Notes on A Factor-Analysis Comparative Study of the Structure of Leisure Activities in Four Different Samples

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ABSTRACT: *The following paper investigates the thesis of a generally valid structure of leisure activities in four different samples. The results are discussed in terms of their methodological and sociological meaning.*

KEYWORDS: *Leisure, factor-analysis, factor-structure.*

This study, which tries to investigate the thesis of a generally valid structure of leisure activities, is based on four samples. Samples 1 and 2 are representative of the population of Groningen, Netherlands, and its near surroundings. R. Wippler and V. Delden kindly provided us with the correlation matrices for leisure activity of these two samples. Sample 3 is a quota sample from the socioeconomic middle class in Bonn, Germany, and the surrounding area including subjects from 20 to 59 years of age. The fourth sample (a quota sample) consists of middle class elderly persons from 60 to 78 years of age living in West Germany, especially in the areas Ruhrgebiet, Bonn, Frankfurt, and Heidelberg (Table 1).

TABLE 1

DESCRIPTION OF THE 4 SAMPLES USED IN THIS COMPARISON AND RELIABILITY COEFFICIENTS.

1.1. Description of The Samples

Sample	Size	Social Status	Average Age	% Men	% Married
1	800	Low, middle and upper class	36	52.0%	69.9%
2	1000	Low, middle and upper class	40	51.9%	70.3%
3	222	Middle class	44	50.0%	59.2%
4	222	Middle class	68	53.2%	62.0%

1.2. Reliability Coefficients

Variable	Reliability Coefficient
1. Time awake per day	.82
2. Frequency of radio listening per week	.71
3. Frequency of visits per week	.74
4. Frequency of watching television per week	.69
5. Number of concerts per year	.79
6. Frequency of taking walks per week	.83
7. Frequency of going out to cafes at restaurants per week	.72
8. Frequency of reading newspaper per week	.80

Following similarly constructed interviewing guidelines, information about frequency and other characteristics of leisure activity was gathered from all four samples. Samples 1 and 2 were questioned about a different number of activities than were samples 3 and 4, but the phrasing of questions and the coding of data were comparable for all samples.

The information was recorded by the interviewers on rating scales for eight different activities. The following variables were included in the four factor analyses of this investigation:

1. time awake per day
2. frequency of radio listening per week
3. number of visits per week
4. frequency of watching television per week
5. number of concerts per year
6. frequency of taking walks per week
7. frequency of going out to cafes or restaurants per week

8. frequency of reading newspaper per week.

We were able to administer our questionnaire to sample 4 at three points of measurements within three years (1966, 1967, 1968). The path analytical algorithm reported by Heise in Blalock (1971) yielded sufficient reliability coefficients for the eight scales (Table 1).

Statistical Evaluation of Data

A satisfactory representation of the respective relationships was obtained from the linear amount of common variance, as measured by the correlation coefficients in samples 3 and 4.

The Bartlett I-Test of randomness (Uberla, 1968: 131) was applied to all four correlation matrices. The matrices differed clearly from random correlation matrices. The matrices were then factor-analyzed using the principle axis method. The square of the multiple correlation coefficient was used as first communality approximation. This approximation was refined by six iterations. The goal for the first step of the computation was to extract enough factors to account for 95 percent of the common variance.

The number of factors was determined using the following criteria:

1. The number of factors should lie between one quarter to one half of the total number of variables.
2. The number of factors is determined by the number of Eigen-Values greater than or equal to 1.0. (Experience has shown that this criterion generally underestimates the number of factors when applied to data containing a small number of variables, as is here the case.)
3. The number of factors can be approximated by the ordinal number of differences greater than or equal to 0.10 between Eigen-Values.
4. A factor should account for at least five percent or more of the total variance.
5. Furntratt criterion (1969): Following the application of the above criteria 1-4 and the rotation of the obtained factors according to Kaiser's Vari-max procedure, the Furntratt criterion was also used to further substantiate the final selection. This involved following three guidelines:
   5a. A factor should include at least three variables.
   5b. The radio of a^2/h^2 of the variables in question should be at least 0.50.
   5c. In order to be sufficient, the communality (h^2) of the variables should be at least 0.20.

The factors obtained for the four samples in this manner were then rotated for similarity following the procedures suggested by Sixtl (1964) and Fischer and Roppert (1967). The results allow interpretation of three sorts of coefficients:

1. Global similarity coefficients of at least 0.80 indicate similarity of the factor matrices compared in pairs (Gebhardt, 1968).
2. Similarity coefficients of at least 0.80 indicate similarity of the factors compared (Gebhardt, 1968).
3. Coefficients of at least 0.80 indicate similarity of location in factor space for the variables compared.

Results of The Factor Analyses

The four factor analyses yielded between five and six factors using the 95 percent criterion. These five to six factors account for varying amounts of the total variance, from 26.8 percent (sample 1) to 30.6 percent (sample 4) and 34.6 percent (sample 3) all the way to 41 percent (sample 2). In other words, between 73.2 percent and 59 percent of the total variance remains unexplained. This sizable amount can be attributed to the specialized nature of the variables.

Completion of computations using the criteria described above reduced the number of factors to two per sample. Special emphasis was given to the difference criterion and Furntratt's guidelines in obtaining these results, because the Burt criterion leads to less accurate results when applied to larger samples such as those being used here. The two-factor solution accounts for varying amounts of the total variance. This solution accounts for 16.1 percent of total variance in sample 1 with 1000 subjects; 19.2 percent in sample 4; 20.6 percent in sample 3; and 27.3 percent in sample 2.

