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Factoring the Personal Profile System for Construct Validity: Three Analyses Under Different Standardization Assumptions

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Running Head: PPS CONSTRUCT VALIDITY FACTORS

Abstract

Three types of data were factor analyzed using principal components extractions with orthogonal and oblique rotations to test publisher claims for construct validity of the Personal Profile System. MOST-LIKE endorsements of 96 behavioral descriptors were coded with 4, LEAST-LIKE with 1, and unendorsed with 2.5. Behavioral descriptor date from 1045 Senior Noncommissioned Air Force Officers were factored as raw data, as mean corrected data, and as standardized z-scores (correlations). The most efficacious solution was produced with standardized z-scores generating four factors accounting for 86% of total variance. The measure of sampling adequacy for every descriptor exceeded .922. The first factor was a general one loading about equally well on each of the Dominance, Influencing, Steadiness, and Compliance dimensions. The second factor was bi-scalar with dominant loadings on Steadiness and Compliance descriptors, the third was essentially uni-scalar resembling the Dominance dimension, and the fourth was uni-scalar with generally weak loadings on Influencing, its closest PPS dimension. All descriptors loaded on at least 1 factor at .30 or higher accommodating a marginally acceptable theoretical degree of psychometric and measurement properties and indicating 4-factor construct relevance. Results do not completely support previous Personal Profile System publisher claims for instrument dimensionality and scaling properties.

Factoring the Personal Profile System for Construct Validity: Three Analyses Under Different Standardization Assumptions

Abilities to understand, predict, direct, change, and control human behavior are often difficult to acquire, yet are highly desirable, personal attributes helpful for success in a variety of inter-personal environments. Personnel in political, religious, health, industrial, and governmental environments often need to assimilate as well as to label and understand the foregoing human behavioral skills. To that end, a number of educational methodologies have been applied with varying degrees of success.

Although the range of methodologies is broad, many have in common a need for assessment that often begins with psychological testing, sometimes with a battery of tests, sometimes with but one or two instruments. Psychological testing instruments usually have been designed to measure emotional, motivational, behavioral, interpersonal, or attitudinal attributes. Sometimes they are designed to measure responses of the same persons on different occasions or under different constraints (conditions). Although these instruments have a relatively short history of but a few decades, they have been influential in assessment within many social areas and institutional environments.

Moreover, psychological testing instruments have been used extensively, particularly in management and leadership training, in a variety of professional and middle management positions primarily to promote employee understanding of the work-oriented behavioral tendencies of themselves and others. One of the largest groups under recurring psychological scrutiny consists of personnel in The United States Armed Services.

The military uses psychological instruments for a multitude of reasons, including classification and career field placement (Military Guide, 1984). For military purposes, the most popular psychological instruments may be characterized best as essentially paper-and-pencil, self-report questionnaires suitable for group administration and capable of immediate scoring by respondents with immediate feedback to them. Similar characterizing criteria apply in industrial and commercial environments.

The Personal Profile System (PPS) has been used at the USAF Senior NCO Academy for several years as an integral component of leadership behavioral studies. It has been rated consistently by Senior NCO Students as one of the top leadership and management lessons in the curriculum. The views of its authors on its interpretation consistently have been accepted virtually without independent study or verification. In addition, PPS guided interpretations have withstood theoretically critical reviews not only in Air Force but also in civilian circles. However, in spite of its widespread use, there is a paucity of independent studies to define empirically its conceptual properties. This report is an extension of an earlier one (Henkel & Wilmoth, 1991) laying the theoretical foundation for the need for independent construct validity studies for the PPS.

Purpose of Study

Thus, the purpose of this study was to compare 3 exploratory factor analytic approaches for construct validation of the Personal Profile System with the objective of confirming with at least one of them the 4 factor dimensions claimed for the instrument by its publisher (Personal Profile System, 1986). Traditional confirmatory factor analytic methods were not applied due to uncertainty on a more fundamental theoretical level: How should observed PPS data be transformed for factoring to produce the greatest degree of theoretical efficacy against the standard of published claims and scoring algorithms? To what degree should standardization of the data be required for the factoring process? Should there be factoring of a moment matrix, a covariance matrix, a correlation matrix? Herein lies the exploration. That factoring algorithm (discovered through systematic exploration) producing the closest fit to the factor validity claims of PPS would be considered either as validating or not validating construct validity claims of PPS. Having no a priori evidence concerning either the data transformations or factor analytic methods of PPS, it was not possible to undertake confirmatory analyses in the classical sense of the word. There was no hard evidence on which to make the required decisions for classical confirmatory analyses.

Subjects

Participation was limited to senior noncommissioned officers (SNCOs) attending the USAF Senior Noncommissioned Officer Academy (SNCOA) located at Gunter Air Force Base, Alabama during 1987 and 1988. Subjects were selected to attend the SNCOA by the Air Force Military Personnel Center, Randolph Air Force Base, Texas. The selection was based on specified percentages for each Air Force occupation code that was represented on the corresponding promotion list. These subjects were comprised into five different instructional classes: 87E, 88A, 88B, 88C, and 88D.

