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COMPARISON OF TECHNIQUES FOR ANALYSING PERSONAL CONSTRUCT SYSTEMS

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ABSTRACT

There have been many approaches to the extraction of personal construct systems from repertory grid data. Generally the proponents of one approach to grid analysis use it exclusively and do not compare it with others. They, and their clients, become familar with the "meaning" of one form of analysis and find any other less meaningful for them. However, it is clearly of interest to analyse the relationships between various forms of grid analysis both in terms of their comprehensibility and in terms of their comprehensiveness. Do apparently very different forms of analysis produce similar results - extract the same "meaning"? Does any one technique extract more information than others?

In this paper we discuss the uses made of grid analysis and the desirability of certain properties in that analysis, such as ease of visual presentation, ease of verbal presentation, obvious relationship to the original data, and so on. We go on to compare a number of different analysis techniques on a range of data: INGRID (principal components analysis); FOCUS (cluster analysis); ENTAIL (logical entailment analysis).

INTRODUCTION

There have been many approaches to the extraction of personal construct systems from repertory grid data. Generally the proponents of one approach to grid analysis use it exclusively and do not compare it with others. They, and their clients, become familar with the "meaning" of one form of analysis and find any other less meaningful for them. However, it is clearly of interest to analyse the relationships between various forms of grid analysis both in terms of their comprehensibility and in terms of their comprehensiveness. Do apparently very different forms of analysis produce similar results - extract the same "meaning"? Does any one technique extract more information than others?

In this paper we discuss the uses made of grid analysis and the desirability of certain properties in that analysis, such as ease of visual presentation, ease of verbal presentation, obvious relationship to the original data, and so on. We first illustrate the relationship between some commonly used methods of analysing such data by comparing them on an example of a binary grid. This shows the high degree of correspondence between the methods in the clusters produced. We then go on to illustrate a new method of grid analysis recently developed (Gaines & Shaw 1981a), and show that it subsumes and extends the previous techniques. A further example is given to compare these various methods with rating scale data.

REPERTORY GRID ANALYSIS

The analysis of repertory grids has attracted much technical literature and it is worth emphasizing here the role of such analysis. It is to extract possible structure in the personal meanings of an individual and reflect it back to him in such a way that it aids his coming to terms with his problems. The

words possible and reflect are significant since it is the essence of Kelly's approach that one is indeed dealing with personal meaning and that any analysis is subject to debate; it is the basis of a conversation rather than some form of absolute model. Clinicians using the repertory grid elicit it through such a direct conversation. In operationalizing Kelly's work through a computer the aim (Gaines & Shaw 1981a) is to develop a conversational, dialectical, system of computer programs for the self-reflective study of one's role as a personal scientist.

Thus in using the data gathered in a repertory grid we have essentially a problem of communication - how can we present the data in a comprehensible form that will be the topic of a conversation? If our analysis is one that leads to hypothesized structure in the grid then some form of visual presentation of that structure is attractive. Clearly it should be in a readily assimilated form. Less obviously, if it is going to be discussed, then it must be possible to state the structure present in linguistic as well as pictorial form. Still less obviously, if we are to be able to argue about the meaning of the analysis, then its derivation from the original data should be apparent in its presentation. It is these considerations we have in mind when reviewing possible methods of grid analysis.

For any given construct we may regard the numbers in the grid as a vector of values giving the assignment of each element in turn to one or other of the poles of the construct. From this point of view each construct becomes represented as a point in a multi-dimensional space whose dimension is the number of elements involved. A natural relation to examine between constructs is then the distance between them in this space. Two constructs which are zero distance apart are such that all elements are construed in the same way in

relation to them and hence we might infer that they are being used in the same way - in some way they are equivalent constructs. For constructs which are not equivalent we may analyse the entire constellation in space to determine a set of axes such that the projection of each construct onto the first axis accounts for most of the distance between them, the projection on the second axis accounts for most of the remaining distance, and so on. This is a principal components analysis of the construct space, and it is related to the factor analysis of semantic space used in the study of semantic differentials. We may also group constructs together that are close together in space using some form of cluster analysis.

The first example shown in Figure 1 is a repertory grid from Leach (1981) which was completed by a man whose wife had recently died of cancer. The elements he uses are shown as columns -- the people he was in contact with during the event, and the construct names are shown on either side of each row. A '1' indicates assignment of the element in that column to the left pole of the construct, and a '2' indicates assignment to the right pole.

This grid has been analysed using a form of Slater's (1977) INGRID program for determining the principal components. Figure 2 shows the eight elements and the two poles of each of the seven constructs plotted against the first two principal components. In this case the first component accounted for 68.5% of the variance in the data, and the second, third and fourth components accounted for 9% each. This indicates the almost linear nature of this construct system as can be seen from the elliptical shape of the clusters. It can be seen that the left-hand poles of constructs 6 and 8 are fairly close to the right-hand poles of constructs 4,5 and 7. There is a mirror image of the right-hand poles of constructs 6 and 3, together with the left-hand poles of constructs 4, 5 and 7.

