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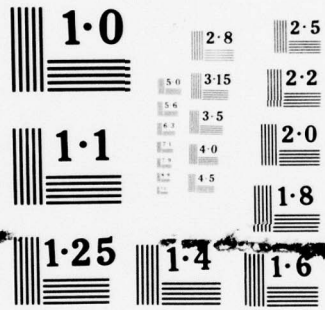
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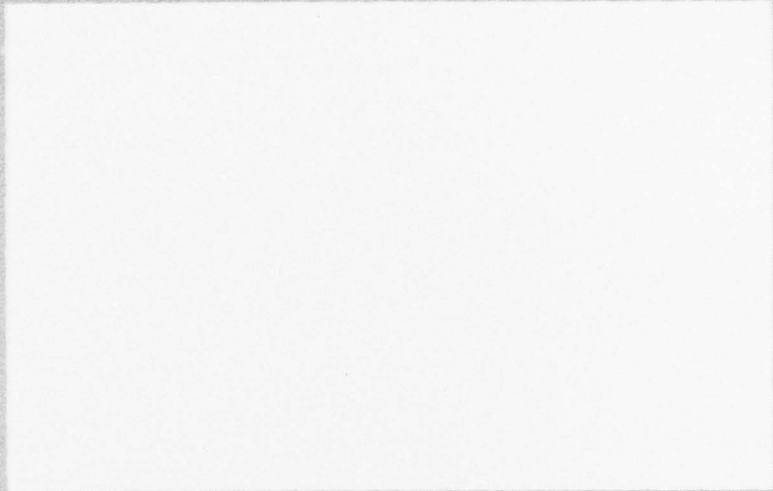
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THREE-MODE MULTIDIMENSIONAL SCALING WITH  
POINTS-OF-VIEW SOLUTIONS

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## ABSTRACT

In the area of multidimensional scaling research, the three most popular models are Tucker and Messick's (1963) Points-of-View, Carroll and Chang's (1970) INDSCAL, and Tucker's (1972) Three-Mode procedures. However, each of these models has some theoretical and/or methodological difficulties in application to the real world. In this report, a new quantitative model, called 3M-POV, has been developed by combining the Three-Mode and Points-of-View models into a single analytic procedure. While the strengths of all three models have been kept, their difficulties have been eliminated. For illustration, Osgood et al (1975) indigenous inter-concept distances among 22 kincepts from 28 language/culture communities have been applied and resulted in very interesting solutions. It is anticipated that this approach can be fruitfully applied to our survey data obtained from three diverse samples to contrast the points-of-view of men and women on subjective culture variables associated with sex-role relations.

Many types of psychological scaling studies require subjects to estimate the similarity or dissimilarity between stimuli. Although there are a number of task types that may be used, the end result is an  $n \times n$  ( $n$  = number of stimuli) square symmetric data matrix which represents the judgments for a single subject. A classic problem is how to combine the matrices from a number of subjects so as to not lose sight of possible individual differences that might exist. The simplest solution is, of course, to ignore individual differences and use various averaging algorithms. However, such a procedure requires an assumption of subject homogeneity which is often unwarranted. More distressingly, analysis of the combined matrix often results in a stimulus configuration which is clearly not representative of any single subject (Silver, Landis, and Messick, 1966). In such a case, the psychological meaning of the results is open to question. The problem, then, is how to analytically separate subgroups of subjects so that the structure of each subgroup's judgmental space is unique with respect to the others, and the individual matrices comprising each subgroup have maximal similarity. In the past fifteen years, three approaches to solving this problem have been proposed: the Tucker and Messick (1963) Individual Differences model for Multidimensional Analysis (referred to hereafter as the Points-of-View, POV, model), the Carroll and Chang (1970) Individual Differences in Multidimensional Scaling model (INDSCAL) and the Tucker (1972) three-mode multidimensional model. Unfortunately, as we shall see later in this paper, all three have certain computational and theoretical properties which render them, perhaps, not the most appropriate methods to investigate individual differences. We shall suggest that while the problems with INDSCAL are theoretical in nature, those of POV and three-mode are merely that the models do not yield complete solutions by themselves. It will be demonstrated that by casting the POV

approach within a three-mode paradigm the problems can be resolved. The resulting model is most powerful and gives results which are not only easy to interpret but also representative of complete solutions on individual similarities and differences in judgment. In laying the groundwork for the introduction of this approach, which we shall call the Three-Mode Points-of-View model (3M-POV), it is necessary to examine the logic underlying multidimensional scaling.

Given a square, symmetric input matrix of similarity judgments from an individual, both metric (Torgerson, 1968) and non-metric (Shepard, 1962a, 1962b) multidimensional scaling (MDS) techniques can be employed. In the case of the usual metric MDS approach, for example, the analytic procedure consists of two general steps: (1) Solve for a geometric configuration in which all objects are treated as individual vectors with respect to a common origin at the centroid of all points (vector termini). This is the problem of transforming judgments of proximity or dissimilarity to scalar products between all object vectors in a real, Euclidean space. (2) Determine the dimensionality of the space and projections of the vectors on the axes which can account for the entire inter-object distances. This is the problem of identifying the spatial structure for the configuration of a given set of objects in a Euclidean space. The projections on the resultant dimensions are usually called an individual's private perceptual structure of the objects which, as the basic goal of the general MDS model, is analogous to the factor matrix in factor analysis. However, for better characterization of inter-object relationships, this private structure matrix may be, and frequently quite necessarily, rotated through various rotational schemes, as used in factor analysis, to a psychologically meaningful orientation for interpretation.

However, standard metric or non-metric MDS techniques operate only on a single matrix of distance or proximity measures which are usually obtained from a single individual. When there is a group of individuals judging the same set of objects, investigation of individual differences in object similarity requires a two-step procedure: (1) Apply the above analytic methods to all individual judgments separately, i.e., to obtain a private perceptual structure for each individual in the group, regardless of the

number of individuals involved; and (2) Assess individual differences based on comparisons of the resultant perceptual structures of all individuals.

It is apparent that when the number of subjects is large, this procedure is cumbersome and subject to possible perceptual and cognitive errors on the part of the investigator. Furthermore, in some psychological scaling research, all subjects sampled may not necessarily be distinctive in judgments. In fact, if subjects share some common demographic characteristics, e.g., same sex, age, or economic background, some response homogeneities among them should be expected. Therefore, separate scaling analysis for each individual appears statistically unnecessary. Even when the subjects might differ on a number of interesting characteristics, an ideal approach would still be just to analyze representative data for different response-homogeneous subgroups or types of individuals.

As an approach to the problem of identifying subgroups, Tucker and Messick (1963) developed an individual difference model for multidimensional scaling. This model, in reverse of the usual two-step scaling procedure, proposed the following: individuals are first assigned to "idealized subject types". The assignment is based on the distributional characteristics of factor coefficients of individual vectors from a factor analysis of an inter-subject cross-products matrix computed across the entire  $\underline{n}(\underline{n}-1)/2$  object pairs of similarity measures. The coordinates of centroids of each subject cluster (their "point-of-view") are used to create an "ideal" inter-object similarity matrix. Each of these "ideal" matrices is then subjected to standard multidimensional scaling analysis, yielding private object dimensions and projections of objects on them. Individual differences in perceptions of objects between all "ideal" individuals can therefore be characterized by comparisons of their resultant private structures.

Some empirical studies have demonstrated the utility of this model (POV) for investigating individual differences in the perception of: political figures (Tucker and Messick, 1963), social desirability (Wiggins, 1966), color perception (Helm and Tucker, 1962), personality trait inference (Walters and Jackson, 1966), dimensions of semantic space (Wiggins and Fishbein, 1969), complex random forms (Silver, Landis, and Messick, 1966 ; Landis and Slivka, 1970; Richards, 1972), structured visual stimuli (Landis, Silver, Jones, and Messick, 1967; Landis and Slivka, 1970), self concept in disadvantaged children (Landis, Hayman and Hall, 1971), and kinship conceptions (Tzeng, Osgood and May, 1976). Landis and his associates also demonstrated a relationship between individual viewpoints about visual stimuli and perceptual-cognitive style (Landis et al., 1967; Landis and Slivka, 1970).

However, in recent years, this model has become less popular. The following are the most frequently cited problems: (1) non-linearity of the input, inter-object distances (Carroll and Chang, 1970), (2) less "parsimony" of the solutions producing larger numbers of object dimensions for all viewpoint spaces than other comparative models (Carroll and Wish, 1974), and (3) less "economy" in computation requiring separate MDS analyses for every idealized subject (Carroll and Wish, 1974). At the same time that these problems were being cited, the introduction of a more powerful model--INDSCAL (Individual Differences in Multidimensional Scaling, Carroll and Chang, 1970), which apparently did not suffer from these problems undoubtedly contributed to the apparent demise of the POV approach.