This subject group (n = 1045) was limited as an Air Force administrative policy to: (a) students selected from the top 50 % of E-7s (Master Sergeants) selected for promotion to E-8 (Senior Master Sergeants) based on promotion fitness examination scores and promotion board scores determined by evaluating individual performance reports, and (b) a few E-9s (Chief Master Sergeants). These students were the only airmen eligible to participate by virtue of being the only ones in the SNCOA at the time the study was conducted.

Clearly, the participants met the Personal Profile System instrument eligibility standards of verbal comprehension and sufficient life experience. Performax stated "these two conditions are fulfilled roughly at the chronological age of the senior high school student" (PPS Manual, 1986, p.17). An assumption underlies the study: The participants responded honestly to the PPS instrument with no intent to misrepresent themselves in terms of MOST-LIKE and LEAST-LIKE behaviors called forth by the PPS items.

Generalizability of findings may be limited to the senior noncommissioned officer population from whom the sample was drawn or to groups having similar characteristics. However, in generalizability terms, subjects represented (a) over 200 different jobs that are classified by the Air Force into seven occupational clusters, and (b) a variety of educational levels. Educational levels ranged from high school graduate with some college (46 %) to a small number with master's degrees (3 %). Approximately 36 % possessed Associate of Applied Science Degrees usually in their respective occupational areas, and 15 % held baccalaureate degrees.

The majority of the population and the sample consisted of white males. The typical class was comprised of 231 males and 10 females that represented 202 Caucasians, 36 blacks, and 3 others (racial group). The average student had 17.8 years of service in the military. The sample average age was 38.5 years.

Instruction

Instruction consisted of a full-time course of 40 academic days duration conducted by the United States Air Force to prepare SNCOs for advanced leadership and management of human resources. In the Air Force, this course is considered as the capstone of enlisted professional military education (AFR 50-39, 1983).

Administration of the Instrument

The administration of the PPS instrument was completed in an environment meeting the requirements set by the Personal Profile System Manual (1986). Assistance with interpretation of the instructions provided by the SNCOA instructors was in accordance with PPS procedures outlined by Geier (1979). They limited their explanations to those which diminished apprehension and clarified directions (PPS Manual, 1986). Subjects were informed that confidentiality of results would be maintained. Scoring for feedback was done by the subjects, scoring for this report was computerized.

The Instrument

The PPS generates four subscores known as PPS dimensions of human behavior: Dominance (D), Influencing (i), Steadiness (S), and Compliance (C). Out of these four PPS dimensions there are 1028 possible behavioral classifications. Fifteen behavioral classifications are said to be basic.

Subjects made a set of 48 selections: 24 were of behavioral descriptors MOST-LIKE, and 24 LEAST-LIKE each subject's self perception. The four Personal Profile System dimensions of human behavior (Geier, 1979) were computed for each of n=1045 sets of SNCO behavioral responses by PPS algorithms. The four PPS dimensions served as criterial standards against which factor analytic outcomes for the subject group were to be compared for construct validity verification claimed by the instrument authors.

Coding Procedure

House (1982) argued for ordinal scaling of each of the 96 instrument adjectives. The supporting argument was based on inherent ordinality within behavioral adjective ratings clustered into groups of 4 adjectives within which each subject selected 2 adjectives: one as MOST-LIKE and one as LEAST-LIKE. House argued for one adjective in each group of 4 to be rated as 4 if selected as MOST-LIKE, another to be rated as 1 if selected as LEAST-LIKE, and the remaining 2 to be rated as 2.5. The 2.5 ratings represented the average of the two ranks (2 and 3) not selected since not being selected as either MOST- or LEAST-LIKE constituted an intermediate tied condition within each predetermined group of 4 adjectives. Thus, all 96 (96 = 24 X 4) adjectives were scored for each subject as 4, 2.5, or 1. Factor analyzed, then, were the 96 adjective vectors across the 1045 cases. These conditions reflect 2 mathematical assumptions: (a) the scaling of all variables by the method just described would be adequate, and (b) all factor analytic models involving those variables would be neither over nor under-specified.

Variations in the Factor Analyses

In the current study the procedure of choice for construct validation was factor analysis. Many researchers consistently have stressed the importance of factor analysis in establishing construct validity for tests or measuring instruments (Borg & Gall, 1979; Burke, 1980; Cronbach, 1970; Rummell, 1970). Basically, factor analysis is designed either to test theory about underlying structure (confirmatory) or to determine underlying structure (exploratory), which in this case would be to determine the number and nature of constructs needed to account for the observed interrelationships among the 96 variables (Rummell, 1970). Factor analysis also reveals the proportions of variance the variables shared with each other (Tabachnick & Fidell, 1983). In a weak sense confirmation thereby required similarity or matching; and in the strong sense, systematic, non-chance correspondence between loadings from unconstrained exploratory factors and construct claims of PPS authors.