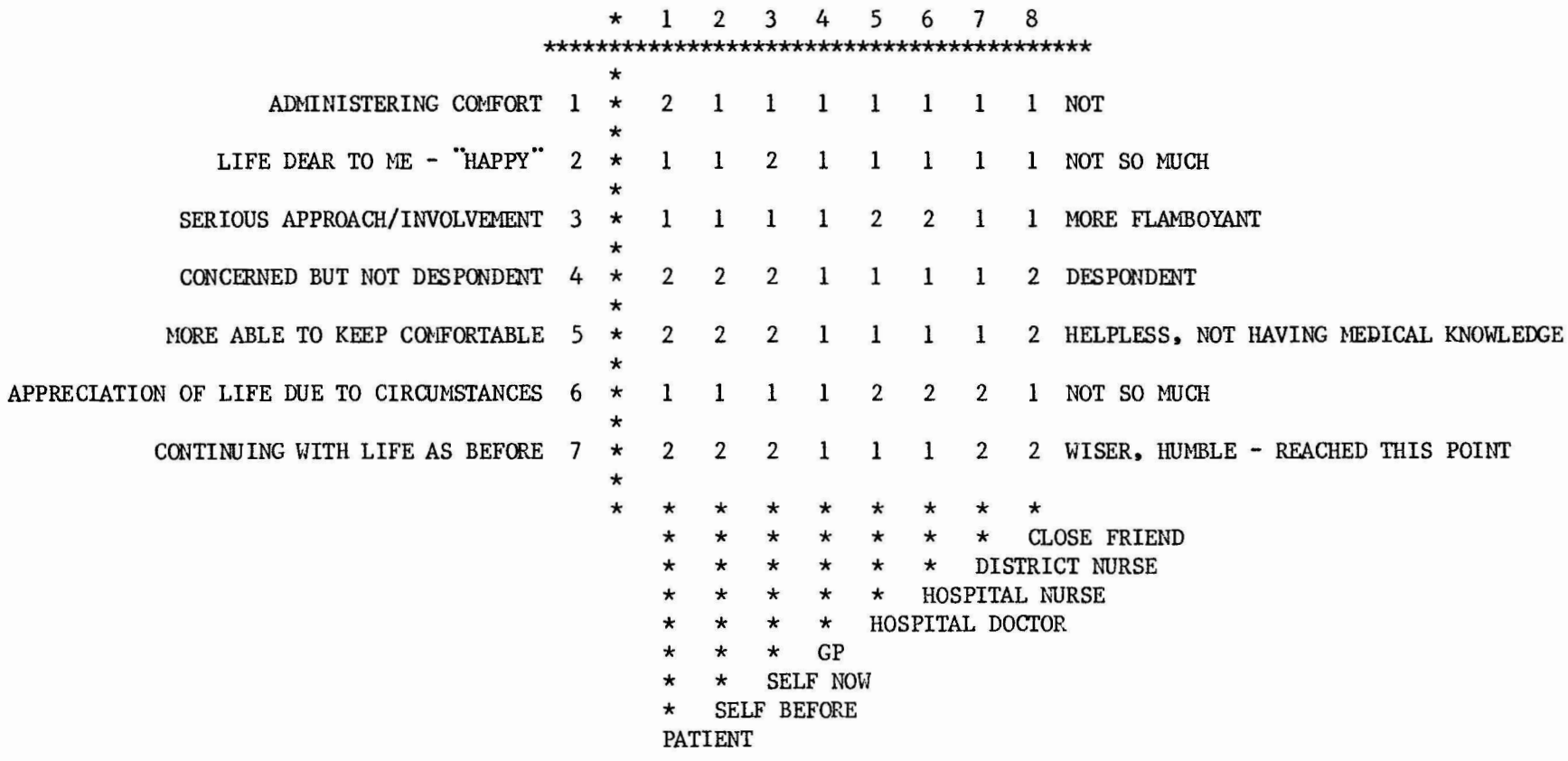


Figure 1 Raw Grid from Leach (1981)

