 1: Matrix of Behavioral Differential Scale Factors

Scales*	Loadings on 3 Varimax Rotated Factors**		
	I	II	III
1. (would not) Invite to my club	-174.6	7.4	35.5
2. (would) Admire the character of	107.6	24.9	-31.0
3. (would) Exclude from my neighborhood	-153.7	-14.3	7.6
4. (would not) Go out on a date with	4.1	169.6	5.3
5. (would) Accept as close kin by marriage	118.1	-46.6	-18.7
6. (would not) Fall in love with	29.9	171.1	8.5
7. (would) Treat as an equal	150.6	41.0	-13.0
8. (would) Accept as an intimate friend	139.1	3.0	-23.3
9. (would) Admire the ideas of	114.5	24.5	-36.0
10. (would not) Treat as a subordinate	138.3	35.6	-7.2
11. (would not) Eat with	-158.4	-40.6	5.8
12. (would) Elect to political office	71.4	-5.5	-93.1
13. (would) Be commanded by	5.4	-17.5	-129.6
14. (would not) Prohibit from voting	158.9	80.1	23.4
15. (would) Marry	-36.6	-170.2	-12.0

* (Designation) indicates direction of high score

** Since covariance rather than z-scores were used, these loadings are not in the normal range of factor loadings based on correlations.

factor of Social Acceptance vs. Social Distance. The second factor, which accounts for approximately 30 percent of the rotated variance, shows high loadings on the items, "would go out on a date with," "would fall in love with," and "would marry," and is clearly interpretable as Marital Rejection vs. Marital Acceptance. The third factor, which accounts for about 10 percent of the rotated variance, has high loadings on the two items, "would be commanded by" and "would elect to political office." Since these loadings are negative, the factor may be described as Non-Subordination vs. Subordination.

Mode 2. The Stimulus Factor Matrix

In the same manner, the covariance matrix of the twenty-eight person stimuli was factored and a principal axis factor matrix of this mode was obtained. Several factor solutions were explored, involving orthogonal rotations by the Varimax criterion. However, these solutions were very difficult to interpret. The variables (person-stimuli) with the highest and lowest loadings did not constitute clearly interpretable poles of a factor. Thus, the stimulus characteristic sex did not constitute a clear factor with males at one end of the pole and females at the other. Instead, one factor emerged with female Caucasians clustered together at one end of the pole and Negroes at the other end. In another case, male medical students clustered together in contrast to female laborers. Other clusterings were even less clearly interpretable. It appeared, therefore, that orthogonal rotation by means of the Varimax criterion was not necessarily the most desirable means of obtaining simple structure for this mode.

As an alternative, the technique of multiple discriminant analysis was utilized. Discriminant analysis is normally used for estimating the position of an individual on a line that best separates classes or groups. This position may be regarded as a linear function of the individual's m test scores.

In our case, the principal axis factor loadings of the twenty-eight stimuli were treated as test scores and discriminant analyses were carried out to determine the extent to which the various stimulus characteristics constituted mutually orthogonal classes or groups with significant discriminant functions.

Multiple discriminant functions may be computed as the vectors associated with the eigenvalues of the determinantal equation

$$W^{-1}A - \lambda I = 0$$

where I = an identity matrix

and W = the pooled within-groups deviation scores cross-products matrix.

In addition, $A = T - W$

where T = the total sample deviation score cross-products matrix.

Thus, A = the among-groups cross-products of deviations of group from grand means weighted by the group sizes:

$$a_{ij} = \sum_{k=1}^{g} N_g(\bar{X}_{ik} - \bar{X}_i)(\bar{X}_{jk} - \bar{X}_j).$$

The eigenvectors v_i which are associated with the eigenvalues λ_i are computed and form a coefficient of the discriminant functions. The normalized vectors may be scaled to show the relative contributions of the variables to the discriminant function by multiplying corresponding elements by the square roots of the diagonal elements of the W matrix. In our case, these scaled vectors were then used to transform the principal axis factor loadings of the stimulus mode in order to obtain rotated factor loadings corresponding more closely to the actual discriminant functions involved.