From among the plethora of factor analytic options the procedures applied in this study were among those recommended in Rummel's (1970) Chapter 12: "Matrix Transformations". Rummel's recommendations included factoring symmetric matrices of:

1. Raw data cross products (or products of moments about zero). Throughout this report these are referred to as inner products. Were one to use LISREL confirmatory procedures one would process the MOMENT matrix.

2. Cross products of column centered vectors or variables corrected for their means. In LISREL terms, one would process the COVARIANCE matrix.

3. Cross products between vectors normalized to a common length of 1 (unity).

4. Cross products between doubly centered vectors (corrected for means in both columns and rows).

5. Cross products of standardized vectors (variables of z-scores). This procedure more conventionally is a factor analysis of a correlation matrix. In LISREL terms, one would process the CORRELATION matrix.

6. Distances between vectors, perhaps after distributional or matrix transformations.

7. Transactions which, in this case, would be joint occurrences among pairs of adjectives across the 1,045 subjects.

The factor analysis procedure is general in nature in having the capacity to determine a basis dimensionality (a mathematical property) of any symmetric matrix (Rummel, 1970). Thus, factor analysis may be applied to correlation matrices, to mean corrected raw data (deviation) matrices, to matrices of raw data, to transaction matrices, and to other typologies (many of which were noted in the foregoing list) of symmetric matrices. Not all of the symmetric matrix possibilities may be analyzed with common computerized statistical routines without specialized preparation of the data. For symmetric matrices other than Covariance and Correlation matrices one could compute cosines between the data vectors, and factor analyze the cosine matrices.

Clearly, PPS constructs (if based on factor analyses) were most likely derived from one of the first five procedures in the preceding list. Of those, the first, second, and fifth representing increasing levels of standardization are further developed in the following for application to PPS adjective selections by the subjects.

Each factor analysis with data coded according to the House (1982) algorithm was undertaken in 3 stages using SAS Release 5.18 (1988): (a) the initial principal components factor matrix was defined without estimating intercepts, (b) the initial factor matrix was rotated under varimax criteria, (c) the orthogonal criterion of varimax was relaxed to produce an oblique structure. Each behavioral adjective descriptor was viewed as analogous to a test item with 4 degrees of correctness (although the 2nd and 3rd degrees could not be distinguished and were coded as 2.5). In other words, factor analyses of the 96 descriptors were conducted under the same constraints that would be applied to factor analyzing a test of 96 items, each item coded (evaluated by a teacher or other evaluator) for correctness as a rating on the same scale ranging from 1 to 4.

The first of the analyses used unadjusted House-coded data vectors to produce raw data cross products in the symmetric matrix analyzed. The raw data were input for analyses without correction, the procedure generated no intercept, and the resulting "covariations" uncorrected for their means were factored. That is, factoring was undertaken for a symmetric matrix of uncorrected cross product moments computed from deviations from the origin. This procedure was justified under the two assumptions that a correction for means might be unnecessary since all adjectives were similarly scaled and a correction for means might corrupt the findings if PPS considered variation in the means as important in establishing factor (construct) relationships.

The second analysis was based on a symmetric matrix of cosines between vectors corrected for their item mean values (that is, on a covariance matrix); the third, on vectors corrected for both their item mean values and their standard deviations (that is, on a cross product matrix of z-scores). The third analysis may be viewed as more traditional or more standard in being equivalent to factor analyzing a symmetric matrix of cosines between z-score cross products; that is, to factoring a correlation matrix.

Results

Overview

The purpose of this study was to test, through factor analyses, the construct validity claimed (Geier, 1979) for the Personal Profile System by its authors and publishers. In this section of the report factor analytic results and conclusions are followed by reliability results.

Factor Analytic Results

The factor analysis statistical procedure was applied to PPS data coded according to the House algorithm (1982). The House coded data were factor analyzed at 3 levels of standardization in search of a best comparison to the PPS 4-Construct Criterion. The symmetric matrices that were factor analyzed possessed a representative variety of scaling artifacts: no adjustments, corrections for means, corrections for means and standard deviations.

In the PPS algorithm for scaled scores (either D, i, S, C) there were linear combinations of the MOST LIKE scores and LEAST LIKE scores. Each of the 96 adjectives on the instrument was endorsed as MOST LIKE or LEAST LIKE or was not endorsed by each subject. The MOST LIKE endorsements (using the House algorithm) were coded with 4, the LEAST LIKE with 1, and the unendorsed items were coded with 2.5. Therefore, if a factor were similar to a PPS scale, the factor should load positively on many of the same adjectives (vectors or variables) as the MOST LIKE endorsements accumulated into the PPS scale.

