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The interpretation of canonical correlations presents some problems. The problem to which the first section of this monograph is addressed is the interpretation of the canonical solution. The authors suggest a summary for determining the proportion of variance of one set predicted by another set (R). The relative contributions of variables to the general index have therefore been proposed as an indication of the relative importance of the variables to the canonical solution. The second section of the monograph attempts to establish a description of the value system utilized by contemporary adolescents in assigning status to other members of their sub-culture. The sample consisted of 12th graders in seven schools. Sociograms were constructed giving student's choices and rejections of males and females separately. Findings, concerning values and status are presented. The authors feel that the technique used was valuable. By utilizing the canonical solution with R, and the proportioned squared multiple correlations, one can look at the way two sets of variables are related in multiple populations, and then to select the more important variables for further study. (SJ)

Project TALENT

INTERPRETING CANONICAL CORRELATIONS THEORY AND PRACTICE

William A. Love, Jr.

and

Douglas K. Stewart

American Institutes for Research
and
School of Education, University of Pittsburgh

1968

Major Project TALENT Publications

Flanagan, J. C., Dailey, J. T., Shaycoft, Marion F., Gorham, W. A., Orr, D. B., & Goldberg, I. *Designing the study.* (Technical report to the U. S. Office of Education, Cooperative Research Project No. 635.) Washington, D. C.: Project TALENT Office, Univer. of Pittsburgh, 1960.

Flanagan, J. C., Dailey, J. T., Shaycoft, Marion F., Gorham, W. A., Orr, D. B., & Goldberg, I. *The talents of American youth.* Vol. 1. *Design for a study of American youth.* Boston: Houghton Mifflin, 1962.

Flanagan, J. C., Dailey, J. T., Shaycoft, Marion F., Orr, D. B., & Goldberg, I. *Studies of the American high school.* (Final report to the U. S. Office of Education, Cooperative Research Project No. 226.) Washington, D. C.: Project TALENT Office, Univer. of Pittsburgh, 1962.

Shaycoft, Marion F., Dailey, J. T., Orr, D. B., Neyman, C. A., Jr., & Sherman, S. E. *Studies of a complete age group - Age 15.* (Final report to the U. S. Office of Education, Cooperative Research Project No. 635.) Pittsburgh: Project TALENT Office, Univer. of Pittsburgh, 1963.

Flanagan, J. C., Davis, F. B., Dailey, J. T., Shaycoft, Marion F., Orr, D. B., Goldberg, I., & Neyman, C. A., Jr. *The American high-school student.* (Final report to the U. S. Office of Education, Cooperative Research Project No. 635.) Pittsburgh: Project TALENT Office, Univer. of Pittsburgh, 1964.

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Shaycoft, Marion F. *The high school years: Growth in cognitive skills.* (Interim report 3 to the U. S. Office of Education, Cooperative Research Project No. 3051.) Pittsburgh: Project TALENT Office, American Institutes for Research and Univer. of Pittsburgh, 1967.

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Cooley, W. W., & Lohnes, P. R. *Predicting development of young adults.* (Interim report 5 to the U. S. Office of Education, Cooperative Research Project No. 3051.) Palo Alto: Project TALENT Office, American Institutes for Research and Univer. of Pittsburgh, 1968.

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

INTERPRETING CANONICAL CORRELATIONS:

THEORY AND PRACTICE

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American Institutes for Research

and

School of Education, University of Pittsburgh

1968

PREFACE

In September of 1966, the authors came to Project TALENT for a nine month program of study in the areas of methodology and computer applications. This period of study was funded by the Office of Education Post-Doctoral Fellowships, (O.E.G., 1-6-062084-1789). During our stay at TALENT, we had the opportunity of working with and being guided by many outstanding teachers. We are particularly grateful to W. W. Cooley, who was director of Project TALENT and the man directly responsible for bringing us there; Marion Shaycoft (associate director), Charles Hall (director of school studies), Bary Wingersky (director of computer systems), and Paul Lohnes (director of guidance studies).

While we would like to express our thanks to all these people, we would especially like to thank Dr. Lohnes for his guidance in the work which resulted in this monograph. As a result of his multivariate seminar in the fall and winter of 1966-67, we became interested in canonical correlation. The problem of redundancy across batteries came directly out of questions raised by Dr. Lohnes in this seminar. We would also like to express our special thanks to Bary Wingersky for deriving a set of formal proofs which undergird the work presented here. The authors freely admit to being "empirical statisticians," by which we mean, that when a given procedure seems to be the common-sense way to do it, we try it out with data to see how the results look. At least one member of the Project TALENT staff has commented that we proceed with a combination of platonic logic and analogy. As satisfying

as this has been to the authors, we are aware that it causes some heightened eyebrows in the academic community. As a result, we turned to Mr. Wingersky for his help and he furnished us with a set of formal proofs, which seemed to indicate that the work presented here has some mathematical underpinning.

The order of presentation of topics represents the evolution of our thinking. When the problem of assessing the amount of information in one battery of tests first came up, we began to work on this problem, and when we developed what we felt was a solution, we drafted a paper titled, "A General Canonical Correlation Index," (a revised form of which has since been accepted for publication by Psychological Bulletin). As we worked on this paper, we came to have the strong feeling that the multiple regression systems underlying the two batteries was related to the canonical solution. We also became convinced that there was a better way to interpret the contribution of variables to the canonical solution than by looking at the canonical weights and loadings. As we began to work on this problem, we developed our second paper, which has also been submitted for publication under the title, "Assessing the Relative Importance of Variables in the Canonical Solution." In the process of developing this second paper, we concluded that the multiple regressions of one battery upon the other was the key, and that there was a simple method of computing the cross-multiple correlations given the information that is calculated in the computer program we used. A short paper demonstrating the algorithm used to compute the cross-multiple correlations based on the loadings of the variables on the canonical variates has been accepted for publication by Behavioral Science.

The material covered in these papers has been combined in the initial section of this monograph entitled, "Interpreting Canonical Correlation." After spending several months completely immersed in this particular technique, the authors were anxious to try it out on some data of their own. The particular area of application of sociometric data is an area with which we are substantively concerned.

We would like to thank everyone at Project TALENT, from the director to the secretarial staff, who made this research possible. We are aware that we absorbed an inordinate amount of everyone's time and we are grateful for the cheerful help and guidance that was given us. The actual data analysis for this monograph utilized the set of programs developed by Dr. Paul Lohnes for the forthcoming second edition of the Cooley and Lohnes book, "Multivariate Procedures for the Behavioral Sciences."

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INTERPRETING CANONICAL CORRELATION

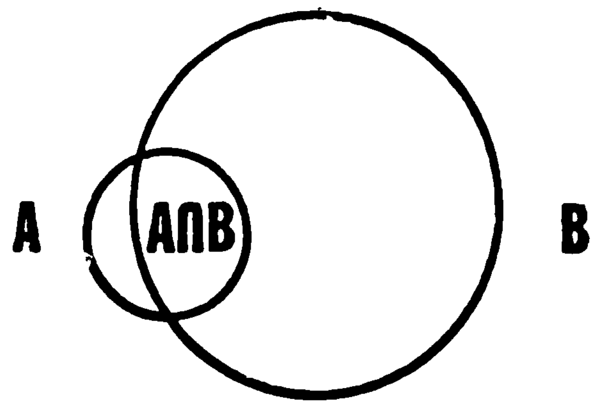
The interpretation of canonical correlations presents some problems. Whereas a squared multiple correlation represents the proportion of criterion variance predicted by the optimal linear combination of predictors, a squared canonical correlation represents the variance shared by linear composites of two sets of variables, and not the shared variance of the two sets.

Unfortunately, therefore, canonical correlations cannot be interpreted as correlations between sets of variables. It is important to note, that a relatively strong canonical correlation may obtain between two linear functions, even though these linear functions may not extract significant portions of variance from their respective batteries. This is the problem of interpretation to which this paper is addressed.

Rozeboom (1965) has suggested the relevance of information theoretic concepts in dealing with canonical correlations. Uncertainty and alienation are considered parallel, and similarly, redundancy and correlation are treated as analogous. Given this approach, Rozeboom develops a general index which is similar to one presented by Anderson (1958, p.244). Both measures are symmetric, i.e., given two sets of variables, one number is presented which presents the magnitude of their intersection. A directional or non-symmetric index is possible by pursuing the information theoretic analogies suggested by Rozeboom. In addition to the primitive concept of uncertainty (or entropy)

Shannon (Shannon and Weaver, 1949) discusses conditional uncertainty. Similarly, one may discuss the complement of conditional uncertainty as conditional redundancy. A non-symmetric measure is considered desirable because one set of variables may be almost completely subsumed by a larger set, i.e., redundancy can be represented as the intersection of two sets of variables, and it is desirable to represent the proportion of one set which is in the intersection (see Fig. 1).

FIGURE I



In the case pictured in Figure 1, it is clear that most of set A is contained in set B, whereas a relatively large portion of set B is outside the intersection. This paper proposes an index based on canonical correlation which is non-symmetric and has been worthwhile in the analysis of various partitioned matrices.

If we were to factor analyze two sets of variables independently and then develop weights which would rotate the two factor structures to maximum correlation, we would have a canonical solution (Hotelling, 1935). In the canonical case the factors are usually referred to as canonical variates. The correlation between the first factor of the left set and the first factor of the right set is the first canonical

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correlation $\left(R_{c_1}\right)$. In order to take advantage of the well developed language of factor analysis, we shall call them canonical factors.

Since the complete factor structure of a set of variables will contain as many factors as there are variables,[1] it is obvious that if the larger set is composed of five variables and the smaller set of three variables, only three factors can be extracted from the smaller set. As a result, R_c's are available between three of the factors of the larger set and the three factors of the smaller set. The remaining two factors in the larger set have no counterpart in the smaller set and do not enter into the canonical solution.

In the traditional interpretation of canonical correlations, the magnitude of the R_c's, whether or not they are significantly non-zero, and the weights used to obtain the R_c's are considered (Cooley and Lohnes, 1962). The interpretation of these weights has all the problems attendant to the beta weights of common multiple regression. At the suggestion of Meredith (1964), some investigators now compute the correlations between the variables in a set and the canonical factors of that set (the factor loadings of factor analytic parlance).[2]

Before we consider a method of calculating an index of redundancy we should agree on vocabulary. We need one index for the redundancy in the left set given the right and another index for the reverse relation. For the sake of simplicity, we will consider one set of variables as the predictor or conditioning set and the other set as the criterion, as in

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[1]This is true only where the rank of the matrix equals the order. In general this is the case and will be assumed in this paper.