Before we discuss the INDSCAL model, we should note that the difficulties of the POV model have been resolved (Carroll and Chang, 1970; Cliff, 1968;

Tzeng, Note 1). For example, the problem of non-linearity of input inter-object distances can be avoided by using squared inter-object distances (Carroll and Change, 1970), or by assigning subjects to different cluster types through individual factor coefficients, rather than factor loadings (Cliff, 1968). The critique of "parsimony" of solutions can also be eliminated if the sum of resultant object dimensions for all viewpoints through the POV model has not been confused with the group common object dimensions through other models such as INDSCAL (Tzeng, Note 1). As to the problem of "economy" in computation, Tzeng (Note 1) has argued that in order to have maximal information on individual differences, it is necessary to do separate MDS analyses for different ideal subjects. Empirical evidence on this aspect will also be presented later.

It is clear that while the construct of the POV model per se will not hinder its application, the comparative procedure, INDSCAL, would only be the case if the construct of INDSCAL is valid and its procedure is more powerful. Based on a detailed evaluation of the INDSCAL model, Tzeng (Note 1) has found that the model is less preferable with respect to both the validity of the construct and utility of its solution.

In essence, from a three-mode similarity matrix of  $n$  by  $n$  objects by  $N$  individuals, INDSCAL will yield two kinds of output matrices: one is the "group object matrix", defining the coordinates of  $n$  input stimuli on each of the resultant unrotated dimensions in a group common object space, and the other is the "subject matrix", defining weights of all object dimensions for each subject in the subject space. The following properties of the INDSCAL solutions have frequently been reported as different from those of other MDS techniques (c.f., Carroll and Wish, 1974): (1) The INDSCAL dimensions (unrotated) are "common to all individuals and correspond to a 'fundamental'

physiological, perceptual, or conceptual process"; they are basic implicit criteria actually employed by subjects in discriminating among different objects. (2) The INDSCAL dimensions are uniquely determined and cannot be rotated except for a permutation of dimensions. Mathematically, a rotation of the group stimulus space will change the individual space; statistically, a rotation of axes will deteriorate the fit of the data to the INDSCAL model. In application, a rotation will complicate and often attenuate the utility of the model. (3) The number of dimensions for the object space is equal to the number of dimensions for the subject space. (4) The INDSCAL dimensions nearly exhaust all underlying independent features actually used by all different subjects. As Carroll and Wish (1974) note: "The required dimensionality (of the object space) is simply the dimensionality of the direct sum of the different points of view spaces." (5) When two subjects have identical weights (or pattern of weights) on all object dimensions, they are considered as having an identical structural contour of the private object spaces with the same underlying psychological dimensions used in the entire process of similarity judgments. With these characteristics, the INDSCAL model has been praised as a provocative approach to most problems related to invariance and reliability of MDS (Green and Carmone, 1972). However, according to Tzeng (1975), the process of human judgment involves three major variables: unique characteristics of the individuals making the judgments, characteristics of the objects being judged, and the underlying criteria, i.e., semantic distinctions and general cognitive frames of references, which the individuals use. For the implicit judgments of individuals in MDS research, global similarity judgments provide only relative proximities or distances among stimulus objects. This is because there are only two sources of variance involved, individuals and objects

of judgment. Therefore, the object dimensions resulting from MDS techniques, including the INDSCAL model, are not uniquely determined and do not automatically represent either the underlying psychological variables utilized by the subjects or the denotative components of objects which are familiar to average individuals (Tzeng and Osgood, 1976). Under this circumstance, there seems no theoretical justification to support the two most fundamental constructs of the INDSCAL model: discovery of psychological process of similarity judgments, and the dimensional uniqueness of its solutions. In fact, Tzeng (Note 1) has demonstrated empirically that typical INDSCAL solutions can be subjected to various rotational schemes without deteriorating the original goodness of fit measures or changing the individual space.

Perhaps, the most serious problem with the INDSCAL model is that it looks like a tri-linear or three-mode model in construct (i.e., dimensions for both the object and subject modes are independently determined; thus, dimensionality of one matrix is not a function of dimensionality of the other), but it is bilinear in computation. Because it is bilinear, the subject dimensions and the group common object dimensions are unnecessarily restricted to be equal; that is, each subject dimension is postulated to be associated with a single concept dimension. As a result, this restriction along with the bilinear computational procedure would usually distort the complex nature of input data. For example, in contrast to the property (4) above, Tzeng (Note 1) found that INDSCAL object dimensions are not psychologically independent in representing the direct sum of all subjects' private spaces.

Given the fact that the first four properties of INDSCAL lack theoretical justification, the last property--inferring subjects with similar

contours of private spaces (or within the same point of view) as having the same psychological processes in similarity judgments -- becomes quite unwarranted. It should be pointed out however, that since results from other MDS procedures are rotatable, such inference of identical process of cognition among individuals with the same private structures is not normally made.

It should be clear by now that INDSCAL is just another MDS model with stronger, but unnecessary, assumptions about the data and solutions. Compared with the POV model in both a hypothetical (Tzeng, Note 1) and an empirical (Dobson and Poy, Note 2) study, the INDSCAL procedure was reported to be inferior with respect to both the validity and reliability of its solutions. Therefore, contrary to common belief, the POV model, which has its distinctive utility in differentiating individuals in similarity ratings, is superior.

Although the POV is more powerful than INDSCAL, it has an obvious handicap as far as providing complete scaling information. No direct solution is available for a group common stimulus space and distributional characteristics of such common stimulus dimensions within each idealized individual space. Thus, each individual structure is treated independently and comparisons between such structures are difficult if not impossible. Tucker's (1972) three-mode MDS model provides a partial solution to these problems. The Tucker model, like INDSCAL, assumes that all individuals share a common object space and that individual differences are due to

different ways of perceiving the common space. (The three modes come about by considering the object X object matrix as defining two of the modes with the third coming from the respondents.) Typical output includes two outer mode matrices (analogous to unrotated factor matrices): a group object space matrix with orthogonal dimensions and a person space matrix with its own dimensions which characterizes the homogeneities in subject responses. An inner-core matrix is also derived which gives the loadings of the person space dimensions on the object dimension. As in ordinary three-mode factor analysis (Tucker, 1966) rotations for both the subject and object structures are permissible as well as frequently desirable. The inner-core matrix can then be correspondingly rotated for interpretation.

The Tucker approach is preferable to INDSCAL because it is truly tri-linear in computation. However, this approach does not provide one element of important information that is given in the POV procedures -- private and unique object structures for the person spaces. The investigator then faces the problem in making psychological sense out of the group-common object dimensions and the individual core matrix as the sole basis for making inferences. These inferences become quite difficult when the two outer matrices are of more than three dimensions and the rotated core matrix contains no obvious pattern of inter-correlations. Another problem arises when the number of judged objects is small and the subjects come from a large sample of heterogeneous individuals. In this case, the number of object dimensions tends to equal the number of objects. After rotation

each object vector will define a single rotated object dimension with zero loadings on the others. Under such circumstances, the object space solution becomes meaningless and the complicated inner-core matrix becomes the sole source for identification of individual differences (see Tzeng, Note 1 for an example of this type of problem). Given these problems, it would seem reasonable to propose a new model which would draw upon the respective strengths of both the POV and the Tucker three-mode approaches. In such a case, one should not only be able to determine common object spaces (and the comparative loadings of idealized individuals on them) but also derive unique and multi-group common object spaces. The presentation of such a model, developed by extending the usual three-mode scheme to derive the POV solution, is the object of the present paper.

For purposes of illustration, this model, identified as 3M-POV (3 Mode Multidimensional Scaling with Points of View Solutions) was applied to Osgood's indigeneous interconcept distances among 22 kinship terms which are obtained from a cross-cultural research in 28 language/culture communities.

#### THE 3M-POV MODEL

##### Typical Three-Mode Scaling Solution

The computational procedures of Tucker's (1972) three-mode MDS scaling model can be stated in terms of  $N$  individuals' scalar-products matrices among  $n$  stimuli converted from observed proximity (distances) responses. Let  $X_i$  be an  $n \times n$  symmetric scalar products matrix with elements  $X_{jki}$  representing

the scalar product between the object vectors  $\underline{j}$  and  $\underline{k}$  for individual  $\underline{i}$ . For  $\underline{N}$  individuals,  $X$  will be a three-way scalar products matrix consisting of  $\underline{N}$  two-mode matrices of  $\underline{n} \times \underline{n}$ .