The question is on how many of the same adjectives should an empirical factor be loaded in order to be designated as similar to one of the PPS scales. A possible answer to that question lies in the properties of the binomial distribution function when applied to the expected distribution of chance endorsements. The probability of selecting an item randomly under Bernoulli distribution assumptions (Burington & May, 1970) from a set of 4 items is 1/4; thus the Binomial mean for selections of the 24 items composing any one PPS scale is 6. The variance for the Binomial Distribution based on 24 selections is 24*(1/4)*(3/4) or (9/2), yielding a standard deviation of about 2. With 95 % confidence, therefore, one would expect no more than about 10 endorsements by chance alone on any one of the PPS scales.

Under the foregoing reasoning, an empirical factor loading positively on 10 or more items in the PPS algorithm for a scale should reflect properties of the respective PPS scale. For labeling purposes, however, a factor should be named with a PPS scale name only if it is the dominant scale represented in the factor. When more than one PPS scale is represented by having at least 10 or more of its items loaded on a factor, the factor should be labeled as bi-scalar or tri-scalar. When no PPS scale is represented, the factor should be labeled with an arbitrary label such as Factor 1, Factor 2, Factor 3, Factor 4. A factor drawing from all 4 dimensions should be considered a general factor.

Raw Inner Products o. Data Vectors

An unconstrained principal components analysis employing the MOST and LEAST PPS raw data as coded by the House algorithm (1982) was used to analyze the symmetric matrix of inner products between all possible pairs of variables. The principal diagonal displayed the sums of raw data squares, while the off diagonal cells contained the sums of raw data cross products. Tables 1 and 2 display a few of the eigenvalues and eigenvalue proportions of variance for unadjusted raw data inner products. Applying the scree criterion (Cattell, 1966) to the eigenvalue proportions of variance produced essentially a one-factor solution. As indicated in Table 2, the eigenvalue proportions are essentially flat beginning with the second one at .018. Additional factor analytic results are not presented because this solution seemed to capitalize too much on measurement artifacts.

Table 1

Eigenvalues for Unadjusted Raw Data Inner Products

619782.	13083.	10856.	5343.3	3089.7	2656.	2511.3
2064.8	2023.3	1898.7				
1784.8	1672.5	1657.1	1575.2	1545.2	1504.5	1455.7
1435.4	1370.3	1345.6				
. . . other increasingly smaller eigenvalues . . .						
11.1	9.4	8.7	8.0	7.0	6.9	6.1
5.3	5.020	4.3				
4.1	4.0	3.6	3.3	3.0	2.3	
Sum of Eigenvalues 723457				Eigenvalue mean 7536		

Note. Entries represent behavioral descriptors or adjectives of the PPS instrument and are in the same order as presented on the PPS answer sheet.

Table 2

Eigenvalue Proportions of Variance for Inner Products of Unadjusted Raw Data

.8567	.01808	.01501	.00739	.00427	.00367	.00347
.00285	.0028	.00262				
.00247	.00231	.00229	.00218	.00214	.00208	.00201
.00198	.00189	.00186				
. . . other smaller and smaller proportions . . .						

Note. Entries represent behavioral descriptors or adjectives of the PPS instrument and are in the same order as presented on the PPS answer sheet.

Cross Products of Centered Data Vectors in a Covariance Matrix

An unconstrained principal components analysis employing the MOST and LEAST PPS raw data coded by the House algorithm (1982) was used to factor analyze the cosines of angles between centered (all having the same mean, thus, covariance equivalent) data vectors. The analysis resulted in a ten-factor solution based on eigenvalue scores and the scree plot. The eigenvalues for the ten factors were 13.11, 10.89, 5.37, 3.09, 2.67, 2.52, 2.06, 2.02, 1.90, and 1.78. Together they accounted for 44 % of the total variance. Both varimax and promax rotations were then initiated to determine the best fit.

Communality values tended to be low. Additionally, Measure of Sampling Adequacy (MSA) values tended to be low. In order to maximize simple structure and theoretical clarity, items that exhibited factor loadings of .30 and higher were used to define a factor. Based on the obvious lack of fit to the PPS criterial standard and on the difficulty of resolving the findings, this analysis is not reported further.

Standardized Data Vectors

The third analysis consisted of employing the SAS Release 5.18 (1988) FACTOR procedure to factor analyze the cosines of angles between centered (same mean) and standardized (same standard deviation) data vectors. This is equivalent to factor analyzing correlations between vectors. Squared multiple correlations between each variable and the factors were used for final estimates of communality which were quite high. Also, as reported in Table 3, the MSA for all variables was quite high with an overall MSA of .947. Thus the data were judged suitable for principal components analysis. Four factors were retained for rotation based on the eigenvalue scores and the scree plot. The eigenvalues for the four factors were 82.08, 1.66, 1.57, and .785. Conjointly, they accounted for 86 % of the total variance. Both varimax and oblique rotations were computed in determining the best fit to the PPS criteria.

