1962

Intraindividual Verbal-Numerical Discrepancies: Dichotomy or Continuum, Personality Characteristic or Psychopathology?

Richard H. Dana
Portland State University

Arnold E. Dahlke

Intraindividual Verbal-Numerical Discrepancies: Dichotomy or Continuum, Personality Characteristics or Psychopathology?[1]

Richard H. Dana Arnold E. Dahlke
University of Nevada

Intraindividual differences in verbal and numerical abilities have been observed since the inception of appropriate measuring instruments. Whether verbal and numerical ability occur in the form of a continuous distribution or as dichotomous categories has both theoretical and practical importance. That such variation has meaning in terms of predictable college academic success is recognized. Less apparent, but equally important, are relationships between intraindividual verbal and numerical variation and personality characteristics and/or psychopathology. In college situations the American Council on Education Psychological Examination (ACE), with Linguistic (L) and Quantitative (Q) components, and the School and College Ability Tests (SCAT), with Verbal (V) and Quantitative (Q) components, are traditionally used to predict academic achievement.

Research on this problem can be formalized in two directions: (a) comparison of extreme ability groups, verbal versus numerical, with external personality criteria; (b) demonstrations that intraindividual ability differences markedly affect grade-point average and reflect group differences in psychopathology.

---

[1]This study was supported by two grants-in-aid from the Graduate Research Council, University of Nevada. The cooperation of the Office of Student Affairs, and especially of Dean Sam Basta and Jim Hayes is gratefully acknowledged. Clerical assistance was provided by Donald Mueller. The item analysis was greatly facilitated by Browning Churn.

Extreme Ability Groups. Three studies employ ACE component scores (Altus, 1952; Monroe, 1946; Pemberton, 1951) and external measures of personality; e.g., Rorschach, Minnesota Multiphasic Personality Inventory (MMPI), and inventories for personality, interests, values. Groups are typically formed from available S populations in terms of large L-Q component score differences and minute Q-L differences. Results indicate that the L-Q groups are "subjective"; Q-L groups are "objective." Where cross-validation has been attempted (Altus, 1958; Spilka & Kimble, 1958), partial confirmation of original studies occurs. One additional supportive study (Himmelweit, 1945), using separate measures of verbal and numerical ability, also maintained the apparent dichotomy in personality characteristics with a large psychopathological population.

Certain methodological criticisms are germane to all of the cited studies. No serious attempt is made to describe the research population or the particular S groups except to designate sex and occupation. Generality of findings may thus be reduced.

To dichotomize Q-L and L-Q groups, without use of appropriate control groups for each, introduces bias. First, possible differences are magnified by use of extreme groups, thereby fostering unreal cross-validation expectations which, in fact, are not met. This crystallizes the assumption that verbal and numerical abilities are qualitatively different and makes increasingly difficult investigation of hypotheses concerning quantitative intraindividual differences.

That such intraindividual differences should occur along a continuum, or dimension, is congruent with predictions from a personality theory (Dana, 1954), as well as implications from a statement of theory restricted to verbal-numerical ability (Spilka, 1958).

In addition, the majority of potential Ss are excluded by definition of the experimental groups. This means that inferences from obtained results

may accrue only to a statistically insignificant sample of the relevant population.

With respect to base rates in a college population, it should be noted that Spilka (1958), in a sample of 1160 Ss found 54 per cent L<5 Q and 29 per cent Q<5 L. The mean differentials, L-Q = 27.3 and Q-L = 18, were significantly different in a random subsample of 447 Ss.

These two strictures, inadequate S description and the assumption of a Q and L dichotomy, suggest that control groups are necessary as well as adequate methodological consideration of the dichotomy-continuum issue. The conclusion that intraindividual discrepancies between verbal and numerical abilities do exist and are related to personality variables is not questioned. That these differences have the importance and generality suggested by all past studies is definitely open to experimental scrutiny.

Only one study (Monroe, 1946) recognized that absolute ability; i.e., magnitude of total ACE scores, may be an important variable. This awareness was not, however, implimented in the research design.

Grade-Point Average and Psychopathology. Effects of intraindividual verbal and numerical differences on grade-point averages were studied by Fritz (1954). With Q and L scores discrepant by 5 centiles (N=200), a correlation of .62 with criterion (GPA) was obtained; with Q and L scores discrepant by <50 centiles (N=200), a correlation of .37 occurred. When the large difference group was subdivided according to direction of difference, the high Q-L group had significantly lower grade-point average than the high L-Q group, independent of the curriculum followed.

In order to test the hypothesis that this difference in college achievement was related to psychopathology, Dana (1957) rated 43 freshman autobiographies on a 1 to 5 scale, with 5 indicative of psychopathology, and compared these ratings with ACE scores. Reliability of ratings was not determined. For the entire group, a Pearson product-moment correlation of

.19 was obtained. However, where Q exceeded L, the coefficient was .77 (N=14), and where L exceeded Q, the correlation was .03.

The present study investigates the hypothesis that differences in verbal and numerical ability are related to personality and psychopathology variables. It differs from past studies in the use of control groups to avoid maximizing minimal differences from extreme population segments.

Method

All new admissions to the University of Nevada, Fall 1958, completed an Information Sheet, the SCAT and the MMPI (N=761). V and Q differences on the SCAT were stratified (Table 1). Stratification was based on percentile difference regardless of where the difference occurred. It is recognized that equal percentile score differences are not equal raw score differences.

Insert Table 1 about here

Eight groups, 30 Ss per group, except for Group 1 (N=18), were formed: (1) Male, experimental, V-Q= >25; (2) Male, control, V-Q= <10; (3) Male, experimental, Q-V= >25; (4) Male, control, Q-V= <10; (5) Female, experimental, V-Q= >25; (6) Female, control, V-Q= <10; (7) Female, experimental, Q-V= >25; (8) Female, control, Q-V= <10. For Group 1 the total potentially available S population was 20 (Table 1). Homogeneous percentile groups were used because of their direct utility in counseling situations. The eight groups were matched on total raw SCAT score and age (Table 2). First generation Ss were excluded; almost all Ss were freshmen.

Insert Table 2 about here

MMPI records were machine scored on the three validity scales (L, F, K) and the nine clinical scales (Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma) and Social Introversion (Si). Nine additional scales, selected on the basis of adequacy of validity data (Dana, 1954), were hand scored due to smearing and fading of

electro-graphic pencil marks: Achievement (Ac), Taylor Anxiety (A), Dependency (De), Dissimulation (Di), Dominance (Do), Ego Strength (Es), Hostility (Ho), Responsibility (Re), and Social Desirability (Sd). Raw scores were used throughout and corrections for K were not added to the clinical scales, except for the group profiles.

Results

Means and sigmas for the male and female experimental and control groups are contained in Tables 3 and 4. Male and female, experimental versus control comparisons were made by means of 88 t-tests (Tables 5,6). Male and female, experimental versus experimental and control versus control comparisons were made by means of 88 t-tests (Tables 7,8). Analysis of variance was not used because of concern with detailed comparisons with previous studies.

Insert Tables 3 and 4 about here

Figures 1-8 present the male and female, experimental versus control (Groups 1-2; 3-4; 5-6; 7-8), experimental versus experimental (Groups 1-3; 5-7), and control versus control (Groups 2-4;6-8) profiles of mean raw MMPI clinical scale scores with mean group K scores added.

Insert Figures 1, 2, 3, 4, 5, 6, 7, 8 about here

For the experimental versus control comparisons, seven were significant at the <.05 level; five of these differences occurred between Groups 1 and 2 (Tables 3, 5). Group 1 was higher than Group 2 on Hy, Pd, Mf (<.01), Do, and lower on Es. Group 3 was higher than Group 4 on Ac (Tables 3, 5); Group 5 was higher than Group 6 on L (Tables 4, 6). Group 1 was higher than Group 3 on Mf (<.001), and Do (<.001), and lower on Ac (<.05) (Tables 3, 7); Group 5 was higher than Group 7 on Mf (<.01), and lower on Ac (<.05) (Tables 4, 8). For the control-control comparisons, Group 6 was lower than Group 8 for L (<.001) and Es (<.05) (Tables 4, 8). Tables 5, 6, 7, and 8 include data for the reduced groups which will be discussed below.

Insert Tables 5, 6, 7, 8 about here

Item Analysis. Following the assumption, based on evidence from the statistical analysis, that the experimental groups are significantly different from the control groups, the formula for the standard error of proportions was used (Underwood, 1954). The proportion of the control groups answering MMPI items "Yes" was taken as the hypothetical true proportion. The standard error of the proportion changes as a function of the hypothetical true proportion (Figure 9). It was decided to use the sigma values when p = .50; i.e., the largest sigma. As a result some items at $p > .80$ and $p < .20$ were lost; thus, some items close to the .05 level are lost. By adopting this cut-off, the standard for acceptance of any item was somewhat more rigorous than the conventional .05 level. The same method was used for all group comparisons and assumed equal N groups. However, Group 1 had 18 Ss, and accuracy was thus reduced to the extent that unequal Ns distort the presumed normal distribution. Cross validation will indicate the advisability of this procedure.

Insert Figure 9 about here

Chance expectations, with an N of 566 items, would be that approximately 28 items would significantly differentiate any two groups. Tables 9, 10, 11, 12, 13, 14, 15, and 16 present the item numbers and direction of difference. In all comparisons the N of significant items greatly exceeds chance. Table 17 contains the Ns of differentiating items for all groups compared.

Insert Tables 9, 10, 11, 12, 13, 14, 15, 16 about here

The resultant experimental-control group scales may be labeled Male Verbal (MV) (Table 9) and Female Verbal (FV) (Table 11), which differentiate high from low verbal scores by sex, and Male Quantitative (MQ) (Table 10),

and Female Quantitative (FQ) (Table 12), which differentiate high from low quantitative scores by sex. The resultant experimental-experimental group scales may be labeled Male Verbal-Quantitative (MVQ) (Table 13), and Female Verbal-Quantitative (FVQ) (Table 15), or high V-Q difference and high Q-V differences where high scores differentiate the V group and low scores differentiate the Q group. The resultant control-control group scales MCC and FCC (Tables 14 and 16), were not used as they represent the middle part of the continuum where the range of SCAT component score differences was 1 to 9 points.

