VALIDATION OF THEORIZED FACTOR STRUCTURE OF THE PERSONAL ORIENTATION INVENTORY

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The work of Barker and Barker has produced a method which can be used to evaluate theories regarding factor structure of large data matrices. (Barker, B. M., & Barker, H. R., 1975; Barker, H. R., & Barker, B. M., 1975A, 1975B, 1976; Hunnicutt & Barker, 1974). The method employs an indirect factor analysis program developed by Barker (1973) which is based on a mathematical technique offered by Horst (1965). The procedure provides a way of performing a full-scale factor analysis of large data sets under specific conditions (Barker & Barker, 1976). Previously, such factor analyses have been rendered impractical or impossible due to several limitations. The first and most prohibitive of these limitations is that most computers can factor no more than one hundred variables at a time. Even when a greater computer capacity exists, the cost in computer time of factoring a large matrix can be prohibitive (Barker, Fowler, & Peterson, 1971).

The method proposed by Barker and Barker (1976) offers a means of factoring large data sets under specific conditions. Five years of research on Horst's indirect factor method summarized by Barker and Barker (1975) resulted in virtually perfect replication of a factor analysis using conventional factor analytic methods. This indirect factor analysis was accomplished in four minutes of computer time as opposed to 50 hours for the conventional solution. The purpose of this study was to demonstrate the value of the indirect method of factor analysis as a technique for testing hypotheses regarding factor structure of large data sets. Consequently, several theories regarding the Personal Orientation Inventory (POI) were selected from the literature for evaluation using the indirect method.

The POI, developed by Everett L. Shostrom, is frequently used to measure dimensions of personality. The POI consists of 150 pairs of value statements which are scored twice to yield scale scores purporting to measure aspects of self-actualization and personality orientation. Of these scales, the Time (TC) and Support (I) scales are expressed in terms of ratios. The other ten subscales yield a profile of the individual which is interpreted by comparison to that of a self-actualized person.

Various theories exist regarding dimensions of the POI. Shostrom himself does not conceptualize the POI scales "as representing independent dimensions" (1972, p. 21), and, in fact, several studies have indicated that subscales are intercorrelated (Damm, 1969; Klavetter & Mogar, 1967). Klavetter and Mogar (1967) hypothesize that the subscales may "lack unique variance" (p. 424), since the TC, I, and SAV scales were found to account for most of the test's variance. As a result of this study, Klavetter and Mogar conclude that twelve subscales are redundant and that a more accurate instrument would consist of fewer scales with less item overlap. In 1969 Damm conducted a study which supports the findings of Klavetter and Mogar. His findings indicate that the most useful subscales are the I and TC scales.

While these studies appear to indicate that the POI may have only two dimensions, another study, conducted in 1974 by Silverstein and Fisher, presents five item clusters comprised of 74 POI items. These five clusters were obtained by applying elementary linkage analysis to POI data and are free of item overlap.

In summary, evidence exists which appears to indicate that the POI may be measuring somewhat global aspects of the construct rather than twelve specific characteristics. The degree of intercorrelation which apparently exists between subscales appears to lend support to the hypothesis that the POI has fewer than twelve dimensions.

Methodology

Subjects of this study were students enrolled in the Colleges of Education, Home Economics, Engineering, and Arts and Sciences at the University of Alabama during the spring semester of the 1976 academic year. A sample of 501 subjects was obtained.

The 501 subject data base was factor analyzed by a conventional principal axis solution in order to generate an empirical set of findings to be compared with current theories. A conventional factor analysis program (CORR12) developed by Barker (1973) was used. None of the existing statistical programs at the University of Alabama computer installation could handle a matrix of this size (150 x 150), due to the enormous amount of core space required and to impractical length of run time. Consequently, the size of CORR12 was incremented so that this factor analysis could be carried out. CORR12 was developed in such a way that only the upper triangular matrix of correlations is worked with in the computer. This alone saves enormous computer core space and cuts computer run time drastically. Despite use of this procedure, at the present time CORR12 takes up almost all the allotted core space. Results of this conventional factor analysis constituted one of the theories to be tested regarding dimensions of the POI and provided a means of testing the value of the indirect factor method itself.

