A COMPARISON OF EPPS SCORES OBTAINED FROM THE STANDARD FORCED-CHOICE PROCEDURE AND A RATING-SCALE PROCEDURE

by

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We have carefully read the thesis entitled A Comparison of EPPS Scores Obtained from the Standard Forced-choice Procedure and a Rating-scale Procedure submitted by Chadwick Karr in partial fulfillment of the requirements of the degree of Doctor of Philosophy and recommend its acceptance. In support of this recommendation we present the following joint statement of evaluation to be filed with the thesis.

Adequate assessment of personality variables is one of the most crucial problems in the prediction of personal adjustment to domestic, community, educational and vocational situations. A great deal of research has been conducted as a basis for developing useful self appraisal personality inventories. Much further research is needed, however, in determining the relative advantages of different kinds of item formats in assessing personality variables.

In this research Mr. Karr has made a comparative study of the forced choice and rating scale formats.

In the first part of the study he has shown that by using suitable scoring methods for the rating scale format it is possible to obtain results very similar to the forced choice procedure.

The second part of the study indicates rather clearly that each format measures uniquely and reliably factors not measured by the other. In particular it is shown that the social desirability factor is much more prominent in the rating scale format than in the forced choice.

It is believed that this thesis makes original and useful contributions to the theory and technique of personality measurement.

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CHAPTER I

INTRODUCTION

Recent investigation has stressed the confounding effect of response sets on the measurement of personality variables. For example, the set to acquiesce (7, 8) has been shown to account for varying amounts of the systematic variance in scores on the California F Scale (4). Hanley (18), working with scales characterized by the yes-no or true-false type of response category, has shown that another response set may be operating independently of the acquiescence set. This other set has been operationally defined by Edwards (12). He refers to it as the tendency to give socially desirable responses in self-description; this is, briefly, the SD set. In a recent monograph, Edwards (14) summarized the literature and his own research concerning this variable.

Although not much can be done to guarantee control of response sets, the set to acquiesce can be neutralized by having half the statements of a monad scale keyed in one direction, and the other half keyed in the opposite direction. The SD set is not so easily controlled. Edwards (12) showed that from knowing the location of a statement on the SD continuum one can predict with a high degree of accuracy the proportion of individuals who will endorse this statement when describing themselves. Evidence such as this indicates that the SD set is pervasive, and that it tends to mask or override other dimensions of a statement which might be more relevant for assessment of personality or prediction of behavior.

Various methods have been devised for controlling or negating the SD set. One method is to phrase statements so that they tend to cluster within a given range on the SD continuum. Buss and Durkee (2) used this procedure in constructing an inventory to assess hostility, a relatively socially undesirable characteristic. Their statements tended to cluster at the unfavorable end of the SD scale. Similarly, statements may be chosen to represent only the midpoint, as in the case of neutral statements, or the favorable end of the SD continuum. Another method is to include in a self-description inventory a correction scale such as the K Scale of the MMPI (22) or the SD Scale designed by Edwards (14, ch. 4). Still another method is to pair items on either their preference value, which is related to their SD value, or on their SD value itself. This third method is referred to as the forced-choice technique. In constructing the Gordon Personal Profile, Gordon (16) paired statements on their preference value. Edwards (13) paired statements on their SD value in his Personal Preference Schedule (EPPS).

The current popularity of the forced-choice method as a means of controlling both the acquiescence and the SD response sets has focused attention on the type of scores this method produces. Scores on forced-choice inventories, such as the EPPS, are an example of what Cattell (3) calls ipsative or intra-individual scores; i.e., an individual's score on a given EPPS variable is meaningful only in relation to his scores on the other EPPS variables.

Clemans (5) explored the methodological and statistical problems involved in ipsative measures. Most pertinent at this point is his statement that "...there is always a set of raw or absolute measures underlying the ipsative set" (5, p. 73). Clemans discussed many other properties of ipsative matrices. Some of these pertain to the present investigation, and will be referred to later in the development of this report.

Wright (27), following Clemans' lead (5), undertook to show that EPPS scores were "underlaid" by raw measures. Whereas Clemans started with raw scores and worked toward ipsative scores, Wright started with the ipsative EPPS scores and tried to reproduce them by operating on raw or interactive scores as defined by Cattell (3). To obtain his raw data, Wright (27) administered a self-description rating scale made up of EPPS statements presented one at a time. The variable scores obtained from the rating scale form of the EPPS were compared with variable scores obtained by administering the standard forced-choice form of the EPPS to the same Ss. The rating-scale variable scores were next standardized by variables and then ipsatized by individuals. These transformed variable scores were also compared to conventional EPPS scores. The results of this latter comparison showed that standardized-ipsatized rating-scale scores tended to correlate highly with EPPS scores which were already in ipsative form.

The present investigation is concerned with two separate problems arising from Wright's (27) work.

Problem I. Can one devise a method of scoring responses given to separate EPPS statements such that the scores for variables will correlate more highly (than Wright's normative-ipsative scores) with conventional EPPS scores for corresponding variables?

Problem II. Wright showed that the factor structure of the matrices of variable scores for the rating scale and the EPPS were not identical. Presumably, one of the major differences lay in the presence of one or more SD factors in the rating-scale score matrix. Can one determine more precisely what reliable systematic variance is present in variable scores from statements rated one at a time which is not present in forced-choice EPPS variable scores, and vice versa?

To investigate these problems, a further analysis of Wright's (27) data was undertaken.

CHAPTER II

SOURCE OF DATA

As indicated previously, the present investigation consisted of a further analysis of data collected by Wright (27). These data were used because of the considerable statistical information available on the data.

Wright employed two measures of personality--the standard Edwards Personal Preference Schedule (EPPS) and a modified version of this inventory, hereafter referred to as the Rating Scale, which will be described later. He administered these inventories to 153 students in undergraduate psychology classes. The order of administration of the inventories was EPPS the first day, Rating Scale the second day, EPPS the seventh day, and Rating Scale the eighth day. The statistical data of Wright's that were used in the present study were based on the 92 Ss present for all four inventory administrations. The sex, age, and college class distribution of this group was described by Wright (27, p. 73).

The EPPS is a forced-choice duad personality inventory which provides measures on 15 personality variables. These are: Ach, Achievement; Def, Deference; Ord, Order; Exh, Exhibition; Aut, Autonomy; Aff, Affiliation; Int, Intraception; Suc, Succorance; Dom, Dominance; Aba, Abasement; Nur, Nurturance; Chg, Change; End, Endurance; Het, Heterosexuality; and Agg, Aggression. This inventory contains 210 items, omitting the 15 duplicate items, with each item consisting of a pair of statements. In constructing the inventory, Edwards paired the statements on the basis of their social desirability scale values. These scale values had been determined by the method of successive intervals (15, ch. 5). Since S is instructed to select from each pair of statements the one more characteristic of him, the total score for any S always equals the number of items, i.e., 210. Differences between Ss are, therefore, limited to differences in the pattern or profile of the variable scores. Since each variable is represented in 28 comparisons, the raw score on each variable can vary from 0 to 28. However, each variable scale contains only nine different statements; in each variable scale eight of the nine statements are paired three times with statements from the remaining scales, and one of them is paired four times.

To form the Rating Scale, Wright (27) listed in random order the 135 different statements of the EPPS. On this form of the inventory S was asked to indicate on a nine-point scale how well or how poorly each statement described himself. The descriptive category "as poor as possible" was weighted 1; the category "as good as possible" was weighted 9. The variable scores for the Rating Scale were obtained by adding the response weights for each of the nine items representing the variable. Since each variable was represented nine times, the minimum possible score for any variable was now nine; the maximum possible score was now 81.

CHAPTER III

PROBLEM I

Procedure for Problem I

To obtain scores on the variables from Rating Scale raw data which would correlate highly with EPPS scores on the same variables, two methods of scoring the Rating Scale were devised. One method of scoring was called the difference method; the other, the zero-one method. It should be recalled that the ratings had originally been done on single, non-paired items.

Difference method. The first method of scoring the Rating Scale was designed to produce variable scores which would have maximum stability (test-retest reliability) while correlating highly with EPPS variable scores. For each S, the raw data consisted of the weights which S had assigned to the 135 statements of the Rating Scale. These weights were pooled for each set of nine statements. Since the same statements are used three or four times in the EPPS format, it was necessary to add some statement-weights three times and some four times to get 28 weights for each variable. These weights were summed for each of the 15 variables. Then the sum of the weights of the 28 statements paired with the statements on a given variable in the EPPS format was subtracted from the sum for the given variable. Hence each S now had 15 difference scores, some positive and some negative. The sum of these 15 scores for each S equalled zero. For a given variable, these difference scores had a maximum range of 448 since the lowest possible score was now -224, the highest +224. The only way in which the maximum possible score could be obtained is illustrated by the following hypothetical example. If all nine statements representing a particular variable were rated as high as the scale allowed, they would each have a weight of nine. These extreme ratings would give this variable a total score of 28 times a weight of nine, or 252. If the statements paired with this variable had each been rated as low as the scale would allow, they would have a pooled weight of 28 times one, or 28. To obtain this variable's difference score, one would subtract 28 from 252. Since it is possible for a variable to have a score of +224, it is also possible for a variable to have a score of -224. Neither of these values is likely to occur. The difference scores for the 92 Ss used in this investigation did not exceed plus or minus 100.

Zero-one method. This procedure was designed to match as closely as possible the EPPS method of scoring. It was believed that, if the assigned statement-weights were compared statement by statement as they appeared in the EPPS format, one would produce variable scores which would correlate more highly with EPPS scores than would the difference scores. In addition, the zero-one procedure would yield scores having the same maximum range and the same total score for each S as in the standard EPPS.

Basically this method is quite simple. However, without machine-scoring techniques it is quite laborious. For each S statement-weights were compared for the statement pairs as they appeared in the EPPS. The variable to which the statement of a pair with the greater weight belonged received a score of one. The variable to which the statement of the pair with the lesser weight belonged received a score of zero. If the weights for the paired statements were equal, each variable received a score of .5. The score on any given variable was the sum of these values. As with the EPPS, the variable scores obtained by the zero-one method could range from 0 to 28, and they summed to 210 for each S.

Treatment of results. The difference scores obtained for the first and second administrations of the Rating Scale were correlated with each other and with the first and second administrations of the EPPS. Letting D equal the matrix of difference scores obtained from the Rating Scale, and Z the matrix of scores obtained from the standard EPPS, the five correlation matrices obtained were $r_{D_1D_2}$, $r_{D_1Z_1}$, $r_{D_1Z_2}$, $r_{D_2Z_1}$, and $r_{D_2Z_2}$. The diagonal elements of the matrices $r_{D_1D_2}$ and $r_{Z_1Z_2}$ give the test-retest reliabilities for each variable. The latter matrix had been obtained previously by Wright (27).

The geometric means of the diagonal elements of the four correlation matrices representing correlations between the difference method and the EPPS were computed. These mean r values were corrected for attenuation. These corrected correlations represent the correlation possible between the measures had both been perfectly reliable. Means and medians for the resulting 15 correlations--for both the uncorrected and the corrected r's--were obtained. In the process of obtaining the correlation matrices, variable means and standard deviations were obtained for the two administrations of the difference-scored Rating Scale.

The same operations were performed on the zero-one variable scores of the Rating Scale. The same comparisons were made with the EPPS variable scores.

It should be noted that the z' transformation was not used in determining the geometric mean of the r's for each variable. The z' transformation is most appropriate when one is making parametric statistical tests between r's when the population parameter is very high. Wright (27) reported means of correlations from both untransformed and transformed correlation coefficients. The means based on the z' transformation were consistently, but only slightly, higher than those based on the untransformed r's. Differences were more noticeable in the two forms of mean coefficients when the r's for the variables had been corrected for attenuation before the z' transformation had been made. The mean r for rs based on the z' transformation increases markedly if one of the rs approaches 1.0000 since under this condition the corresponding z' value approaches infinity.

The z' transformation was not used in the present investigation because of the relative stability of rs based on 92 observations and because of the practically insignificant differences found by Wright between transformed and untransformed mean rs. The correction for attenuation was done after, not prior to, the averaging of the rs.

The difference method of scoring made use of Wright's (28) program for scoring rating scales on an IBM Type 650 electronic computer. The zero-one method of scoring (21) was programmed by the present investigator and Wright. The correlation matrices were obtained by using two programs written by Dvorak and Wright (10, 11).

Results and Discussion of Problem I

Means and standard deviations. Table 1 gives the mean and standard deviation of each variable for the first and second administration of the original Rating Scale and the EPPS. These data were taken directly from Wright's (27) report and are based on 92 *Ss*. Table 2 gives the mean and standard deviation of each variable for the first and second administration of the difference-scored Rating Scale, and the zero-one-scored Rating Scale. Table 3 shows the result of comparisons made between corresponding variable means for first and second administrations of the original Rating Scale, the difference- and zero-one-scored Rating Scale, and the EPPS.

The rank ordering of the variable means for the difference and zero-one methods of scoring the Rating Scale correlated more highly with corresponding

Table 1

Means and Standard Deviations for the Variables of the Original Rating Scale and the EPPS

(N = 92)

	Means				Standard Deviations			
	Rating Scale		EPPS		Rating Scale		EPPS	
Admin.	First	Second	First	Second	First	Second	First	Second
Ach	63.6413	63.0326	14.7826	15.3261	9.1682	9.1063	4.7385	5.2484
Def	55.0109	54.5435	12.2283	12.5217	7.0869	7.5359	2.8668	3.9605
Ord	55.6739	55.4022	11.0870	11.4457	9.1831	9.5051	4.2875	5.2901
Exh	49.1630	48.9783	14.1739	14.4130	9.1432	9.1566	3.4377	3.6926
Aut	50.5870	50.5761	12.1957	12.9239	8.6552	8.9457	4.3544	4.8840
Aff	63.0435	62.8043	16.7500	16.7391	8.4799	8.2006	4.5603	4.4181
Int	61.1739	61.7826	19.1413	19.1848	10.5156	10.2415	4.8958	5.3668
Suc	53.1304	52.5652	11.0109	10.3478	10.3382	10.6591	4.5575	4.8465
Dom	53.3696	54.3913	14.8587	15.2065	9.8825	9.4259	5.0853	5.0294
Aba	49.6848	47.5761	13.1522	12.2283	10.2701	10.8590	5.4770	6.4640
Nur	62.1848	61.5217	15.7174	15.1522	7.9848	8.3571	4.7281	4.7843
Chg	59.1739	59.1087	16.2174	15.7500	7.8818	9.2354	4.7016	4.8580
End	57.3696	56.9783	13.6413	13.4891	8.5828	9.1673	4.9686	5.1742
Het	58.2174	57.0435	15.6304	16.2174	8.8389	9.3713	5.3074	5.7234
Agg	36.1087	36.9130	9.4130	9.0543	9.5899	10.0215	3.8931	4.1843

Table 2

Means and Standard Deviations for the Variables of the Difference-Scored and the Zero-One-Scored Rating Scale
(N = 92)

	Means				Standard Deviations			
	Difference-Scored		Zero-One-Scored		Difference-Scored		Zero-One-Scored	
Admin.	First	Second	First	Second	First	Second	First	Second
Ach	13.000	12.250	16.6576	16.5707	26.394	27.822	4.6573	5.1072
Def	-4.500	-5.435	13.1848	12.8804	20.751	22.254	3.5674	3.6583
Ord	-9.207	-7.761	12.1304	12.4076	26.824	28.057	4.9728	5.3120
Exh	.337	-.815	14.0652	13.6902	25.504	26.052	4.4339	4.2681
Aut	-6.598	-5.609	12.8750	12.8478	26.079	25.902	4.7621	4.6834
Aff	6.457	10.946	15.2174	16.1957	21.857	21.349	4.2550	4.3468
Int	20.348	24.098	17.5978	18.1576	28.924	27.660	5.1602	5.1799
Suc	-9.511	-10.467	11.5761	11.4565	29.347	30.861	5.0102	5.3011
Dom	2.837	6.228	14.1630	14.7065	31.294	28.886	4.9019	4.8372
Aba	-2.870	-10.620	13.4674	12.3696	33.870	36.876	5.1845	5.7915
Nur	4.739	4.946	14.3315	14.3804	17.566	19.504	3.8103	4.1320
Chg	7.185	6.761	15.6685	15.6087	23.527	24.937	4.2164	4.6897
End	-.391	-1.370	13.8859	13.6087	26.508	28.167	4.7714	5.0313
Het	8.696	6.924	15.9076	15.7120	26.665	26.390	5.2238	5.0276
Agg	-30.522	-30.076	9.2717	9.4076	26.105	27.024	3.9249	3.7907

Table 3

Correlated t-Test Comparisons of Rating Scale and EPPS Means for First and Second Administration
(N = 92)

	Original Rating Scale Means		Difference-Scored Rating Scale Means		Zero-One Scored Rating Scale Means		EPPS	Means
	$\bar{X}_1-\bar{X}_2$	t	$\bar{D}_1-\bar{D}_2$	t	$\overline{01}_1-\overline{01}_2$	t	Z_1-Z_2	t
Ach	.6087	1.448	.750	.515	.0869	.316	-.5435	1.734
Def	.4674	.996	.935	.603	.3044	.992	-.2934	.945
Ord	.2717	.629	-1.446	1.024	-.2772	1.014	-.3587	1.112
Exh	.1847	.443	1.152	.785	.3750	1.253	-.2391	.756
Aut	.0109	.025	-.989	.732	.0272	.091	-.7282	2.160*
Aff	.2392	.657	-4.489	3.472**	-.9783	3.221**	.0109	.036
Int	.6087	1.282	-3.750	2.422*	-.5598	1.809	-.0435	.140
Suc	.5652	1.068	.956	.595	.1196	.386	.6631	2.005*
Dom	-1.0217	2.396*	-3.391	2.355*	-.5435	2.167*	-.3478	1.086
Aba	2.1087	3.121**	7.750	3.550**	1.0978	2.924**	.9239	2.545*
Nur	.6631	1.604	-.207	.158	-.0489	.192	.5652	1.840
Chg	.0652	.149	.424	.278	.0598	.193	.4674	1.490
End	.3913	.790	.979	.530	.2772	.870	.1522	.414
Het	1.1739	2.893**	1.772	1.311	.1956	.668	-.5870	1.473
Agg	-.8043	1.590	-.446	.296	-.1359	.519	.3587	1.127

* $p < .05$

** $p < .01$

EPPS variable means than did the original Rating Scale means. When the means for the two administrations were combined, the rho values were .95, .91, and .74, respectively. The variable means for the difference method correlated .98 with the means for the zero-one method. No similar comparison could be made with variable means for Wright's (27) normative-ipsative-scored Rating Scale because that method of scoring produced variable means which were equal.