Insert Table 17 about here

An immediate, although insufficient substitute, for cross-validation of the items differentiating various groups was attempted. Pearson product-moment correlations, using Z scores, were run between Q and L difference scores and new MMPI scale scores for each of the combined groups (1-2; 3-4; 5-6; 7-8) and for the eight separate groups. The correlations for the combined groups were consistently high ($<.001$ level) due to an artifact. Scores at each end of the continuum were grouped such that high difference scores go with low MMPI scale scores. When separate correlations were run, seven of eight coefficients were non-significant. For the male groups, the coefficients were in the anticipated direction with experimental groups approaching significance and control groups at zero order. The one significant figure, FL scale with Group 6 difference scores, was unexpected and may be attributed to chance. These results point toward the possibility of appreciable item loss upon cross-validation. In addition, these new MMPI scales while adequate as group measures are probably not usable for individual prediction. Table 18 summarizes these results for ML, MQ, FL and FQ. It will be noted that two of the Ns are less than 30; two Ss were dropped because L scores were zero, and, therefore the L scores in terms of Z were at infinity.

Insert Table 18 about here

In order to further assess the usefulness of these scales for group prediction and the feasibility of cross-validation, t-tests were run between MMPI scale scores for the separate groups. Table 19 presents these t-test comparisons. All t's are significant at <.0001 level of confidence. Thus, the scales do differentiate among groups at a level commensurate with use in counseling situations.

Insert Table 19 about here

This process of obtaining Pearson product-moment correlations between Q and L difference scores and new MMPI scales was repeated for MLQ and FLQ (Table 20). Again, the artifactual combined group correlations occurred, although coefficients for MLQ versus Group 1, and MLQ versus Group 4 did attain significance. These results further support the expectation of successful cross-validation. Cross-validation should provide enhanced correlation magnitudes. The t-tests between MMPI scale scores for the separate groups were also rerun and were significant at $<.01$ level of confidence (Table 21). The increase in N of groups used probably is responsible for the reduction in magnitude of obtained t's.

Insert Tables 20 and 21 about here

Discussion of Results

Several problems are raised by these results: (a) the small total N of significant t's; (b) the clustering of significant comparisons from Groups 1-2; i.e., 6 of 14; (c) evidence bearing directly on the assumption of dichotomy or continuum of V and Q scores; (d) the equivalence of SCAT and ACE scores, since past studies used difference scores obtained from the ACE.

Chance or genuine group differences?

The total N of significant t-tests barely exceeded chance with 14 of 176 comparisons at the $<.05$ level of confidence. Rational arguments for the

the acceptance of inferences from these results are not meaningful. Empirical evidence from item-analysis, to be discussed below, and the results of cross-validation of resultant MMPI scales for different S groups, will suggest whether or not the obtained differences are, in fact, real differences.

Groups 1-2 comparisons: inadequate matching? The differences between Groups 1 and 2 may obtain as a function of inadequate matching procedures which resulted in extreme variability of total SCAT scores (Table 2). The sigma for Group 1, Q-V male experimental group, is over three times the magnitude of the sigma for the control group. In other words, the ranges of SCAT scores are 41 and 8, for Groups 1 and 2, respectively. To explore the meaning of these total SCAT variability differences, the data were plotted on two-dimensional charts, percentile difference scores on the ordinate and total adjusted raw scores on the abscissa. Then, the Ss in Groups 1 and 2 were matched for range of total SCAT score (11 points), reducing the combined N to 12 or six Ss per group. Using the table for small Ns, the t-tests were recalculated (Tables 5,6,7,8).

The results of this process with Groups 1 versus 2 were that three significant differences emerged (F, Hs, Pa, Sc, Di, Do, A); one original difference was reduced in magnitude (Mf); and one remained the same (Es) (Table 5).

Similar treatment occurred with all other group comparisons. The reduction to an 11 point range of total SCAT scores was maintained; the N of Ss per reduced group varied as indicated. For Groups 3 versus 4, the reduced Ns were 7 and 5, respectively. One original difference was lost (Ac); one new difference emerged (Ma) (Table 5). For Groups 5 versus 6, the reduced Ns were 16 and 9, respectively. One original difference was lost (L); no new differences were discovered (Table 6). For Groups 7 versus 8, the reduced Ns were 20 and 13, respectively. Two new differences were obtained (Mf, Di) (Table 6).

Experimental versus experimental comparisons, Groups 1-3, resulted in a reduction of Ss to 12 and 20, respectively. Two original differences remained the same (Mf, Ac); one was reduced in magnitude but remained significant (Do); and one new difference occurred (Pa) (Table 7). Comparison of Groups 5 and 7, with reduction to 12 Ss per group, resulted in loss of two original differences (Mf, Ac); and no increment (Table 8).

Control versus control comparisons, Groups 2 and 4, resulted in reduction to 7 and 6 Ss, respectively. Three differences were obtained (Hs, D1, A) (Table 7). Comparison of Groups 6 and 8, with reduced Ns of 9 and 13, respectively, resulted in reduction of magnitude of one original difference (L); loss of another original difference (Es); and no gain (Table 8).

MMPI score changes thus occur as a function of total SCAT score. Adequate control groups must be matched for SCAT score variability.

Dichotomy or continuum?

Figure 10 depicts the theoretical clash of assumptions, dichotomy or continuum of verbal-numerical abilities. Several crude tests of this issue are possible: (a) reliability of the verbal-numerical differences; (b) N of significant differences obtaining between groups; (c) N of significant differences resultant from the item-analyses of MMPI data; (d) N of new MMPI scale items overlapping in any two group comparisons; (e) rank-order of new MVQ and FVQ MMPI scales.

Insert Figure 10 about here

One approach to the issue of dichotomy or continuum is found in the statistical data present in the SCAT manual (1958). The S_m for V is 3.26, 2.80 for Q, and 4.29 for total, based on Kuder-Richardson Formula 20 estimates of internal consistency (.92, .93, and .95, respectively), and a V-Q correlation of .53. This suggests a range of error on V or Q of

approximately 12 to 18 points for any one S. However, the r_{diff}, as calculated from available manual data, is .84 and no S_m of the differences is reported. It is suggested, although selective sampling prevents empirical verification from the data in this study, that the S_m of the Q and V differences is greater than the S_m of the separate components. Control groups may thus not be dichotomized into $\leq$10 percentile points from zero difference as a result of overlap due to the relatively high S_m of the differences. It is probably feasible, therefore, to consider control groups as equivalent and that the small N of significant control-control differences are attributable to chance.

Were Q and V scores the result of dichotomous factors, then one would expect approximately an equal N of experimental versus experimental and control versus control differences. If Q and V scores lie on a continuum, then predictions would call for a greater N of experimental versus experimental differences, and fewest control versus control differences. Slight support for the existence of a continuum is found in the N of group differences which, when corrected for N of comparisons, follow the rank order indicated but do not attain significance ($X^2 = 1.4$).

A third source of evidence comes from the N of significant items obtained in the item-analyses. For a continuum, it would be predicted that the experimental-experimental comparisons would yield the greatest N of items, the experimental-control comparisons a lesser N, and the control-control comparisons the fewest N of significantly differentiating items. For a dichotomy it is not possible to predict the order; perhaps experimental-experimental and control-control should produce an equivalent N of items since the contrasted groups are presumably identical. The results (Table 17) strongly support the continuum hypothesis, with N of significant items for the male and female

comparison groups all in the predicted direction.

Insert Table 17 about here

Another line of evidence from the item-analyses is contained in the item overlap; i.e., the N of identical items in any two separate group comparisons when (a) experimental-experimental groups are compared with control-control, and when (b) experimental-experimental groups are compared with experimental-control (starting from V). For a continuum, predictions call for little overlap for (a) and considerable overlap for (b), since there are varying degrees of just one group (V to Q) involved. For a dichotomy, predictions demand much overlap for (a) and little overlap for (b), since there are two distinct major groups (V to zero and zero to Q) involved. Table 22 contains these results which, again, provide strong support for the continuum hypothesis.

Insert Table 22 about here

One more possible comparison, experimental-control with control-control, did not offer clear-cut possibilities for prediction of difference between dichotomy and continuum. Little or no overlap would be expected for each group and the results were confirmatory, male = 0; female = 1.

Another continuum-dichotomy hypothesis is derivable from the new MVQ and FVQ MMPI scales. For a continuum to exist, the mean scale scores should be rank-ordered from extreme V to extreme Q with no significant difference between control groups (i.e., between lowest V and lowest Q group). For a dichotomy, there should be a significant difference between control groups. The results (Table 21) strongly confirm the continuum hypothesis, with descending rank-orders, as predicted, and significant differences between experimental and control groups, and no difference between control groups.

The present study should be redesigned on the basis of the evidence for the existence of an intraindividual quantitative-verbal ability continuum. Samples of Ss should be selected representing the entire range from V to Q. The obtained difference scores would then be correlated with personality variables.

ACE-SCAT equivalence. The studies which preceded this research employed the ACE. The SCAT manual (1958) reports estimated ACE-SCAT relationships of .85 for Linguistic versus Verbal components, .75 for Quantitative versus Quantitative, and .88 for total scores, based on the questionable procedure of using a half-length form of the SCAT. No estimates of the relationships of ACE-SCAT component difference scores are reported in the manual.

As a result, some estimate of comparability, using the present data, was mandatory. Ss who had taken the SCAT were invited for retesting on the ACE and a total of 110 responded on three separate occasions. Chi-squares were run to determine whether or not there was differential group participation in retesting. Actual group percentages for ACE male and female Ss were used for the expected frequencies. Chi-squares for both male and female returnees were non-signficiant. The ACE returnees were thus representative of the original SCAT groups.

In comparing component difference scores on the ACE and SCAT, it is necessary to assume the existence of a continuum between verbal and numerical scores. This occurred because the Ns in separate experimental and control groups were so small that sampling errors in correlations computed from them would be large. Consequently, the separate male and female groups were combined for ACE-SCAT correlations. Raw scores were used, differences were plotted separately for males and females, and Pearson product-moment correlations were computed. Both coefficients were significant at .001 level (Male = .73; Female = .55). These figures provide empirical justification

for use of SCAT component difference scores in a manner similar to past research with ACE component difference scores.

Summary

Past research on the meaning and nature of verbal-numerical ability test score differences has suggested that such differences are related to personality characteristics and that components are dichotomous.

Using a male and female, high and low Q-V and V-Q, control group design, eight groups of college Ss were matched on total SCAT scores average, among other variables. MMPI records from these groups were scored for 22 scales. Male and female, experimental-control, experimental-experimental, control-control comparisons were made by means of 176 t-tests which yielded 14 significant relationships, two of these between Groups 1 and 2.