In order to determine the discriminating power of test scores (in our case, the PA factor loadings) for a given discriminant function, Wilks' lambda criterion may be used. This may be derived as a function of the roots of $W^{-1}A$ as follows:

$$\Lambda = \prod_{i=1}^{r} \left[\frac{1}{(1+\lambda_i)} \right]$$

In the present data, the twenty-eight stimuli represent combinations of five different characteristics. Thus, theoretically there might be five discriminant functions or groups into which the stimuli could be classified. However, for any given number of groups, g, and any given number of test scores, m, the maximum number of discriminants is indicated by the lesser of the two numbers g - 1 and m. Furthermore, it will be recalled from the earlier results with the present data that one of the five stimulus characteristics accounted for no significant amount of variance in the analysis of variance design. This was the characteristic of skin color. For both of the above reasons, only four characteristics were retained as possible discriminant functions. These were race, occupation, religion, and sex. For three of these four discriminant functions, Wilks' lambda criterion yielded an F ratio which was significant beyond the .01 level. For purposes of the present exploratory study, the one characteristic which did not reach statistical significance by this criterion, that of religion, was nevertheless retained.

Tables 11a through 11d present the principal axis factor loadings for the four stimulus mode factors which have been transformed by means of the scaled vectors obtained from the coefficients of the four discriminant functions of race, occupation, religion, and sex.

Table 11a presents the results for Stimulus Mode Factor I: RACE (Caucasian-Negro). This table has been arranged in such a way as to illustrate the fact that this factor is being determined by the discriminant function of RACE. The 28 stimuli have been rearranged by listing them in descending order of the algebraic magnitude of their transformed factor loadings. Thus, stimulus number 13 is listed first because its loading has the highest algebraic value and so on down through stimulus number 12, whose factor loading has the lowest algebraic value. An inspection of the first column of stimulus characteristics shows that this factor is clearly separated by the discriminant function of RACE with stimulus persons who are Caucasian having

Table 11a

Transformed Principal Axis Factor Loadings of Stimulus Mode Obtained from Discriminant Function Analysis

Factor I: Race (Caucasian-Negro)

Stimulus Number	Stimulus Characteristics				Transformed Factor Loading
	Race	Occupation	Religion	Sex	
15.	Cauc.	Med. St.	Chris.	F	.388
17.	Cauc.	Laborer	Chris.	F	.373
19.	Cauc.	Med. St.	Chris.	M	.367
24.	Cauc.	Med. St.	Jew	F	.366
25.	Cauc.	Laborer	Chris.	M	.363
10.	Cauc.	Laborer	Chris.	M	.361
21.	Cauc.	Med. St.	Jew	M	.359
6.	Cauc.	Med. St.	Chris.	F	.354
9.	Cauc.	Med. St.	Jew	F	.351
2.	Cauc.	Laborer	Chris.	F	.347
26.	Cauc.	Med. St.	Jew	M	.343
1.	Cauc.	Med. St.	Chris.	M	.331
27.	Cauc.	Med. St.	Moslem	M	.329
18.	Cauc.	Med. St.	Moslem	F	.325
5.	Cauc.	Med. St.	Moslem	M	.305
28.	Cauc.	Med. St.	Moslem	F	.298
16.	Negro	Med. St.	Chris.	M	.234
11.	Negro	Med. St.	Chris.	M	.221
23.	Negro	Med. St.	Moslem	M	.221
8.	Negro	Laborer	Chris.	M	.220
7.	Negro	Laborer	Chris.	F	.215
3.	Negro	Med. St.	Chris.	F	.214
4.	Negro	Med. St.	Chris.	F	.213
14.	Negro	Laborer	Chris.	M	.205
22.	Negro	Med. St.	Moslem	F	.203
20.	Negro	Med. St.	Moslem	F	.201
13.	Negro	Laborer	Chris.	F	.199
12.	Negro	Med. St.	Moslem	M	.198

Wilks' Lambda = .07590; f = 70.00398; df = 4,23; $p < .01$

Table 11b

Transformed Principal Axis Factor Loadings of Stimulus Mode Obtained from Discriminant Function Analysis

Factor II: Occupation (Medical Student-Laborer)