To solve for the subject space matrix, let  $X$  be rearranged into a single  $\underline{n}^2 \times \underline{N}$  matrix  $\tilde{X}$  with each column representing the  $\underline{n} \times \underline{n}$  scalar products matrix for a single individual. By the Eckart-Young (1936) theorem, the cross-products matrix of  $\tilde{X}$  (i.e.,  $\tilde{X}'\tilde{X}$ ) can be decomposed to obtain the subject coefficient matrix  $Z$  of order  $\underline{N} \times \underline{N}$ . That is

$$[1] \quad \tilde{X}'\tilde{X} = ZL_1Z' \quad ,$$

where  $L_1$  is a diagonal  $\underline{N} \times \underline{N}$  matrix of eigenvalues of  $\tilde{X}'\tilde{X}$  and will be used to retain  $\underline{m}$  number of significant dimensions for the subject space.

For the object space, an  $\dot{X}$  matrix is obtained by rearranging the three-mode matrix  $X$  into a two-mode  $\underline{nN} \times \underline{n}$  matrix with each column containing a column of  $\underline{n} \times \underline{n}$  scalar products from all subjects. The cross-products matrix of  $\dot{X}$  (i.e.,  $\dot{X}'\dot{X}$ ) will then be decomposed to yield both the object space coefficients matrix  $B$  of order  $\underline{n} \times \underline{n}$  and the eigenvalues matrix  $L_2$  as

$$[2] \quad \dot{X}'\dot{X} = BL_2B'$$

Roots in  $L_2$  will be used to retain  $\underline{p}$  number of significant object dimensions.

Given an input  $\tilde{X}$  and the two outer-mode solution matrices  $--Z_m$  ( $\underline{m}$  columns of  $Z$ ) and  $B_p$  ( $\underline{p}$  columns of  $B$ ), a "raw" three-way core matrix  $G_m$  can then be solved for by

$$[3] \quad \tilde{G}_m = (B_p \bar{X} B_p)' \tilde{X} Z_m$$

The symbol  $\bar{X}$  stands for a Kronecker product, and  $\tilde{G}_m$  is of order  $\underline{p}^2$  by

$\underline{m}$  in correspondence to the retained object and subject factors respectively.

The basic formula for estimating the three-mode input data matrix  $X$  can then be written as

$$\begin{aligned}
 [4] \quad \tilde{X}^* &= (B_p \bar{X} B_p) (B_p \bar{X} B_p)' \tilde{X} Z_m Z_m' \\
 &= (B_p \bar{X} B_p) \tilde{G}_m Z_m' \quad .
 \end{aligned}$$

When all  $\underline{n}$  columns of  $B$  and  $\underline{N}$  columns of  $Z$  are retained, perfect fit of the input data matrix  $\tilde{X}$  should be expected.

To facilitate interpretation, Tucker (1972) also suggested transformation for both the object and person spaces by squared, non-singular matrices  $T$  and  $U$  of orders  $\underline{p}$  and  $\underline{m}$  respectively so that

$$[5] \quad B_p^* = B_p T$$

and

$$[6] \quad Z_m^* = Z_m U$$

Where  $B_p^*$  and  $Z_m^*$  are the rotated object space and person space matrices. The core matrix  $\tilde{G}_m$  is also correspondingly transformed by the equation

$$[7] \quad \tilde{G}_m^* = (T \bar{X} T)' \tilde{G}_m U \quad .$$

This transformation will not affect the basic model in [4] as can be seen by

$$\begin{aligned}
 [8] \quad \hat{X}^* &= (B_p^* \bar{X} B_p^*) \tilde{G}_m^* Z_m^{*'} = (B_p T \bar{X} B_p T) (T \bar{X} T)' \tilde{G}_m U U' Z_m' \\
 &= (B_p \bar{X} B_p) (T \bar{X} T) (T \bar{X} T)' \tilde{G}_m U U' Z_m' \\
 &= (B_p \bar{X} B_p) \tilde{G}_m Z_m' \quad .
 \end{aligned}$$

In order to identify individual differences in utilization of common object space dimensions, Tucker suggests construction of a cosine matrix among these common object dimensions for each individual. Thus a matrix  $H_i$ , a  $p \times p$  core matrix for each individual  $i$ , is rearranged from a column vector  $H_i$  derived from

$$[9] \quad \tilde{H}_i = \tilde{G}_m Z_i'$$

This matrix known as an "individual characteristic matrix" (Tucker, 1972) can then be normalized into a matrix of correlation form with identities in the diagonals. The off-diagonal entries are interpreted as cosines of angles among the common object space dimensions. The normalization procedure is accomplished by first defining a diagonal matrix  $W_i$  which contains the square roots of the diagonal entries in matrix  $H_i$  as

$$[10] \quad W_i^2 = \text{Diag} (H_i) \quad ,$$

and then rescaling  $H_i$  for each individual private space as

$$[11] \quad R_i = W_i^{-1} H_i W_i^{-1} \quad .$$

Note that the characteristic matrix  $H_i^*$  and intercosines  $R_i^*$  among rotated object space dimensions for each individual can also be obtained from [6] and [7] in the same fashion as per [9], [10] and [11]. That is,

$$[12] \quad \tilde{H}_i^* = \tilde{G}_m^* Z_i^{*'} \quad .$$

$$[13] \quad W_i^{*2} = \text{Diag} (H_i^*) \quad .$$

and

$$[14] \quad R_i^* = W_i^{*-1} H_i^* W_i^{*-1} \quad .$$

Solution of Idealized Individual Object Configuration

In usual applications of the three-mode scaling model presented above, the following solutions can be used for interpretation: (a) eigenvalues of object and of person spaces ( $L_1$  and  $L_2$ ), (b) coordinates (eigenvectors) of objects and of persons in their retained spaces ( $B_p$  or  $B_p^*$  and  $Z_m$  or  $Z_m^*$ ), (c) the core matrix of three way,  $p \times p \times m$  dimensions ( $G_m$  or  $G_m^*$ ), and (d) the characteristic matrix ( $H_i$  or  $H_i^*$ ) and its normalized correlations among  $p$  object space dimensions ( $R_i$  or  $R_i^*$ ) for each individual. As already indicated, no attempt is made for identification of idealized individuals and determination and comparison of all private object spaces, even though they are extremely important for precise information on individual differences in judgment. Therefore, in order to obtain both solutions in a single analytic procedure, the following formulation was developed by building the POV model into the three-mode approach.

Identification of Idealized Individuals. For identification of subject clusters, instead of working on the observed proximity measures (or distances) as done in the POV model, the scalar products matrix  $\tilde{Z}$  is employed because both proximity measures and scalar products are functionally equivalent with respect to the patterns of inter-object relationships across all  $N$  individuals. In fact, the subject coefficient matrix  $\tilde{Z}$ , as obtained in [1] through the three-mode scaling model, can be thought of as the component scores matrix used in the POV model for identifying idealized individuals. That is, following the Eckart-Young theorem,  $\tilde{X}$  of  $\underline{n}^2 \times \underline{N}$  can be redefined as

$$[15] \quad \tilde{X} = YL_1Z' \quad ,$$

where  $Y$  contains the characteristic vectors of  $\tilde{X}\tilde{X}'$ ,  $YL_1$  is the loadings of  $\underline{n}^2$  pairs of objects on  $\underline{m}$  components, and  $Z$  is the component scores of individuals indicating the weights to be applied to  $YL_1$  to recover a close approximation to  $\tilde{X}$ . Therefore, as in the POV procedure, this component scores matrix  $Z$  will be used to determine or isolate homogeneous subgroups of individuals who exhibit similar viewpoints about the inter-relationships among object vectors.

However, in order to avoid possible difficulties inherent in subjective observations of pair-wise factor plots, an objective procedure and a computer program have been developed by Tzeng and May, (Notes 3 and 4). The basic scheme is that in an  $\underline{m}$  multidimensional subject space, a subgroup of individuals whose vector termini being relatively closer as compared with the dispersion of the entire vector termini in the space can be clustered together as a homogeneous subject type sharing a similar point of view in judgments. The centroid of such a cluster in the space will then represent the vector of this idealized individual. A brief description of the analytic procedure is as follows: Given the individual coefficient matrix  $Z_m$  in the retained  $\underline{m}$  dimensional space, inter-subject Euclidean distances (or squared distances) are first computed yielding an  $\underline{N} \times \underline{N}$  distance matrix. A Johnson (1967) type hierarchical clustering of individuals is then performed on this matrix based on a centroid approximation method. That is, every subject is treated as a separate entity or node at the bottom level of the (reversed) tree and the two entities with the smallest distance are selected to form a new cluster (entity) at the next higher level. The distances from this new entity to other outside nodes are then computed from

the centroid of these two member nodes. In fact, they are approximated by averaging distances of the two member nodes in the cluster with all outside (non-member) nodes. This clustering procedure continues at the next higher level until all entities are grouped into a single global entity. A post-hoc treatment of the hierarchical tree is finally conducted to evaluate all trientity relationships in the tree at all levels. As a result, among any three nodes at all levels which are under a common least upper node, the node in the middle is always closest to the outside node.

