THE STABILITY OF COGNITIVE STRUCCURE IN THE ATTITUDE STUDY

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The problem of attitude and attitude change is viewed in two different ways by consistency theorists. One applies to daily life. It was vividly portrayed by Newcomb in a Psychology Today interview as follow:

> I happen to have studied the tendency toward balance, but that doesen't mean there is anything inherently good or desirable about it. Education, life itself, thrives on imbalances. Without them you would live like an oyster, utterly passive. Most kinds of fun and excitment begin with inconsistency, with the possible exception of nurequited love. The best scientist, for example, looks for the inconsistencies.......
>
> My point is not that we don't seek inconsistencies, but that we have trouble living with them for very long. The direction of change is very likely to be toward balance. (Tavris, 1974)

The other way is to view them as everyday problems encountered by those who are engaged in attempting to survey, or to alter, the social attitudes of other persons. These problems can be summarized as : (1) increasing the validity of attitude measurement, (2) increasing the action-predicting power of attitude measurement, (3) incrasing the effectiveness of attitude change procedures, and (4) decreasing the guilt feeling of propagandists(Ossgood, 1960).

What we were concerned about in this paper was limited to the use of cognitive structure as a valid measurement of attitude. Here we represented cognitive structure in the aggregate level as a graph or a picture which showed delicately balanced relationships among self, the attitude object, and beliefs or objects functionally relevant to the attitude object. With the help of Galileo system, the three types of elements of cognitive structure were arrayed on a picture of multiple dimensions. Distances between self and the cognitive object were supposed to indicate the intensity of the attitude toward the object. If the attitude object was far away from the self, it reflected that the group held a negative attitude toward the object. On the contrary, if the self and the object were close to each other, the gorup was supposed to have a favorable attitude. Change in distance between the self and Object was considered as attitude change.

The stability of cognitive structure defined above was fundamental to its applicability as ereliable measurement for attitude and its change. If the aggregate cognitive structures were proved to be stable across homogeneous groups prior to exposure to any treatments, we could thus assess first that it was a fairly reliable instrument. Secondly, we might estimate attitude change by comparing cognitive structures measured before and after any treatments. Finally, retention of attitudes could be assessed through comparing cognitive strucures measured at different times. Consequently, this paper was aimed to examine the stability of cognitive structures across homogeneous groups.

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To test the stability of cognistive structure, we took "contraceptives" as attitudinal object and administered Galileo questionnaires at female workers of eight factories. Comparing the cognitive structures derived from the data, we found that they were fairly stable. In the following discussion, we will first briefly introduce Galileo system since it is a relatively new approach. Then, we will present the data used in this paper. Finally, the stability of cognitive structure will be discussed.

I. The procedures of the Galileo system:

The Galileo system is a mood of multiple-dimensional scaling. The system consists of a set of measurements, dissonance inducing techniques, and a package of computer programs using the multiple-dimensional scaling method (Gillham & Woelfel, 1977). Briefly speaking, it is composed of the following basic procedures:

1. Identifying beliefs and objects functionally relevant to the attitude object.
2. Choosing any arbitrary pair of objects. The separation between the pair is designated as a standard for the separation between cognitive elements.
3. Asking respondents to estimate the separation among all pairs of cognitive elements as a ration of this standard. The separation is called elsewhere ratio judments of separation(Danes and Woelfel, 1975).
4. Aggregating the scores taken from individual samples.
5. Arranging the aggregate scores of a separation into a matrix. The matrix is then converted to a deviation matrix with origin at either an arbitrary point or the centroid of all the points which represent cognitive elements (Torgerson, 1958).
6. Converting the deviation matrix into a scalar products matrix by premultiplying it through its transpose.
7. Transforming the scalar products matrix to principal axes, the result is the desired matrix.
8. Plotting the factor loadings of the first few dimensions, the result is an aggregate cognitive structure,

In this study, procedure 1 was carried out with depth interview. A small representative sample of 21 women was chosen from the study population. They were asked to talk freely about the attitude object in some depth. Eight most frequently mentioned concepts were selected from the depth interviews and taken as beliefs and objects functionally relevant to the attitude object. They were: 2-children is enough, space 3 years, education, heavy burden, child rearing, hurting health, having a boy, and mother-in-law.

As to the procedure 2, "husband vs. wife" was taken as the standard pair for this study, because it carried common and stable meaning to the study population. Moreover, it was relevant to the attitude object - contraceptives, so it rendered estimation of descreppancies between cognitive elements meaningful. The separation between "husband and wife" was set as 100 units.

