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Three-mode analysis of perceptions of economic activities in Eastern and Western Europe [1]

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Abstract

Data on similarities and differences in perceptions of economic activities in Hungary, Poland, the Netherlands and the United Kingdom were collected. The data set is a three-mode one consisting of economic activities (mode 1) scored on rating scales (mode 2) by a number of individuals or judges (mode 3). The major thesis of this paper is that such data should be analyzed by three-mode analysis methods rather than two-mode methods. To demonstrate this, the data were analyzed with three-mode principal component analysis (PCA) using the program TUCKALS3. Both the decisions which precede the three-mode analysis, the three-mode analysis itself, and its interpretation are illustrated and explained. The paper treats three-mode PCA in some detail in order to show how it can be applied to unravel structures in complicated three-mode data which frequently arise in the field of economic perception. The substantive result is that there is a perceptual space common to all four nations. It is characterized by contrasts between economic and social values, by immediate or delayed consequences of activities,

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and by a difference between occupational and private activities. The most striking difference between countries is that the British have a different view of the financial resources necessary for certain activities compared to inhabitants of the other three countries.

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1. Introduction

Because of changes in political and economic systems, and the widespread availability of modern means of communication, life in East and West European countries is gradually becoming more similar. Although their different cultural and economic histories and different current levels of economic welfare may still differentially affect the perceptions of economic activities, in general the perceptions of economic life can be expected to converge across countries. However, the question arises how similar the current perceptions of the same economic activities are in different countries. This question is relevant to the process of European integration. Rather than looking for cognitive universals, i.e. worldwide comparable cognitive structures (cf. Lonner, 1980) we shall deal with similarities and contrasts in the perceptions of economic activities.

The perception of economic activities refers to the way people classify activities in their cognitive representations of reality. In the area of object classification, it has been found that familiarity with objects reduces cultural differences (Pick, 1980). If this result also applies to the classification of activities, it may be hypothesized that familiar activities are perceived in similar ways by people in different countries. In this respect, we are looking for functional equivalence of perceptions in different countries (Berry, 1980).

On the other hand, since Eastern European countries have had different economic experiences than countries in the West, it may be the case that history has differentially affected people's perceptions in these countries. In Eastern European countries, the market system has been reintroduced only recently after the breakdown of the communist system. Bond and Smith (1996) argue that universal processes may be shaped by cultural constraints. In this respect, collective or conservative societies may not perceive economic activities in the same way as individualistic or autonomous societies. (See Schwartz, 1994; Triandis, 1995, for the implications of these cultural distinctions.) This leads to the hypothesis that there will be more similar perceptions of economic activities within Eastern Europe and within Western Europe, because of their similarities in economic history, than between Eastern European countries and Western European countries.

In comparing perceptions of activities across countries empirically, one strives for conceptual equivalence, i.e. activities and aspects of activities should have the same meaning in different countries (Alwin et al., 1994). Usually, this is accomplished by translation and back-translation of survey questions. Since familiarity with the economic activities concerned may also affect the perceptual structures in different countries, familiarity with the activities under study should be more or less the same across countries.

Hofstede (1984) points out that in cross-cultural research, frequently three-mode data are collected. Specifically, several opinions are asked, concerning a number of stimuli, in different countries. Thus there are three modes for such data: the participant or subject mode (generally further subdivided into countries), the stimulus mode (in our case consisting of economic activities) and the aspect mode (usually several psychological or sociological scales). In examining relationships between scales, researchers frequently reduce three-mode data to two-mode data to make them suitable for analysis by standard techniques like principal component analysis (PCA) or factor analysis (FA), which are readily available in commercial software. These are in fact two-mode techniques and they assume subjects to be a random factor. Often the reduction of three-mode data to two-mode data is done by: (1) averaging over subjects so that an activities by scales matrix remains, (2) averaging over subjects, after computing scale correlations based on activities as replications (cf. Osgood et al., 1975, p. 49) or (3) stringing out subject-by-activities combinations, so that a subjects × activities by scales matrix is analyzed. Averaging over subjects and PCA of the reduced data set has been conducted by Slovic et al. (1984), Fischhoff et al. (1978) and Tyszka (1994), among others. In all three types of reductions, sooner or later the activities are treated as if they were a random factor, which clearly is not the case. Furthermore, scale correlations based on group means (ecological correlations) are usually higher than the same scale correlations based on individual data. If ecological correlations are interpreted as if they apply to individuals, the so-called ecological fallacy is committed (Hofstede, 1984).

To avoid these reduction problems, modern methods may be used to analyze three-mode data directly. These methods use the original (non-reduced) data sets to find structure in each of the three modes and across the modes. One such technique will be used here to study the perceptual space of economic activities across four countries: The Netherlands, the United Kingdom, Poland and Hungary, using data collected by Antonides et al. (1997).

The primary purpose of the paper is to demonstrate how a three-mode analysis of data such as ours may proceed. This entails a mix of procedures to handle the problems specific to the data at hand, and procedures which can be used to handle three-mode data more generally in the field of economic psychology. At the same time, we will present a number of substantive conclusions derived from our analysis, so the paper has both a methodological and a substantive content, be it that the main emphasis is methodological. The results can be compared with these from more conventional analyses of the same data set reported by Antonides et al. (1997).

Section 2 describes the survey data and the way we have treated them. Section 3 describes how the three-mode analysis follows on from a two-mode one and it explains the three-mode PCA model and its interpretation. Section 4 gives the results of the analyses, and Section 5 provides both methodological and substantive conclusions.

2. Data

Participants living in the Netherlands, the United Kingdom, Poland and Hungary were asked to complete a questionnaire in the language of their country. After translation from English into Dutch, Polish and Hungarian, the questionnaires were back-translated into English in order to ensure conceptual equivalence. A comparison of activity perceptions across countries should include a wide range of activities and a great variety of people in each country. However, since our interest is in general rather than specific similarities and contrasts, atypical activities were excluded from the study. Moreover, since female labour participation is known to be different across countries, the population selected consisted of males between 30 and 50 years of age in full-time employment. In each country, the participants were sampled from a big city and a medium-sized town during the autumn of 1992.

Forty different activities were identified, but requesting subjects to respond to all forty activities was deemed both unrealistic and counterproductive. Therefore, two reasonably parallel lists, each of 20 activities, were constructed (see Table 1). The selection of activities was such that they were at least to

Table 1
Two parallel lists of economic activities used as stimuli in two different samples in each of the countries

List 1	Abbreviation	List 2	Abbreviation
Going on strike	Strike	Being a member of a union	Union
Changing workplace	Chjob	Working abroad	Abroad
Being employed in an office	Office	Being employed as a teacher	Teach
Being employed as a car mechanic	Mech	Being employed as a house painter	Paint
Being a politician	Politc	Being a professional athlete	Athlet
Being an owner of a bank	Owbank	Being an owner of a newspaper	Newsp
Being an owner of a casino	Casino	Being an owner of a nightclub	Niclub
Studying for a new profession	Profes	Being unemployed	Unempl
Advertising products in the mass media	Adver	Advertising products in an international fair	Advint
Investing in an enterprise	Invest	Buying shares	Stock
Buying property insurance	Insur	Buying life insurance	Lifesr
Taking loans	Loan	Using credit	Credit
Putting money in the bank	Save	Buying government bonds	Bonds
Paying taxes	Paytax	Cheating on taxes	Chetax
Buying a house	House	Buying a car	Buycar
Saving energy	Energy	Educating children	Childr
Gambling on horse racing	Horses	Gambling in the casino	Gambl
Giving bribes	Gbribe	Receiving bribes	Rbribe
Giving money to a beggar	Beggar	Giving to charity	Charit
Being a ‘fence’ for stolen property	Fence	Repairing old clothes	Mend

some degree familiar in each country, covered a wide range of activities, and were fairly representative of economic activities in general. Each respondent rated 20 economic activities on 12 bipolar scales (see Table 2). The total number of respondents was 801, distributed evenly among the countries. Of these, 406 of whom rated the 20 activities in List 1, while 395 rated the 20 activities in List 2. Further details can be found in Antonides et al. (1997).