Stimulus Number	Stimulus Characteristics				Transformed Factor Loading
	Race	Occupation	Religion	Sex	
11.	Negro	Med. St.	Chris.	M	.314
3.	Negro	Med. St.	Chris.	F	.301
4.	Negro	Med. St.	Chris.	F	.296
16.	Negro	Med. St.	Chris.	M	.296
21.	Cauc.	Med. St.	Jew	M	.270
24.	Cauc.	Med. St.	Jew	F	.265
9.	Cauc.	Med. St.	Jew	F	.259
19.	Cauc.	Med. St.	Chris.	M	.255
26.	Cauc.	Med. St.	Jew	M	.252
5.	Cauc.	Med. St.	Moslem	M	.235
15.	Cauc.	Med. St.	Chris.	F	.230
1.	Cauc.	Med. St.	Chris.	M	.224
6.	Cauc.	Med. St.	Chris.	F	.221
22.	Negro	Med. St.	Moslem	F	.209
18.	Cauc.	Med. St.	Moslem	F	.207
23.	Negro	Med. St.	Moslem	M	.203
28.	Cauc.	Med. St.	Moslem	F	.182
12.	Negro	Med. St.	Moslem	M	.181
27.	Cauc.	Med St.	Moslem	M	.179
20.	Negro	Med. St.	Moslem	F	.172
17.	Cauc.	Laborer	Chris.	F	.058
7.	Negro	Laborer	Chris.	F	.043
25.	Cauc.	Laborer	Chris	M	.029
13.	Negro	Laborer	Chris.	F	.021
8.	Negro	Laborer	Chris.	M	.021
2.	Cauc.	Laborer	Chris.	F	.020
14.	Negro	Laborer	Chris.	M	.013
10.	Cauc.	Laborer	Chris.	M	.004

Wilks' Lambda = .13286; F = 37.53004; DF = 4,23; $p < .01$

Table 11c

Transformed Principal Axis Factor Loadings of Stimulus Mode Obtained from Discriminant Function Analysis

Factor III: Religion (Christian-Moslem-Jew)

Stimulus Number	Stimulus Characteristics				Transformed Factor Loading
	Race	Occupation	Religion	Sex	
1.	Cauc.	Med. St.	Chris.	M	-.309
2.	Cauc.	Med. St.	Chris.	F	-.313
13.	Negro	Laborer	Chris.	F	-.316
14.	Negro	Laborer	Chris.	M	-.318
8.	Negro	Laborer	Chris.	M	-.322
7.	Negro	Laborer	Chris.	F	-.328
12.	Negro	Med. St.	Moslem	M	-.334
10.	Cauc.	Laborer	Chris.	M	-.342
6.	Cauc.	Med. St.	Chris.	F	-.342
20.	Negro	Med. St.	Moslem	F	-.343
25.	Cauc.	Laborer	Chris.	M	-.348
22.	Negro	Med. St.	Moslem	F	-.359
17.	Cauc.	Laborer	Chris.	F	-.363
3.	Negro	Med. St.	Chris.	F	-.364
23.	Negro	Med. St.	Moslem	M	-.369
4.	Negro	Med. St.	Chris.	F	-.369
11.	Negro	Med. St.	Chris.	M	-.373
28.	Cauc.	Med. St.	Moslem	F	-.380
19.	Cauc.	Med. St.	Chris.	M	-.381
27.	Cauc.	Med. St.	Moslem	M	-.383
16.	Negro	Med. St.	Chris.	M	-.385
9.	Cauc.	Med. St.	Jew	F	-.385
5.	Cauc.	Med. St.	Moslem	M	-.390
26.	Cauc.	Med. St.	Jew	M	-.391
18.	Cauc.	Med. St.	Moslem	F	-.392
15.	Cauc.	Med. St.	Chris.	F	-.394
24.	Cauc.	Med. St.	Jew	F	-.397
21.	Cauc.	Med. St.	Jew	M	-.400

Wilks' Lambda = .55505; F = 1 88241; df = 8,44; NS

Table 11d

Transformed Principal Axix Factor Loadings of Stimulus Mode Obtained from Discriminant Function Analysis

Factor IV: Sex (Female-Male)