[2]This proposal will be utilized in the forthcoming second edition of Cooley and Lohnes.

multiple regression. We talk about the proportion of variance in the criterion accounted for by the predictors, but seldom if ever consider the reverse relationship. It is obvious that by reversing our definition of criterion and predictor we could develop the index going in the other direction. The canonical factors of the predictor set will be FP_i and similarly FC_i for the criterion set. The variables of the predictor and criterion sets will be P_i and C_i, respectively. Since the index about to be proposed utilizes the concept of a factor extracting a proportion of the variance (more appropriately proportion of trace) of a set of variables (usually a battery of tests), we will define the column sum of the squared loadings of variables within a set on a canonical factor of the set as the variance extracted by that factor. When this is divided by the number of variables in the set (M), the resulting value is the proportion of the variance of the set extracted by that canonical factor. This will be symbolized as VP_i and VC_i. The squared canonical correlations $\left(R_{c_i}^{\;2}\right)$ will be written as λ_i (following Cooley and Lohnes, 1962). This is the proportion of variance in one of the ith pair of canonical variates predictable from the other member of the pair. If the VC_i is multiplied by the λ_i, the resulting figure is the proportion of the variance of the C set explained by correlation between FP_i and FC_i. If this value is calculated for each of the M_c pairs of canonical factors, the result is an index of the proportion of variance of C predictable from P, or the redundancy in C given P.

$$\overline{R} = \sum_{k=1}^{M_c} \lambda_k \; VC_k = \sum_{k=1}^{M_c} \lambda_k \left[\sum_{j=1}^{M_c} \left(L_{jk}^{\;2} \Big/ M_c \right) \right]$$

(where L_{jk} is the correlation between the jth variable and kth canonical factor.)

We have called this index $\bar{R}$ (R bar) because it was noted that if a mult R^2 were computed between the total P set and each variable of the C set, $\bar{R} = \Sigma R^2/Mc$. In other words $\bar{R}$ is the mean squared multiple correlation. The possible range of $\bar{R}$ is from 0.0 to +1.[1]

An example of the use of canonical correlation is presented by Lohnes and Marshall (1965).[2] In this study three scores from the Pintner General Ability Test (PGAT) and ten from the Metropolitan Achievement Test were entered into a canonical correlation with the 7th and 8th year course grades in English, arithmetic, social studies, and science of 230 junior high school students in a small, rural college town. The first two canonical correlations were reported ($R_{c_1} = .90$ and $R_{c_2} = .66$). The canonical weights were reported and interpreted.

In the present analysis of the Lohnes-Marshall data, the weights were ignored and the factor loadings and $\bar{R}$s were inspected.

In the left set, loadings from .707 to .917 are found on the first factor. The loadings on the second factor drop substantially. The same condition holds in the right set. In Table 2, columns 1 and 2 present the canonical correlations and their squares. Note that the upper portion of Table 2 considers the left set as criterion and the right set as the predictor set, while the lower portion reverses these roles. The third column of Table 2 presents the proportions of the variance

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[1] It should be noted that if $Mc \leq Mp$ then $\bar{R} \leq 1.0$. If R is calculated for P and $Mc < Mp$ then $\bar{R} < 1.00$. The only time $\bar{R}$ can equal 1.0 is when each $\lambda = 1.00$ and the canonical factors of the set in question extract 100 percent of the generalized variance in that set.

[2] Professor Paul R. Lohnes graciously allowed us to use his data and modified his latest canonical program to calculate our index.

TABLE 1. FACTOR STRUCTURE

FACTOR STRUCTURE FOR LEFT SET. COLUMNS ARE CANONICAL FACTORS. ROWS ARE TESTS.

1	-.786	.061	-.082	-.313	.054	.163	-.251	.026
2	-.828	-.163	.018	-.191	-.082	.174	-.276	.031
3	-.707	-.462	.009	-.444	.066	-.102	.018	-.152
4	-.800	-.031	.178	-.095	-.071	.451	-.026	.050
5	-.817	.061	.169	-.194	.003	.311	-.136	-.340
6	-.887	.185	-.096	.074	-.080	.005	-.081	-.005
7	-.917	.119	-.055	-.148	.205	-.016	.120	.050
8	-.836	-.066	.088	-.245	-.046	.082	-.001	.210
9	-.903	-.212	-.086	.099	.083	-.042	.069	-.182
10	-.839	-.351	.016	-.006	-.022	.008	.160	-.136
11	-.752	.048	.581	-.123	.063	.053	-.105	-.113
12	-.798	-.360	.136	.011	.065	-.076	-.243	.096
13	-.726	-.190	.218	-.126	.447	.321	-.198	-.023

FACTOR STRUCTURE FOR RIGHT SET. COLUMNS ARE FACTORS. ROWS ARE TESTS.

1	-.847	-.322	-.065	.094	.212	-.326	-.033	-.119
2	-.795	-.446	-.014	-.067	-.230	.255	.117	-.182
3	-.951	.140	.011	-.108	.095	.046	-.099	.206
4	-.878	.241	-.011	.025	-.194	-.055	-.057	-.354
5	-.901	.127	.315	.227	.080	.073	.093	-.002
6	-.743	.001	.540	-.134	-.189	-.021	-.180	-.263
7	-.800	.027	.088	-.222	.412	-.111	.195	-.288
8	-.727	-.079	.209	.034	.063	.335	-.361	-.416

TABLE 2. COMPONENTS OF REDUNDANCY MEASURE

L E F T   S E T

Factor	I Canonical R R_c	II R-Squared λ	III Variance Extracted VC	IV Redundancy $\lambda \cdot VC$	V Proportion of Total Redundancy
1	.9021	.814	.668	.544	.927
2	.6625	.439	.049	.022	.037
3	.5015	.251	.038	.010	.016
4	.3886	.151	.039	.006	.010
5	.3098	.096	.022	.002	.004
6	.2785	.078	.038	.003	.005
7	.1500	.022	.025	.001	.001
8	.0722	.005	.020	.000	.000

Total Variance Extracted from Left Set = .899

$\overline{R}$, Total Redundancy for Left Set, Given Right Set = .586

R I G H T   S E T

Factor	I Canonical R R_c	II R-Squared λ	III Variance Extracted VC	IV Redundancy $\lambda \cdot VC$	V Proportion of Total Redundancy
1	.9021	.814	.695	.566	.923
2	.6625	.439	.050	.022	.036
3	.5015	.251	.056	.014	.023
4	.3886	.151	.018	.003	.004
5	.3098	.096	.045	.004	.007
6	.2785	.078	.038	.003	.005
7	.1500	.022	.039	.001	.001
8	.0722	.005	.068	.000	.001

Total Variance Extracted from Right Set = 1.000

$\overline{R}$, Total Redundancy for Right Set, Given Left Set = .613

of the set extracted by each canonical factor (variate). The fourth column is the amount of redundant variance attributed to each canonical factor. The fifth column expresses the values in the fourth column as proportions of the total redundancy.

From this we see that:

1. The eight canonical factors extract 90 percent of variance of the left set;
2. Fifty-nine percent of the variance of the left set is predicted by the variance in the right set (i.e., $\overline{R} = .59$);
3. Of the redundant variance, 93 percent is associated with the first canonical variate;
4. Despite the large value of $R_{c_2} = .66$, the second canonical variates have very small amounts of variance associated (five percent in both the left and right sets);
5. The eight canonical factors of the right (and smaller) set extract 100 percent of the variance of that set (which is simply to assert that the smaller set is completely factored in the canonical solution);
6. The redundancy of the right set (student grades) given the left set is $\overline{R} = .61$; and
7. Of the redundant variance of the right set, 92 percent is associated with the first canonical variate.

The utility of $\overline{R}$ is as a summary index. In general, it is not to be viewed as an analytical tool. Certain associated indices, however, have obvious analytic applications. For example, the proportion of

redundant variance associated with a given factor is instructive in determining whether the factor deserves interpretation and further attention (in the case noted above a canonical correlation of .66 was associated with only .05 of the variance of either side, and only four percent of the redundant variance - in short, this index instructs us differently than does the canonical correlation alone).

If we accept the $\overline{R}$ index as a summary measure, we are then ready to look at the second important problem in the interpretation of a canonical correlation, namely the contribution of a variable to the total canonical solution. Traditionally, when we attempt to interpret canonical correlation, we look at the size of the canonical weights on a given canonical factor, and the magnitude and significance of the R_c associated with that canonical factor. If we designate one set of variables as predictors (the P set), and one set as criterion variables (the Q set), we must consider one matrix of correlations (or loadings) associated with the variables and canonical factors of the P set and another matrix for the Q set. For descriptive purposes, we need an index which summarizes the contributions of each variable to the total solution.

We have already established that the $\overline{R}$ associated with the criterion set of variables is equal to the mean R^2 of each variable in the Q set, regressed on the total P set. This leads us to believe that the cross set multiple regression systems may hold the key to interpretation.

In the computation of the $\overline{R}$ index, we develop a matrix composed of the squared loading of the variables on the canonical factors. If

we title this matrix of squared loadings L, then L_{ij} represents the proportion of variance of the *i*th variable associated with the *j*th canonical factor. The canonical solution demands that each canonical factor be orthogonal to each other factor. This means that the proportion of the variance of a variable which is correlated with one canonical factor, is by definition, orthogonal to all the other factors and that, as a result, if we sum these squared loadings across the canonical variates, we have an index that is analogous to the communality of one matrix factor analysis. Since we are concerned with the interpretation of the canonical problem, we may note that if we multiply the squared canonical loading L_{ij} by the squared canonical correlation λ_j, we will determine the proportion of the variance of the *i*th variable of the criterion set predicted by the *j*th canonical composite of the predictor set. If, for the *i*th variables, we sum across the proportions predicted from each of the canonical composites of the P set, the resulting index is the total proportion of the *i*th variable predictable from the P set. Let us state this more precisely.

Given two sets of variables (designated P and Q), the multiple correlations between each element of one set and all elements of the opposing set can be simply computed. Given a matrix of squared canonical loadings (L_p, where L_p is a variable by canonical variate matrix for the P set), and a column vector of squared canonical correlations (λ),

$$R_p = L_p\lambda$$

where R_p is a column vector of squared multiple correlations between each element of the P set and all elements of the Q set. Thus, in

order to compute squared multiple correlations:

1. Square each element of a canonical loading matrix (forming L_p);
2. Multiply each element of the *j*th column of the L_p by the square of the *j*th canonical correlation (λ_j);
3. The sum of the elements in the *i*th row is the squared multiple correlation of the *i*th variable of the P set with the variables of the Q set.

