3 The Potential of Facet Theory for Applied Social Psychology

Introduction

In order to illustrate a relatively new approach to research methods and data analysis, most commonly referred to as facet theory (Gratch, 1973), the present paper describes three examples of the approach in use. The range of data types and variety of modes of analysis which can be accommodated by this approach are exemplified, starting with a simple example dealing with energy conservation in universities, then moving on to examine differences between prisoners and staff in their evaluation of prison buildings, and finally considering the more complex methodological issues involved in establishing the structure of housing satisfaction. However, whilst this paper essentially concerns research procedures, especially the use of multivariate statistics, I wish to make the case that the facet approach holds particular potential for applied social psychology.

The value of the facet approach derives from the fact that it provides a metatheoretical framework for empirical research. Guttman (1979), a major advocate, has recently summarised its promise as follows:

> Facet theory is proving to provide an effective approach for fruitful design of content, leading to appropriate data analysis techniques, and producing laws of human behaviour in a cumulative fashion. One byproduct is the establishment of more solid bases for policy decisions.

This 'byproduct' is one important reason for my interest in facet theory. For whilst it does not guarantee application, the facet approach does facilitate the exploration of applied problems and generates results which are potentially more open to application: more open in the sense that they have a form and structure which is more synomorphic with the form and structure of decision-making than are the results of conventional approaches to research.

Some of the limitations of conventional psychological research strategies and modes of data analysis have recently been summarised by Bynner (1980). He indicated that these deficiencies are a product of the inappropriateness for psychology of the agricultural examples upon which Fisher (1935) based his original work on analysis of variance. Adding to these criticisms, Bartram (1980) has argued for the insignificance of tests of significance and Guttman (1977) has launched an attack on many habitual usages of statistics, showing, for example, that

the mean is not a measure of central tendency and pointing out that analysis of variance does not analyse variance.

Multi-dimensional scaling

One recent methodological development which seemed to offer hope for providing valid descriptions of the more complex sets of variables found in applied research is that which sits under the broad label of multidimensional scaling (MDS) (Romney et al, 1976). Unfortunately, with a few notable exceptions, this approach appears to have been limited to developments in statistics. In general, ways of summarising the issues being explored as well as the results of MDS research have not moved far beyond mathematical descriptions. Furthermore, the plethora of techniques being used frequently encounter many of the pitfalls of earlier approaches in relying on psychological assumptions which are neither explicit nor demonstrably valid.

The facet-theory perspective on social science research has emerged out of the MDS literature. This perspective, whilst certainly not free of its own deficiencies, promises to provide a new approach which will produce more applicable results, both because it leads to precise definitions of the issues studied, and because it is an unashamedly non-metric, multivariate approach. Such approaches to research are certainly not new, although their use in applied research has been limited. Nonetheless, an established expert, Coombs (Lingoes, 1979, p.vii), is now calling for approaches to multivariate research which recognise that 'the analysis of data inevitably implies a theory'. The facet approach provides a framework for presenting that theory.

Introducing facet theory

Facet theory, as an approach to the design of research projects, measuring instruments and data analysis, developed out of the work of Guttman (1954) and his colleagues (Foa, 1953). They were concerned with the selection of items for test construction and with weaknesses in factor-analytic procedures (Guttman, 1954), as well as with the lack of clarity of existing approaches to the definition of research problems. This approach has now evolved into a research orientation with the explicit aim of revealing 'laws' (Shye, 1978).

Facet theory utilises three major constituents of scientific activity: (a) formal definition of the variables being studied, (b) hypotheses of some specified relationship between the definition and an aspect of the empirical observations, and (c) a rationale for the correspondence between (a) and (b).

The definition is provided by the specification of the facets from which the variables are derived, and the conceptual relationships they bear to each other. A facet may be, in essence, any way of categorising observations so long as the elements of the category scheme are mutually exclusive. For example, sex or intelligence can each form a separate facet because no observation of a person can

show him/her to be of different sexes or levels of intelligence at the same time. The sex facet normally has two 'elements' - male and female. The intelligence facet could have as many elements as there are different test scores. On the other hand, classifying people in terms of their personality profiles would be a facet approach only if each aspect of personality (e.g., extraversion, neuroticism, psychoticism) were treated as a separate facet.