2.1. Nature of the data

The most common data structure is a data matrix with subjects as rows and variables as columns, and such data are often referred to as *profile data*. Generally, the subjects are considered to be a sample from a particular population. The primary statistics of interest in this case are the means of the variables and their covariance matrix, while the subjects are a random factor. When the subjects are measured under several conditions, we obtain *three-mode profile data* of subjects by variables by conditions. If the data are

Table 2
Perceptual scales used to evaluate economic activities

	Abbreviation
To what extent is this activity profitable? Unprofitable – **Profitable**	Profitable
To what extent is this activity prestigious? Not prestigious – **Prestigious**	Prestigious
To what extent is this activity moral? Immoral – **Moral**	Moral
To what extent is this activity beneficial for society? Harmful for society – **Beneficial for society**	Beneficial
To what extent does this activity require effort? **Requires little effort** – Requires great effort	Effort
To what extent does this activity require knowledge? Requires little knowledge – **Requires much knowledge**	Knowledge
To what extent does this activity require financial resources? Requires little financial resources – **Requires a lot of financial resources**	Resources
To what extent are consequences of this activity delayed? Consequences delayed – **Consequences immediate**	Consequences
To what extent is this activity known to you? Unknown – **Well-known**	Known
To what extent is this activity risky? Risky – **Non-risky**	Non-risky
To what extent is this activity sensible? Not sensible – **Sensible**	Sensible
To what extent is this activity pleasant? Unpleasant – **Pleasant**	Pleasant

visualized as arranged in a block (technically called an *array*), then the data matrix for each subject is a (*frontal*) *slice* of this block, like a slice of a cake.

The present data are, however, not profile data (even though in the Antonides et al., 1997, paper they were treated as such), because it is not the covariance structure and the means that are of prime interest, but the interrelationships between activities and scales, which provide us with the perceptual structure of the economic activities. The task of the subject is a judgmental one. Each subject or judge assigns a value to each activity-scale combination by judging the appropriateness of a scale for an activity or, put differently, each judge assesses the similarities between activities and scales. The natural way to arrange the data into a three-way array is therefore economic activities by scales by judges, and a frontal slice consists of the activities by scales judgments of a single person. We will refer to such data as *judgmental data*. A well-known related example of such data are semantic differentials, in which concepts have to be judged on bipolar scales by several individuals (judges). To us it seems ill-advised to perform a standard principal component analysis for each judge; after all, the activities do not constitute a random factor, and the interest is in the interactions between rows (economic activities) and columns (scales). Instead, we propose to analyze ordinary (two-mode) judgmental data via *biplots* using the *singular value decomposition*, and three-mode judgmental data via *joint plots* using *three-mode principal component analysis* as one of the three-mode generalizations of the singular value decomposition. All these technical terms will be explained in detail below.

As mentioned above, for practical reasons (see Antonides et al., 1997) there were two versions of the questionnaire, each with a different list of 20 economic activities. As the relationships between the activities themselves, and those between activities and scales, make up the perceptual structure of the economic activities, some way had to be found to combine the activities into a single list. Furthermore, our interest centred primarily around similarities and differences between countries rather than between individual judges within countries. We therefore decided to assess whether it was possible to reduce the data set by averaging over subjects within countries, and analyze an activities by scales by countries array. If this proved possible without a substantial loss of fit of the model to the data, it would simplify describing and presenting the results. As we will show below, such an assessment can be performed with the same three-mode methods that we propose to use to analyze the interrelationships themselves. Note, however, the same scales had been used for all subjects, an analysis of all subjects could have been performed. In that case, however, the components of the subjects could not easily have been interpreted.

A problem with the analyses of the present data performed by Antonides et al. (1997), apart from their conceptualization as profile data, was that separate analyses were performed for each country, and these separate analyses then had to be compared. In particular, varimax-rotated components from different analyses were compared, but as there was no link between the analyses, there was no guarantee that the varimax-rotated components were aligned properly. This was clear from the solution for Hungary, where the first two varimax-rotated components seemed to have changed places compared to the other countries. To ensure that all components were optimally aligned some systematic procedure should have been applied, for example Procrustes rotation (see e.g., Gower, 1975). Without such an alignment, the rationale for comparing the activities across countries on the basis of component scores becomes uncertain. Antonides et al. (1997) solved this problem by first performing a principal component analysis on all their data – a 32 040 (subjects $\times$ activities) by 12 (scales) data matrix – and subsequently analyzing the two-dimensional component scores with 80 (40 activity means for each component) factorial analyses of variance. This is clearly a very unwieldy procedure.

By using three-mode methods we intend to present a simultaneous analysis of each of the three modes of the data, economic activities, scales, and judges, as well as of their interrelationships, via a very parsimonious model. In particular, we will use a model that assumes that there is a single set of components for each of the modes, and that the relationships between the modes reside in parameters which describe the relationships between these components. The crucial test of whether such an approach is appropriate consists of assessing how well the model fits the data, and how well the data for each country are represented by the model. One way to do this is to compare the solution for all countries together with the separate solutions for each of the countries. The details of this comparison will also be explained below.

3. Overview of the methods of analysis

In this section we will first discuss biplots as the way of analyzing the data of a single judge to investigate his or her perceptual structure. In order to simplify presentation we will assume that a judge in this case is a country and that the data are mean scores of subjects in that country. Then we will explain how to handle the data of several countries by discussing several methods for three-mode data analysis.

3.1. Biplot analysis of the data of a single judge

The judgmental data for a single judge (country) consist of a data table with economic activities as rows and rating scales as columns. The information relevant to our study is contained in the interaction between activities and scales; in particular we want to compare the relative positions of the activities on the scales, and the relative positions of the scales on the activities, irrespective of the mean values of the scales and the mean values of the activities. To eliminate the mean information the data should be double-centred, i.e.

$$\tilde{z}_{ij} = z_{ij} - \bar{z}_{i.} - \bar{z}_{.j} + \bar{z}_{..}. \tag{1}$$

Thus each activity-scale combination is expressed as a deviation from its row and its column mean, and represents the interaction between an activity and a scale.

The perceptual structure follows from the so-called singular value decomposition of the double-centred data table. The singular value decomposition is defined as

$$\tilde{z}_{ij} = \sum_{s=1}^{S} \lambda_s a_{is} b_{js} = \sum_{s=1}^{S} \left(a_{is}\sqrt{\lambda_s}\right)\left(b_{js}\sqrt{\lambda_s}\right), \tag{2}$$

where a_{is} are the coefficients of the eigenvectors of the activities, b_{js} those of the eigenvectors of the scales, and the λ_s the singular values. There is a simple relationship between these coefficients with the results from a principal components analysis. The a_{is} are the scores of the ith activity on the sth component, the $\lambda_s b_{js}$ are the loadings on the sth component and λ_s is the square root of the sth eigenvalue. Thus the squares of the λ_s represent the amount of variation accounted for, where variation is a general term for sums of squares, which may or may not be of deviation scores. Note that because we do not standardize the scales the loadings are not exactly variable-component correlations, and the λ_s are not exactly variances.