Inadequate group matching on SCAT score variability led to rematching for range of SCAT score difference, and replication of the 176 t-tests yielding 19 significant relationships, one of these between Groups 1 and 2. MMPI item-analyses from the original groups were made to develop scales of items which significantly differentiated between groups; eight new MMPI scales resulted. Pearson product-moment correlations between these new MMPI scales and respective Q and V difference scores were computed; t-tests were run between MMPI scale scores for the separate groups. These results suggested that, although some item attrition would occur upon cross-validation, the resultant scales would be useful for group prediction.

Five different approaches were used to evaluate the assumption of dichotomy versus continuum of intraindividual linguistic-quantitative scores. All five methods concurred in providing strong presumptive support for the existence of a continuum.

Empirical comparison of ACE-SCAT samples indicated the equivalence of the linguistic-quantitative difference scores.

References

Altus, W. D. Personality correlates of Q-L variability on the ACE. J. consult. Psychol., 1952, 16, 284-291.

Altus, W. D. Group Rorschach and Q-L discrepancies on the ACE. Psychol. Rep., 1958, 4, 469.

Dana, R. H. Personality Orientation: an organizational focus for current research. J. Psychol., 1954, 37, 139-150.

Dana, R. H. An MMPI Compendium. St. Louis: State Hospital Research Project, 1956 (mimeographed).

Dana, R. H. Personality adjustment and ACE scores. Unpublished paper, University of Nevada, 1957.

Dana, R. H., Dahlke, A. E., & Mueller, D. J. Intraindividual verbal-numerical abilities and personality. Paper read at Western Psychol. Assoc., April, 1959.

Fritz, M. F. Q and L difference scores on the ACE test. Proc. Iowa Acad. Sci., 1954, 61, 356-357.

Himmelweit, H. T. The intelligence-vocabulary ratio as a measure of temperament. J. Personality , 1945, 14, 93-105.

Monroe, Ruth L. Rorschach findings on college students showing different constellations of subscores on the ACE. J. consult. Psychol., 1946, 10, 301-316.

Pemberton, Carol Personality inventory data related to ACE subscores. J. consult. Psychol., 1951, 15, 160-162.

Spilka, B. Numerical-verbal ability differential: a theory and research program. Psychol. Newsltr., 1958, 10, 48-56.

School and College Ability Tests. Technical Report. Princeton: Educational Testing Service, 1958.

Underwood, B. J., Duncan, C. P., Taylor, Janet A., & Cotton, J. W. Elementary Statistics. New York: Appleton-Century Crofts, 1954.

Table 1

Stratification of Total Available Population*

Male			Female		
Group	N	%	Group	N	%
(V-Q)>25	20	2.63	(V-Q)>25	37	4.86
(V-Q)<10	33	4.34	(V-Q)<10	34	4.47
(Q-V)>25	193	25.36	(Q-V)>25	55	7.23
(Q-V)<10	52	6.83	(Q-V)<10	46	6.04
26>(V-Q)<9	32	4.20	26>(V-Q)<9	35	4.60
26>(Q-V)<9	99	13.01	26>(Q-V)<9	49	6.44
(V-Q) = 0	9	1.19	(V-Q) = 0	2	0.26

*Total N = 761

Table 2

Mean Age and SCAT Comparisons for

Experimental and Control Groups

Group	Mean AGE	SD	t-test	Total SCAT	SD	t-test
1	21.89	5.60	1.318	297.06	6.09	0.028
2	19.90	3.55		297.00	8.66	
3	19.37	2.79	0.838	296.63	5.60	0.340
4	20.30	5.30		297.90	19.35	
5	19.47	4.27	0.056	297.23	7.21	0.167
6	19.40	5.18		297.73	14.46	
7	18.00	0.07	0.000	295.00	6.35	0.731
8	18.00	0.07		296.63	10.22	

Table 3

MMPI Means and Standard Deviations for Male Groups

	Mean		SD		Mean		SD	
Scale	1	2	1	2	3	4	3	4
L	3.56	3.70	2.16	1.95	3.30	3.83	1.83	2.15
F	5.06	3.50	2.65	2.08	4.67	3.87	2.93	3.01
K	15.44	15.30	5.61	5.31	13.83	14.33	3.70	4.45
Hs	5.56	3.73	3.84	2.87	5.73	4.57	4.01	3.59
D	20.06	18.17	2.85	4.28	18.10	18.13	4.62	4.42
Hy	21.72	19.10	4.26	3.22	19.50	19.50	5.37	3.56
Pd	18.17	14.97	4.80	3.36	16.60	16.40	4.05	3.69
Mf	28.33	23.07	4.86	4.04	21.97	22.53	3.99	4.46
Pa	10.17	8.80	3.37	2.25	8.87	8.73	3.32	3.03
Pt	12.28	10.23	7.15	6.47	12.53	10.90	5.57	6.51
Sc	13.67	9.60	8.48	5.52	11.37	10.10	4.75	6.45
Ma	16.94	16.47	5.82	3.99	17.20	16.93	3.72	4.26
Di	11.11	8.87	5.43	5.18	11.47	12.10	4.92	9.34
Ac	10.56	10.37	2.50	2.15	12.50	10.87	3.00	2.40
De	18.89	18.10	6.77	7.36	19.40	17.63	8.08	6.82
Do	18.39	16.77	2.14	3.27	15.73	17.23	2.91	3.32
Es	46.83	49.83	4.86	4.29	48.57	48.53	6.09	5.68
Ho	16.83	16.90	9.08	8.43	20.20	18.13	6.06	6.53
Re	20.06	20.30	5.38	4.19	20.83	20.83	2.81	1.12
Sd	31.67	29.33	4.60	9.51	29.53	28.97	7.38	9.41
Si	25.06	26.10	6.79	9.07	26.10	25.40	9.25	8.44
A	15.67	12.17	7.62	8.01	13.93	13.07	6.56	7.33

Table 4

MMPI Means and Standard Deviations for Female Groups

	Mean		SD		Mean		SD	
Scale	5	6	5	6	7	8	7	8
L	4.17	2.87	2.72	1.28	4.73	4.17	2.20	1.81
F	3.87	4.37	2.89	2.67	2.87	3.27	2.52	3.14
K	16.63	15.27	4.76	4.20	16.43	15.67	5.33	4.44
Hs	4.33	4.53	4.17	3.85	3.83	4.83	2.30	4.28
D	19.30	18.23	4.36	4.26	18.50	18.10	4.13	3.38
Hy	22.20	20.80	5.05	4.43	20.83	21.37	4.37	5.11
Pd	15.23	15.40	3.87	3.89	15.20	15.90	3.42	3.42
Mf	37.40	37.90	4.03	4.09	34.73	36.83	3.67	4.62
Pa	9.83	9.43	2.10	2.82	8.87	99.47	2.28	2.11
Pt	10.33	12.57	6.62	6.50	11.63	11.90	8.58	6.37
Sc	9.07	11.20	6.32	5.53	8.80	9.63	6.88	6.60
Ma	15.13	16.03	3.30	4.38	15.77	16.47	4.55	4.58
Di	8.73	10.77	5.71	5.25	9.00	10.97	6.49	7.39
Ac	11.70	12.90	2.55	3.54	13.20	13.37	2.74	1.98
De	19.83	23.13	8.79	9.08	20.57	19.63	9.17	7.50
Do	16.00	17.27	7.80	3.43	15.13	16.73	3.93	3.13
Es	47.33	43.90	7.41	9.60	45.53	47.87	6.93	3.51
Ho	12.10	15.37	7.13	6.83	13.47	15.37	6.38	8.60
Re	23.17	22.27	3.00	3.30	22.30	21.33	3.44	3.66
Sd	31.97	30.07	4.94	6.24	30.53	30.77	7.42	5.63
Si	26.23	25.73	9.64	8.55	24.57	24.10	9.67	8.41
A	12.97	14.90	7.69	7.18	13.50	14.77	9.18	7.42

Table 5

Male Experimental-Control Group Comparisons

	One-Two		Three-Four	
Scale	Full	Reduced	Full	Reduced
L	0.222	0.000	1.000	0.629
F	0.208	2.482[a]	1.026	0.121
K	0.083	1.546	0.467	1.494
Hs	0.171	2.667[a]	1.160	0.488
D	1.229	1.820	0.025	0.593
Hy	2.183[a]	0.359	0.000	0.513
Pd	2.424[a]	0.329	0.196	0.979
Mf	3.757[c]	2.667[a]	0.514	0.726
Pa	1.489	2.225[a]	0.167	1.218
Pt	0.972	2.012	1.025	1.008
Sc	1.770	3.001[a]	0.852	0.840
Ma	0.296	0.106	0.262	2.606[a]
Di	1.374	2.673[a]	0.321	0.415
Ac	0.260	0.599	2.296[a]	1.020
De	0.369	2.422[a]	0.903	0.798
Do	2.025[a]	0.497	1.829	1.532
Es	2.113[a]	2.585[a]	0.026	1.871
Ho	0.026	0.230	1.247	0.081
Re	0.158	0.890	0.000	0.027
Sd	1.120	0.032	0.252	1.930
SI	0.441	1.538	0.300	2.084
A	1.447	3.795[b]	0.473	0.492
Age	1.318	0.000	0.056	0.268
SCAT	0.028	0.515	0.167	0.086
p=.05	1.960	2.228	1.960	2.228

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

Table 6

Female Experimental-Control Group Comparisons

	Five-Six		Seven-Eight	
SCale	Full	Reduced	Full	Reduced
L	2.321[a]	1.630	1.098	0.159
F	0.685	0.231	0.533	0.763
K	1.153	0.486	0.589	1.006
Hs	0.194	0.862	1.111	1.418
D	0.939	0.437	0.404	0.135
Hy	1.120	0.347	0.432	0.713
Rd	0.167	0.729	0.787	0.152
Mf	0.467	0.739	1.458	2.578[b]
Pa	0.606	1.254	1.053	0.275
Pt	1.302	0.628	0.136	1.253
Sc	1.365	0.770	0.469	1.186
Ma	0.882	0.150	0.583	0.177
DI	1.417	0.108	0.082	2.418[a]
Ac	1.481	1.551	1.027	0.531
De	1.404	0.126	0.427	1.041
Do	0.804	0.275	1.720	0.285
Es	1.524	0.495	1.614	1.000
Ho	1.787	0.664	0.955	1.739
Re	1.084	0.805	1.043	1.921
Sd	1.284	0.387	0.139	0.482
Si	0.208	0.782	0.198	1.777
A	0.990	0.308	0.580	1.587
Age	0.838	0.000	0.000	0.600
SCAT	0.340	1.780	0.731	0.761
p=.05	1.960	2.069	1.960	1.960