II. The data:

To test the stability of cognitive structures among homogeneous groups, female workers from eight factories were asked to estimate the separation among all pairs of cognitive elements as a ration to the standard pair - husband vs. wife. Since we had ten elements included in the cognitive structure - i.e. self, the attitude object(contraceptive), and the eight relevant beliefs and objects stated above -, the workers in total had to make 45 (10 x 9/2) estimations.

The results of the test were shown in Table 1. Sizes of factories included in the eight factories ranged from twenty to seventy. In total, 409 workers participated in the tests and 379 workers completed the questionnaires. The response rate was as high as 92.7%. For individual factories, the return rates of questionnaires were all above 85%.

The validity of workers' responses was a concern. Therefore, some workers were randomly selected and questioned about principles of filling out the questionnaires after they had finished the tests. Numbers of workers questioned were shown in the column "check" of Table 1. Fortunately, the workers all gave correct principles as instructed.

TABLE 1
THE RESULTS OF TESTS OF EIGHT FACTORIES

FACTORY NUMBER	PRODUCTS	NUMBER OF CASES Completed	Incompleted	TOTAL	CHECK
01	shoe	41	5	46	8
02	toy	37	3	40	5
03	shoe	21	3	24	5
04	shoe	69	9	78	9
05	mechanical parts	38	1	39	7
06	toy	64	2	66	8
07	shoe	62	3	65	5
08	shoe	47	4	51	3
TOTAL		379	30	409	50

III. The test of the stability of cognitive structures:

The stability of the Galileo system of measurement has been reported in several studies. Gillham and Woelfel (1977) used two ways: (1) the correlation of the corresponding cell entries across mean matrices, and (2) the orthogonal decomposition procedure. Woelfel and associates (1980) checked the reliability of the raw pair comparison measures with their coefficients of variation and the reliability of overall configuration with correlations between corresponding dimensions of the configurations. Cody (1977) tested the stability of spaces with a cross-group correlation procedure which provided the correlation and angles between a concept and itself with data measured at different points of time and a factor correlation between factors obtained also from data measured at different points of time. These studies all shared the conclusion of stability.

In this study, the stability of cognitive structures across homogeneous groups is examined in two ways. First, we checked mean distances of paired comparisons for baseline total as a whole and baseline individual factories. These data were our basic inputs. If people had a similar tendency in scoring the paired comparisons, similar cognitive structures would result. Secondly, we compared the cognitive structures presented in three dimensional pictures. The pictures were the results of transforming and adjusting our mean distances. Generally, the first three dimensions were able to explain a majority of the overall variances. If this was true, cognitive structures which were represented by projections of coordinates of the first three dimensions on isometric-orthographic papers thus became visible, comprehensible and meaningful. The Comparison of cognitive structures was made between eight factories as a whole and factories 6 and 7. Factories 6 and 7 were relatively larger and thus had stable mean matrices, so they were selected for comparison.

(I) The stability of mean distances:

In this study, we found that mean-distances were fairly stable across homogeneous groups. It was also found that variation was caused by sample size and age. In the following discussion, we will first present the procedures for data arrangement, then discuss the correlations between the eight factories as a whole and the component factories.

A. The procedures of data arrangement:

Female workers were asked to score 45 paired comparisons. These scores were averaged for each factory with the exception of a few extreme values greater than 500. The exclusion of extreme scores reduced each group by 2 to 3 cases. Thus we had 45 mean distances for each group. Usually, they were arranged in matrix format. The mean-distances matrix for the eight factories as a whole was shown in Table 2 as an example.

The next step was to arrange the 45 mean-distances into single columns by "stacking the second column of (a mean matrix) below the first. The third is placed below the second, the fourth below the third, and so on until the triangular matrix is emptied" (Gillham & Woelfel, 1977, p. 227).

B. The correlations of mean distances:

The correlations between the total and its component factories were fairly high. It ranged from .55 to .83 (see Table 3, panel 1). It seemed that the correlations were subjected to the influence of factory size. When the factory sizes were some sixty female workers, the correlations were about .80. When the factory sizes were less than fifty female workers, the correlations not only decreased but also fluctuated between .55 and .67. Mean-distances matrices were fairly stable if factory sizes were 100 or more.

It was interesting to note that educational level had no effect on workers' scoring of paired comparisons. As shown in the second panel of Table 3, the correlation between total and its workers with primary or less education was .94 The correlations between total and the other two higher levels of education were still as high as .91. This phenomenon basically showed that educational levels had no effect on scoring of paired comparisons. Moreover, we has noted that the three educational levels had about equal numbers of female workers; each had more than 100 cases.