Table 3

Standardized Analysis Communality Estimates, Promax and Varimax Rotated Factor Loadings, and Kasier's Measures of Sampling Adequacy (MSA)

Item Code	DiSC	Communality	Varimax Rotated Factor Loadings F1	F2	F3	F4	Promax Rotated Factor Loadings F1	F2	F3	F4	MSA
GENTLE	S	.914	.57	.58	.38	.33	.87	.86	.73	.73	.949
PERSUV	i	.939	.70	.33	.55	.20	.93	.71	.83	.62	.948
HUMBLE	C	.854	.34	.68	.44	.30	.71	.89	.73	.69	.943
ORIGIN	D	.902	.55	.48	.55	.25	.86	.81	.84	.68	.949
ATTRAC	i	.904	.62	.46	.46	.31	.89	.79	.78	.71	.954
GODFER	C	.858	.54	.53	.45	.28	.84	.82	.76	.69	.951
STUBBR	D	.863	.54	.40	.64	.08	.82	.73	.86	.53	.948
SWEET	S	.897	.51	.59	.36	.40	.83	.86	.70	.77	.951
EASLED	C	.876	.43	.66	.43	.26	.78	.89	.74	.68	.948
BOLD	D	.893	.53	.40	.64	.22	.84	.75	.88	.64	.949
LOYAL	S	.941	.73	.43	.43	.22	.95	.77	.76	.64	.951
CHARM	i	.886	.48	.55	.46	.38	.81	.84	.77	.77	.950
OPNMND	i	.934	.75	.41	.40	.23	.95	.76	.74	.64	.947
OBLIG	C	.869	.40	.65	.48	.25	.76	.88	.77	.67	.945
WLPWR	D	.888	.50	.48	.62	.16	.82	.80	.87	.60	.948
CHRFUL	S	.914	.53	.49	.47	.42	.85	.81	.78	.79	.949
JOVIAL	i	.911	.54	.47	.48	.41	.85	.80	.79	.79	.946
PRECISE	C	.915	.45	.64	.52	.16	.90	.79	.82	.61	.945
NERVY	D	.869	.30	.59	.61	.23	.69	.84	.84	.64	.940
EVTEMP	S	.897	.68	.49	.36	.26	.92	.80	.71	.66	.943
COMPET	D	.872	.52	.36	.68	.12	.81	.71	.89	.55	.938
CONSID	S	.927	.68	.50	.38	.27	.93	.82	.73	.68	.945
JOYFUL	i	.906	.43	.59	.45	.42	.79	.86	.76	.79	.944
HARMON	C	.892	.56	.56	.43	.27	.86	.85	.76	.69	.945
FUSSY	C	.846	.50	.52	.54	.18	.81	.81	.81	.61	.941
OBENT	S	.928	.71	.48	.39	.20	.94	.80	.74	.63	.944
UNCONQ	D	.871	.51	.50	.56	.22	.83	.81	.83	.64	.944
PLAYFL	i	.869	.48	.48	.45	.46	.80	.78	.75	.81	.941
BRAVE	D	.923	.60	.43	.57	.23	.89	.78	.85	.66	.934
INSPIR	i	.935	.72	.37	.47	.24	.94	.74	.79	.66	.932
SUBMIS	S	.872	.48	.58	.44	.33	.81	.85	.76	.73	.932
TIMID	C	.861	.37	.68	.44	.27	.73	.89	.74	.67	.927
SOCIBL	i	.892	.46	.38	.55	.49	.79	.72	.81	.82	.928
PATENT	S	.874	.61	.53	.40	.25	.88	.82	.73	.67	.932
SLFREL	D	.936	.64	.41	.59	.13	.90	.76	.86	.58	.934
SFTSPK	C	.878	.50	.67	.38	.19	.81	.90	.71	.62	.930

(table continues)