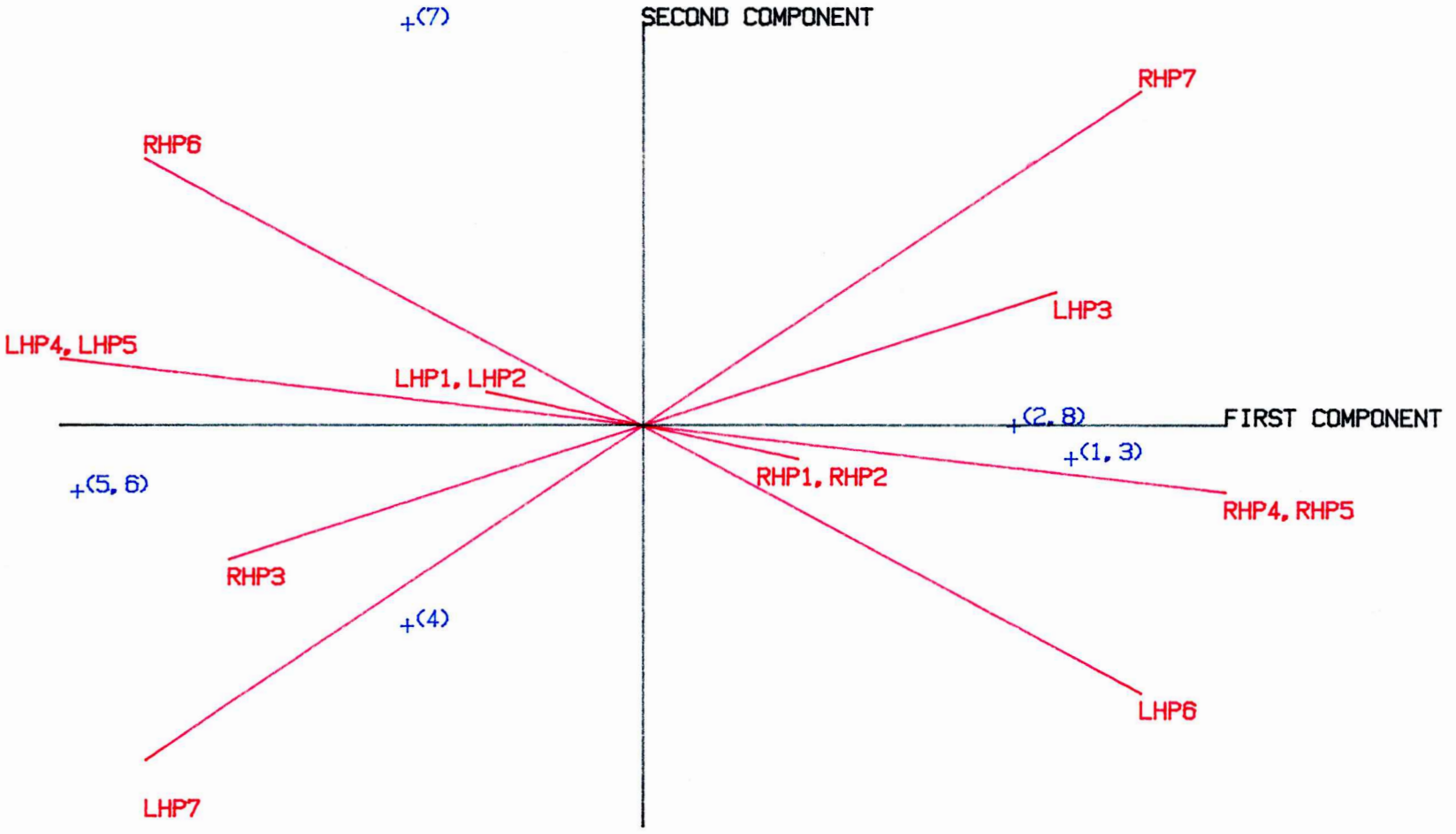


Figure 2 INGRID Analysis of Grid from Leach (1981)

Because the assignment of elements to poles is such that the vector of assignments to the left-hand pole is the reverse of that to the right-hand pole such a mirror image is bound to occur with conventionally elicited grids. Although one will see from Figure 3 that constructs 1 and 2 are not identical they are shown to be so in these two dimensions. One can also see from its short length that the line denoting constructs 1 and 2 is not properly represented on these two axes, but clearly has components in other dimensions. Again, elements 2 and 8 are shown to be identical, and closely associated with elements 1 and 3. On the other side of the diagram elements 5 and 6 are identical, and clusters more loosely with elements 4 and 7.

Shaw's (1980) FOCUS algorithm is a distance-based hierarchical cluster analysis technique that sorts the constructs into a linear order such that constructs closest together in the space are also closest together in the order. It has the advantage in presentation that the sorting is used only to re-present the original grid re-organized by the 'neighbourness' of constructs and elements. It is left to the user to construe his own personal meaning into the result and confirm this directly in terms of the original data. Figure 3 shows the grid of the example as processed by FOCUS. In re-organizing the grid FOCUS has reversed constructs 4, 5 and 7. Concentrating on the construct analysis, it can be seen that constructs 4 and 5 are equivalent and close neighbours of 7, and that this cluster is itself a close neighbour of the cluster formed by 3 and 6. Constructs 1 and 2 are not linked into the other constructs at a meaningful level. Now looking at the elements there are two main clusters: 5 and 6 being construed identically -- the hospital doctor and the hospital nurse -- joining at a lower level is 4 and then 7 -- the GP and the district nurse. The other cluster is much tighter having a centre of 2 and 8 -- self before and close friend -- being construed identically, and linking either side with 1 and 3 --