TABLE 2

MEAN-DISTANCES MATRIX FOR THE EIGHT FACTORIES AS A WHOLE

	1	2	3	4	5	6	7	8	9	10
1	0.0									
2	59.384	0.0								
3	78.634	73.243	0.0							
4	83.318	70.443	89.718	0.0						
5	76.921	86.489	90.026	92.687	0.0					
6	79.100	70.530	70.352	90.937	80.087	0.0				
7	63.805	55.116	73.087	74.854	64.485	71.265	0.0			
8	84.050	81.040	84.271	85.646	75.037	75.329	87.485	0.0		
9	78.064	69.273	76.583	73.115	78.349	92.189	71.815	80.179	0.0	
10	65.605	61.518	75.170	85.547	74.687	81.504	58.499	80.869	73.333	0.0

TABLE 3

THE CORRELATIONS (PEARSON r) OF MEAN-DISTANCES BETWEEN THE TOTAL AND ITS COMPONENTS

I. the total and the individual factories:

	Factories							
	1	2	3	4	5	6	7	8
r	.65	.57	.67	.79	.74	.83	.81	.55
N	40	37	21	68	38	64	62	49

II. the total and the total by education:

	Primary and Less	Junior High	Senior High and Above
r	.94	.91	.91
N	128	125	122

III. the total and the total by age:

	15-	15-19	20-24	25-29	30-39
r	.82	.98	.72	.60	.64
N	32	222	68	21	11

Notes: a. All of the input sizes for correlations were 45 concept-pair means.
b. All of the correlations were significant at the .01 level.

On the other hand, age had some effect on scoring of paired comparisons. As shown in the third panel of Table 3, age 15-19 was the majority. It accounted for about 60% of the total and their ways of scoring paired-comparisons constituted the main stream of the total. The correlations of scoring between this age group and the total was .98. The correlations for other age groups and the total were slightly lower, ranging from .60 to .82. Their group sizes were less than 100 cases. Probably, the smaller size partly explained the lower correlations because smaller size made correlations fluctuate.

Since both sample size and age influenced scores of mean distances, we further examined the age distributions of factories 6 and 7. The congruence in terms of age distributions for comparison total and factories 6 and 7 is shown in Table 4. Neither factory had significant differences from the total in age distributions. Therefore, we might conclude that the difference of correlation .8 and 1.0 reflected random errors caused by smaller sample size. As sample size increased, the random error averaged out. We thus might expect higher correlations when sample size was increased up to around 100.

TABLE 4

AGE DISTRIBUTIONS FOR THE TOTAL AND FACTORIES 6 AND 7

	AGE					
	20-	20-24	25+	TOTAL	X^2	p
Comparison Total	254	68	32	354		
Factory 6	44	15	2	61	2.99	$> .20$
Factory 7	43	7	3	53	2.44	$> .20$

(II) The stability of cognitive structures:

After a series of data transformations and adjustments, our data showed that cognitive structures were very stable across homogeneous groups.

A. The data transformation and adjustment:

1. The basic transformation procedures:

The Galileo system is one variant of metric multi-dimensional scaling. Its classical approach was developed by Yound and Householder (1938) and Richardson (1938), but Torgerson (1952, 1958) is best known for general improvement and dissemination of the approach. The approach began with a precisely scaled n x n data matrix S which is called mean-distances matrix in this study (see Table 2 for example). Any cell S_{ij} represents the measured average dissimilarity or difference between the ith and jth object or concept scaled. The matrix was first converted into a matrix of scalar product B. Secondly, the scalar product matrix was factor-analyzed. Finally, the factor loadings were plotted on principal axes to produce the aggregate cognitive structure. The factorization used in the Galileo system is identical to the factor analysis algorithm commonly employed with the exception of using a scalar product matrix as input. We focused our discussion on the procedures to convert mean-distances matrix into scalar product matrix and the correlations of the resultant.

The technique used to convert the matrix of inter-point separation S into a matrix of scalar product was developed by Young and Householder in 1938. The conversion could be better expressed with the following formulas (Torgerson, 1952; Woelfel, 1977):

$$b_{jk} = \frac{1}{2}(d_{ij}^2 + d_{ik}^2 - d_{jk}^2) \quad \ldots\ldots(1)$$

where the b_{jk} = an element of scalar product matrix

d_{ij} = average distance between i and j

d_{ik} = average distance between k and i

d_{jk} = average distance between j and k

i = an arbitrary point

j and k= concepts or beliefs

The element b_{jk} might be considered to be the product of vectors from point i to points j and k. Or this followed directly from the cosine law. That gives the three points i,j, and k.

$$d_{jk}^2 = d_{ij}^2 + d_{ik}^2 - 2\, d_{ij}\, d_{ik} \cos\theta_{jik} \quad \ldots\ldots(2)$$

Which rearranged as:

$$d_{ij} d_{ik} \cos\theta_{jik} = \frac{1}{2}(d_{ij}^2 + d_{ik}^2 - d_{jk}^2) \ldots\ldots(3)$$

From equations 1 to 3, it was seen that $b_{jk} = d_{ij} d_{ik} \cos\theta_{jik}$, the scalar product of vectors from point i to points j and k. Thus each arbitrary point selected as origin had a unique B matrix, although the separate relations among the points in the space remained invariant.

