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A cluster analysis on Roger Barker's behavior mechanisms and action patterns

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I. INTRODUCTION

A. Preamble (Historical Overview)

Social indicators have been a topic of interest for many decades as the term first appeared in the early 1930s. Many outstanding sociologists and economists have made contributions to this topic. One important contribution was the idea of social system accounts suggested by Bertram M. Gross in his conceptual paper "The state of the nation: social systems accounting" (Bauer, 1966), which played an important role in the social indicator movement. Social system accounts are a broader view than economic accounts and their purpose is to measure all activities society undertakes. The present system of National Income and Product Accounts (NIPA) only provides data on the production and consumption of market goods and services while most non-market activities are not included (Note: government services are non-market but evaluated as wages/salaries in the NIPA). Social accounting provides a framework describing the entire array of social activities including both market and non-market activities.

Two difficult problems related to social system accounting are: (1) how to measure or value non-market activities, and (2) how to find the linkage combining social and economic indicators? There are two major empirically based approaches to these problems that have been developed since the social accounting concept appeared. One is called the demographic accounts (DA) approach. This approach is essentially based on traditional demographic and sociological notions of human population stocks and transitions among various social demographic states. DA describes and models changes in the composition of human populations and therefore social change. The principal underlying DA, according to Land and McMillen (1980), is that of double entry bookkeeping, which shows that the inflows of population (such as births, immigration and population surviving from the previous period) into the given time period are exactly the same as the flows of population (such as deaths, emigration and population surviving into the next period) from that time period. By recording these two sides of a demographic account, one can create an input-output table in a matrix form which is viewed by Land and McMillen as a tool for the analysis of social change since it can depict changes in the social states or attributes of the population over time.

Further, Richard Stone (1981) demonstrated the possibility of a linkage between the demographic accounts and economic accounts. He suggests that the linkages between demographic and economic matrices can be achieved by employing precisely the same definitions and classifications, so that the cells within the matrices would be related to identical sets of individuals. Examples provided by Stone are combined demographic-economic models for labor, education, and health.

Another approach is called time-based accounts (TA), that is, accounting based on time-budgets. Karl A. Fox (1973, 1974a, b, 1980, 1985) applied economic theories about the production of goods and services among households and about the production of public goods to conceptualize the relationship between various kinds of personal and social inputs and various measures of personal and social outcomes. He proposed a set of social accounts termed TAMs (time allocation matrices) based on Barker's concept of behavior settings as a basic unit. The idea of the model is to use a complete time budget (i.e., using data from time use surveys which provide information on a household's allocation of time among various activities) to calculate the optimal allocation of a person's time among behavior settings to maximize his total utility. Fox's work on TAMs (or T_{ij}) is "perhaps the most comprehensive attempt at a theoretically based system of social indicators to date" (Carley, 1981, p. 63).

B. Objectives

Barker has made available to Fox the actual ratings on behavior mechanisms (BM) and action patterns (AP) (i.e., Barker's variables in his social accounting framework) from the 1963-64 survey data. The genotype groupings were made from 884 behavior settings that were distinguished in that survey.

In this thesis, we use a SAS clustering program to do an analysis on the 1963-64 data. The primary objectives are as follows:

(1) Barker's variables. We will introduce and specify Barker's variables as a social accounting framework, and analyze Barker's behavior settings, genotypes, and authority system with these variables.

(2) Barker's total system and authority system (or subsystem). We will use the optimal clustering result with the same number of genotypes to compare to the framework Barker distinguished, and try to determine whether these two results are the same. If so (or if not) how does the composition of the genotypes differ?

(3) Principal components and correlation coefficients. Using the results of principle components analysis and correlation coefficients, the difference between two variables or behavior settings within an authority system can be distinguished.

(4) Grouping analysis. Using the results of clustering to analyze genotypes within the total system and each subsystem, and to see if fewer groupings can be utilized to describe Barker's community without losing information.

(5) Business settings and the S.I.C. (Standard Industrial Classification system). How well will Barker's business settings correspond to S.I.C. groupings at various digit levels?

C. Plan of the Study

The behavior setting and its associated concepts will be frequently used in this thesis. In Chapter II, we will describe Barker's two surveys (1951-52 and 1963-64) in the small town in Midwest and discuss the concepts Barker developed from his study (behavior settings, genotypes, authority systems, action patterns, behavior mechanisms, etc.). We will also discuss the contribution of Fox's work on social accounts using Barker's concepts (TAMs, time budgets, social and total income, total income matrix, life style measure, etc.). Prescott's economic concepts related to performance and community social models are also included in this chapter.

In Chapter III, we introduce the methods of analysis used in the research which includes cluster analysis, correlation coefficients and matrices, and principal component analysis.

In Chapter IV, the empirical results are discussed and interpreted. The objective is to compare the number of Barker's genotypes to our results and to see if we can use a smaller number of genotypes. In addition, the private enterprises (one of Barker's authority systems) are compared to the S.I.C in this chapter.

In the last chapter, we will summarize the results, conclusions, and suggest topics for further research.

II. REVIEW OF LITERATURE

This chapter emphasizes the literature on the concepts of behavior settings developed by Barker, Fox, and Prescott, etc. The review will be divided into three sections. The first section deals with Barker's two behavior setting surveys. The second section is concerned with Fox's study on social accounts combined with Barker's concepts. Prescott's work on performance and community social models will be reviewed in the third section.

A. On Barker's Behavior Setting Surveys

Roger Barker, an experimental psychologist, is the founder of the behavior setting concept. After several extensive research years in the field of child development and community behavior, he and his associates built a series of new concepts in a comprehensive classification of social activities in a small community.

Behavior settings are the basic spatial units in Barker's authority systems and community. In order to describe and measure the environment of human behavior, Barker divided the community into several parts or units which he called behavior settings. The basic definition of behavior setting, Barker stated was that, " behavior settings are units of the environment that have relevance for behavior. They provide the primary data of the study to be reported here. We have dealt only with the settings that occur outside the homes of the community, that is, the public behavior settings. The number of public behavior settings in the town is a measure of size of the town's public environment" (Barker, 1968). In Barker's system, examples of behavior settings would include a bank, a grocery store, a Sunday worship service or a high school mathematics class. (The household behavior settings were not included in his system, but can be easily measured.). Behavior settings have their location in space, time of beginning, duration and end. A closed setting, such as an empty classroom or a closed store or a bank is not a behavior setting.

Using the behavior setting concept and method, Barker and his associates conducted two important surveys in 1950-51 and 1963-64 in his Midwest Psychological Field Station in a small town located in northeastern Kansas that he termed "Midwest". In these surveys, Barker found that children's changing behavior can be accounted for by transitions among settings. Each setting had its own "program" which reflected a particular pattern of the children such as coming from school classes to playgrounds or to the street. Further, the same rule was true for adults' behavior as they moved from banks to grocery stores or to business meetings. In short, a person's behavior was structured by behavior settings and the entire set of settings provided the framework to constitute the environment of its residents' behavior.

The other important concept Barker used in his survey is the concept of genotypes. In the 1950-51 survey, Barker observed a total of 585 community behavior settings which existed during the year and grouped them into 107 'varieties'. In the 1963-64 survey, the total behavior settings increased to 884, and were grouped into 198 'genotypes'.

The genotype (or varieties) concept classified settings with identical or closely similar programs into separate groups. The criteria Barker used for grouping settings into the genotypes was mainly the 'interchangeability' of leadership and inputs. Barker divided the participants in each setting into six zones depending on the degree of the participation. Barker's zones are 6-single leader, 5-joint leader, 4-operatives, 3-customers, clients or pupils, 2-spectators or audience members and 1-onlookers. Since some of these zones (especially lower level zones) may be hard to distinguish such as spectators and on-lookers, the interchangeability of zone 5/6 became the major criteria for grouping settings into the genotypes. "Two behavior settings are of the same genotype if, when their zone 5/6 performers are interchanged, they receive and process the same inputs as formerly, in the same way and without delay" (Barker, 1968,

p. 83). When this is true, two or more settings belong to the same genotype. Two grocery stores, for example, could exchange stock, personnel, bookkeeping systems, shelving, and so forth, with little interruption in their operation. They belong to the same genotype. An example is genotype 177 in Barker's 1963-64 survey which has 4 service stations and genotype 153 which has 3 real estate offices. By using the concept of genotypes, Barker and Schoggen measured social change by analyzing new genotypes and disappearing old ones in Midwest between 1950-51 and 1963-64.

Behavior settings can be analyzed by many different variables. Barker provided ratings on "behavior mechanisms" and "action patterns" which were termed quasi-inputs and quasi-outputs by Prescott (1985). Behavior mechanisms are observable activities of people in the setting which included gross motor activity (GM, use of large muscles), talking (T, all forms of verbalizing), thinking (TH), affective behavior (AF, overt emotionality), listening (LI), looking (L) and manipulation (MA, use of hands).

Action pattern ratings are the degree of occurrence of 11 habitat qualities and are used in discriminating habitat units (behavior settings) and in measuring the degree to which they possess various qualities. The eleven action patterns included social contact (SOC, interpersonal interaction), recreation (REC, play, sports, games), aesthetics (AES, making the environment more beautiful), business or earning a living (BUS, exchanging goods, services, or privileges for money), nutrition (NUTR, eating and drinking), education (EDUC, formal education of any kind), government (GOVT, making, implementing, and evaluating government regulations), personal appearance (PERS, improving appearance via clothing, grooming, adornments), physical health (PHY, promoting health), professional involvement (PROF, paid rather than voluntary performance in setting), and religion (REL, behavior concerned with worship). The extent to which an action pattern occurs within a behavior setting is rated and reported by Barker as prominent, secondary or absent. A prominent action pattern is a major component which occurs in connection with 80 percent or more of the standing pattern of a behavior setting. For example, the action pattern of recreation is the prominent in High School Boys Basketball game. Usually, more than one action pattern can be prominent in the same behavior setting. An example is social contact which is prominent in a household auction in addition to business.

Barker divided his public settings system into five different "authority systems" (i.e., private enterprise, voluntary association, government, church and school). The private enterprises are market-oriented and the rest belong to the non-market system. Thus, Barker's system included most market and non-market activities in public settings, and it can be arranged into three levels --- behavior settings, genotypes, and authority systems. But we note here that behavior settings in one genotype do not necessarily belong to the same authority system. An example is genotype 162 which includes 15 behavior settings of restaurants and organization dinners for the public, but only 5 behavior settings belong to the private enterprise authority system. Using genotype concepts, Barker and Schoggen (1973) measured social change in terms of the changing number of genotypes in Midwest.

B. On Fox's Social Accounting Approach

Karl A Fox was a pioneer in introducing Barker's behavior setting concepts into a social accounting system and made many contributions. One of his most important contributions was TAMs (time allocation matrices) or T_{ij}.

Fox and van Moeseke (1973) developed a total income model (i.e., not only money income from property and transfer payments, but also social media of exchange, such as professional standing, political power etc.). In this model, Fox used Barker's concept of behavior settings and Talcott Parson's concept of "generalized media of social exchange". (Parson suggests a series of 'things' that could be exchanged among individuals, such as influence, money, power, value commitments, ideology, reputation and so on). Fox and van Moeseke supplied a scalar measure of total income of an individual.

The model would be:

$$\text{maximize} \quad U(x) \qquad (1)$$

$$\text{subject to} \quad AX \leq b \qquad (2)$$

$$X \geq 0 \qquad (3)$$

Where, X represents the percent of time spent in M behavior settings; U is an individual's utility function; A and b are real matrices, with dimensions mxn and mx1; b denotes the endowment (or resources) in terms of the different media of exchange; and the elements a_{ij} of A are input coefficients: a unit of the jth activity absorbs a_{ij} units of b_i. The matrices X, A, b express the individual's life style, environment, and endowment, respectively. Thus, this model described the individual seeking to maximize his utility or well-being, U(x), during the year by allocating his time X among the n behavior settings in his community under the constraints of his endowment (the vector b).

To explain the constraints more clearly, Fox lists three rows of equation (2)

$$-p_1x_1+p_2x_2+\ldots+p_nx_n \leq y \quad (4)$$

$$x_1+ x_2+\ldots+ x_n \leq 1 \quad (5)$$

$$-w_1x_1-w_2x_2-\ldots-w_nx_n \leq -w \quad (6)$$

Where $x_1, x_2, \ldots, x_n$ denote the person's time spent on different behavior settings and y is property and transfer income or endowment. We assume x_1 denotes time spent on work while p_1 is the wage rate; x_2 denotes time spent on shopping at the grocery store and the like. Thus the equation (4) is the income constraint, equation (5) is the time constraint, and equation (6) is the reduced form of $w_1x_1+w_2x_2+\ldots+w_nx_n \geq$ W which may define a condition of outputs obtained among different settings. For a local politician, W was the total votes needed to win an election. Thus w_1 means votes received per unit of time spent at work (e.g., law practice or the like), w_2 is votes gained per unit of time spent at the grocery store, and so on. For a social research worker, W might be interpreted as a publication requirement and w_j ($j=1, \ldots, n$) may denote average outputs obtained from time spent in each behavior setting as work, relaxation, etc. Clearly, by collecting all the information about residents activities among the behavior settings by occupancy time (O.T.), we can assess the life style of the community.