Since, $\Sigma R^2/M = \bar{R}$, if we compute $R^2 i/\Sigma R^2 i$, we may interpret these proportioned R^2 as indices of the contribution of all the *i*th variable to the canonical solution.

To demonstrate the techniques described above, the authors have reanalyzed data presented by Lohnes (1966), who factored two sets of measures which he termed: 1. Abilities (designated L) and 2. Motives (designated R).

The factors of the Abilities Domain are: 1. Verbal Knowledge; 2. Perceptual Speed and Accuracy; 3. Mathematics; 4. Hunting-Fishing; 5. English Language 6. Visual Reasoning; 7. Color, Foods; 8. Etiquette; 9. Memory; 10. Screening; 11. Games. Those in the Motives Domain are: 1. Business Interests; 2. Conformity Needs; 3. Scholasticism; 4. Outdoors, Shop Interests; 5. Cultural Interests; 6. Activity Level; 7. Impulsion; 8. Science Interests; 9. Sociability; 10. Leadership; 11. Introspection.

Table 3 shows the canonical loadings and correlations for the two sets. Given that $M_L = M_R$ where M is the rank of the sets, all variance is extracted from both sides. Table 2 presents the column

vectors R_L and R_R which contain squared multiple correlations. The mean of the first column ($\bar{R}$) is interpretable as the proportion of set variance predicted by the variables of the opposing set. Column 2 presents each squared multiple correlation as a proportion of the sum of the first column and therefore can be interpreted as the proportion of $\bar{R}$ attributable to each variable. The proportion of left variance predicted by the right set of variables ($\bar{R}_{L.R}$) and the proportion of right variance predicted by the left set of variables ($\bar{R}_{R.L}$) are both approximately .10, indicating relative independence between the two sets. The proportioned R^2 (Column 2 of Table 4) for each variable is useful for describing the area of redundant variance. In the Abilities (left) set, Verbal Knowledge (.270), Mathematics (.207), and English Language (.121) are the important variables. In the Motives (right) set, Scholasticism (.241) and Science Interests (.152) are the major contributors. While the overlap between the two systems is approximately 10 percent, the area of overlap tends to be the result of the relationship between academic ability variables in the left set and academic interest variables in the right set.

The problem to which this section has been addressed is the interpretation of the canonical solution. We have suggested a summary for determining the proportion of variance of one set predicted by another set ($\bar{R}$). The relative contributions of variables to the general index have therefore been proposed as an indication of the relative importance of the variables to the canonical solution. It should be emphasized that $\bar{R}$ is the mean of squared multiple correlations only

TABLE 3

CANONICAL LOADINGS AND CORRELATIONS

Left Set - Columns Are Canonical Factors, Rows Are Tests

1	.766	-.127	.067	-.364	-.349	.321	-.016	-.026	-.129	[illegible]	.011
2	.117	-.180	.105	.516	-.483	.076	-.083	.010	.463	[illegible]	.259
3	.546	.455	-.085	.556	.411	.007	-.024	.006	-.080	.014	[illegible]
4	-.113	.242	-.480	-.029	-.330	-.114	-.689	.074	-.295	.156	[illegible]
5	.304	-.567	-.068	-.079	.316	-.612	-.142	-.030	-.033	.243	.107
6	.075	.142	-.595	-.235	.062	-.074	.287	.437	.390	-.043	.352
7	.076	.015	.041	.045	-.234	-.146	.355	.533	-.176	.390	-.567
8	-.046	-.321	.016	.368	-.137	-.072	-.020	.444	-.397	-.522	.213
9	.087	-.027	-.135	.049	-.095	-.232	-.109	-.123	.536	-.511	-.577
10	-.066	-.198	-.562	.249	-.164	.108	.450	-.493	-.272	-.007	-.120
11	-.072	-.447	-.155	.065	.401	.614	-.239	.257	.127	.116	-.275
R_c	.664	.445	.393	.336	.302	.201	.132	.126	.054	.036	.010

Right Set - Columns Are Canonical Factors, Rows Are Tests

1	-.169	-.189	.334	.401	.206	-.337	-.398	-.261	.301	.004	.436
2	.236	-.473	-.268	.379	-.432	-.091	.491	-.182	.105	.054	.147
3	.763	.188	.136	.259	.141	-.320	.007	.340	-.066	.190	-.137
4	-.116	.302	-.564	-.045	-.350	-.541	-.297	.043	-.002	-.256	.064
5	.262	.002	.459	-.585	-.338	-.162	.135	.076	.234	-.186	.353
6	-.337	.365	.081	.293	-.203	.166	.248	.547	.444	.142	.118
7	.029	.356	.362	.285	-.552	.170	-.158	-.214	-.501	.061	.028
8	.552	.291	-.288	.096	.125	.501	-.215	-.092	.194	-.190	.352
9	-.058	-.553	-.019	-.013	-.318	.353	-.506	.436	-.021	-.131	.024
10	.141	-.002	.231	.290	-.003	-.042	.035	.006	.202	-.714	-.537
11	.048	.078	-.034	-.151	-.285	.139	-.204	-.419	.561	.386	-.432

TABLE 4. PROPORTIONED R^2

Left

Variable	R^2	$R^2_i \,/\, \Sigma R^2_i$
1	.293	.270
2	.067	.062
3	.224	.207
4	.072	.066
5	.131	.121
6	.073	.067
7	.016	.015
8	.043	.039
9	.011	.010
10	.076	.070
11	.078	.072

$$\frac{\Sigma R^2}{M} = \bar{R}_{L.R} = .098$$

Right

Variable	R^2	$R^2_i \,/\, \Sigma R^2_i$
1	.068	.058
2	.118	.101
3	.282	.241
4	.098	.084
5	.114	.097
6	.098	.084
7	.086	.073
8	.177	.152
9	.084	.072
10	.027	.023
11	.018	.015

$$\frac{\Sigma R^2}{M} = \bar{R}_{R.L} = .106$$

when all roots are removed (which is to say, H_q contains R^2 when all roots are considered, but is smaller if fewer than M_q roots are c nsidered). Researchers may, on occasion, wish to impose criteria as to which roots are used (such as significance levels), such that $\overline{R}$ is no longer the mean of squared multiple correlations.

Chapter II

ABILITIES, MOTIVES, SEX, AND SOCIOMETRIC STATUS

Since Moreno (1937) introduced sociometry to the social sciences, sociometric status has been related to countless other indices. Indeed, the technique has become so popular, that not only have numerous journal articles and books been written on the subject, but a whole journal itself has been devoted to the subject. One of the on-going concerns of the researcher utilizing sociometric data, is identifying the correlates of sociometric status. Arguments have been made that people choose each other because their personalities are complementary (Winch, R.F., Ktsanes, T., Ktsanes, V., 1955), because their personalities are the same (Izard, C.E., 1960), because they were placed close together physically (Byrne, D., 1961), or because they held certain personality traits that were generally valued (Bonney, M.E., 1946, Rosenberg, M., 1950). This last line of research is most related to the present study. Indeed, we will look at the personality correlates of sociometric status in our sample. However, we will consider these correlates as descriptions of valued roles in our present adolescent society. Coleman (1963) has pointed out that when we are looking at sociometric nominations, we may consider the sociometric status index as a measurement of the subject's role in contemporary adolescent society. The assumption being, that one who has been evaluated positively, also possesses those traits which are evaluated positively. Since the research method of choice here is canonical

correlation, it should be noted that we are relating personality factors within the individual to the role evaluation accorded him by his peers. This research strategy is considerably different from one in which we are attempting to optimize the prediction of the status of individuals. In the case where we are trying to achieve maximum predictive efficiency, there are numerous parameters that need to be included. For example, it has been shown that not only the personality of the person being chosen should be considered, but the needs of the chooser (Stock, D., 1952). Since we have chosen not to consider tightly defined sub-sets of the data, such as rural southern females, and have decided not to consider the personality, the needs or the demographic characteristics of the chooser, we are essentially attempting to establish a description of the value system utilized by contemporary adolescents in assigning status to other members of their sub-culture.

The Sample

In 1960, over four hundred thousand high school students were tested for two days in 1,353 schools. This program established the data base for Project TALENT, a longitudinal study of American youth. Sociometric data were collected from eight of the TALENT schools with enrollments of between 270 and 600 students. These schools were located in settings which ranged from rural to suburban. Geographically, they represented each of the U. S. Office of Education's continental regions. The students in these schools could be described as coming from middle class homes. The

greatest weakness in the sample is the lack of large lower class metropolitan schools. One problem that arises from the data collection procedures utilized is, that we have no information concerning race or religion of the subjects. The magnitude of this problem becomes apparent when we consider a questionnaire filled out by school administrators. One question was designed to assess the proportion of the school's population which could be considered belonging to a minority group. The minorities represented were: (1) Spanish (Latin-Americans), (2) Orientals, (3) American Indians, (4) Negroes, and (5) French Canadians. One school reported that 20 to 30% of its students were French Canadians, and only two schools reported no minority at all. Even these reporting categories obscure the possibility that either Catholic or Jewish minorities may have been present. The lack of this information serves to make the interpretation of our analysis more difficult. For example, if a student has traits that are usually associated with sociometric status, but this student belongs to a minority and, as a result, has low status, our conclusion would be that our predictor variables are not good predictors of sociometric status. It has been shown that people tend to choose others of the same race and religion, thus, no relationships among abilities, motives and sociometric status may appear in our data, even though they do exist within sub-groupings.

In the present study, only 12th grade students and 7 of the 8 schools were included. The data from the 8th school was omitted because of incompleteness. The analysis was limited to 12th graders

for two reasons; (1) differences associated with maturation would not have to be taken into consideration and, (2) by the end of high school, it is assumed that status should be reasonably stable and the effects of propinquity on status would be minimized. It has been shown that simply sitting close to someone increases the probability of choosing that person as a friend (Byrne, D., 1961). Newcomb (1961) has shown that the effects of propinquity tend to decrease over time.