Torgerson (1958) proposed another procedure to assure that the resulting map or plot would be centered on the page. His procedure takes the exact center of the configuration as the centroid. While functionally equivalent to the Young and Householder solution, Torgerson's procedure was more commonly used. Any element b_{jk}^* in Torgerson's (1958) "double centered" scalar products matrix was given by:

$$b_{jk}^* = \frac{1}{2}(d_{jk}^2 - d_{.j}^2 - d_{.k}^2 - d_{..}^2)$$

where $d_{.j}^2 = \frac{1}{n}\sum_{k=1}^{n} d_{jk}^2$

$$d_{.k.}^2 = \frac{1}{n}\sum_{k=1}^{n} d_{jk}^2$$

$$d^2_{..} = \frac{1}{n^2} \sum_{j=1}^{n} \sum_{k=1}^{n} d^2_{jk}$$

2. The data adjustment:

In order to make a better comparison of cognitive structures, we adjusted the data with two methods--mean-distances and rigid motion. The mean-distances adjustment was designed to minimize the differences between spaces for cognitive structures and thus make them more comparable. One earlier study (Barnett, Serota & Taylor, 1976) indicated a multi-dimensional space could essentially "shrink" over time or due to an experimental manipulation. In Cody's (1977) two studies, the shrinking phenomenon was also observed. His control groups had larger space than the study groups'. Later on, we found a slightly expanding phenomenon for the experimental groups of this study. The overall average mean-distances for the total was 76.32. The grand means for factories 6 and 7 were 72.35 and 62.61 respectively. Since any statistical analysis computed across groups would be biased due to shrinking or expanding, all spaces must be adjusted by an additive constant. For better comparison across groups, we decided that an additive constant be computed by subtracting the obtained overall grand mean-distances from 100. The remainder was added to each of the 45 mean-distances. For example, the additive constant used for the comparison total was 23.68 (100-76.32). For other groups, it ranged from 1.78 to 37.39. This way of adjusting scores had been tried by Cody (1977) to provide a better space comparison. The adjusted mean-distances, then, were converted into scalar products matrices and further factor-analyzed.

Tables 5,6 and 7 show the adjusted matrices of coordinates for the total and factories 6 and 7. Eigenvalues and percentages of variances explained by each factor were also shown in the tables. Eigenvalue was the sum of the squared components of each factor. It was noticed that there were one to two negative eigenvalues in the three tables. They indicated imaginary components of the eigenvectors. "While these imaginary components and negative roots were initially considered by many psychometricians to be artifactual or indications of errors, their consistent recurrence, stability over time and generally lawful behavior ... seem to indicate they should not be disregarded..." (Woelfel, 1978, p.25). The negative eigenvalues reflect the existence of non-Euclidian separation or inconsistent relations among concepts. In spatial terms, non-Euclidian spaces are warped or bent (Woelfel, 1978).

Percentage of common variance explained by each individual factor was the proportion of individual eigenvalues to the sum of eigenvalues. As shown in Tables 5,6 and 7, their first three dimensions accounted for about 50-60% of total variances. Or a 3-dimensional space representation had only about 50-60% of explanation power.

The rigid motions (Woelfel and Danes, 1977) was a kind of distance-preserving transformation. It consisted of rotations and translations on the coordinates. The purpose of translations was to place the _i_th concept, especially the concept "self" on the origin of the reference frame, so that the reference frames were centered on the same concept for better visual comparison. The translation, however, might take a larger space, so it was not adopted here.

The second adjustment employed here was rotation. The two sets of coordinates

Table 5. Matrix of adjusted coordinates for the To Tal

		1	2	3	4	5	6	7	8	9	10
1	2-CH	2.063	-28.693	-0.958	7.854	43.727	-34.299	-0.946	-13.882	-4.343	0.003
2	SPAC	7.775	-18.573	-4.755	14.467	-2.417	-7.835	-2.558	45.213	15.192	0.013
3	EDUC	-1.329	2.558	60.987	-24.437	-14.895	-8.498	-23.453	0.131	-4.899	-0.172
4	ECON	51.172	32.558	-6.727	38.809	-1.803	8.743	-15.699	-5.215	-12.625	0.019
5	CHIL	-25.732	-10.192	-47.561	-16.927	-26.942	-9.936	-18.551	-1.618	-17.434	0.134
6	HURT	-47.616	8.154	18.843	37.797	-12.738	0.707	28.194	-1.731	-10.550	-0.053
7	HAVI	5.677	-31.132	-3.496	10.199	-19.880	13.239	-2.535	-25.941	29.843	0.010
8	MOTH	-31.369	55.268	-11.894	-14.627	24.617	6.833	-8.547	-0.518	18.457	0.033
9	CONT	37.032	17.306	-5.917	-33.886	-12.614	-13.892	37.539	-1.647	0.598	0.017
10	SELF	- 2.328	-27.253	1.479	-19.249	22.945	44.937	6.556	5.208	-14.239	-0.004