From Tables 1 and 2 it may be seen that the variable Aggression consistently had the lowest mean. The highest mean on the original Rating Scale scores was on the variable Achievement for both administrations. For the two arbitrary methods of scoring the Rating Scale and for the EPPS, Intraception had the highest mean on both administrations. Abasement showed the greatest shift in mean value for all sets of data; the means on the second administration were consistently lower. The statistically significant drop in size of the mean for Abasement (Table 3) is in line with findings reported by Holliday (19). In a test-retest reliability study of the MMPI using normal college Ss, Holliday found the means of the clinical scales tended to drop on retest, whereas the K and L scale means tended to rise. She suggested that this result might "...be attributed to an increased defensiveness, and a desire to appear more acceptable socially" (19, p. 29). Merrill and Heathers (24) in their study on the relationship between the EPPS and MMPI found that, for college counseling-center male clients, Abasement was the EPPS variable most positively related to the MMPI clinical scales, most negatively related to the MMPI K Scale, and most negatively related to Edwards' (14) SD Scale. Merrill and Heathers also found Dominance the EPPS variable most negatively related to MMPI clinical scales, most positively related to the MMPI K Scale, and most positively related to Edwards' SD Scale. As shown in Table 3, the mean score on Dominance was consistently higher on the second administration of the Rating

Scale and the EPPS. This shift was also in the more socially acceptable direction, and was statistically significant for the Rating Scale data but not for the EPPS.

In spite of changes in the size of variable means from the first administration to the second, the rank ordering of the means for the two administrations was highly similar for all scoring procedures. The respective _rho_'s for the original Rating Scale, the difference-scored Rating Scale, the zero-one-scored Rating Scale, and the standard EPPS were .997, .95, .96, and .95.

With respect to standard deviations, scores for Deference tended to be least variable when both administrations of the EPPS and all methods of scoring the Rating Scale were taken into account. Similarly, scores for Abasement tended to be most variable.

Reliabilities. Table 4 contains the test-retest reliability coefficients for the variables for the difference-scored and zero-one-scored Rating Scale and for the EPPS. The reliabilities for the arbitrary scoring methods come from the diagonal elements of Tables A and F given in the Statistical Appendix. For the difference and zero-one methods, scores for Deference had the lowest reliability (r = .77 and .67, respectively). For the EPPS, Exhibition was lowest (r = .64) and Deference second lowest (r = .67). For the difference and zero-one methods, Dominance had the highest reliability (r = .90 and .88, respectively); for the EPPS, Abasement (r = .84).

On the 15 variables, nine of the test-retest reliabilities for the difference-scored Rating Scale were .85 or above; only Deference and Nurturance were below .80. For the zero-one-scored Rating Scale, four variables had reliabilities above .85; six were below .80; one, Deference, was below .70. On the EPPS no variables had a reliability coefficient above .85; six had

Table 4

Test-Retest Reliability Coefficients for the Difference and the Zero-One Methods of Scoring the Rating Scale and for the EPPS*
(N = 92)

	Difference Method	Zero-One Method	EPPS
Ach	8699	8594	8254
Def	7656	6724	6663
Ord	8805	8731	8134
Exh	8529	7851	6435
Aut	8769	8198	7632
Aff	8372	7737	7963
Int	8647	8369	8359
Suc	8716	8368	7764
Dom	8988	8796	8176
Aba	8300	7924	8445
Nur	7778	8150	8106
Chg	8218	7847	8043
End	8280	8089	7620
Het	8819	8520	7648
Agg	8544	7906	7200
Mean	8475	8120	7763
Median	8544	8150	7963

*Decimals omitted.

reliabilities below .80; Deference and Exhibition were below .70. The median test-retest reliability for the 15 variables was .85 for the difference method, .82 for the zero-one method, and .80 for the EPPS. The median test-retest reliability for the original Rating Scale variable scores was .89, and for the normative-ipsative-scored Rating Scale (27), .88.

Both the difference and the zero-one variable scores showed lower test-retest reliabilities than the original Rating Scale variable scores. This might have been anticipated because these methods produce difference scores in which error variances of the scores summate (17, p. 393). In spite of the range of median reliabilities for the EPPS and the various methods of scoring the Rating Scale, these median test-retest reliabilities based upon an administration interval of one week are all as good or better than those usually found for inventories which purport to measure personality variables (cf. 1). For example, Holliday's (19) study showed a median test-retest reliability for normals of .71 for 13 MMPI scales based on the Group Form; of .76 for the Individual Form. Her time intervals averaged 17 and 16 days, respectively. Cottle (6) showed a median reliability for normals of .76 using the MMPI Individual Form alternately with the Group Form for test-retest. His time interval was less than one week.

Indices of congruency. Table 5 gives the correlations between corresponding variables for the four combinations of the two administrations of the difference-scored Rating Scale and the EPPS, the geometric means of the variables for the four sets of coefficients, and the geometric means of the variables corrected for the unreliability of the measures. At the foot of each column are the mean and median values of the correlations in that column. Table 6 gives the same information for the zero-one method in its comparison with the EPPS. (The complete tables of correlations between all pairs of

Table 5

Summary Table of Correlations between Corresponding Difference-Scored and EPPS Variables, and Their Geometric Means Uncorrected and Corrected for Attenuation (N = 92)

	$r_{D_1Z_1}$	$r_{D_1Z_2}$	$r_{D_2Z_1}$	$r_{D_2Z_2}$	Geometric Mean	r_c
Ach	.7842	.7786	.7649	.8155	.7856	.9272
Def	.5439	.6107	.5169	.5397	.5517	.7725
Ord	.6638	.6876	.6876	.7403	.6942	.8203
Exh	.6327	.6760	.6125	.7082	.6563	.8859
Aut	.8171	.8402	.7370	.7976	.7970	.9742
Aff	.7073	.7657	.7429	.7597	.7435	.9106
Int	.7563	.8253	.6968	.7785	.7628	.8972
Suc	.7060	.7894	.6910	.8256	.7509	.9128
Dom	.8338	.8305	.7869	.8267	.8192	.9557
Aba	.8212	.7606	.7761	.8088	.7913	.9452
Nur	.7413	.7145	.6689	.7088	.7079	.8916
Chg	.7673	.7443	.7731	.8536	.7835	.9637
End	.6732	.7883	.7030	.8316	.7463	.9396
Het	.7362	.7644	.6849	.7849	.7416	.9031
Agg	.6733	.6370	.6751	.7440	.6813	.8687
Mean	.7238	.7475	.7012	.7682	.7342	.9046
Median	.7362	.7644	.6968	.7849	.7463	.9106

Table 6

Summary Table of Correlations between Corresponding Zero-One-Scored and EPPS Variables, and Their Geometric Means Uncorrected and Corrected for Attenuation (N = 92)

r	$r_{o^{-1}_1 Z_1}$	$r_{o^{-1}_1 Z_2}$	$r_{o^{-1}_2 Z_1}$	$r_{o^{-1}_2 Z_2}$	Geometric Mean	r_c
Ach	.8009	.7625	.7576	.8069	.7817	.9282
Def	.5809	.6402	.5788	.6113	.6023	.8999
Ord	.7033	.7434	.7079	.7921	.7358	.8731
Exh	.6721	.7051	.6012	.7251	.6742	.9485
Aut	.7969	.8520	.7332	.8347	.8029	1.0150
Aff	.6957	.7613	.7372	.7548	.7368	.9387
Int	.7655	.8075	.7526	.8112	.7838	.9371
Suc	.7330	.7957	.7300	.8764	.7816	.9697
Dom	.8761	.8370	.8302	.8715	.8534	1.0062
Aba	.8379	.7827	.7961	.8529	.8169	.9987
Nur	.7368	.7503	.6771	.7677	.7322	.9008
Chg	.7754	.7229	.8059	.8445	.7859	.9893
End	.7098	.7895	.7457	.8593	.7741	.9860
Het	.7498	.7620	.7087	.8226	.7597	.9412
Agg	.6543	.6388	.6806	.8124	.6934	.9190
Mean	.7392	.7567	.7229	.8029	.7543	.9501
Median	.7368	.7620	.7332	.8124	.7741	.9412

Table 7

Summary Table of Correlations between Corresponding Normative-Ipsative-Scored and EPPS Variables, and Their Geometric Means Uncorrected and Corrected for Attenuation
(N = 92)

	$r_{Y_1Z_1}$	$r_{Y_1Z_2}$	$r_{Y_2Z_1}$	$r_{Y_2Z_2}$	Geometric Mean	r_c
Ach	.7497	.7702	.7557	.8083	.7706	.9051
Def	.4753	.5385	.4462	.4858	.4853	.6740
Ord	.5945	.6417	.6340	.7070	.6430	.7515
Exh	.5950	.6302	.5570	.6449	.6058	.8070
Aut	.8092	.7924	.7570	.7739	.7829	.9517
Aff	.7650	.7984	.7667	.7879	.7794	.9168
Int	.7689	.8290	.6993	.7848	.7691	.8944
Suc	.6901	.7978	.6692	.8239	.7423	.8980
Dom	.8127	.8007	.7786	.8290	.8050	.9354
Aba	.8002	.7428	.7516	.7826	.7690	.9174
Nur	.8015	.7206	.7473	.7199	.7466	.9063
Chg	.7543	.7690	.7551	.8476	.7806	.9448
End	.6719	.7809	.6864	.8154	.7361	.9063
Het	.7390	.7896	.6992	.8098	.7582	.9116
Agg	.5123	.5051	.5572	.6160	.5459	.6888
Mean	.7026	.7271	.6840	.7491	.7147	.8673
Median	.7497	.7702	.6993	.7848	.7582	.9063

variables appear in the Statistical Appendix.) Table 7 gives the same information for Wright's (27) normative-ipsative method. For the four methods of scoring the Rating Scale, the correlations between the second administration of the Rating Scale and the second administration of the EPPS tended to be the highest. This may reflect an increasing stability in S's reaction to a given statement.

The geometric means summarize the relative degree of relationship between corresponding variables as measured by the EPPS and three methods of scoring the Rating Scale. The larger the value of a mean coefficient, the greater the success in obtaining variable scores from the Rating Scale which would approximate those of the EPPS. The method of scoring the Rating Scale which showed the greatest success was the zero-one method. Of the 15 corresponding coefficients 13 were higher for the zero-one method than for the difference method. Next best was the difference method with 11 corresponding coefficients larger than those for the corresponding normative-ipsative method. However, these differences were slight since the median coefficient for each method was practically the same; it was .75 for the difference method, .77 for the zero-one method, and .76 for the normative-ipsative method.

Some EPPS variables were more successfully predicted by the corresponding Rating Scale variables than others. As measured by the difference, zero-one, and normative-ipsative methods of scoring the Rating Scale, Deference showed the lowest degree of relationship with Deference as measured by the EPPS with r equal to .55, .60, and .49 respectively, accounting for only 30%, 36%, and 24% of the variance in the corresponding EPPS scale. Perhaps this low degree of relationship can be attributed to the comparatively small standard deviation for Deference as measured by the EPPS and the various methods of scoring the Rating Scale. Dominance consistently showed the highest degree or relationship with r equal to .82, .85, and .80, respectively.

When these geometric mean r's were corrected for attenuation due to lack of reliability of the measuring instruments, the difference, zero-one, and normative-ipsative methods maintained their relative degree of success in approximating EPPS variable scores. All 15 of the variables for the zero-one method r_c's were larger than the corresponding difference method r_c's. Twelve of the difference method r_c's were larger than the corresponding normative-ipsative r_c's. The medians were again fairly similar being .91 for the difference method, .94 for the zero-one method, and .91 for the normative-ipsative method.

The rankings of the sizes of the corrected geometric mean coefficients were also fairly similar. The ranks of the difference method coefficients correlated .88 with the ranks for the zero-one method coefficients and .89 with the normative-ipsative coefficients. The zero-one ranks correlated .79 with the normative-ipsative ranks.

For the difference and the normative-ipsative methods, Deference was still lowest in relationship to EPPS Deference with the r_c equal to .77 and .67, respectively. For the zero-one method Order was lowest with r_c equal to .87; Deference was second lowest, .90. Highest for the three methods of scoring the Rating Scale was Autonomy, with .97 for the difference method, 1.02 for the zero-one, and .95 for the normative-ipsative.

The higher corrected values for the zero-one method and the lower corrected values for the normative-ipsative method is in part related to the method of correcting for attenuation. In the correction formula, the denominator terms are the test-retest reliabilities of the measures correlated. Since the reliabilities of the zero-one scores tended to be lower than those of the difference or normative-ipsative scores, the zero-one uncorrected coefficients tended on the average to be enhanced more by the correction procedure than the difference or normative-ipsative coefficients.

In conclusion, one can say that the variable scores as obtained by the zero-one method correlated slightly more highly on the average with EPPS variable scores than variable scores obtained by the difference or normative-ipsative methods ($p > .01$, sign test). This was true whether the coefficients were uncorrected or corrected for attenuation. It is not likely that substantially higher correlations could be obtained than those found unless one used a group of Ss with a greater "range of talent." The correlations were probably attenuated by other factors in addition to week-to-week variance. One of these factors might be a difference in test-taking attitude toward the Rating Scale as compared with that toward the forced-choice EPPS.

It would appear from these results that approximately the same data can be obtained from the Rating Scale as can be obtained from the standard EPPS. In addition, the time required for administering the Rating Scale is considerably less than that required for the standard EPPS. However, this saving in administration time is offset by the relative inconvenience of scoring the Rating Scale, and the relative lack of normative data.

CHAPTER IV

PROBLEM II

The problem of this phase of the investigation was to determine and analyze the reliable systematic variance in the original Rating Scale variable scores obtained for each of the 92 Ss by Wright (7) which was not present in the EPPS variable scores, also obtained for each S by Wright; and, conversely, to determine and analyze the reliable systematic variance in the EPPS variable scores which was not in the original Rating Scale variable scores.

Treatment of the Data

Multiple prediction procedures were used to determine the systematic variance in one inventory's score matrix which was not in the other. Factor analytic procedures were used to analyze this systematic variance.

To gain increased stability of results, S's variable scores from both administrations of each inventory were pooled. This pooling was not done with the variable scores themselves, but was accomplished by adding together four sets of Wright's (27) relevant correlation matrices based on these variable scores. One set of correlations was the correlation matrices of the variables for the two Rating Scale administrations, that is, $r_{X_1X_1}$, $r_{X_1X_2}$, $r_{X_2X_1}$, and $r_{X_2X_2}$, where X equals the Rating Scale and the subscripts stand for the first or second administration. The second set of r's was similar but based on the EPPS variables ($r_{Z_1Z_1}$, $r_{Z_1Z_2}$, $r_{Z_2Z_1}$, and $r_{Z_2Z_2}$, where Z equals the EPPS). The third set was the intercorrelations among the variables from both inventories ($r_{X_1Z_1}$, $r_{X_1Z_2}$, $r_{X_2Z_1}$, and $r_{X_2Z_2}$). The first two sets of matrices presumably contained the same systematic variance which would have been in their corresponding score matrices if the raw score matrices had been transformed to standard score matrices. The adding of these particular correlation matrices results in a matrix sum which equals the variance-covariance matrix of each set when the variable scores are pooled prior to correlating. The three variance-covariance matrices were transformed into correlation matrices. These resulting correlation matrices were designated by the symbols ρ_{xx}, ρ_{zz}, and ρ_{xz}.

The next step was to develop two matrices of beta weights which would be premultiplied by ρ_{xz} or its transpose, ρ_{zx}. The resulting product, $\rho_{xz}\beta$, was subtracted from ρ_{xx} to obtain the variance-covariance matrix of the errors of prediction when predicting Rating Scale variable scores from EPPS variable scores when all scores are in standard-score form. Similarly, the product $\rho_{zx}B$ was subtracted from ρ_{zz} to give the variance-covariance matrix of the errors of prediction when predicting EPPS variable scores from the Rating Scale variable scores when all scores are in standard-score form.

An error-of-prediction matrix is assumed to contain the systematic variance in one set of variable scores which is not accounted for by the variance in the other set of variable scores. These error matrices are partial variance-covariance matrices, and are labeled C_{xx} and C_{zz} in the Mathematical Appendix.[1] The error matrices were then transformed into the partial correlation matrices, P_{xx} and P_{zz}. Each was then factor-analyzed until four factors were extracted.