Item Code	DiSC	Communality	Varimax Rotated Factor Loadings F1	F2	F3	F4	Promax Rotated Factor Loadings F1	F2	F3	F4	MSA
ADVENT	D	.868	.41	.37	.70	.27	.75	.71	.90	.66	.947
RECPT	C	.926	.70	.43	.44	.24	.93	.78	.77	.66	.954
CORDAL	i	.907	.58	.54	.42	.33	.87	.84	.75	.73	.953
MDERT	S	.857	.51	.64	.38	.21	.81	.88	.71	.63	.949
TALK	i	.898	.34	.43	.64	.42	.72	.75	.86	.78	.925
CONTRL	S	.873	.72	.53	.26	.12	.90	.79	.62	.54	.922
CONVEN	C	.939	.54	.56	.51	.27	.86	.87	.82	.71	.935
DECISE	D	.942	.59	.45	.57	.28	.89	.80	.86	.70	.935
POLISH	i	.873	.51	.53	.50	.28	.83	.83	.80	.69	.956
DARING	D	.889	.09	.44	.69	.26	.75	.76	.90	.67	.953
DIPLOM	C	.914	.72	.46	.36	.25	.94	.78	.71	.66	.954
SATFD	S	.891	.56	.56	.45	.26	.86	.85	.77	.68	.956
AGGRES	D	.944	.70	.30	.58	.18	.92	.69	.84	.61	.947
LFPRTY	i	.888	.41	.50	.52	.45	.77	.80	.80	.81	.945
ESMARK	S	.901	.54	.63	.39	.26	.85	.89	.73	.68	.947
FREFUL	C	.903	.54	.62	.44	.19	.85	.88	.76	.64	.949
CAUTUS	C	.912	.40	.77	.39	.09	.74	.94	.71	.54	.993
DETERM	D	.906	.44	.70	.47	.03	.77	.91	.77	.51	.988
CONVINC	i	.912	.43	.72	.46	.10	.77	.92	.76	.56	.991
GDNATR	S	.892	.43	.74	.38	.13	.76	.93	.70	.57	.991
WILLN	S	.900	.63	.48	.47	.23	.90	.80	.78	.66	.940
EAGER	D	.915	.62	.45	.52	.24	.90	.79	.82	.67	.941
AGREBL	C	.895	.62	.59	.30	.27	.88	.85	.67	.68	.937
HIGHSP	i	.837	.31	.46	.66	.31	.69	.75	.86	.69	.930
CONFID	i	.920	.69	.36	.51	.25	.92	.73	.80	.66	.951
SYMPAH	S	.893	.48	.61	.42	.34	.82	.87	.74	.74	.951
TOLERT	C	.874	.60	.60	.32	.23	.86	.86	.68	.64	.949
ASSERT	D	.894	.43	.43	.68	.24	.78	.76	.90	.65	.949
WELDIS	C	.922	.71	.45	.42	.20	.93	.79	.76	.63	.940
GENROS	S	.921	.56	.55	.42	.36	.87	.85	.75	.76	.941
ANIMTD	i	.876	.25	.61	.57	.34	.66	.85	.81	.72	.932
PERSIT	D	.909	.63	.41	.56	.19	.89	.76	.84	.63	.940
ADMIRB	i	.928	.65	.45	.46	.29	.92	.79	.78	.70	.957
KIND	S	.920	.67	.49	.37	.3.	.92	.81	.72	.71	.955
RESIGN	C	.876	.38	.72	.39	.25	.74	.91	.71	.66	.951
FORCAR	D	.892	.48	.35	.71	.20	.79	.70	.91	.61	.951
RSPECT	C	.936	.70	.45	.43	.23	.94	.79	.77	.65	.950
PIONER	D	.876	.38	.47	.66	.27	.75	.78	.88	.68	.946
OPTIMS	i	.879	.59	.43	.52	.26	.87	.77	.81	.67	.948
ACOMMD	S	.876	.50	.64	.35	.31	.81	.88	.69	.71	.946
ARGUMT	D	.884	.39	.44	.71	.20	.74	.76	.91	.62	.942
ADAPT	C	.953	.77	.42	.39	.20	.96	.77	.73	.63	.947

(table continues)

Item Code	DiSC	Communality	Varimax Rotated Factor Loadings				Promax Rotated Factor Loadings				MSA
			F1	F2	F3	F4	F1	F2	F3	F4	
NONCHT	S	.883	.46	.63	.43	.30	.80	.88	.75	.71	.947
LGTHRT	i	.924	.55	.52	.44	.38	.87	.83	.77	.77	.949
TRUST	i	.870	.60	.49	.43	.30	.87	.80	.75	.70	.940
CONTNT	S	.828	.42	.60	.47	.26	.76	.85	.76	.67	.936
POSTVE	D	.922	.67	.35	.56	.20	.91	.72	.83	.62	.941
PEACFL	C	.897	.50	.59	.47	.29	.83	.87	.78	.71	.942
GDMIX	i	.854	.48	.42	.51	.45	.79	.74	.78	.79	.945
CULTRD	C	.881	.55	.54	.47	.24	.85	.84	.78	.66	.950
VIGORS	D	.925	.62	.37	.61	.16	.89	.73	.87	.60	.950
LENINT	S	.882	.56	.65	.32	.22	.84	.88	.68	.64	.947
COMPAN	i	.912	.57	.49	.43	.40	.87	.81	.76	.78	.948
ACCURT	C	.938	.68	.46	.47	.23	.93	.80	.79	.66	.949
OUTSPK	D	.893	.41	.34	.75	.20	.75	.69	.93	.60	.940
RSTAIN	S	.883	.55	.68	.28	.21	.83	.89	.64	.63	.942
RESTLS	D	.839	.48	.51	.59	.09	.79	.79	.83	.53	.967
NEIHBR	S	.952	.62	.51	.46	.31	.91	.84	.79	.73	.973
POPLAR	i	.897	.58	.44	.46	.40	.87	.78	.77	.77	.970
DEVOUT	C	.863	.54	.55	.47	.21	.84	.84	.78	.64	.970

Note. DiSC column represents four dimensional assignment of PPS.