Other theories regarding dimensions of the POI selected for study were tested using the indirect method (CORR99) developed by Barker (1973). In addition to the theory based on a direct factor analysis, two theories from the literature were examined. The first of these comprised scales proposed by Shostrom (1972); the second, item clusters developed by Silverstein and Fisher (1974). A third theory was generated by randomly assigning variables to arbitrarily selected numbers of totals.

The information measure D (relative uncertainty reduction) was selected to provide an objective measure of the degree to which theorized dimensions reflect actual factor structure of the data set. In an ideal solution all cell entries in the matrix of factors would appear in the diagonal. Such a solution would indicate complete agreement of item subsets (totals) with actual factor structure. Frequently, however, certain items are found to load inappropriately. Items which fail to load as expected onto factors appear as false negatives. Those which load onto factors contrary to expectation appear as false positives. The D measure expresses the relationship between rows (subsets of items) and columns (factors). Use of this statistic also permits comparison between theories of degree of agreement between a priori item subsets and actual factor structure.

Results

Theories tested were rank ordered with respect to adequacy (most adequate = 1.0) in reflecting factor structure of the POI as follows:

1. Five factors based on results of direct factor analysis of the data set, D = .94.
2. Ten subscales hypothesized by Shostrom, D = .79.
3. Five item clusters proposed by Silverstein and Fisher, D = .52.
4. Shostrom's ratio scales, I and TC; D = .41.
5. Randomly formed totals, D = .41.

The relatively low D measures obtained for Shostrom's theory (Tables 2 and 4) and the theory of Silverstein and Fisher (Table 3) may be due to several factors. Both Shostrom's subscales and the item clusters proposed by Silverstein and Fisher do not include all 150 POI items. It was to be expected that different configurations of item loadings would result from factor analysis of all 150 variables and, while factorial purity of Shostrom's subscales was tested using only 54 items due to omission of overlapping items, it is likely that had Shostrom's ten subscales been tested intact, without taking into account item overlap, a different solution would have been obtained.

Other variables to be considered include the fact that Shostrom does not hypothesize the 12 POI scales as reflecting factorially pure dimensions. Construction of the POI did not include factor analysis of items. Silverstein and Fisher (1974) describe problems encountered in factor analysis of the POI which resulted in their turning to elementary linkage analysis in order to examine structure of the POI. The relatively low D measures obtained when their proposed item clusters were evaluated may reflect the inadequacy of the method employed in forming these five clusters or differences inherent in samples used. (Silverstein and Fisher used a sample from a prison population; the present study, a sample of supposedly normal subjects.)

In order to generate a third theory to be tested, items comprising the POI were factored c conventionally using a principal axis solution. When the scree test (Cattell, 1966) was applied to the eigenvalues, five factors seemed important. These five factors were rotated to a varimax criterion. An item was identified with a rotated factor if its varimax load was equal to or exceeded + or - .3. Items whose loads equaled or exceeded + or - .3 on more than one factor were omitted from the analysis.

The varimax rotation of the five factor solution resulted in identification of 84 items. It was noted that a surprisingly large number of items (63) failed to load onto any of these five factors. Furthermore, in most cases item loads used in identifying items with factors were found to range between + or - .3 and + or - .5. Based on identification of items with factors, the five factors were named as follows: (1) Self-perception; (2) Self-actualizing Values; (3) Existentiality; (4) Sensation Responsiveness; and (5) Inner-other Support.

Direct factor analysis resulted in an impressive degree of agreement of factor structure and a priori item subsets (Table 5). Three factors were perfectly identified by the indirect method and a four factor resulted in only two false negatives and one false positive. The remaining factor resulted in seven false negatives which is disappointing. Nevertheless, the obtained D measure indicates a high degree of similarity between theorized and actual factor structure.