Stimulus Number	Stimulus Characteristics				Transformed Factor Loading
	Race	Occupation	Religion	Sex	
6.	Cauc.	Med. St.	Chris.	F	.143
15.	Cauc.	Med. St.	Chris.	F	.116
2.	Cauc.	Laborer	Chris.	F	.112
9.	Cauc.	Med. St.	Jew	F	.096
3.	Negro	Med. St.	Chris.	F	.095
24.	Cauc.	Med. St.	Jew	F	.095
4.	Negro	Med. St.	Chris.	F	.084
17.	Cauc.	Laborer	Chris.	F	.084
13.	Negro	Laborer	Chris.	F	.069
18.	Cauc.	Med. St.	Moslem	F	.068
28.	Cauc.	Med. St.	Moslem	F	.065
7.	Negro	Laborer	Chris.	F	.062
20.	Negro	Med. St.	Moslem	F	.060
22.	Negro	Med. St.	Moslem	F	.057
5.	Cauc.	Med. St.	Moslem	M	-.200
12.	Negro	Med. St.	Moslem	M	-.209
23.	Negro	Med. St.	Moslem	M	-.216
14.	Negro	Laborer	Chris.	M	-.218
8.	Negro	Laborer	Chris.	M	-.222
27.	Cauc.	Med. St.	Moslem	M	-.242
21.	Cauc.	Med. St.	Jew	M	-.246
11.	Negro	Med. St.	Chris.	M	-.247
16.	Negro	Med. St.	Chris.	M	-.249
10.	Cauc.	Laborer	Chris.	M	-.252
26.	Cauc.	Med. St.	Jew	M	-.265
25.	Cauc.	Laborer	Chris.	M	-.268
19.	Cauc.	Med. St.	Chris.	M	-.284
1.	Cauc.	Med. St.	Chris.	M	-.286

Wilks' Lambda = .02289; F = 245.44040; df = 4,23; $p < .01$

the most positive loadings and stimulus persons who are Negro having the least positive loadings. This relationship is emphasized by listing the designation "Caucasian" first and underlining it in the title of the factor. Later, when interpreting the relationships among the factors of the various modes in the core matrix, it becomes important to keep the direction of the poles in mind. As can be seen at the bottom of Table 11a, the Wilks' Lambda for the discriminant function of RACE yielded an F ratio which was significant beyond the .01 level. Thus, the clear separation by RACE which is shown in column 1 of the stimulus characteristics is to be expected.

Table 11b presents the corresponding results for the Stimulus Mode Factor II: OCCUPATION (Medical Student-Laborer). Once again the 28 stimuli have been rearranged according to the magnitude of their transformed factor loadings. An inspection of the second column of stimulus characteristics shows a clear separation of the stimuli on this factor by occupation. Correspondingly, the Wilks' Lambda criterion yields an F value which is significant.

Table 11c presents the results for Factor III: RELIGION (Christian-Moslem-Jew). Although the stimuli have once again been rearranged according to the algebraic value of their factor loadings with the highest (or least negative) stimulus first, and the lowest (most negative) stimulus last, an inspection of the third column of stimulus characteristics does not show the same clear-cut separation by RELIGION as could be seen in the case of the RACE and OCCUPATION factors. Accordingly, the Wilks' Lambda criterion yields an F value which is nonsignificant. A close inspection of the RELIGION column does show a certain tendancy for Christian stimulus persons to be first, Moslem stimulus persons somewhere in the middle, and Jewish stimulus persons to be last when ordered by their transformed factor loadings. However, it is only a trend which is not very consistent.

Finally, Table 11d presents the transformed factor loadings of Stimulus Mode Factor IV: SEX (Female-Male). An inspection of the fourth and last column of the stimulus characteristics shows quite clearly that the stimuli on this factor are separated by the discriminant function of SEX with females having the highest loadings and males the negative loadings. An inspection of the column of factor loadings shows a very sharp break between female and male stimulus persons, and a very great difference in the algebraic values of the first and last stimuli. Accordingly the Wilks' Lambda criterion yields a F value which is highly significant.

Mode 3. The Core Matrix

Table 12 presents the results of the final transformed core matrix. The reader will recall that the principal axis factor matrix for mode 1 was transformed by means of Varimax rotations which permitted the interpretation of three scale factors. The principal axis factor matrix for mode 2 was transformed by means of multiple discriminant function analysis and 4 stimulus factors were retained. The principal axis factor matrix for mode 3 was also subjected to transformation by means of Varimax rotations and 4 Varimax rotated person factors were retained. The person factors are not interpretable by themselves, but only in relation to the responses on scale factors to the stimulus factors which formed the basis for the mode 3 factor matrix. The corresponding transformed characteristic vectors of the three factor matrices-sometimes loosely referred to as "counter-rotations" - tie the three factor matrices together in a core matrix of "box," thus making it possible to interpret the person factors as "idealized persons."