We refrain from citing the role of the two factors in these very low communality figures at this point to avoid unnecessarily complicating the main trend of the results. In all samples, the two-factor solution contained one factor accounting for 8.25 percent or 17.5 percent of the total variance and a second factor accounting for 7.5 percent to 10.1 percent. A verbal description of the factors appears as inadvisable for the individual samples as it does for all samples taken together. For each sample, the various leisure activities constituting the two factors appeared in different order, so a naming of the factors is very difficult (Table 2).

The fact that the total communality, i.e. that part of the variance to be explained by a proposed two-factor solution, is so low means that several interpretations are permissable. The correlation matrices alone already showed that the leisure activities included in this study appear to be relatively independent of one another, with little common variance. This would result in the observed low communalities of the individual variables due to high specific contributions to the total variance. Equally possible is that low reliability could be holding down the communality. This argument however does not hold if we generalize the reliabilities coefficients of sample 4 on the other three samples. On the other hand, it could be the case that the interdependence of leisure activities does in fact vary from sample to sample. Before arriving at a more definite conclusion, the similarity rotation of the four solutions must be considered.

Factor Structure Comparisons

The method described by Gebhardt (1968) among others of comparing factor solutions for similarity was applied using pairs of samples. Table 3 shows the results. On the whole, the overall similarity coefficients of the factor matrices were insufficient.

The coefficients for the factors show similarity with the first factor only in sample 1 and sample 2; for the second factor in sample 1 and sample 3 (Table 3).

The fact that more than half of the items did not fill equivalent positions in the factor space when compared two by two makes even clearer the

TABLE 2

SOME CHARACTERISTICS OF THE FACTOR-SOLUTIONS

Variable	Sample 1		Sample 2		Sample 3		Sample 4	
	h^2 in factor		h^2 in factor		h^2 in factor		h^2 in factor	
1	.15	1	.55	1	.04	1	.36	1
2	.04	1	.25	2	.38	2	.14	2
3	.04	1	.12	2	.19	2	.17	1
4	.30	2	.33	1	.49	2	.01	2
5	.24	2	.17	1	.31	1	.17	1
6	.04	1	.40	2	.02	2	.20	2
7	.03	2	.33	1	.01	1	.15	2
8	.39	1	.13	1	.21	1	.45	1
Whole variance	100%		100%		100%		100%	
Variance of factor 1	8.3%		17.5%		10.5%		11.7%	
Variance of factor 2	7.9%		9.8%		10.1%		7.5%	
Rest variance	83.9%		72.7%		79.4%		80.8%	

TABLE 3

SIMILARITY COEFFICIENTS FOR THE 2 FACTORS BETWEEN THE 4 SAMPLES

		FACTOR 2			
		I	II	III	IV
Factor 1	I	—	0.56	0.89	0.20
	II	0.80	—	0.61	0.40
	III	0.63	0.47	—	0.77
	IV	0.97	0.63	0.20	—

general lack of similarity of results obtained from the different samples (Table 4).

Discussion

It should be pointed out that in our case, factor analysis did not have

TABLE 4 OVERALL SIMILARITY COEFFICIENTS BETWEEN THE MATRICES OF THE 4 SAMPLES				
		I	II	III	IV
Over-all Similarity	I	–			
	II	0.53	–		
	III	0.76	0.30	–	
	IV	0.63	0.54	0.50	

the desired effect of giving insight into the structure of the data, to follow the argumentation used by Uberla (1968). We consider the following reasons of primary importance in explaining the discrepancy between Bishop's (1970) and Witt's (1971) results, where the factor analyses was considered a success. First of all, the neterogeneity of the subject samples; and secondly, the heterogeneity of the variable samples.

It was to be expected, that similarities in leisure activities would at least be found between the representative samples 1 and 2. On the contrary, we found no similarities between the samples, and the individual variables fill highly different locations in the factor space. Systematically increasing similarities did not become apparent. This is the case in spite of the sufficient similarity of some variables in some cases, i.e. their belonging to the same factor. The difficulty of designating the factors is due to the unsystematic variations in the variables which characterize them. For this reason we have refrained from giving a name to the factors as they appear in all four samples as a whole.

When not even representative samples produce the same or similar results based on factor analyses, it is time to examine the existing concept of representativeness. We raise the question, whether the requirements used to ensure the representativeness of a sample can be geared to the needs of current research in the social sciences. It is entirely possible that so called representative samples differ in certain critical dimensions, for example personality variables, and consequently in their leisure activity as well. Differences of this nature would automatically lead to contradictory results of factor analyses. This is the case especially for our samples 3 and 4, but samples one and two could just as easily have been composed of unlike subsamples.

Sixtl (1967) and other authors have repeatedly called attention to the dependency of factor analytical results on the subject and variable samples. The statistically low correlation of the items to one another can be explained by the fact that the large samples are composed of sub samples which, despite their internal homogeneity, differ in their leisure activity. The problem of numerous leisure activities which hardly correlate with one another occurs repeatedly in the literature and leads to correspondingly low common variance among the items. This is especially true when the variables are sufficiently reliable.

Nevertheless, Bishop (1970) and Witt (1971) were able to establish

strong similarities between different samples. It remains for future investigations to determine to what extent factor analysis may be a useful instrument in defining the structure of leisure activity.

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