Recent reviews of facet theory, such as those of Borg (1978) and Shye (1978), have all emphasised its wide range of modes of use. For example, Payne et al. (1976) used it as a basis for classifying and ordering job-satisfaction variables. It was used by Elizur and Guttman (1976) to formulate and then test hypotheses concerning relationships between attitudes towards work and technological change.

Above all, facet theory is a set of related ideas about how to do research and why it should be done in that way (Runkel and McGrath, 1972). As a consequence, it is difficult to present the richness and potential of the approach briefly, except through the discussion of examples. This paper, therefore, describes increasingly complex examples of facet theory in use, taking the opportunity, along the way, of illustrating the more formal properties of the approach. Of course, facet theory has a number of important weaknesses, but for the sake of clarity of presentation an examination of them is left to the concluding section.

Towards applicability

My own conversion to the use of facet theory grew out of my disquiet with the applicability of my own work, when that work made use of conventional approaches to research. I found, for example, that decision-makers were not interested in a significant difference between two levels of a variable if that variable was not under their control, or if the actual size of the difference was so small that it was not worth the administrative upheaval to change things. It became apparent to me that it is often more important for a manager to make sure that he or she has not forgotten some crucial issue than to focus on the precise details of any particular situation. Clearly stating the concerns with which the world faces them seems to be a critical consideration for most senior managers and policy-makers. This can be seen in a perusal of management guides, briefs to policy-makers, or programmes for architects. Essentially, they consist of lists.

I remember my own initial dismay on finding that systematic design procedures in architecture consist almost entirely of checklists specifying what to do and when. The hypothetico-deductive system on which I had been schooled, the axioms, hypotheses, theories and tests of what was happening, were nowhere to be found. How could this be 'systematic'? It was only when I was faced, as a consultant myself, with directly guiding decision-making that I began to appreciate the real complexities of the world we operate within and that the applied scientist's task is to provide a coherent resume of that world so that it can be understood and acted on. Simplifying the problems to be studied, in advance of studying them, for the sake of some notional 'scientific rigour', seemed to me to be like the joke about a

person searching for something he had lost where it was easy to see, rather than in the area where he had lost it!

It began to dawn on me that in shaping research so as to increase its potential for use by decision-makers, a number of aspects of the 'real world' in which problems are solved are especially significant for research methodology. In summary, they are as follows.

The categorical nature of policy-making and action-taking. After any deliberations a decision is made whether to proceed or not, to reconsider at a later date, or to forget the whole issue. These are categories of action, not amounts or degrees of action. As a consequence, research results which derive from assumptions about continuous variables and present those results as graphs, correlations, means or any other summary of undifferentiated variables, require conversion into discrete, categorical forms amenable to action. Methods which are derived from non-metric procedures thus have more potential for producing applicable results.

The multivariate structure of human experience and action. The complexity of the physical and social environment outside of the laboratory is the main reason why those interested in the rigorous testing of theories have typically shunned field-studies. The converse of this, however, has not been so logically followed. This is the requirement of field-based research, especially if it is problem-oriented, to incorporate a number of variables into its explorations in any study. The process of isolating variables for examination in the field by controlling the conditions under which they occur, say by selecting sites in which potentially 'contaminating' variables are absent, ignores the fact that to the person wishing to act upon the results of research those theoretical 'contaminants' may well be the very reason for requiring research assistance.

Often action is facilitated if the options available can be specified. This in turn requires that the problems and their component parts be determined and unequivocally labelled. Research procedures which relate directly to the definition of the variables being studied thus have greater potential for application than those which result in purely numerical outcomes.

The concepts being examined need to be specified in other than operational terms. The pertinence of any definition to a policy-maker is often ignored because social scientists appear to learn that definition is a technical rather than a theoretical problem. They are provided with the notion of 'operational' definitions and then resolve the problem of specifying what is being measured by reference to some other measuring device similarly defined. Not surprisingly, decision-makers become impatient with advisors who insist that the devices being used 'measure what they measure'.

These four aspects of applied problems, which must be recognised if the results of research are to be applicable, each find a response, to differing degrees, in the facet approach, as is illustrated through the examples to be presented.

An example from energy conservation: facets of action

The first example illustrates a simple use of facet theory to provide an ordered set of categories of behaviour. The example gives an insight into some of the fundamental principles of the theory, using as its vehicle a study of the actions taken by British universities when attempting to increase energy conservation. These actions provided us (Miles and Canter, 1976) with an opportunity to study the structure of energy-conservation actions within British universities. The data were provided by writing to the Registrars of all 50 institutions and asking them for details of the energy-conserving activities carried out by their universities. A direct content-analysis of the responses from the 43 replies provides the basis of our illustration.