EIGENVALUES (ROOTS) OF EIGENVECTOR MATRIX--

8007.488	7471.105	6596.261	5926.098	4717.920	3919.925	3474.668	2972.777	2282.693	-0.052

NUMBER OF ITERATIONS TO DERIVE THE ROOT--

30	17	16	11	13	16	11	12	4	14

PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS-

17.650	16.467	14.539	13.062	10.399	8.640	7.659	6.552	5.031	0.000

PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS IN THEIR OWN SPACES-

17.650	16.467	14.539	13.062	10.399	8.640	7.659	6.552	5.031	100.000

SUM OF ROOTS 45.368.882******** WARP FACTOR = 1.0000**********

NUMBER OF DIMENSION IN REAL SPACE 9

NUMBER OF OIMENSION IN IMAGINARY SPACE 1

Table 6. Matrix of adjusted coordinates for factory 6

		1	2	3	4	5	6	7	8	9	10
1	2-CH	-6.577	-32.181	-24.753	7.621	33.546	13.236	5.311	-11.319	-26.496	0.025
2	SPAC	-2.213	0.009	15.577	-15.281	14.117	21.753	-5.204	38.520	-2.425	-0.050
3	EDUC	9.359	-10.076	12.589	55.213	-31.356	-16.716	0.920	9.553	-10.639	0.180
4	ECON	-14.465	56.216	22.818	-1.045	28.056	-27.555	-1.639	-6.464	-8.013	-0.003
5	CHIL	-3.043	-12.878	-23.496	-44.492	-30.044	-30.815	-10.901	2.826	-8.937	-0.145
6	HURT	47.179	-18.665	46.182	-18.266	-3.943	11.311	-4.282	-17.282	1.971	-0.060
7	HAVI	-34.859	-33.764	2.591	11.823	17.699	-11.647	-21.187	-4.216	27.052	0.039
8	MOTH	53.785	19.065	-41.769	8.717	13.064	-3.329	7.419	3.187	17.040	0.028
9	CONT	-21.038	34.241	-14.598	4.726	-27.801	38.029	-20.619	-11.693	0.589	0.015
10	SELF	-28.127	-1.967	4.858	-9.016	-13.240	5.733	50.182	-3.110	9.857	-0.029

EIGENVALUES (ROOTS) OF EIGENVECTOR MATRIX--

7921.743	7491.348	6207.392	5973.799	5447.920	4390.471	3643.278	2225.958	2088.739	0.064

NUMBER OF ITERATIONS TO DERIVE THE ROOT--

37	10	55	20	11	13	7	23	4	8

PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS-

17.452	16.504	13.675	13.161	12.002	9.673	8.026	4.904	4.602	0.000

PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS IN THEIR OWN SPACES-

17.452	16.504	13.675	13.161	12.002	9.673	8.026	4.904	4.602	100.000

SUM OF ROOTS 45390.711********** WARP FACTOR = 1.0000 ********

NUMBER OF DIMENSIONS IN REAL SPACE 9

NUMBER OF DIMENSIONS IN IMAGINARY SPACE 1

Table 7. Matrices of rotated coordinates for the total, factory 6, and factory 7

THE ROTATED COORDINATES OF SPACE NUMBER 1
(THE TOTAL)

		1	2	3	4	5	6	7	8	9	10	11
1	2-CH	2.063	-28.693	-0.958	7.854	43.727	-34.299	-0.946	-13.882	-4.343	0.0	0.003
2	SPAC	7.775	-18.573	-4.755	14.467	-2.417	-7.835	-2.558	45.213	15.192	0.0	0.013
3	EDUC	-1.329	2.558	60.987	-24.437	-14.895	-8.498	-23.453	0.131	-4.899	0.0	-0.172
4	ECON	51.172	32.558	-6.727	38.809	-1.803	8.743	-15.699	-5.215	-12.625	0.0	0.019
5	CHIL	-25.732	-10.192	-47.561	-16.927	-26.942	-9.936	-18.551	-1.618	-17.434	0.0	0.134
6	HURT	-47.616	8.154	18.843	37.797	-12.738	0.707	28.194	-1.731	-10.550	0.0	-0.053
7	HAVI	5.677	-31.132	-3.496	10.199	-19.880	13.239	-2.535	-25.941	29.843	0.0	0.010
8	MOTH	-31.369	55.268	-11.894	-14.627	24.617	6.833	-8.547	-0.518	18.457	0.0	0.033
9	CONT	37.032	17.306	-5.917	-33.886	-12.614	-13.892	37.539	-1.647	0.598	0.0	0.017
10	SELF	2.328	-27.253	1.479	-19.249	22.945	44.937	6.556	5.208	-14.239	0.0	-0.004
11		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