Given this kind of resultant hierarchical tree, subjects clustered together under some node (i.e., within some criterion boundary of inter-subject distances) will reflect their closeness in the  $m$  dimensional space and will therefore be identified as an idealized individual. Let us assume that there are a total of  $g$  idealized individuals isolated and each contains different numbers of individual member vectors in the space. Each idealized individual vector in the space can then be located precisely at the centroid of the cluster, by averaging the coefficients of all member individuals on  $m$  axes. Consequently, the original individual factor coefficients matrix  $Z_m$  of  $N$  by  $m$  will be reduced to matrix  $S_g$  of  $g$  by  $m$ . This idealized individual coefficient matrix can further be rotated to simple structure, signifying a clearer pattern of idealized individual vectors in the person space as

[16]

$$S_g^* = S_g U^* .$$

Derivation of Idealized Individual Private Configurations. In correspondence to the characteristic matrices  $\tilde{H}_i$  and  $\tilde{H}_i^*$  in [9] and [12] for a subject  $i$ , two idealized individual characteristic matrices, defined as  $\hat{H}_g$  and  $\tilde{H}_g^*$  of order  $p$  by  $p$  by  $g$  with respect to both unrotated and rotated object space solutions respectively, can also be obtained for all  $g$  idealized individuals from the core matrix  $\tilde{G}_m$  and the idealized individual coefficient matrix  $S_g$ . That is,

$$[17] \quad \tilde{H}_g = \tilde{G}_m S_g', \quad ,$$

and

$$[18] \quad \tilde{H}_g^* = \tilde{G}_m^* S_g^{*'} = (T \bar{X} T)' \tilde{G}_m U^* U^{*'} S_g' .$$

Given these idealized individual characteristic matrices and the (rotated) common object space matrices ( $B_p$  and  $B_p^*$ ), the estimated three-mode scalar products matrix  $\tilde{X}^*$  of  $\underline{n}^2$  by  $\underline{N}$  from all  $\underline{N}$  subjects, in [4] and [8], will be reduced to matrix  $\tilde{X}_g^*$  of  $\underline{n}^2$  by  $\underline{g}$  as follows:

[19]

$$\begin{aligned} \tilde{X}_g^* &= (B_p \bar{X} B_p) \tilde{G}_m S_g' \\ &= (B_p \bar{X} B_p) \tilde{H}_g \quad , \end{aligned}$$

and

$$[20] \quad \begin{aligned} \tilde{X}_g^* &= (B_p^* \bar{X} B_p^*) (T \bar{X} T)' \tilde{G}_m U^* U^{*'} S_g' \\ &= (B_p^* \bar{X} B_p^*) \tilde{G}_m^* S_g^{*'} = (B_p^* \bar{X} B_p^*) \tilde{H}_g^* . \end{aligned}$$

Note that this matrix  $\tilde{X}_g^*$  is the estimated scalar products for all  $g$  idealized individuals. For an idealized individual  $j$ , his estimated scalar product matrix, defined as  $X_j^*$ , can be expressed as

$$[21] \quad X_j^* = B_p H_j B_p \quad ,$$

or

$$[22] \quad X_j^* = B_p^* H_j^* B_p^* \quad .$$

It is clear that if idealized individual  $j$  represents only a unique subject  $i$  in the subject factor space, an identical estimation of his scalar products matrix, as derived in [8] and [21] or [22], can be expected.

Like  $H_i$  in [9], the idealized individual characteristic matrix  $H_j$  and  $H_j^*$  would represent the canonical intercorrelations among all  $m$  group common object dimensions. With this property, it can be decomposed to solve for a cosine matrix that will transform the group common object space to the private perceptual space for any idealized individual  $j$ . This can be accomplished by solving for the eigenvalues and eigenvectors of such idealized individual's characteristic matrices. For example,  $H_j^*$  in [22] is decomposed yielding a diagonal eigenvalue matrix  $Q_j$  and an eigenvector matrix  $F_j$ ,

$$[23] \quad H_j^* = F_j Q_j F_j' \quad .$$

Suppose  $r$  significant roots are retained and denoted as  $Q_{r_j}$ , then the corresponding vectors, denoted as  $F_{r_j}$  of order  $p$  by  $r$ , will be the cosine matrix we want to convert an idealized individual private space matrix  $B_{r_j}^{**}$  for idealized individual  $j$  from the common (rotated) group object space  $B_p^*$ :

$$[24] \quad B_{r_j}^{**} = B_p^* F_{r_j} = (B_p^* T) F_{r_j} \quad .$$

After this transformation,  $X_j^*$  in [22] can be expressed in a different form as

$$\begin{aligned}
 [25] \quad X_j &= B_p^* H_j^* B_p^* = B_p^* F_{r_j} Q_{r_j} B_p^* \\
 &= B_{r_j}^{**} Q_{r_j} B_{r_j}^{**} .
 \end{aligned}$$

It is interesting to note that since [25] and [22] are equivalent,  $Q_{r_j}$ , the retained characteristic roots matrix of  $H_j^*$  obtained via [23], will be identical to the characteristic roots matrix of the scalar products matrix  $X_j^*$  in [22]. Accordingly, the idealized individual private space matrix  $B_{r_j}^{**}$  in [24] will be identical to the characteristic vectors of  $X_j^*$ . This implies that under the present 3M-POV construct, the contour of resultant private object configurations of an idealized individual will be identical to that obtained from the POV model.

Furthermore, it should be noted that when an idealized individual  $j$  is defined uniquely by a single subject vector  $\underline{i}$  in the space (thus  $\underline{i} = \underline{j}$ ), the present construct, with the condition of retaining all roots for both the object and subject modes, will yield a precise solution as obtained through standard MDS procedure on individual  $\underline{i}$ 's proximity measures. This can be shown as follows: Let us rewrite [8] for a complete solution matrix  $X_i$  for subject  $\underline{i}$  as

$$[26] \quad \tilde{X}_i = (B \bar{X} B) \tilde{G} Z_i ,$$

with orders of  $\underline{n}$  by  $\underline{n}$  for  $B$ ,  $\underline{n}^2$  by  $\underline{N}$  for  $\tilde{G}$ , and  $\underline{N}$  by  $\underline{1}$  for  $Z_i$ . This matrix  $\tilde{X}_i$  is exactly subject  $\underline{i}$ 's scalar product matrix converted directly from his proximity measures of  $\underline{n}$  objects. Based on the derivation method for idealized individual  $\underline{j}$ 's coefficient matrix, it is evident that column vector  $Z_i$  is identical to column vector  $S_j$  for this single subject  $\underline{i}$ . Therefore, his scalar products matrix  $\tilde{X}_i$  can be defined as

$$\begin{aligned}
 [27] \quad \tilde{X}_i &= (B \bar{X} B) \tilde{G} S_i \\
 &= (B \bar{X} B) \tilde{H}_i \quad ,
 \end{aligned}$$

where  $\tilde{H}_i$  is a column vector of  $\underline{n}^2$  by  $\underline{1}$ . Let  $\tilde{X}_i$  be rewritten in non-Kronecker form  $X_i$  of order  $\underline{n}$  by  $\underline{n}$  and substitute complete solutions from

[23] for  $\tilde{H}_i$ , Eq [27] can be extended as

$$\begin{aligned}
 [28] \quad X_i &= B H_i B = B F_i Q_i F_i' B' \\
 &= B_i^* Q_i B_i^* \quad .
 \end{aligned}$$

$Q_i$  and  $B_i^*$  will then become the (unrotated) characteristic roots and vectors of the scalar product matrix  $X_i$ . This resultant equation from the present 3M-POV model is exactly the preliminary solution for individual  $i$ 's proximity judgments under the standard MDS model.