Fox formed a large two-way table or matrix (TAMs), or T_{ij}, where i (rows) indexes various individuals (or group of individuals) and j (columns) indexes behavior settings. Thus, each row across columns represent the individual's life style, which is called a time-allocation vector (TAV). Fox suggested that we can also form a TAV for categories classified by age, sex and socioeconomic status.

C. Alternative Approach on Modeling Ecobehavioral System

Following Fox's Time Allocation Matrix, there are several approaches for modeling ecobehavioral systems at the community level (Prescott, 1982, 1985, 1991; Sengupta, 1980a, b, c).

Prescott proposed a dynamic microanalytical simulation of a community based on Barker's data for Midwest. Such a socio-metric model of Barker's community would be used to calculate normative measures of performance of the system and would be related to Fox's T_{ij} (or TAMs) for each accounting period with i indexing all individuals in the community. To make the model more implementable, Prescott reduced Barker's 198 genotypes (1963-64 catalog) substantially and condensed the 884 behavior settings into about 40-60 "prototype settings" instead of genotypes. Each prototype setting would be modelled in some detail and its flowchart described the relationships which might be present in a behavior setting, and illustrated possible variables that might influence the setting's performance norms. It was suggested that, within each prototype setting, the exogenous variables would strongly affect the setting's performance, the dependent endogenous variables would measure its performance in the current period, and forward linkages would influence the setting's performance in the succeeding period. The entire model would specify causal therefore dynamic relationships among Barker's behavior settings and would supply a comprehensive set of social accounting tables for the community.

Prescott also used cluster analysis to study varieties from the earlier Barker survey (1950-51) to compare optimal groupings to the categories used by Barker. These data included only (1-0) or prominent-nonprominent ratings on BM and AP that Barker had published (Prescott, 1982). This suggested that Barker's data could be grouped in different ways in a social accounting system and that research on 1963-64 data would be more interesting.

Further, Prescott suggested more detailed strategies of clustering analysis on Barker's comprehensive data from the 1963-64 survey, which were made available to Karl Fox in 1985. He stated that the eleven action patterns and five behavior mechanisms of the data provided a unique organizing filter through which society might be classified. If this 16-element vectors of 0 to 9 ratings are exactly similar as between two settings the distance measure is zero; the clustering program groups settings with similar (though not necessarily identical) vectors. When constrained to 198 groups the cluster analyses would classify the 884 behavior settings into "optimal clusters" which could be compared to Barker's genotypes; separate analyses would be run for the five classes of authority systems. This analysis also supplies a test of how well the "zone 5/6 program comparability" criterion performs with the setting characteristics of action patterns and behavior mechanisms (Prescott, 1991).

III. METHOD OF ANALYSIS

Barker divided his total community system of Midwest into five authority systems based on the characteristics of the controlling or executive setting. These are:

Private enterprises include all settings under the control of behavior settings operated by private citizens in order to earn a living; Churches comprise those settings that are controlled by central administrative settings of churches; Government agencies embrace all behavior settings managed by executive settings of town, county, state, or federal governments, excluding school-controlled settings; the authority system Schools covers the settings under the aegis of executive settings operated by private or public educational agencies (town, district, county, state, or national school boards or committees); Voluntary associations comprise all settings other than those in the first four classes. Each behavior setting of a town occurs in only one authority system; the five classes of authority systems control all public behavior settings of a town (Barker and Schoggen, 1973, p. 41).

Barker's data for the total community system are used to do a similar classification but based on the ratings of action patterns (AP) and behavior mechanisms (BM) supplied by Barker. The actual rating on these variables of each behavior setting was made as a ranking from 0 to 9. A SAS cluster computer routine is used to perform this analysis. The results will be compared with Barker's systems to attempt to condense the number of genotypes.

A. Cluster Analysis

The literature on cluster analysis is still quite new (Aldenderfer and Blashfield, 1984; Everitt, 1984; Lorr, 1983). During the past three decades, there have been a tremendous expansion in the development of definition and methodology related to clustering following the seminal publication on numerical taxonomy by Sokal and Sneath (1963). The literature is scattered topically over several scientific disciplines, notably biology, economics, political science, medicine and the social and behavioral sciences.

Basically, the definition of clustering in our study is grouping entities (or behavior settings here) into subsets or homogeneous subgroups based on their similarity across a set of attributes (or variables). The latter are Barker's ratings on BM and AP. By using 5 BM and 11 AP as objective criteria, the hierarchical clustering algorithm will search for relatively homogeneous subgroups of behavior settings such that behavior settings within each cluster will be more similar to each other across the 16 variables than to individuals outside the cluster.

Our cluster analysis begins by estimating a data matrix. Using the five authority system data ratings by Barker, we assembled a two-way data matrix table of each system. The rows represent behavior settings (i.e., entities) and the columns represent the attributes or variables of 5 behavior mechanisms and 11 action patterns. Each cell represents the sensitivity of the variable in the behavior settings rated by Barker from 0 to 9. Our interest is to find out which behavior settings are similar and dissimilar to each other.

The second step is to standardize the raw data matrix. Since the variables we chose may arbitrarily affect the similarities among the behavior settings, standardizing the variables (attributes) to zero mean and unit variance removes these effects. On the other hand, standardizing makes variables (attributes) more equal to the similarities among behavior settings. The standardizing function we used is:

$$Z_{ij} = \frac{X_{ij} - \bar{X}_i}{S_i}$$

Where

$$\bar{X}_i = \frac{\sum_{j=1}^{t} X_{ij}}{t}$$

and

$$S_i = \left(\frac{\sum_{j=1}^{t} (X_{ij} - \bar{X}_i)^2}{t-1} \right)^{1/2}$$

The above function says that the standardized value Z_{ij}, for any jth variable and ith behavior setting, can be calculated by taking the corresponding value, X_{ij}, in data matrix, subtracting from the mean, $\bar{X}_i$, of the values of the jth variable, and dividing the result by the standard deviation, S_i, of the values of the ith behavior setting.

The next step is to form the correlation matrix and use it to assess the relation between any two behavior settings. It should be noted that the degree of similarity among behavior settings will be computed using one of several statistical coefficients. Correlation coefficients and Euclidean distance are popular indices found in most kinds of research such as social, behavioral and economical sciences, and are indices that emphasize different aspects of profile similarity (Edelbrook, 1979; Skinner and Blashfield, 1982; Skinner, 1978). In this study, methods using Raw data, Correlation coefficients and Euclidean distance as a measure of similarity will be performed respectively in the private enterprise system and then compared. The Euclidean distance and raw data are the measures of choice utilized in the other four authority systems. It should be emphasized that the

Euclidean distance measure of similarity was chosen as opposed to the Correlation coefficient in this study. One reason is that the Euclidean distance measure is sensitive to those aspects of cluster profiles that are of interest to this study. That is, the profile aspects of height and aspects of scatter between the variables that distinguish one cluster uniquely, as well as significantly from another cluster. The Correlation coefficient as a measure of similarity considers clusters to be similar if their profiles are similar, ignoring aspects of height and scatter, even when those aspects are disparate across the resulting cluster profiles that are obviously unique and otherwise dissimilar. The Euclidean distance between two behavior settings with respect to all 16 measurement variables may be written in vector notation as:

$$d^2(X_i, X_j) = (X_i - X_j)'(X_i - X_j)$$

Where $d(X_i, X_j)$ is the Euclidean distance between settings X_i and X_J, which are row vectors each with 16 columns listing the 11 AP and 5 BM measurements on the ith and jth settings, respectively. The product of the different row vector $(X_i - X_j)'$ by its transpose is a scalar.

The Pearson Correlation coefficient r_{jk} (also called correlation coefficient Q) is defined on the range $-1.0 \leq r_{jk} \leq 1.0$. The value $r_{jk}=1.0$ indicates maximum similarity and the value $r_{jk}=-1.0$ indicates maximum dissimilarity. The formula of correlation between any two behavior settings in the data matrix may be defined as:

$$r_{ih} = \frac{\Sigma\ (X_{ij} - \bar{X}_i)(X_{hj}-\bar{X}_h)}{\sqrt{\Sigma(X_{ij}-\bar{X}_i)^2}\ \sqrt{\Sigma(X_{hj}-\bar{X}_h)^2}} = \frac{S_{ih}}{S_i\ S_h}$$

Where $\bar{X}_i$ and $\bar{X}_h$ are the behavior setting means and the denominator represents score dispersion in a profile. S_{ih} is the covariance between the behavior settings that express the profiles of i and h. S_i and S_h are the respective standard deviations.

The final step is to choose a clustering method and use it to transform the resemblance matrix into a tree, which can be easily seen the similarities and dissimilarities between all pairs of objects (behavior settings). A wide variety of clustering methods are available and different methods are likely to produce different results when applied to the same data. Also, the relative merits and demerits among the clustering techniques are hard to judge. Essentially the cluster analysis techniques can be classified into five types, i.e., hierarchical, optimization, density or mode-seeking, clumping and others (see Cormack, 1971; Everitt, 1984). Hierarchical clustering methods are the most popular ones among these techniques since their results can be easily seen. A hierarchical scheme can be defined as a nested family of clusters that can be represented as a tree beginning at the top branches and merging successively until the trunk is reached (Lorr, 1983, p. 195). The most frequently used techniques of Hierarchical clustering in practice are the methods of single linkage, complete linkage, average linkage, centroid, median, and minimum variance (Ward's). Among them the average linkage and Ward's methods have the better reputation due to their greater accuracy. The general formula of average method between two clusters is

$$D_{jm} = (N_k D_{jk} + N_l D_{jl}) / N_m$$

Where D_{jm} is the average distance between pairs of observations, one in each cluster. N_i is the number of observations in cluster i (i=j, m, k, l ...). The formula of Ward's method between two clusters is defined as

$$D_{jm} = ((N_j + N_k)D_{jk} + (N_j + N_l)D_{jl} - N_j D_{kl}) / (N_j + N_m)$$

The distance between two clusters in Ward's method is the ANOVA sum of squares added up over all the variables. The definition of the variables is the same as for the average formula.

In this study, average linkage and Ward's methods are utilized and compared in the private enterprise system and the average clustering method is used in other systems.

B. Principal Components Analysis

Principal component analysis (PCA) is a multivariate technique for examining relationships among several quantitative variables such as our 5 BM and 11 AP. The main function of PCA is to summarize data and to reduce the number of variables in clustering. The principal components are linear combinations of observed variables such that each is orthogonal to every other one and each accounts for the maximum amount of variance in the matrix. Principal component analysis is one of the most popular methods of ordination, that is, the procedures that permit the mapping of n entities or behavior settings in a low-dimensional attribute or variable space. The points can then be visually inspected to identify clusters. PCA mainly emphasizes the correlation between two variables.

The PCA is performed on the total community system (i.e., the 884 behavior settings with 16 variables) and each

5 authority systems prior to the clustering analysis to interpret the relationships among variables. Since we have 16 variables in the study, the results of the correlation matrix or simple PCA cannot derive a complete and clear understanding of the relationships among the variables. Therefore, factor analysis is used here to summarize most of the original information (variance) in a minimum number of factors for prediction. On the other hand, through the application of factor analytic techniques it is frequently possible to reduce the correlation matrix to a smaller set of relationships in the factor matrix. The process of principal component analysis can be illustrated by the following steps. First, the Pearson's correlation matrix is computed, then the unrotated factor is transferred for the use in next step. Finally, we use the Varimax rotation to provide a meaningful solution.

Following the principal components analysis, the mean score and standard deviation for the total community and five subsystems are calculated and tabulated. By comparison, one can see which variables are related to each other within the system and which variable is more sensitive to the system than the other.

For the analysis of the total system, Fox pointed out that Barker found 198 genotypes in Midwest in 1963-64, Schoggen conjectured that there might be around 400 genotypes in the largest cities, and Fox's own conjecture is that there are no more than 300 in nonmetropolitan commuting fields within central cities of less than 50,000 people (Fox, 1989). Prescott also suggested that it seems likely that Barker's genotypes could be grouped into about 40-60 prototypes which would differentiate internal processes essential to maintaining all social activities (Prescott, 1991). Combining all these ideas, 50 groups (prototypes) are clustered from the 884 behavior settings by using average method of clustering in this study. The result would be discussed in detail in the next chapter.

IV. EMPIRICAL RESULTS

Prior to the clustering, the principal components analysis was performed on the total system and each of the five subsystems on the 16X16 matrix of scale intercorrelations. The intent was to establish the necessary component structure and scores to see the relationship among the variables in a given system.

Through the cluster analysis method, we have the new groups of five authority systems and the total system which are somewhat different from Barker's system. This chapter is mainly concerned with comparing these two systems.