When the energy crisis of the mid-1970s began to be felt, most British universities considered what they should do to conserve funds by conserving energy. I was intrigued, but not surprised, to learn that in the traditions of university autonomy each institution was carrying out its own conservation activities independently from, and in virtual ignorance of, the actions of all the other universities. It was therefore of interest and of potential value to establish whether there were any similarities in the actions taken by different universities and whether any pattern could be discerned, within their activities, which would reveal an underlying consistency to university decision making. A lack of consistency would raise questions about administrative idiosyncrasies. The existence of a common framework could be used to guide concerted action.

The objective, then, was to provide a coherent account of the actions being taken by the universities and to establish the nature of the relationships among these actions. Of course, by providing university administrations with an indication of what other universities were doing and how their own behaviour fitted that general framework, we could not guarantee that taking any given action would inevitably have the desired effects. Nonetheless, at the very least we could enable an administration to know whether their actions were unusual. Furthermore, knowledge of what comparable administrations are doing in response to commonly experienced conditions can be taken as a form of guidance.

However, in order to get beyond a series of anecdotes, or further than a simple list of what was happening, it was important to establish the structure of the actions taken. For example, if it could be demonstrated that some actions were the usual precursors to others then this would suggest that jumping ahead of the sequence might carry unwelcome costs. The significance of any structure revealed will depend on the particular form it takes, so further consideration must follow the presentation of the results. The properties of the problem being investigated can now be specified in order to show the particular value of a facet approach.

1. We are operating upon the content analysis of a set of recorded events. The data are categorical.
2. Any categories derived from the data will form the actual content of any summary model produced. Analysis techniques are therefore required

which will not arbitrarily categorise the data. In other words, we must be able to see exactly what is happening to the data so that any substantive manipulations can be controlled.

3. It is necessary to go beyond univariate cross-tabulations of each category of action with every other. It is the overall pattern of relationships which is being sought.
4. It is implicit that there will be some sequence or direction to the actions being studied most probably in the direction of earlier or later actions, or of greater or lesser amounts of action. Any analytical procedure should reveal this.

Whilst a number of statistical procedures will cope individually with each of the four problem characteristics above, the facet approach is able to respond to all four. As indicated earlier, it also goes further by providing a systematic, formal procedure for describing and, in effect, defining the variables being examined.

Generating the facets

In the present case the facets are the classes of actions taken by British universities. Any method for classifying a university's actions, derived from a conventional content-analysis of the responses from Registrars, could from a facet, provided that each sub-category (or 'element' of the facet) is mutually exclusive and that it is possible to classify all universities on all facets. A facet is thus different from a 'variable' in that it is one way of categorising the observations. In some studies a number of variables may be so similar that they are all derived from the same facet elements, or pre-defined facets may not be represented by any of the variables being measured. Technically, a facet is 'any set playing a role of a component set of a Cartesian space, this set being called a facet of that space' (Canter, 1977). A 'Cartesian' space is one for which the co-ordinates are simply distances, not angles or specific dimensions. The reference to Cartesian space here also indicates that no assumptions are being made about the dimensionality of the facets. It further implies that the observations are being classified on all the facets. A facet applicable to any observation is applicable to all (Runkel and McGrath, 1972, p. 19).

Three sources were drawn upon to generate facets for the energy-conserving actions. One was a consideration of the actions available to the universities. A second was examination of the replies from the Registrars. The third was a consideration of the existing literature and other sources of concepts for classifying energy-conservation actions (cf. Arbuthnot, 1977; Pallack et al, 1980). In order to present this material as a simple example, only those major facets of immediate interest are discussed. The four main classes of action, which constitute the four facets, were *(A) overall measures, (B) establishing committees, (C) appointing officers, and (D) examining alternative sources of energy*. These four are of especial interest because they range from actions taken by central administrative authorities to those which are carried out by individuals peripheral to those authorities, a sequence which reflects the essentially autocratic, hierarchical

structure of British universities. I return to this relationship between the types of action after considering each in a little more detail.

(A) *Overall measures:* procedures carried out by central university authorities on systems directly under their control, such as lowering the general temperature, reducing the number of lights available for use, and reducing the use of water.