The eigenvectors from the singular value decomposition may be used to construct a so-called *biplot* (Gabriel, 1971; Gower and Hand, 1996) in which both the activities and scales are displayed. There are several ways to construct coordinates in a biplot, and we will use *symmetrical scaling*, which implies that $a_{is}\ \sqrt{\lambda_s}$ and $b_{js}\ \sqrt{\lambda_s}$ will be displayed in the plot. The origin of a biplot is the average value for each scale and each activity (because of the double-centring of Eq. (1)). To interpret a biplot we first draw arrows from the origin to each scale point. The arrow defines the direction or axis of the scale point in the plot. To indicate such an axis the arrow back from the origin, as has been done with the dotted line for 'consequences' in Fig. 2. To evaluate the relative importance of a scale for a particular activity we drop a perpendicular from an activity to (or *project* an activity onto) the axis of the scale, as is shown for 'unemployed' onto the axis of 'consequences'. If the projection is on the negative side of the arrow (i.e. on the opposite side of the origin from the scale point) then the activity has a lower than average score on that scale. Similarly if the projection on the positive side (as activity ‘unemployed’ has for the ‘consequences’ scale) then it has a higher than average score on that scale. The order of the projections of the activities on a scale indicates the relative importance of the scale for the activities. Scales which are close together have similar arrangements of activities and are thus highly associated.

Conspicuously missing from the above discussion is any mention of interpreting components. The main reason for this is that techniques based on singular values (including principal component analysis) essentially seek optimal low-dimensional spaces (planes in the two-dimensional case), rather than latent variables, as is for instance done in common factor analysis. We may quote in this context from the Gower and Hand (1996) book on biplots:

> “And one can [...] seek to describe particular eigenvectors in terms of properties of the samples which are characterized by these eigenvectors – a process known as *reification*. Reification receives very little mention in this book, partly because we regard it as being open to over-enthusiastic misinterpretation but more because our main objective is to interpret multidimensional displays in terms of the original variables. We regard principal axes and similar constructs as providing essential scaffolding on which to base our plots, but the scaffolding is removed for display purposes”. (p. 11, 12).

On this point we agree entirely with Gower and Hand. We use directions in displays only to point to common meaning of scales or of economic activities, rather than assuming that those directions correspond to specific latent constructs. A further implication is that there is no one single correct direction in a multidimensional display or space.

3.2. From separate analyses to a single joint analysis

As we have four countries in our study we can produce four biplots. However, as mentioned above, this poses the problem of comparing the separate analyses. There are several ways of proceeding to combine these in an appropriate manner. One can, for instance, take a cross-validation approach and assess how well the solution for one country fits that for another country. This will still leave us without a common basis for comparison. Another approach is to first find a joint orientation of the four activities component spaces and a joint orientation of the four scale spaces using Procrustes analysis (Gower, 1975), and then assess how well each country concurs with this joint solution. Here, we will pursue a third approach, which is to find, directly, a joint solution for both a common activity space and a common scale space, and assess how well these common spaces fit the double-centred data of each country. There are several models for finding these common spaces simultaneously. A first model which stays as close as possible to performing separate analyses is the so-called Tucker2 model which was first formulated by Tucker (1972), see also Kroonenberg and de Leeuw (1980). It has the form

$$\tilde{z}_{ij}^{k} = \sum_{p=1}^{P}\sum_{q=1}^{Q}\lambda_{pq}^{k} a_{ip} b_{jq}, \quad k = 1, \ldots, K. \tag{3}$$

The double-centred data table for each country k is now modeled as in Eq. (1), but with coefficients for the activities a_{ip}, coefficients for the scales b_{jq} and singular values λ_{pq}^{k}. Note that the coefficients for the activities and scales are independent of k, and thus common to all countries, but that the singular values may be different between countries. In addition, we see that the number of components for activities P and for scales Q may be different, and it turns out that the singular values λ_{pq}^{k} may become negative, indicating inverse relationships between components of different modes. As in the two-way case, the squares of the singular values indicate the amount of variation accounted for. To emphasize the similarity in treatment between activities and scales, we will use the term *scores* for the coefficients both of the activity components and of the scale components.

In many cases it turns out that it is advantageous to achieve even further parsimony by computing components for the third mode (here countries) as well. This will enable us to inspect in a relatively straightforward manner the extent to which countries are similar and the extent to which they are different. The three-mode model which includes such components is generally referred to as the Tucker3 model and was introduced by Tucker (1966), see also Kroonenberg and de Leeuw (1980), and Kroonenberg (1983b). It has the form

$$\tilde{z}_{ijk} = \sum_{p=1}^{P}\sum_{q=1}^{Q}\sum_{r=1}^{R}\lambda_{pqr} a_{ip} b_{jq} c_{kr}, \tag{4}$$

where the c_{kr} are the coefficients for the countries (again R may be different from P or Q), and the λ_{pqr} are the three-mode singular values. Because this model is symmetric in all modes the index k is no longer written as a superscript. The singular values can be arranged into a three-mode array Λ, which is called the *core array* or core matrix. The squared singular values yet again represent the amount of variation accounted for. The squared three-mode singular values can be added for each component of each mode to provide measures of variability accounted for by each component of each mode. When divided by the total variability – SS(Tot) – they indicate the proportional fit of a component in much the same way as in ordinary component analysis.

Other models have been proposed to deal with three-mode data, especially the Parafac model (see Harshman and Lundy, 1984a, b, 1994), but we will restrict this presentation to the Tucker3 model; for an annotated bibliography of the literature on the subject of three-mode analysis, see Kroonenberg (1983a), which includes both theoretical and applied papers.

In practical applications, one generally only needs a limited number of components and therefore one seeks to approximate the data with a limited number of terms in the models. It can be shown that one may split the total sum of squares or variation of the data into a fitted and residual part, i.e. SS(Total) = SS(Fit) + SS(Res), and what is more the same can be done for the separate levels of each mode; that is to say, for each economic activity, each scale, and each country, the total sum of squares can also be split into a fitted and a residual part. This is particularly useful for the countries, because once we have fitted a model, we can compare how well the model fits the data for each country, and compare the result with the separate analyses. Many of the details as well as practical examples can be found in Kroonenberg (1983b).

Given that we have a joint solution for the countries, we would like to have a way of displaying the perceptual structure of the economic activities. As will be shown in more detail in the example, we can present side by side the part of the perceptual structure which the countries have in common and the part in which they differ. The way of displaying this structure is similar to the biplot in the single country case. To see this we will first rewrite the model equation of the Tucker3 model (Eq. (4)), using the symbol $\approx$ to indicate that we are using an approximation with a limited number of components:

$$\tilde{z}_{ijk} \approx \sum_{r=1}^{R} c_{kr} \left(\sum_{p=1}^{P} \sum_{q=1}^{Q} \lambda_{pqr} a_{ip} b_{jq} \right) = \sum_{r=1}^{R} c_{kr} d_{ij}^{r}. \tag{5}$$

Thus the d_{ij}^{r} are equal to the expression between brackets,

$$d_{ij}^{r} = \sum_{p=1}^{P} \sum_{q=1}^{Q} \lambda_{pq}^{r} a_{ip} b_{jq}. \tag{6}$$

It can be shown that Eq. (6) may be written as

$$d_{ij}^{r} = \sum_{s=1}^{S_r} \theta_s^r \alpha_{is}^r \beta_{js}^r = \sum_{s=1}^{S_r} \left(\alpha_{is}^r \sqrt{\theta_s^r}\right)\left(\beta_{js}^r \sqrt{\theta_s^r}\right), \tag{7}$$

where the $\alpha_{is}^r \sqrt{\theta_s^r}$ are the joint plot coordinates for the activities, the $\beta_{js}^r \sqrt{\theta_s^r}$ the joint plot coordinates for the scales. The equation has exactly the same form as Eq. (2) except for the superscript r. In other words, for each component r of the third mode, we can construct a *joint (bi)plot*. Thus with the Tucker3 model there are as many joint plots as there are components in the third mode, i.e. there are R of them. The mode which is not displayed in the joint plot, here the third mode, is called the *reference mode*. As we will see numerically for our data, the joint plot associated with the first component of the countries will be the most important one, followed by the one associated with the second country component, etc. Note that the c_{kr} serve as weights for the joint plot coordinates (right-hand side of Eq. (5)), and each country k has a set of weights (c_{k1}, c_{k2},...,c_{kr}), one for each country component r. The interpretation of the joint plot is completely analogous to the ordinary joint plot (further details about constructing joint plots can be found in Kroonenberg, 1983b, p. 164ff.).