[a] $p<.05$ [b] $p<.01$ [c] $p<.001$

Table 7

Male Experimental-Experimental and

Control-Control Group Comparisons

	One-Three		Two-Four	
Scale	Full	Reduced	Full	Reduced
L	0.026	0.517	0.241	1.364
F	0.464	0.734	1.780	0.984
K	1.059	1.183	0.758	1.717
Hs	1.143	0.051	0.989	2.676[a]
D	1.782	1.486	0.561	0.808
Hy	1.542	1.421	0.449	1.000
Pd	1.129	0.332	1.538	2.188
Mf	4.576[c]	3.535[c]	0.491	1.284
Pa	1.275	2.242[a]	0.100	0.360
Pt	0.124	2.235	0.392	2.155
Sc	1.027	1.081	0.318	1.922
Ma	0.167	0.430	0.430	1.026
DI	0.225	0.559	1.631	2.567[a]
Ac	2.366[a]	2.471[a]	0.833	0.243
De	0.230	0.098	0.251	2.051
Do	3.547[c]	2.578[b]	0.535	0.132
Es	1.067	1.250	0.985	0.812
Ho	1.364	1.394	0.621	1.187
Re	0.546	0.487	0.520	0.870
Sd	1.209	1.059	0.145	0.698
Si	0.437	0.406	0.304	0.494
A	0.787	0.498	0.448	3.126[b]
Age	1.730	0.901	0.219	0.943
SCAT	0.238	1.468	0.229	0.731
p=.05	1.960	1.960	1.960	2.201

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

Table 8

Female Experimental-Experimental and Control-Control Group Comparisons

	Five-Seven		Six-Eight	
Scale	Full	Reduced	Full	Reduced
L	0.862	0.692	3.333[c]	2.625[a]
F	1.408	0.831	1.429	0.398
K	0.150	0.350	0.351	0.232
Hs	0.581	1.007	0.280	0.744
D	0.714	1.734	0.129	0.680
Hy	1.105	0.977	0.452	1.024
Pd	0.031	0.000	0.521	0.211
Mf	2.644[b]	1.055	0.930	0.527
Pa	1.684	1.989	0.061	0.156
Pt	0.647	0.393	0.396	0.229
Sc	0.156	0.749	0.981	0.340
Ma	0.610	1.156	0.376	0.854
Di	0.168	1.136	0.119	0.545
Ac	2.174[a]	1.229	0.627	0.634
De	0.314	0.394	1.598	0.437
Do	0.537	1.174	0.621	0.180
Es	0.957	0.735	2.089[a]	1.390
Ho	0.774	0.183	0.000	0.898
Re	1.024	0.360	1.022	0.993
Sd	0.867	0.235	0.449	0.365
Si	0.654	1.767	0.731	0.367
A	0.239	0.755	0.068	0.017
Age	1.830	0.410	1.443	0.404
SCAT	1.253	0.706	0.334	0.085
p=.05	1.960	2.074	1.960	2.086

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

Table 9

MMPI MV Scale (i.e., Items Differentiating Groups One and Two)

1*	95	163*	223*	300*	407*	501*
6*	98	165*	234	304*	408*	503
13	99*	179	238	316*	410*	506
21	102	195	239	319	434*	521
22	118	198*	250*	361	452*	525
41	124*	208*	255	368	461*	536
62	126	215	264*	378*	463*	537*
71*	127	216	268*	379*	465	546
73	132	217	274*	396	468	559
77	137*	219*	292	399*	477*	
78	140	221*	296	401*	498	
81*	142	222*	298*	406*	499	

* "False" responses

Table 10

MMPI MQ Scale (i.e., Items Differentiating Groups Three and Four

15	100	147	224	262	321	437
28*	115*	162*	228	268	372	458
78*	118*	163*	234	289	380	522
79*	120	189*	235*	298*	394	523*
91	136	193	244	313	398	551
97	145*	219	259*	319	434*	556*
						566

* "False" responses

Table 11

MMPI FV Scale (i.e., Items Differentiating Groups Five and Six)

11*	87	176	253	307*	437*	522
15*	102	183*	259*	314*	440*	539
45*	109*	201*	270	316*	444	546
63*	120*	208*	278*	321*	461	548*
67*	135*	222	287*	329	475*	351*
78	142*	231*	296*	407	518*	554*
80	165*	239*	300			

* "False" responses

Table 12

MMPI FQ Scale (i.e., Items Differentiating Groups Seven and Eight)

6*	119*	234*	313	413	453*	524*
15*	124*	254*	322*	415	465*	528
21*	131*	261*	329	428	468*	530*
36*	142*	282*	381*	433*	490	539*
39*	181*	283	399	441*	492	545*
67*	198	287*	407*	447*	498*	562
96	226*	304*	409	452*	505*	563*
97*	229	308*				

* "False" responses

Table 13

MMPI MVQ Scale (i.e., Items Differentiating Groups One and Three)

6*	81*	172	239	329	410*	499
13	84*	173*	244*	337*	423*	501*
18	91*	181*	254*	368	425*	503
21	98	189	259	378*	426	506
26*	100*	203	262*	380*	428	521
46*	102	204	264*	387*	437*	522*
56	117*	208*	266	390*	443	527*
62	124*	215	268*	394*	452*	536
64*	126	216	276*	395*	455*	537*
68	135*	217	283*	398*	458*	550*
71*	136*	219*	287*	399*	460*	554
73	142	221*	300*	406*	461*	559
77	165*	223*	304*	407*	475*	
78	167*	228*	313*	408*	477*	
80*	171*	235	327*	409*	492*	

* "False" responses

Table 14

MMPI MCC Scale (*i.e.*, Items Differentiating Groups Two and Four)

72*	112*	145*	253	391*	436*	523*
79*	116*	193	284	404*	438*	534*
89*	118*	195*	289	413*	484	546*
94*	120	238*	307	425*	496	556*
100	129*	240*	379			

* "False" responses

Table 15

MMPI FVQ Scale (i.e., Items Differentiating Groups Five and Seven)

6*	102	232*	300	391*	475*	524
21	117*	234	308	404*	478	550*
57*	127*	237	313*	413*	487	551*
58*	131	249*	367	421	488*	552
78	163*	266*	370	436*	492*	554*
79*	176	270	381	453	502	556*
81	198*	282	384	464	507*	557*
84*	226	283*	390*	465	522	558*
95*	229*					

* "False" responses.

Table 16

MMPI FCC Scale (i.e., Items Differentiating Groups Six and Eight)

15	115*	239	316*	407*	484*	539*
45	120	255	340*	428	486	549
57*	157	259	370	429	496	557*
79*	165	295*	372	444*	509	558*
111*	167*	297	378*	468*	523	559*
112*	183	307	390*	475	530	

* "False" responses

Table 17

Numbers of Items Significantly Differentiating Experimental-Experimental (E-E), Experimental-Control (E-C), and Control-Control-(C-C) Male and Female Groups

	Sex	
Comparison	Male	Female
E-E	102	58
E-C	81	46
E-C	43	52
C-C	32	41

Table 18

Product-Moment Correlations Between Four New MMPI Experimental-Control Group Scores for Male Verbal (MV), Male Quantitative (MQ), Female Verbal (FV), and Female Quantitative (FQ) with SCAT Component Difference Scores

Group	Scale	r	N	Mean
1+2	MV	.79**	48	
1	MV	.35	18	46.6
2	MV	.05	30	28.2
3+4	MQ	.83**	59	
3	MQ	.32	29	28.1
4	MQ	.06	30	18.3
5+6	FV	.65**	60	
5	FV	-.05	30	29.4
6	FV	.49*	30	18.8
7+8	FQ	.52**	59	
7	FQ	.03	30	32.8
8	FQ	.07	29	22.1

*$p < .01$
**$p < .001$

Table 19

Comparisons of Male and Female Groups

on MV and FV MMPI Scales

Male				Female			
Group	Mean	SD	t-test	Group	Mean	SD	t-test
1	46.8	7.3	15.5*	5	29.7	2.8	10.9*
2	28.2	4.8		6	18.8	4.8	
3	28.1	3.3	10.9*	7	32.8	6.0	7.6*
4	18.3	3.3		8	22.1	4.7	

*$p < .0001$

Table 20

Product-Moment Correlations Between Two New MMPI Experimental-Experimental Group Scores for Male Verbal-Quantitative (MVQ) and Female Verbal-Quantitative (FVQ) with SCAT Component Difference Scores

Group	Scale	r	N	Mean
1+2	MVQ	.63**	48	60.2
1	MVQ	.47*	18	60.2
2	MVQ	-.20	30	45.4
3+4	MVQ	.58**	59	
3	MVQ	.04	29	35.0
4	MVQ	.57**	30	43.0
1+2+3+4	MVQ	.71**	107	
5+6	FVQ	.46**	60	
5	FVQ	-.03	30	36.3
6	FVQ	.22	30	30.9
7+8	FVQ	.62**	59	
7	FVQ	.10	30	22.1
8	FVQ	-.11	29	29.4
5+6+7+8	FVQ	.72**	119	

*p<.05

**p<.001

Table 21

Comparisons of Male and Female Groups

on MVQ and FVQ MMPI Scales

Male				Female			
Group	Mean	SD	t-test	Group	Mean	SD	t-test
1	60.2	7.4	7.0***	5	36.3	4.8	4.3*
2	45.4	6.2		6	30.9	4.9	
			1.5				1.3
4	43.0	6.3	5.3***	8	29.4	3.8	6.6***
3	35.0	5.1		7	22.1	4.5	

*p<.01

***p<.001

Table 22

Item Overlap for Experimental-Experimental (E-E), Experimental-Control (E-C), Control-Control (C-C) Male and Female Group Comparisons