Table 4 reports the factor correlations for the promax rotation. The inter-factor correlations are substantial for the oblique solution.

Table 4

Standardized Analysis Inter-Factor Correlations

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
FACTOR 1	.00	.70	.67	.59
FACTOR 2	.70	1.00	.64	.59
FACTOR 3	.67	.64	1.00	.54
FACTOR 4	.59	.59	.54	1.00

It is clear from the Promax Rotated Loadings of Table 3 and the corr lation measures of Table 4 that specification of factor names and properties from the oblique solution would be most difficult. Just 8 of the 384 loadings are smaller than .60 and each of those are under the fourth factor.

Table 5 summarizes counts of variables having various magnitudes of loadings for the varimax rotation under each of the 4 rotated factors. No variable loads larger than .50 on the fourth factor. No variable has a negative loading on any factor. One can judge the similarity of the results of varimax rotation of the initial factors to dimensions claimed by PPS. The columns do not sum to 96 because some adjectives loaded on more than 1 factor.

Table 5

Numbers of Z-score Standardized Data Varimax Loadings Broken Down by Magnitude Levels and by PPS Dimensional Assignment

Magnitude	Factor															
	1				2				3				4			
	D	i	S	C	D	i	S	C	D	i	S	C	D	i	S	C
GE .60	6	7	9	8	1	2	9	10	13	2						
LT .60 & GE .50	7	7	10	9	3	6	9	8	10	8		3				
LT .50 & GE .40	6	7	5	4	13	12	6	6		14	10	14		9	2	

Note. DiSC columns represent the four dimensions of PPS.

One should label the first factor as a general one, the second as bi-scalar being a combination (in loadings greater than .50) of PPS "S" and "C" dimensions, the third as uni-scalar "D", and the fourth (if anything) as a very weak uni-scalar "i".

Communality values also were quite high indicating a large amount of variance in each variable was common within the factors. The final communality estimates showed that all variables were well accounted for by the rotated factors.

Reliability Results

Since an approximation to interval coding was a consequence of the House algorithm for all vectors included in the factor analyses, the reliability algorithm was applied under identical constraints only to the first 3 factors having properties somewhat comparable to the PPS dimensions. Proportion of variance interpretations should govern evaluation of reliability findings. The observed reliability coefficients of .83, .79, and .80, respectively for the three factors, are not as large as would be expected for an instrument having well-developed psychometric properties. Because the PPS scoring algorithm for its four scales involves both addition and subtraction operations, no PPS reliabilities were computed for comparison.

It should be noted that all claims pertaining to the factor analytic findings are based on a precise set of decision criteria: (a) that a four factor solution be undertaken for comparability with PPS if not in violation of scree and eigenvalue constraints of factor analysis; (b) that for a factor to be labeled with a PPS scale label the factor must load on at least 10 items in the PPS scoring algorithm for that scale; (c) that the factor may be uni-scalar, bi-scalar, tri-scalar with respect to the PPS scale algorithms;

(d) that "loading" on a factor meant that an item was loaded with a value of .40 or larger; (e) that the symmetric matrix analyzed was based on z-score standardizations. If one alters any of these decision criteria, one should expect a consequent alteration in the findings and whatever conclusions are drawn from them.

Conclusions and Implications

Sequentially, analyses were based on increasing degrees of standardization for the House-coded data. At each level of standardization a symmetric matrix was factor analyzed. Only when a symmetric matrix of cosines was analyzed would there be outcomes at all comparable to factor analyzing a covariance or a correlation matrix. Principal factors extraction with varimax and promax rotations were performed, using the SAS Release 5.18 (1988) PROC factor procedure, on 96 behavioral descriptors from the PPS instrument coded according to the House algorithm (1982).

The House coded data were factor analyzed at 3 levels of standardization intended to compensate for different scaling or measurement artifacts. The inner products analysis resulted in a one factor solution, and complete factor analytic results were not reported because this solution capitalized too much on measurement artifacts. The analysis of the cosines of angles between centered data vectors resulted in a ten-factor solution satisfying both eigenvalue and scree plot criteria. But only 44 % of the total variance was accounted for, plus communality values and MSA values tended to be low. Moreover, the largest factor loadings exhibited relatively low values. Based on deviations between the findings and the PPS criterial standard, one should not claim this analysis as supporting PPS dimensional claim criteria.

MSA for factor analyris of z-score standardizations was quite high with an average of .947 indicating the data were adequate for the analysis employed. Communality values also were quite high indicating a large amount of factor variance was shared with the variance of the variables. Moreover, the final communality estimates showed that all variables were well accounted for by the factors produced. The standardized analysis accounted for 86 % of the total variance.

The orthogonal (varimax) rotation was followed by an oblique (promax) rotation. The varimax rotation maximized the variance of the loadings across variables within the factors (Tabachnick and Fidell, 1983). The promax rotation relaxed the orthogonality criterion and constructed an oblique factor matrix in which high loadings of varimax were fit to higher loadings and low loadings were deemphasized in the fit (Rummell, 1970).