Using BM and AP as the basic criteria, the empirical results of the total and five subgroups are tabulated. The items of the table are genotype, total settings in the genotype, number of the basic group, the number of behavior setting (BS) in the basic group, new group, number of settings in new group from the genotype, and alien group and its settings (number of misclassified BS). The rules for tabulating settings are as follows:

(1) Basic group. If the new group comprises all or some settings of Barker's one genotype only, then we call the group the basic group. For easy comparison in some tables, the basic group may be divided into same group and base group. The former is defined where the behavior settings in

the new group are exactly the same settings as that in one genotype, while the latter is defined as some settings of one genotype.

(2) New group. This group includes more than one genotype and their whole settings.

(3) Alien group. The alien group is defined as a group consisting of some misclassified settings and it is not the basic group. Thus, if settings in the genotype do not belong to the basic group we count it as a setting in the alien group.

(4) Number of misclassifications (settings in alien group). In general, all of Barker's behavior settings that do not belong to the basic and new group fall into this category.

The following example may clarify our classification scheme depending on these rules.

Suppose we have Barker groups:

Genotype	I	II	III
Settings	1,2,3	4,5,6,7	8,9,10,11,12

If clustering results are exactly the same as genotypes I, II, III, then they are basic and the same.

Now suppose we have:

I	II	III
4,5,6	1,2,3,7	8,9,10,11,12

Then III is basic-same, I is basic-base and II is alien with the number of misclassifications equal to 1 (i.e., setting 7).

Now suppose we have:

I	II
1,2,3,4,5,6,7	8,9,10,11,12

or

III	IV	V
1,2,3,4	5,6,7	8,9,10,11,12

Then I or III is new group, II or V is basic-same and IV is basic-base. If all settings 1-12 are in one group then it is another new group. The new group mean all settings of over 1 genotype.

Suppose we have:

I	II	III	IV
1,2,3	4,5	6,7	8,9,10,11,12

Then I and IV are basic-same. The II and III are both basic-base. Here we note that there is no unique base group for Barker's genotype II.

Now finally we suppose:

I	II
1,2,4,5,6,7	3,8,9,10,11,12

Then both I and II are simply alien groups.

Based on these rules, the comparison would be made after accounting for the number and percentage of each group and its settings in the total system and each subsystem.

A. The Total Community System

The total system of 884 behavior settings was analyzed using a Varimax, or orthogonal, rotation of component loadings. Through the SAS procedure, the correlation matrix (intercorrelations among the 16 variables) was obtained and transformed to a factor matrix (unrotated). Then the Varimax rotated component analysis factor matrix is shown in Table 1. The results show that there are five large eigenvalues, 3.53, 2.80, 1.69, 1.35, and 1.22 in the principal component matrix, which together account for 66% of the standardized variance. Thus the first five principal components provide a good summary of the data. The factor analysis retains five components on the basis of eigenvalues greater than one rule since the sixth eigenvalue is 0.91. The sums of squared factor loadings (eigenvalue) are shown in each of the columns, these eigenvalues for factors one, two, three, four, and five are 2.83, 2.58, 1.97, 1.73, and 1.47, respectively. These values indicate the relative importance of each factor in accounting for the variance associated with the variables being analyzed. Thus, factor one is most important since it accounted the most variance and so on. The total sum of squares is 10.59 which represents the total amount of variance extracted by the factor solution.

The size of the communality is also an useful index for assessing how much variance in a specific variable is accounted for by the factor solution. Large communalities mean that a large amount of the variance in a variable has been extracted by the factor solution. Small communalities indicate that a substantial portion of the variance in a variable is unaccounted for by the factors. In this case, the communality ranges from 0.48 for nutrition to 0.82 for gross motor activity. The percentage of trace for each of the five are 18%, 16%, 12%, 11%, and 9%, respectively. They are obtained by dividing each factor's sum of squares by the trace for the set of variables being analyzed (The trace for our variable set is 16 which is the number of variables). The total percent of trace can be used as an index to determine how well a particular factor solution accounts for what all the variables together represent. If the variables are all very different from each other this index will be low. The index for this solution shows that 66 percent of the total variance is represented by the information contained in the factor matrix. Therefore the index for the present solution is high and the variables are in fact highly related to each other.

Tables 2 and 3 present the means and standard deviations of the total and five authority systems of behavior settings on 11 AP and 5 BM. Figures 1 and 2 exhibit the total system mean profiles. It can be seen that the mean values of AP physical health has the lowest score, and social contact has the highest score for the whole community. On the other hand, the scores of five variables of BM are quite stable. This may suggest that social contact is more significant than the other variables of AP in the public behavior setting of the total system.

Inspection of the mean values of a given variable across five systems provides an indication of its differentiating value. For example, AP professional and BM gross motor activity, whose means are clearly the highest for the business system, seems to differentiate well this group from the other four. For the AP social contact, the systems of church, school and voluntary association have much higher scores than that of the other two. Figures 3 and 4 depict the whole scenario of five systems on the AP and BM. If we combine all mean values across 16 variables, the situation may allow us to know roughly the characteristics for each system. However, the standard deviations on the various systems of the variable under examination have to be taken into consideration for a more precise evaluation of its differentiating power and stability of the variable in a specific system.

B. Private Enterprise System

The private enterprise system includes 132 behavior settings and 70 genotypes out of a total of 884 BS and 198 genotypes. The principal component analysis, comparison of different input data and clustering method used, and comparison between S.I.C. and the private enterprise system are the main concerns of this section.

1. The results of PCA

Using the same procedure as the total system, the 132 behavior settings with 11 AP and 5 BM are analyzed. The correlation matrix and transformed factor matrix (unrotated) were obtained and the Varimax rotated component analysis factor matrix is shown in Table 4. The results show that the eigenvalues indicate that six or seven components provide a good summary of the data. Six can account for 72% of the standardized variance and seven components explain 78% of the variation. The factor analysis retains six components on the basis of eigenvalues greater than one rule. Table 4 shows that the variances explained by each factor are 2.70, 2.14, 2.07, 1.82, 1.47, and 1.36, respectively, and the percentage of trace for each of six are 17%, 13%, 13%, 11%, 9%, and 9%, respectively. The total percent of trace (72%) indicates that the variables in the system are highly related to each other in general. The total communality estimates show that all the variables are well accounted for by six factors, with final communality estimates ranging from 0.54 for personal appearance to 0.84 for thinking.

To examine the rotated factor solution in more detail, we use all loadings ± 50 or above as our cutoff point for this solution and find that five variables, that is, BM thinking, talking, and AP business, government, social contact, loaded significantly on the first factor. All these five variables are positively related to each other and BM thinking gets the highest loading of 0.81. Thus, factor one may be interpreted as job doing and public relations among the settings. Factor two has two variables, AP aesthetics and education, both with positive significant loading of 0.87. From this scoring procedure and the signs of the variable loadings, this factor can be described as the setting with high education exhibiting aesthetics as well. The same situation is explained in factors 4, 5, and 6. That is, recreation is highly related to nutrition, physical health is highly related to affective behavior, and religion is highly related to professionalism. For the factor three, gross motor activity is highly positively related to manipulation and highly negatively related to personal appearance.

2. Results from clustering analysis

In Chapter 3, it was stated that the different input data matrix would produce different clustering results. We also indicated that using different clustering methods will give different results even when using the same input data.

To choose one suitable input data matrix and clustering method from the various quantitative taxonomic methods, we performed the following analyses. First, we use three processed data matrices (i.e., standardized Raw data set, Euclidean distance, and Correlation coefficient) from the original 132 behavior settings and 70 genotypes and two cluster methods (i.e., average linkage and Ward's method) to form 70 new groups for the private enterprise system. Then the comparisons were tabulated. Table 5 exhibits the results we calculated. The average method using Euclidean distance seems like the best one for the present study since it is closest to the original genotype. In the table, the item of same group means how many new groups are exactly the same as the original genotype. The item of included settings indicates how many behavior settings are involved in these new groups. So, from the Section 1, the results state that the average method by using Euclidean distance as input set gets the highest 40 same groups out of 70 which reaches 57% of the total genotypes, and these same groups included 63 behavior settings out of 132 which reaches 48% of the total. The average method by using Correlation coefficient as input obtained the lowest 28 same groups out of 70 which reached 40% of the total genotypes, and these groups included 35 behavior settings out of 132 and it reached only 27% of the total. Clearly, the average method of clustering by using Correlation coefficient as the input set is not the best method from the point view of Section 1.

Section 2 of the table shows the results of the base group and its included setting by using a different data matrix and cluster method. The included settings in this section are defined as the number of behavior settings that belong to these base groups. We note here also that each base group in this table is formed from some (not all) behavior settings of one genotype, which is different from the rule of the basic group made at the beginning of the chapter which in fact included both same group and base group in the table. By checking this kind of new group, we find that average method by using Correlation coefficient attains the highest group number and included setting. In contrast, the average method using Euclidean distance has the lowest which has 18 groups out of remaining 30 genotypes and included 25 behavior settings out of the remaining 69 BS. They obtained 26% and 19% of the total, respectively.

For section 3, the new group is defined as the group which combined more than one entire genotype. The average method using Correlation coefficient shows its competitiveness since it got the highest of 8 new groups. On the other hand, the average method using Euclidean distance still is the lowest. Combining all these three sections we get the total group of section 4.

The results state that the average method using Euclidean distance has the highest number of total groups (i.e., adding same group, base group and new group together) which gets 63 groups out of 70 or 90% of the total. The average method using standardized raw data has the highest included behavior settings with 108 out of 132 obtaining 82% of the total. By viewing the table and considering the whole four sections, we conclude that Ward's method using Euclidean distance is inferior to the other three methods. We also note that the results between the average method by using the raw data set and using Euclidean distance are very close to each other. That is why we consider using the raw data set instead of Euclidean distance in the total community system when the computer capacity is limited by using Euclidean distance in the large sample. By comparing the remaining three, the average method using Euclidean distance as input might be thought of as closest to the original genotype especially considering section 1. Thus, the average method using Euclidean distance would be used for the analysis of all the authority systems.

By using the suggested method and raw input data matrix, a more detailed analysis is possible. Table 6 shows that the basic group, which included both same and base group, obtained 58 original genotypes out of a total of 70 with 88 BS out of 132 in the system, and included 83% and 67% of the total genotype and BS, respectively. This result shows us the extent of the similarity between the original genotype and new clustering group. It suggests that the clustering groups may represent the original one if 11 AP and 5 BM are rated carefully. The more interesting results might be on the new group and alien group, since these two groups reflect differences among the two different criteria, i.e., Barker's genotype (or zone 5/6) criteria and our AP and BM criteria. But the question is which grouping is more reasonable to the system? To do this, we listed three tables of actual ratings of 11 AP and 5 BM on the each setting of new, alien groups, and genotypes (Table 7 to Table 9).

First let us check the reasoning of the four new groups in Table 7. Group 1 was formed by genotypes 11, 97, 153 and included a total of 6 settings. The table shows that 7 out of 11 ratings of AP are exactly the same in these six settings. The ratings of the rest of 5 AP and 5 BM are close enough to each other. Thus, this result strongly shows the similarity among the settings according to AP and BM criteria. However, from the viewpoint of Barker's genotype criteria, they should not be the same group (genotype) if their zone 5/6 cannot exchange among the settings.

For instance, genotype 11 is named as "Auditing and investigating company offices" with a setting of "Bonded audit service business office". Genotype 97 is named as "Insurance offices and sales routes" with settings of "Deed farm bureau insurance office" and "Hardy insurance office". Genotype 153 is named as "Real estate agents offices" with settings of "Haines real estate office", "Royce real estate" and "Town real estate". The zone 6 of setting in genotype 11 defined by Barker as a proprietor who consults with investigative staff in office and by phone, consults with clients via telephone, and manages the office. The zone 6 of settings in genotype 97 is defined as insurance agent who manages, sells insurance, records claims and arranges for the claim adjuster. The same zone of settings in genotype 153 is defined as licensed real estate broker who lists farms and homes for sale, shows property to customers and closes sale. The total settings in these genotype of new group 1 have no zone 5. Clearly, the zone 6 among the settings are not interchangeable each other. Therefore they cannot be the same group by Barker's criteria.

For the new group 2, which included genotype 16 and 19, we found even higher similarity among the settings compared to new group 1. Nine of 11 AP and one of 5 BM rating are the same among the three settings. The rest of the ratings of them are also highly similar. Thus, there is another strong result of a new group depending on AP and BM criteria. But the conclusion may differ by using Barker's genotype criteria. Genotype 16 is named as "Barbershops" with settings of "Keith barbershop" and "Riffle barber shop", while genotype 19 is named as "Beauty shops" with a setting of "Burgess beauty shop". The zone 6 of settings in genotype 16 is defined as Barber who cuts hair, sells products for grooming and manages shop. The zone 6 of setting in genotype 19 is defined as operator-manager who cuts, washes, sets styles color, combs hair of customer and carries out management routines. As with as new group 1, all three settings have no zone 5. It can be seen that zone 6 in genotype 16 cannot exchange with that of genotype 19 though some functions of zone 6 are the same. Therefore, they cannot be in the same group. The same situation may exist in the remaining 2 new groups.