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[1]The Mathematical Appendix gives the rationale and the computational steps for obtaining the two partial correlation matrices and estimates of reliability. The method was originally suggested by Dr. Paul Horst. Dr. William M. Meredith is the author of the appendix. Edward F. Gocka translated the matrix-algebra computational steps into an IBM Type 650 flow chart. Machine computation was supervised by Gocka.

To determine how many of these factors could be considered reliable, the rationale summarized by Wright (27) was followed. Wright stated:

> The amount of variance accounted for by any given factor can be determined by computing the sum of squares of that factor loading vector, although following Horst (20) and as summarized by Meredith and Wright (23), the value is usually obtained in the factoring process. Referred to as Δ^2, it is the root or eigenvalue associated with the factor vector. The sum of the roots indicates the total amount of variance extracted by the factors given. Horst has pointed out in unpublished notes that if the factor extraction is continued until the sum of the roots equals the sum of reliabilities of the variables, then all the reliable variance will have been accounted for (27, p. 34).

The computational steps required for estimating the sum of the Δ^2 elements are given in the Mathematical Appendix.

The vectors of reliable factor loadings for the unpredicted variance in the Rating Scale were rotated to simple structure and correlated with sums of the social-desirability scale values for each of the nine statements which make up the 15 EPPS variables.

The partial correlation matrices were obtained by procedures not yet written in report form. The program used for the factor analysis is a modification of Wright's (26) principal axis program which has also not yet been written in report form.

Results and Discussion of Problem II

. Pooled correlation matrices and their derivatives. The matrix sum of the Rating Scale correlation matrices which were taken from Wright's (27) report is given in Table 8. The comparable EPPS matrix is given in Table 9. The sum of the matrices of correlations between the Rating Scale and the EPPS is given in Table 10. The distinguishing characteristic of the Rating Scale variance-covariance matrix given in Table 8 was the predominance of positive values; out of a total of 105 off-diagonal elements, only 7 were

Table 8

Variance-Covariance Matrix Representing the Sums of the Correlations of Rating Scale Variables for First and Second Administration

$(r_{11} + r_{12} + r_{21} + r_{22} = S_{xx})$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	3.8074	.8642	.4870	1.9184	1.6483	.4496	1.4689	.3640	1.9057	-.0988	.7273	.8737	1.6408	1.9524	.8416
Def		3.6282	2.3448	.0864	.1265	1.6760	1.0534	1.0679	.6392	1.4003	2.1064	.9339	1.5109	.4743	.0773
Ord			3.8066	.0139	.0920	1.5038	.7104	1.2030	-.1107	1.2574	1.8278	.3860	1.7181	.5918	.2074
Exh				3.8108	2.1290	.0294	.8897	1.2261	1.4176	.2707	.1835	.7928	.1986	1.3911	2.5147
Aut					3.7856	.2141	1.3254	.3199	1.4758	-.2128	.2494	1.3469	.6247	.8733	2.0599
Aff						3.8278	1.6424	2.1369	.9047	.7629	3.1151	2.2215	.6268	.8596	-.4117
Int							3.8102	1.0301	1.1054	.1928	1.8053	1.4781	.8319	1.3100	.5992
Suc								3.7698	.4581	1.0658	2.2042	1.4037	.0240	.7323	.4590
Dom									3.8244	-.7013	.8333	1.5690	.5777	1.5416	1.3900
Aba										3.6308	1.3205	.1752	.4180	.2567	.0312
Nur											3.7688	1.7445	1.0937	.7294	-.5035
Chg												3.7870	.3477	.6333	.5881
End													3.7204	.3151	-.0522
Het														3.8224	1.1094
Agg															3.7598

Table 9

Variance-Covariance Matrix Representing the Sums of the Correlations of EPPS Variables for First and Second Administration

$(r_{11} + r_{12} + r_{21} + r_{22} = S_{zz})$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	3.6508	-.9491	-.5698	.8182	.6531	-1.5712	-.0052	-.8088	.6455	-1.4319	-1.6308	-.4326	.2714	.7685	.5590
Def		3.3326	.7687	-.5714	-.8478	.5564	.3852	-.5232	-.4939	.0571	.3720	-.3812	.7401	-.8918	-.7455
Ord			3.6268	-.6975	-.6075	-.6465	-.7923	-.1614	-.9780	.3030	-.4739	-.5772	.9475	-.1688	.0467
Exh				3.2870	1.3459	-1.2887	-1.0927	-.1289	.4158	-.1514	-.8835	-.1565	-.2975	-.4084	.7003
Aut					3.5264	-1.1485	-.3606	-.7406	.4327	-1.0010	-1.3727	-.0398	-.0613	-.1734	.9370
Aff						3.5926	.4682	.6581	-.6393	-.1624	2.0006	.9013	-.7010	-.8002	-1.0946
Int							3.6718	-.2922	-.4920	-1.0671	-.0052	.2081	-.1986	.0193	-.6860
Suc								3.5528	-1.4991	.9658	1.1023	.1191	-1.3085	-.2462	-.9245
Dom									3.6352	-.9307	-1.0290	-.4627	-.2593	.5313	1.1892
Aba										3.6890	1.0083	-.3827	-.3918	-.6960	-.5461
Nur											3.6212	.0621	-.2376	-1.2828	-1.4167
Chg												3.6086	-.9600	-.5476	-.9060
End													3.5240	-.6786	-.3794
Het														3.5296	.3188
Agg															3.4400

Table 10

Variance-Covariance Matrix Representing the Sums of the Correlations between Rating Scale Variables (Rows) and EPPS Variables (Columns)

$$(r_{x_1z_1} + r_{x_1z_2} + r_{x_2z_1} + r_{x_2z_2} = S_{xz})$$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	2.8238	-.9471	-.9141	.6474	.4727	-1.1299	.0708	-.8320	.4864	-.9519	-.8656	-.2326	.3119	.5665	.3448
Def	-.4634	1.1192	.3614	-.5698	-.8628	.4725	.1851	-.2559	-.3544	.5270	1.0408	-.1791	.1977	-.7142	-.4131
Ord	-.5464	.4575	1.9268	-.7146	-.9763	.3366	-.5272	.0671	-1.1019	.6503	.6881	-.1658	.5238	-.4084	-.3485
Exh	1.3666	-1.3537	-.5004	2.0779	.9585	-1.5643	-.4471	.2909	.1652	-.2537	-.8352	-.1924	-.6570	.4548	.6509
Aut	1.0550	-1.2298	-.6224	1.2543	2.6868	-1.1648	-.0814	-.6379	.1854	-.7708	-1.1655	.2506	-.3925	.0278	.8806
Aff	-.9486	-.2294	-.7678	-.8580	-.9916	2.3985	.2562	.9185	-.3977	.1309	1.7939	1.0278	-1.0083	-.4849	-1.0008
Int	.4418	-.5441	-.8744	-.7789	-.1294	.3057	2.4972	.0924	-.5046	-.6921	.3041	.2785	-.6340	.3850	-.6087
Suc	-.3395	-.7531	-.3891	-.1526	-.6891	.6318	-.2864	2.5538	-.8144	.5492	1.2785	.2935	-1.1317	-.1765	-.8763
Dom	1.1844	-1.0880	-1.0945	.1514	.5403	-.5403	-.1583	-.9552	2.6583	-1.1943	-.8738	.0716	-.6110	.7664	1.0084
Aba	-.8549	.2182	.2261	-.0847	-.9762	-.1534	-.5671	.8219	-1.1134	2.9976	1.0672	-.3050	-.4254	-.6317	-.8191
Nur	-.8184	-.1067	-.7106	-.8075	-.9976	1.5130	.2441	.8399	-.5902	.5942	2.4463	.4984	-.6633	-.7160	-1.0042
Chg	-.1260	-.6784	-.9882	-.1720	.3248	.7719	.2621	.1963	.0340	-.4457	.2307	2.7304	-1.1941	-.2730	-.7379
End	.5853	.1989	.3134	-.3082	-.2678	-.3730	-.0967	-1.1160	-.1907	.0471	.2433	-.5129	2.3737	-.8196	-.2306
Het	1.3536	-.9446	-.4475	-.2057	-.1901	-.5709	-.1373	-.3159	.3205	-.5018	-.7331	-.5128	-.4704	2.6643	.0244
Agg	.5848	-1.0303	.2885	.9320	1.1921	-1.5484	-.3468	-.2264	.4593	-.4700	-1.4775	-.3784	-.5165	.7785	1.9393

negative. For the corresponding EPPS matrix, 71 out of 105 were negative. The non-symmetric Rating Scale-EPPS variance-covariance matrix had a total of 129 negative off-diagonal elements out of a possible 210, 69 below the diagonal and 60 above.

The basis for these disparate proportions of positive elements is explained by Clemans (5). The EPPS variance-covariance matrix resembles a first centroid residual matrix in its proportion of positive to negative signs because it is based on ipsative rather than on raw or normative measures. The preponderance of negative signs indicates that a factor is missing from the EPPS standard score matrix which is larger in size than any of the remaining factors.

The correlation or ρ forms of these matrices are given in Tables 11 through 13. The two symmetric correlation matrices, ρ_{xx} and ρ_{zz}, have unity in their diagonals because of the manner in which the variance-covariance matrices on which they were based were transformed into correlation matrices. By pre- and post-multiplying a variance-covariance matrix by a diagonal matrix whose diagonal elements are the reciprocals of the square roots of the corresponding diagonal elements of the original matrix, one transforms the original matrix into a correlation matrix with diagonal elements of unity. The non-symmetric matrix, ρ_{xz}, in Table 13 does not have diagonal elements of unity. This matrix was transformed into a correlation matrix by pre-multiplying by the diagonal matrix used to pre- and post-multiply the variance-covariance matrix based on the Rating Scale, and it was post-multiplied by the diagonal matrix used to pre- and post-multiply the variance-covariance matrix based on the EPPS.

As with the two symmetric correlation matrices, ρ_{xx} and ρ_{zz}, the patterning of positive and negative signs in ρ_{xz} is identical with that in

Table 11

Correlations Derived from the First and Second Administrations of the Rating Scale *

(ρ_{xx})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	10000	2325	1279	5036	4342	1178	3857	0961	4994	-0266	1920	2301	4360	5118	2224
Def		10000	6309	0232	0341	4497	2833	2888	1716	3858	5696	2519	4112	1274	0209
Ord			10000	0036	0242	3940	1865	3176	-0290	3382	4826	1017	4565	1551	0548
Exh				10000	5605	0077	2335	3235	3713	0728	0484	2087	0527	3645	6643
Aut					10000	0562	3490	0847	3879	-0574	0660	3557	1665	2296	5460
Aff						10000	4301	5625	2365	2046	8202	5835	1661	2247	-1085
Int							10000	2718	2896	0518	4764	3891	2210	3433	1583
Suc								10000	1206	2881	5848	3715	0064	1929	1219
Dom									10000	-1882	2195	4123	1532	4032	3666
Aba										10000	3570	0472	1137	0689	0084
Nur											10000	4618	2921	1922	-1338
Chg												10000	0926	1665	1559
End													10000	0836	-0140
Het														10000	2926
Agg															10000

*Decimals omitted.

Table 12

Correlations Derived from the First and Second Administrations of the EPPS*

(ρ_{zz})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	10000	-2721	-1566	2362	1820	-4338	-0014	-2246	1772	-3902	-4485	-1192	0757	2141	1577
Def		10000	2211	-1726	-2473	1608	1101	-1521	-1419	0163	1071	-1099	2160	-2600	-2202
Ord			10000	-2020	-1699	-1791	-2171	-0450	-2693	0828	-1308	-1595	2650	-0472	0132
Exh				10000	3953	-3750	-3145	-0377	1203	-0435	-2561	-0454	-0874	-1199	2083
Aut					10000	-3227	-1002	-2092	1209	-2775	-3841	-0112	-0174	-0491	2690
Aff						10000	1289	1842	-1769	-0446	5547	2503	-1970	-2247	-3114
Int							10000	-0809	-1347	-2899	-0014	0572	-0552	0054	-1930
Suc								10000	-4171	2668	3073	0333	-3698	-0695	-2644
Dom									10000	-2542	-2836	-1278	-0724	1483	3363
Aba										10000	2759	-1049	-1087	-1929	-1533
Nur											10000	0172	-0665	-3588	-4014
Chg												10000	-2692	-1534	-2571
End													10000	-1924	-1090
Het														10000	0915
Agg															10000

*Decimals omitted.

Table 13

Correlations Derived from the First and Second Administrations of the Rating Scale (Rows) with the EPPS (Columns)*

(ρ_{xz})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	7574	-2659	-2460	1830	1290	-3055	0189	-2262	1307	-2540	-2331	-0628	0851	1545	0953
Def	-1273	3219	0996	-1650	-2412	1309	0507	-0713	-0976	1440	2871	-0495	0553	-1996	-1169
Ord	-1466	1284	5186	-2020	-2665	0910	-1410	0182	-2962	1735	1853	-0447	1430	-1114	-0963
Exh	3664	-3799	-1346	5871	2615	-4228	-1195	0791	0444	-0677	-2248	-0519	-1793	1240	1798
Aut	2838	-3462	-1680	3556	7354	-3158	-0218	-1739	0500	-2063	-3148	0678	-1075	0076	2440
Aff	-2538	-0642	-2061	-2419	-2699	6468	0683	2491	-1066	0348	4818	2765	-2745	-1319	-2758
Int	1185	-1527	-2352	-2201	-0353	0826	6676	0251	-1356	-1846	0819	0751	-1730	1050	-1681
Suc	-0915	-2125	-1052	-0434	-1890	1717	-0770	6978	-2200	1473	3460	0796	-3105	-0484	-2433
Dom	3170	-3048	-2939	0427	1471	-1458	-0422	-2591	7129	-3180	-2348	0193	-1664	2086	2780
Aba	-2348	0627	0623	-0245	-2728	-0425	-1553	2288	-3065	8191	2943	-0843	-1189	-1765	-2318
Nur	-2206	-0301	-1922	-2294	-2736	4112	0656	2295	-1595	1594	6622	1351	-1820	-1963	-2789
Chg	-0339	-1910	-2666	-0488	0889	2093	0703	0535	0092	-1192	0623	7386	-3269	-0747	-2044
End	1588	0565	0853	-0881	-0739	-1020	-0262	-3070	-0519	0127	0663	-1400	6556	-2262	-0645
Het	3623	-2647	-1202	-0580	-0518	-1541	-0366	-0857	0860	-1336	-1970	-1381	-1282	7254	0067
Agg	1578	-2911	0781	2651	3274	-4213	-0933	-0619	1242	-1262	-4004	-1027	-1419	2137	5392

*Decimals omitted.

the variance-covariance matrix from which it was obtained.

Table 14 gives the regular inverse of the correlation matrix of the pooled Rating Scale administrations. Table 15 gives similar data for the EPPS administrations.

Because an EPPS score matrix is ipsative in Clemans' sense (5), correlation matrices based upon all 15 EPPS variables have no regular inverse. A regular inverse cannot be computed unless the rank of a matrix is equal to its order. For a correlation matrix based on a 15-variable ipsative score matrix, the rank cannot exceed 14, whereas the order is 15. A method for finding an inverse using the correlations for all 15 variables of the EPPS correlation matrix is Horst's (20) "general" inverse procedure which gives an exact "least-square" solution. Rather than use this procedure, one variable was arbitrarily dropped from the EPPS ρ matrix, making its rank equal to its order, and then the regular inverse of the matrix was obtained. The variable deleted was the fifteenth, Aggression. The deletion of one variable removes no systematic variance from the matrix since with an ipsative measure the original score matrix always sums to a constant for each case. Hence the fifteenth variable adds no "information"; it is always exactly determined by the difference between the sum of the other fourteen and the total constant of 210.

Comparing Tables 14 and 15, all the elements of the inverse based on the EPPS ρ matrix were positive, and all the off-diagonal elements were larger than the corresponding values in the Rating Scale ρ inverse. Ten of the corresponding 14 diagonal elements were also larger. This indicated that this EPPS ρ matrix contained less systematic variance than the Rating Scale ρ matrix. Another way of saying this is that the determinant (17, p. 481) of the EPPS ρ matrix was of less magnitude (closer to zero) than the determinant of the Rating Scale ρ matrix.