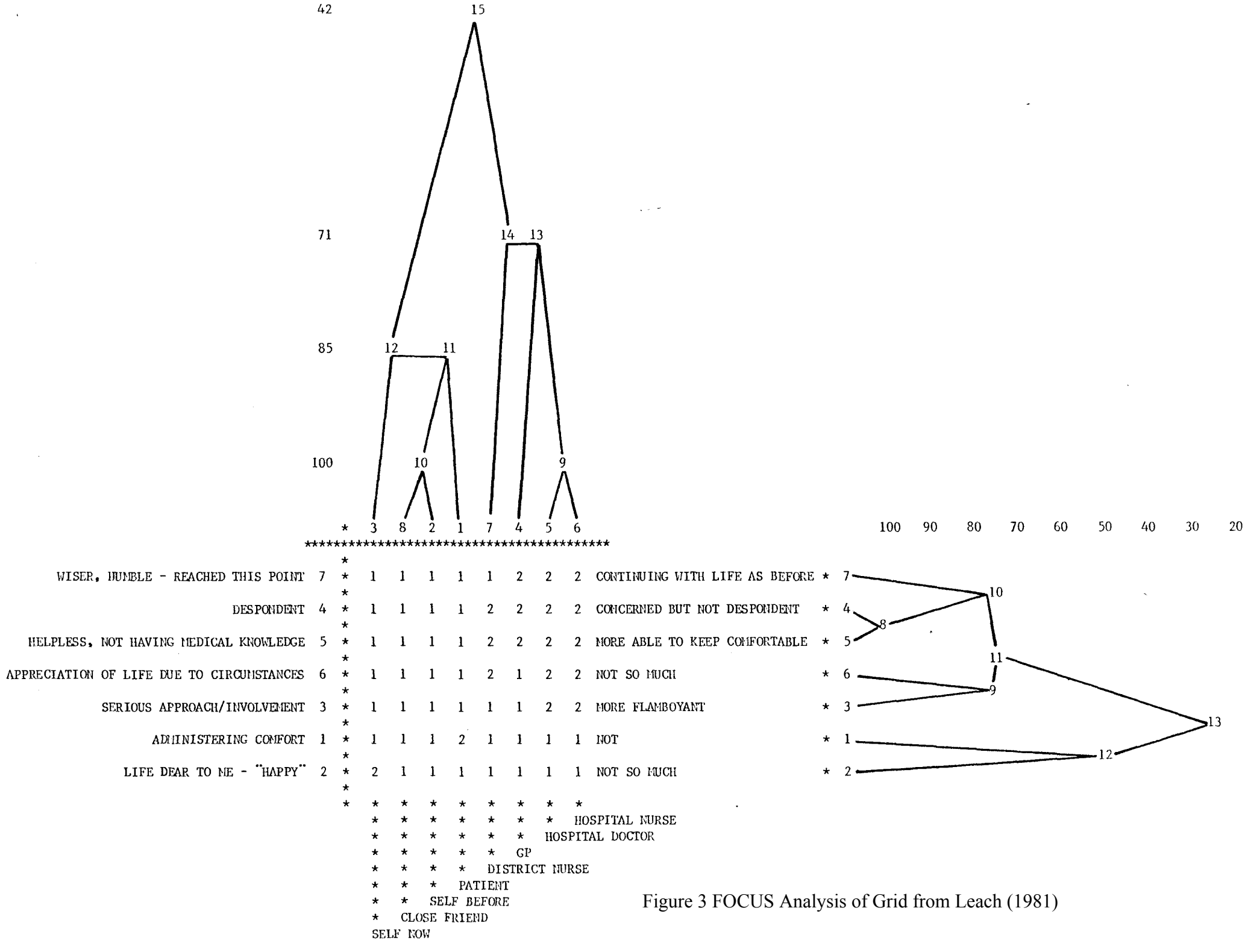


Figure 3 FOCUS Analysis of Grid from Leach (1981)

the patient and self now.

The reversal performed by FOCUS is an important operation in analysing a repertory grid. Kelly (1955 p.283) uses such a process of reversal (which he calls "reflection") in his analysis of repertory grids, and the need for it clearly arises from the artificiality of the assignment of "left-hand" and "right-hand" poles to a construct. Unless some special additional rationale is in operation, what are called the left-hand and right-hand poles of a construct may be reversed without distorting the grid providing the assignment of elements to those poles is also reversed. In principal components analysis such reversals show up in the clustering of left-hand poles together with right-hand poles, for example as in Figure 2.

It is convenient to make a point here that applies to all techniques for grid analysis. Any relation we infer between constructs from a given grid are derived from the set of elements used in eliciting that grid. Hence they should be qualified by a reference to that set: not "constructs 4 and 5 are equivalent", but rather "in relation to elements 1 through 8, constructs 4 and 5 are equivalent". To the extent that we drop this qualification we are proceeding inductively rather than deductively and our conclusions may be incorrect. This applies to any conclusion that extends the relation between constructs to elements that have not been tested, for example "in relation to the people you have considered, constructs 4 and 5 are equivalent".

The alternative to distance-based methods of grid analysis is a logical analysis, looking at constructs as predicates applying to elements (see companion paper Gaines & Shaw 1981b). Figure 4 shows the directed graph of entailment relations between the poles of the constructs derived by ENTAIL from the grid of the example. There are effectively two main sub-graphs which are