A similar analysis can also be applied in the alien group. Table 8 lists the actual ratings on 11 AP and 5 BM of the settings in 5 alien groups. Alien group 1 included genotypes 14, 48, 83 and 162. From the table, the rating of AP and BM on each setting are very similar. Thus it indicates that the formation of the alien group would be quite reasonable according to AP and BM criteria. On the other hand, we can see the difference with regards to the zone 5/6 interchangeability. Genotype 14 is named as "Bakery services" with the setting of "Mrs. Lyon home bakery", and Genotype 48 is named as "Delivery and Collection routes" with one setting of "Manor bakery route". Genotype 83 is named as "Grocery stores" with the setting of "Thomas fruit market", and Genotype 162 is named as "Restaurants and Organization dinners" for the public with the setting of "Highway lunchroom".

The zone 6 of a setting in genotype 14 is defined as Baker who prepares and bakes food on order and accepts pay. The zone 6 of setting in genotype 48 is defined as Deliverers who take papers, etc., to homes and leave them, and come at regular intervals to collect for goods and service. The same zone in genotype 83 is defined as manager who manages business, prices goods, prepares advertising and takes inventories. Finally, the zone in genotype 162 is defined as cafe proprietor or proprietors (zone 5) who plan, order food, establish prices and may aid in cooking and serving food. Therefore, these zone 5/6 leaders cannot be exchanged among the settings in the alien group. The same situations are also occurring in other alien groups.

To see more clearly the difference between these two criteria and between alien group and genotypes, some settings related to both genotypes and alien groups were chosen in Table 9. It would be useful to compare the ratings in Table 8. One example would be the alien group 7 compared to genotypes 104 and 180.

Alien group 7 consisted of genotype 104 with setting 2 and genotype 180 with setting 1. Genotype 104 is named as "Knitting classes and services" which included setting 1 of "Knitting class, Mrs. Layman" and setting 2 of "Layman Knitting service". Genotype 180 is named as "Sewing service" with setting 1 of "Betson sewing service" and setting 2 of "Dewdney sewing and baking service". Clearly, the settings of Layman knitting service and Betson sewing service are very similar in rating on AP and BM so they formed as alien group 7.

The settings 1 and 2 in genotypes 104 and 180 are not close in ratings to each other but they are grouped as genotypes according to zone 5/6 criteria. Another example is the comparison between alien groups of 1, 2, 3, 4 and genotypes of 48, 83, 92, and 162. In general, these settings in alien groups have the same common features. That is, the rating on settings in one alien group are very close just like we found in Table 8. By checking Table 9, we find that the settings in one genotype are not necessarily similar in rating. For genotype 48, the rating on the settings of 1, 4, 6 are similar but different with other settings. Therefore genotype 48 is divided into 4 new groups by the clustering. The genotypes 83, 92, and 162 also indicate the same phenomenon. The example of setting 1 and 3 in genotype 83 are close but very different with setting 2, so settings 1 and 3 formed one basic-base and setting 2 belong to alien group 1.

By comparing these two criteria, we can only list the differences between them, but cannot say one criteria is necessarily superior to the other. The clustering results only show that the basic groups have met both criteria, and that the new and alien groups supplied some possibilities of condensing and regrouping Barker's raw data by combining the two criteria. We will discuss these possibilities and offer some suggestions in the next chapter.

3. Private enterprises and S.I.C.

The Standard Industrial Classification (S.I.C.) is the major tool for promoting the comparability of statistics describing various aspects of the economy in this country. It defines industries according to the composition and structure of the economy, and includes the entire field of economic activities. SIC is designed for use in the classification of establishments by type of activity in which they are involved. On the other hand, SIC is used not only to show how industries comprise the economy, but also indicates the emerging and rapidly growing industries. Barker's genotypes of private enterprise system also reflects the structure of the industry but depends on the changeability of major components among settings. Thus, there exists some linkage between these two systems.

The basic unit of the SIC is the establishment. The establishment is an economic unit, generally at a single physical location where business is conducted or where services or industrial operations are performed. This definition is quite similar to that of behavior settings for enterprises.

By comparing Barker's system to the 1972 SIC manual, we find that three or four digit codes are very close to the Barker's genotype, and most behavior setting genotypes are identical to the four digit SIC code. For the remaining genotypes, several situations could occur. First, a few genotypes are not in conformity with the SIC code such as genotype 51 of dinners with business meetings and genotype 167 of sales promotion parties. Table 10 lists these genotype settings with unclassified SIC codes. If there exists a linkage between the two systems, we may treat it as

SIC code 9999 (unclassified). This phenomenon also gives us an impression that the Barker's genotype concepts are broader and more detailed than that of the present SIC.

Second, some behavior settings belonging to one genotype may be listed in different 3 or 4 digit SIC codes. An example is genotype 83 (grocery store) which includes 3 behavior settings (Reids grocery store, Weylens grocery store, and Thomas fruit market). But in the SIC system, the former two settings belong to code 541 or 5411, and the third one belongs to code 543 or 5431. Another situation is that two or three genotypes could belong to one 3 or 4 digit SIC code. The example is that of genotype 98 (ironing services), 108 (laundries, self-service), and 109 (laundry service) which belong in three 4 digit codes (7212, 7215, and 7212, respectively), but belong to one 3 digit code (721). All these examples suggest that we can easily conform Barker's genotypes with the SIC by modifying the genotypes or relaxing the SIC code from 4 to 3 digits.

When considering the comparison between our clustering results to the SIC code, we would find that Barker's genotype formation is much closer to the SIC than our clustering results which depend on 11 AP and 5 BM since most alien and new groups cannot conform to the 3 or 4 digit SIC code. On the other hand, some exceptions are still encouraging. For instance, the new group 3, which includes genotype 34 (cleaner, dry cleaning plants) and genotype 109 (laundry services), have the same three digit SIC code 721. Another case is alien group 7 which is classified in 4 digit code 4999, but it is separated into genotype 104 with setting 2 of "Layman knitting service" and genotype 180 with setting 1 of "Betsons sewing service". Thus, the results of these comparisons indicate that not one of the three systems is perfect, and reconciliation may be advisable. Also to do this, more research on the relationship among these three systems is needed, and Barker's concept of genotype and setting would play a key role in the procedure.

C. Comparison Among the Subsystems

In this section, the results of the principal factor component and clustering for the remaining four subsystems are examined, and then comparisons are made among all five subsystems. Finally, the possibility of condensing 198 genotypes into 50 prototypes is also discussed.

1. The results of the other four subsystems

By using the same procedures, the principal component analysis and clustering are performed and tabulated. For the church system, the results show from the principal components that the eigenvalues indicate that five components provide a good summary of the data, which can account for 66% of the standardized variation. The factor analysis retains five components based on the eigenvalues greater than one rule. Table 11 lists the variances explained by each factor and the percentage of trace for each of the five factors. The total percent of trace (68%) shows that the variables in the church system are highly related to each other. The total communality estimates show that all the variables are well accounted for by five factors, with the final communality estimates ranging from 0.45 for talking to 0.83 for religion. Using all loadings $\pm$ 0.50 or above as our cutoff point for the solution, the first factor shows that five variables, AP nutrition, recreation, religion, and BM gross motor activity, manipulation, and thinking, are loaded significantly. The sign of the variables indicates that gross motor activity is highly positively related to manipulation, nutrition, and recreation, but highly negatively related to religion and thinking. Other factors also show the similar relationship among different variables. All the factors can be interpreted according to remaining variables on each factor.

For the rest of the three systems, Government, School and Voluntary association systems, the rotated factor retains six, five, and five components, respectively. The total percentage of trace for the three systems are 71%, 68%, and 64%, respectively, which indicates that the variables of 11 action patterns and 5 behavior mechanisms in all three systems are highly related to each other. The total communality estimates for all three systems state that all the variables are well accounted for. The more detailed rotated factor solution is listed in Tables 12 to 14.

Clustering analysis is also performed on these four systems. By using the average method and two input data matrices, (raw data and Euclidean distance), we find that Euclidean distance as an input data set is not necessarily the superior one. The detailed summary of the clustering results as tabulated in Tables 15 to 18 indicate a better result for the input data set.

2. The results on the comparison among five subsystems

Performing the average clustering method by using both Euclidean distance and the raw data set on the five subsystems, we tabulate the results in Table 19. The private enterprise system attained the highest number of basic groups by using the Euclidean distance input. It obtained 58 basic groups and included 88 behavior settings out of 132 BS. Thus, it is the closest to Barker's original genotypes. By contrast, the church system got the lowest basic group by using Euclidean distance. It obtained only 16 basic groups out of 31 total genotypes and 36 behavior settings out of 193 total BS in the system.

The percentage of basic group and its included settings best reflects the degree of conformity between Barker's genotypes and the clustering groups criteria. Inspecting the percentage of basic group, the results show that the private enterprise system using Euclidean distance obtained the highest (83%) of the total of 70 genotypes, and voluntary association system using Euclidean distance got the lowest (50%) of the total of 48 genotypes. The second highest percentages are attained by the private enterprise and government systems by using the raw data set. They received the same (77%) of the total genotypes. On the other hand, the percentage of included settings also reflected the similarity between these two systems. While the private enterprise system using Euclidean distance continues to get the highest (67%) of the total settings on the system, the church system using Euclidean distance obtained the lowest percentage. The second highest percentage of the settings was attained by the private enterprise system using the raw data set.

Section 2 of Table 19 lists the results of the degree of dissimilarity of the genotypes and misclassifications of the settings. We note that the church system using Euclidean distance got the highest percentage of both alien group and included settings for 45% and 80%, respectively. The private enterprise system using Euclidean distance got the lowest percentage. The last section shows the number of new groups which includes more than one of Barker's genotypes and its settings. The table shows that all of the five subsystems have not many new groups. The range of the new groups and among the systems are from 7 in private enterprises to only 0 or 1 in church system.

In general, these results show that the clustering result from the private enterprise system by using the average method was closest to the Barker genotypes among the five subsystems. The church system of original genotypes was most dissimilar to the clustering result. The second, third, and fourth best would be the systems of government, school, and voluntary associations, respectively. The question may arise as to why we attain such different results when performed with the same cluster method in the data set of five subsystems. A statistic of interest is the ratio between the genotype and behavior settings (i.e., genotype/setting or G/S ratio). This ratio would be an important index to predict the potential goodness of fit between the two criteria. From the table, we found that the larger the ratio in one system, the larger the percentage of included genotypes and settings in the basic group, and the smaller the percentage of included genotypes and settings in new and alien groups. On the other hand, the smaller G/S ratio means that each genotype in one system has a larger number of settings on average, and vice versa. Since the AP and BM ratings on a few settings are not always similar with others in one genotype, they may form an alien group with other settings. Thus, by performing the cluster method depending on the AP and BM criteria, the system with smaller G/S ratio would have a higher probability to produce more alien groups and less basic groups than the system with larger G/S ratio. The same situation may be true when we begin to condense the Barker's genotypes. This would be clearer in the following section.

3. The possibility of condensing Barker's genotype

Barker divided his 884 behavior settings into 198 genotypes depending on the exchangeability rule (or zone 5/6 program). Adopting the views expressed at the end of section B in Chapter III and suggested by Prescott, 50 prototypes were grouped through clustering according to 11 AP and 5 BM. By using the average method and raw data input matrix for the analysis, the result can be seen in the Table 20. The table shows that if we condense the total 198 genotypes into 50 prototypes, the genotypes in the private enterprise (business) system would be reduced from 70 to 21. The number of genotypes in the church system would be reduced from 31 to only 9 prototypes. The genotypes in government, school, and voluntary association systems would be reorganized from 52, 68, and 48 to 23, 25, and 19 prototypes, respectively.

Although the clustering does condense the number of genotypes, the interpretation of the results is more difficult. For more detail, there are only 10 basic groups retained out of the 50 prototypes, and only 12 behavior settings included out of 884 in the total system. Most of the rest of these groups are alien groups, and settings are highly mixed among the prototypes.

The same situation occurred in the five subsystems. For the private enterprise system, there were 9 basic groups out of 21 with 14 out of 132 behavior settings. The church system has only 3 basic groups with 5 BS's. The government, school, and voluntary association systems have 11, 6, and 9 basic groups of genotypes with 12, 9, and 9 BS's, respectively. The new groups were also few in all the systems. Further, these systems have quite a few alien groups. These results are not a surprising considering that when the total number of genotypes was reduced, the highly mixed genotype settings would certainly form into new groups. If we related the results to the original G/S ratio and the ratio after condensing the total and five subsystems, we would note that all the total and subsystems had a the very low G/S ratio after the total system was reduced from 198 genotypes to 50 prototypes (see Table 20). Therefore noncomforming results between Barker's system and clustering are generated according to our exist criterion scheme.