Table 14

The Regular Inverse of Pooled Correlations of the Rating Scale Variables

(ρ^{-1}_{xx})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	2.8163	-.3556	.1087	-1.2370	-.3656	.3660	-.3098	.1597	-.5881	.1457	.1017	-.0677	-.8624	-.8711	.9471
Def		2.2776	-.9640	.2212	.2599	-.0087	-.0969	.1539	-.3314	-.4507	-.5921	-.1161	-.1155	.2811	-.2286
Ord			2.3033	.3185	-.0897	-.2980	.2044	-.2989	.5204	.0104	-.3287	.2888	-.6904	-.3175	-.5177
Exh				3.0945	-.5030	.2816	.1499	-.9145	.1007	-.2138	-.1767	.1098	.1777	.0150	-1.4876
Aut					2.0527	.1326	-.3246	.2958	-.0205	.0593	-.1615	-.5001	-.1129	.2321	-.6822
Aff						4.2303	-.0969	-.4744	-.0349	.3657	-2.5858	-1.1839	.1371	-.4862	.2004
Int							1.6861	.0568	.2347	.1906	-.7519	-.1342	-.0346	-.2787	-.2332
Suc								2.1270	.1613	-.0836	-.8423	-.1923	.3027	.0068	-.0350
Dom									2.0504	.5269	-.5917	-.4081	-.0371	-.3540	-.6756
Aba										1.5047	-.7096	-.0585	-.0063	-.2199	-.1216
Nur											4.9166	.2192	-.3055	.2379	.9269
Chg												2.0241	.0468	.2399	-.0877
End													1.7938	.3496	.0474
Het														1.7406	-.3193
Agg															2.7266

Table 15

The Regular Inverse of Pooled Correlations of the EPPS Variables

(ρ^{-1}_{zz})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	3.7897	1.4494	2.6439	1.4476	2.4464	2.4787	2.2192	1.8838	2.7012	3.1583	2.0207	1.7659	1.7483	2.2011	
Def		1.9840	1.0654	.7884	1.4807	.8928	1.0064	1.2285	1.5040	1.4771	1.0675	1.0840	.8777	1.4839	
Ord			4.0725	2.1145	2.6269	2.5332	2.8230	1.9923	3.2655	2.9967	2.2330	1.9161	1.8238	2.5182	
Exh				2.7871	1.2815	1.9527	2.0841	1.2558	1.9661	2.0145	1.3805	1.2532	1.5638	1.9924	
Aut					3.7645	2.2783	2.3244	2.0373	2.8133	3.0593	2.1387	1.7629	1.9509	2.5511	
Aff						3.9953	2.1586	1.6450	2.5087	3.0224	.7974	1.2399	2.0012	2.2400	
Int							3.5608	1.9367	2.9614	3.0578	1.8365	1.7045	2.0056	2.3415	
Suc								3.0937	2.7649	2.0994	1.2160	1.5339	2.0723	1.9005	
Dom									4.6174	3.4261	2.2838	2.2326	2.4850	2.6971	
Aba										4.7751	1.8567	2.1585	2.4537	2.9324	
Nur											3.4443	1.5877	1.3441	2.2323	
Chg												2.5062	1.7277	1.9791	
End													3.0707	2.2493	
Het														3.7237	
Agg															

Variance-covariance matrices of the predictions, and multiple R's. When the matrices of regression weights had been calculated (Tables 16 and 17), they were each pre-multiplied by the previously obtained non-symmetric correlation matrix based upon the pooled correlations between the Rating Scale and EPPS variables. The products of these multiplications were two symmetric variance-covariance matrices. Table 18 gives the variance-covariance matrix of the Rating Scale variables as predicted from the EPPS data, when all variables are originally in standard units. Similarly, Table 19 gives the variance-covariance matrix of the EPPS variables as predicted from the Rating Scale data.

Table 18 has as its diagonal elements the squared multiple correlations of each Rating Scale variable with all the EPPS variables. At this point the EPPS variables had been combined linearly to give the best prediction of the separate Rating Scale variables in the "least square" sense. The correlation between these weighted sums of predictor variables and the Rating Scale variables is given by R, the coefficient of multiple correlation. In other words, R gives us a measure of the success of our prediction. These R's are presented in Table 20. Also presented are the R's corrected for attenuation, and the estimated reliabilities of the predictions[2] and the criterion measure; it should be recalled that the criterion measure here is the inventory form which is being predicted. The lowest multiple correlation was for Deference ($R = .47$); the highest, for Abasement ($R = .85$). The data in Table 1 showed that for the original Rating Scale and EPPS variable scores, Deference tended to have the smallest, Abasement the largest average standard deviation.

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[2]A procedure for deriving the estimated reliabilities of the predictions is given in the Mathematical Appendix. This procedure was developed by Dr. William M. Meredith.

Table 16

"Least Square" Regression Weights for Predicting Rating Scale Variance from the EPPS *

$(\beta = \rho^{-1}_{zz} \rho_{zx})$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	7318	0626	0527	1271	0803	1277	2119	1724	1104	2526	1067	1547	1467	3772	-6318
Def	-0795	2245	-0768	-2194	-1782	-0843	-1350	-0492	-1615	1196	-0573	0115	-1407	0056	-4637
Ord	-1584	0198	4640	0193	-0320	0577	0581	0828	-1018	1293	-0498	0294	-1223	0319	-3922
Exh	-0132	-0956	-0435	4846	0156	0246	-0133	0252	-1768	1147	-0964	-0336	-1105	0484	-2600
Aut	-0378	-1301	-1415	-0509	6052	0092	1137	0347	-0253	0744	-0189	2233	-1237	0674	-3761
Aff	-0705	-1108	0630	-2646	-1196	5657	0131	0073	-1137	0375	0031	0599	-0565	1423	-7154
Int	-0220	-0188	-0993	0511	0181	0685	7200	0382	-0736	1733	0259	0960	-0596	0183	-4830
Suc	-1444	-2104	-1620	0348	-1626	1146	0185	7180	-0335	0286	-0116	1005	-2130	-0313	-4240
Dom	-0809	-0688	-1899	-0944	-1627	1306	-0067	1594	5872	0177	0126	1972	-1088	0152	-5974
Aba	0140	0327	0264	-0787	-0322	0921	0877	0248	-1741	9474	0223	0963	0534	1654	-7141
Nur	1258	2597	1424	0983	0160	2479	2450	2972	0253	2205	6626	1968	0767	1933	-5403
Chg	0104	-0523	-0265	-0309	0163	1688	0598	1143	0352	0798	0883	7798	-0265	0325	-4646
End	0268	-1389	-0463	-1512	-1605	-0269	-0578	0153	-1416	0014	-1074	-0271	5619	0511	-6140
Het	0071	-1360	-0581	0392	-0688	0677	1355	0702	-0452	1053	-0161	0978	-1885	8002	-4599
Agg															

* Decimals omitted.

Table 17

"Least Square" Regression Weights for Predicting EPPS Variance from the Rating Scale

$(B = \rho_{xx}^{-1} \rho_{xz})$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	.9173	-.1586	-.1777	-.0025	-.0314	-.0897	-.0481	.0371	-.1280	-.1785	-.1597	.0499	-.1036	-.1484	.2488
Def	-.1038	.6108	-.0980	.0646	.0323	.0206	.1865	-.1582	.0168	-.1316	.0422	-.1719	.0367	-.0727	-.0357
Ord	.0048	-.0893	.8613	-.0659	-.1328	-.0968	-.2155	-.0720	-.1274	-.0068	-.2437	.1961	-.0837	.0316	-.0047
Exh	-.0745	-.0277	.0213	.8831	-.1367	-.1250	-.0676	-.0356	-.0409	.0827	.1128	.0772	-.0370	-.1300	-.3303
Aut	-.0072	-.1310	-.1066	.2441	.9653	-.0958	-.1922	-.0909	-.0721	-.0239	-.1460	-.1275	-.0499	-.1086	.0687
Aff	-.1878	-.0318	-.1731	.0695	-.1707	1.0007	-.0398	.0548	.0631	-.0159	-.0275	-.1180	-.1303	-.2345	.0773
Int	-.0135	-.0021	-.0402	-.3177	-.1976	-.0087	.9989	.0589	-.1555	-.1054	-.0975	-.0553	-.1122	.0807	-.2279
Suc	.1347	-.1833	-.0621	-.1822	-.0087	-.1234	-.0699	.8353	-.1028	-.0069	-.0233	-.1799	-.0267	.0388	-.1624
Dom	.0032	-.1903	-.0542	-.0815	-.0692	-.1349	-.1300	-.1974	1.0197	.0347	-.2254	-.2185	-.1369	.0397	.2087
Aba	-.0855	-.0970	-.0606	.0000	-.1492	-.1520	-.1257	.0798	.0005	.8708	-.0320	-.0754	-.1636	-.1349	-.1300
Nur	-.1949	-.0810	-.2612	-.0386	.0566	-.1041	-.1850	-.0762	-.1194	.0134	.9981	-.0133	-.0665	-.0897	.1890
Chg	-.0304	-.0212	.0226	-.0469	-.0048	-.0957	-.0247	-.0864	-.1985	-.0435	-.1385	1.0957	-.1432	.0175	-.3506
End	-.0962	.0134	-.0428	-.0732	-.0802	-.0832	-.0590	-.1741	-.0037	.0721	.0420	-.1779	.8477	-.1406	-.1243
Het	.0267	-.0393	-.0220	-.1642	-.0376	-.1023	-.1457	-.1192	-.0757	-.0528	-.1073	-.1203	.0627	.8984	-.1925
Agg	-.0565	-.0798	.0995	-.2930	-.0366	-.0556	-.0092	.0125	-.0669	-.1045	-.0624	-.1438	.0021	.0562	.7902

Table 18

Variance-Covariance Matrix of the "Least Square" Predictions of the Rating Scale from the EPPS*

$(\rho_{xz}\ \rho^{-1}_{zz}\ \rho_{zx} = \rho_{xz}\ \beta)$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	6202	-0777	-1405	2858	2285	-1533	1318	-0813	2508	-1347	-0852	0097	1815	2987	0856
Def		2210	1444	-1756	-2026	0737	-0025	-0358	-1328	1672	1712	-0643	0870	-1261	-1811
Ord			3746	-1439	-2025	0411	-1093	0068	-2641	1668	0775	-1198	1099	-0792	-0853
Exh				5196	3151	-2021	0156	0823	1094	-0220	-1366	-0073	-1078	1474	2936
Aut					6174	-2045	0687	-1255	1408	-1744	-1844	1334	-0673	0351	3069
Aff						5057	1141	2583	-0359	0421	3909	2594	-1229	-0604	-2868
Int							5467	0573	0191	-0696	1442	1259	-0613	1073	-0419
Suc								5500	-0870	1446	2768	1172	-2054	-0168	-0863
Dom									6141	-3159	-0769	1332	-0775	1789	1498
Aba										7211	1865	-0918	0168	-0841	-1554
Nur											4903	1658	-0137	-0766	-2690
Chg												6109	-1702	-0494	-0746
End													5226	-0896	-1409
Het														6157	0996
Agg															4541

* Decimals omitted

Table 19

Variance-Covariance Matrix of the "Least Square" Predictions of the EPPS from the Rating Scale *

$(\rho_{zx}\, \rho_{xx}^{-1}\, \rho_{xz} = \rho_{zx}\, B)$

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	7623	-2511	-1711	2207	2047	-4129	-0067	-1938	1768	-3209	-4146	-1174	0958	2548	1624
Def		4173	1764	-1647	-2106	1535	0821	-1130	-1249	1001	1661	-0576	1826	-1817	-1088
Ord			6104	-0729	-1228	-1078	-1751	-0541	-2011	1064	-1216	-1025	2011	-0165	0825
Exh				6145	3514	-3175	-2588	-0313	0409	0060	-1886	-0269	-0476	-0993	1388
Aut					7628	-3055	-0916	-2032	1048	-2529	-3563	0516	-0374	-0198	2851
Aff						7407	1290	1957	-1190	-0117	4549	2322	-1653	-1914	-2710
Int							7397	-0196	-1246	-2135	0369	0466	-0724	0219	-1572
Suc								7228	-3156	2289	3103	0453	-3194	-0795	-2451
Dom									7804	-2545	-2642	-1176	-0380	1483	3279
Aba										7731	2842	-0958	-0397	-2219	-2166
Nur											7402	0326	-0639	-3261	-3247
Chg												7988	-2707	-1420	-2561
End													7052	-1341	0309
Het														7525	0923
Agg															5822

*Decimals omitted.

Table 20

Reliabilities, Multiple R's, and Multiple R's Corrected for Attenuation Representing the Success of Predicting the Rating Scale Variables from the EPPS*

	Estimated Reliability of the Prediction	Estimated Reliability of the Criterion	R	Rc
Ach	9016	9494	7875	8512
Def	8425	8975	4701	5406
Ord	8986	9492	6121	6627
Exh	8524	9504	7208	8009
Aut	8895	9434	7857	8526
Aff	8922	9550	7111	7704
Int	8780	9502	7394	8095
Suc	8485	9389	7416	8308
Dom	9075	9541	7836	8422
Aba	8610	8983	8492	9656
Nur	8927	9387	7002	7649
Chg	8561	9438	7816	8695
End	8695	9248	7229	8062
Het	8223	9535	8467	8861
Agg	0218	9361	6739	4.7180
Mean	8156	9389	7284	
Median	8695	9438	7394	8308

*Decimals omitted.

The multiple R for Abasement indicates that the variance related to Abasement in the Rating Scale standard scores was largely accounted for by the EPPS data, whereas the variation in Deference was not. In Table 13 (ρ_{xz}) the diagonal element which represents the correlation between Rating Scale Abasement scores and EPPS Abasement scores for the pooled administrations was .82, the largest diagonal element. This suggests that Abasement scores from the Rating Scale were more closely related to Abasement scores from the EPPS than were scores on any other corresponding variables. A conclusion one might draw from this is that Abasement scores were least affected by the form of the inventory used. If it could be shown that this close relationship (R = .85) was the result of the failure to control the influence of social desirability in S's evaluation of the statements measuring Abasement, then this would be an unfavorable characteristic of this particular scale. On the other hand, if it could be shown that the relationship indicates that the Abasement scale is least affected by item format, then this would be a favorable characteristic. A converse problem exists in the present study with regard to the relative failure of the EPPS to predict Deference in the Rating Scale. The data from this investigation do not provide enough evidence to clarify the issue. The problem presented is not a simple one. For example, evidence from other studies indicates that the relationship of these two scales, Deference and Abasement, to social desirability is determined in large measure by the group tested. Merrill and Heathers (24), using college counseling-center male clients found that the r_t between Deference and Edwards (14, ch. 4) SD Scale was .20, that between Abasement and the SD Scale was -.46. Crow (9), using veterans hospitalized in a VA neuropsychiatric hospital, found r_t's between the same variables of .52 and .03, respectively. Edwards (14, p. 64), using largely college students, reported Pearson r's of .09 and -.14 between the same variables and his SD Scale.

There is a characteristic of the Abasement scale which should be mentioned which makes it quite different in phrasing from the EPPS statements representing all the other variables except Aggression. Abasement statements are all of the "I feel ...." type, in contrast to the almost universal "I like ...." type. Two-thirds of the Agression statements are also of the "I feel ...." type. Although one does not know whether the scores for Abasement are primarily a function of statement construction, or of Abasement as a variable, one might assume that, since the values for the Aggression indices did not correspond to those for Abasement, the difference between Abasement and other variables is a function of something other than statement form.

As shown in Table 20 the median corrected R for predicting Rating Scale variance from EPPS standard scores was .83. The lowest R_c was .54 for Deference; the highest reasonable R_c was .97 for Abasement.

The unreasonable size of the corrected R for Aggression ($R_c = 4.72$) is a function of having deleted Aggression in the ρ matrix based on the pooled EPPS administrations (ρ_{zz}). The deletion of Aggression values meant that the variance of the corresponding Aggression values of the Rating Scale standard score matrix had to be predicted by the remaining undeleted 14 variables of the EPPS standard score matrix. As a result, the estimated test-retest reliability estimate for the predicted value for Aggression was very low (see Table 20, column 1). When the R for a variable with low reliability is corrected for attenuation, the corrected R becomes greatly inflated.

Table 19 has as its diagonal elements the squared multiple correlations of each EPPS variable with all the Rating Scale variables. These R's are presented in Table 21. Also presented are the R's corrected for attenuation, and the estimated reliabilities of the predictions and the criterion. The median R for predicting EPPS variance from Rating Scale standard scores was .86.

Table 21

Reliabilities, Multiple R's, and Multiple R's Corrected for Attenuation Representing the Success of Predicting the EPPS Variables from the Rating Scale*

	Estimated Reliability of the Prediction	Estimated Reliability of the Criterion	R	Rc
Ach	9335	9043	8731	9503
Def	8883	7997	6460	7664
Ord	9212	8971	7813	8594
Exh	9063	7831	7839	9305
Aut	9196	8657	8734	9789
Aff	9274	8866	8606	9492
Int	9132	9106	8601	9431
Suc	9274	8741	8502	9443
Dom	9289	8996	8834	9664
Aba	8929	9157	8793	9724
Nur	9022	8954	8603	9572
Chg	8952	8915	8938	1.0005
End	9122	8649	8398	9454
Het	9365	8667	8675	9629
Agg	8815	8372	7630	8882
Mean	9124	8728	8344	9343
Median	9132	8866	8603	9492

*Decimals omitted.

The lowest multiple correlation was again for Deference, $\underline{R}$ = .65; the highest, .89 for Change. The corrected median $\underline{R}$ was .95. Deference remained lowest with $\underline{R}_c$ equal to .77, and Change highest with $\underline{R}_c$ equal to 1.00. Abasement ranked third highest out of 15.

It is apparent from the multiple $\underline{R}$'s in Table 21 that predicting EPPS variance from Rating Scale scores was more successful than predicting Rating Scale variance from EPPS scores. For both directions of predicting, least success was had with Deference.

Error-of-prediction matrices. When one of the predicted matrices was subtracted from its criterion ρ counterpart—e.g., $\rho_{xx} - \rho_{xz}\beta$,—the result was a symmetric error-of-prediction matrix labeled $\underline{C}$ in the Mathematical Appendix. These error-of-prediction matrices are presented in Tables 22 and 23. They are partial variance-covariance matrices which presumably contain the variance of one inventory's variables with the influence of the other inventory's variables partialed out. The matrix in Table 22 contains the variance in the Rating Scale ρ matrix which was not predicted from the EPPS data. The elements in this matrix were all positive. The matrix in Table 23 contains the variance in the EPPS ρ matrix which was not predicted from the Rating Scale data. It had 78 negative out of a possible 105 above-the-diagonal elements.