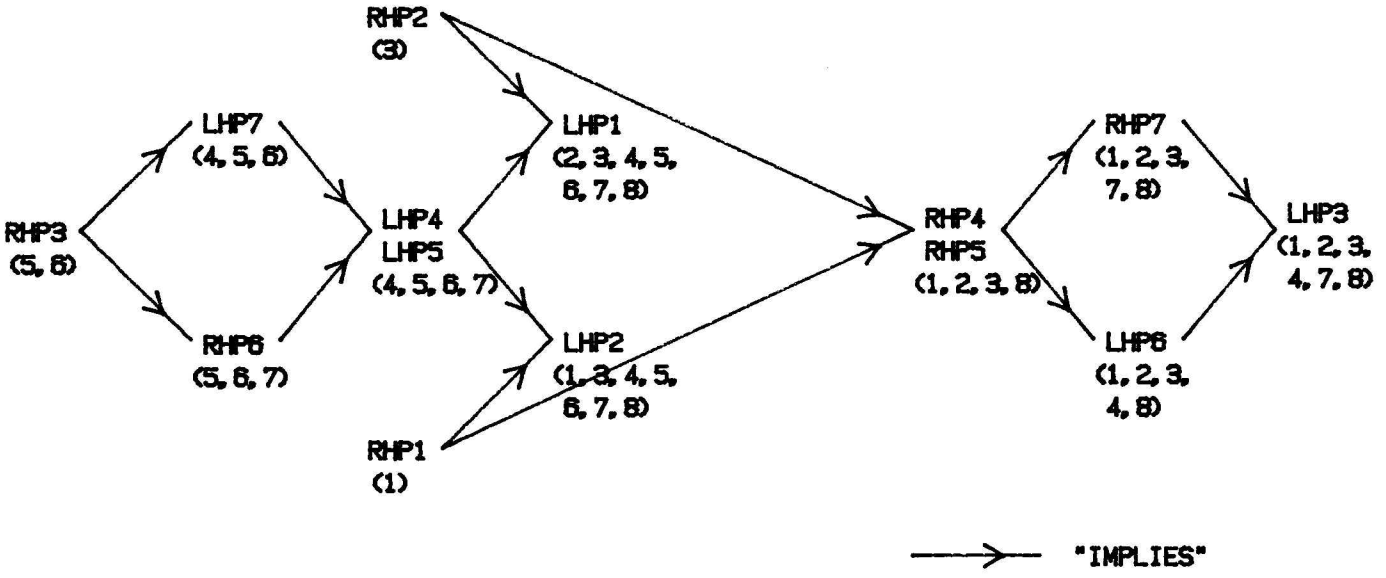


Figure 4 ENTAIL Analysis of Grid from Leach (1981)

mirror images of one another here connected by weak entailments involving constructs 1 and 2. One of the graphs shows the entailments for one set of poles, and the other the entailments for the opposite poles. Note that the "reversal" of constructs 4, 5 and 7 apparent in the INGRID and FOCUS analyses shows up as LHP4, LHP5 and LHP7 appearing in the graph of the right-hand poles of the other constructs and vice versa. Because of the essential bipolarity assumed in the elicitation of the grid the two graphs are essentially the same with the arrows and poles reversed in one relative to the other.

It is very interesting to compare Figure 4 with the results of the INGRID clustering in Figure 2 and the FOCUS clustering in Figure 3. We can see that the same hierarchy of construct clusters has turned up: ((3,6,7,(4,5),1,2). Thus the ENTAIL analysis gives rise to the same basic clustering as did INGRID and FOCUS. Both the fundamental and empirical similarities are important in their own right since these programs are widely used for grid analysis and one would hope that any new technique would continue to provide at least the same basic analysis.

However, there is additional information in Figure 4 that goes beyond that available in Figures 2 and 3. This comes from the directed nature of the entailment links shown. There is equivalence only between LHP4 and LHP5 - all the other relations are one way only. To show the significance of this we have indicated the elements assigned to each pole. The asymmetry of the entailment relation may be seen by considering that from LHP6 to LHP3 for example. We see from the descriptions of the poles that he is saying that people who have an appreciation of life due to the circumstances of his wife's death also have a serious approach. However, the converse does not hold. From the element data in Figure 4 we can see the reason for this asymmetry. For example, from the elements assigned to LHP6 and LHP3 we can see that the entailment between them

not being mutual is due to element 7 -- the district nurse -- being seen as having a serious approach to life but not so much related to the circumstances of his wife's death. In this case only one element breaks down the equivalence. Thus the construct analysis produced by ENTAIL has reproduced the clusters shown by INGRID and FOCUS but it has also shown up new features of the data not evident in these distance-based and essentially symmetric forms of analysis.

EXTENDING ENTAILMENT TO RATING SCALES

It is common in many practical applications of repertory grids to use an N-point scale with 1 being an assignmment to the left-hand pole and N being an assignment to the right-hand pole, and intermediate numbers representing some form of 'intermediate' assignment. N is usually odd, 5 or 7, to allow a 'neutral' mid-point to the scale.

For the second example we are using a grid elicited from a 14 year old student on the PEGASUS program. He defined his purpose in eliciting the grid as helping him "to distinguish the books I have recently read" (Pope & Keen 1981). PEGASUS normally uses a 5-point rating scale as can be seen from Figure 5 which is the FOCUS analysis given at the end of PEGASUS. The construct clusters appearing here are 3 and 4; 1,2, 6 and 9; with 5 and 10 on the outsides of this group; and separately 7 and 8. The element clusters are 4 and 3 joining more loosely with 7 and 1; 2 and 6; and 5 and 8.

These groupings are again apparent in the principal component analysis shown in Figure 6. Here we see constructs 3 and 4 forming a cluster with 9, 10, and 6, and more loosely joined with 2, 1, 5 and 8; and 7 contributing mostly to the second component. The element clusters show the pairs 3 and 4; 7 and 1; 2 and 6; and 5 and 8 as did FOCUS.