The algorithms for estimating the parameters of the Tucker3 and Tucker2 models are described in Kroonenberg and de Leeuw (1980), and they are implemented in the programs TUCKALS3 and TUCKALS2 which are contained in the three-mode data analysis package 3WAYPACK (Kroonenberg, 1994, 1996). All analyses reported in this paper including the two-mode ones were carried out with these programs.

4. Results

4.1. Data reduction

The necessity of collecting the data with two different sets of economic activities made it imperative to devise a way of merging the two data sets without losing too much information. With a single data set it would be possible to look at all possible differences between countries using all activities at the same time. The basic procedure for combining the data was to first reduce data set I to an activities of list I by scales by countries block, and data set II to an activities list II by scales by countries block, and then merge the two data sets by stacking them on top of each other in order to end up with an all activities by scales by countries block; the procedure is summarized in Fig. 1. Of course, a reduction from subjects to countries cannot be done without a proper assessment of whether this would lead to a serious distortion of the scales space and activity space. The data reduction was carried out via several three-mode analyses, where the results from the reduced data were compared with those of the non-reduced data.

As can be seen from Fig. 1 the two data sets, i.e. Z_1 with 20 Activities I rated on 12 scales by 406 respondents, and Z_2 with 20 Activities II rated on the same 12 scales by 395 respondents, only had the scales in common. With three components for each mode, separate three-mode analyses for each data set yielded relatively low, fitted sums of squares: 0.262 for $\bar{Z}_1$ and 0.252 for $\bar{Z}_2$. Further analyses of the results suggested that the primary cause of the low fit was considerable random variability in the responses of the subjects. To assess this numerically and to assess whether data within a country could be aggregated, further analyses were carried out on the two condensed data sets in which, within each country, the data were aggregated over all respondents, i.e. on $\bar{Z}_1$ and $\bar{Z}_2$ shown in Fig. 1. The fitted sums of squares for these two analyses were 0.729 and 0.704, respectively. Because one cannot compare these values directly with the previous ones, the fit of the scales space and the activities space of the reduced analyses should be evaluated for the original data (for details see Veldscholte et al., 1995, and for the procedure see Van der Kloot and Kroonenberg, 1985). The loss in fit for the Activities I data set was 0.001 and for the Activities II data set 0.002, showing that the two spaces were identical to the original ones in both data sets. In other words, whether one uses all subjects or only their countries of origin, the resulting structure for the scales and that for the activities remains the same in both data sets, therefore aggregation has only removed subject variability without damaging the overall structure.

The two condensed data sets, $\bar{Z}_1$ and $\bar{Z}_2$, both have size 20 (activities) $\times$ 12 (scales) $\times$ 4 (countries), and differ only in the activities. This means that we can now combine the two data sets by stacking them as is shown in the bottom part of Fig. 1. The resulting single data set (40 activities $\times$ 12 scales $\times$ 4 countries) was the desired basis for further analyses. However, we should establish first that the structures of the scales space and that of the countries for the total data set is sufficiently similar to the corresponding spaces for each of the constituent data sets to allow the merger. Using the spaces from the total data set for the separate data sets resulted again in negligible losses of fit in both data sets (0.014 and 0.010 for $\bar{Z}_1$ and $\bar{Z}_2$, respectively).

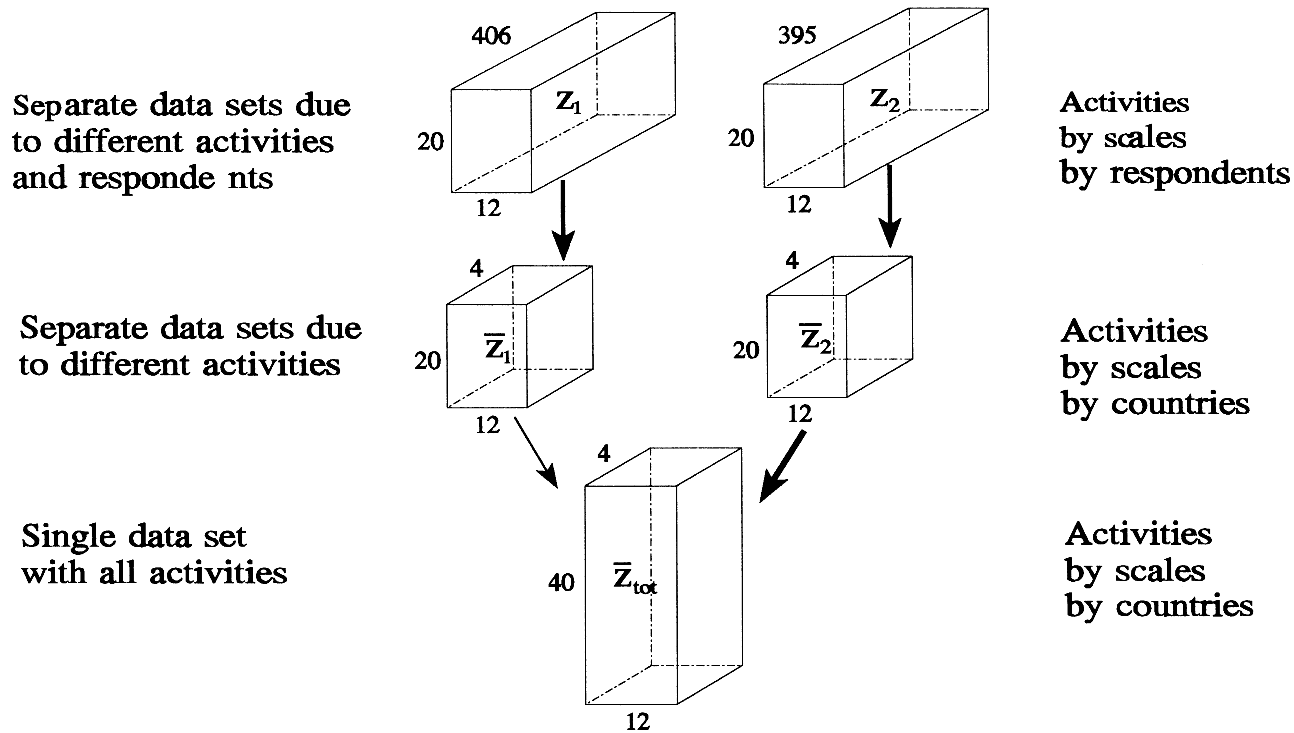

Fig. 1. Summary of construction of the single three-mode data set (Numbers indicate the number of levels in each mode).

To summarize, we have now acquired a single data set in which all the relevant information is present. Note that the aggregation process maintains the three-mode nature of the data. All that has been removed is variability which did not contain information about the structure of the scales or of the economic activities. The possibility of combining data from two or more different, but parallel, lists should be useful in other research projects where it is not feasible to present subjects with all the stimuli, concepts, etc. By carefully designing the study, subsets of stimuli can later be merged as we have done here.

4.2. Analysis of fit and model selection

The total data set consists of four (frontal) slices of 40 activities × 12 scales, one for each country. In addition to analyzing the complete data set, we wanted to acquire information on the analyses for each country, so that we could assess how well the joint analysis represented the data of the individual countries. We carried out separate singular value decompositions on the double-centred data of each country, and several three-mode analyses on the complete data set. The results of all these analyses are given in Table 3.