Table 12

Final Transformed Core Matrix

Mode 3 PERSON FACTORS	Mode 2 STIMULUS FACTORS	Mode 1 SCALE FACTORS: I. Social Acceptance vs. Social Distance	II Marital Rejection vs. Marital Acceptance	III. Non-subordination vs. Subordination
I.	I. Race (Cauc.-Negro)	.136	-.184	.274
	II. Occ. (Med. St.-Lab.)	.094	-.067	-.113
	III. Rel. (Chris.-Mos.-Jew)	-.092	-.013	-.148
	IV. Sex (Female-Male)	.020	-.083	.113
II.	I. Race (Cauc.-Negro)	-.033	.261	-.261
	II. Occ. (Med. St.-Lab.)	-.011	.105	.024
	III. Rel. (Chris.-Mos.-Jew)	.074	-.109	.131
	IV. Sex (Female-Male)	.300	.390	-.389
III.	I. Race (Cauc.-Negro)	-.051	.252	-.026
	II. Occ. (Med. St.-Lab.)	-.041	-.020	.079
	III. Rel. (Chris.-Mos.-Jew)	.044	-.086	-.026
	IV. Sex (Female-Male)	-.039	.048	.009
IV.	I. Race (Cauc.-Negro)	.310	.021	.151
	II. Occ. (Med. St.-Lab.)	.124	-.342	-.190
	III. Rel. (Chris.-Mos.-Jew)	-.211	-.064	-.141
	IV. Sex (Female-Male)	.114	.034	-.040

Person Factor I seems to be characterized by Marital Acceptance (negative rejection) of Caucasian stimulus persons (in Table 12 this loading of -.184 may be seen as the intercept of scale factor 2, Marital Rejection, with stimulus factor 1, Race). At the same time, there is a high loading on Non-subordination with respect to Caucasian stimulus persons. Furthermore, there is a moderate loading on Social Acceptance of Caucasian stimulus persons.[4] In addition to the loadings for the stimulus factor Religion, which we shall ignore here, further loadings suggest some tendency toward Subordination with respect to medical students and Non-subordination with respect to females. This subject type may be conceived of as probably a white who bases his acceptance or rejection of stimulus persons (in terms of Marital Acceptance and Social Acceptance) primarily upon race rather than upon status or other factors. However, he would not subordinate himself to Caucasians generally. He would be somewhat more willing to subordinate himself on the basis of status (medical student) but would not subordinate himself to females. It may be that subjects of this type would contain a somewhat higher proportion of males as indicated by some tendency toward Marital Acceptance of females (or Marital Rejection of males). However, this loading is not very high so that this subject type may also be represented by a certain type of white female who rejects Negroes but would not subordinate herself generally to Caucasians or to other females.

Person Factor II is characterized by Social Acceptance toward females,

---

[4] It was arbitrarily decided to underline loadings of .150 or above in Table 12 in order to call attention to the higher loadings. An exception to this occurs in the single case where the stimulus factor Religion has a relatively high loading in the fourth person factor. Since the factor, Religion, showed a non-significant discriminant function, this dimension is not particularly interpretable.

Marital Rejection of females, and Subordination toward females. Furthermore, there is a strong tendency toward Marital Rejection of Caucasians but Subordination toward Caucasians. This subject type may clearly be conceptualized as a Negro female who likes (socially accepts) other females and would subordinate herself to them, but of course would not express Marital Acceptance toward them. Furthermore, she expresses Marital Rejection (but not Social Distance) toward Caucasians but would subordinate herself to them. Such an idealized subject type is very readily conceivable.

Person Factor III is a bit difficult to interpret since there is only one high loading. This loading indicates Marital Rejection (but no significant amount of Social Distance) toward Caucasian stimulus persons. This subject type may be conceived of as a Negro of either sex who expresses rejection of Caucasians only on the Marital Rejection factor. The slight positive loading on Marital Rejection of females might indicate a slightly greater tendency for this person to be female, although this loading is not very high. It may be recalled from the analysis of variance results in Tables 5 and 8, that although for Negro subjects, race accounted for less variance on the Social Distance factor than for white subjects, it accounted for somewhat more variance on the part of Negro females than on the part of Negro males. Similarly, in Tables 6 and 9, race was shown to account for much less variance on the Marital Acceptance factor for Negro subjects than for white subjects, but more so for Negro females than for Negro males.