			1	2	3	4	5	6	7	8	
TOTALLY COMMERCIALISED	1	*	5	1	2	2	3	1	2	4	WRITTEN AS LITERATURE
SENSATIONAL	2	*	4	2	2	2	3	1	4	4	PLAIN
EXTERNAL CONFLICT ONLY	3	*	5	3	3	3	2	1	4	3	MUCH CONFLICT INTERNALLY
FLAT	4	*	5	3	3	4	2	1	3	3	HAD SOMETHING
RELEVANT TO TODAY	5	*	3	1	1	3	2	2	2	4	NOT RELEVANT
SIMPLE	6	*	4	1	3	2	3	1	4	3	COMPLEX
ENJOYABLE	7	*	3	3	2	2	5	3	2	5	NOT ENJOYABLE
COMPULSIVE	8	*	4	2	2	2	5	1	3	5	NOT COMPULSIVE
FORGET IT	9	*	4	1	3	3	2	1	4	2	MEMORABLE
POOR VALUE	10	*	5	1	4	4	3	1	5	4	WORTH THE MONEY
		*	*	*	*	*	*	*	*	*	
			*	*	*	*	*	*	*	*	MEMOIRS OF A FOX HUNTING MAN
			*	*	*	*	*	*	*		CATCH 22
			*	*	*	*	*	*			THE DEEP
			*	*	*	*	*				HIGH WIND IN JAMAICA
			*	*	*	*					THE ODESSA FILE
			*	*	*						THE DOGS OF WAR
			*	*							THE MONEY CHANGERS
			ST	JOAN							