THE ROTATED COORDINATES OF SPACE NUMBER 2
(THE FACTOR 6)

		1	2	3	4	5	6	7	8	9	10
1	2-CH	-3.349	-26.246	-7.510	3.105	36.344	-18.578	3.045	-18.945	33.291	0.025
2	SPAC	4.300	-12.893	-7.315	13.479	-1.993	-12.919	5.959	45.063	3.650	-0.050
3	EDUC	-5.175	3.282	60.773	-19.718	-12.593	-1.075	-22.162	-5.478	7.968	0.180
4	ECON	45.871	31.061	-6.046	40.010	-6.423	23.441	-15.633	-0.564	2.149	-0.003
5	CHIL	-24.400	-4.593	-42.199	-22.642	-34.882	13.209	-16.552	-8.529	10.851	-0.145
6	HURT	-48.655	7.992	16.565	36.612	-16.056	3.398	33.823	4.542	-5.007	-0.060
7	HAVI	11.247	-40.483	-0.696	10.747	-5.304	-27.899	-17.933	-24.022	-23.720	0.039
8	MOTH	-26.167	51.841	-9.270	-12.211	38.924	-13.958	-15.229	3.214	-7.399	0.028
9	CONT	37.610	17.928	-3.846	-34.470	-13.331	-10.845	37.080	-0.602	-4.651	0.015
10	SELF	8.718	-27.890	0.455	-14.904	15.315	45.226	7.601	5.321	-17.134	-0.029

THE ROTATED COORDINATES OF SPACE NUMBER 3
(THE FACTORY 7)

		1	2	3	4	5	6	7	8	9	10	11
1	2-CH	5.619	-28.480	-15.003	25.782	35.176	-25.265	2.010	-7.900	-15.093	0.140	-8.995
2	SPAC	3.068	-18.116	1.720	19.152	3.489	1.896	-10.987	30.819	-1.512	0.078	-7.115
3	EDUC	-3.746	4.056	58.088	-20.231	-27.616	-3.740	-20.106	8.082	-7.694	-0.055	-4.458
4	ECON	63.006	28.736	-7.686	33.236	3.436	-13.288	-18.575	-0.724	-2.901	0.087	9.095
5	CHIL	-31.086	-11.720	-41.712	-9.749	-23.125	-20.499	-29.174	-5.602	-5.146	-0.006	8.602
6	HURI	-33.842	-5.206	23.541	29.994	-8.860	-6.203	20.301	-3.335	3.625	-0.024	9.680
7	HAVI	5.121	-22.973	-9.097	3.951	-27.042	14.834	9.587	-19.379	9.868	0.030	-11.313
8	MOTH	-32.310	64.075	-19.707	-20.479	18.483	13.747	0.913	1.684	9.563	-0.196	-7.015
9	CONT	44.251	27.986	-2.049	-34.544	-8.052	-5.350	34.241	-14.203	7.586	-0.074	2.333
10	SELF	-0.081	-38.358	11.305	-27.111	34.112	43.867	11.791	10.559	1.706	0.021	9.198
11		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. Matrix of adjusted coordinates for factory 7

		1	2	3	4	5	6	7	8	9	10
1	2-CH	-4.232	-47.738	-16.818	-21.532	-12.573	8.643	24.622	-4.479	0.140	-8.995
2	SPAC	-10.870	-26.589	1.578	4.295	-13.756	-17.137	-12.556	17.587	0.078	-7.115
3	EDUC	-11.126	18.847	31.067	56.818	-1.954	-18.256	12.389	-5.134	-0.055	-4.468
4	ECON	67.510	-29.699	-16.986	16.055	-17.265	-5.870	-11.828	-6.575	0.087	9.095
5	CHIL	-24.076	2.080	-47.146	-1.716	39.032	-20.794	5.916	1.404	-0.006	8.602
6	HURT	-51.818	8.140	-11.693	18.318	-21.454	35.165	-3.053	1.828	-0.024	9.602
7	HAVI	-6.342	-10.131	7.323	1.234	33.249	19.047	-21.175	-7.336	0.030	-11.313
8	MOTH	8.326	60.931	-26.306	-26.722	-22.878	-8.816	-4.357	-3.347	-0.196	-7.015
9	CONT	55.917	25.211	22.753	-5.639	19.953	21.965	12.931	10.224	-0.074	2.333
10	SELF	-23.288	-7.053	56.231	-41.111	-2.353	-14.144	-2.889	-4.172	0.021	9.198