Person Factor IV is characterized by Social Acceptance of Caucasians and high Marital Acceptance of medical students as opposed to laborers. Furthermore, although the subject type would not subordinate himself generally, to Caucasians, he would definitely subordinate himself to medical students. There is also a preference of medical students over laborers on the Social Acceptance factor. With no clear indication of preference as to sex on the

Marital Rejection vs. Marital Acceptance factors, this subject type would seem to be a white who may be of either sex. Although subject types I and IV both indicate a clear preference for Caucasians over Negroes, and may be conceptualized as whites of either sex, there are important differences between the two types. Subject type IV would seem to be a person whose clear preference for Caucasians over Negroes is related to a concern with status as evidenced by a sharp preference of medical student over laborer on the Marital Acceptance factor and by subordination toward a medical student, although not toward Caucasians, generally. Thus, whereas the first type consistently prefers Caucasians (rejects Negroes) but pays little attention to status, type IV shows a very high concern for status. His (or her) clear preference for Caucasians over Negroes on the Social Acceptance Factor may be a manifestation of the same over-concern for social norms, for doing the right thing, as is the choice of the high status stimulus person for Marital Acceptance. Although the variables involved here are somewhat different, this finding of two subject types, both of whom are "prejudiced" toward Negroes but in different ways, with one type emphasizing the race factor more than the other type, is somewhat analogous to the findings by Triandis and Davis (1965) of the two types of "race prejudiced" and "belief prejudiced" subjects.

DISCUSSION AND SUMMARY

The present study has dealt with the interpersonal perceptions of subjects who were heterogeneous with respect to race and sex. In addition to conventional factor analyses, based on a two-way classification of scales-by-stimuli, the data were subjected to Tucker's three-mode factor analysis procedure, involving a three-way classification of scales-by-stimuli-by-subjects.

With respect to the latter type of analysis, the study must be considered exploratory in nature. Not only is the technique of multimode factor analysis

itself quite new, but few of the studies reported thus far which have used this technique have involved data resulting from social perceptions. Hoffman and Tucker (1964) have applied three-mode factor analysis to a multitrait-multimethod matrix (Campbell & Fiske, 1959) in a reanalysis of data collected earlier by Kelly and Fiske (1951). Tucker (1964) has also applied this procedure to a variety of other types of data, such as the Parker and Fleishman (1960) complex tracking task data. Levin(1965) has applied the three-mode technique to different sets of data, including those collected by Endler, Hunt and Rosenstein (1962) involving an S-R inventory of anxiousness. Here a mode-of-response factor matrix and a situations factor matrix entered into the determination of three person factors or "idealized subject types" in the core box.

One of the few studies involving the use of three-mode factor analysis with data resulting from social perception is reported by Levin (1965) who reanalyzed Semantic Differential data collected by Ware (1958). In this study, thirty-one concepts were rated on twenty Semantic Differential scales by sixty subjects who were high school students varying in sex and high and low IQ. However, of the thirty-one concepts which were rated, only six represented person stimuli. The others represented inanimate objects, animals, or more or less abstract concepts. In Levin's analysis of this data, only one subject type was obtained in the core matrix.

The data in the present study represented Behavioral Differential judgments of complex person stimuli. Numerous studies using variations of Triandis' (1964) Behavioral Differential have shown these scales to be multidimensional (cf. Triandis, 1967). The complex characteristics of the social stimuli being judged were chosen so as to form a factorial design. Finally, the subjects used in the present study were heterogeneous not only with respect to sex, but also with respect to race. Thus, complex interactions between characteristics of the stimuli, the scales, and the subjects might be expected to produce

a somewhat more differentiated core matrix than that reported by Levin (1965).

In the present study, it was possible to interpret four different person factors or "idealized subject types" by inspecting the three-dimensional matrix formed by the core box. The first person factor was characterized primarily by Marital Acceptance and Social Acceptance of Caucasian stimulus persons, together with a strong tendency toward Non-subordination toward such stimulus persons. The second person factor was characterized by Social Acceptance of, and Subordination toward, female stimulus persons, together with Marital Rejection of females. In addition, there was Marital Rejection of, and Subordination toward, Caucasian stimulus persons. The third person factor showed only one high loading, representing Marital Rejection of Caucasian stimulus persons. Finally, the fourth person factor was characterized by a high degree of Social Acceptance of Caucasians and high Marital Acceptance of, and Subordination toward, medical students. The first subject type and the fourth subject type seemed to differ primarily in the high concern of the latter for status, as compared to the primary concern of the former for race.