Finally, for better characterization of each idealized individual's private perceptual structure  $B_{r_j}^{**}$  of  $\underline{n}$  by  $\underline{r}$  obtained in [24], a transformation matrix  $T_r$  of  $\underline{r}$  by  $\underline{r}$  from various rotational schemes, orthogonal as well as oblique, can further be applied. As a result, the final object configuration matrix for each idealized individual  $j$  would become

$$[29] \quad B_{r_j}^{***} = B_{r_j}^{**} T_r \quad .$$

The diagonal core matrix  $Q_{r_j}$  in [25] will then be correspondingly rotated to  $Q_{r_j}^*$  by  $T_r$ . That is

$$[30] \quad Q_{r_j}^* = T_r' Q_{r_j} T_r \quad .$$

Like the subject characteristic matrix  $H_i^*$  in [9], this matrix will represent the canonical correlations among  $\underline{r}$  retained dimensions within each

idealized individual private space. A normalization procedure used in [10] and [11] can therefore be employed yielding an intercosines matrix among rotated object space dimensions for each idealized individual.

The entire 3M-POV procedure described above can be summarized as follows: Given a three-mode  $n$  by  $n$  by  $N$  scalar products matrix, the usual two outer-mode and one inner core solution matrices of the three-mode scaling model can first be obtained. Factor coefficients of all subjects are then used to derive inter-subject Euclidean distances for clustering individual vectors by the Tzeng-May hierarchical clustering algorithm. Various homogeneous subgroups of subjects will next be isolated representing different points-of-view about inter-object relationships. For each subject cluster, an idealized individual vector is defined at the centroid of the member vectors in the space. The coefficients of all idealized individual vectors are then derived from averaging coefficients of their respective member vectors on all retained axes.

The next step is to solve for private perceptual structures for each idealized individual  $j$  by the following steps: (a) use idealized individual  $j$ 's coefficients as the transformation cosines to derive an idealized individual characteristic (inner core) matrix  $H_j^*$  of order  $p$  by  $p$  with respect to the group common object dimensions; (b) decompose this characteristic matrix to solve for its eigenvalues and eigenvectors; (c) transform the group common object space into an idealized individual private space by the eigenvectors which are in correspondence to  $r$  significant roots retained; and (d) submit the obtained idealized individual private configurations to some rotational scheme for interpretation and inter-idealized individual comparisons.

Table 1  
 General Indices and Two-Letter Key for 28 Language/Culture Communities

Key Location, Language	Site of Location	Language Family	Colleagues in the Field
FR France, French	Paris, Strasbourg	Indo-European (Romance)	Abraham A. Moles; Françoise Ene
BF Belgium, Flemish	Brussels	Indo-European (Iranic)	Herbert Rigaux; Robert Hogenraad
ND Netherlands, Dutch	Amsterdam	Indo-European (Germanic)	Mathilda Jansen; A.J. Smolenaars
GG Germany (West), German	Munster	Indo-European (Germanic)	Sulbert Ertel
SW Sweden, Swedish	Uppsala	Indo-European (Germanic)	Ulf Himmelstrand
AEw United States American English	Illinois State (White Subjects)	Indo-European (Germanic)	Center for Comparative Psycho- Linguistics
AEB United States, American English	Trenton, Chicago (Black Subjects)	Indo-European (Germanic)	Dan Landis; James E. Savage; Tulsi B. Saral
YC Yucatan (Mexico), Spanish (Mayan)	Ticul, Chablekal, Kom Chiem	Indo-European (Romance)	Victor M. Castillo-Vales
HS Mexico, Spanish	Mexico City	Indo-European (Romance)	Rogelio Dian-Guerrero
CS Costa Rica, Spanish	San Jose, Liberia, C. Quesada	Indo-European (Romance)	Flora Rodriguez
BP Brazil, Portuguese	Sao Paulo	Indo-European (Romance)	Sylvia T. Maurer-Lane

Table 1 Continued

<u>Key Location, Language</u>	<u>Site of Location</u>	<u>Language Family</u>	<u>Colleagues in the Field</u>
HM Hungary, Magyar	Budapest	Finno-Ugric	Jeno Putnoky
YS Yugoslavia, Serbo-Croatian	Belgrade	Indo-European (Slavic)	Djordje Kostic; Tomislav Tomekovic
IT Italy, Italian	Padova	Indo-European (Romance)	Giovanni d'Arcais
GK Greece, Greek	Athens	Indo-European (Greek)	Vasso Vassiliou
TK Turkey, Turkish	Istanbul	Altaic	Beglan B. Tôgroi
LA Lebanon, Arabic	Beirut	Afro-Asiatic (Semitic)	Lutfy N. Diab; Levon Melikian
IF Iran, Farsi	Tehran	Indo-European	Tehran Research Unit (U. of Ill.)
AD Afghanistan, Dari	Kabul	Indo-European (Iranic)	Noor Ahmad Shaker
AP Afghanistan, Pashtu	Kabul, Kandahar	Indo-European (Iranic)	Noor Ahmad Shaker
DI Delhi (India), Hindi	Delhi	Indo-European (Indic)	Krishna Rastogi; Ladli C. Singh
CB Calcutta (India), Bengali	Calcutta	Indo-European (Indic)	Rhea Das; Alokanda Mitter
HK Mysore (India), Kannada	Mysore City, Bangalore	Dravidian	A. Shanmugan; B. Kuppuswamy
MM Malaysia, Malay	Kuala Lumpur	Malayo-Polynesian	Jerry Boucher
TH Thailand, Thai	Bangkok	Kadai	Jantorn Rufener; W. Michiarajote
HC Hong Kong, Cantonese	Hong Kong	Sino-Tibetan	Anita K. Li; Brian H. Young
JP Japan, Japanese	Tokyo	Japanese	M. Asai; Y. Tanaka; Y. Iwamatsu

## ANALYSIS OF AN ILLUSTRATIVE SET OF DATA

Material

The data used for this illustration were from Osgood's cross-cultural research conducted at the Center for Comparative Psycholinguistics at the University of Illinois. A brief orientation to this research is necessary (Osgood, 1962, 1971; Osgood, May & Miron, 1975). In compiling an Atlas of Affective Meaning, subsets of 40 subjects in each of some 28 cultures rated subsets of some 620 translations-equivalent concepts against 13 culturally indigenous but functionally equivalent semantic differential scales: four each for Evaluation (E), Potency (P), and Activity (A) and one for Familiarity. The concept profiles are expressed by the three factor composite scores (means of 40 subjects across four scales on each factor). In order to make manageable the analysis of similarities and differences, about 50 categories, such as Months and Seasons, Color Terms, Emotions, and Occupations, were devised for the concepts in the Atlas. For all such categories various standardized analytic procedures were devised, and computation of interconcept distance matrix within each culture was one of them.

In this study, twenty-two concepts in the Atlas Kinship category for the 28 language/culture communities described in Table 1 were used. There were 19 kinships, AUNT, BRIDE, BRIDEGROOM, BROTHER, COUSIN, DAUGHTER, FATHER, FATHER-IN-LAW, GRANDFATHER, GRANDMOTHER, HUSBAND, MOTHER, MOTHER-IN-LAW, RELATIVES, SISTER, SON, UNCLE, WIFE, AND I-MYSELF (ego). Added to this set were three common nouns. individualized PERSON and FRIEND, and generalized MOST PEOPLE.

For each community, standard composite factor scores of the 22 Kincepts on E, P, and A were first transformed into indigenous interconcept distances in the Euclidean affective space, yielding a 22 x 22 (kinship by kinship) symmetric distance matrix. After each indigenous distance matrix was converted to the scalar products between all kinship vectors in the space, a three-mode (22 x 22 x 28) input data matrix was generated and submitted to the procedures developed in this report.

#### Determination of Dimensions

For both the culture and concept modes, principal components analyses for cross-products among variables in each mode (i.e., culture or kincept) across the other modes were obtained. For the culture mode, the first ten characteristic roots are as follows: 12,743; 3,041; 2,042; 1,884; 1,374; 1,115; 1,029; 730; 617; and 558. Root one is considerably larger (44% of the sum of squares) than the remaining roots, reflecting the group average factor obtained when cross-products are analyzed. The differences among successive roots indicate that a break occurs between the fourth and fifth roots. Thus the first four factors, accounting for 68% of the total sum of squares, were retained for subsequent analysis. For the concept mode, the first ten roots are 14,233; 5,503; 2,682; 1,268; 963; 777; 508; 471; 441; and 424. A decision was made to retain the first six dimensions, accounting essentially for 87% of the total sum of squares.

#### Identification of Idealized Cultures

The first four characteristic vectors in the culture space were used as the initial solution of the cultural vector configurations. The 28 x 28 intercultural Euclidean distance matrix was computed from this retained

culture space and submitted to the Tzeng-May hierarchical clustering procedure.