(B) *Committees:* one or more bodies created specifically to consider aspects of energy use and conservation within the university.

(C) *Conservation officers:* people appointed or elected to monitor/promote/explore energy use and conservation within their own departments or the university as a whole.

(D) *Alternative sources:* encouragement or active sponsorship of specified individuals to carry out studies of, or research into, alternative modes of energy production or conservation [I].

Having established these categories of action, each university can be classified in terms of whether or not it has carried out each of the actions within a class, the facets being dichotomous (containing the elements of occurrence and non-occurrence of actions). In effect, a profile can be created for each institution across the four facets of action. Potentially every possible combination ($2^4 = 16$) of action and inaction could combine to provide a characteristic profile. This full set of all possible profiles describes the range of types of energy-conservation activity which is possible within the definition provided by our four facets.

A mapping sentence for energy-conserving actions

One way of summarising the complete set of all possible action profiles is by means of a 'mapping sentence' (cf. Levy, 1976; Borg, 1978). Shye (1978, p. 413) defines a mapping sentence as 'a verbal statement of the domain and of the range of a mapping including connectives between facets as in ordinary language'. In the present case the domain is the set of actions being considered. The range (indicated by →[]) in this instance is taken, for simplicity, as dichotomous : the occurrence or not of an action.

Mapping sentence 1

Energy-Conserving Actions in British Universities (after Miles and Canter, 1976)

Whether *(A) Overall Measures,*	*(B) Special Committees,*
[1. Do not][a]	[1. Do not]
[2. Do]	[2. Do]

(C) Appointed Officers and	*(D) Search For Alternatives*
[1. Do not]	[1. Do not]
[2. Do]	[2. Do]
occur in a given university (x) →	[Do not]
	[Do occur]

[a] The [] indicate the facets being utilised to provide the definitional system for the population of each x, i.e., a British university.

The complete set of all possible profiles indicated by the mapping sentence above would number 16, each facet being dichotomous. This is a theoretical set of types of energy-conserving actions which universities might perform. If all the facets are labelled *A–D* and the existence of an action indicated by a 2 and the lack of it by a 1, then the profile for a university which carried out all four sets of actions would be represented by *A2 B2 C2 D2*. An institution which carried out no energy-conserving actions at all would have the profile *A1 B1 C1 D1*. The empirical question, and one concerning which hypotheses can be put forward, concerns which of all the possible profiles actually exists. Furthermore, there is the question as to whether there is any heuristic device which effectively summarises the profiles which actually do exist and their relationships one to another.

In the present case the first point to note is that each of the four facets has a direction to it which can be equated to the direction in the other facets. The 2, denoting the occurrence of an action, has a similar meaning for every facet. As a consequence it is logical to say that the more 2's any university has in its profile, the more active it is in energy conservation. Furthermore, if the simplest possible count of amount of action is taken, all universities can be put in order on the basis of the number of 2's they have in their profiles. The greater the number of actions they have taken, the more 'energy-conserving' they are. This makes minimum demands on the data by giving equal weight to each facet. It also, of course, takes no account of the success of the actions (an issue not explored by the universities).

Of the 16 potential action profiles there are many which would show the same amount of 'energy conservation' but in quite different ways. For example, *A2 B2 C1 D1* would have the same 'score' as *A1 B1 C2 D2*, even though it represents virtually opposite actions. As a consequence, on a directly numerical basis the 16 profiles can be only partly ordered, because there are many profiles whose orders, being qualitatively different, cannot be quantitatively compared with each other (cf. Shye, 1978, p. 265). Yet it is frequently possible to put forward a psychological hypothesis which predicts that the full number of mathematically possible combinations will not actually exist. In the present case this can be done by referring back to the possible relationships among the facets.

A cumulative scale

It was pointed out earlier that the four facets were possibly reflections of four steps

of action away from the central authority of the university. Indeed it was the representatives of this authority, the Registrars, who provided an account of the institutions' actions. Let us posit, then, that it is considerably easier for an autocratic organisation such as a British university to carry out central measures, less easy to establish special committees, even less easy to appoint officers, and difficult to encourage particular individuals to explore alternative sources of energy. Under such circumstances the number of potential profiles of conservation actions would be greatly restricted. The easiest way to appreciate these restrictions is by considering that an institution which has carried out a 'difficult' act such as appointing an officer is also likely to have carried out the other 'easier' acts. Hence profiles including a C2 (conservation officer) would be expected also to contain A2 (overall measures) and B2 (committees).