Several conclusions can be drawn from Table 3. For an adequate representation either three or four components can be chosen for the separate analyses, except that for the UK two components seem sufficient to represent the structure. Moreover on the average, the joint analyses lead to a loss of around 10% in the variance accounted for each country, except for the UK, where they incur a loss of 20–25%. Note that the results for the separate

Table 3
Analyses of fit of separate and joint analyses

Country	Analyses per country						Joint analyses SS(Fit)		
	SS(Fit)		Fit per component						
	3*3	4*4	1	2	3	4	2 × 2 × 2	3 × 3 × 2	4 × 4 × 2
Hungary	0.77	0.85	0.45	0.20	0.12	0.08	0.59	0.68	0.74
Netherlands	0.78	0.85	0.41	0.24	0.13	0.07	0.53	0.71	0.77
Poland	0.76	0.84	0.40	0.22	0.14	0.08	0.55	0.69	0.76
UK	0.92	0.96	0.57	0.23	0.12	0.04	0.65	0.69	0.79
Overall							0.57	0.69	0.76

analyses presented in Table 3 do not provide any information on the comparability of scales and activities spaces across countries, even though one might think so on the basis of the comparable fits for each component for the countries. The fit for a component can refer to entirely different spatial arrangements for different countries. The results of the joint analyses indicate, however, that the three-dimensional and four-dimensional structures of the scales and those of the activities are largely the same across countries. Whether the orientation of these spaces is the same in each country has to be established separately. One way of doing this is to fit the scales space and the activities space of the joint solution to each of the countries, parallel to the procedure used for assessing the reduction of the data in Section 4.1. When this is done, the results show that the orientation is indeed largely the same, except that for the UK the second and the third components are highly correlated (details not presented). To summarize, the comparison of the fits of the separate and joint analyses show that the joint analysis manages to approximate the separate analyses reasonably well but with somewhat less success in the case of the UK.

We have used the fit measures to assess the similarity between the separate analyses and the joint analysis. They are also useful in deciding which joint analysis gives the best balance between fit and interpretability. With too few components only very global patterns can be described; with too many components the wealth of information obscures the general patterns and introduces the dangers of interpreting idiosyncrasies. In contrast with two-mode principal component analysis, any increase in the number of components in one mode changes the coefficients and variability of components in other modes. Thus a single decision has to be taken on the numbers of components for all modes together. For the total $40 \times 12 \times 4$ data set several different TUCKALS3 solutions were compared. The starting solution was three components for each mode. To avoid too much complexity, a fourth component for the modes was not considered.

From the solutions obtained it became clear that for the *countries* mode, two components sufficed for describing this structure. The third component for countries did not explain more than 0.01 of the variability. The choice between two or three components for the activities and scales modes had to be a compromise between goodness of fit and parsimony. Obviously, the $2 \times 2 \times 2$ solution which had a fit of 57% was much simpler and easier to interpret but the difference in fit of 13% from the $3 \times 3 \times 2$ solution was too large to ignore. The scores for the activities and those for the scales in the $2 \times 2 \times 2$ solution resembled the scores of the first two components in the $3 \times 3 \times 2$

solution to a large extent. The third components in the $3 \times 3 \times 2$ solution thus provided extra information. These components also turned out to be meaningful, so it was decided to interpret this solution. With the preferred solution, a total of almost 70% of the variability in the data could be explained by the model.

4.3. Countries

The ratio of the explained variability for the first and second modes of the countries in Table 4 is about 1:22. The explained variability of the second component for the countries is only 0.03, so it may be concluded that the structure for the four countries is basically one-dimensional. This first dimension captures what is similar in the four countries, as can be seen from the similar weights on this component of all the countries except the UK, which is noticeably lower. Given the similarity between the scales spaces and the activities spaces already observed in Section 4.1, it comes as no surprise that the explained variability of the first component is so much larger than the second one. The second component indicates that some countries have additional structure in their relationship between scales and activities, which could not be captured by the shared representation. In particular there is a part of the structure in the UK data which is not present in Hungary, and present in a reversed manner in the Netherlands and, to a lesser extent, in Poland. These specific differences between countries in their scale and activity structure will be discussed in Section 4.6. Note that it is possible to find a varimax rotation of the countries space, such that the UK takes up a component on its

Table 4
Unrotated and rotated components for countries from a $3 \times 3 \times 2$ three-mode solution

Country	Unrotated components		Varimax components		Fit
	1	2	1	2	
The Netherlands	**0.54**	**0.43**	**0.68**	−0.13	0.71
Poland	**0.51**	0.26	**0.57**	0.01	0.69
Hungary	**0.54**	−0.05	**0.45**	0.30	0.68
The United Kingdom	**0.39**	**−0.86**	−0.05	**0.95**	0.69
Proportion of variability accounted for	0.66	0.03	0.53	0.17	0.69

Note 1: Coefficients greater than 0.30 have been set in bold.
Note 2: The lengths of the components are set equal to 1 rather than to the explained variability.
Note 3: The Fit is the proportion variability of a country accounted for by the model.

own and Hungary has sizeable coefficients on both rotated components. In this case we prefer the unrotated components, especially because we wish to describe in a compact manner what the countries have in common, and only after that consider how they deviate. But it is clearly possible to give other representations of the same data.

4.4. Perceptual scales

In Table 5 we have presented both the unrotated and the varimax-rotated components of the three-dimensional scales space. Here, the rotated space shows a fairly clear structure and this is the one we will describe, but note that it is the structure of the scales in the three-dimensional space which is our primary concern. The first rotated component shows a direction in space in which there is a contrast between familiar activities and those which are profitable and require effort and knowledge. The second component shows a contrast between activities that require resources and are pleasant, and there which are moral, non-risky, and require effort and are beneficial to

Table 5
Unrotated and varimax components for perceptual scales from a $3 \times 3 \times 2$ three-mode solution

Perceptual scale	Unrotated components			Varimax components			Fit
	1	2	3	1	2	3	
Non-risky	**0.44**	0.12	−0.09	**0.33**	**−0.33**	−0.00	0.73
Known	**0.38**	**0.33**	**0.28**	**0.57**	0.00	0.10	0.66
Moral	**0.31**	−0.06	−0.12	0.14	**−0.28**	−0.12	0.68
Beneficial	**0.28**	−0.24	−0.16	0.02	**−0.30**	**−0.26**	0.66
Profitable	**−0.31**	−0.19	−0.12	**−0.37**	0.09	−0.04	0.54
Knowledge	**−0.33**	−0.19	−0.27	**−0.47**	−0.03	0.01	0.66
Resources	**−0.39**	0.04	**0.58**	0.04	**0.70**	−0.01	0.79
Pleasant	−0.10	−0.13	**0.38**	0.07	**0.36**	−0.20	0.46
Effort	−0.22	0.08	**−0.53**	**−0.41**	**−0.28**	**0.29**	0.71
Consequences	−0.21	**0.77**	−0.11	0.11	0.07	**0.79**	0.86
Prestigious	0.01	**−0.26**	0.07	−0.07	0.05	**−0.26**	0.41
Sensible	0.15	**−0.26**	0.09	0.05	−0.03	**−0.30**	0.64
Proportion of variability accounted for	0.40	0.17	0.12	0.28	0.22	0.20	0.69

Note 1: Scales coefficients greater than 0.25 have been set in bold.
Note 2: The lengths of the components are set equal to 1 rather than to the explained variability.
Note 3: The Fit is the proportion variability of a scale accounted for by the model.

society. Finally, the third component provides us with the contrast between activities which have immediate consequences, are prestigious and require effort, and those which are sensible and beneficial to society.

Without knowing which activities correspond to these directions in the scales space it is difficult to evaluate these results, and it is exactly for this purpose that we intend to make the joint biplots. We want to couple scale usage to specific activities. The scales space has not come about in isolation but is the result of judgments made in response to specific economic activities. Thus in line with the quotation from Gower and Hand (1996) given above, we do not intend to stick specific labels on these components.

Note that according to the final column of Table 5, not all scales are equally well fitted by the model. In particular, for prestigious (0.46) and pleasant (0.41), the fit equals less than half the variability of these scales, while the delayed versus immediate consequences scale fits best (0.86). These values may be compared with the overall fit (0.69) which is also equal to the average fit of the scales.