The EPPS partial variance-covariance matrix, C_{zz}, resembles in its ratio of positive to negative signs a first centroid residual matrix. The elements in C_{zz} are on the whole much closer to zero than in the corresponding matrix for the Rating Scale, C_{xx}. At this point one can be certain that the total systematic variance in C_{zz} is less than the total systematic variance in C_{xx}. The diagonal elements are equal to $1-\underline{R}^2$, so these elements indicate the

Table 22

Partial Variance-Covariance Matrix of the Rating Scale Variables with the Influence of the EPPS Variables Partialed Out*

(C_{xx})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	3798	3102	2685	2179	2056	2711	2539	1774	2486	1081	2772	2204	2545	2131	1369
Def		7790	4865	1989	2367	3760	2858	3246	3044	2186	3985	3163	3243	2535	2020
Ord			6254	1475	2268	3528	2958	3108	2351	1714	4051	2215	3466	2343	1401
Exh				4804	2454	2098	2179	2412	2619	0948	1850	2160	1605	2171	3707
Aut					3826	2607	2803	2102	2470	1170	2504	2224	2338	1944	2391
Aff						4943	3160	3043	2724	1625	4292	3240	2890	2851	1783
Int							4533	2145	2704	1214	3322	2633	2823	2360	2002
Suc								4500	2076	1434	3080	2543	2118	2097	2082
Dom									3859	1277	2964	2791	2307	2243	2168
Aba										2789	1705	1390	0970	1530	1638
Nur											5097	2960	3058	2688	1352
Chg												3891	2629	2159	2305
End													4774	1731	1269
Het														3843	1931
Agg															5459

*Decimals omitted.

Table 23

Partial Variance-Covariance Matrix of the EPPS Variables with the Influence of the Rating Scale Variables Partialed Out*

(C_{zz})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	2377	-0210	0145	0155	-0227	-0209	0053	-0308	0004	-0693	-0339	-0017	-0202	-0407	-0047
Def		5827	0447	-0080	-0367	0073	0280	-0390	-0170	-0838	-0590	-0523	0334	-0783	-1114
Ord			3896	-1291	-0471	-0713	-0420	0091	-0682	-0235	-0092	-0571	0640	-0307	-0693
Exh				3855	0439	-0575	-0557	-0064	0793	-0495	-0675	-0185	-0398	-0206	0694
Aut					2372	-0172	-0087	-0060	0160	-0246	-0278	-0628	0200	-0294	-0161
Aff						2593	-0001	-0114	-0579	-0329	0998	0182	-0317	-0333	-0404
Int							2603	-0614	-0101	-0715	-0383	0106	0172	-0166	-0359
Suc								2772	-1016	0379	-0030	-0121	-0504	0099	-0193
Dom									2196	0003	-0194	-0102	-0345	0001	0084
Aba										2269	-0083	-0091	-0690	0290	0633
Nur											2598	-0154	-0026	-0327	-0767
Chg												2012	0015	-0114	-0010
End													2948	-0583	-1399
Het														2475	-0008
Agg															4178

*Decimals omitted.

proportion of the variance in one set of variables which is independent of the variance in the other set of variables.

Matrices factored. To convert the two symmetric variance-covariance error-of-prediction matrices into correlation matrices, they were each pre- and post-multiplied by a diagonal matrix whose elements were the reciprocal square roots of the corresponding diagonal elements of the same matrix. Hence these two symmetric correlation matrices of the prediction errors had unity for their diagonal elements. The partial correlation matrices are given in Tables 24, and 25. As with the partial variance-covariance matrices upon which they were based, all elements of the partial correlation matrix for the Rating Scale variables with the influence of the EPPS variables partialed out were positive (P_{xx}), whereas a majority of the elements of the partial correlation matrix for the EPPS variables with the influence of the Rating Scale variables partialed out were negative (P_{zz}).

Factor analysis of the Rating Scale partial correlation matrix. The first four factor-loading vectors obtained from the Rating Scale partial correlation matrix are given in Table 27. Since the sum of the communalities of the first two factors exhausted the estimated reliable variance as given by the sum of the first column of Δ^2 elements in Table 26, the third and fourth factors may be considered unreliable.

The first two factor-loading vectors for the Rating Scale variance not predicted from EPPS scores are reproduced in Table 28 together with their communalities. The first factor was relatively large; it accounted for 86% of the reliable variance of the Rating Scale variables which was not predicted by the EPPS variables. The second factor accounted for the remaining reliable variance. This latter factor was characterized by large positive loadings in

Table 24

Partial Correlation Matrix of the Rating Scale Variables with the Influence of the EPPS Variables Partialed Out*

(P_{xx})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	10000	5704	5508	5101	5394	6256	6118	4290	6494	3323	6301	5733	5976	5577	3006
Def		10000	6970	3251	4335	6059	4810	5483	5553	4691	6324	5745	5317	4632	3098
Ord			10000	2691	4635	6345	5556	5859	4786	4105	7175	4490	6344	4779	2398
Exh				10000	5725	4305	4669	5187	6083	2590	3738	4995	3352	5053	7240
Aut					10000	5995	6731	5066	6429	3582	5670	5764	5470	5070	5232
Aff						10000	6675	6451	6236	4377	8551	7389	5948	6541	3432
Int							10000	4749	4466	3414	6911	6269	6068	5654	4024
Suc								10000	4983	4049	6431	6078	4569	5043	4202
Dom									10000	3892	6684	7202	5375	5824	4723
Aba										10000	4522	4220	2657	4674	4198
Nur											10000	6647	6198	6072	2564
Chg												10000	6100	5582	5002
End													10000	4042	2487
Het														10000	4215
Agg															10000

*Decimals omitted.

Table 25

Partial Correlation Matrix of the EPPS Variables with the Influence of the Rating Scale Variables Partialed Out*

(P_{zz})

	Ach	Def	Ord	Exh	Aut	Aff	Int	Suc	Dom	Aba	Nur	Chg	End	Het	Agg
Ach	10000	-0563	0477	0511	-0956	-0842	0213	-1198	0019	-2982	-1364	-0080	-0761	-1679	-0149
Def		10000	0939	-0168	-0988	0187	0718	-0971	-0476	-2304	-1515	-1527	0805	-2063	-2258
Ord			10000	-3331	-1548	-2243	-1319	0277	-2332	-0792	-0290	-2039	1887	-0990	-1717
Exh				10000	1453	-1820	-1758	-0197	2726	-1673	-2132	-0664	-1181	-0666	1730
Aut					10000	-0693	-0348	-0235	0702	-1060	-1121	-2873	0756	-1213	-0511
Aff						10000	-0002	-0427	-2425	-1358	3845	0795	-1146	-1316	-1227
Int							10000	-2284	-0423	-2941	-1474	0463	0622	-0653	-1087
Suc								10000	-4116	1511	-0112	-0510	-1762	0380	-0567
Dom									10000	0015	-0811	-0483	-1355	0002	0278
Aba										10000	-0343	-0424	-2666	1224	2054
Nur											10000	-0673	-0093	-1289	-2327
Chg												10000	0062	-0512	-0035
End													10000	-2160	-3987
Het														10000	-0024
Agg															10000

*Decimals omitted.

Table 26

Reliability Estimates of the Variables in the Partial Correlation Matrix for the Rating Scale and for the EPPS

(Δ^2_x and Δ^2_z)

	Rating Scale Δ^2	EPPS Δ^2
Ach	.7062	.3841
Def	.8237	.5763
Ord	.8580	.6124
Exh	.7371	.2880
Aut	.6738	.1754
Aff	.7987	.3552
Int	.7430	.4099
Suc	.6791	.3564
Dom	.7338	.2901
Aba	.2760	.2634
Nur	.7765	.3187
Chg	.6296	.0448
End	.6996	.3317
Het	.5944	.2682
Agg	.0692	.4452
$\Sigma\Delta^2 =$	9.7987	5.1198

Table 27

Unrotated Factor-Loading Matrix of the Partial Correlation Matrix of the Rating Scale*

	I	II	III**	IV**
Ach	7655	-1229	-2103	1701
Def	7361	-2524	3014	1707
Ord	7357	-4042	2199	2485
Exh	6518	5978	-1775	0828
Aut	7629	1918	-2186	1398
Aff	8583	-1935	-0161	-2931
Int	7969	-0583	-2614	0380
Suc	7386	0268	1957	-2074
Dom	8179	1216	-1961	-0576
Aba	5604	1219	6734	0225
Nur	8528	-3132	0115	-2126
Chg	8229	0565	-0068	-2008
End	7228	-3116	-2124	3537
Hct	7416	1043	0661	-2833
Agg	5696	7046	1242	1820
$\Sigma\Delta^2$	8.3777	1.4143	.9355	.6059
Cumulative $\Sigma\Delta^2$	8.3777	9.7920	10.7275	11.3334

*Decimals omitted
**Unreliable factors

Aggression and Exhibition and by fairly large negative loadings in Order, Nurturance, Endurance, and Deference.

The vectors of factor-loadings for these two factors were normalized and then plotted on a two-dimensional graph. The normalizing process places each variable on the graph an equal distance from the point of origin. The orthogonal reference axes were rotated so as to achieve a close approximation to simple structure (25), a procedure which should yield data more meaningful psychologically. On the basis of graphical measurements, a transformation matrix--given in Table 28--was computed which, when pre-multiplied by the original vectors of factor-loadings, gave the two vectors shown to the right in Table 28. By this procedure high loadings on the original vectors were maximiezed and low loadings minimized. The slight changes in the second set of communalities as compared with the first set were due to rounding errors.

These two simple-structure vectors were correlated with the sums of the social-desirability scale values for the 15 variables of the EPPS. Pearson r's were obtained which showed that Factor I correlated .89 and Factor II correlated -.81 with these SD scale value sums. The basis for these high correlations can be seen by looking at the rotated factor loadings in Table 28. This table shows that the highly socially desirable variables, such as Nurturance and Affiliation, tended to have the highest loadings on Factor I, whereas undesirable variables, such as Aggression and Exhibition, had the lowest. On Factor II, the situation was reversed; Aggression and Exhibition now had high loadings and the more socially desirable variables had low loadings.

Although Wright (27) did not rotate the factor-loading vectors that he obtained by factoring the matrices of variable scores for the first administrations of the Rating Scale and the EPPS, his first two factor-loading vectors for the original Rating Scale scores showed quite similar characteristics to

Table 28

Factor-Loading Vectors for the Rating Scale Partial Correlation Matrix before and after Rotation to Simple Structure

	Before Rotation I	Before Rotation II	Before Rotation h^2	Transformation Matrix		After Rotation I	After Rotation II	After Rotation h^2
Ach	.7655	-.1229	.6011	.513	.858	.7198	.2873	.6007
Def	.7361	-.2524	.6055	.858	-.513	.7611	.1611	.6052
Ord	.7357	-.4042	.7046			.8386	.0306	.7042
Exh	.6518	.5978	.7822			.2526	.8473	.7817
Aut	.7629	.1918	.6188			.5562	.5559	.6184
Aff	.8583	-.1935	.7741			.8357	.2743	.7736
Int	.7969	-.0583	.6384			.7136	.3588	.6380
Suc	.7386	.0268	.5462			.6200	.4019	.5459
Dom	.8179	.1216	.6837			.6394	.5239	.6833
Aba	.5604	.1219	.3289			.4183	.3921	.3287
Nur	.8528	-.3132	.8254			.8924	.1688	.8249
Chg	.8229	.0565	.6804			.6771	.4706	.6799
End	.7228	-.3116	.6195			.7800	.1034	.6191
Het	.7416	.1043	.5608			.5828	.4699	.5605
Agg	.5696	.7046	.8209			.1273	.8968	.8205
$\Sigma\Delta^2$	8.3777	1.4143	9.7905					
Reliable $\Sigma\Delta^2$ =			9.7987					

the factor-loading vectors found in this investigation in the Rating Scale partial correlation matrix. The first vector from his Rating Scale factor loading matrix (27, p. 115) correlated .80 (27, p. 50) with the sums of the social-desirability scale values for the variables. His second vector correlated -.71. It would not be proper to attach too much significance to correlations of factor loadings, either with other measures or with other factor loadings, since there is no way of knowing if common elements are involved. (There is a proper procedure for determining if factors obtained from the same score matrix are correlated, but it was not undertaken in this investigation.) In spite of this stricture it would appear that the first two Rating Scale factors as found by Wright (27) resemble the first two rotated factors found in the unpredicted Rating Scale variance as shown in Table 28.

<u>Factor analysis of the EPPS partial correlation matrix.</u> The first four factor-loading vectors obtained from the EPPS partial correlation matrix from which the influence of the Rating Scale variables had been removed are presented in Table 29. Also included are two vectors of communalities, and the cumulative Δ^2 elements.

The first two Δ^2 elements for the factors from the EPPS partial correlation matrix were of approximately equal size, accounting respectively for 40% and 38% of the reliable variance. The third Δ^2 element accounted for the remaining 22% plus some additional unreliable variance. Hence only the first three factors may be considered reliable.

The sum of all three of these Δ^2 elements was smaller than the Δ^2 element of Factor I from the Rating Scale partial correlation matrix; hence, they accounted for a smaller proportion of the total variance. However, taken individually, they each were larger than the Δ^2 element of Factor II

Table 29

Unrotated Factor-Loading Matrix of the Partial Correlation Matrix of the EPPS

	A	B	h^2	C	h^2	D*
Ach	.0564	.3401	.1188	-.0829	.1257	-.0233
Def	-.2627	.3591	.1980	-.2035	.2394	.0993
Ord	-.4988	-.1073	.2603	-.6321	.6599	-.0146
Exh	.6219	.2712	.4603	.0737	.4657	.4233
Aut	.1982	.2219	.0885	-.0351	.0898	.5954
Aff	-.3596	-.0230	.1298	.7644	.7141	.0557
Int	-.1207	.4447	.2123	.0326	.2134	-.4295
Suc	-.1504	-.5738	.3519	-.0520	.3546	.4592
Dom	.5715	.3501	.4492	-.0020	.4492	-.1774
Aba	.2265	-.7011	.5428	-.0856	.5502	-.1244
Nur	-.4161	-.1500	.1956	.5587	.5078	.0960
Chg	-.0026	.0035	.0000	.3330	.1109	-.4762
End	-.4665	.3990	.3768	-.2627	.4458	.0715
Het	.2087	-.3849	.1917	-.1374	.2106	-.3222
Agg	.5872	-.2689	.4171	.0235	.4177	-.0913
$\Sigma\Delta^2$	2.0725		1.9243		1.5629	1.3451
Cumulative $\Sigma\Delta^2$	2.0725		3.9969		5.5598	6.9048

*An unreliable factor

from the Rating Scale matrix; hence each accounted for proportionally more variance than did the Rating Scale Factor II.

The first two factor loading vectors were normalized and plotted on a two-dimensional graph. Each was found to have variables with both high positive and high negative loadings. No rotation was attempted. It was assumed that the loss of the large first centroid as a function of the ipsative nature of the inventory made it impossible to approximate simple structure. This assumption is based on the following statements from Clemans:

> It is not unreasonable to state...that ipsative covariance matrices contain essentially the same amount of "information" as the first centroid residual obtainable from the intercorrelation matrix of the absolute measures for the same traits. Furthermore, the fact that this information is missing from an ipsative intercorrelation matrix will make it next to impossible to make anything psychologically meaningful out of a factor analysis of such data (5, p. 78).
>
> It would seem that performing such an analysis would serve no purpose other than determining the rank of the matrix. For this reason, if such a set of data is factor analyzed, it is recommended that no attempt be made to rotate the resulting vectors to simple structure form (5, p. 81).

Although these vectors of factor loadings may prove to be psychologically meaningless, one can describe their characteristics and perhaps speculate about their nature. Factor A seems to be a variable which is negatively related to Order, Endurance, and Nurturance, and positively related to Dominance, Aggression, and Exhibition. Factor B appears to be a variable which is negatively related to Abasement and Succorance, and positively related to Intraception. Factor C appears to be a variable which is negatively related to Order and positively related to Nurturance and Affiliation.

Even though variables, rather than people, were factored, these three factors from the EPPS partial correlation matrix may represent personality types. What is being suggested is that these factors represent three relatively homogeneous sub-groups within the 92 Ss who were tested. Each hypothetical sub-group was presumably guided by its own group norms in filling out the inventories. It is further suggested that the Rating Scale did not tend to separate these groups because that scale did not force a choice between alternatives which in general were acceptable on a broader social-norm base.

The factor loadings on Factor A showed a relationship to the sums of the social-desirability scale values for each of the EPPS variables. This relationship was similar in magnitude and direction to the relationship between rotated Factor II of the Rating Scale partial correlation matrix and the sums of social-desirability scale values. These rank-order correlation coefficients were -.73 and -.70 respectively. Factors B and C showed no appreciable relationship to the sums of the social-desirability scale values; the rank-order correlations were .07 and .12, respectively. Judging from the correlation between Factor A and the sums of the social-desirability scale values of the variables, it would appear that the hypothetical personality type suggested by Factor A has a set of values which is at variance with the pattern of values generally accepted as the "good" values.

To recapitulate, the Rating Scale variable scores contained reliable systematic variance which was unpredictable from EPPS data, and which was disproportionately divided between two factors. Factor I, because of its large size and high loadings in socially favored variables, is probably related to the tendency to subscribe to socially desirable characteristics. The second factor with its high loadings in Exhibition and Aggression might be an opposite kind of a tendency, namely, a tendency to endorse socially undesirable characteristics or at least to react negatively to socially desirable statements. Factors such as these may be interpreted as response sets. It must be recalled that these factors were found by determining what was in the Rating Scale standard score matrix that was not in the corresponding EPPS matrix.