Sociometric Data

The sociometric data was collected by distributing to each student, two rosters; one containing the names of boys, the other, the names of girls. Each student was asked to nominate three persons of the same sex he (she) liked (hereafter referred to as same-sex acceptance), three he did not like (same-sex rejection), three persons of the opposite sex he liked (cross-sex acceptance), and three persons of the opposite sex he did not like (cross-sex rejection). This procedure resulted in eight categories of information:

1. Males' choices of:
   a. males
   b. females
2. Males' rejection of:
   a. males
   b. females
3. Females' choice of:
   a. males
   b. females

4. Females' rejection of:

   a. males

   b. females

This particular scheme of data collection has both advantages and disadvantages. On the positive side, it allows the researcher to determine, for example, whether certain measures tend to be positively correlated with high sociometric status when males are choosing males, but negatively correlated when females are choosing males. In other words, do males value certain things in a male that females do not? On the other hand, this procedure makes it impossible to consider questions of cohesiveness. Cohesiveness is frequently operationalized as the number of choices a particular sub-group makes within its ranks as opposed to the number of outside choices. In our sample, sex cohesiveness cannot be determined. Assuming each subject made the three choices as directed, the number of within-sex choices is three times the number of subjects. As a result, using a fixed number of choices, our scaling is ipsative.

Since the schools were of different size and the number of boys and girls differed from school to school, if sociometric status is defined as the number of positive choices or rejections a person receives, then the scores would not be comparable across schools or sexes. To counter this problem, all sociometric scores were converted to z scores, and as a result, represent relative standing within a school and sex.

Jamrich has proposed that rather than simply counting up the choices

a person received, we should consider the status of the chooser. A person who receives, for example, five choices from the five most popular students in a class, is considerably different from the person who receives five choices from persons who are themselves rejects, particularly when the subjects are limited to a relatively small number of choices. If, in a class, there is a clique that is rejected or ignored by the class in general, and if each member of the clique chooses other members of the clique, each could then receive enough choices to have at least moderate status. In order to avoid this situation, Jamrich proposed a procedure involving matrix algebra. He recommends constructing a sociometric choice matrix, so that each row represents the choices a subject makes and each column represents the choices a subject receives. The entries are a "one" for a nomination and a "zero" for no nomination. If the 1-0 choice matrix is squared and added to itself ($C + C^2$), the column sums take into account, not only the number of choices a person receives, but the number of choices received by the choosers. This procedure is a variation of the one suggested by Festinger (1949) and Luce and Perry (1949).

Since one of the primary questions to be investigated is whether the variables are related to sociometric status for males and females in the same way, each analysis considered males and females separately.

To accomplish this, six indices of sociometric status were computed for each subject and converted to a z score form: a same-sex acceptance score, a same-sex rejection score, a cross-sex acceptance score, and a cross-sex rejection score. These scores were based on the matrix of

peer nominations and two additional scores were computed from the Jamrich procedure: a same-sex acceptance score and a same-sex rejections score yielding a total of six scores.

The last of these scores (the Jamrich same-sex rejection score) is an unusual sort of index. Since the Jamrich procedure weights the person's status by the status of the people that nominate this individual, and since this is a matrix made up of rejections, it yields a score which is more heavily weighted, if the person that is doing the rejection has also been highly rejected himself. The rationale for the use of this particular index was the assumption that people who have themselves been rejected, should be sensitized to questions of acceptance. As a result, it was theorized, that possibly they would be more accurate in their perceptions of other outcasts. This speculation was derived from the work of Davis, Gardner and Gardner (1941). In this particular study, the observers distinguished six separate social classes in a southern town. However, they noted that members of the upper-most class reported only five, grouping the bottom two together as "Po' Whites." On the other hand, members of the lowest class differentiated between the lowest three, but grouped the upper three as "society." From this, it is possible, that if the most rejected are analogous to the lower socioeconomic groups in the previously cited study, then it may be that while the upper class will only see a group of rather undersirable individuals, and will sprinkle their rejections somewhat at random, those who are actually rejected will have a much clearer view of status differences of those at the bottom of the pecking order.

An alternate procedure was available. If we had wished to speculate that the most important rejection is the rejection issued by a person of high status, then we could have utilized each person's Jamrich acceptance score as a multiplier of his rejection nominations. In other words, when a high status person rejected someone, it would have more impact than a low status person rejecting. However, because of the intriguing possibility suggested by the work of Davis, Gardner and Gardner (1941), it was decided to use the first procedure.

It should be noted, that the Jamrich procedure assumes, that the rows and columr are the same people, as in most sociometric matrices. If it were applied to sociometric choices of one sex to the opposite sex, then we would have different people in the rows and columns, and because of this, the results would be uninterpretable. As a result, Jamrich scores are only available for within-sex nominations.

Measures of Abilities and Motives

The measures of Abilities and Motives used in this study are those derived by Lohnes (1966) in his study of adolescent personality. They are the result of a factor analysis of the TALENT battery. The details of this analysis are discussed in his monograph and briefly in the Appendix. Lohnes conceptualizes two essentially independent dimensions of personality. The first of these, which he refers to as the "Abilities Domain," was developed from sixty performance tests. The second, the "Motives Domain," was developed from thirty-eight typical performance items in the TALENT battery. Each of these domains is defined by eleven factors. In the Abilities Domain, the factors extract fifty-one percent of the variance and the Motives Domain,

fifty-eight percent. There is evidence that these twenty-two factors, which he refers to as the MAP factors (an acronym for "measuring adolescent personality") are capable of doing as much predictive work as the ninety-eight tests from which they were derived (Cooley, W. W. and Lohnes, P., 1968). This evidence leads us to believe that most of the "useful" variance is represented in these factors. Lohnes (1966) has commented that even less factors are probably warranted, but that the chief virtue of reporting 11 factors from each domain is to show that, after this point, each additional factor extracted accounts for so little variance that the extraction is unwarranted.

The use of these factors has two advantages. The first is that they have reduced a battery of 98 tests to 22, which makes the problem of conceptualizing the data easier. The second advantage is that they provide an orthonormal base for the tests, and as a result, when we talk about something, such as math ability, we know that it is not correlated with verbal ability. On the negative side, we have the problem of semantics. In Chapter I of his monograph, Lohnes discusses previous studies which have attempted to derive a factor analytic structure of personality. He notes that, by and large, there is high correspondence between the factors he identifies and those identified by other authors in the area of ability. Nearly all of these studies report a verbal factor, a math factor, etc. It must be noted, however, when we are comparing the results of factor analyses based on different data bases, we may be able to identify verbal ability factors in both batteries, but to say that these factors are identical

across batteries, in terms of the underlying variable that is being measured, is impossible. As a result, we may say that the factor structure reported here seems to be quite similar to other reported factor structures. The limitation, of course, on this is that when we begin to speak of a verbal ability factor, we are in some ways tied to the data from which it was derived. And when we are talking about another set of factors derived from another set of tests, they are not identical. The problem is also complicated somewhat by the fact that all abilities tend to be generally positively correlated. As a result, the math factor is something like math ability with verbal ability partialed out, whereas, math performance in the schools is related both to this math ability and to verbal ability.

The problem of interpretation becomes even more difficult in the Motives Domain. This conceptual domain is very similar to what many test constructors have called personality. The problem here, is that not only are the factors which Lohnes derives based on a different data matrix, but the naming process for these concepts is clouded by the theorist's own conceptual framework. Clinicians, personality theorists, psychiatrists, and psychoanalysts, have generated an immense number of concepts. Both the process of test development and the names applied to scales or factors are effected by the theoretical biases of the investigator. As a result, in some tests, we have a factor identified as aggression. In another battery of tests, we may find a factor identified as aggression and a factor identified as autonomy. But, in the second test, it is difficult to tell conceptually,

which is closer to the factor identified as agression in the first.

We need only look at the various frames of reference, which have generatd our personality tests, to get some notion of the difficulty of equating the labels assigned to factors in one study to scales developed in other studies. The Blackie test (Blum, G., 1950) is oriented toward the psycho-sexual stages of Freudian theory. The Minnesota Multiphasic Personality Index (Hathaway and Starke, 1951) was designed to measure diagnostic syndromes (schizophrenia, psychopathy, etc.) and as a result, the sub-scales have titles which indicate pathology. Another group of tests, such as the California Psychological Inventory (Gough, H. G., 1956-57) and the Edwards Personal Preference Schedule (Edwards, Allen L., 1953-59) are designed to measure traits of personality. Lohnes' motive factors are most akin to this later group, though it must be remembered that he includes four factors which are more like the constructs usually found in interests inventories. An additional problem is that some of these tests are factor analytically derived, some are not. The California Psychological Inventory is not, and as a result, the concepts utilized therein are highly inter-correlated, whereas, Lohnes' are not.

Because of the conceptual difficulties encountered here, we must be very careful not to assume that a factor name, as proposed by Lohnes, measures the same thing as a scale or factor of another test, simply because the concepts seem to be similar. On the other hand, it is extremely difficult to even relate Lohnes' factors to the scales of something like the MMPI (Minnesota Multiphasic Personality Index).

Another problem is that whenever we are considering factors with a number of relatively strong relationships, in which some of the loadings are positive and some are negative, it is possible that the construct title may not accurately reflect the content of the factor. In this case, it is quite easy to begin to reify constructs.

The Relation Among the Different Sociometric Indices.

As a preliminary step, the sex acceptance scores, same-sex rejection scores, Jamrich acceptance scores, and Jamrich rejection scores were intercorrelated for males and for females. Inspection of Table 1 indicates that the intercorrelations are almost identical for both sexes, all correlations being significant beyond the .01 level of confidence. The correlation between acceptance and rejection accounts for approximately eleven percent of the variance in both sexes. Normally, we think of popularity as being a unidimensional continuum. This is an accurate description, if we think of popularity as being defined in the same way as the acceptance scores. From the standpoint of any one person, it is usually possible to rank all the other persons on an effective continuum, running from highly positive to highly negative. Certainly, some people tend to be liked by almost everyone. Others tend to be disliked by almost everyone. For these people, the idea of an unbroken continuum is quite reasonable. However, there are also individuals who tend to polarize opinions. These persons are either rejected or accepted by almost everyone. We might think of these persons as those who polarize opinions. Any position assigned to them on a continuum, such as the acceptance

score, would simply be an average of the number of choices they received from people who liked them and the number of low ratings they received from people who did not like them. From this standpoint, we might consider the rejection score and acceptance score taken together as some sort of an index of social visibility. Indeed, this may indicate some type of leadership quality. At any rate, we may say that acceptance and rejection are neither a continuum nor are they totally orthogonal.

For both the males and the females, the correlation between same-sex acceptance and Jamrich acceptance accounts for slightly over twenty-five percent of the variance. Thus, these two indices measure different things, which is not surprising, considering how the two scores were derived. The same-sex acceptance score might be viewed as an index of a person's general popularity, and as a result, it is probably related to the "image" that this person projects to his peers. The Jamrich type score, on the other hand, is developed by heavily weighting the choices of people who are themselves highly popular. As a result, this score is a measure of membership in the power structure or a measure of acceptance in the "in" clique. If a subject is chosen by a popular person, his Jamrich scores increase materially. He may receive relatively few total choices and still come up with a high score.