4.5. Activities

For the economic activities we have also presented both the unrotated and the varimax-rotated solutions (Table 6). Inspecting the coefficients of 40 activities on three components is much more difficult than inspecting those of the 12 scales. By a careful rearrangement of the table, including highlighting the higher coefficients, we have tried to supply some insight into the numbers, but in general it is easier to interpret a plot of the components. We will postpone presenting a plot until we come to the joint biplots. A cursory inspection of Table 6 shows that the subjects perceived some contrast between socially acceptable activities like saving energy and giving to charity versus giving bribes and being a fence for stolen property. Another contrast can be seen between being unemployed, giving money to a beggar, and paying taxes, versus being a rich man or woman who owns a bank, casino, newspaper or part of a firm. A third contrast exists between money demanding activities like buying a car or a house or gambling in a casino, versus being gainfully employed in some fairly normal job. But it is not really easy to make sense out of the arrangements of the activities, and mostly the common terms employed rest on speculation. One needs to display the scales and the activities in the same space to make coherent and substantive statements about the judgmental processes of the subjects.

Table 6
Unrotated and rotated components for economic activities from a 3 × 3 × 2 three-mode solution

Activity	Unrotated components			Varimax components			Fit
	1	2	3	1	2	3	
Saving energy	**0.26**	−0.13	−0.04	**0.28**	0.08	−0.05	0.74
Giving to charity	**0.27**	−0.05	0.20	**0.25**	0.11	0.20	0.80
Buying life insurance	0.17	−0.16	0.19	**0.24**	−0.04	0.17	0.79
Educating children	0.11	−0.21	0.07	0.22	−0.10	0.04	0.66
Buying property insurance	0.17	−0.09	0.17	0.20	0.02	0.16	0.74
Studying for a new profession	0.06	−0.20	−0.10	0.17	−0.10	−0.13	0.67
Receiving bribes	−0.13	0.16	−0.02	−0.20	0.04	0.00	0.52
Gambling on horse racing	−0.14	0.22	0.13	**−0.24**	0.06	0.16	0.74
Cheating on taxes	**−0.25**	0.09	−0.06	**−0.25**	−0.08	−0.06	0.63
Giving bribes	−0.22	**0.25**	0.10	**−0.32**	0.03	0.13	0.78
Being a 'fence' for stolen property	**−0.25**	0.21	−0.03	**−0.33**	−0.04	−0.01	0.79
Being unemployed	0.05	**0.38**	−0.10	−0.21	**0.33**	−0.03	0.85
Giving money to a beggar	**0.25**	0.20	0.11	0.07	**0.29**	0.15	0.72
Paying taxes	**0.25**	0.13	−0.02	0.11	**0.27**	0.01	0.63
Repairing old clothes	0.17	0.15	**−0.27**	0.02	**0.26**	**−0.24**	0.71
Being a member of a union	**0.26**	0.04	−0.01	0.17	0.20	0.01	0.92
Taking loans	0.06	0.15	−0.07	−0.05	0.16	−0.05	0.37
Going on strike	0.00	0.18	−0.04	−0.12	0.14	−0.02	0.42
Using credit	0.04	0.12	−0.02	−0.05	0.12	−0.00	0.22
Advertising products in mass media	−0.01	−0.12	0.10	0.08	−0.11	−0.08	0.39
Buying government bonds	−0.01	−0.13	0.12	0.09	−0.12	0.10	0.49
Advertising products at an int. fair	−0.05	−0.14	−0.07	0.04	−0.13	−0.09	0.34
Being an owner of a nightclub	−0.23	−0.04	0.05	−0.15	−0.18	0.04	0.49
Buying shares	−0.11	−0.19	0.17	0.06	**−0.24**	0.13	0.34
Being an owner of a newspaper	−0.20	−0.16	−0.04	−0.05	**−0.24**	−0.07	0.79
Investing in an enterprise	−0.12	−0.23	0.11	0.07	**−0.26**	0.08	0.74
Being an owner of a casino	**−0.26**	−0.16	0.03	−0.09	**−0.29**	0.00	0.76
Being an owner of a bank	−0.21	**−0.25**	−0.05	−0.00	**−0.31**	−0.09	0.66
Buying a car	0.03	0.12	**0.33**	−0.03	0.06	**0.34**	0.69
Gambling in the casino	−0.15	**0.26**	**0.25**	**−0.26**	0.06	**0.28**	0.77
Putting money in the bank	0.16	−0.09	**0.27**	0.20	0.00	**0.26**	0.79
Buying a house	−0.03	−0.01	0.19	0.00	−0.05	0.18	0.44
Changing workplace	0.01	0.08	−0.13	−0.05	0.08	−0.12	0.26
Working abroad	−0.05	−0.00	−0.15	−0.05	−0.02	−0.15	0.35
Being employed in an office	0.13	−0.03	−0.16	0.10	0.08	−0.16	0.72
Being employed as a prof. athlete	−0.09	−0.07	−0.17	−0.04	−0.09	−0.18	0.35
Being employed as a politician	−0.15	−0.14	−0.18	−0.05	−0.18	−0.20	0.81
Being employed as a house painter	0.09	0.04	**−0.26**	0.03	0.12	**−0.25**	0.71
Being employed as a car mechanic	0.02	−0.07	**−0.28**	0.04	0.00	**−0.28**	0.64
Being employed as a teacher	0.09	−0.10	**−0.34**	0.10	0.03	**−0.35**	0.65
Percentage variability accounted for	0.40	0.18	0.11	0.31	0.27	0.11	0.69

Note 1: Scales coefficients greater than 0.23 have been set in bold.
Note 2: The lengths of the components are set equal to 1 rather than to the explained variability.
Note 3: The Fit is the proportion variability of an activity accounted for by the model.

The last column of Table 6 shows how well the model succeeded in fitting each of the activities, and these numbers may be used to assess whether there are activities whose variability did not fall into line with the other ones. In particular, the activities using credit (0.22), changing workplace (0.26), advertising products at an international fair (0.34), being 'employed' as a professional athlete (0.35), and working abroad (0.35) could not be described adequately with the scales in the study. The explanation for the lack of fit of the latter three might be their rather unusual character; not many people have much familiarity with such activities. The first two activities may have mixed associations, e.g., using credit may be either socially acceptable and socially unacceptable, depending on the purpose and the amount of credit.

4.6. The core matrix with three-mode singular values

The Tucker3 model presented in Eq. (4) not only contains the coefficients of the three modes, but also the three-mode generalizations of the singular values, as expressed by the λ_{pqr}. The parameters in the model serve a dual purpose. They are the weights for the combinations of components coefficients, and thus indicate which combinations are important; in addition their squares indicate the amounts of variability accounted for by the combinations of components. In Table 7 (part (a)) we see that λ_{111}, λ_{221}, and λ_{331} are the most important combinations of components, and all refer to the first

Table 7
Unrotated core matrix with three-mode singular values and variability accounted for by by combinations of components

Components	Frontal slice 1			Components	Frontal slice 2		
	Scales	Scales	Scales		Scales	Scales	Scales
	1	2	3		1	2	3
a. *Unrotated core matrix with three-mode singular values*							
Activities 1	**27.55**	0.78	0.91	Activities 1	−2.87	0.75	2.39
Activities 2	−0.97	**17.79**	−0.31	Activities 2	−0.73	1.36	4.23
Activities 3	−0.92	−0.99	**13.79**	Activities 3	−0.69	2.76	3.97
b. *Variability accounted for by combinations of components*							
Activities 1	**0.395**	0.000	0.000	Activities 1	0.004	0.000	0.003
Activities 2	0.000	**0.165**	0.000	Activities 2	0.000	0.001	0.009
Activities 3	0.000	0.001	**0.099**	Activities 3	0.000	0.004	0.008

component of the countries as all their last indices are equal to 1. Earlier we have seen that all countries have sizeable coefficients for this countries component, and thus the combinations represented in the first frontal slice of the core matrix pertain to what the countries have in common. The next largest three-mode singular value is λ_{232} ($=4.23$) and it refers, together with all the other singular values in the second core slice, to the second component of the countries. However, because the values are so dispersed in this slice it is difficult to evaluate its nature in relation to the activities and scales. To do this we will have to look at the joint biplot for this core slice, which we will do shortly.