EIGENVALUES (ROOTS) OF EIGENVECOTR MATRIX--

11860.878	9561.348	8323.750	6744.148	4665.570	3524.720	1744.527	591.237	-0.082	-669.145

NUMBER OF ITERATIONS TO DERIVE ROOT--

12	15	11	7	10	6	5	4	6	19

PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS-

25.591	20.630	17.960	14.551	10.067	7.605	3.764	1.276	0.000	1.444

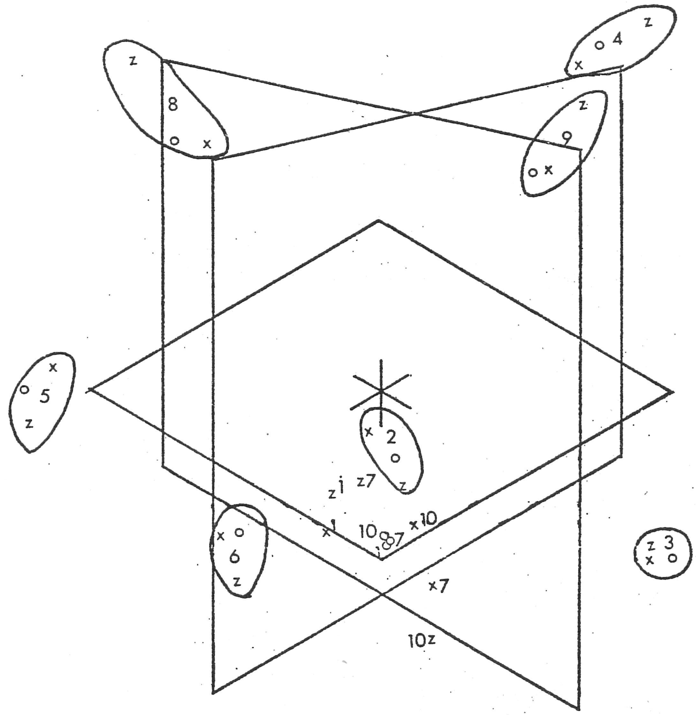
PERCENTAGE OF VARIANCE ACCOUNTED FOR BY INDIVIDUAL FACTORS IN THEIR OWN SPACES-

25.227	20.336	17.704	14.344	9.923	7.497	3.710	1.258	0.012	99.988

SUM OF ROOTS 46346.960******** WARP FACTOR = 1.0144*********

NUMBER OF DIMENSIONS IN REAL SPACE 8

NUMBER OF DIMENSIONS IN IMAGINARY SPACE 2



#	CONCEPT
1	2-child family
2	Space 3 years
3	Education
4	Heavy burden
5	Child rearing
6	Hurting health
7	Having a boy
8	Mother-in-law
9	Contraceptives
10	Self

O The total
X Factory 6
Z Factory 7

Figure 1. Comparison of cognitive structures for the total and factories 6 and 7

which were set for comparison were rigidly rotated to a least-squares best fit on each other. It was accomplished by successive pair-wise rotation of the eigenvectors until the total squared distance of concepts from their counterparts across observers was minimized (Woelfel, et al., 1975). A common approach was to hold one set of coordinates constant and simply rotate the other set. The set held constant was usually the origin of the basis for comparison with others. It was thus named the main space.

Table 8 shows adjusted matrices of coordinates for the comparison total and factories 6 and 7 after rotation. The coordinates of the first three factors were projected on isometric-orthographic paper. The result is shown in Figure 1.

B. The evidence of stability:

In Figure 1, concepts for the total were represented with o; its counterpart of factory 6, with x; and its counterpart of factory 7, with Z. It was obvious from the figure that identical concept numbers clustered together. The clustering phenomenon indicated stability of cognitive structures. Since the first three dimensions explained at most 60% of total variance, we had two supplemental correlations to confirm this conclusion, the correlations of concepts and dimensions.

Table 9 shows correlations and angles between counterpart concepts of the total and factories 6 and 7 summarized over ten dimensions. The angles between two cosθ (Rummel, 1967). As shown in Table 9 eight out of ten correlations between the total and factory 7 were .90 or above, and the other two were as high as .87. Similarly, eight out of ten concepts of factory 6 and the total were also highly correlated, i.e., .84 and above.