On the other hand, one promising situation is that one condensed group (prototype) usually including most genotype settings belong to the one subsystem and a few genotype settings of other subsystems. This may mean that there still exist some differences among the subsystems when performing the clustering method to form the prototypes. These situations may allow us to consider another regrouping scheme that will more closely conform to the criteria between the zone 5/6 program and actual rating of 11 AP and 5 BM. These suggestions are made in the next chapter.

V. CONCLUSION AND DISCUSSION

The primary objective of the present study is to compare statistical clustering with the same number of genotypes as Barker distinguished and to condense the original genotypes. In the preceeding chapters, we first considered the relationship among five behavioral mechanisms and eleven action patterns, and then used clustering analysis with these variables. A detailed description and analysis of comparison among the systems, and comparison between Barker's genotype and new clustering prototype are presented. The private enterprise system was compared to the S.I.C. system and Barker's genotype number was reduced. The following conclusions are drawn from this thesis.

First, the results of the principal component factor analysis show that Barker's 11 AP and 5 BM are highly related to each other in all systems. This means that these variables do represent the characteristics of behavior settings in each system. Five and six factors can be chosen for each system and the factor analysis shows the relationship among the variables more clearly than only using component analysis.

Second, the conclusion to this analysis seems to be that Barker's genotype and its "interchangeability of leadership" role are better than the new cluster group only depending on

11 AP and BM. Barker's interchangeability criterion probably distinguishes specialized settings best, i.e., where lawyers cannot be interchanged with barbers, etc. and the AP and BM attributes are closely associated with specialized leadership roles. This conclusion can be illustrated in the clustering results obtained from the private enterprise system. The issue here is why does this nexus get worse as we go from government to schools, to voluntary associations, and to churches by using the same clustering procedure and method. One possible answer might be that there exists a big difference in the G/S ratios among the systems. The smaller ratio usually has potential larger number of new or alien groups. Therefore nonconformity would be larger between the Barker's genotypes and our clustering groups according to the existing accounting scheme. A feasible solution might be generated through modifying our present accounting scheme.

Specifically, suppose we have (link with p. 29):

I	II
1,2,4,5,6,7	3,8,9,10,11,12

We may treat both I and II as basic-base and alien with misclassified setting one (7 and 3) and not simply define them as alien groups. This change would treat most alien groups much closer to the genotypes and the difference would be made smaller. To enhance the relationship between the original genotype and AP and BM, the suggested idea might be that more variables related to genotype settings such as using the number of genotype and system, should be included in the clustering method. It would distinguish one genotype setting to the other. The objective of change is to make clustering groups more in conformity with Barker's genotypes.

Third, the results we attained are that Barker's genotypes and our clustering groups of the private enterprise system are quite comparable with three and four digit SIC codes and remaining differences could be readily reconciled. Especially, Barker's genotype concept is more detailed and broader than that of present SIC code.

In the total system, condensing the genotypes is possible in theory for the similarity among the settings and genotypes. In practice, we may change the existing accounting scheme to conform to the Barker's systems and new clustering systems. The interesting result was that one new cluster group usually collected many more behavior settings from one subsystem than the other. This situation partially indicates that the rating of AP and BM (or characteristics) of one subsystem was distinguished from the other. Therefore, the potential for condensing of the genotypes is possible in practice.

One more conclusion is that there are many different clustering methods and input data matrices and the results would be very different by using different methods and input sets. So, for the future research, the comparison between different clustering methods and input data set in each system might be useful.

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VII. TABLES

Table 1. Varimax rotated factor pattern of total system

	Rotated Factors					Communality
	1	2	3	4	5	
Action pattern:						
Aesthetics	0.02	0.06	-0.09	0.17	0.86	0.78
Business	-0.40	0.27	0.27	-0.50	0.05	0.55
Professional	-0.52	0.33	0.46	0.12	-0.04	0.61
Education	0.01	-0.15	0.12	0.77	0.11	0.64
Government	-0.11	-0.02	0.82	-0.03	-0.15	0.72
Nutrition	0.21	-0.04	-0.17	-0.63	-0.01	0.48
Personal Appearance	0.24	-0.10	-0.05	-0.04	0.66	0.51
Physical Health	0.28	0.46	0.06	0.39	-0.39	0.59
Recreation	0.62	0.41	-0.37	-0.23	0.09	0.75
Religion	0.02	-0.58	-0.35	0.38	0.18	0.64
Social Contact	0.79	-0.25	-0.07	0.14	0.05	0.71
Behavior Mechanism:						
Affective Behavior	0.71	0.34	-0.19	0.02	0.20	0.70
Gross motor activity	0.09	0.86	-0.25	-0.06	-0.10	0.82
Manipulation	-0.05	0.84	-0.01	-0.08	0.09	0.72
Talking	0.83	0.11	0.11	-0.12	0.07	0.73
Thinking	-0.03	-0.15	0.76	0.23	0.01	0.66
Sum of squares (eigenvalues)	2.83	2.58	1.97	1.73	1.47	10.59
Percentage of Trace	0.18	0.16	0.12	0.11	0.09	0.66

Table 2. Means and standard deviations of five authority systems on eleven action patterns

AUTHORITY SYSTEMS	NUM OF SETTING	STATISTIC	ACTION PATTERN										
			AES	BUS	PROF	EDUC	GOVT	NUTR	PERS	PHY	REC	REL	SOC
WHOLE TOWN	884	MEAN	1.82	1.13	2.68	1.67	1.29	1.28	1.67	0.50	2.81	1.38	4.89
		SD	1.98	1.84	2.63	2.35	1.91	1.75	1.27	1.19	2.64	2.54	1.33
BUSINESS	132	MEAN	2.08	4.10	5.86	0.35	1.14	1.23	1.55	0.26	1.65	0.06	3.38
		SD	1.99	2.18	0.89	1.24	1.53	1.99	1.83	1.16	2.09	0.34	1.62
CHURCH	193	MEAN	2.22	0.16	0.88	2.53	0.08	1.05	1.75	0.03	1.97	5.51	5.43
		SD	1.96	0.49	1.49	2.69	0.29	1.63	0.78	0.16	2.15	2.33	0.71
GOVERNMENT	114	MEAN	1.44	0.99	3.25	1.92	4.32	1.19	1.47	0.38	1.87	0.48	1.36
		SD	1.88	1.51	2.56	2.44	2.56	1.79	1.40	0.89	1.87	0.48	1.36
SCHOOL	233	MEAN	1.82	0.53	3.82	2.60	1.55	0.88	1.60	0.91	3.45	0.14	5.07
		SD	2.33	1.30	2.45	2.51	1.35	1.41	1.27	1.60	2.63	0.72	1.25
VOLUNTARY ASSOCIATION	212	MEAN	1.51	0.91	0.77	0.55	0.55	2.00	1.87	0.70	4.50	0.47	5.36
		SD	1.52	1.07	1.38	1.21	1.14	1.82	1.08	1.14	2.53	1.03	0.76

Table 3. Means and standard deviations of five authority systems on five behavior mechanisms

AUTHORITY SYSTEMS	NUM OF SETTING	STATISTIC	BEHAVIOR MECHANISM				
			AFFB	GRMDT	MANIP	TALK	THINK
WHOLE TOWN	884	MEAN	3.64	3.27	3.49	4.34	3.67
		SD	2.17	2.43	2.14	1.56	1.85
BUSINESS	132	MEAN	2.35	4.34	5.27	3.18	3.81
		SD	1.45	2.48	2.39	1.35	2.00
CHURCH	193	MEAN	3.72	1.93	2.22	4.27	3.36
		SD	1.94	1.82	1.60	1.22	1.67
GOVERNMENT	114	MEAN	2.55	2.30	3.04	3.95	4.98
		SD	1.95	2.10	1.90	1.19	1.84
SCHOOL	233	MEAN	4.50	4.09	3.72	4.83	3.66
		SD	2.51	2.54	2.11	1.91	1.91
VOLUNTARY ASSOCIATION	212	MEAN	4.02	3.43	3.51	4.79	3.17
		SD	1.81	2.20	1.67	1.24	1.46

Table 4. Varimax rotated analysis matrix of private enterprise system

	Rotated Factors						Communality
	1	2	3	4	5	6	
Action pattern:							
Aesthetics	-.12	.87	-.06	.01	.03	.10	.78
Business	.65	-.33	.23	.10	-.22	.19	.67
Professional	.22	-.15	.10	-.08	-.36	.67	.66
Education	.02	.87	-.06	.06	-.01	-.07	.77
Government	.74	-.11	-.03	-.01	.07	.27	.64
Nutrition	.01	-.14	-.01	.76	-.05	.15	.63
Personal Appearance	-.09	.19	-.65	-.23	-.02	.15	.54
Physical Health	.04	-.10	.06	-.09	.79	.06	.65
Recreation	.03	.38	-.02	.74	.14	-.31	.80
Religion	-.01	.16	-.04	.06	.33	.76	.72
Social Contact	.56	.17	-.40	.38	.33	-.05	.76
Behavior Mechanism:							
Affective Behavior	.26	.21	-.16	.42	.61	-.01	.68
Gross motor activity	-.13	-.18	.85	-.09	-.01	.16	.81
Manipulation	-.09	.38	.77	-.27	-.06	.03	.81
Talking	.77	.01	-.27	.32	.18	-.15	.79
Thinking	.82	.11	.02	-.34	.22	-.07	.85
Sum of squares (eigenvalues)	2.70	2.14	2.07	1.82	1.47	1.36	11.56
Percentage of Trace	.17	.13	.13	.11	.09	.09	.72

Table 5. Comparison among different data input and cluster methods in private enterprise system*

CLUSTER METHODS	1				2				3				4			
	SAME GROUP		INCLUDED SETTINGS		BASE GROUP		INCLUDED SETTINGS		NEW GROUP		INCLUDED SETTINGS		TOTAL GROUP		INCLUDED SETTINGS	
	NUM	%	NUM	%	NUM	%	NUM	%	NUM	%	NUM	%	NUM	%	NUM	%
AVERAGE METHOD																
INPUT:																
RAW DATA	37	53%	53	40%	17	24%	26	20%	7	10%	29	22%	61	87%	108	82%
EUCLIDEAN DISTANCE	40	57%	63	48%	18	26%	25	19%	5	7%	16	12%	63	90%	104	79%
CORRELATION COEFFICIENT	28	40%	35	27%	24	34%	36	27%	8	11%	32	24%	60	86%	103	78%
WARD'S METHOD																
INPUT:																
EUCLIDEAN DISTANCE	34	49%	54	41%	19	27%	27	21%	6	9%	15	11%	59	84%	96	73%

*Original genotype: 7. Total settings: 132.

Table 6. Summary of clustering in private enterprise system

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
1	1	1	1	1				
2	5	1	1	1				
3	6	1	1	1				
4	9	4	1	4				
5	10	2	1	2				
6	11	1					(1)	1
7	14	1			(1)	1		
8	15	1	1	1				
9	16	2					(2)	2
10	19	1					(2)	1
11	20	1			(2)	1		
12	22	2	2	2				
13	24	6	1	2			(3)	4
14	25	1			(3)	1		
15	30	1	1	1				
16	34	1					(4)	1
17	35	1	1	1				
18	38	1	1	1				
19	47	1	1	1				
20	48	6	2	2	(1)	1		
					(4)	3		
21	49	1	1	1				
22	51	4	1	4				
23	54	1	1	1				
24	62	3	1	3				
25	64	1					(5)	1
26	65	2			(5)	1		
					(6)	1		
27	71	2	1	2				
28	72	1					(3)	1
29	75	1	1	1				
30	77	1	1	1				
31	78	2			(5)	1		
					(6)	1		
32	83	3	1	2	(1)	1		
33	85	2	1	2				
34	92	3	2	2	(3)	1		
35	97	2					(1)	2
36	98	5	1	5				
37	100	1	1	1				

Table 6 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
38	102	2	1	2				
39	104	2	1	1	(7)	1		
40	108	1	1	1				
41	109	1					(4)	1
42	114	2			(6)	2		
43	123	1	1	1				
44	124	3	1	3				
45	127	1	1	1				
46	128	1	1	1				
47	129	1	1	1				
48	131	1	1	1				
49	138	3	1	3				
50	142	2	1	2				
51	145	2			(6)	2		
52	153	3					(1)	3
53	156	2	1	2				
54	162	5	1	3	(1)	1		
					(2)	1		
55	166	7	4	7				
56	167	1	1	1				
57	168	2	2	2				
58	177	4	1	1	(5)	3		
59	180	2	1	1	(7)	1		
60	183	1					(3)	1
61	191	1	1	1				
62	193	1					(5)	1
63	194	1	1	1				
64	196	1	1	1				
65	197	1	1	1				
66	199	1	1	1				
67	200	1			(4)	1		
68	205	1	1	1				
69	208	1	1	1				
70	212	2	1	2				
TOT	70	132	58	88	7	25	5	19