Interpersonal attraction has received a great deal of attention in recent years. Attitudinal similarity, propinquity, and such, have been found to be related to friendship choices. As a result, a person

TABLE 1

CORRELATIONS BETWEEN SOCIOMETRIC INDICES

	1	2	3	4
1		-.334	.527	-.277
2	-.326		-.187	.861
3	.523	-.136		-.169
4	-.235	.808	-.093	

Male correlations are above the diagonal line; female below.

1 = Same-sex acceptance
2 = Same-sex rejection
3 = Jamrich acceptance
4 = Jamrich rejection

MEANS AND STANDARD DEVIATIONS OF FACTOR SCORES

	MALES N = 265			FEMALES N = 337		
ABILITIES	TEST	MEAN	S. D.	TEST	MEAN	S. D.
Verbal Knowledge	A 1	50.59	10.19	A 1	47.26	9.58
Perceptual Speed & Accuracy	A 2	45.1[illegible]	8.41	A 2	48.40	7.37
Mathematics	A 3	59.[illegible]	12.47	A 3	38.57	9.57
Hunting-Fishing	A 4	67.43	11.49	A 4	39.03	8.56
English	A 5	38.17	8.99	A 5	60.09	8.57
Visual Reasoning	A 6	58.29	9.02	A 6	45.21	9.10
Color, Foods	A 7	38.10	9.00	A 7	61.06	10.60
Etiquette	A 8	43.54	9.94	A 8	56.07	9.31
Memory	A 9	42.80	9.28	A 9	53.96	9.99
Screening	A 10	57.25	8.52	A 10	49.64	7.45
Games	A 11	52.03	8.67	A 11	44.64	9.33
MOTIVES						
Business Interest	M 1	46.27	10.00	M 1	51.01	9.97
Conformity Needs	M 2	43.02	9.79	M 2	52.78	9.49
Scholarly Interests	M 3	51.23	7.64	M 3	53.25	6.47
Outdoor & Shop Interests	M 4	64.97	11.64	M 4	38.49	10.42
Cultural Interests	M 5	35.87	10.16	M 5	61.24	11.02
Activity Level	M 6	54.24	8.91	M 6	48.46	7.80
Implusiveness	M 7	52.60	9.93	M 7	46.13	10.46
Science Interest	M 8	59.75	10.60	M 8	36.83	10.22
Sociability	M 9	50.25	9.54	M 9	50.15	9.65
Leadership	M 10	48.69	9.97	M 10	48.07	10.26
Introspection	M 11	51.58	9.81	M 11	47.46	9.90

could achieve a high Jamrich score, because he possessed the necessary attributes to be included in a high status clique. This could be because he lives near the people, and holds certain key attitudes valued by the group. It is quite possible, however, that this person, even though he belongs to a high status clique, is, in general, not valued highly by his peers. As a result, this individual would achieve a high Jamrich type acceptance score, indicating that he is in the social power structure, and yet, receive a relatively low total acceptance score, since the bulk of his peers do not value him. One other interesting point is that correlation between same-sex rejection and Jamrich rejection scores accounts for 74 percent of the variance in the male sample, and 65 percent in the female sample. This finding leads us to conclude that while the two acceptance scores measure something somewhat different, the rejected individuals agree with the group in general, as to who the rejects are.
Since the factors are divided into two logical domains, it was decided that not only would the analysis be divided by sex, but Motives and Abilities factors would be treated separately.

Since this study is exploratory in nature, it was decided to leave the Jamrich scores in the criterion set. The inclusion of variables that are weakly related to the canonical regression system naturally dilutes significance of the χ^2 associated with that canonical correlation. But, since we are interested in relationships, rather than significance, this dilution of the criterion set seemed reasonable.

In the present study, we have attended primarily to two kinds of

TABLE 2

CANONICAL CORRELATIONS BETWEEN MALE ABILITY FACTORS AND SOCIOMETRIC STATUS

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	.062	.069	-.374	.712	.007	.033
2	.014	.312	.190	.244	.008	.039
3	.456	.335	-.120	-.042	.031	.148
4	.606	-.542	.060	.064	.061	.291
5	.418	.487	.286	-.048	.037	.178
6	-.312	-.154	-.059	.231	.013	.061
7	-.076	-.167	.214	.082	.003	.016
8	.439	.030	-.225	.081	.022	.104
9	.056	.069	-.519	-.073	.005	.025
10	-.038	-.287	.518	.140	.011	.051
11	.152	.322	.249	-.215	.011	.054

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.098	.011	.558
2	.090	.006	.340
3	.089	.001	.077
4	.065	.000	.025

Total variance extracted from left set = .341
Total redundancy for left set, given right set = .019

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	.772	.568	.274	.080	.089	.289
2	-.847	.502	.085	.152	.096	.316
3	.504	.534	-.654	.182	.055	.184
4	-.705	.314	.144	.620	.064	.211

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.516	.056	.735
2	.239	.017	.226
3	.133	.002	.029
4	.112	.001	.011

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .076

Canonical R		
1	.3284	Chi square for total = 54.51
2	.2673	
3	.1279	N.D.F. = 44
4	.0859	P < .15

information. One is the amount of variance in the sociometric variables predictable from the MAP factors. The other is the contribution of the individual factors to prediction. Methods for obtaining these statistics have already been discussed. The right $\bar{R}$ is accepted as the amount of variance in the sociometric data predicted by the MAP factors. As to the question of contribution of individual MAP factors to the predictions system, there are three alternate indices available: R^2, $\Sigma R_i^2/M$, and $R_i^2/\Sigma R_i^2$. Each of these indices has something to recommend it. The first, R^2, of course, is an index that we are familiar with. It represents a proportion of variance in one variable predictable from the best linear composite of variables in the other set. However, R^2 does not sum to an interpretable number. The second formula, $\Sigma R_i^2/M$, is as has been previously demonstrated equivalent to the $\bar{R}$ associated with that set. In this case, we can look at the contribution of each variable to the total proportion of its set variance accounted for. The third possibility, and the one chosen, $R_i^2/\Sigma R_i^2$, converts the contribution to each variable to proportion and, as a result, they always sum to one. Since the $\bar{R}$ is computed, we know the proportion of the variance of a set which is accounted for by the other set. By converting to proportions, it is somewhat easier to see how much each variable is contributing to the total $\bar{R}$. (See Table 2.)

Seven and six tenths percent of the variance in the sociometric variables is predictable from the Ability factors. By far, the most important predictor is Hunting and Fishing Knowledge (29 percent). The next most important are English (18 percent) and Mathematics (15 percent).

The only other factor exceeding ten percent is Etiquette.

The relationship between Abilities and sociometric status when females choose other females (Table 3) is somewhat different. The Ability factors account for six and one tenth percent of the variance, which was slightly less than that when males chose males. The total canonical correlation is significant at a level beyond ten percent. This increased significance is the result of the larger sample size of the females (337 females to 265 males). Since no formula is now available to establish confidence limits for the $\overline{R}$ statistics, it is a moot question as to whether these two $\overline{R}$s are significantly different across sexes. The pattern of importance of factors in predicting sociometric status from Ability data when females chose females is different than when males chose males. English dominates the female set (27 percent). The other important factors are Verbal Knowledge (13 percent), Screening (12 percent), Perceptual Speed and Accuracy (12 percent), and Memory (10 percent). The different results for males and females demonstrate the role differences in our culture. For example, Hunting and Fishing are male oriented activities, hence knowledge in these areas is a most important predictor of sociometric status for males, but is unimportant in predicting female status. It is instructive to consider the mean differences on this factor across sexes. For males, the mean of the factor scores is sixty-seven percent and for females is thirty-nine percent (see Table 1).

We should note that the most important predictor among females and the second most important among males is English. From this, we

TABLE 3

CANONICAL CORRELATIONS BETWEEN FEMALE ABILITY FACTORS AND SOCIOMETRIC STATUS

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	.423	.095	-.275	.117	.021	.130
2	.194	.671	-.216	-.085	.019	.117
3	.026	.056	-.424	.186	.004	.027
4	.002	.053	.147	-.115	.001	.004
5	.630	-.163	.079	-.201	.043	.269
6	.182	-.059	.656	.477	.015	.094
7	.196	-.011	-.179	.786	.012	.076
8	.008	.291	-.114	.286	.004	.024
9	.155	.566	.443	-.048	.016	.102
10	-.401	-.237	.089	-.125	.019	.118
11	.212	-.226	-.056	-.033	.006	.040

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.083	.009	.599
2	.092	.003	.192
3	.092	.002	.129
4	.096	.001	.079

Total variance extracted from left set = .363
Total redundancy for left set, given right set = .015

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	.863	.489	-.024	.124	.086	.350
2	-.615	.518	-.373	-.463	.053	.217
3	.493	.351	.635	-.480	.040	.167
4	-.685	.729	-.022	-.004	.066	.267

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.459	.048	.787
2	.290	.009	.145
3	.136	.003	.045
4	.115	.001	.023

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .061

Canonical R

1	.3242	Chi square for total = 57.56
2	.1751	
3	.1430	N.D.F. = 44
4	.1098	

$P < .10$

see that some factors operate in approximately the same way across sexes. In a previous discussion, we pointed out that the English factor is orthogonal to Verbal Knowledge. If we view English as a measure of communication skills, we may speculate that this measures a person's ability to "contact" his peers. Since the nominator is responding to the nominee as he perceives him, it may be that a high score on the English factor indicates an ability to communicate, and as a result, it is possible for this person to be more influential. However, it may also be highly correlated with sociometric status and may be reflecting nothing more than the well documented fact that high sociometric individuals also tend to have high sociometric status.

For females, Verbal Knowledge was the second best predictor of sociometric status. For males, it was next to the poorest. Since Verbal Knowledge is also related to socioeconomic status, this tends to throw some doubt on the previous hypothesis.

The mean on this factor is slightly higher for males than it is for females, and yet, it is not a good predictor for males and it is for females. Since the technique being utilized is correlational in nature, it is impossible to specify cause and effect. It seems probable that girls value academic achievement more highly than do males, and since Verbal Knowledge is highly related to general academic performance, it may be that girls with high Verbal Knowledge tend to do well in the school setting, and, as a result, are valued by other females. If males do not prize this academic orientation as highly as the females, then the fact that Verbal Knowledge is possessed more highly among males may not be related to sociometric status. While this comment is purely

speculative in nature, it may be that the higher mean level of Verbal Knowledge possessed by males is an artifact of a selective dropout rate. If the duller girls tend to stay in school through high school, even when they are not good scholars, then it may be that the male population is biased with weaker students dropping out, and yet, since high grade point average is not a highly valued attribute for males, it may have a little predictive power in a regression equation.