Raw Grid from Pope & Keen 1981

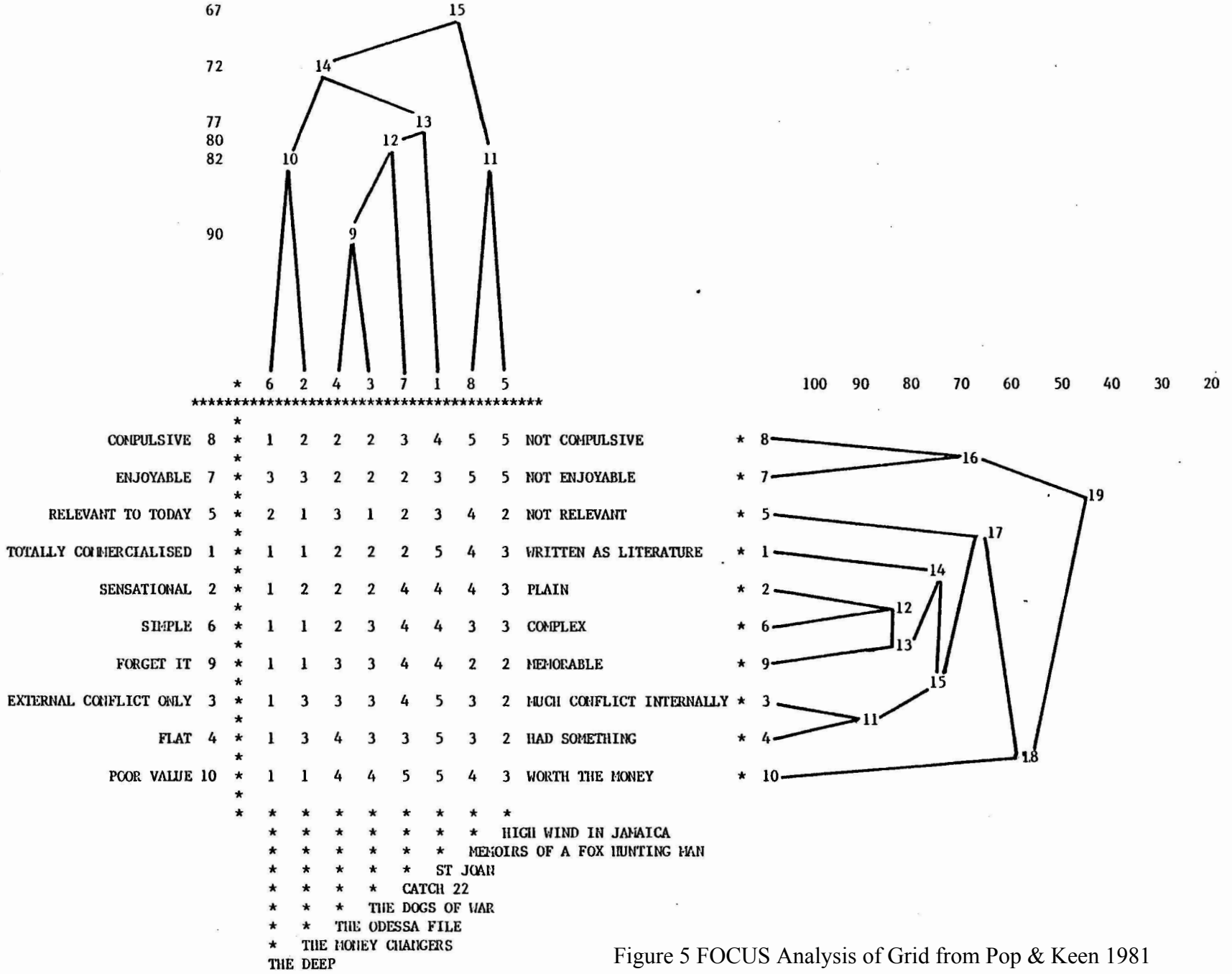


Figure 5 FOCUS Analysis of Grid from Pop & Keen 1981

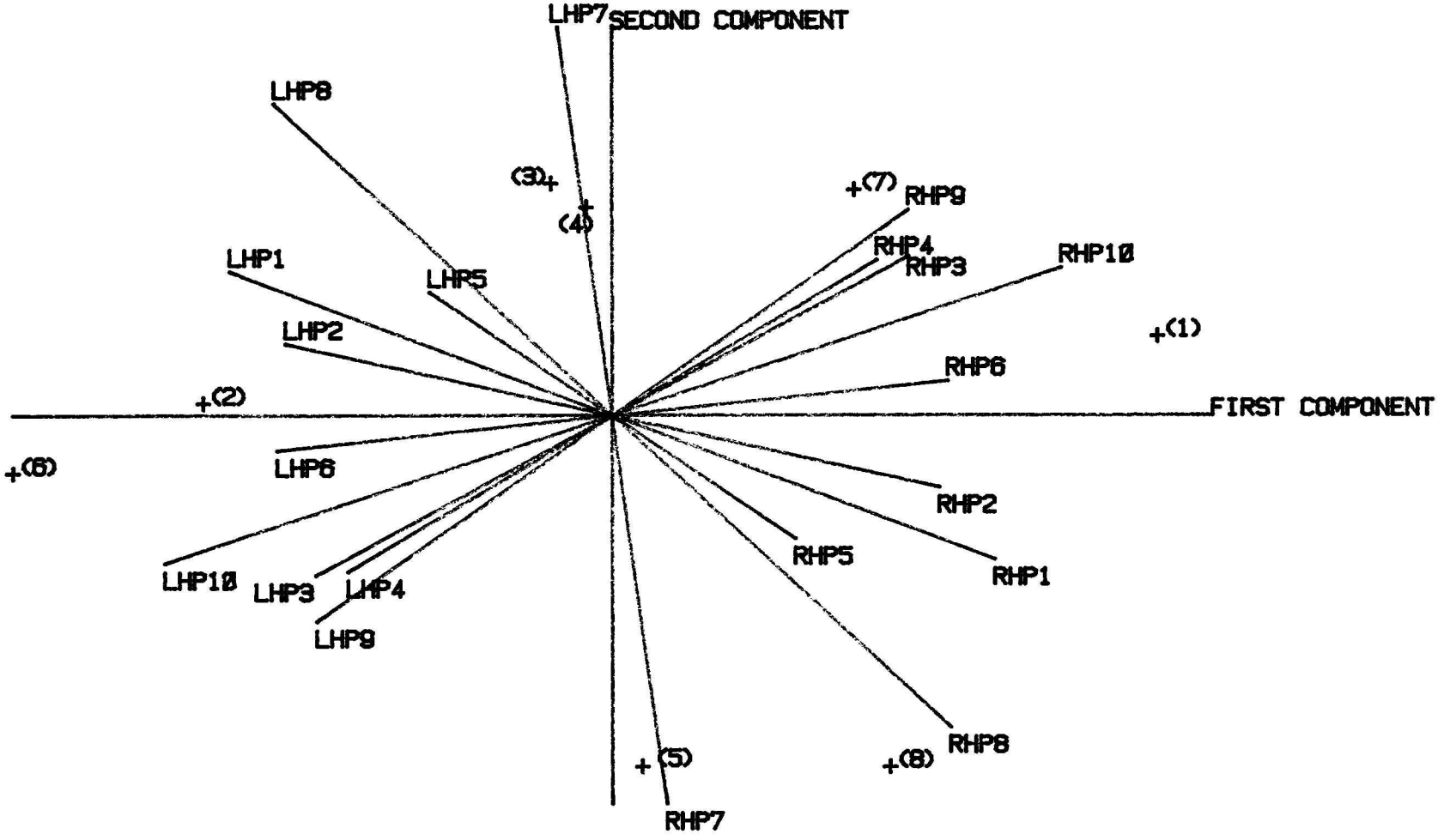


Figure 6 INGRID Analysis of Grid from Pop & Keen 1981

The result of the ENTAIL analysis using the fuzzy predicate "usually" which allows one exception only (Gaines & Shaw 1981b) is shown in Figure 7. Again some of the same clusters occur as did in FOCUS and INGRID. LHP3 and LHP4 occur together, connected into LHP6 and LHP9; LHP2 and LHP1 are linked here but also linked with LHP8 rather than LHP5 as previously. These relationships are reflected in the other part of the graph showing the other poles. Since it is a PEGASUS grid the reversals have already been done during the elicitation stage.

The main dimensions can be clearly seen as being characterized by the initial nodes 3 & 4, 10, 8 and 7 from which all the entailments stem. These are also exemplars of each of the main clusters apparent in FOCUS at the 65% level on the construct tree shown in Figure 5; but in the principal component analysis diagram of Figure 6 only two of these dimensions can be clearly seen as one might expect. It seems, therefore, from the two examples given that ENTAIL picks up any clustering exhibited by the existing distance-based methods of grid analysis in both the constructs and the elements. ENTAIL is equally applicable to the rating scale grid data as to the binary grid data.