Table 7. Actual rating on the BS of five new groups in private enterprise system

NEW GROUP	GENO.	SETTING	AES	BUS	PROF	EDUC	GOVT	NUTR	PERS	PHY	REC	REL	SOC	AFFB	GRMOT	MANIP	TALK	THINK
1	11	1	1	6	6	0	1	0	1	0	0	0	3	2	1	2	3	6
	97	1	1	6	6	0	2	0	1	0	0	0	3	2	1	3	5	7
		2	0	6	6	0	1	0	1	1	0	0	3	2	1	2	4	6
	153	1	0	7	6	0	2	0	1	0	0	0	3	3	2	2	4	6
		2	0	7	6	0	2	0	1	0	0	0	3	3	3	2	5	6
		3	0	7	6	0	1	0	1	0	0	0	3	3	3	2	4	5
2	16	1	2	3	6	0	2	0	9	0	1	0	5	2	2	3	5	3
		2	2	3	6	0	2	0	9	0	1	0	5	2	2	3	5	3
	19	1	3	3	6	0	3	0	9	0	1	0	5	3	2	5	6	4
3	24	3	2	3	6	0	0	0	0	0	0	0	2	1	7	9	2	4
		4	4	3	6	0	0	0	0	0	0	0	2	1	7	9	2	4
		5	3	3	6	0	1	0	0	0	0	0	2	1	7	9	2	4
		6	3	3	6	0	1	0	0	0	0	0	2	1	8	9	2	4
	72	1	5	3	6	0	0	0	1	0	0	0	2	2	7	9	2	4
	183	1	5	3	6	0	0	0	0	0	0	0	2	2	4	8	2	4
4	34	1	3	3	6	0	1	0	4	0	0	0	2	1	5	6	1	3
	109	1	2	3	6	0	0	0	3	0	1	0	4	1	7	7	2	1
5	64	1	0	5	6	0	1	1	1	0	0	0	2	2	9	9	2	3
	193	1	0	6	6	0	2	0	1	0	0	0	1	1	8	8	2	4

Table 8. Actual rating on the BS of selective five alien groups in private enterprise system

ALIEN GROUP	GENO.	SETTING	AES	BUS	PROF	EDUC	GOVT	NUTR	PERS	PHY	REC	REL	SOC	AFFB	GRMOT	MANIP	TALK	THINK
1	14	1	3	5	6	0	0	6	0	0	1	0	2	2	4	4	2	3
	48	3	0	6	6	0	1	6	1	0	0	0	3	2	5	5	3	3
	83	2	0	6	6	0	1	6	1	0	1	0	3	2	3	3	2	3
	162	7	1	5	6	0	2	6	1	0	3	0	3	2	3	4	3	1
2	20	1	1	3	6	0	2	5	1	0	7	0	6	3	4	5	5	4
	162	2	3	5	6	0	3	7	1	0	5	0	5	3	4	6	4	3
3	25	2	0	4	6	0	2	0	1	0	0	0	3	2	2	1	3	1
	92	3	2	3	6	0	2	1	1	0	2	0	3	3	2	1	3	2
4	48	1	0	1	6	0	0	0	1	0	2	0	1	1	7	6	1	2
		4	0	1	6	0	0	0	1	0	2	0	1	1	7	7	2	3
		6	0	1	6	0	0	0	0	0	2	0	1	1	6	6	2	2
	200	1	0	3	6	0	0	0	0	0	0	0	1	1	5	8	2	1
7	104	2	4	1	6	0	0	0	6	0	0	0	2	1	0	6	1	2
	180	1	4	2	6	0	0	0	6	0	0	0	2	1	2	7	1	3
		2	4	2	6	0	0	4	4	0	0	0	2	1	2	7	1	3

Table 9. Actual rating on the BS of six genotypes in private enterprise systemm private

OBS.	GENO.	SETTING	AES	BUS	PROF	EDUC	GOVT	NUTR	PERS	PHY	REC	REL	SOC	AFFB	GRMOT	MANIP	TALK	THINK
1	48	1	0	1	6	0	0	0	1	0	2	0	1	1	7	6	1	2
		2	0	5	6	0	0	0	0	0	2	0	3	4	5	3	3	2
		3	0	6	6	0	1	6	1	0	0	0	3	2	5	5	3	3
		4	0	1	6	0	0	0	1	0	2	0	1	1	7	7	2	3
		5	0	1	6	0	1	6	0	0	0	0	1	1	7	7	1	2
		6	0	1	6	0	0	0	0	0	2	0	1	1	6	6	2	2
2	83	1	1	6	6	1	2	6	2	1	1	0	3	3	7	8	4	5
		2	0	6	6	0	1	6	1	0	1	0	3	2	3	3	2	3
		3	2	6	6	1	2	6	2	1	1	0	3	3	7	7	3	5
3	92	1	1	3	6	0	0	0	1	0	0	0	1	2	3	3	1	3
		2	1	1	6	0	0	4	0	0	0	0	3	1	3	3	3	1
		3	2	3	6	0	2	1	1	0	2	0	3	3	2	1	3	2
4	162	2	3	5	6	0	3	7	1	0	5	0	5	3	4	6	4	3
		4	2	4	6	0	3	6	1	0	3	0	4	4	3	6	4	4
		7	1	5	6	0	2	6	1	0	3	0	3	2	3	4	3	1
		11	2	4	6	0	3	6	1	0	3	0	4	4	3	6	4	4
		15	4	4	6	0	3	6	2	0	3	0	4	4	3	6	4	4
5	104	1	5	1	6	6	0	1	7	0	2	0	5	2	0	7	5	3
		2	4	1	6	0	0	0	6	0	0	0	2	1	0	6	1	2
	180	1	4	2	6	0	0	0	6	0	0	0	2	1	2	7	1	3
		2	4	2	6	0	0	4	4	0	0	0	2	1	2	7	1	3

Table 10. Unclassified genotype settings in private enterprise system

GENO.	TITLE	SETTING	TITLE
51	Dinners with Business Meetings	10	Independent Grocers Association Distributors Dinner Meeting with Business
		12	Morea Company Cattle Feeders Dinner Meeting with Business
		13	Patrons Mutual Insurance Company Dinner Meeting with business
		17	Tomco seed company Dinner Meeting with Business
104	Knitting Classes and Service	1	Knitting Class, Mrs Layman
124	Music Classes, Instrumenta	1	Anita Kelly Piano Lessons
		4	Ewart Kelley Music Lessons
		7	Odessa Jeffeson Piano Lessons
131	Painting Classes	1	Painting Classes, Mrs.Till
142	Piano Recital	1	Piano Recital, Odessa Jefferson Pupils
		2	Piano Recital, Anita Kelly Pupils
167	Sales Promotion	1	Sales Parties (Stanley, Tuperware, Jewelry)
191	Street Fairs	1	Bread Company Miniature Train Ride

Table 11. Varimax rotated analysis matrix of church system

	Rotated Factors					Communality
	1	2	3	4	5	
Action pattern:						
Aesthetics	.13	.69	-.40	-.06	-.14	.68
Business	-.02	-.16	.66	-.12	-.06	.48
Professional	-.32	.10	.14	-.31	.57	.56
Education	-.29	-.31	-.66	.23	-.07	.67
Government	-.14	.76	.01	-.08	.02	.61
Nutrition	.50	-.02	.59	.32	-.04	.70
Personal Appearance	-.19	.43	.13	.66	-.03	.68
Physical Health	.20	-.08	-.11	.09	.83	.75
Recreation	.77	-.01	.16	.40	-.03	.77
Religion	-.76	.07	-.50	-.01	-.02	.83
Social Contact	.05	-.05	.28	.79	-.03	.71
Behavior Mechanism:						
Affective Behavior	.36	.72	-.12	.17	.13	.71
Gross motor activity	.84	.17	-.08	-.14	.08	.77
Manipulation	.79	.23	-.01	-.19	.07	.72
Talking	.17	.60	.20	.15	-.03	.45
Thinking	-.74	-.05	-.11	-.04	.06	.57
Sum of squares (eigenvalues)	3.76	2.36	1.84	1.62	1.08	10.66
Percentage of Trace	.24	.15	.12	.10	.07	.68

Table 12. Varimax rotated analysis matrix of government system

	Rotated Factors						Communality
	1	2	3	4	5	6	
Action pattern:							
Aesthetics	.79	-.11	.08	.29	.25	-.03	.78
Business	-.01	.45	.04	.05	-.27	-.66	.71
Professional	-.08	.41	-.71	-.23	-.06	-.05	.74
Education	.70	-.04	-.07	-.24	-.21	.33	.71
Government	-.40	.76	-.20	-.05	.03	-.02	.78
Nutrition	.41	-.24	.12	.46	-.30	.11	.56
Personal Appearance	.66	-.14	.15	-.10	.16	.05	.52
Physical Health	.16	.15	.15	.14	-.13	.77	.70
Recreation	.52	-.44	.29	.34	.03	-.05	.67
Religion	.09	.03	-.17	-.05	.82	-.02	.71
Social Contact	.42	-.03	.73	-.20	.02	-.01	.75
Behavior Mechanism:							
Affective Behavior	.12	-.09	.39	.30	.69	.05	.74
Gross motor activity	-.14	-.37	-.11	.76	.20	.13	.80
Manipulation	.03	.05	-.02	.91	.03	-.01	.84
Talking	-.03	.14	.86	-.07	-.07	.09	.77
Thinking	-.07	.88	.08	-.13	.00	-.01	.81
Sum of squares (eigenvalues)	2.40	2.20	2.16	2.12	1.50	1.19	11.57
Percentage of Trace	.15	.14	.13	.13	.09	.07	.71

Table 13. Varimax rotated analysis matrix of school system

	Rotated Factors 1	2	3	4	5	Communality
Action pattern:						
Aesthetics	-.07	.77	.06	-.01	.27	.68
Business	-.09	-.09	.06	.81	-.16	.71
Professional	-.51	-.32	.04	-.50	.37	.76
Education	-.31	.00	.52	-.38	.55	.82
Government	-.31	-.17	.63	.04	-.07	.53
Nutrition	.03	-.08	-.17	.78	.18	.68
Personal Appearance	.25	.74	-.08	-.03	-.13	.63
Physical Health	.31	-.46	.21	-.25	.36	.55
Recreation	.79	.08	-.41	-.00	-.00	.80
Religion	-.04	.61	-.03	-.11	.01	.39
Social Contact	.37	.13	-.23	.09	.75	.78
Behavior Mechanism:						
Affective Behavior	.87	.19	-.24	-.02	-.02	.85
Gross motor activity	.76	-.34	-.23	-.04	.12	.76
Manipulation	.75	-.22	.35	-.10	.03	.74
Talking	.74	.12	-.14	.12	.21	.64
Thinking	-.06	.06	.83	-.10	-.03	.71
Sum of squares (eigenvalues)	3.85	2.11	1.93	1.79	1.35	11.02
Percentage of Trace	.24	.13	.12	.11	.08	.68

Table 14. Varimax rotated analysis matrix of voluntary association system

	Rotated Factors					Communality
	1	2	3	4	5	
Action pattern:						
Aesthetics	.02	.64	-.07	.23	-.21	.51
Business	.04	-.22	-.00	.11	-.54	.36
Professional	-.18	-.18	.76	.10	-.28	.73
Education	.14	.15	.58	-.16	.28	.48
Government	-.38	-.02	.71	.03	.12	.66
Nutrition	-.27	.16	-.40	.18	-.49	.53
Personal Appearance	.05	.79	.10	.12	.10	.67
Physical Health	.67	-.17	.20	-.20	.20	.60
Recreation	.68	.18	-.31	.29	-.30	.76
Religion	-.17	.76	-.12	-.06	.14	.65
Social Contact	.11	.32	.04	.65	-.08	.55
Behavior Mechanism:						
Affective Behavior	.71	.24	-.04	.39	-.09	.72
Gross motor activity	.88	-.04	-.12	.04	-.03	.80
Manipulation	.71	-.23	-.20	.31	-.08	.70
Talking	.20	-.01	-.07	.85	.04	.78
Thinking	-.28	-.24	.02	.36	.73	.80
Sum of squares (eigenvalues)	3.13	2.08	1.81	1.81	1.46	10.30
Percentage of Trace	.20	.13	.11	.11	.09	.64

Table 15. Summary of clustering in church system

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
1	44	3	1	3				
2	47	3			(5)	3		
3	50	4	1	1	(9)	1		
					(11)	2		
4	51	1	1	1				
5	53	1			(11)	1		
6	55	1			(7)	1		
7	63	3			(5)	1		
					(8)	2		
8	76	3			(1)	3		
9	82	2			(4)	2		
10	86	1			(5)	1		
11	93	1			(11)	1		
12	117	27	1	1	(3)	5		
					(6)	1		
					(4)	18		
					(10)	2		
13	119	1			(10)	1		
14	125	6	1	6				
15	135	4	1	1	(5)	1		
					(8)	2		
16	137	1			(10)	1		
17	143	3			(5)	1		
					(11)	2		
18	144	8	2	6	(2)	1		
					(6)	1		
19	148	2			(6)	2		
20	157	42	2	14	(2)	1		
					(7)	3		
					(3)	24		
21	158	25	1	3	(2)	6		
					(3)	7		
					(4)	2		
					(7)	6		
					(12)	1		
22	159	10			(2)	10		
23	160	6	2	4	(1)	1		
					(4)	1		
24	161	23	2	2	(1)	7		
					(6)	11		
					(8)	2		