	Sex	
Comparison	Male	Female
(E-E) (C-C)	1	6
(E-E) (E-C)	45	9

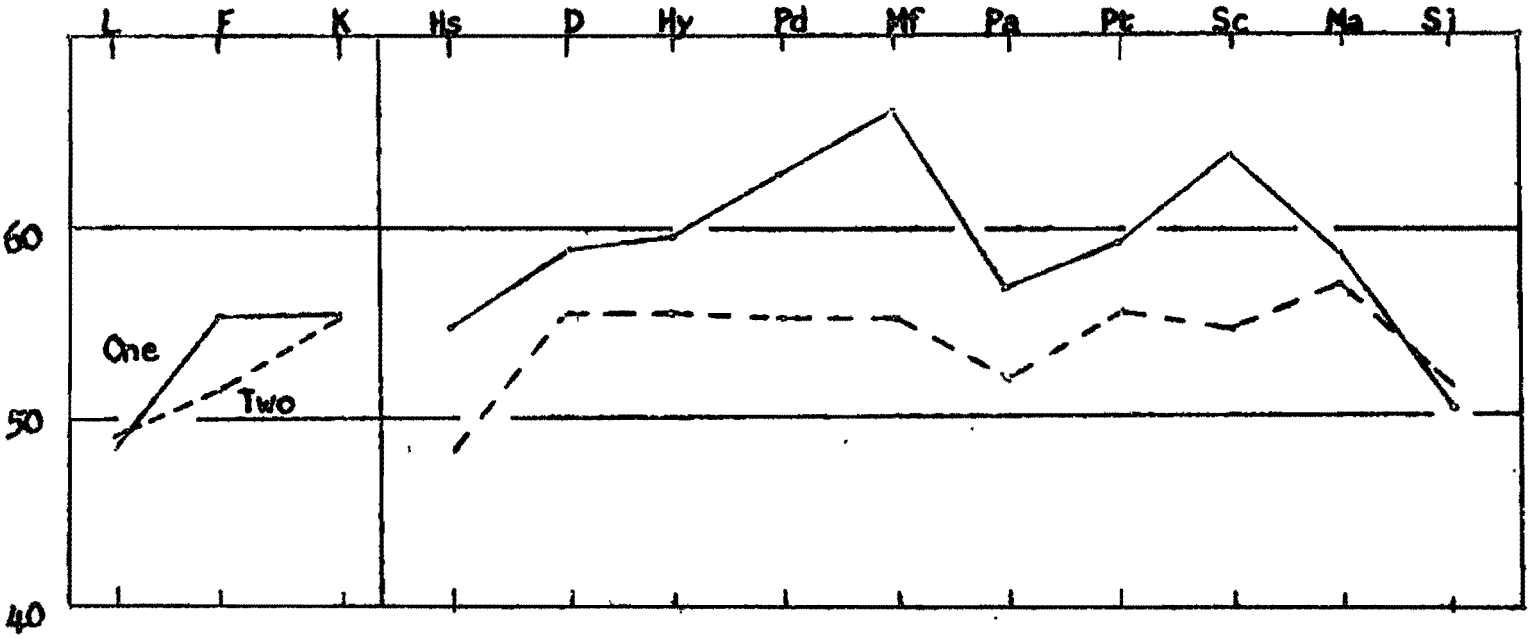


Figure 1.

MMPI Profiles of Groups One and Two

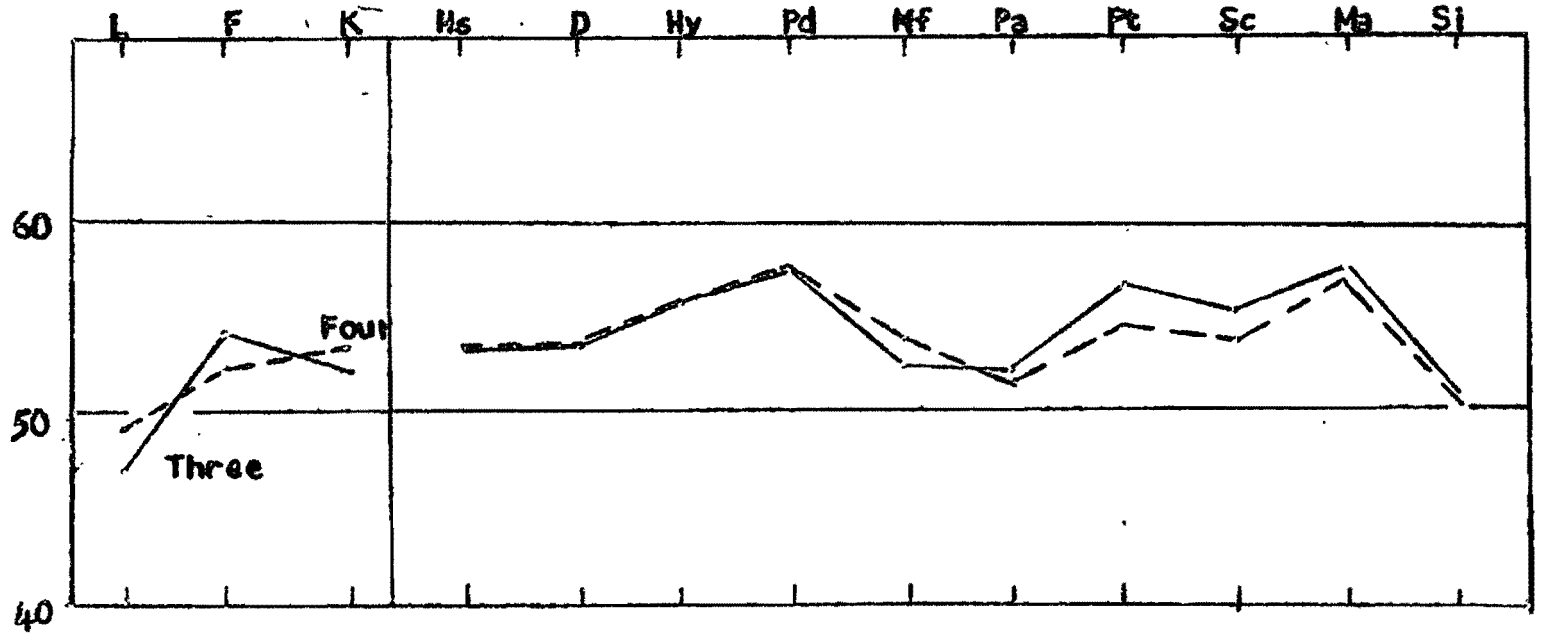


Figure 2.

MMPI Profiles of Groups Three and Four

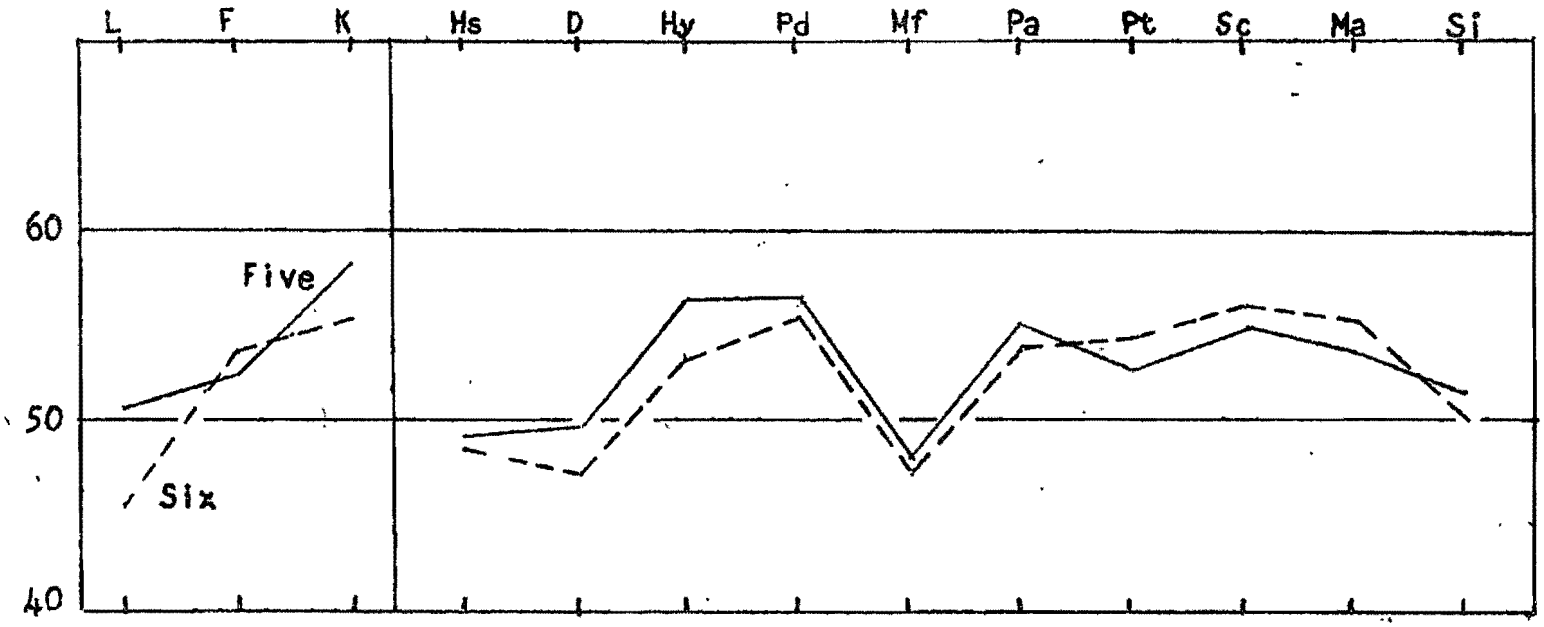


Figure 3.