The resultant tree diagram is given in Figure 1. When level 13 with a criterion distance of .19 was set as the cut-off for accepting clusterings of homogeneous cultural subgroups, thirteen sub-trees, including six combination clusters and seven unique cultures, emerged. If more restricted cut-off levels were employed, CS, FR, and IT would also be excluded from their respective combination clusters. This indicates that they are also potentially unique in affect attribution to kinship conceptions.

As indicated in the method section, the communities within each cluster are considered as member of an "idealized culture" (i.e., culture type), therefore, the centroid of each cluster is considered to be the location of each idealized culture in the "viewpoint" space. Projections for each idealized culture on all four viewpoint dimensions were then obtained by averaging the coordinates of the cultures in each cluster on each dimension. Orthogonal rotations were then carried out for this idealized culture factor configuration, yielding a simple structure of the idealized cultural space as given in Table 2.

It is apparent that each of the four viewpoint dimensions tends to be defined by a unique subset of idealized cultures; dimension 1 is specifically dominated by YS (Idealized Culture XIII) and YC (Idealized Culture XII) with salient loadings .71 and .48 respectively; dimension 2 by BE (Idealized Culture I); dimension 3 by GK (Idealized Culture XI); and dimension 4 by FR and IT (Idealized Culture II) and also by HC (Idealized Culture III). It is interesting to note that these seven cultures are the

FIGURE 1  
HIERARCHICAL CLUSTERING OF CULTURES

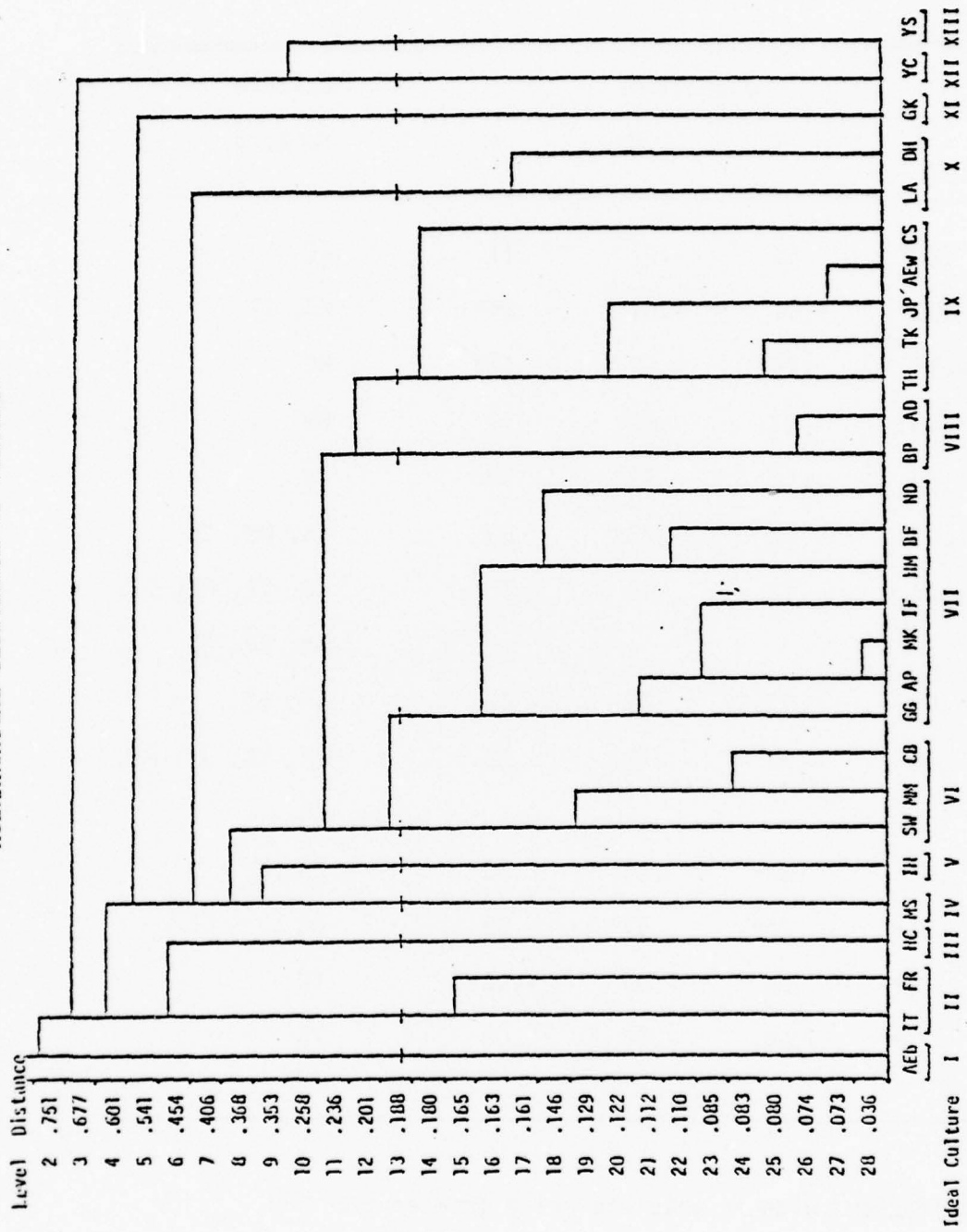


Table 2  
Rotated Factor Coefficients of 13 Idealized Cultures

Ideal Culture	Dimension				Culture Members
	1	2	3	4	
I	.23*	.65*	-.07	.11	BE
II	.05	-.11	-.07	.56*	FR, IT
III	-.16	.28*	-.02	.45*	HC
IV	.16	-.33	.24*	.10	MS
V	.00	-.12	.42*	-.05	IH
VI	-.03	.00	.23*	.00	SW, MM, CB
VII	-.04	.02	.12	.10	GG, AP, MK, IF, HM, BF, NO
VIII	.09	.03	.02	-.02	BP, AD
IX	.12	-.10	.11	.08	TH, TK, JP, AE, CS
X	.04	.33*	.14	.02	LA, DH
XI	.09	.23*	.57*	-.09	GK
XII	.48*	.04	-.09	-.02	YC
XIII	.71*	-.06	-.04	.00	YS

\*Salient coefficient with an absolute value greater than .20.

most unique in the space, as shown in Figure 1, being farthest away from the other clusters.

The fact that, except for FR, IT, LA and DH (Idealized Cultures II and X), other four combination clusters (Idealized Cultures VI-IX) have loadings less than .24 on all four dimensions indicates that their 17 member culture vectors are less dispersed around the origin of the cross-cultural common space. As shown in Figure 1, these four combination clusters meet together in the center of the tree at clustering level 11 ( $d = .24$ ) prior to their connection with other unique clusters at both ends of the tree. This suggests that they have relatively lower affect attribution to the 22 Kinships. Examination of all indigenous input distance matrices in the Atlas confirm the fact that these 17 member cultures have indeed smallest means and standard deviations across all 22 Kinships (means between 1.2 and 1.9 with median equal to 1.6, and standard deviations between .56 and .96 with median equal to .76), whereas the seven unique cultures and Idealized Culture II (FR and IT) have means greater than 1.9 (median = 2.1) and standard deviations greater than .96 (median = 1.03).

#### Concept Factor Loadings

The characteristic vectors of inter-concept cross-products corresponding to the six retained roots were obtained and rotated by Varimax criterion for identification of the group common concept space (Table 3). However, for an objective characterization of the results, the denotative component analysis of Kinships used in the Atlas were adapted in this study (cf., Osgood et al., 1975, Tzeng and Osgood, 1976). That is, eight Kinship

Table 3  
Salient Kinships on Cross-Cultural Common  
Concept Dimensions

<u>Dimension I</u>		<u>Dimension II</u>		<u>Dimension III</u>	
BRIDE	.71	HUSBAND	.49	FATHER	.52
MOTHER	.23	PERSON	.38	SON	.33
RELATIVES	-.36	EGO	.27	GRANDFATHER	.27
EGO	-.31	COUSIN	-.55	FATHER-IN-LAW	.23
BROTHER	-.26	AUNT	-.24	UNCLE	.22
MOST PEOPLE	-.22	UNCLE	-.23	SISTER	-.41
		MOST PEOPLE	-.20	GRANDMOTHER	-.25
		RELATIVES	-.15	DAUGHTER	-.23
				BRIDE	-.23
				RELATIVES	-.18
				AUNT	-.16
<u>Dimension IV</u>		<u>Dimension V</u>		<u>Dimension VI</u>	
GRANDMOTHER	.60	SON	.55	MOTHER-IN-LAW	.58
GRANDFATHER	.58	WIFE	.50	FATHER-IN-LAW	.47
BRIDEGROOM	-.30	DAUGHTER	.47	MOST PEOPLE	.15
COUSIN	-.26	MOTHER-IN-LAW	-.20	MOTHER	-.47
EGO	-.23	MOTHER	-.19	FRIEND	-.27
BRIDE	-.16	FATHER	-.19	FATHER	-.26
				BROTHER	-.16