Note that we have not shown the core slice associated with the rotated activities and scales components. The clear pattern of the unrotated first core slice is completely destroyed by the rotation and therefore this slice becomes rather difficult to interpret. Moreover these rotations have no influence on the joint biplots we are about to present. Only rotations of the third mode, here countries, would have had any effect on the joint biplot, as can be seen from Eq. (5).

It is worth noting that the near diagonality of the first core slice is the result of the rather small variability accounted for by the second country component compared to the first. Ten Berge et al. (1987) have shown that when there is only one component in one of the modes, the first and only core slice will be exactly diagonal. In such a case, the situation becomes very similar to the two-mode case because each component of a mode is linked only with one component in any other mode, and it can be shown that one has a restricted form of the Parafac model (see Harshman and Lundy, 1984a, b, 1994).

4.7. First joint plot: What the countries have in common

Given that we have used the country mode as reference mode (see Section 3.2), we have two joint plots, one for each of the country components. The first joint plot is based on the first frontal slice of the core matrix, which accounted for 69% of the total variability and for 96% ($(0.395 + 0.165 + 0.099 + 0.001)/0.692) \times 100\% = 96\%$) of the total explained variability. In Table 7 (part (a)) the first unrotated frontal slice is approximately diagonal, which points to a nearly perfect one-to-one relationship between the unrotated components for scales and those for activities. For the activity components this implies that the interpretation is very much like that of the perceptual scales, but as mentioned in Section 3.1 the axes are primarily used for scaffolding and not primarily or necessarily for reification. In Fig. 2 we have presented the first two dimensions of the three-dimensional joint plot, and the activities with a sizeable positive coeffi-

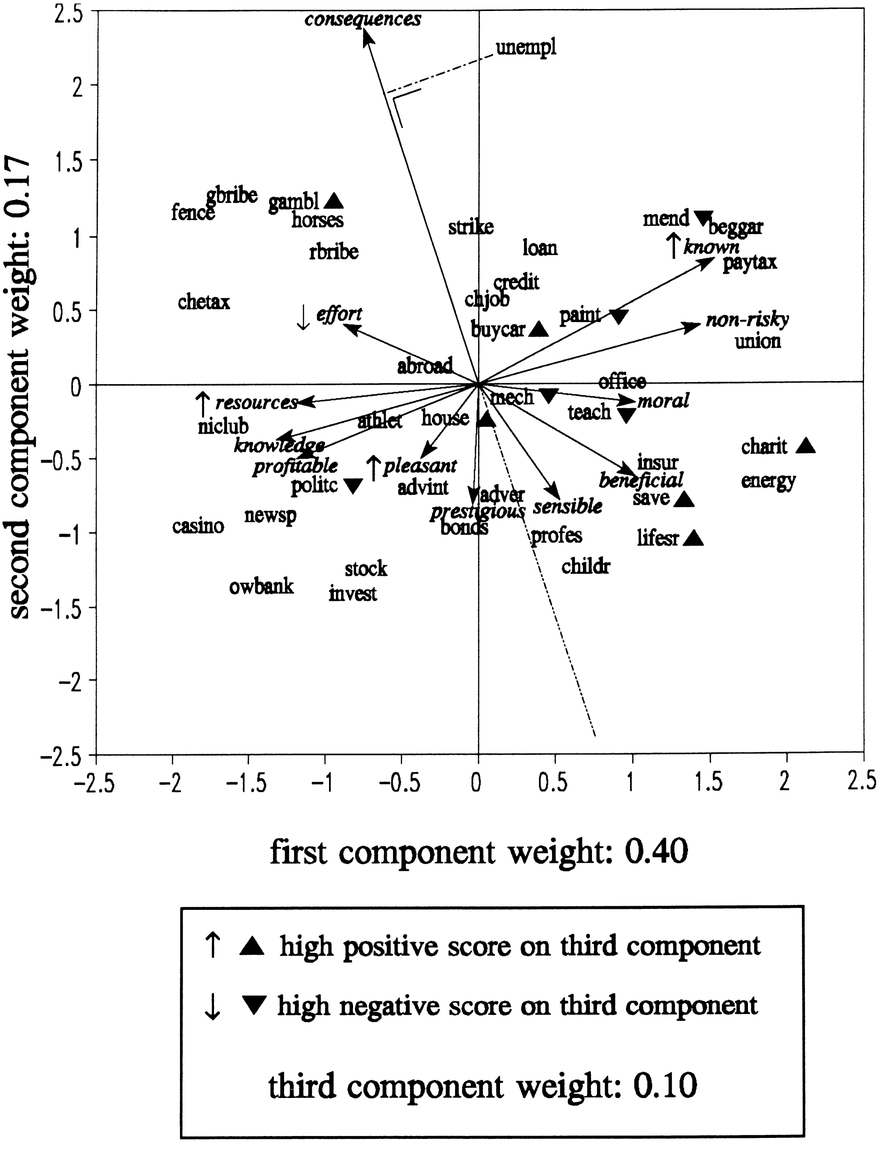

Fig. 2. Joint plot for the first country component.

cient on the third dimension have been indicated by an upright triangle and those with a sizeable negative coefficient with an inverted triangle. Only saving, gambling and charity have high values for both the first dimensions and the third one, so that their position relative to the scales has to be assessed from the full three-dimensional configuration. The scales with high coefficients on the third dimension have been marked with ↑ (positive) and ↓ (negative), respectively. Both effort (↓) and resources (↑) have high values in the first two dimensions and the third, so that the relationships between these scales and the activities have to be judged from the full configuration.

To interpret Fig. 2 it has to be realized that the scales are really bipolar scales and that the lines drawn in the graph point to the end which is given in bold in Table 2. Moreover, the origin of the figure represents the average value for all scales and activities. The importance of a scale for an activity can be judged by dropping a perpendicular on a scale as is shown for the consequences scale. Taking this scale as a starting point, we see that unemployment (unemploy) was considered to have relatively severe immediate consequences compared to the average activity, but that educating children (childr) and investing in an enterprise (invest) were seen as the activities with the most delayed consequences. A particular interesting direction is the one roughly corresponding to the horizontal axis, which separates social activities from more financially directed activities, where the goal of the latter is to increase the possession of money. Obviously, the social activities of paying taxes, giving to charity and giving money to beggars have financial aspects too, although they do not increase the possession of money. The differences between what will be called financial activities and these three activities are twofold. First, these activities concern a loss of money and second, they clearly imply social behaviour. Giving money to charity or giving money to beggars indicates feelings of sympathy for the fate of others. Paying taxes implies contributions to society.

Activities of being a fence, giving and receiving bribes, gambling in the casino or on horses, and cheating with taxes are seen as activities requiring effort, having immediate consequences, being harmful to society, and not very sensible and clearly immoral as well. The opposite of such activities are putting money in the bank (save), educating children, buying life insurance, and saving energy. Moving anti-clockwise we encounter a cluster of profitable, risky, and pleasant activities which require knowledge and resources but are relatively unfamiliar to the respondents, such as owning a bank, casinos, newspapers, and nightclubs, investing in enterprises and bonds. The opposite of these activities are paying taxes, mending clothes and giving money to beggars, rather prosaic activities only too well known to the average respondent. Note that we look at specific directions or axes in the two-dimensional plane without necessarily equating them with the coordinate axes or components.