Table 15 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
					(12)	1		
25	162	4	1	1	(9)	3		
26	164	1			(5)	1		
27	179	1			(8)	1		
28	186	2	1	1	(4)	1		
29	187	1	1	1				
30	192	1			(5)	1		
31	215	2	1	2				
TOT	31	193	19	47	12	146		

Table 16. Summary of clustering in government system

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
1	2	1	1	1				
2	4	2			(1)	2		
3	7	4			(1)	4		
4	28	1	1	1				
5	32	1			(2)	1		
6	36	1			(3)	1		
7	39	3	1	3				
8	40	1					(1)	1
9	41	1					(1)	1
10	51	1	1	1				
11	55	2	1	1	(4)	1		
12	56	2					(2)	2
13	57	1	1	1				
14	63	1	1	1				
15	67	1	1	1				
16	68	2	1	2				
17	70	2	2	2				
18	73	1	1	1				
19	81	9			(2)	5		
					(5)	2		
					(6)	2		
20	84	2	1	2				
21	88	2			(1)	1		
					(4)	1		
22	89	2	2	2				
23	93	1					(3)	1
24	99	1					(2)	1
25	101	2					(1)	2
26	105	1			(7)	1		
27	106	1	1	1				
28	110	2	2	2				
29	115	3	1	2			(2)	1
30	117	26	3	9	(2)	1		
					(3)	1		
					(7)	5		
31	118	5	1	5				
32	119	5	2	2	(6)	1		
					(7)	1		
					(8)	1		
33	122	1	1	1				
34	134	1					(4)	1

Table 16 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
35	144	2	1	1	(8)	1		
36	146	1			(5)	1		
37	147	2	2	2				
38	151	1	1	1				
39	166	1					(3)	1
40	178	3	2	3				
41	181	1			(6)	1		
42	185	1			(2)	1		
43	186	1	1	1				
44	189	1	1	1				
45	192	1					(4)	1
46	203	1	1	1				
47	213	1	1	1				
48	214	1	1	1				
49	216	1	1	1				
50	217	1			(2)	1		
51	218	1	1	1	.			
52	220	1	1	1				
TOT	52	114	40	66	8	36	4	12

Table 17. Summary of clustering in school system

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
1	8	2			(10)	2		
2	12	2	1	2				
3	13	1			(14)	1		
4	17	1			(1)	1		
5	18	13			(1)	10		
					(12)	3		
6	25	1			(10)	1		
7	33	15			(6)	11		
					(13)	3		
					(18)	1		
8	37	1			(3)	1		
9	46	3					(2)	3
10	49	1	1	1				
11	52	1	1	1				
12	56	2			(5)	2		
13	58	13			(3)	12		
					(8)	1		
14	59	2			(3)	1		
					(16)	1		
15	61	5	1	5				
16	63	10			(4)	1		
					(6)	6		
					(13)	2		
					(15)	1		
17	67	1			(11)	1		
18	69	2	2	2				
19	73	4					(1)	4
20	74	5			(1)	4		
					(12)	1		
21	82	2			(11)	2		
22	84	2	1	2				
23	88	3	2	2	(6)	1		
24	96	2	1	1	(21)	1		
25	107	2			(3)	1		
					(6)	1		
26	110	1	1	1				
27	111	2	1	2				
28	115	1	1	1				
29	116	1			(3)	1		
30	117	15	3	8	(5)	2		
					(6)	1		

Table 17 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
					(16)	1		
					(17)	1		
					(21)	2		
31	118	2			(14)	1		
					(20)	1		
32	122	1			(8)	1		
33	124	4	1	4				
34	125	4			(9)	4		
35	126	2			(11)	1		
					(18)	1		
36	130	1	1	1				
37	132	4	2	3			(2)	1
38	133	1			(12)	1		
39	134	2	1	2				
40	135	11	1	1	(4)	9		
					(6)	1		
41	138	2			(6)	1		
					(12)	1		
42	139	2	1	1	(3)	1		
43	140	11	1	11				
44	143	1					(3)	1
45	144	16	4	4	(5)	1		
					(7)	5		
					(9)	1		
					(14)	1		
					(16)	1		
					(17)	2		
					(19)	1		
46	147	3	1	1	(6)	1		
					(22)	1		
47	148	4			(7)	2		
					(19)	1		
					(22)	1		
48	149	1	1	1				
49	150	1			(5)	1		
50	151	1			(7)	1		
51	161	1	1	1				
52	162	3	2	3				
53	164	1					(3)	1
54	168	5	1	3			(1)	2
55	169	1	1	1				
56	170	3	1	1	(5)	2		

Table 17 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
57	172	3			(2)	1		
					(10)	1		
					(20)	1		
58	173	2			(10)	1		
					(20)	1		
59	174	5	3	3	(15)	2		
60	184	2			(3)	2		
61	186	1	1	1				
62	188	2			(8)	2		
63	190	1			(12)	1		
64	195	2			(2)	2		
65	201	7	1	1	(1)	6		
66	210	1			(13)	1		
67	211	2			(1)	2		
68	219	1	1	1				
TOT	68	233	42	72	22	149	3	12

Table 18. Summary of clustering in voluntary association system

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
1	13	2			(1)	1		
					(17)	1		
2	17	15			(1)	1		
					(3)	14		
3	18	1			(3)	1		
4	22	23			(1)	23		
5	26	8			(2)	8		
6	27	1	1	1				
7	29	1			(18)	1		
8	44	1			(20)	1		
9	46	1	1	1				
10	47	1	1	1				
11	50	9	2	4	(2)	3		
					(7)	1		
					(15)	1		
12	51	11			(2)	2		
					(6)	1		
					(7)	7		
					(19)	1		
13	53	15	1	2	(2)	8		
					(7)	2		
					(12)	1		
					(15)	1		
					(20)	1		
14	60	1			(14)	1		
15	63	1					(1)	1
16	73	2	1	1	(13)	1		
17	79	3			(8)	2		
					(17)	1		
18	80	3	1	3				
19	87	4	1	1	(1)	3		
20	90	1			(9)	1		
21	96	1	1	1				
22	103	1	1	1				
23	112	7	1	6	(12)	1		
24	117	35	1	1	(4)	1		
					(5)	11		
					(6)	16		
					(7)	3		

Table 18 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
					(14)	1		
					(19)	1		
					(21)	1		
25	118	13	2	3	(1)	1		
					(2)	4		
					(7)	1		
					(8)	1		
					(11)	2		
					(12)	1		
26	119	6	1	1	(5)	1		
					(6)	1		
					(7)	1		
					(11)	1		
					(21)	1		
27	120	3			(2)	2		
					(8)	1		
28	121	1	1	1				
29	123	1	1	1				
30	132	3	1	2	(10)	1		
31	134	1	1	1				
32	135	1			(9)	1		
33	136	1			(2)	1		
34	143	4			(2)	1		
					(9)	1		
					(10)	2		
35	144	2			(16)	1		
					(18)	1		
36	154	2			(8)	1		
					(9)	1		
37	155	1	1	1				
38	162	3			(13)	3		
39	163	1	1	1				
40	164	1					(1)	1
41	166	1			(2)	1		
42	175	7	3	6	(14)	1		
43	179	1			(2)	1		
44	186	6	1	4	(4)	2		
45	191	1			(16)	1		
46	192	2			(1)	2		
47	202	1			(9)	1		

Table 18 (continued)

OBS.	GENO.	TOTAL SETTING	BASIC GROUP	SETTING IN BASIC GROUP	ALIEN GROUP	SETTING IN ALIEN GROUP	NEW GROUP	SETTING IN NEW GROUP
48	204	1			(12)	1		
TOT	48	212	26	44	21	166	1	2

Table 19. Comparison among defferent subsystems using Euclidean distance and raw data set*

AUTHORITY SYSTEMS	GENO.	TOTAL SETTING	G/S RATIO	BASIC GROUP		OCCUPIED SETTINGS[1]		ALIEN GROUP		OCCUPIED SETTINGS[2]		NEW GROUP		OCCUPIED SETTINGS[3]	
				NUM	%	NUM	%	NUM	%	NUM	%	NUM	%	NUM	%
ENTERPRISE:															
RAW DATA	70	132	0.53	54	77%	79	60%	9	13%	24	18%	7	10%	29	22%
EUCLIDEAN DISTANCE	70	132	0.53	58	83%	88	67%	7	10%	25	19%	5	7%	19	14%
CHURCH:															
RAW DATA	31	193	0.16	19	61%	47	24%	12	39%	146	76%				
EUCLIDEAN DISTANCE	31	193	0.16	16	52%	36	19%	14	45%	155	80%	1	3%	2	1%
GOVERNMENT:															
RAW DATA	52	114	0.46	40	77%	66	58%	8	15%	36	32%	4	8%	12	11%
EUCLIDEAN DISTANC	52	114	0.46	33	63%	40	35%	13	11%	56	49%	6	12%	18	16%
SCHOOL:															
RAW DATA	68	233	0.29	42	62%	72	31%	22	32%	149	64%	3	4%	12	5%
EUCLIDEAN DISTANCE	68	233	0.29	37	54%	72	31%	30	44%	155	67%	1	1%	6	3%
VOLUNTARY ASSOCIATION:															
RAW DATA	48	212	0.23	26	54%	44	21%	21	44%	166	78%	1	2%	2	1%
EUCLIDEAN DISTANCE	48	212	0.23	24	50%	66	31%	21	44%	137	65%	3	6%	9	4%

*Using average cluster method.

Table 20. Comparison between genotype and prototype

AUTHORITY SYSTEMS	NUM OF SETTING	TOT GENOTYPE INCLUDED	G/S RATIO	TOT PROTOTYPE INCLUDED	G/S RATIO
WHOLE TOWN	884	198	0.22	50	0.06
BUSINESS	132	70	0.53	21	0.16
CHURCH	193	31	0.16	9	0.05
GOVERNMENT	114	52	0.46	23	0.20
SCHOOL	233	68	0.29	25	0.11
VOLUNTARY ASSOCIATION	212	48	0.23	19	0.09