The subject types which emerged from this analysis clearly do not represent merely the four groups of subjects who were used in the experiment (Negro males, Negro females, white males and white females). Rather, they are differentiated on the basis of their social perceptions of the complex stimulus persons involved in the design. Obviously, factors other than the gross characteristics of the sex or race of the respondent determine the configuration of responses to such complex person stimuli. This finding might be compared to the finding by Ware (1958), in the original analysis of his data, that there were no significant differences in the results obtained from high and low IQ and male and female subjects, with respect to the factor structure of Semantic Differential scales; or a comparable finding by Bopp (1965) which showed no such differences between schizophrenics and normals. However, the technique

of three-mode factor analysis provides a tool with which differences that do exist among subject types with respect to their social perceptions may be identified, even though such differences may not relate to gross demographic characteristics of the subjects.

The present findings with respect to the first and fourth person factors are of some interest. Both of these subject types indicate a clear preference for Caucasian stimulus persons over Negroes. However, they differ in that the first type places primary emphasis upon race whereas the second type also places strong emphasis upon occupational status. This finding may be analogous (although by no means completely comparable to) the finding by Triandis and Davis (1965) of two types of "prejudiced" subjects, one of which was designated as conventionally "race prejudiced" type. Both the procedure employed by Triandis and Davis (Davis & Triandis, 1965; Triandis and Davis, 1965), utilizing the Tucker and Messick (1963) method of factoring subjects, and the present technique of three-mode factor analysis, result in "subject types," although the mathematical procedures used are somewhat different. It is interesting, therefore, that these two techniques should both yield two subject types which, although both "prejudiced," show a clear differentiation in the manner in which such "prejudice" is expressed.

Not all of the subject types in the present study were clearly interpretable. This may well have been due to certain difficulties involved in the different methods used to transform the characteristic vectors of the three modes of data. However, the technique described here was seen to be potentially useful as a means of describing idealized subject types based on social perception data of the type described here.

Since those data were originally collected, some progress has been made in the further development of Behavioral Differential and Semantic Differential

scales for use in person perception, especially in culturally heterogeneous groups (Davis, 1966). These developments have consisted largely in a systematic exploration of the multidimensionality of Behavioral and Semantic Differential scales, as well as in the selection of scales particularly relevant for the study of intercultural negotiations. Also, the subjects used in the present study, although heterogeneous with respect to race and sex, were certainly rather homogeneous with respect to many other characteristics since they were all middle-class, Midwestern undergraduate college students. The use of subjects more heterogeneous with respect to cultural background characteristics, as well as the use of scales which reflect more clearly the multidimensionality of social perceptions, may well lead to an extremely useful differentiation of subjects on the basis of social perception data.

Bopp, Joan. A quantitative semantic analysis of word association in schizophrenia. Unpublished doctoral dissertation, University of Illinois, 1955.

Campbell, D. T., & Fiske, D. W. Convergent and discriminant validation by the multi-trait-multi-method matrix. Psychological Bulletin, 1959, 56, 81-105.

Davis, E. E. A methodological study of Behavioral and Semantic Differential Scales relevant to intercultural negotiations. Urbana, Illinois: Group Effectiveness Research Laboratory, Department of Psychology, University of Illinois, 1966.

Davis, E. E., & Triandis, H. C. An exploratory study of intercultural negotiations. Urbana, Illinois: Group Effectiveness Research Laboratory, Department of Psychology, University of Illinois, 1965.

Endler, N. S., Hunt, J. McV., & Rosenstein, A. J. An S-R inventory of anxiousness. Psychological Monographs, No. 536, 1962, 76, No. 17.

Fishbein, M. The relationship of the behavioral differential to other attitude instruments. Paper read at the American Psychological Association Convention, Los Angeles, 1964.

Harman, H. H. Modern factor analysis. Chicago: University of Chicago Press, 1960.

Hoffman, E. L., & Tucker, L. R. Three-way factor analysis of a multitrait-multimethod matrix. Urbana, Illinois: Department of Psychology, University of Illinois, 1964.

Kelly, E. L., & Fiske, D. W. The prediction of performances in clinical psychology. Ann Arbor: University of Michigan Press, 1951.

Levin, J. Three mode factor analysis. Psychological Bulletin, 1965, 64, 442-452.

Natker, N. Determinants of social acceptance or rejection among Negro and white students. Unpublished B. A. Honors Thesis, University of Illinois, 1964.

Osgood, C. E. Studies on the generality of affective meaning systems. American Psychologist, 1962, 17, 10-28.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. The measurement of meaning. Urbana, Illinois: University of Illinois Press, 1957.