MMPI Profiles of Groups Five and Six

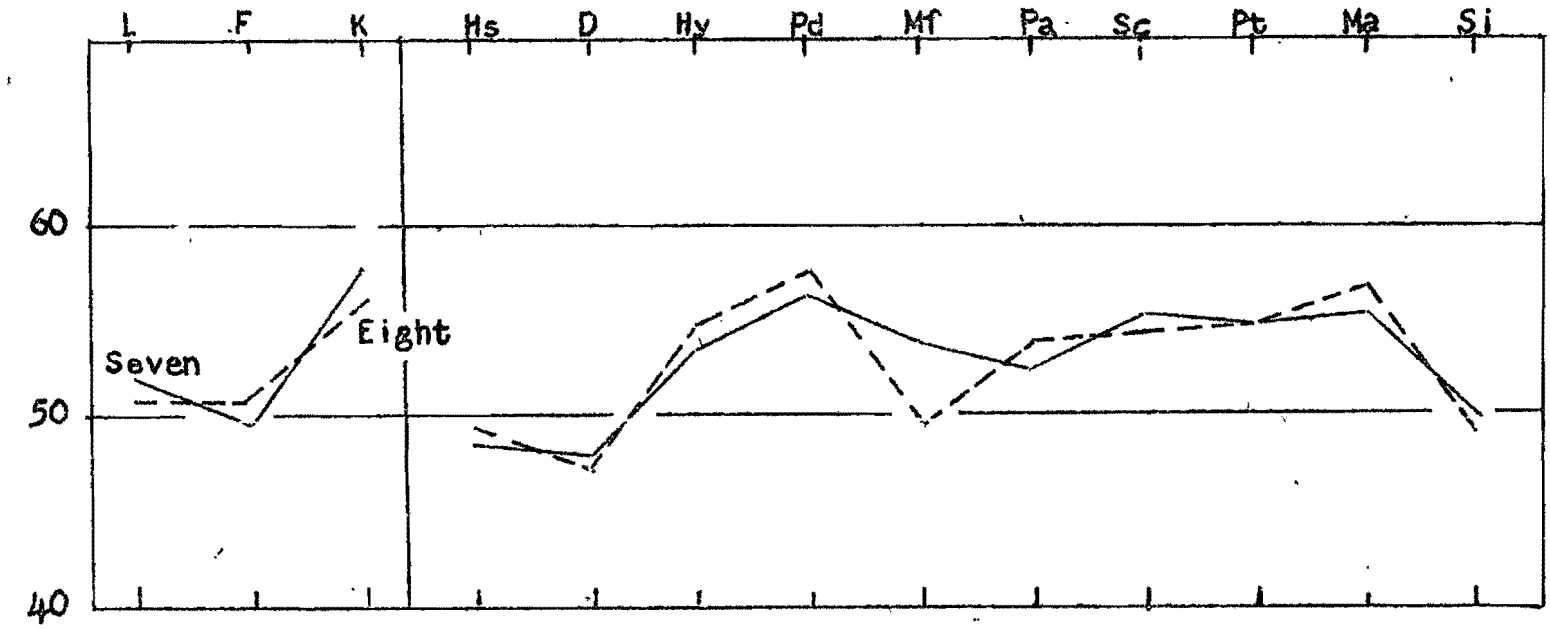


Figure 4.

MMPI Profiles of Groups Seven and Eight

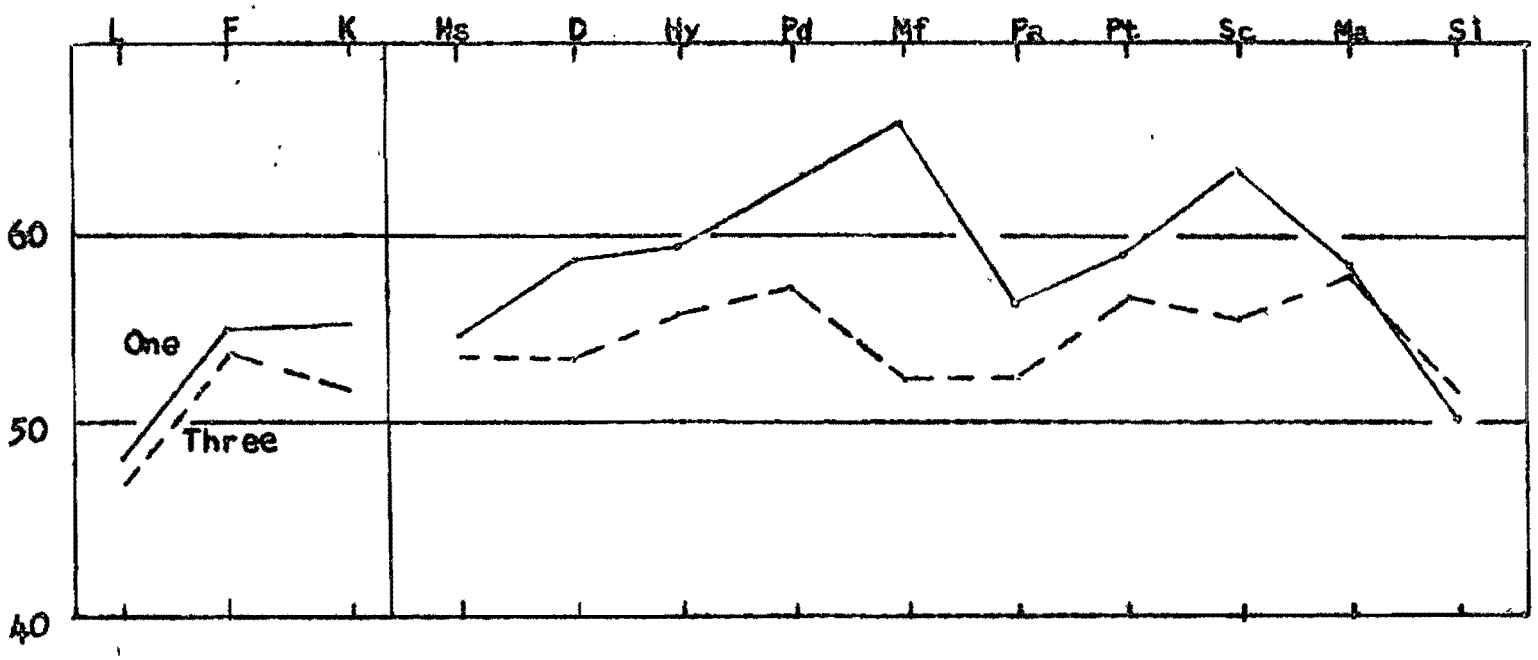


Figure 5.

MMPI Profiles of Groups One and Three

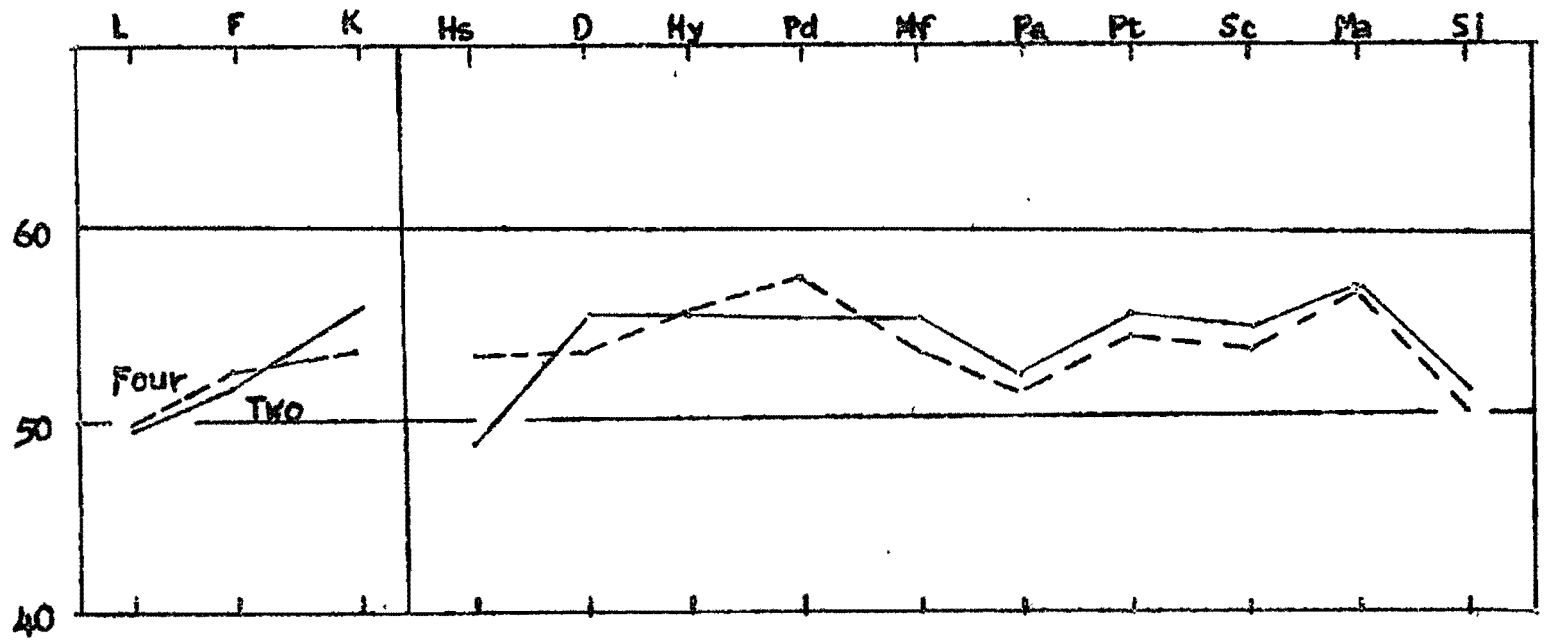


Figure 6.