Therefore, one might conclude that the effects of these response sets are more controlled in the EPPS than in the Rating Scale.

The standard scores of the EPPS variables contained three reliable factors of moderate size which were unpredictable from Rating Scale data. Each of these was bipolar. These factors challenged an interpretation, so it was hypothesized that they may represent fairly homogeneous sub-groups of Ss within the larger sample. Further research is required to determine if groups with distinct sub-group values would also obtain significantly different factor scores on the EPPS.

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STATISTICAL APPENDIX

Instructions for Reading Matrix Tables

Each element of the following tables which appear in 15 x 15 square matrix form has a row-column identification. The table heading gives the key. The first-mentioned inventory in the table heading determines the general row identification. The second-mentioned inventory in the table heading determines the general column identification. The abbreviations for variables given for each row and column determine the specific identification. Thus the element in Table A corresponding to Ach_1 on the left (row) and Agg_2 at the top (column) gives the correlation between Achievement as measured by the first-administration of the difference-scored Rating Scale and Aggression as measured by the second administration of the difference-scored Rating Scale.

The upper triangular matrices have identical corresponding elements below the diagonal, so these elements have been omitted.

Table A

Correlations between the First and Second Administrations of the Difference-Scored Rating Scale*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_1	8699	-2583	-2487	3051	1651	-3377	0922	-3293	1186	-3335	-3591	-1205	1496	2149	0042
Def_1	-1943	7656	4116	-3262	-2906	1064	-1152	-0096	-2191	1821	1683	-1437	1946	-2419	-1897
Ord_1	-3552	4072	8805	-3089	-3516	0948	-1860	0942	-3792	1774	1675	-2137	2291	-1504	-0917
Exh_1	2454	-4240	-2215	8529	3508	-4336	-1608	-1590	0146	-0338	-3151	-2128	-1478	1087	3589
Aut_1	2626	-3072	-2298	3563	8769	-3747	0005	-3329	1638	-3188	-3689	0756	-0613	-0563	2889
Aff_1	-3282	1044	-0900	-3880	-2611	8372	1043	3203	-0695	-0481	5259	3772	-2827	-1214	-3412
Int_1	0306	-0580	-0936	-2004	-0764	1202	8647	0065	-1506	-1391	0887	0225	-1051	-0262	-2072
Suc_1	-2600	-0075	0003	-0425	-2531	3269	-0738	8716	-3077	1085	2468	0403	-2448	-0624	-3390
Dom_1	2222	-2121	-4108	0392	1048	-1134	-1170	-2588	8988	-3786	-1353	1033	-0860	0609	3272
Aba_1	-3408	2636	2083	-1307	-1676	0130	-1795	0723	-3960	8300	1967	-1459	-0510	-1616	-2092
Nur_1	-4614	1580	0315	-3164	-3485	5219	0823	3345	-1590	2669	7778	1690	-1429	-2124	-4817
Chg_1	-0991	-0876	-2699	-1618	1069	2960	-0353	0543	1536	-2023	1178	8218	-1531	-1925	-1368
End_1	0894	1928	2683	-2022	-1295	-0762	-0567	-2510	-1282	0172	-1191	-1597	8280	-2092	-1186
Het_1	1544	-1315	-1331	-0258	-0775	-2512	-0009	-1536	1160	-0317	-3242	-2149	-0364	8819	0882
Agg_1	-0020	-2348	-0477	3855	2362	-4110	-2090	-1709	2546	-1700	-3548	-2059	-1060	0446	8544

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table B

Correlations between the First Administration Difference-Scored Rating Scale (Rows) and the First Administration of the EPPS (Columns)*

(N = 92)

	Ach_1	Def_1	Ord_1	Exh_1	Aut_1	Aff_1	Int_1	Suc_1	Dom_1	Aba_1	Nur_1	Chg_1	End_1	Het_1	Agg_1
Ach_1	7842	-1919	-2100	3079	1750	-4007	0346	-1986	0945	-3073	-3227	-1365	0943	1561	1411
Def_1	-2906	5439	1965	-1766	-2081	2010	1187	-1233	-2006	1077	1922	-0977	2502	-2668	-0756
Ord_1	-2660	1709	6638	-2050	-2064	1452	-1487	0213	-3702	1671	0804	-0224	2289	-0944	-1140
Exh_1	2684	-2496	-0562	6327	3370	-4402	-3089	-0229	1577	0098	-2438	-1189	-0610	-0053	2189
Aut_1	2603	-1662	-1382	3688	8171	-3649	-0491	-2512	1596	-3052	-4529	0548	-0274	-0237	2736
Aff_1	-3566	0489	-1204	-2569	-3114	7073	1125	2892	-1351	-0857	4488	3470	-2998	-1114	-3370
Int_1	0059	-0889	-1815	-2737	-1192	1152	7563	0342	-2109	-1095	1135	-0093	-0815	0894	-2083
Suc_1	-1414	-1497	-0177	-1383	-1461	1779	-1343	7060	-2836	1465	3234	0838	-2456	-0220	-2648
Dom_1	1618	-1015	-2432	0142	0459	-0870	-0506	-3146	8338	-3495	-2023	-0553	-0865	1062	2958
Aba_1	-3368	1632	0403	-1104	-2651	0839	-1624	1754	-2737	8212	2592	-0646	-0780	-1466	-1947
Nur_1	-3745	0181	-0531	-2339	-3116	4223	0035	2922	-1339	1626	7413	0797	-1714	-1816	-3689
Chg_1	-0659	0036	-1271	-0742	1082	2229	0036	0035	-0307	-1597	-0664	7673	-2419	-1811	-1341
End_1	-0301	2034	1223	-0420	-1008	0090	0545	-2691	-2120	0385	0632	-1490	6732	-2747	-0215
Het_1	2297	-0039	0503	-0408	-1110	-1885	-0321	-1182	1233	-1298	-2846	-2866	-0306	7362	-0246
Agg_1	-0094	-0879	1015	1619	2277	-3352	-1636	-1803	3589	-1417	-3899	-2256	0608	0750	6733

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table C

Correlations between the First Administration Difference-Scored Rating Scale (Rows) and the Second Administration of the EPPS (Columns)*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_1	7786	-1545	-2001	1687	2128	-3031	0460	-2584	0696	-3277	-3543	-0584	1706	1363	0841
Def_1	-1927	6107	2146	-2620	-3038	0748	0537	-0558	-0949	0957	2082	-1620	1761	-2117	-1166
Ord_1	-3105	2858	6876	-2265	-4075	0799	-1961	0390	-2793	1965	1405	-0716	1404	-0769	-0655
Exh_1	2431	-2587	-0641	6760	3205	-4323	-2433	-0685	-0079	0392	-2082	-1049	-1071	0494	2719
Aut_1	1836	-2715	-1247	3772	8402	-2945	0114	-3037	1783	-2896	-3992	0145	-0388	-0374	2923
Aff_1	-3111	-0221	-1960	-2783	-3140	7657	1142	2873	-0974	-0261	3959	2986	-2466	-0787	-2468
Int_1	0198	0105	-1729	-3164	-0332	2069	8253	0620	-2169	-2219	0372	0240	-1062	-0385	-1300
Suc_1	-2348	-0452	-0121	-0147	-2616	2183	-0443	7894	-3268	1711	3229	-0049	-2153	-0795	-2767
Dom_1	2233	-1962	-2607	0338	2046	-1073	-1057	-3812	8305	-3304	-2647	-0051	-0683	1983	2913
Aba_1	-3225	1503	1264	0323	-2139	-0332	-1701	1904	-2742	7606	2894	-1206	-0740	-2978	-1804
Nur_1	-3382	1657	-1114	-2464	-4336	4816	-0327	3164	-2414	2453	7145	1596	-0899	-2178	-3827
Chg_1	-1534	-1060	-1932	-0231	1504	2540	0443	0435	0844	-1532	-0572	7443	-2375	-1132	-2088
End_1	0066	2313	2255	-1384	-1578	-0619	-0197	-2808	-0270	-0205	-0303	-1690	7883	-2429	-1381
Het_1	2503	-1140	-0901	-1597	-0284	-1417	-0548	-1181	0678	-0837	-2383	-2003	-0554	7644	0140
Agg_1	0215	-1343	1412	2425	2645	-4071	-2166	-1965	2164	-1325	-2989	-1611	-0380	1594	6370

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table D

Correlations between the Second Administration Difference-Scored Rating Scale (Rows) and the First Administration of the EPPS (Columns)*

(N = 92)

	Ach_1	Def_1	Ord_1	Exh_1	Aut_1	Aff_1	Int_1	Suc_1	Dom_1	Aba_1	Nur_1	Chg_1	End_1	Het_1	Agg_1
Ach_2	7649	-1791	-1596	2555	1540	-4219	0348	-2304	1470	-3114	-4213	-1271	1482	1782	1779
Def_2	-3060	5169	2446	-1270	-1692	2835	1077	-1742	-2287	0867	2109	-0231	2275	-2955	-1783
Ord_2	-1879	2255	6876	-1168	-1271	0334	-1663	-0439	-3178	1704	0144	-1419	2540	-1198	-0594
Exh_2	2493	-3206	-1295	6125	2993	-4170	-1662	0564	1147	-0287	-2408	-1246	-0909	0180	2553
Aut_2	1730	-2150	-1921	3631	7370	-2807	-1370	-1591	0689	-1615	-3065	0311	-0581	-0088	2602
Aff_2	-4047	1332	-1587	-2841	-2809	7429	1249	2959	-2235	-0616	5160	3248	-2421	-2175	-2753
Int_2	0161	-0679	-1727	-1961	-0687	0528	6968	-0045	-1583	-1759	1130	-0152	-0552	1308	-2353
Suc_2	-1692	-1234	-0399	-1723	-1521	1832	-0519	6910	-1892	1492	3239	0511	-2648	-0923	-2502
Dom_2	1799	-0517	-2627	0119	0042	-1073	-0458	-3040	7869	-3297	-2272	-0248	-0751	1071	3242
Aba_2	-3341	1588	0858	-0966	-2610	0557	-2022	1856	-1804	7761	2587	-0869	-1137	-1282	-2010
Nur_2	-3860	0815	-0841	-2453	-2839	4711	0570	2723	-1870	1470	6689	1621	-2432	-2285	-2559
Chg_2	-0944	0122	-1964	-1690	0765	2459	1066	0098	-0714	-1700	0522	7731	-2449	-1233	-2320
End_2	0608	1642	1889	-0329	-0323	-0702	-0785	-3386	-0791	-0187	-0542	-1862	7030	-1638	-0132
Het_2	2968	-1190	0134	-0226	-0862	-1790	-0118	-0503	0717	-1962	-2770	-1818	-0182	6849	-0612
Agg_2	0263	-1430	1002	1551	1865	-2933	-1339	-2266	3633	-1321	-4364	-2260	0117	1605	6751

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table E

Correlations between the Second Administration Difference-Scored Rating Scale (Rows) and the Second Administration of the EPPS (Columns)*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_2	8155	-2408	-1380	1695	2402	-3671	0483	-2980	1947	-3822	-4260	-0976	1997	1440	1333
Def_2	-2996	5397	2269	-2602	-2829	1450	0308	-0567	-0758	1256	2509	-0720	1454	-1929	-2107
Ord_2	-2058	2943	7403	-2317	-2568	-0379	-1853	-0319	-2632	1725	0661	-1992	2252	-1464	-0099
Exh_2	2556	-2276	-1078	7082	3281	-4097	-1253	-0035	-0141	-0508	-2342	-1714	-1404	0318	3126
Aut_2	1459	-2340	-1551	3873	7976	-1983	-0744	-2034	0571	-1756	-3112	-0314	-0557	-0825	2796
Aff_2	-3705	0960	-1258	-1995	-3599	7597	0794	2806	-1178	-0037	4714	2806	-2253	-1510	-3329
Int_2	0236	0497	-2128	-2752	-0255	1230	7785	0109	-1390	-2307	-0085	0646	-1201	0609	-1527
Suc_2	-2815	-0392	-0635	-0150	-2510	2301	-0036	8256	-3002	1548	3068	0003	-2254	-1033	-2280
Dom_2	2647	-1557	-2689	-0262	1498	-1164	-0794	-3963	8267	-3110	-2473	-0229	-0766	1995	3058
Aba_2	-3569	1494	1033	0188	-2435	0107	-1481	1764	-3209	8088	2807	-1473	-0560	-2465	-1890
Nur_2	-4047	1555	-0728	-2185	-3231	4937	0053	3130	-2528	1577	7088	2463	-1950	-3105	-2392
Chg_2	-2101	-0790	-2278	-0295	0447	2505	1032	0415	0364	-1303	0544	8536	-2435	-0790	-3310
End_2	1247	1470	2547	-1826	-1322	-1802	-1515	-3059	0607	-0095	-0813	-2214	8316	-1247	-1284
Het_2	3111	-2240	-1570	-1217	-0257	-0729	-0335	-0653	0128	-1868	-2292	-0565	-0607	7849	-0442
Agg_2	0805	-1505	1250	1805	2958	-3238	-1679	-2888	3000	-1827	-3992	-1804	-0952	1695	7440

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table F

Correlations between the First and Second Administration of the Zero-One-Scored Rating Scale*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_1	8594	-1934	-0912	2768	0380	-3500	1086	-2434	0461	-3677	-3668	-1498	1403	1951	0345
Def_1	-2589	6724	3167	-2714	-2650	1191	-0964	-0845	-1031	0676	1901	-0007	1486	-2442	-0488
Ord_1	-2151	3174	8731	-2669	-3891	-0016	-1210	-0150	-3786	1481	0688	-1716	2224	-1481	0252
Exh_1	2832	-2660	-2143	7851	3032	-3674	-2057	-0673	0958	-0322	-2852	-1360	-1015	-0075	2642
Aut_1	0960	-2526	-3284	3182	8198	-3161	-0719	-2535	1761	-2048	-2782	0784	0217	0502	2179
Aff_1	-3092	0857	-1493	-2812	-2442	7737	0634	2404	-0811	-0006	5248	2366	-3224	-1311	-3072
Int_1	0958	-0438	-0761	-2086	-0849	1371	8369	0301	-2274	-1849	0209	0416	-1751	0146	-2715
Suc_1	-1536	-1005	0193	-0120	-1797	1820	-0808	8368	-3496	1215	1981	-0315	-2837	-0273	-2600
Dom_1	0700	-2084	-3977	0929	1514	-1633	-1221	-2482	8796	-2252	-1225	0176	-0321	0732	3533
Aba_1	-3589	2606	2167	-1191	-0771	0110	-2207	0765	-2427	7924	1814	-0972	-0929	-2924	-1276
Nur_1	-4901	1474	0844	-2588	-3629	4650	0091	2880	-1595	2906	8150	0842	-2267	-2845	-3630
Chg_1	-1270	0098	-2119	-1481	0858	2300	0768	-0212	-0427	-0976	0515	7847	-1208	-1894	-2318
End_1	1440	1969	1891	-1465	-0827	-0668	-0358	-3172	-0835	-1328	-2019	-1158	8089	-0868	-0987
Het_1	1521	-2724	-1906	-0411	-0290	-1924	-0347	-0618	2133	-0980	-2756	-2150	0066	8520	0668
Agg_1	0781	-1975	-0278	2627	2697	-3158	-1916	-1800	2709	-0904	-3346	-2078	-0326	0290	7906

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table G

Correlations between the First Administration of the Zero-One-Scored Rating Scale (Rows) and the First Administration of the EPPS (Columns)*

(N = 92)

	Ach_1	Def_1	Ord_1	Exh_1	Aut_1	Aff_1	Int_1	Suc_1	Dom_1	Aba_1	Nur_1	Chg_1	End_1	Het_1	Agg_1
Ach_1	8009	-1696	-1077	2753	1630	-4293	0100	-2211	0872	-3148	-3635	-1684	1610	1574	1460
Def_1	-3114	5809	1435	-1218	-2161	2003	0741	-1429	-1109	0811	1194	0384	1653	-3004	0196
Ord_1	-2582	1485	7033	-2388	-2356	0808	-1061	-0008	-3846	2276	0624	-0612	2463	-0920	-0637
Exh_1	3106	-2569	-0907	6721	3430	-4093	-3099	-0310	1749	-0541	-2472	-1201	-0470	-0149	2126
Aut_1	1438	-1898	-1954	3300	7969	-2522	-0848	-2156	1609	-2468	-3974	0228	-0210	0292	2309
Aff_1	-3427	0859	-1476	-1936	-3171	6957	1063	2916	-1382	-0551	4572	3274	-3295	-1435	-3246
Int_1	0760	-0831	-1883	-2859	-1121	1048	7655	0515	-2130	-1798	1139	0050	-0652	0770	-2265
Suc_1	-0888	-1734	0401	-1182	-0627	1119	-1480	7330	-3189	1305	2702	0440	-2694	0092	-2543
Dom_1	1347	-1330	-2926	0809	0326	-1029	-0686	-3195	8761	-2764	-1802	-0954	-0828	0949	2844
Aba_1	-3562	1588	0598	-1839	-2641	0714	-1606	1670	-2080	8379	2606	-0383	-0895	-2086	-1474
Nur_1	-4165	0731	-0314	-2197	-3692	4211	-0039	2505	-0924	2143	7368	0858	-1906	-2180	-3254
Chg_1	-0597	0057	-0935	-0796	0645	1619	0502	-0154	-1198	-0889	-0658	7754	-2083	-1434	-1790
End_1	-0247	2049	1365	-0260	0023	-0141	0705	-3019	-2079	-0522	-0051	-1419	7098	-2843	0342
Het_1	2232	-0160	-0091	-0094	-0719	-1919	-0906	-0842	1548	-1484	-2413	-2961	-0670	7498	-0029
Agg_1	0234	-1060	0655	1484	2080	-3171	-1417	-1992	3744	-1116	-4214	-2473	0688	0977	6543