Parker, J. F., Jr., & Fleishman, E. A. Ability factors and component performance measures as predictors of complex tracking behavior. Psychological Monographs, No. 503, 1960, 74, No. 16.

Triandis, H. C. Toward an analysis of the components of interpersonal attitudes. In Carolyn and M. Sherif (Eds.), Attitude, ego-involvement and change. New York: John Wiley, 1967.

Triandis, H. C. Exploratory factor analyses of behavioral component of social attitudes. Journal of Abnormal and Social Psychology, 1964a, 68, 420-430.

Triandis, H. C., & Davis, E. E. Race and belief as determinants of behavioral intentions. Journal of Personality and Social Psychology, 1965, 2, 715-725.

Triandis, H. C., Davis, E. E., & Takesawa, S. I. Some determinants of social distance among American, German, and Japanese students. Journal of Personality Social Psychology, 1965, 2, 540-551.

Triandis, H. C., & Triandis, Leigh M. Race, social class, religion, and nationality as determinants of social distance. Journal of Abnormal and Social Psychology, 1960, 61, 110-118.

Triandis, H. C., & Triandis, Leigh M. A cross-cultural study of social distance. Psychological Monograph, 1962, 76, No. 21 (Whote No. 540).

Tucker, L. R. A method for synthesis of factor analysis studies. Personnel research section report, No. 984, Washington, D. C., Department of the Army, 1951, pp. 120.

Tucker, L. R. The extension of factor analysis to three-dimensional matrices. In Fredericksen (Ed.), Contributions to mathematical psychology. New York: Holt, Rinehart, and Winston, 1964.

Tucker, L. R. Some mathematical notes on three-mode factor analysis. Psychometrika, 1966, 31, 279-311.

Tucker, L., & Messick, S. An individual differences model for multidimensional scaling. Psychometrika, 1963, 28, 333-367.

Ware, E. E. Relationships of intelligence and sex to diversity of individual semantic meaning spaces. Unpublished doctoral dissertation, University of Illinois, 1958.

Wrigley, C., & Neuhaus, J. O. The matching of two sets of factors. Contract memorandum report, A-32, Urbana, Illinois: University of Illinois, 1955, Pp. 13.

DOCUMENT CONTROL DATA - R & D DD form 1473

1. ORIGINATING ACTIVITY

Group Effectiveness Research Laboratory
Department of Psychology
University of Illinois, Urbana, Illinois

2. REPORT SECURITY CLASSIFICATION

Unclassified

3. REPORT TITLE

Multimode Factor Analysis of Interpersonal Perceptions

4. DESCRIPTIVE NOTES (Type of Report and Inclusive Dates)

Technical Report

5. AUTHORS

Davis, Earl E.; Grobstein, Nadine Natker

6. REPORT DATE

December, 1966

7a. TOTAL NO. OF PAGES

42

7b. NUMBER OF REFERENCES

26

8a. CONTRACT NO.

2870
NR 177-472
ARPA Order #454

9a. ORIGINATOR'S REPORT NUMBER

Technical Report No. 36

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this Document is Unlimited

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

Department of the Navy
Office of Naval Research
Group Psychology Branch

DD Form 1473

13. ABSTRACT

Data resulting from the interpersonal perceptions of 88 students who were heterogeneous with respect to race and sex were subjected to a variety of analyses, including Tucker's three-mode factor analysis procedure. Ss responded on Semantic and Behavioral Differential scales to complex person stimuli designated in terms of race, sex, and other characteristics which formed a factorial design. The data were reduced to a two-way classification of scales-by-stimuli, using Ss' mean group responses, and conventional factor analyses of scales were performed. Analyses of variance were carried out to determine the relative weights of the stimulus factors in determining the responses of the various groups of Ss on the scale factors. Finally, the three modes of the data classified in terms of scales-by-stimuli-by-subjects were subjected to Tucker's three-mode factor analysis. After obtaining principal axis factors for the three modes, the scale and subject mode factors were rotated by Varimax and the stimulus mode factors were transformed by means of discriminant function analysis. Counter-rotations of the three modes yielded a core matrix linking the scale factors to the stimulus factors. Although not all of the subject types were clearly interpretable in the present study, this type of analysis, with some modifications, would appear to have great potential value in treating complex interpersonal perception data.

14. KEY WORDS

Multimode factor analysis
Interpersonal Perceptions
Semantic Differential
Behavioral Differential
Three-mode factor analysis