This same phenonemon is reflected in Screening. This factor measures either functional illiteracy or negativism (at least toward authority, since the tests were administered by the schools). Since our subjects are twelfth graders in what seem to be average to good schools, it would seem that in our sample, a high score is probably a measurement of negativism.

In the male sample, Screening contributes only slightly to the canonical solution. For the females it is more important, but it loads negatively on three of the four canonical factors of the Abilities set. This implies that Screening is negatively related to sociometric status. In other words, the higher a female scores on this factor, the lower she tends to be in sociometric status. From this, it seems reasonable to speculate that males do not respond strongly to negative behavior, either by rewarding or punishing, in terms of sociometric choices. However, females tend to withhold postive choices and assign negative choices to the nonconformer (i.e. negative scoring female). This does not mean that a male achieves popularity by rule-breaking behavior.

We get a note of moderation from the Etiquette factor. This

factor was important for males, but not for females--a surprising result, until we looked at the mean differences. Females surpassed males on this factor by a margin of fifty-six to forty-three (see Table 1). Thus, it is possible that the relationship is curvilinear. This is a speculation which has not been tested empirically, but if it is the case, it would explain our results. If the correlation between Etiquette and sociometric status is positive both for males and females to a point around fifty and then becomes trivial, we could explain our situation. What could create this particular arrangement? If Etiquette is viewed as something which society demands to a certain extent, then it may be that most males are rewarded as they approach this minimum, but that most females are at a point where more Etiquette Knowledge is not rewarded. Since most males fall below fifty and most females above it, and if the relationship is curvilinear, an expected minimum may exist. This interpretation is made very tentatively. It should also be noted that there is a distinction between knowledge and action. The Etiquette factor measures knowledge, not how the individual behaves in a given situation.

Two other factors are important in the female sample: Perceptual Speed and Accuracy and Verbal Knowledge. As has been mentioned before, this investigation was conducted with a correlational technique, and as a result, cause and effect are hard to specify. If the speculation that high grade point average is more valued by females than by males is correct, it may be that both Perceptual Speed and Accuracy and Verbal Knowledge tend to contribute to grade getting ability. Lohnes has suggested that Visual Reasoning may be another component of general intelligence, and as a result, related

to grade getting ability. The Perceptual Speed and Accuracy factor is also related to the kinds of activities necessary for doing well in typing, bookkeeping and other such courses that many females take.

Among the males, the only other highly related factor that has not already been considered is Mathematics. This is a knowledge somewhat like Hunting and Fishing, in that males score much higher than females on this factor. The mathematically oriented professions: engineering, physics, etc., tend to be viewed as appropriate professions for the male, and as a result, it seems likely that this ability is viewed as a male-role appropriate skill. Again, it may not cause high sociometric status, but a male who accepts a highly male oriented value system may tend to work harder in math than in some other areas.

In summary then, we see some similarities and some differences. Both males and females seem to be rewarded for communication skills. As was previously speculated, this may simply mean that those who can communicate better are more effective in their relationships. It may also mean that this skill is found in middle-class homes and that higher socioeconomic status is related to higher sociometric status. In terms of sex-appropriate roles, males seem to value maleness of knowledge--in other words, ability in areas that are associated with the male role in our culture. Females also value sex-appropriate abilities, but these factors among females tend to be those correlated with getting along in the high school setting, making good grades and not expressing negativism, rather than with career oriented skills.

The second domain for which Lohnes has derived factors is Motives,

which he divides into two sets. One set is oriented toward Personality Needs in the Murray tradition: 1) Conformity Needs; 2) Scholasticism; 3) Activity Level; 4) Leadership; 5) Impulsion; 6) Sociability; and 7) Introversion. The other set is comprised of Interests: 1)Business Interests; 2) Outdoor-Shop Interests; 3) Cultural Interests; and 4) Science Interests.

The Motives factors account for eight and two tenths percent of the variance in the sociometric measures among males (see Table 4); the total canonical is significant at $P<.005$. Thus Motives are somewhat better predictors of sociometric status than Abilities. As far as the contribution of each factor to predictability is concerned, Business Interest, Scholasticism, Impulsion, and Introversion are the least important. The major contributions are made by Outdoors-Shop Interest (16 percent) from the Interests group, and Sociability (14 percent) from the Personality Needs group. Five of the factors cluster around ten percent. Conformity is positively related to sociometric status, as are Science Interest and Leadership. The overall relationship of Cultural Interest and Activity Level to status seems to be negative.

When females choose other females, the Motives factors account for only five and eight tenths percent of the variance, compared to eight and two tenths percent for the males. However, a more clear-cut pattern emerges here than in the male data. The overwhelming predictor here is Leadership (25 percent). Conformity (12 percent) and Sociability (10 percent) are the next most important factors. Among

TABLE 4

CANONICAL CORRELATIONS BETWEEN MALE MOTIVES FACTORS AND SOCIOMETRIC STATUS.

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

					R^2	$R_i^2/\Sigma R_i^2$
1	-.015	.023	.392	.076	.005	.017
2	.309	.114	-.624	.182	.030	.105
3	.221	.403	-.162	.001	.019	.069
4	.449	-.364	-.131	-.427	.046	.164
5	-.396	-.139	.247	-.049	.031	.109
6	-.108	-.611	.016	.324	.027	.094
7	-.251	.172	.025	.391	.015	.052
8	.399	-.107	-.077	.510	.032	.112
9	.376	.217	.592	.331	.039	.140
10	.366	.351	.191	-.067	.032	.115
11	-.068	.114	-.348	.228	.006	.021

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.092	.016	.637
2	.084	.005	.206
3	.106	.003	.124
4	.083	.001	.034

Total variance extracted from left set = .365
Total redundancy for left set, given right set = .026

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

					R^2	$R_i^2/\Sigma R_i^2$
1	.590	.710	.315	.220	.096	.293
2	-.745	-.167	.317	.563	.106	.317
3	-.145	.967	-.112	-.174	.063	.195
4	-.562	-.126	-.109	.810	.064	.195

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.310	.055	.664
2	.371	.023	.282
3	.056	.002	.020
4	.263	.003	.033

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .082

Canonical R

1	.4195	Chi square for total = 78.86
2	.2501	
3	.1731	N.D.F. = 44
4	.1023	
		P < .005

TABLE 5

CANONICAL CORRELATIONS BETWEEN FEMALE MOTIVES FACTORS AND SOCIOMETRIC STATUS

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	-.006	-.264	-.236	.415	.008	.040
2	.402	.003	-.581	.198	.022	.118
3	.284	-.192	.397	.301	.014	.074
4	.348	-.033	.004	-.513	.014	.074
5	.210	-.194	-.056	-.128	.006	.034
6	-.226	.277	-.473	.141	.014	.076
7	-.388	.252	.151	.087	.018	.093
8	.124	.251	.232	.565	.010	.055
9	.126	.544	.112	.202	.020	.104
10	.574	.562	.103	-.092	.048	.254
11	-.251	.391	-.030	-.143	.015	.079

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.094	.008	.480
2	.101	.006	.347
3	.080	.002	.105
4	.091	.001	.067

Total variance extracted from left set = .366
Total redundancy for left set, given right set = .017

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

					R_i^2	$R_i^2/\Sigma R_i^2$
1	.906	.307	.236	.172	.080	.345
2	-.494	.497	.329	-.633	.044	.189
3	.776	-.221	-.048	-.589	.060	.262
4	-.345	.728	-.220	-.550	.047	.203

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.446	.039	.683
2	.230	.014	.236
3	.054	.001	.021
4	.270	.003	.060

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .058

Canonical R		
1	.2969	Chi square for total = 62.16
2	.2430	
3	.1507	N.D.F. = 44
4	.1128	
		P < .05

males, the relationship of Motives to sociometric status is somewhat complicated, but among females it seems to be more clear-cut.

When males and females are contrasted, it is clear that male popularity as awarded by other males is more predictable than female popularity as awarded by other females. This result may be due to physical attractiveness, since this is more important in females than in males. An unattractive girl, with the kind of scores on these factors that should predict high status, does not receive it. Remember that while sociometric status has been converted to z scores to adjust for the size of the samples, the original scaling is ipsative, and as a result, one girl is chosen, another is not. Although we are considering the choice of females by other females, it must be noted that attractiveness is simply more important for females in our contemporary culture than it is for males. The factors operate quite differently within the two sex groups. In the Ability set for males, the factor that is clearly masculine (Outdoor-Shop Interest) is dominant, followed by Sociability. Sociability is also important in the female set, but among females, Leadership is the clearly dominant factor. It may be noted here that it is possible that Sociability is our friendliness factor. Bonney (1946) has shown that the frequent finding of little relationship between personality tests scores and sociometric status is simply the result of what the tests measure. In his study he compared standardized personality tests and tests which measured personality traits such as loyalty and dependability. In his study the scales which measured those behaviors related to interpersonal relations were much better predictors than the standard

personality inventories.

Among females, Leadership is the dominant factor, since this factor is defined primarily by the sub-scale which measures the Leadership position (Lohnes, P., 1966). In some senses, this factor is contaminated. If we view sociometric choices as votes, we already know that people who score high on this scale have tended to receive votes for offices, and to the extent that popularity is correlated with office-holding, then they measure the same thing.

When males choose males or when females choose females, conformity tends to be important in both sets. Science Interest is important among males, but not so among females. However, this is consistent with our previous findings that males prize masculine traits. In the same way, females do not penalize other females for Cultural Interests, while males seem to view this interest as inappropriate for males, and as a result, penalize those males who are high on this factor. Activity Level is penalized in both groups, but more so by males. Since this Activity Level is orthogonal to Leadership, it may be a rejection of the eager-beaver who is not accepted. Rosenberg (1950) has also reported that rejected members of groups tend to be compulsive, competitive and energetic.

Overall, males seem to prize masculine traits, whether Abilities or Interests, and the ability to be friendly and communicate easily. For females, the more obviously sex-oriented Abilities, i.e., Etiquette, seem to be less important in their choices. We have seen that females tend to accord high status to females who do well on Ability factors

associated with achieving good grade point averages. In the Motives domain, the most highly prized trait is Leadership. From this, we speculate that what is prized among females is good academic citizenship, since making good grades and being active in school activities are usually considered evidence of good citizenship in the schools.