While the rive factor solution appears to be an accurate reflection of factor structure of the POI, examination of these results appears to indicate possible deficiencies in the POI itself. Factors which emerged from the direct factor analysis do not appear clean. The cumulative proportion of variance (.17) associated with the solutions is not impressive and the number of POI items (84) identified with factors was surprisingly small. Other items which failed to meet the criterion of loading + or - .3 or better on a factor presumably loaded on negligible factors. Furthermore, most items which met the criterion set for identification with a factor had loadings which ranged between + or - .3 and + or - .5. Such loads are low.

Previous studies (Damm, 1969; Klavetter & Mogar, 1967; Silverstein & Fisher, 1974) indicate that the POI would be more useful and actual dimensions more accurately expressed if it were made up of fewer than 12 scales. The present study supports this contention. These results indicate that the POI should be examined through means of item analysis, further factor analytic studies, and other suitable techniques in order to reduce the number of test items to those which appear to contribute to reliability and factorial purity of the scales.

Results of this study support earlier studies by Barker and Barker (1975B; 1976) in demonstrating validity of the indirect method as an appropriate technique in evaluating theories regarding factor structure of large data sets. The direct factor analysis represents a criterion by which accuracy of the indirect method can be measured. As expected, the obtained D measure of .94 indicates a high degree of agreement between the a priori item subsets based on the direct factor analysis and actual factor structure as measured by the indirect method.

Of additional interest are differences in cost and in computer time between applications of a conventional factor analysis and the indirect method. Two direct factor analyses of the POI required more than 25 minutes of computer run time and $147 charged to the computer account. Five analyses using the indirect method cost a total of $12.16 and approximately 12 minutes of computer run time. These figures illustrate that, under certain specific conditions, the indirect method has great practical value over more conventional factor analytic programs in analyses of very large data sets.

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TABLE 1
Association Between Item Subsets and Varimax Factors
(Randomly Formed Totals)

	I	II	III	IV	V	false −	sum
1	4					26	30
2		11				19	30
3			3			27	30
4				5		25	30
5					8	22	30
false +							0
sum	4	11	3	5	8	119	150

$H_x = 1.18$ $H_{xy} = 3.01$

$H_y = 2.31$ $D = .41$

TABLE 2

Association Between Item Subsets and Varimax Factors
(Shostrom's Support and Time Ratios)

	I	II	false −	2
1	11		12	23
2		4	123	127
false +				0
	11	4	135	150

$H_x = .61$ $H_{xy} = .94$

$H_y = .55$ $D = .41$

TABLE 3

Association Between Item Subsets and Varimax Factors
(Theory Based on the Work of Silverstein and Fisher)

	I	II	III	IV	V	false −	sum
1	5					2	7
2		6				10	16
3			5			3	8
4				2		8	10
5					10	23	33
false +	1						1
sum	6	6	5	2	10	46	75

$H_x = 2.13$ $H_{xy} = 3.00$

$H_y = 1.80$ $D = .52$

TABLE 4

Association Between Item Subsets and Varimax Factors
(Shostrom's Ten Subscales)

	I	II	III	IV	V	VI	VII	VIII	IX	X	false -	sum
1	4											4
2		6									3	9
3			1									1
4				3							2	5
5					2							2
6						4					3	7
7							2					2
8								4			1	5
9									5			5
10										5	11	16
false +	3											3
sum	7	6	1	3	2	4	2	4	5	5	20	59

$H_x = 3.11$ $H_{xy} = 3.75$

$H_y = 3.01$ $D = .79$

TABLE 5

Association Between Item Subsets and Varimax Factors
(Theory Based on Direct Factor Analysis)

	I	II	III	IV	V	false -	sum
1	13					7	20
2		11					11
3			22			2	24
4				18			18
5					11		11
false +			1				1
sum	13	11	23	18	11	9	85

$H_x = 2.32$ $H_{xy} = 2.66$

$H_y = 2.51$ $D = .94$