MMPI Profiles of Groups Two and Four

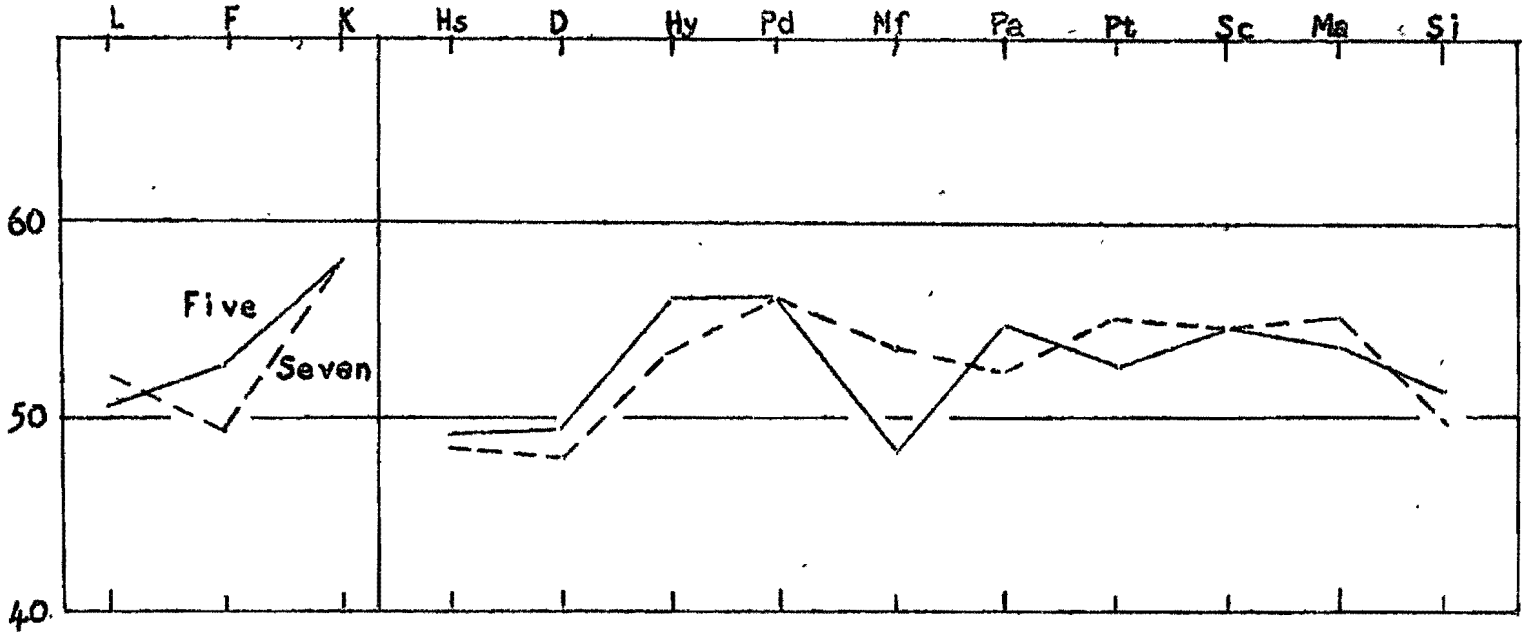


Figure 7.

MMPI Profiles of Groups Five and Seven

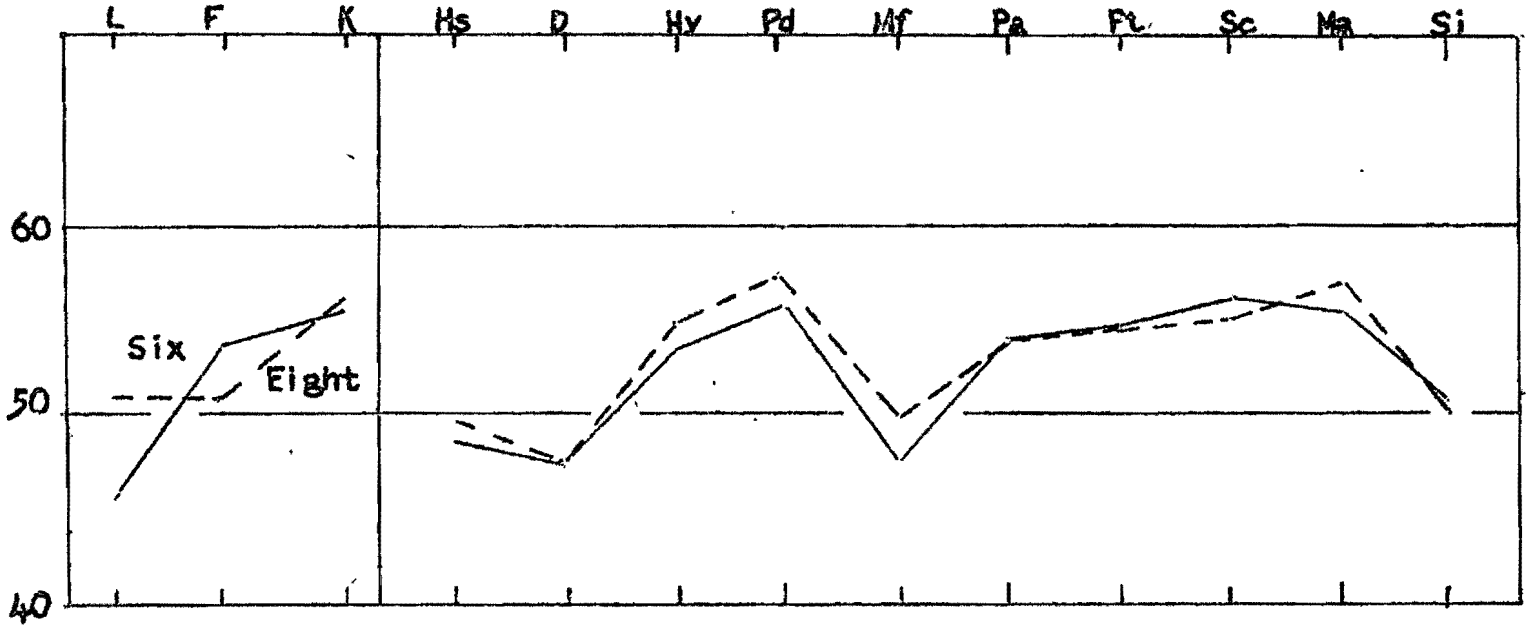


Figure 8.

MMPI Profiles of Groups Six and Eight

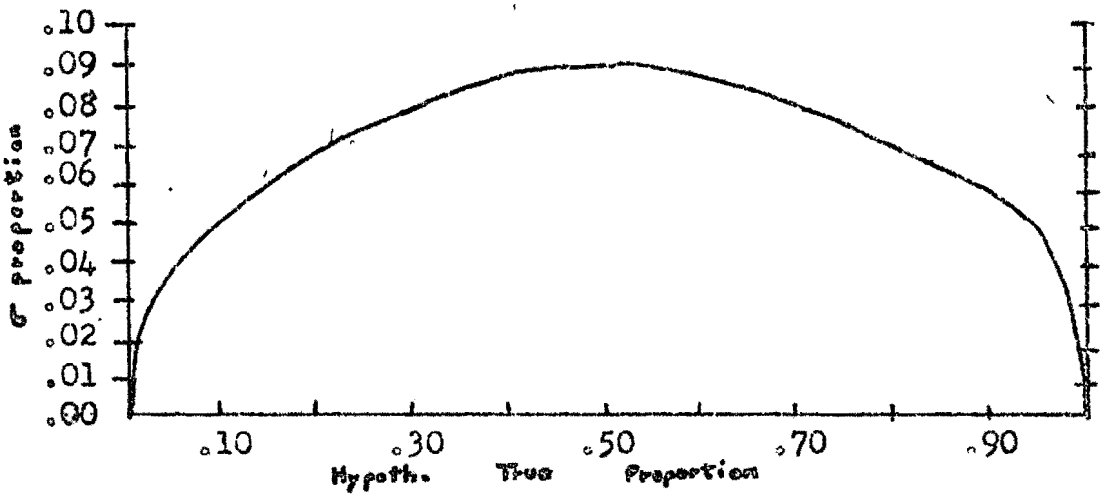


Figure 9.

Change in Standard Error of Proportion ith

Size of Hypothetical True Proportion

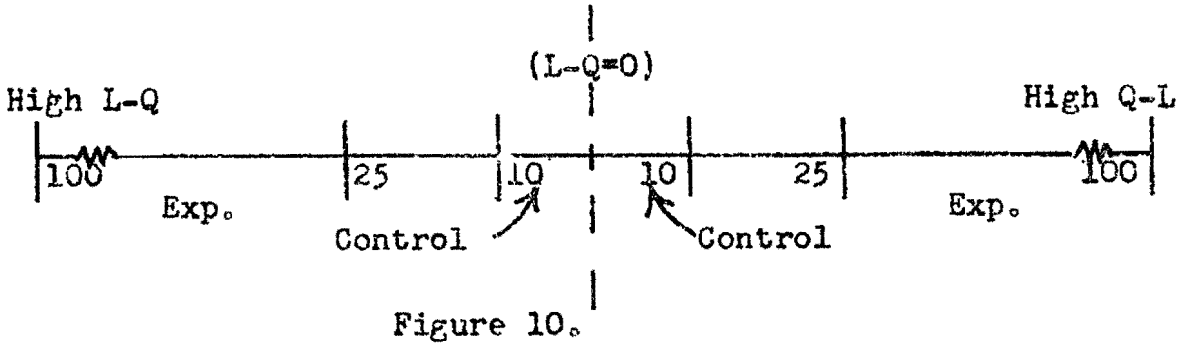
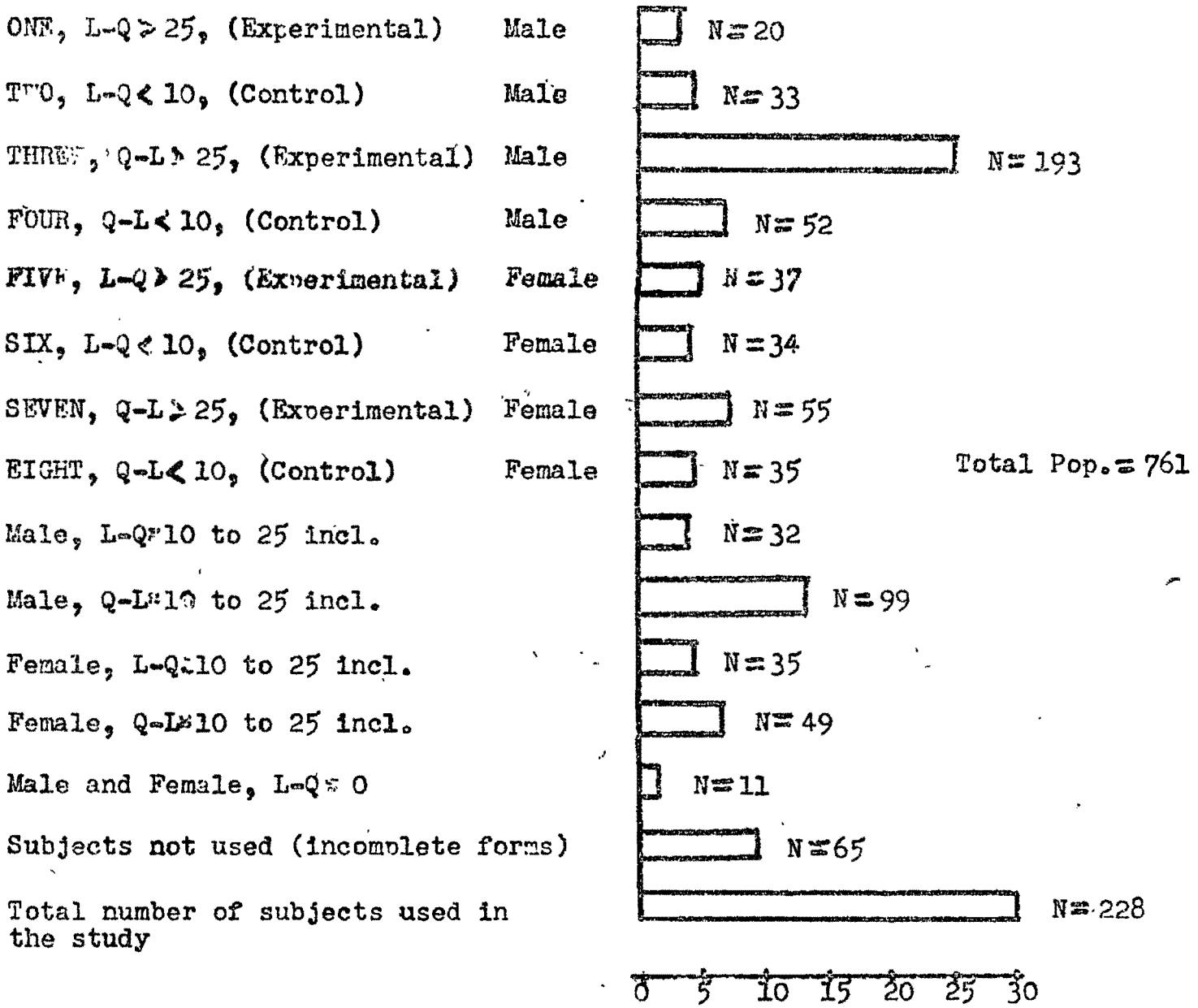