One might ask why abilities and motives were not related to sociometric status simultaneously. Research has indicated that the factor structure across domains is nearly orthogonal (Chapter I). If they were totally orthogonal, then we could simply sum the right $\overline{R}$s to find out what proportion of the variance of the sociometric variables is predictable from the two domains. Since the overlapping information is about ten percent, it is possible that this is also the predictive variance. To determine this the 22 factors were run against the four sociometric variables for males and for females. In the males, the right $\overline{R}$ for Abilities was .076, and for the Motives .082. These sum to fifteen and eight tenths percent of the variance. In the 22 factor canonical, the right $\overline{R}$ was .140, which means the difference is less than two percent. Therefore, each set of factors predicts a different part of the sociometric data. In the female data, the two sets taken separately add to eleven and nine tenths percent, whereas, in the 22 factor solution, eleven and one tenths percent was accounted for. This finding leads us to believe that a person is responded to in toto. The behavior associated with these factors, as well as other behaviors, function as cues by which the observer creates a gestalt of the person.

So far, we have only considered the case where sociometric choices are made within a set. What happens when males choose females and

and vice versa? Do they evaluate persons of the opposite sex in the same way they do persons of the same sex? For this portion of the analysis, we will not consider Jamrich type scores. Since this procedure assumes that the same person is represented by a row and a column of the sociometric matrix, the index would be uninterpretable when he is not (and impossible to compute when there are more choices than chosen, since the matrices are not comfortable for multiplication).

When females choose males (see Table 6) the pattern of the Ability factors is more like the one they use for females, than the one males use for other males, in that English (41 percent) is by far the most important factor. The only other two factors of importance are Hunting and Fishing (12 percent) and Etiquette (16 percent). The Ability factors account for 9.1 percent of the variance in the sociometric data and the significance of the total canonical correlation is less than the one percent leve.

When males choose females (see Table 7), Abilities play a less important role than in the within-sex choices of males. The proportion of variance accounted for drops to 3.6 percent and the significance goes to less than the 50 percent level, which indicates a chance relationship. Some of the factors do moderately well in predicting status, but the degrees of freedom associated with those that do not dilute the significance of the solution. If we look with caution at the factors that seem to be important, we see Screening accounts for 27 percent of the right $\overline{\overline{R}}$. Apparently, males do not object to other males having a negative attitude, but penalize a female for

TABLE 6

CANONICAL CORRELATIONS BETWEEN MALE SOCIOMETRIC STATUS AS ASSIGNED BY FEMALES AND MALE ABILITY VARIABLES.

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

			R_i^2	$R_i^2/\Sigma R_i^2$
1	.235	.187	.008	.051
2	.097	-.311	.004	.027
3	.298	.156	.012	.076
4	.104	-.760	.020	.122
5	.715	-.120	.066	.412
6	-.239	.028	.007	.046
7	-.001	.073	.000	.001
8	.437	-.131	.025	.156
9	.143	.396	.008	.047
10	-.214	-.207	.007	.045
11	-.143	-.028	.003	.016

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.092	.012	.809
2	.088	.003	.191

Total variance extracted from left set = .180
Total redundancy for left set, given right set = .015

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

			R_i^2	$R_i^2/\Sigma R_i^2$
1	.916	.402	.112	.615
2	-.634	.773	.070	.385

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.620	.079	.869
2	.380	.012	.131

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .091

Canonical R

1	.3576	Chi square for total = 43.54
2	.1773	

N.D.F. = 22

$P < .01$

TABLE 7

CANONICAL CORRELATIONS BETWEEN FEMALE SOCIOMETRIC STATUS AS ASSIGNED BY MALES AND FEMALE ABILITY FACTORS

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

			R^2	$R_i^2/\Sigma R_i^2$
1	.544	-.156	.015	.187
2	.093	-.358	.003	.041
3	.273	-.222	.005	.059
4	.042	.035	.000	.001
5	.436	.331	.012	.146
6	.335	.399	.009	.113
7	.500	-.063	.012	.154
8	.047	.074	.000	.003
9	.005	-.196	.001	.011
10	-.581	.489	.022	.272
11	-.048	.207	.001	.013

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.116	.006	.777
2	.073	.002	.223

Total variance extracted from left set = .189
Total redundancy for left set, given right set = .007

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

			R^2	$R_i^2/\Sigma R_i^2$
1	.997	-.079	.048	.659
2	-.327	-.945	.025	.341

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.550	.027	.728
2	.450	.010	.272

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .036

Canonical R

1	.2196
2	.1485

Chi square for total = 23.67

N.D.F. = 22

$P < .5$

for this behavior, as do females when choosing other females. Verbal Knowledge (19 percent), English (15 percent), and Visual Reasoning (11 percent) also enter in. At this point, it seems as if they are rewarding good citizenship in the schools, as did females when choosing females. Color-Food is also important (15 percent), which is, of course, a femininity variable.

In general, it seems that a double standard is implied by the data in that both sexes agree that a girl must be a good academic citizen to be popular, while no such constraint is laid on males. As was pointed out earlier, some of the factors seem to be effective predictors, but overall, the canonical correlation is not significant, implying that Abilities simply are not too important when males choose females. This finding is reasonable when we consider that in our culture a woman's attractiveness is not usually based on her abilities to any substantial extent.

The Motives domain in cross-sex choices really comes into its own (see Table 8). When females choose males, the Motives factors account for a whopping fifteen and three tenths percent of the variance. The total significance is beyond the one percent level. The most important factors are Outdoor-Shop Interests (24 percent), Leadership (19 percent), and Scholasticism (19 percent).

Motives are also potent when males choose females. (See Table 9.) These factors account for eight and nine tenths percent of the variance in the sociometric choices and the significance is lower than the one percent level. Leadership accounts for forty-five percent of the right $\overline{R}$.

TABLE 8

CANONICAL CORRELATIONS BETWEEN MALE SOCIOMETRIC STATUS AS ASSIGNED BY FEMALES AND MALE MOTIVE FACTORS.

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

			R^2	$R_i^2/\Sigma R_i^2$
1	.292	.248	.022	.062
2	.333	-.269	.028	.079
3	.573	.039	.067	.186
4	-.393	-.828	.085	.238
5	.069	.394	.013	.037
6	-.012	.095	.001	.002
7	-.272	.143	.017	.046
8	.180	.224	.011	.029
9	.375	-.268	.034	.095
10	.580	-.046	.068	.191
11	-.195	-.252	.013	.035

Factor	Variance Extraction	Redundancy	Proportion of Total Redundancy
1	.119	.024	.738
2	.108	.009	.262

Total variance extracted from left set = .227
Total redundancy for left set, given right set = .033

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

			R^2	$R_i^2/\Sigma R_i^2$
1	.969	.246	.195	.640
2	-.499	.866	.110	.360

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.594	.121	.790
2	.406	.032	.210

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .153

Canonical R

1	.4505
2	.2808

Chi square for total = 79.71

N.D.F. = 22

$P < .01$

TABLE 9

CANONICAL CORRELATIONS BETWEEN FEMALE SOCIOMETRIC STATUS AS ASSIGNED BY MALES AND FEMALE MOTIVE FACTORS.

Factor structure for left set.
Columns are canonical factors. Rows are MAP factors.

			R^2	$R_i^2/\Sigma R_i^2$
1	-.205	-.350	.010	.054
2	.221	-.266	.009	.049
3	.406	-.403	.029	.151
4	.117	-.095	.002	.012
5	.189	-.033	.005	.026
6	.088	.087	.001	.007
7	-.098	.573	.013	.070
8	.229	.087	.008	.040
9	.373	.209	.021	.109
10	.770	.320	.087	.451
11	.156	.265	.006	.031

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.103	.014	.823
2	.084	.003	.177

Total variance extracted from left set = .187
Total redundancy for left set, given right set = .018

Factor structure for right set.
Columns are canonical factors. Rows are sociometric variables.

			R^2	$R_i^2/\Sigma R_i^2$
1	.995	-.102	.140	.780
2	-.151	.989	.039	.220

Factor	Variance Extracted	Redundancy	Proportion of Total Redundancy
1	.506	.071	.796
2	.494	.018	.204

Total variance extracted from right set = 1.000
Total redundancy for right set, given left set = .089

Canonical R

1	.3751	Chi square for total = 62.47
2	.1922	

N.D.F. = 22

$P < .01$

Scholasticism is fifteen percent and Sociability, nineteen percent. Comparing males and females, we note that when females choose males, they accent Outdoor-Shop Interests, which is a factor males use in choosing other males.

Males stress Leadership when they choose females, to almost twice the extent females do when choosing other females (45 percent to 25 percent). Both sexes stress Scholasticism in their cross-sex choices, which is surprising, since it is not particularly important in within-sex choices for either sex. Males emphasize Leadership in cross-sex choices, while females value Sociability. When we compare cross-sex patterns for males and females, we note that the most important factor for within-sex choices by either sex also turns out to be the most important factor when they are choosing members of the opposite sex. However, surprisingly, the second most important factor for choices within-sex turns out to be less important in the cross-sex case for both males and females. When choosing across sexes, the second most important factor is the factor that was the most important for status with the chosen sex. To illustrate, remember that when boys choose boys and status is related to Motives, the best predictor is Outdoor-Shop Interests, and the second best is Sociability. When females choose males, the best predictor is still Outdoor-Shop, but the second best predictor becomes Leadership, which was the best predictor when girls chose other girls. We may speculate that sociometric status has two somewhat distinct roots. On one hand, when a girl chooses a boy, she is expressing her personal preference for this boy. Another

root of popularity is the status this boy holds among other males. The girl may choose him, not because of his personal attractiveness, but because he has high status among other males and is desirable as a person who has status. If we trace the social development of children, we can find some basis for this speculation. Younger children tend to play primarily within their own sex groups and certain personality traits are related to sociometric status. As children grow older, they begin to socialize more extensively across sex lines. When it turns out that the best cross-sex predictor is Outdoor-Shop for a girl choosing a boy, she may simply be acknowledging that he has status among males and that Outdoor-Shop is correlated with this status. On the other hand, since the second best predictor is Leadership, a trait which girls depend on heavily to evalute other girls, it may mean that she is also applying some of the standards across groups that she has learned to use within her group. From this, we may speculate that if girls choose boys because they are popular with other boys, then both sexes should use the same pattern of factors. Since the first factor is the same, we get some support for this notion. But, since the second factors change as they do, we must acknowledge that they they also use some portions of the choice pattern customarily reserved for choices within sex.

We previously noted that a double standard seems to exist in within-sex choices. Males are rewarded for maleness of interest and personality, but females are rewarded for being good citizens. A similar pattern emerges for cross-sex choices: males stress Leadership and females stress Outdoor-Shop Interests.