The negative direction of the axis along the third dimension points to activities which are not the most pleasant ones and which require few resources, such as being a teacher, a car mechanic, a house painter, or a politician (all of which are occupations or occupational activities), and in addition mending clothes. The opposite side of this axis shows pleasant activities requiring considerable resources, such as buying a car or a house, gambling in the casino and on horses, and putting money in the bank. A summary of these relations might be given in terms of earning and spending money. Alternatively, a distinction between conservatism (security, conformity, and tradition) versus affective autonomy (including stimulation and hedonism) comes to mind (Schwartz, 1994).

The relations displayed in the first joint plot are those which are common to all countries, because all countries have a more or less equal coefficient on this component (see Table 3). The somewhat lower score for the United Kingdom indicates that the British expressed the general structure less emphatically.

4.8. Second joint plot: How the countries differ

From Table 3 we noted that the second country component was rather small compared to the first one, indicating that the countries were more similar than different. From an exploratory point of view the second country component refers to the most salient differences between countries. However, at the same time its small size makes it difficult to assess its generalizability. Before one can make strong statements on the basis of the patterns observed, support from a similar study is needed.

To construct the second joint plot we have to use the frontal slice associated with the second country component which shows a contrast between the United Kingdom and the Netherlands (and Poland). The weights of the axes of this second joint plot were 0.027, 0.003 and 0.001, respectively, so that only the first axis, which accounted for 3% of the variation, can be seriously interpreted for structural differences between countries. The second joint plot therefore can be visualized as a single line.

From the one-dimensional Fig. 3 it becomes apparent that the variation between countries is mainly restricted to the evaluation of the financial

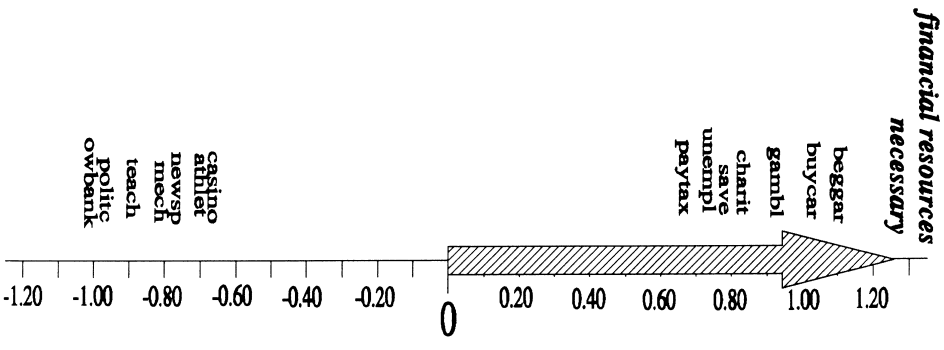

Fig. 3. First axis joint plot for the second country component.

resources necessary for a number of activities. The positive coefficient for the Netherlands (and Poland) in Table 3 indicates that Fig. 3 displays the situation for these countries. For the United Kingdom, however, the arrow for resources should be reversed, i.e. it points with equal length to the negative direction.

It should be stressed that the second joint plot shows a refinement of the general pattern shown in the first joint plot. For example, in the first plot, representing the general opinion in all countries, it was evident that owning a casino was considered to be an activity requiring considerable financial resources. Because the resources vector in the second joint plot (Fig. 3) points away from owning a casino, it may be concluded that the Dutch (and the Poles) considered owning a casino comparatively less financially demanding than the British. The same can be said about owning a bank or a newspaper and being a politician. In the Netherlands (and Poland) gambling was perceived as requiring comparatively much larger amounts of money than in the UK, while being unemployed and buying a car also appeared to be more expensive for the Dutch and the Poles than for the British.

The British judged the occupational activities of being a teacher, a car mechanic or an athlete, which overall are not associated with requiring much money, to require more financial resources than the Dutch did. Finally, the British rated the four activities of paying taxes, giving money to a beggar, giving to charity and putting money in the bank as less expensive than the Dutch.

In general, the United Kingdom showed the largest deviations from the general perceptual structure. In addition more differences between the Netherlands and the United Kingdom were found than between these countries two, and Poland and Hungary. In other words, the largest differences between countries are between the two Western countries and not between East European and the West European countries.

5. Discussion and conclusions

5.1. Methodological conclusions

In this paper perceptions of economic activities from four different countries expressed via judgments on perceptual scales were analyzed with three-mode data analytic techniques. It was proposed to view the data as judgmental data rather than profile data, that is, to keep the interrelationships between economic activities and the perceptual scales as the focus of the analysis. Using three-mode techniques for three-mode data has the advantage that no condensation to two modes is necessary. This makes three-mode analysis a particularly useful tool in cross-cultural research, where frequently countries, regions, or cultural groups can be represented by the third mode (for an additional example, see Kroonenberg and Kashima, 1997). By means of a joint analysis, the perceptual spaces of the countries derived via separate analyses could be combined in a fairly natural way ending up with a perceptual space for economic activities and perceptual scales which is common to all countries, as well as components which captured the most important similarities and differences between the countries.

At the same time, we advocate viewing such perceptual spaces in terms of the original variables, instead of depending on the reification of components which span the space. However, if one wants to conduct theory-based analyses of perceptions of economic activities, rather than explore their structure, structural equation modelling (see e.g., Bollen, 1989) might be more appropriate. By explicitly describing latent variables and their structure, structural models could be tested for the concepts by activities covariance matrix, in the same way as they are for multitrait-multimethod matrices (see e.g., Wothke, 1995, for a review). However to be successful such analyses require detailed a priori knowledge of the perceptual structure, and analyses such as there presented here can be helpful in describing such structures. From this point of view statistical tests are not really very useful for the present analyses, which are explicitly and unashamedly descriptive. Choosing the numbers of components is not so much a question of correctness as of descriptive adequacy. The number of components depends primarily on the detail with which one would like to describe the data at hand. Choosing fewer components leads to a global and stable picture painted with a broad brush; adding more components means using a finer brush to add finer details which will become more and more data dependent.

For the present data the use of three-mode techniques had an additional advantage because it allowed the combination of all available data into a single data set, eliminating a large amount of variation unrelated to the general perceptual structure.

5.2. Substantive conclusions

A three-dimensional perceptual structure for both activities and scales distinguished between social and economic values. Furthermore, the consequences of an activity were perceived as more or less independent of their social and economic values. A further axis pointed towards a distinction between earning and spending money which also may be interpreted in terms of exertion (during occupational activities) and relaxation (during spare time activities), respectively. This common structure proved to be valid for all four countries. Minor differences between countries concentrated on the necessity of money for certain activities. In contrast with the expectation that perceptual structures in the two countries with a continuous history of a capitalist market economy would be different from those in post-communist countries, differences between the Netherlands and the United Kingdom were most prominent. In addition, however, the British showed the largest deviation from the general structure.

The dimensions found are quite different from those found in Tyszka (1994) and Antonides et al. (1997), who analyzed (part of) the same data. The major reason for this probably lies in the fact that they treated the data in an entirely different manner, i.e. as profile data rather than judgmental data, and that they used two-mode techniques for the three-mode data.

By comparison, Foa et al. (1987) have also found a relatively invariant two-dimensional structure of social resources in five different cultures (see also Foa and Foa, 1974). Their interpretation of the dimensions (concreteness and particularism) is somewhat similar to our distinction between economic versus social activities. However, the other axes in our analysis seem to be different and theoretically significant. Delay of consequences has been studied frequently both as a delay of gratification in psychology (e.g., Mischel, 1974), and as a time preference in economics (e.g., Thaler, 1981). The perception of activities in terms of earning and spending money may be related to Schwartz's distinction (Schwartz, 1994) between the cultural values of conservatism and affective autonomy, respectively. However, this refers to the more general question of conceptual equivalence of value scales and perceptual scales, which is a point of concern for future research.

In summary, one can say that three-mode exploratory techniques can be extremely helpful in analyzing large complex data because it becomes possible to reduce large amounts of data to a limited number of parameters without damaging the structure present in the data. Because of the complexity of the data themselves one should not expect that the results of such analyses will necessarily be simple.

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