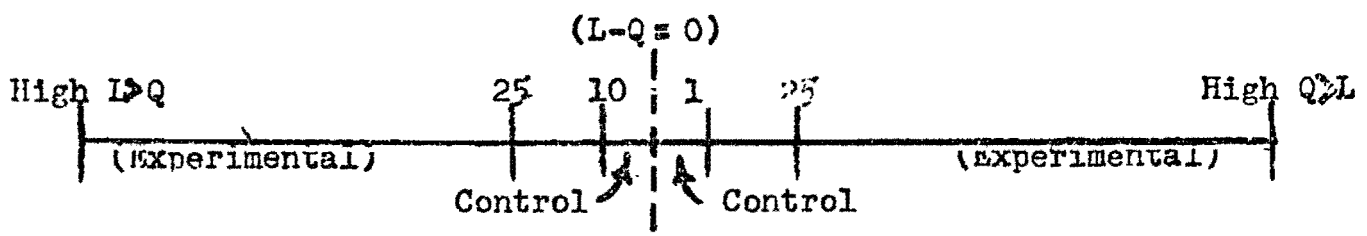
Figure 10.

Dichotomy or Continuum?

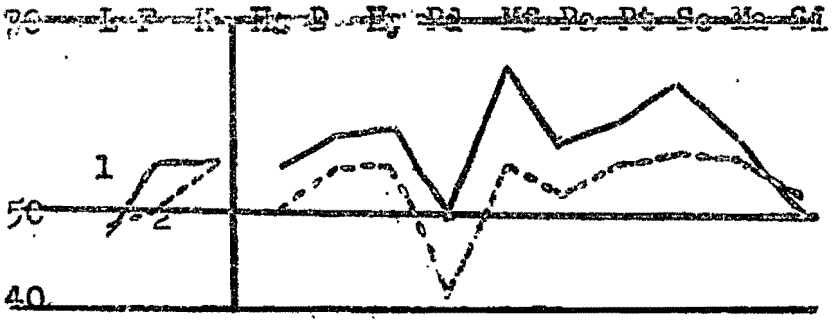


(Figure one)

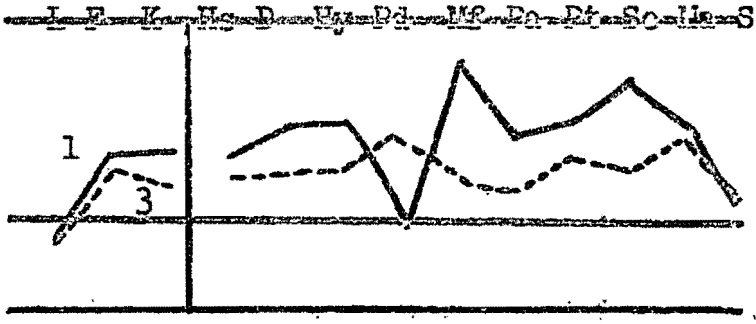
STRATIFICATION OF AVAILABLE POPULATION



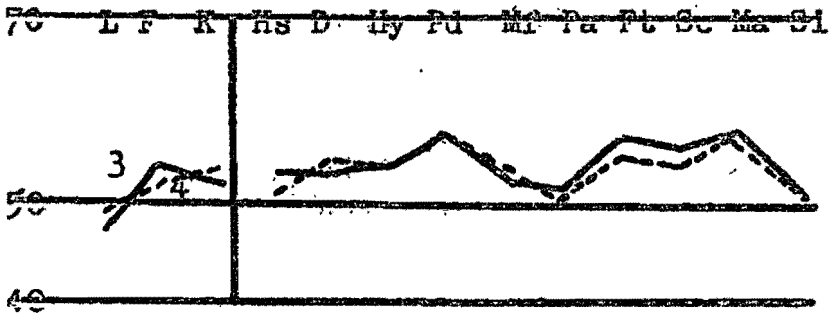
(Figure two): DICHOTOMY OR CONTINUUM?



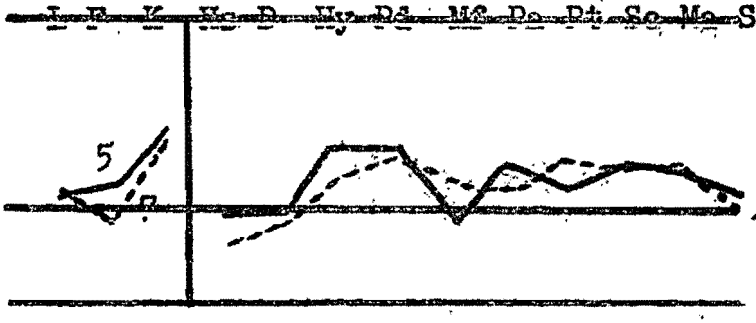
(a) Male L>Q, experimental vs control (group one vs group two)



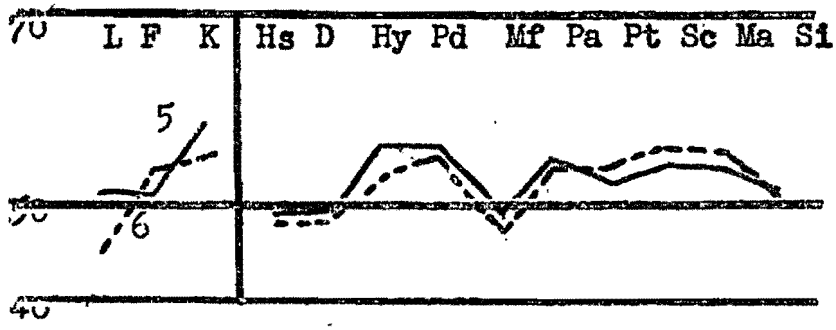
(e) Male, exper. vs exper. (one vs three)



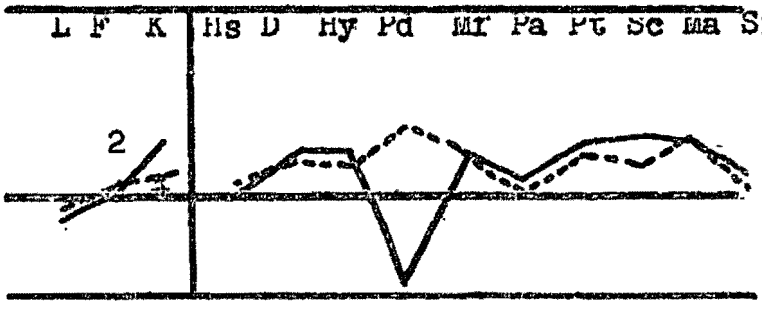
(b) Male Q>L, experimental vs control (group three vs group four)



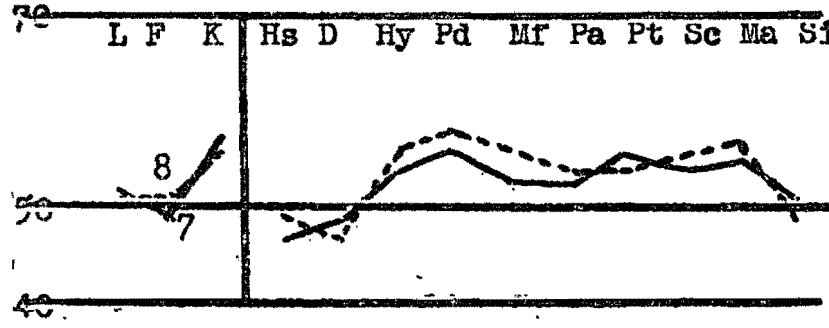
(f) Female, exper. vs exper. (five vs seven)



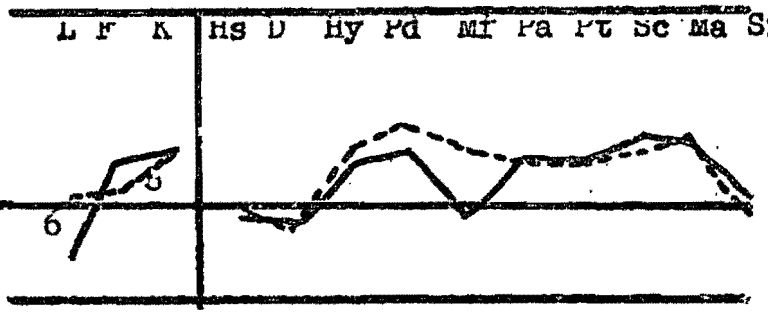
(c) Female L>Q, exper. vs control (five vs six)



(g) Male, control vs control (two vs four)



(d) Female Q>L, exper. vs control (seven vs eight)



(h) Female, control vs control (six vs eight)

(Figure three)

MEAN MMPI PROFILES FOR EXPERIMENTAL AND CONTROL GROUPS