In order to maximize simple structure and theoretical clarity, items that exhibited the highest factor loadings (above .40) were used to define a factor. But, based on loadings of .30 and higher (Tabachnick and Fidell, 1983), all 96 of the PPS variables contributed. The 4 acceptably loaded factors in the varimax rotation are judged as non-conformable to the 4 scores generated by the PPS algorithm.

In the promax solution almost every PPS adjective loaded systematically high on each factor creating interpretive complexity completely inconsistent with expectations based on PPS claims. It is unlikely PPS developed constructs from a non-orthogonal rotational algorithm.

The varimax rotation analysis produced factors closest to that of the PPS dimensions and thus was selected as the best solution. The second factor resembled the PPS Steadiness and Compliance dimensions by highly loading on 23 of their behavioral descriptors. The third factor was similar to a PPS scale in that it displayed 23 high loadings from the Dominance behavioral factor dimension. There the similarity ends. The fourth factor loaded too weakly on the PPS items to be considered anything but an artifact of requiring a four-factor solution for comparability with PPS. Therefore, the results of this study do not fully confirm the four dimensions of human behavior as described by the PPS authors and publishers.

However, all PPS behavioral descriptors loaded at .30 or higher on at least one factor in the standardized solutions. Therefore, the descriptors seem to contribute in a meaningful way to the measure of whatever the PPS measures, indicating behavioral descriptors of the PPS may be relevant but should be renamed and rescaled according to a different algorithm for better psychometric and measurement properties. These findings do not justify published construct validity of the PPS. Moreover, the factor analyses used in this study did not fully confirm the four dimensions of human behavior as theorized by the PPS authors and publishers.

Finally, the process of gathering construct validity evidence should involve examination of the instrument's use in the specific situations for which it was designed (Standards of Educational, 1983). The situation concerning the current study is the student population at the United States Air Force Senior Noncommissioned Officer Academy which incorporates the PPS instrument in its core curriculum. On the other hand, SNCOA students are similar to thousands of other experienced mid-level civilian managers attending leadership and management classes in that they are learning the skills some suggest are necessary for success. Because of the number of students involved and their similarity to civilian groups, it is proposed that the results would be applicable in other educational situations.

<u>Summary</u>

Unfortunately, the fourth factor was defined at best by only nine PPS Influencing loadings that were also loaded on other factors. Thus, the fourth factor was determined not viable. Because of the questionable nature of the fourth factor in terms of highest loadings and its small amount of variance accounted for, it was concluded that the PPS adjectives align in but 3 somewhat reliable dimensions.

<u>Implications</u>

PPS seems to be well received by a variety of audiences and displays a certain amount of face validity. It is reported to be effective in getting people interested in their own behaviors and in better understanding the behaviors of others. This in itself allows the PPS to enjoy much success and suggests that it is somewhat of an effective educational instrument. The PPS instrument does this while offering its users economy in terms of time and cost, an added advantage of ease of administration, and simple immediate feedback. Although findings revealed adequately the Dominance and marginally the Influencing dimensions as reported by the PPS, the absence of well defined dimensions of Compliance and Steadiness weaken the behavioral dimension claims made by the PPS.

Therefore, caution should be exercised in labeling as just D, i, S, or C from PPS scores in correspondence with PPS dimensions. Each respondent to the PPS instrument should be encouraged to reflect on the analysis beyond the PPS dimensional letters to include information from the best matching of the fifteen classical PPS Profiles. Additional reflection of this kind would provide a more comprehensive view of behavioral patterns defined by the instrument.

Recommendations

The results of this study should be approached with caution. In dealing with construct validity, a number of studies should be conducted (Brown, 1983). Since this is the only known factor analytic study on the PPS, therefore, it is recommended that it be replicated in the following modified ways:

1. With a more typical population incorporating a broader distribution of ages, more females, and a broader spectrum of educational levels and occupational activities.

2. With a confirmatory factor analysis employing the Lisrel VII model (Jöreskog & Sörbom, 1988). The Lisrel VII model linked with PRELIS would be advantageous because it is capable of analyzing a polychoric correlation matrix weighted by an asymptotic covariance matrix, thereby adding a larger level of analytic conformability to the House coded data.

3. With transactional data reflecting joint occurrences of the behavioral adjectives in the endorsement process. Although a factor transaction analysis is not traditionally used in the field of education, PPS variables seem to present an excellent opportunity for its application as recommended by Rummel (1970).

4. With emphasis on more correctly naming the dimensions of the behavioral adjective clusters defined by the factor analyses.

5. With revision of the PPS scaling algorithm for the behavioral descriptors to an algorithm having better psychometric and measurement

properties. Adjustments of the ordinal results from the House algorithm might produce factor properties closer to the PPS criterial standard.

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