\*Salient loadings whose absolute values exceed .15 are reported in this table.

components devised by Osgood (Tzeng, Note 7) were used to probe each factor structure. These eight components and their coding systems are as follows: (a) Sex (with trinary codings, +/0/- for male/either/female respectively), for example, UNCLE is coded +, RELATIVE is coded 0, and WIFE is coded - ; (b) Generation (with +/0/- codings for grandparents/parental/ego generations); (c) Typical age (with +/0/- for old/middle/young); (d) Nuclearity (with +/00/- for nuclear family/irrelevant/non-nuclear family); (e) Consanguinity (with +/00/- for blood related/unrelated/by law); (f) Specificity with +/00/- for particular person/irrelevant/more-than-one person); and (g) Maritality (with +/0/- for must be/indefinite/must have been). Note that the symbol 00 represents irrelevance or non-differentiation of a component for a given concept. For example, the concept BRIDE is 00 on components Generation, Lineality, and Specificity because it can refer to all three generations, both lineal or non-lineal relationship, and one or many persons.

Since the codings of all 22 Kinships are available in the Atlas, it is easy to compare the codings of all concepts salient on each concept dimension across all eight denotative components (features). For the present identification of concept factors, however, only the features having a consistent pattern of codings from all concepts on either or both polarities of a concept dimension will be reported.

Dimension 1 is dominated by BRIDE and MOTHER in the positive pole and RELATIVE, EGO, BROTHER and MOST PEOPLE on the negative pole. Given the fact that the respondents were unmarried teen-age boys, the concepts RELATIVE, BROTHER and MOST PEOPLE may have been perceived as unmarried males. This seems to be supported by the characteristics of the positive

pole which are -Sex (female) and +Maritality (married). The concepts salient on Dimension 2 are HUSBAND, PERSON, EGO on the positive pole and COUSIN, AUNT, UNCLE, MOST PEOPLE and RELATIVE on the negative pole. Such bipolarities are well differentiated by the underlying features of Nuclearity and Specificity.

The third dimension, defined by FATHER, SON, GRANDFATHER, FATHER-IN-LAW, and UNCLE on one hand, and SISTER, GRANDMOTHER, DAUGHTER, BRIDE, RELATIVE and AUNT on the other, is clearly defined by a single Sex component with +Sex for the positive pole and -Sex for the negative pole. The fourth factor, comprising GRANDMOTHER, GRANDFATHER versus BRIDEGROOM, COUSIN, EGO, and BRIDE seem to separate the grandparental generation from ego generation and also old people from younger people. Both features, Generation and Age, are confounded for this concept factor, interestingly enough.

For the fifth dimension, concepts salient on the positive pole, SON and DAUGHTER (with the exception of WIFE), are -Generation, -Age, and -Maritality, whereas concepts salient on the negative pole, MOTHER-IN-LAW, MOTHER and FATHER, are <sup>o</sup>Generation, <sup>o</sup>Age, and <sup>o</sup>Maritality. Since all these concepts tend to be +Nuclearity and +Lineality, this dimension may reflect a generational differentiation within the nuclear family. The last dimension, defined by MOTHER-IN-LAW, FATHER-IN-LAW and MOST PEOPLE versus MOTHER, FRIEND, FATHER and BROTHER, seems to represent personalities presently having close or remote relationships with the teen-age boys. It is interesting to note that except for MOST PEOPLE and FRIEND, other salient concepts are well accounted for by two confounded semantic features, Consanguinity and Nuclearity.

Table 4  
Characteristic Roots of Core Matrices of the  
13 Idealized Cultures

Idealized Culture	Dimension					
	1	2	3	4	5	6
I	30.96 (.75) <sup>a</sup>	8.19* (.20)	4.17 (.10)	3.68 (.09)	-1.17 (-.03)	-4.67 (-.11)
II	42.74 (.77)	8.02 (.14)	5.92* (.11)	1.12 (.02)	.34 (.01)	-2.53 (-.05)
III	29.60 (.75)	7.92* (.20)	3.68 (.09)	1.05 (.03)	-0.83 (-.02)	-1.90 (-.05)
IV	34.21 (.71)	10.95 (.23)	6.76* (.14)	2.52 (.05)	-0.05 (.00)	-5.96 (-.12)
V	31.20 (.70)	8.51 (.19)	5.50* (.12)	2.37 (.05)	-0.41 (-.01)	-2.33 (-.05)
VI	17.63 (.67)	4.06 (.15)	3.11* (.12)	1.51 (.06)	.09 (.01)	.00 (.00)
VII	14.02 (.61)	4.55 (.20)	2.49* (.11)	1.22 (.05)	.57 (.03)	.18 (.01)
VIII	4.74 (.47)	2.70 (.27)	1.48* (.15)	.78 (.08)	.58 (.06)	-.17 (-.02)
IX	18.12 (.60)	6.25 (.21)	4.34* (.15)	1.76 (.06)	.66 (.02)	-.78 (-.03)
X	19.52 (.64)	6.19* (.20)	2.61 (.09)	1.98 (.06)	1.15 (.04)	-.72 (-.02)

Table 4 Continued

XI	43.82	16.38*	7.17	6.01	3.41	-.20
	(.57)	(.21)	(.09)	(.08)	(.04)	(.00)
XII	22.06	6.31*	3.68	1.49	.46	-1.19
	(.67)	(.19)	(.11)	(.05)	(.01)	(-.04)
XIII	37.07	10.67*	5.09	3.70	2.90	.68
	(.61)	(.18)	(.08)	(.06)	(.05)	(.02)

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<sup>a</sup>Proportion of sum of squares accounted for by each dimension.

\*Cut off point. This root and those above were retained.

Table 5  
Salient Loadings of Five Idealized Cultural  
Private Configurations

Idealized Culture I: BE			
Dimension 1		Dimension 2	
HUSBAND	.39	BROTHER	.27
PERSON	.26	FRIEND	.26
MOTHER-IN-LAW	.18	MOTHER	.25
SON	-.47	FATHER	.25
WIFE	-.41	EGO	.17
DAUGHTER	-.39	GRANDFATHER	.15
GRANDFATHER	-.24	GRANDMOTHER	.15
		MOTHER-IN-LAW	-.49
		BRIDE	-.38
		COUSIN	-.32
		FATHER-IN-LAW	-.27
		BRIDEGROOM	-.20

Idealized Individual II: FR and IT					
Dimension 1		Dimension 2		Dimension 3	
EGO	.37	FATHER-IN-LAW	.36	MOTHER-IN-LAW	.44
SON	.29	FATHER	.34	MOST PEOPLE	.32
BRIDEGROOM	.19	GRANDFATHER	.25	COUSIN	.28
BROTHER	.18	MOTHER-IN-LAW	.25	RELATIVES	.20
HUSBAND	.16	UNCLE	.18	AUNT	.18
GRANDMOTHER	-.50	BRIDE	-.45	FATHER-IN-LAW	.18

Table 5 Continued

GRANDFATHER	-.46	DAUGHTER	-.41	MOTHER	-.42
AUNT	-.18	SISTER	-.29	FATHER	-.37
		WIFE	-.26	FRIEND	-.23
				GRANDFATHER	-.23
				HUSBAND	-.18

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 Idealized Culture IX: TH, TK, JP, AE, and CS
 

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Dimension 1		Dimension 2		Dimension 3	
EGO	.34	FATHER	.51	MOTHER-IN-LAW	.54
BRIDEGROOM	.23	UNCLE	.23	FATHER-IN-LAW	.40
SON	.20	MOTHER	.20	MOST PEOPLE	.26
BROTHER	.18	GRANDFATHER	.17	MOTHER	-.49
GRANDMOTHER	-.61	DAUGHTER	-.48	FATHER	-.27
GRANDFATHER	-.53	WIFE	-.36	BRIDE	-.24
		BRIDE	-.32	FRIENDS	-.20
		SISTER	-.25		

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 Idealized Culture XI: GK
 

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Dimension 1		Dimension 2	
BRIDEGROOM	.27	SON	.51
EGO	.31	WIFE	.43
HUSBAND	.18	DAUGHTER	.42
GRANDMOTHER	-.60	COUSIN	.23
GRANDFATHER	-.56	HUSBAND	-.34
		PERSON	-.27
		MOTHER-IN-LAW	-.19

Table 5 Continued

Dimension 3		Dimension 4	
BRIDE	.48	MOTHER-IN-LAW	.56
SISTER	.36	FATHER-IN-LAW	.47
GRANDMOTHER	.19	MOTHER	-.48
DAUGHTER	.19	FATHER	-.30
FATHER	-.46	EGO	-.27
SON	-.33	BROTHER	-.15
GRANDFATHER	-.28		
FATHER IN LAW	-.23		
UNCLE	-.20		

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Idealized Culture XIII: YS

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Dimension 1		Dimension 2	
GRANDFATHER	.43	MOTHER-IN-LAW	.58
GRANDMOTHER	.39	FATHER-IN-LAW	.40
FATHER	.26	HUSBAND	.21
MOTHER	.19	PERSON	.18
WIFE	-.37	MOTHER	-.38
SON	-.36	FATHER	-.34
DAUGHTER	-.35	FRIEND	-.20
BRIDE	-.21	SON	-.16
EGO	-.20		

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\*Salient loadings whose absolute values exceed .15 are reported in this table.