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table H

Correlations between the First Administration of the Zero-One-Scored Rating Scale (Rows) and the Second Administration of the EPPS (Columns)*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_1	7625	1267	-0717	1543	1907	-3384	0001	-2504	0608	-3590	-3704	-0758	2066	1455	0813
Def_1	-2035	6402	1957	-2306	-3557	0558	0541	-0612	-0009	0677	1292	-0344	0790	-2051	-0654
Ord_1	-2779	2885	7434	-2737	-4238	0013	-1536	0063	-2920	2211	1310	-1005	1853	-1024	-0520
Exh_1	2894	-3030	-0983	7051	3441	-3814	-2727	-0921	0430	-0022	-2077	-0820	-1089	0153	2820
Aut_1	0640	-2965	-1935	3717	8520	-2260	-0446	-2463	1863	-2396	-3513	0104	-0540	0036	3012
Aff_1	-2809	-0161	-2241	-2475	-3120	7613	0925	2920	-1192	-0002	4402	2734	-2793	-1001	-2222
Int_1	0558	0747	-1730	-3132	-0603	2226	8075	0660	-2173	-2708	0133	0387	-0952	0011	-1865
Suc_1	-1756	-0617	0260	0124	-1814	1507	-0497	7957	-3660	1646	2883	-0463	-2467	-0760	-2516
Dom_1	1819	-2143	-2906	1477	2319	-1320	-1313	-3821	8370	-2665	-2590	-0619	-0622	1818	2937
Aba_1	-3166	1501	1343	-0135	-2287	-0471	-1645	1547	-2069	7827	2804	-1292	-0547	-3291	-1677
Nur_1	-3560	1874	-0799	-2677	-4425	4465	-0848	2716	-1924	3023	7503	1357	-0970	-2513	-3416
Chg_1	-1209	-0977	-1676	-0509	1054	2034	1151	0759	-0180	-1011	-0821	7229	-2080	-1497	-1779
End_1	-0024	2640	2317	-1278	-1044	-0664	0265	-3118	-0212	-1211	-0964	-1466	7895	-1856	-1374
Het_1	2376	-1668	-1382	-1324	0176	-1647	-1058	-0779	1135	-0884	-2317	-1849	-0612	7620	0440
Agg_1	0361	-2031	0934	2702	2931	-3807	-1425	-2606	2153	-0973	-3075	-1956	-0306	1498	6388

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table I

Correlations between the Second Administration of the Zero-One-Scored Rating Scale (Rows) and the First Administration of the EPPS (Columns)*

(N = 92)

	Ach_1	Def_1	Ord_1	Exh_1	Aut_1	Aff_1	Int_1	Suc_1	Dom_1	Aba_1	Nur_1	Chg_1	End_1	Het_1	Agg_1
Ach_2	7576	-1890	-1056	2392	1364	-4457	0211	-2354	1173	-3012	-4172	-1892	2252	2143	1661
Def_2	-2789	5788	2318	-0126	-1620	2843	1245	-1955	-2580	0701	1517	0341	1801	-3597	-1365
Ord_2	-1826	1737	7079	-1655	-1611	0282	-1470	-0280	-3159	1863	0065	-1165	2364	-1679	0363
Exh_2	2208	-2736	-1245	6012	3065	-3689	-1776	0468	1162	-0152	-1700	-1413	-0731	-0173	1605
Aut_2	1131	-1901	-2570	2832	7332	-2206	-0924	-1710	1141	-0983	-2947	-0288	-0691	-0042	2661
Aff_2	-3948	1568	-1640	-2631	-3194	7312	1552	2393	-2267	-0463	4921	3266	-2529	-1992	-2408
Int_2	0802	-0405	-1639	-2204	-1062	0024	7526	-0477	-1209	-2355	0553	0265	-0679	1575	-2053
Suc_2	-1414	-1585	-0510	-0905	-1581	1470	-0764	7300	-2050	1459	3354	0416	-3101	-0525	-2564
Dom_2	1276	-0277	-2721	0747	0084	-1169	-0737	-3223	8302	-2960	-2351	-0892	-0383	1302	2931
Aba_2	-3266	0829	0558	-0909	-2079	0243	-2432	1925	-1333	7961	2711	-0343	-1631	-1641	-1625
Nur_2	-3699	1156	-1111	-2250	-2660	4934	0216	2529	-1247	1115	6771	1236	-2390	-2478	-2398
Chg_2	-0789	-0763	-1273	-1441	0958	1393	1087	-0151	-0894	-1071	-0285	8059	-2106	-1099	-2224
End_2	0429	1655	2361	-0121	0508	-1213	-1279	-3198	-0610	-0507	-1408	-2216	7457	-1521	0421
Het_2	2848	-0868	0029	-0257	-0104	-1926	-0509	-0426	0373	-2355	-2991	-1937	0376	7087	-0469
Agg_2	0591	-1356	0904	1418	1038	-2613	-1829	-1856	3960	-0619	-3805	-3035	-0447	1580	6806

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

Table J

Correlations between the Second Administration of the Zero-One-Scored Rating Scale (Rows) and the Second Administration of the EPPS (Columns)*

(N = 92)

	Ach_2	Def_2	Ord_2	Exh_2	Aut_2	Aff_2	Int_2	Suc_2	Dom_2	Aba_2	Nur_2	Chg_2	End_2	Het_2	Agg_2
Ach_2	8069	-2890	-0589	1613	1701	-3947	0354	-2548	1479	-3708	-3957	-1286	2268	1712	1433
Def_2	-2762	6113	2204	-2055	-3004	1128	0618	-0595	-0603	0901	1895	-0374	0890	-2503	-1153
Ord_2	-2098	3208	7921	-2507	-3044	-0765	-1900	-0469	-2525	1874	0668	-1641	2077	-1536	-0049
Exh_2	1996	-2222	-1046	7251	3253	-3861	-1598	-0229	-0097	0169	-1507	-1691	-1218	-0179	2414
Aut_2	0949	-2351	-2302	3943	8347	-1566	-0449	-2201	0625	-1497	-3075	-0475	-0729	-0728	3030
Aff_2	-3368	0648	-1553	-1828	-3518	7548	1070	2222	-1336	0061	4768	2699	-2507	-1440	-2629
Int_2	0781	0925	-1993	-3338	-0304	1068	8112	-0281	-1049	-2965	-0962	0936	-0862	0738	-1327
Suc_2	-2206	-0789	-1049	0390	-2205	1884	-0072	8764	-3380	1671	3277	-0036	-2742	-1179	-2196
Dom_2	2277	-1863	-2748	0424	1866	-1159	-1505	-4039	8715	-2885	-2606	-0910	-0307	2357	2838
Aba_2	-3482	0665	0640	0561	-1923	-0277	-1411	1774	-2877	8529	2669	-1347	-0911	-2607	-1791
Nur_2	-3726	1845	-1112	-2393	-2969	5250	-0492	2561	-1931	1844	7677	1694	-1986	-3459	-2048
Chg_2	-1986	-0791	-1832	0043	0604	1745	1175	0364	-0026	-0930	-0366	8445	-2255	-0967	-2767
End_2	0925	1919	3122	-1770	-0777	-2178	-1668	-3118	0764	-0725	-1481	-2450	8593	-0622	-1440
Het_2	2764	-1794	-1399	-1572	0288	-0929	-0704	-0499	0232	-2402	-2736	-0617	0079	8226	-0563
Agg_2	1233	-1832	1278	1996	2130	-3019	-1963	-2775	3249	-1262	-3747	-2444	-1434	1507	8124

*Decimals omitted. A correlation of .267 is significantly different from zero at the .01 level.

MATHEMATICAL APPENDIX

William M. Meredith

We wish to evaluate by factor analytic procedures the reliable variance remaining in the Rating Scale after variance accounted for by the EPPS has been removed from the Rating Scale results and vice versa. Prior to doing this we wish to pool the results of the first and second administrations of both the EPPS and the Rating Scale in order to produce more reliable results. Because significant differences exist between the first and second administrations of both the Rating Scale and the EPPS it is necessary to standardize all matrices of observations prior to pooling. We denote by

X_1 = the 92 x 15 matrix of Rating Scale responses summed over variables, obtained from the first administration,

X_2 = the analogue of X_1 obtained from the second administration,

Z_1 = the 92 x 15 matrix of EPPS responses summed over variables, obtained from the first administration,

Z_2 = the analogue of Z_1 obtained from the second administration.

We let

$$x_1 = (X_1 - 1\,\bar{X}_1')D_{\sigma_{X_1}}^{-1} \qquad (1)$$

$$x_2 = (X_2 - 1\,\bar{X}_2')D_{\sigma_{X_2}}^{-1} \qquad (2)$$

$$z_1 = (Z_1 - 1\,\bar{Z}_1')D_{\sigma_{Z_1}}^{-1} \qquad (3)$$

$$z_2 = (Z_2 - 1\,\bar{Z}_2')D_{\sigma_{Z_2}}^{-1} \qquad (4)$$

where $\bar{X}_1$ denotes the vector of means from the first administration of the

Rating Scale and $D_{\sigma_{x_1}}$ denotes a diagonal matrix of Rating Scale standard deviations from the first adminstration, etc. Then x_1, x_2, z_1, z_2 are standard score matrices with zero means and unit variances.

We will work with the matrices

$$x = (x_1 + x_2)D^{-1}_{\sigma_{x_1+x_2}} \quad , \qquad (5)$$

and

$$z = (z_1 + z_2)D^{-1}_{\sigma_{z_1+z_2}} \quad , \qquad (6)$$

which are the pooled results in standardized form (zero means and unit variances). We are going to determine new sets of variables, say χ and ζ, from X and Z, that are uncorrelated with z and x respectively, and are residual variables consisting of the portions of x and z that cannot be accounted for by z and x respectively. We also require that χ and ζ have zero means and unit standard deviations.

Then it is well known that

$$\chi = (x - z\,\beta)(I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} \quad , \qquad (7)$$

and

$$\zeta = (z - x\,B)(I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} \qquad (8)$$

where β is the matrix of "least square" regression weights for predicting x from z, and B is the matrix of least square regression weights for predicting z from x, $D_{R_{(x\,|\,z)}}$ is a diagonal matrix whose non-zero elements are the appropriate multiple correlations of each x variable with all the z variables and $D_{R_{(z\,|\,x)}}$ is a diagonal matrix whose non-zero elements are the multiple correlations of each z variable with all the x variables.

We wish to factor the intercorrelations of χ and ζ respectively. We denote these matrices by P_{xx} and P_{zz}. The elements of P_{xx} are the partial correlations between each x_i and x_j with the influence or effects of z removed. Similarly the elements of P_{zz} are the partial correlations between each z_i and z_j with the influence of x removed. Since χ and ζ have zero means and unit variances we have that

$$P_{xx} = \frac{\chi'\chi}{n} \quad , \tag{9}$$

and

$$P_{zz} = \frac{\zeta'\zeta}{n} \quad , \tag{10}$$

or

$$P_{xx} = \frac{1}{n}(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} (x' - \beta' z')(x - z\,\beta)(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}}$$

$$= (I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} (\frac{x'x}{n} - \beta'\frac{z'x}{n} - \frac{x'z}{n}\beta + \beta'\frac{z'z}{n}\beta)(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} . \tag{11}$$

Similarly

$$P_{zz} = (I - D^2_{R_{(z \mid x)}})^{-\frac{1}{2}} (\frac{z'z}{n} - B'\frac{x'z}{n} - \frac{z'x}{n}B + B'\frac{x'x}{n}B)(I - D^2_{R_{(z \mid x)}})^{-\frac{1}{2}} . \tag{12}$$

We now define

ρ_{xx} = the matrix of intercorrelations of the x variables,

ρ_{zz} = the matrix of intercorrelations of the z variables,

ρ_{zx} = the matrix of correlations of the z with the x variables.

Since x and z have zero means and unit standard deviations

$$\rho_{xx} = \frac{x'x}{n} \quad , \tag{13}$$

$$\rho_{zz} = \frac{z'z}{n} \quad , \tag{14}$$

and

$$\rho_{zx} = \frac{z'x}{n} \quad . \tag{15}$$

It is well known that

$$\beta = \rho_{zz}^{-1} \rho_{zx} \quad , \tag{16}$$

and

$$B = \rho_{xx}^{-1} \rho_{xz} \quad . \tag{17}$$

Substituting we obtain

$$P_{xx} = (I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} (\rho_{xx} - \rho_{xz} \rho_{zz}^{-1} \rho_{zx} - \rho_{xz} \rho_{zz}^{-1} \rho_{zx} + \rho_{xz} \rho_{zz}^{-1} \rho_{zz} \rho_{zz}^{-1} \rho_{zx})(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} \quad , \tag{18}$$

or

$$P_{xx} = (I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} (\rho_{xx} - \rho_{xz} \rho_{zz}^{-1} \rho_{zx})(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} \quad , \tag{19}$$

We let

$$\rho_{xx} - \rho_{xz} \rho_{zz}^{-1} \rho_{zx} = C_{xx} \quad . \tag{20}$$

Now the matrix $\rho_{xz} \rho_{zz}^{-1} \rho_{zx}$ is the variance-covariance matrix of the least square predictions of x based on z and its diagonal elements are the squared multiple correlations of each x_i with z. The diagonal elements of ρ_{xx} are unity, hence it follows that

$$D_{C_{xx}} = (I - D^2_{R_{(x\,|\,z)}}) \quad . \tag{21}$$

Therefore

$$P_{xx} = D_{C_{xx}}^{-\frac{1}{2}} \, C_{xx} \, D_{C_{xx}}^{-\frac{1}{2}} \quad . \tag{22}$$

Similarly

$$P_{zz} = D_{C_{zz}}^{-\frac{1}{2}} \, C_{zz} \, D_{C_{zz}}^{-\frac{1}{2}} \quad , \tag{23}$$

where

$$C_{zz} = \rho_{zz} - \rho_{zx} \, \rho_{xx}^{-1} \, \rho_{xz} \quad . \tag{24}$$

Computationally the matrices ρ_{xx}, ρ_{zx} and ρ_{zz} may be found by the following equations. Since we have

$$\rho_{xx} = \frac{x'x}{n} = \frac{1}{n} D^{-1}_{\sigma_{x_1+x_2}} (x_1' + x_2')(x_1 + x_2) D^{-1}_{\sigma_{x_1+x_2}} \quad , \tag{25}$$

then

$$\rho_{xx} = D^{-1}_{\sigma_{x_1+x_2}} \left(\frac{x_1' \, x_1}{n} + \frac{x_1' \, x_2}{n} + \frac{x_2' \, x_1}{n} + \frac{x_2' \, x_2}{n}\right) D^{-1}_{\sigma_{x_1+x_2}} \quad . \tag{26}$$

Now since x_1 and x_2 are in standard units (zero means and unit variance) the submatrices in parentheses are correlation matrices. We denote $\frac{x_1' \, x_1}{n}$ by $r_{x_1x_1}$, the intercorrelations of the first administration of the rating scale; $\frac{x_1' \, x_2}{n}$ by $r_{x_1x_2}$, the correlation of the first with the second administration of the rating scale; its transpose $\frac{x_2' \, x_1}{n}$ by $r_{x_2x_1}$, etc. Then

$$\rho_{xx} = D^{-1}_{\sigma_{x_1+x_2}} (r_{x_1x_1} + r_{x_1x_2} + r_{x_2x_1} + r_{x_2x_2}) D^{-1}_{\sigma_{x_1+x_2}} \quad . \tag{27}$$

Furthermore it is evident that the diagonal elements of the sum in parentheses are the variances of the pooled administrations. We denote

$$S_{xx} = (r_{x_1x_1} + r_{x_1x_2} + r_{x_2x_1} + r_{x_2x_2}) \quad . \tag{28}$$

Then

$$\rho_{xx} = D_{S_{xx}}^{-\frac{1}{2}} \; S_{xx} \; D_{S_{xx}}^{-\frac{1}{2}} \quad . \tag{29}$$

We similarly define

$$S_{zx} = (r_{z_1x_1} + r_{z_1x_2} + r_{z_2x_1} + r_{z_2x_2}) \quad , \tag{30}$$

and

$$S_{zz} = (r_{z_1z_1} + r_{z_1z_2} + r_{z_2z_1} + r_{z_2z_2}) \quad . \tag{31}$$

Then

$$\rho_{zz} = D_{S_{zz}}^{-\frac{1}{2}} \; S_{zz} \; D_{S_{zz}}^{-\frac{1}{2}} \quad , \tag{32}$$

and

$$\rho_{zx} = D_{S_{zz}}^{-\frac{1}{2}} \; S_{zx} \; D_{S_{xx}}^{-\frac{1}{2}} \quad , \tag{33}$$

(remember $\rho'_{zx} = \rho_{xz}$ in this notation.)