TABLE 9

CORRELATIONS AND ANGLES FOR EACH CONCEPT BETWEEN THE TOTAL AND FACTORIES 6 AND 7

CONCEPT	1	2	3	4	5	6	7	8	9	10
Factory 6	.77 39.6	.95 17.9	.97 13.8	.96 17.3	.84 33.0	.99 8.7	.31 72.1	.87 29.3	1.00 5.6	.98 10.5
Factory 7	.90 26.4	.87 30.1	.97 13.8	.93 20.8	.95 19.0	.94 20.3	.87 29.1	.97 14.5	.95 17.4	.94 19.9

Note: The first numbers are correlations and the second numbers are angles.

Only one concept had a moderate correlation of .77 and another one had a low correlation of .31. In terms of angles, the majority were less than 30 degrees. Overall, counterpart concepts were clustered together.

Here the correlations of dimensions were also checked. Table 10 shows correlations of dimensions between the total and factories 6 and 7. The first three factors were highly correlated. For factory 7, the others were also highly correlated with the exception of factor 9 which had a moderate correlation. For factory 6, seven out of ten dimensions were also very highly correlated, so the angles were less than 30 degrees. Factor 6 had a moderate correlation of .61, hence a larger angle, 52.2 degrees. But factors 9 and 10 had negative correlations; therefore, the angles were greater than 90 degrees. Since dimension 6 and higher had very little share of variance explanation power, their influences had to be limited.

TABLE 10

CORRELATIONS AND ANGLES BETWEEN FACTORS FOR THE TOTAL AND FACTORIES 6 AND 7

FACTOR	1	2	3	4	5	6	7	8	9	10
Factory	.99	.99	.99	.99	.94	.61	.95	.97	-.39	-.80
6	8.6	8.7	6.9	7.7	20.8	52.2	18.1	14.1	113.2	143.2
Factory	1.00	.97	.96	.95	.94	.87	.92	.91	.53	1.00
7	5.4	14.2	15.9	18.9	19.6	29.2	22.8	25.0	57.6	0.0

Note: The first numbers are correlations and the second numbers are angles.

IV. Summary:

The stability of cognitive structures was considered very important. The existence of stability assured us that random errors were limited. We thus were allowed to attribute obvious change to a manipulation effect. In the Galileo system, the manipulation effect had a more specific focus. It emphasized dynamic movements of specific concept in a predicted direction.

In this study, we confirmed stability across homogeneous groups through a series of checks. First, we checked the correlations of mean-distances matrices between the comparison total and its components. We found that there were moderate to high correlations of mean-distances matrices between the total and the subgroups. It seemed that sample size had an effect on the correlations. When sample size was large enough, say 100 or more, the correlations became steadily high.

Finally, we checked the stability of cognitive structures. They were 3-dimensional pictures representing balanced relationships among cognitive elements. Our data after adjustment showed that concepts for the two sub-groups and the total did not randomly scatter. On the contrary, concepts and their counterparts were clustered together. The correlations of their locations were mostly high. The phenomena of clustering and high correlations of their locations indicated the existence of stability of cognitive structures across homogeneous groups.

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認知架構在態度研究中之穩定性

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認知架構是否能成爲一種衡量態度的準確工具呢？答案的肯定與否取決於認知架構的穩定性。有了穩定性，認知架構才可能是衡量態度的可靠工具。也才可能用來判斷認知架構的變化是否可用來指示態度的變化。

本文中，作者依據平衡學理將認知架構界定爲一種圖形。在該圖形中，自我、態度目的物，和一群與態度目的物有功能關係的信念或事物呈現一種微妙的平衡狀態。如果〝自我〞接近〝態度目的物〞，則顯示該群人採取贊成該〝態度目的物〞的態度。反之，〝自我〞遠離〝態度目的物〞，則表示該群人持反對的態度。

在本研究裡，認知架構之測定係藉助於〝伽俐略系統〞（ Galileo System ）。〝伽俐略系統〞基本上是多度空間標示法（ Multiple dimensional scaling ）之一種分支。它包含一組特殊的測量方法，一種引起不平衡的技巧，以及一系列處理多度空間標示法的電腦程式。本文裡，對〝伽俐略系統〞的基本程序也作了簡要的介紹。

在本文裡，認知架構之穩定性一共從三方面予以檢討。第一是檢討受試者之填答平均數是否穩定。其次是檢討三度空間的認知架構圖之穩定性。最後則檢討十度空間彼此間之相關情形。從以上三種檢討中，我們發現採用〝伽俐略系統〞所繪製出來的認知架構具有高度穩定性。

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