VIII. FIGURES

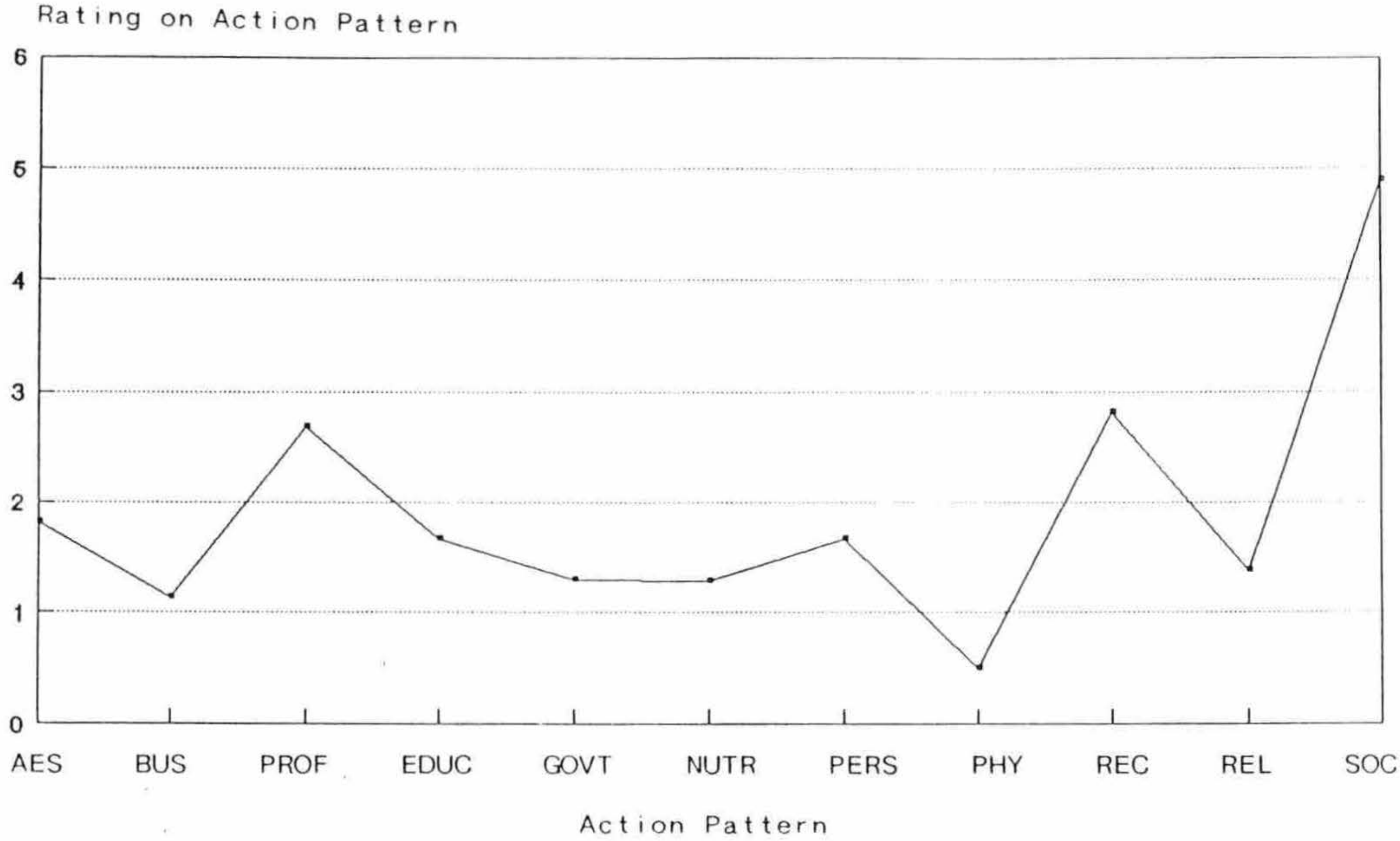

Figure 1. Mean score of action pattern on the total system

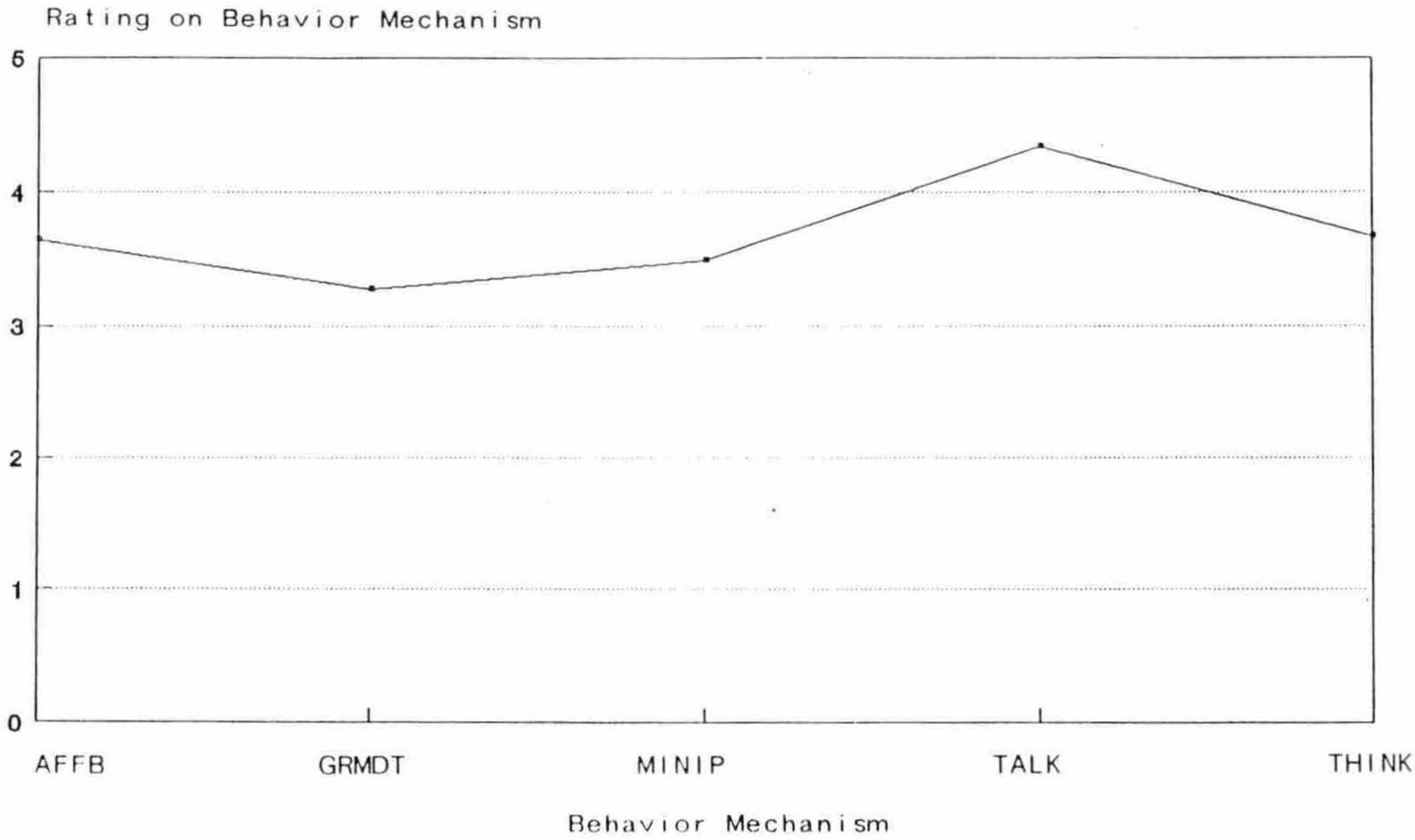

Figure 2. Mean score of behavior mechanism on the total system

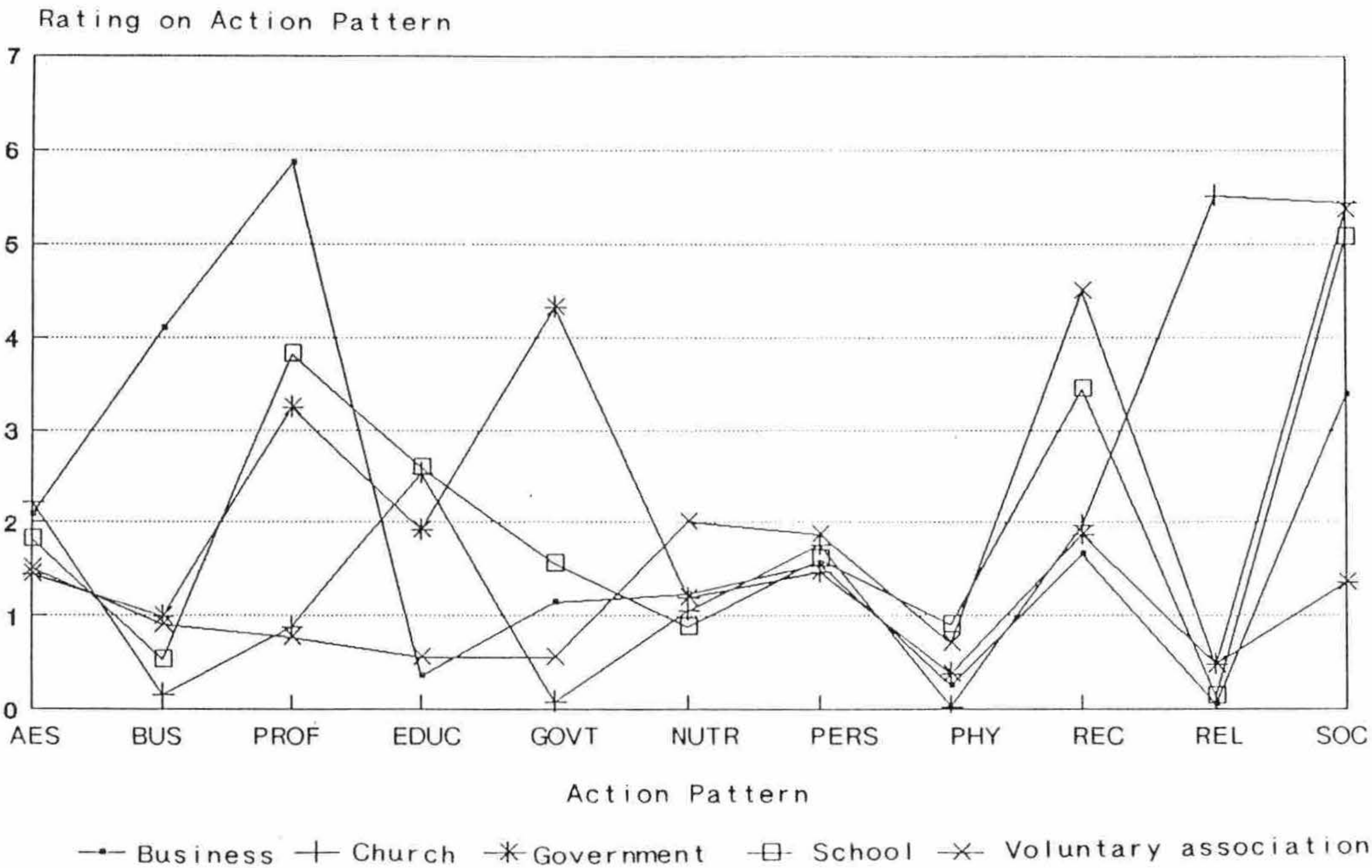

Figure 3. Mean score of action pattern on the five subsystems

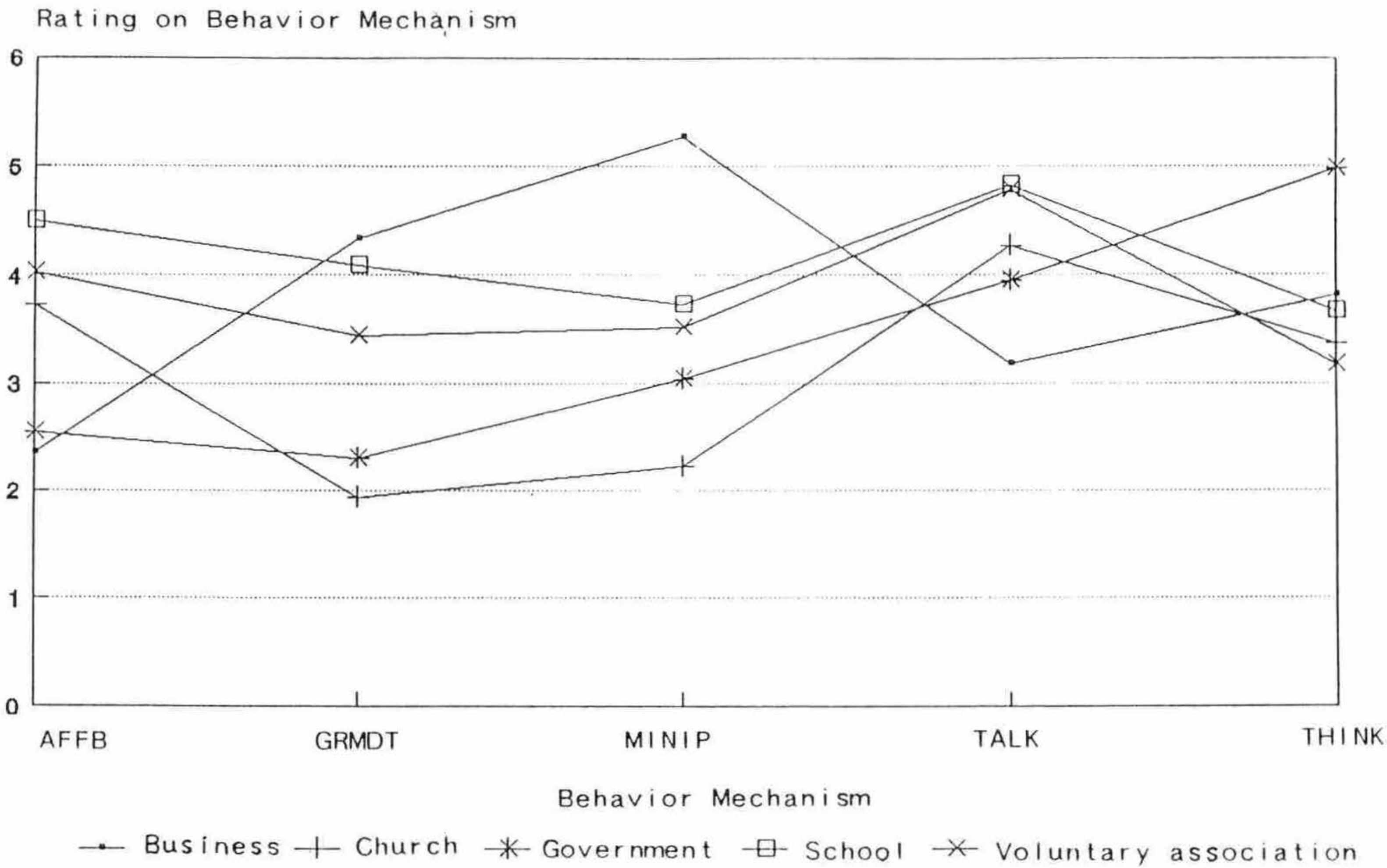

Figure 4. Mean score of behavior mechanism on the five subsystems

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