One of the most interesting comparisons deals with the amounts of variance in the sociometric data extracted by the various analyses. Since the Jamrich-type scores are less predictable, the analysis which does not include them tends to have higher $\overline{R}$s. In cross-sex choices, female status is much less predictable than that of males. This result is almost undoubtedly due to the importance of physical attractiveness in female status. In within-sex choices for both sexes, Motives are only slightly more important than Abilities, probably indicating that people of the same sex take a more balanced view of the same sex peers, but that Motives-type factors are more related to the content of cross-sex contacts. The tendency toward greater predictability in cross-sex choices may reflect a lower proportion of sociometric choices based on propinquity. Girls are thrown with girls for many activities and the same is true with boys. As a result, some within-sex choosing is based on such chance events as two boys being on the basketball team.

As we have looked at this data, we have considered many statistical indices. What conclusions can we draw from this data? Many of the conclusions will be quite obvious. However, in many ways, this is to be expected. Social psychology has been defined as the science of the obvious and yet, our folk language tells that "A stitch in time saves nine," but "Haste makes waste." Frequently the obvious things only seem obvious after they have been pointed out.

At a very general level, we have seen that the sociometric status of males, as accorded by other males, is related to having interests, personality characteristics, and abilities that conform to the

cultural image of the male. In the Abilities areas, there was considerable stress on those factors that are related to future careers which are more frequently pursued by the males. When females choose other females, again the pattern that developed stressed a female appropriate role. In this case, there was more of a tendency for the female Abilities and Motives to be related to fitting with the demands of the school. In the cross-sex choices, we found a tendency for the use of some of the standards that were utilized in choosing within their own sex and some of the standards that were utilized by members of the other sex. This is not particularly surprising when we realize that there are some standard expectancies that apply to individuals regardless of sex, and some standard expectancies that apply to members of one sex only, or at least apply much more strongly. The results of this study generally conform to the findings of Gordon (1957) and Coleman (1961). In both of these studies it was found that social status among girls was related to normative behavior, particularly to such things as Leadership ability and their success in roles considered appropriate for females. In the case of males in the two studies just cited, we find that one of the very strong indicators of prestige for a male is athletic prowess. In our study, such information was not considered and as a result, it had no chance to show up in the analysis. Since the original plan was to relate sociometric status to the MAP factors as developed by Lohnes, athletic prowess among males as well as physical attractiveness among females are attributes that we may only speculate about.

In any study of this type, much of the predictive power is lost

because some significant parameters are not included in the model, such as not having an index of attractiveness for females or a measurement of athletic prowess for males. We also do not have race or religious information. Situational factors such as the number of contacts that existed between individuals are also not included. As we have mentioned previously, propinquity has been found to be related to attraction. The same is true of attitudinal similarity.

Throughout these findings, we have seen a suggestion of socioeconomic status. This variable was purposely also not included in the study. Williams (1967) has shown that it is highly related to the MAP factors, but by the same token, the variance accounted for by socioeconomic status is also accounted for by these factors. It would have been possible to remove the effect of socioeconomic status from the factors (creating a part-canonical solution), but so much variance would go out of such factors, as Verbal Knowledge, that it would be impossible to name or interpret the remaining portion.

Hopefully, the present study demonstrates a utilization of what the authors consider a valuable technique. By utilizing the canonical solution with $\overline{R}$, and the proportioned squared multiple correlations we are able to look at the way two sets of variables are related in multiple populations, and then to select the variables which seem worth while for additional, more intensive study.

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APPENDIX

Project TALENT constitutes a massive data base from which one can select variables for analysis. It is not unusual to be confronted by numerous variables, all of which possess face validity with respect to the intended theoretical domain. To simplify the problem of conceptualizing the data, one may either discard variables, or form indices which are composites of the original variables. This latter approach is generally to be preferred, in that increasing information increases the reliability of measures. In the case of the studies included in this monograph, 60 Abilities and 38 Motives measures have been reduced to 22 variables. The technique used to form the composite indices is known as factor analysis.

Given a correlation matrix of M variables (where the rank of the matrix is assumed equal to the order), the principle components supply an orthogonal basis for the M dimensional space. A few of the principle components may be accepted as indices of the domain in question. It is often the case, however, that the principal components are not themselves clearly interpretable (i.e., they do not possess face validity for any of our theoretical constructs). Given that any orthonormal transformation of an orthonormal basis for a space also spans the space, we may rotate the basis supplied by the characteristic roots and vectors. For various reasons, we normally accept a model of reduced rank for rotation. Thus, we may select the first four roots for rotation. It should be noted that as in the case of the full rank model, rotation of a reduced rank model spans the reduced

space.

Lohnes chose to take a sample of ninth grade boys, a sample of ninth grade girls, a sample of twelfth grade boys and a sample of twelfth grade girls for his analysis. Mean differences are associated with these four groups and as a result, if the raw scores are poured into a correlation, we find a correlated means effect. This essentially means that two variables may be practically uncorrelated within any of these cells, but that twelfth graders tend to score higher on both variables than do ninth graders, and as a result, when all cells are taken together, a spurious correlation arises.

A second way of approaching the problem is to compute a pooled correlation matrix. In the first chapter of this monograph, we present a canonical correlation between the Motives and Abilities reported by Lohnes. For this analysis the matrices were pooled. Our correlation matrix of supposedly orthogonal elements has off diagonal correlations in the neighborhood of .04, because the factors were derived using the first procedure.

A third approach to this problem was employed by Lohnes. In addition to the test scores, he developed two binary vectors representing sex and grade. In the sex vector and the grade vector, one sex was zero and the other was one. He intercorrelated these scores, developing point biserial correlations between sex, grade, and the tests. He then passed a factor through sex, removing all variance associated with sex from the correlation matrix. He repeated the procedure for grade, leaving a residual matrix free of sex and grade

related variance. This was the matrix submitted to principal components factor analysis. It should be noted he dealt with Motives and Abilities separately, following the same procedure in both cases. As a result, the factors in each domain are orthogonal within the domain, but not necessarily orthogonal across domains. The canonical correlation mentioned previously deals with the relationship between the domains.

Lohnes' factors are:

1. Verbal Knowledges.

   This is the most important factor in the Abilities set. Every one of the sixty subscales is correlated with this factor. This is close to general intelligence. Lohnes (1966, pp. 3-30) says, "VKN is a general source of variance in acquisition and retention of the many subordinate specific knowledges from which lighter level achievement descends."

2. Perceptual Speed and Accuracy.

   The title is self-explanatory. This factor is made up of four highly speeded scales. The intercorrelations between these scales are rather low.

3. Mathematics.

   Lohnes views this factor along with Verbal Knowledge and English Language as the core educational achievement traits. This factor is located by three math tests and the Physical Science Information Test. Surprisingly, arithmetic does not come out on this factor.

4. Hunting-Fishing.

   This factor measures knowledge of Fishing and Hunting.

5. English Language.

As is demanded by the factor analytic solution, this factor is orthogonal to Verbal Knowledge. It measures knowledge of the mechanics of the language and communication skills.

6. Visual Reasoning.

This factor is very similar to what is frequently called spatial ability. It is also highly related to mechanical and abstract reasoning ability. Lohnes points out that it might be viewed as a second orthogonal component of intelligence.

7. Color-Foods.

Again, the factor name is adequate. This factor measures knowledge in these two areas.

8. Etiquette.

This factor is defined by the Etiquette information test.

9. Memory.

This factor measures two kinds of memory. One is the memory for meaningful sentences over a period of fifteen minutes. The other is immediate recall of English equivalents of essentially meaningless words.

10. Screening.

This factor is defined by the Screening information tests which are composed of items so simple that only functional illiterates or extremely negative subjects could miss them.

TABLE A: ABILITIES DOMAIN

Design Factors	Variance Extracted	
Sex	5.7%	
Grade	7.8%	
	13.5%	13.5%

Ability Factors:

Number	Factor Name	Variance Extracted	
A 1	Verbal Knowledge	18.7%	
A 2	Perceptual Speed & Accuracy	3.6%	
A 3	Mathematics	4.1%	
A 4	Hunting-Fishing	2.2%	
A 5	English	6.6%	
A 6	Visual Reasoning	5.3%	
A 7	Color, Foods	1.9%	
A 8	Etiquette	1.6%	
A 9	Memory	2.1%	
A 10	Screening	3.3%	
A 11	Games	1.5%	
	Total extracted by Abilities factors:	50.9%	
		Total:	64.4%

11. Games.

This is also a one-test factor. The Games test measures knowledge of sedentary games, such as checkers, chess, and bridge.

The factors of the Motives domain are largely defined by their names:

M1. Business interest.

This factor is defined in terms of interest in the activities of businessmen (giving orders to employees, etc.).

M2. Conformity needs.

This dimension is largely a measure of the extent to which the adolescent subscribes to the middle class mores of American society.

M3. Scholarly interests.

This factor is associated with curriculum, study habits, grades, and courses.

M4. Outdoor and Shop interests.

This dimension is defined by hunting, fishing, mechanical and similar sex-linked indicators.

M5. Cultural interests.

This factor is correlated with museum visiting, playing a musical instrument, etc.

M6. Activity level.

This dimension is defined primarily by work, hobbies, and associational membership.

M7. Impulsiveness.

This factor is defined by an Impulsiveness scale (with a loading of .89 on this factor).

M8. Science interest.

This dimension is dominated by interest in physical science and is sex linked (i.e., males are higher than females).

M9. Sociability.

This factor is defined in terms of frequency of dating and other social activities.

M10. Leadership.

This dimension is defined by items requesting number of leadership positions held (e.g., captain of athletic team, officer of a club, chairman of a committee).

M11. Introspection.

This facto .east clear in its significance (as well as explaining the least variance of the eleven motives factors) and is largely defined by extra-curricular reading and self-confidence.

TABLE B: MOTIVES DOMAIN

Design Factors	Variance Extracted	
Sex	9.1%	
Grade	4.2%	
	13.3%	13.3%

Motives Factors:

Number	Factor Name	Variance Extracted	
M 1	Business Interest	8.7%	
M 2	Conformity Needs	11.1%	
M 3	Scholarly Interests	6.6%	
M 4	Outdoor & Shop Interests	6.8%	
M 5	Cultural Interests	5.8%	
M 6	Activity Level	4.0%	
M 7	Impulsiveness	2.8%	
M 8	Science Interest	4.3%	
M 9	Sociability	2.8%	
M 10	Leadership	3.1%	
M 11	Introspection	2.4%	
	Total extracted by Motives factors:	58.4%	
		Total:	71.7%

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