CONCLUSIONS

In this paper we have shown the similarities in the resulting clusters of constructs and elements produced by the variety of commonly used distance-based grid analysis programs. We have suggested that a repertory grid may be regarded as a logical structure in which the poles of constructs are predicates applying to the elements, and how this type of analysis can be used to obtain asymmetric relations between elements and between construct poles such as that of implication. We have given examples of such analysis produced by the computer program ENTAIL both with binary and multipoint rating grids, and illustrated

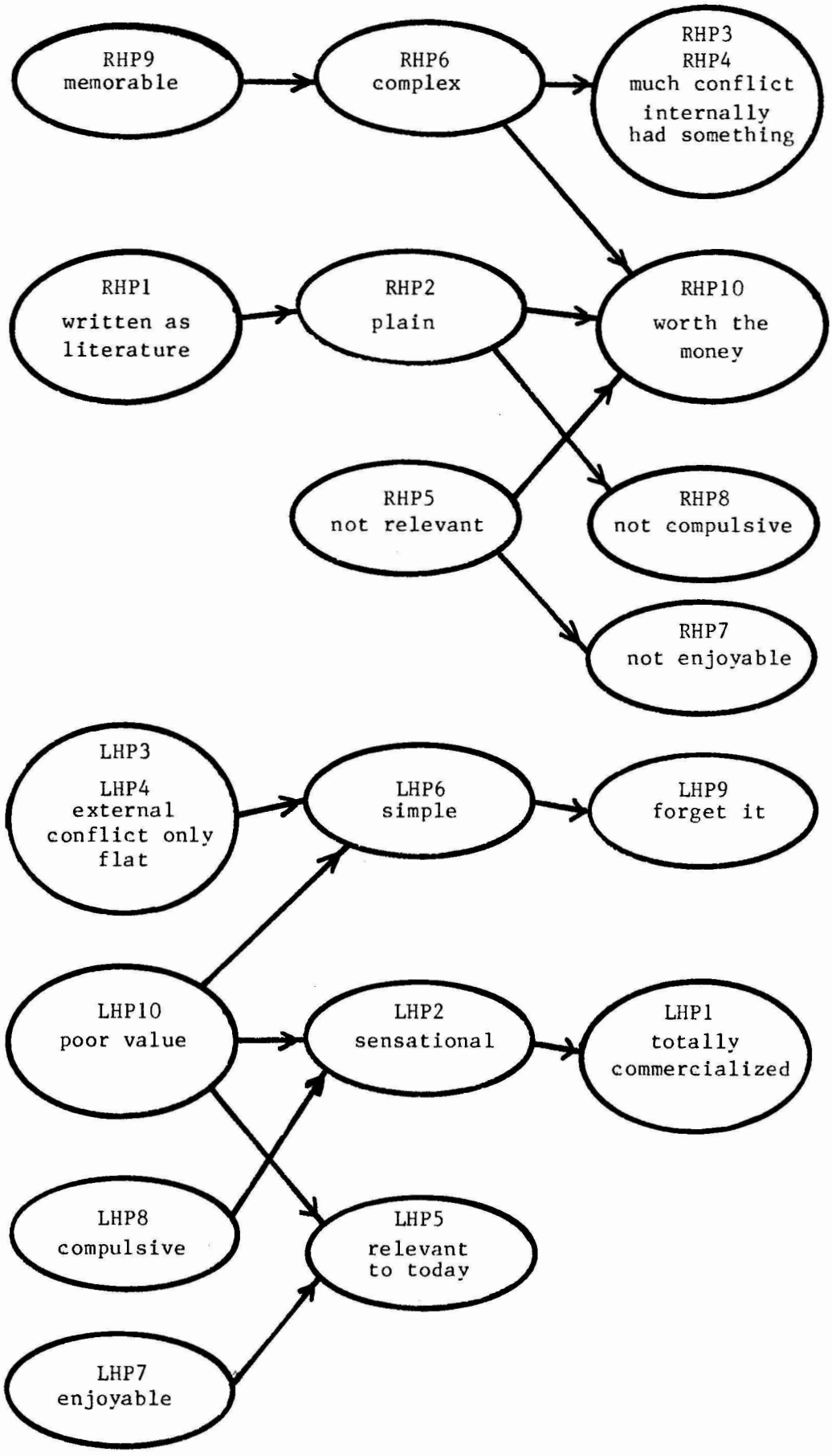


Figure 6 ENTAIL Analysis "Usually" of Grid from Pop & Keen 1981

that the results both reflect those of previously used methods and go beyond them in producing a set of hierarchies of relationships of implication.

In terms of our original questions it seems that all the methods considered extract similar structure from the data in terms of the "clusters" apparent, and this would also be expected on theoretical grounds. Additionally the ENTAIL analysis extracts asymmetric relations between constructs which the other methods cannot do by reason of the symmetric distance measures used. However, it will also be very apparent from the figures that the three different forms of data presentation resulting (Figures 2, 3 & 4 or 5, 6 & 7) present the data in different ways and each has its attractions. The INGRID mapping of elements and constructs into a cross-section of a rotated space is a natural presentation of the key features of that space to those who think of it in spatial terms. The FOCUS presentation of a sorted grid makes it apparent how the the clusters indicated arise from the original data and is a natural presentation of the structure of the grid as it arises from that data. The ENTAIL presentation of the logical relations between constructs makes the implications inherent in the data apparent and is naturally interpreted in verbal terms. Since all three techniques have their merits and it is computationally straightforward for any computer analysis to produce all three forms of diagram we see little point in arguing for one form as against another. They should each be available to anyone studying and interpreting a grid as constructive alternatives on the same material.

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