The computational steps to this point are

1. Determine S_{xx}, S_{zz} and S_{zx} by

$$S_{xx} = r_{x_1x_1} + r_{x_1x_2} + r_{x_2x_1} + r_{x_2x_2} \quad , \tag{34}$$

$$S_{xz} = r_{x_1z_1} + r_{x_1z_2} + r_{x_2z_1} + r_{x_2z_2} \quad , \tag{35}$$

$$S_{zz} = r_{z_1z_1} + r_{z_1z_2} + r_{z_2z_1} + r_{z_2z_2} \quad . \tag{36}$$

2. Determine the correlation matrices of the pooled administrations ρ_{xx}, ρ_{xz} and ρ_{zz} by

$$\rho_{xx} = D_{S_{xx}}^{-\frac{1}{2}} \; S_{xx} \; D_{S_{xx}}^{-\frac{1}{2}} \quad , \tag{37}$$

$$\rho_{zz} = D_{S_{zz}}^{-\frac{1}{2}} S_{zz} D_{S_{zz}}^{-\frac{1}{2}} \quad , \qquad (38)$$

$$\rho_{xz} = D_{S_{xx}}^{-\frac{1}{2}} S_{xz} D_{S_{zz}}^{-\frac{1}{2}} \quad , \qquad (39)$$

$$\rho_{zx} = D_{zz}^{-\frac{1}{2}} S_{zx} D_{xx}^{-\frac{1}{2}} \quad . \qquad (40)$$

We also define $\rho_{zz_{(14)}}$ which is ρ_{zz} with a row and corresponding column removed, and $\rho_{xz_{(14)}}$ which is ρ_{xz} with the corresponding column removed. This is necessary in this case for the EPPS is an ipsative test. Hence its correlation matrix is of rank one less than its order and no regular inverse exists. We could compute its general inverse or can use only 14 variables and obtain the same accuracy of prediction of x.

3. Compute the matrix of regression weights for predicting x from z,

$$\beta = \rho_{zz_{(14)}}^{-1} \rho_{zx_{(14)}} \quad . \qquad (41)$$

4. Compute the matrix of regression weights for predicting z from x,

$$B = \rho_{xx}^{-1} \rho_{xz} \quad . \qquad (42)$$

5. Compute the covariance matrix of the predictions of x by

$$\rho_{xz_{(14)}} \rho_{zz_{(14)}}^{-1} \rho_{zx_{(14)}} = \rho_{xz_{(14)}} \beta \quad . \qquad (43)$$

6. Compute the covariance matrix of the predictions of z by

$$\rho_{zx} \rho_{xx}^{-1} \rho_{xz} = \rho_{zx} B \quad . \qquad (44)$$

7. Determine the partial covariance matrix C_{xx} by

$$C_{xx} = \rho_{xx} - \rho_{xz_{(14)}} \rho_{zz_{(14)}}^{-1} \rho_{zx_{(14)}} = \rho_{xx} - \rho_{xz_{(14)}} \beta \quad . \qquad (45)$$

8. Find the partial covariance matrix C_{zz} by

$$C_{zz} = \rho_{zz} - \rho_{zx} \rho_{xx}^{-1} \rho_{xz} = \rho_{zz} - \rho_{zx} B \quad . \tag{46}$$

9. Find the partial correlation matrix of the x variables with the influence of z partialed out by

$$P_{xx} = D_{C_{xx}}^{-\frac{1}{2}} C_{xx} D_{C_{xx}}^{-\frac{1}{2}} \quad . \tag{47}$$

10. Determine the partial correlation matrix of the z variables with the influence of x partialed out by

$$P_{zz} = D_{C_{zz}}^{-\frac{1}{2}} C_{zz} D_{C_{zz}}^{-\frac{1}{2}} \quad . \tag{48}$$

We are now ready to factor P_{xx} and P_{zz} except we need to know the reliabilities of the variables χ and ζ whose intercorrelations P_{xx} and P_{zz} represent. In order to determine equations for estimating these reliabilities we must first determine the reliabilities of the variables represented in x and z respectively. Since x and z represent the pooling of two administrations of the same test we may use the Spearman-Brown formula for the reliability of a test of doubled length which is $\frac{2r_{ii}}{1 + r_{ii}}$ where r_{ii} denotes the observed reliability.

We let the reliability of the i'th component of x by denoted by ${}_x\rho_{ii}$. Then

$${}_x\rho_{ii} = \frac{2\,{}_xr_{ii}}{1 + {}_xr_{ii}} \quad , \tag{49}$$

where ${}_xr_{ii}$ denotes the observed reliability for the same component from a single administration. Similarly

$$ {}_z\rho_{ii} = \frac{2\,{}_z r_{ii}}{1 + {}_z r_{ii}} \quad . \tag{50} $$

The scalars ${}_x r_{ii}$ and ${}_z r_{ii}$ may be obtained from the diagonals of $r_{x_1 x_2}$ and $r_{z_1 z_2}$ respectively (or from $r_{x_2 x_1}$ and $r_{z_2 z_1}$).

Now suppose we were able to have two observations of χ denoted by χ_1 and χ_2. Then it would be necessary to have two observations of x and z, say ${}_1x$, ${}_2x$, ${}_1z$ and ${}_2z$. The reliabilities of the components of χ would be found from the diagonal elements of the matrix $\frac{\chi_1' \chi_2}{n}$.

We assume that the matrix of regression vectors for predicting ${}_1x$ from ${}_1z$ would be the same as that for predicting ${}_2x$ from ${}_2z$, and that the multiple correlation of each ${}_1x_i$ with ${}_1z$ would be the same as that of ${}_2x_i$ with ${}_2z$. Using these assumptions and the definition of χ we have

$$ \frac{\chi_1' \chi_2}{n} = \frac{1}{n}(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} ({}_1x' - \beta' {}_1z')({}_2x - {}_2z\, \beta)(I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} $$

$$ = (I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} \left(\frac{{}_1x' {}_2x'}{n} - \beta' \frac{{}_1z' {}_2x}{n} - \frac{{}_1x' {}_2z}{n} \beta + \beta' \frac{{}_1z' {}_2z}{n} \beta\right) (I - D^2_{R_{(x \mid z)}})^{-\frac{1}{2}} \quad . \tag{51} $$

Implicit in the assumption that β is the same for ${}_1x$, ${}_1z$ and ${}_2x$, ${}_2z$ is the assumption that ${}_1z' {}_2x = {}_2z' {}_1x = \rho_{zx}$. We further denote by $D_{{}_x\rho_{ii}}$ and $D_{{}_z\rho_{ii}}$ diagonal matrices of the reliabilities of the components of x and z, respectively. We define

$$ D_{u_x} = I - D_{{}_x\rho_{ii}} \tag{52} $$

and

$$D_{u_z} = I - D_{{}_z\rho_{ii}} \quad , \tag{53}$$

which are diagonal matrices of the unreliabilities of x and z respectively.

Then

$$\frac{{}_1x'{}_2x}{n} = \rho_{xx} - D_{u_x} \quad , \tag{54}$$

and

$$\frac{{}_1z'{}_2z}{n} = \rho_{zz} - D_{u_z} \quad . \tag{55}$$

We then obtain

$$\frac{X_1' X_2}{n} = (I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} (\rho_{xx} - D_{u_x} - \beta'\rho_{zx} - \rho_{xz}\beta + \beta'\rho_{zz}\beta - \beta' D_{u_z}\beta)$$

$$(I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} = (I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} (\rho_{xx} - D_{u_x} - \rho_{xz}\beta - \beta' D_{u_z}\beta)$$

$$(I - D^2_{R_{(x\,|\,z)}})^{-\frac{1}{2}} \quad . \tag{56}$$

We are only interested in the diagonal of $\frac{X_1' X_2}{n}$ or the diagonal matrix of reliabilities of the elements of χ which we will denote by ${}_\chi D_{ii}$.

Then

$${}_\chi D_{ii} = (I - D_{u_x} - D_{\rho_{xz}\beta} - D_{\beta' D_{u_z}\beta})(I - D^2_{R_{(x\,|\,z)}})^{-1} \quad . \tag{57}$$

Since $D_{\rho_{xz}\beta}$ is exactly the diagonal of squared multiple correlations of each x_i with z we obtain

$${}_\chi D_{ii} = I - (D_{u_x} + D_{\beta' D_{u_z}\beta}) D^{-1}_{C_{xx}} \quad . \tag{58}$$

Similarly

$$_{\zeta}D_{ii} = I - (D_{u_z} + D_{B'}D_{u_x}B)D^{-1}_{C_{zz}} \quad . \tag{59}$$

Knowing the reliabilities of the components of χ and ζ we would then factor P_{xx} until

$$\Sigma\, \Delta_x^2 \geqslant 1'[I - (D_{u_x} + D_{\beta'}D_{u_z}\beta)(D^{-1}_{C_{xx}})]1 \quad , \tag{60}$$

and P_{zz} until

$$\Sigma\, \Delta_z^2 \geqslant 1'[I - (D_{u_z} + D_{B'}D_{u_x}B)D^{-1}_{C_{zz}}]1 \quad , \tag{61}$$

where $\Sigma\, \Delta_x^2$ and $\Sigma\, \Delta_z^2$ denote the sum of the latent roots in P_{xx} and P_{zz} respectively.

The computational procedure for these subsequent steps will be:

11. Determine vectors of reliabilities denoted by $_x r_{ii}$ and $_z r_{ii}$ of the reliabilities of x_1 and x_2. These will be obtained from the diagonal elements of the matrices $r_{x_1x_2}$ and $r_{z_1z_2}$ respectively.

12. Determine $2_x r_{ii}$ and $2_z r_{ii}$.

13. Determine diagonal matrices $I + D_{_x r_{ii}}$ and $I + D_{_z r_{ii}}$ where $D_{_x r_{ii}}$ and $D_{_z r_{ii}}$ are diagonal matrices made up from the vectors $_x r_{ii}$ and $_z r_{ii}$ respectively.

14. Compute the vectors

$$_x\rho_{ii} = 2_x r_{ii}(I + D_{_x r_{ii}})^{-1} \quad , \tag{62}$$

and

$$_z\rho_{ii} = 2_z r_{ii}(I + D_{_z r_{ii}})^{-1} \quad . \tag{63}$$

These vectors are vectors of estimated reliabilities for the components of the matrices x and z.

15. Compute the vectors of unreliabilities of x and z

$$(I - D_{{}_x\rho_{ii}})1 = 1 - {}_x\rho_{ii} = D_{u_x}1 \quad , \tag{64}$$

and

$$(I - D_{{}_z\rho_{ii}})1 = 1 - {}_z\rho_{ii} = D_{u_z}1 \quad . \tag{65}$$

$D_{{}_x\rho_{ii}}$ and $D_{{}_z\rho_{ii}}$ are diagonal matrices made up of the elements of the vectors ${}_x\rho_{ii}$ and ${}_z\rho_{ii}$ and D_{u_x} and D_{u_z} are diagonal matrices of the unreliabilities of x and z, respectively.

16. Compute the matrices $\beta^{(2)}$ and $B^{(2)}$ where (2) denotes the operation of squaring each element of β and B rather than squaring the matrices β and B.

17. Compute the vectors

$$1'd_{u_z}\beta^{(2)} \quad , \tag{66}$$

where d_{u_z} is a 14 x 14 matrix obtained by deleting the unreliability from D_{u_z} corresponding to the deleted variable in β and

$$1'D_{u_x}B^{(2)} \quad . \tag{67}$$

It can be shown that

$$1'd_{u_z}\beta^{(2)} = 1'D_{\beta'}d_{u_z}\beta \quad , \tag{68}$$

and

$$1'D_{u_x}B^{(2)} = 1'D_{B'}D_{u_x}B \quad . \tag{69}$$

18. Compute

$$1'D_{u_x} + 1'd_{u_z}\beta^{(2)} = V_x' \quad , \tag{70}$$

and

$$1'D_{u_z} + 1'D_{u_x} B^{(2)} = V_z' \quad . \tag{71}$$

19. Determine the vectors

$$D^{-1}_{C_{xx}} V_x \quad , \tag{72}$$

and

$$D^{-1}_{C_{zz}} V_z \quad . \tag{73}$$

20. Find

$$1 - D^{-1}_{C_{xx}} V_x = {}_{\chi}D_{ii} 1 \quad , \tag{74}$$

and

$$1 - D^{-1}_{C_{zz}} V_z = {}_{\zeta}D_{ii} 1 \quad . \tag{75}$$

21. Will stop factoring P_{xx} when

$$\Sigma \Delta_x^2 \geqslant 1'{}_{\chi}D_{ii} 1 = 1'(1 - D^{-1}_{C_{xx}} V_x) = 15 - 1'D^{-1}_{C_{xx}} V_x \quad , \tag{76}$$

and P_{zz} when

$$\Sigma \Delta_z^2 \geqslant 1'{}_{\zeta}D_{ii} 1 = 1'(1 - D^{-1}_{C_{zz}} V_z) = 15 - 1'D^{-1}_{C_{zz}} V_z \quad . \tag{77}$$

It would be advantageous to be able to estimate the reliabilities of the predictions of x and z from z and x, respectively, in order that the various multiple correlations could be corrected for attentuation. The reliability of the predictions of x would be given by the diagonal elements of the matrix

$$D^{-\frac{1}{2}}_{\beta'\frac{z_1'z_1}{n}\beta} \left[\beta'\frac{z_1'z_2}{n}\beta\right] D^{-\frac{1}{2}}_{\beta'\frac{z_2'z_2}{n}\beta} \quad , \tag{78}$$

under the assumption that we have two observations of x and z. We have

$$D^{-\frac{1}{2}}_{\beta'\frac{z_1'z_1}{n}\beta} \left[\beta'\frac{z_1'z_2}{n}\beta\right] D^{-\frac{1}{2}}_{\beta'\frac{z_2'z_2}{n}\beta} = D^{-\frac{1}{2}}_{\beta'\rho_{zz}\beta} \beta'(\rho_{zz} - D_{u_z})\beta \, D^{-\frac{1}{2}}_{\beta'\rho_{zz}\beta} \ . \tag{79}$$

Now

$$D_{\beta'\rho_{zz}\beta} = D_{\rho_{xz}\rho_{xx}^{-1}\rho_{zx}} = D^2_{R(x\,|\,z)} \quad , \tag{80}$$

and since we are interested in only the diagonal elements of the matrix we may write

$$D_{ii(x\,|\,z)} = D^{-1}_{R(x\,|\,z)} \left(D^2_{R(x\,|\,z)} - D_{\beta' D_{u_z} \beta}\right) D^{-1}_{R(x\,|\,z)} \tag{81}$$

or

$$D_{ii(x\,|\,z)} = I - D_{\beta' D_{u_z} \beta} \, D^{-2}_{R(x\,|\,z)} \quad , \tag{82}$$

where $D_{ii(x\,|\,z)}$ denote the diagonal matrix of reliabilities of the predictors of the x variables based on the z variables. Similarly

$$D_{ii(z\,|\,x)} = I - D_{B' D_{u_x} B} \, D^{-2}_{R(z\,|\,x)} \ . \tag{83}$$

The following computational steps are used to determine the estimated reliabilities of the predictions of the variables.

22. Compute the vectors

$$1'D_{\beta'}d_{u_z}\beta = V'_{(x\,|\,z)} \quad , \tag{84}$$

and

$$1'D_{B'}D_{u_x}B = V'_{(z\,|\,x)} \quad . \tag{85}$$

These are the same as

$$1'd_{u_z}\beta^{(2)} \tag{86}$$

and

$$1'D_{u_x}B^{(2)} \tag{87}$$

of step 17.

23. Determine the diagonal matrices

$$D^{-1}_{\rho_{xz_{14}}\rho^{-1}_{zz_{14}}\rho_{zx_{14}}} = D^{-2}_{R_{(x\,|\,z)}} \tag{88}$$

and

$$D^{-1}_{\rho_{zx}\rho^{-1}_{xx}\rho_{xz}} = D^{-2}_{R_{(z\,|\,x)}} \quad . \tag{89}$$

24. Compute the vectors

$$V'_{(x\,|\,z)}\, D^{-2}_{R_{(x\,|\,z)}} \tag{90}$$

and

$$V'_{(z\,|\,x)}\, D^{-2}_{R_{(z\,|\,x)}} \quad . \tag{91}$$

25. Then the reliability of the predictions of x from z will be given by

$$1' D_{ii_{(x \mid z)}} = 1' - V'_{(x \mid z)} \, D^{-2}_{R_{(x \mid z)}} \quad , \qquad (92)$$

and the reliabilities of the predictions of z from x will be given by

$$1' D_{ii_{(z \mid x)}} = 1' - V'_{(z \mid x)} \, D^{-2}_{R_{(z \mid x)}} \quad . \qquad (93)$$

VITA

Chadwick Karr was born February 12, 1919 in Yakima, Washington. He is the son of Arthur T. Karr, now deceased, and Harriet Chadwick Karr. He was graduated from the following Yakima Schools: Nob Hill Grade School, Franklin Junior High School, and Yakima Senior High School. He received his high school diploma June, 1937. He attended the University of Washington during his freshman, sophomore, and senior years, and received a B.A. degree in Sociology August, 1941. He attended Washington State College during his junior year.

From 1941 to 1948 he was manager of a 100 acre family fruit growing operation in Yakima. During World War II he had an agricultural deferment. His father died after a long illness in 1946, and in 1948, in partnership with his mother, he built a commercial fruit packing and cold storage warehouse in Yakima. He served as manager of the commercial operation until 1954.

In 1954 he was admitted to Graduate School at the University of Washington. He received an M.S. degree in psychology December, 1956.

On August 10, 1942 he married Marian Elizabeth Kershaw. They have two children, Susan Elizabeth born 1946, and Sarah Kathryn born 1950.