### Idealized Cultural Characteristic Matrices

Based on the following three solutions: a raw three-mode  $6 \times 6 \times 4$  (concept factors by concept factors by culture viewpoint dimensions) inner core matrix per [3], the transformation matrix  $T$  for the final concept factor coefficients from [5], and the resultant idealized cultural factor coefficients  $S_g^*$  and its transformation matrix  $U^*$  from [16], thirteen two-mode characteristic matrices  $H_j^*$  were derived from [17] -- one for each idealized culture with rows and columns corresponding to the six resultant dimensions of the object space. A principal components analysis was applied to them separately. The distributions of their eigenvalues, given in Table 4, were then used to decide the number of object dimensions retained for each idealized cultural private space.

### Conceptual Structures of Culture Types

The retained factor coefficients of kinship terms within each idealized cultural private space were rotated orthogonally with the arimax criterion, yielding 13 separate structures of idealized cultures. However, the results, reported in the present illustration as given in Table 5, include only five idealized cultures: I (BE), II (FR and IT), XI (GK), XIII (YS) and IX (TH, TK, JP, AE and CS). This is based on the consideration that while each of the first four idealized cultures represents a separate viewpoint dimension in Table 2, the last one represents the five combination cultures (i.e., Idealized Cultures VI-X) which are close to the centroid of the viewpoint space. Evaluation of these five private conceptual structures seems enough to demonstrate the construct and utility of the present 3M-POV model.

Idealized Culture I. There are only two dimensions in the conceptual space of this culture type which is represented by Black American English (BE). The first factor, comprising HUSBAND, FRIEND and MOTHER-IN-LAW versus SON, WIFE, DAUGHTER, and GRANDFATHER tends to differentiate kinships in terms of three denotative components: Age, Nuclearity and Consanguinity. It is interesting to note that Generation and Specificity are completely non-discriminative for this factor. The second dimension has the leading kinships of MOTHER-IN-LAW, BRIDE, COUSIN, FATHER-IN-LAW, BRIDEGROOM on the negative side and BROTHER, FRIEND, MOTHER, FATHER, EGO, GRANDFATHER, and GRANDMOTHER on the positive side. It is obvious that the concepts on the negative pole tend to reflect marital relationships whereas the concepts on the positive pole tend to be +Lineality and +Consanguinity.

Idealized Culture II. The dimensions of Idealized Culture II, representing French (FR) and Italian (IT), are almost identical to three factors of the cross-cultural common space. While Dimension 1, with salient kinships EGO, SON, BRIDEGROOM, BROTHER, and HUSBAND versus GRANDMOTHER, GRANDFATHER and AUNT, is clearly characterized by Age (young versus old). The second dimension, dominated by FATHER-IN-LAW, FATHER, GRANDFATHER, MOTHER-IN-LAW, and UNCLE versus BRIDE, DAUGHTER, SISTER, and WIFE, is well accounted for by the Sex component. The third dimension is defined by MOTHER-IN-LAW, MOST PEOPLE, COUSIN, RELATIVE, AUNT, FATHER-IN-LAW versus MOTHER, FATHER, FRIEND, and GRANDFATHER. It can be identified by marital relationships for the positive pole (except MOST PEOPLE) and Consanguinity for the negative pole (except FRIEND).

Idealized Culture IX. This idealized type represents three Asian member cultures, Thai (TH), Turkish (TK) and Japanese (JP), and two

American groups, American English (AE) and Costa Ricans (CS). All three conceptual dimensions have maximal similarities to the cross-cultural common factors. That is, Dimension 1, dominated by EGO, BRIDEGROOM, SON, BROTHER versus GRANDMOTHER and GRANDFATHER, is well differentiated by Age (young versus old) and Generation (grandparental versus ego generation). Dimension 2, dominated by FATHER, UNCLE, MOTHER and GRANDFATHER versus DAUGHTER, WIFE, BRIDE and SISTER seems to reflect kinship conceptual differences in Sex and possibly also in Consanguinity (blood-related versus unrelated). Dimension 3, characterized by MOTHER-IN-LAW, FATHER-IN-LAW, and MOST PEOPLE versus MOTHER, FATHER and FRIEND, seems to reflect a close or remote relationship among individuals in society. The fact that BRIDE is also salient on this dimension may suggest its connotation of being a girl friend for the teen-age male subjects within this culture type.

Idealized Culture XI. This type is represented by a single language/culture community, Greece (GK), which has salient loadings on two cross-cultural viewpoint dimensions in Table 2. The first dimension, dominated by GRANDMOTHER and GRANDFATHER on one hand and BRIDEGROOM and EGO on the other hand, seems to be an Age differentiating component. But the presence of HUSBAND on the "young" pole makes this factor distinct. Dimension 2, like the first dimension of BE, consists of the concepts HUSBAND, PERSON and MOTHER-IN-LAW versus SON, WIFE and DAUGHTER. The only difference is the appearance of an extra concept associated with +Nuclearity: GRANDFATHER for BE and COUSIN for GK. Dimension 3, identical to the third factor of the cross-cultural common space, is clearly a Sex determining factor. Dimension 4 characterized by MOTHER-IN-LAW and FATHER-IN-LAW versus MOTHER,

FATHER, EGO and BROTHER is differentiated by Nuclearity and Consanguinity.

Idealized Culture XIII. The other single community, uniquely representing an idealized culture and defining a cross-cultural viewpoint dimension, is Yugoslavia (YS). The first factor seems to be culturally unique. The leading concepts on the positive pole -- GRANDFATHER, GRANDMOTHER, FATHER and MOTHER are +Age, +Lineality and +Consanguinity and <sup>o</sup>Maritality, whereas the concepts on the negative pole -- WIFE, SON, DAUGHTER, BRIDE and EGO -- tend to be -Age, and +Nuclearity (possibly +Lineality also). The second dimension is a cross-cultural common factor, characterizing personalities with a close or remote relationship with the young male subjects.

By way of summarizing the preceding results, it is obvious that five of the six cross-cultural common structures of kinships in Table 3 (except Dimension 1) are identifiable from at least two private configurations of the present five idealized cultures. Among them, four dimensions, III to VI, are most salient, being shared by most idealized cultures. On the other hand, it should be noted that although most dimensions in each private space can basically be accounted for by the group common space, some unique characterizations of these dimensions exist for subsets of idealized cultures. This suggests that for detailed information on cross-cultural commonalities as well as idealized cultural uniquenesses, the present model would provide a promising objective course for further pursuits. However, detailed interpretation of the data presented above is beyond the scope of the present paper which is methodological in focus. Such interpretations and discussions can be found in Landis and Tzeng (Note 4) where a culturalogical analysis of the Black English data is made against the backdrop of the other twenty-seven cultures.

## CONCLUSION

The present analysis demonstrates an integration of the Three-Mode and Points-of-View models in multidimensional scaling. Although the Three-Mode model has been considered more powerful, it does not automatically provide necessary and more comprehensible information on the similarities and differences in individual conceptual structures among objects (here, kinship terms) which are usually the target of the POV procedure. The present results illustrate the use of this integration for complete quantitative measures of group common as well as individual unique conceptual structures at an easily understandable level. A computer program has been completed which will perform the entire analytic algorithm developed in this paper. Instructions for, and illustrations of, its application will soon be available in a monograph prepared by the author (Tzeng and Landis, Note 6).

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