An examination of the 16 possible profiles in the light of the most strict interpretation of the order amongst the facets reveals that only five profiles would be likely to actually exist, as shown in *Figure 1*.

Figure 1 represents a cumulative, 'Guttman' scale, first presented by Stouffer et al (1950). Such a scale is one type of theoretical structure which provides a heuristic device for summarising the relationships among facets and the basis for a more formal hypothesis of the structure inherent in a set of observations. As the present paper proceeds other forms of structural hypothesis will be presented.

In the case of energy conservation all but one of the 43 responding universities had profiles the same as one of those in Figure 1. In other words, if those profiles are taken to be a hypothesis then it can be shown to account for 98% of the observations. Depending upon the use to which the results are to be put this figure will be acceptably high or not. Certainly for most psychological activity it is respectable, within the limits of the sample and the data-collection procedure. For the present purposes the structure certainly seems to describe the relationships among the set of energy-conservation events sufficiently well to allow this example to be taken one stage further.

A1	E1	C1	D1
A2	E1	C1	D1
A2	B2	C1	D1
A2	E2	C2	D1
A2	B2	C2	D2

Figure 1 Cumulative scale for energy-conserving actions represented as facet profiles. These four profiles account for the actions of 42 out of the 43 universities that responded (see mapping sentence 1 for key).

Some consequences

What I wish to argue is that a set of actions structurally related in the way described might well be considered as a flow diagram with prescriptive as well as descriptive

properties. The four facets can be thought of as part of a series of possible actions which could be initiated by a university administration, the easiest action, the implementation of central measures *A*, being done first, followed by *B*, *C* and then *D*. This is not to suggest that this is inevitably the optimum sequence, only that it presents a feasible sequence. The order of the actions certainly raises some questions. For example, why are central actions typically taken before any group has been appointed to oversee those actions? Further, what is the institutional nature of energy conservation which creates situations in which individuals or groups are appointed (*C*, *D*) only once more general actions have been taken (*A*, *B*)? The answers which any particular university gave to these questions would carry implications for future actions.

The structure, then, and its interpretation as a sequence of actions, throws light on the organisation of British universities in response to the perception of an energy crisis. It also helps to illustrate how structural hypotheses of defined domains of concern can be explored. Yet in the present example the possibility for application derives from the fact that a simple structure has been identified: a cumulative ordering of the facets. The simplest consequence, therefore, is to use the model as a sequence of actions to take. However, this would virtually accept current practice. More profound consequences would follow from questioning the patterns revealed, for example by exploring why the investigation of alternative sources (*D*) is such a late stage in administrative actions.

An example from prisons: regional hypotheses for people

The second example illustrates the accommodation of more diverse sources of information and the development of more complex structural models than in the preceding energy-conservation example, for which only the actions performed were considered. In one sense, therefore, all the facets were drawn from what Guttman has called the same 'universe of content' (cf. Borg, 1978, p. 66). Other ways of thinking about universities, such as in terms of their age or their size, were not part of the original mapping sentence. In the language of traditional experimental psychology, relationships among 'dependent' variables were being considered. However, many important research questions have always concerned relationships among 'independent' and 'dependent' variables. As Guttman and Levy (1980) among others have pointed out, whether a variable is recognised as dependent or independent is arbitrary in the sense that it is determined by the phrasing of the research question. Nonetheless, there are many occasions when it is clear that the way in which variables are measured, defined or controlled distinguishes them from each other to the extent that they can be considered as deriving from different domains of concern. On such occasions the pattern of the relationships among the variables is likely to be more complex than that illustrated in the preceding example, requiring more sophisticated computing procedures.

The difference between the present example and the previous one is analogous

to that between the statistics of association and the statistics of differences. Conventionally, the relationships among energy-conservation actions across universities would be studied using bivariate measures of association, such as chi square. The second example, from prisons, would be analysed by examining differences in the effects of 'treatments' using, say, analysis of variance.

A further distinction between the second example and the first is that the actions chosen for study in the previous example were such that a limited number of actions could be readily identified. It was therefore possible to include them all in the definition of the problem, through the mapping sentence. The structure which then resulted from an examination of the action profiles provided, as a consequence, a description of how all the facets actually related one to another. Although the rationale was presented only briefly, the reasons for the structure found were shown to derive from a consideration of each of the facets themselves and the nature of their coexistence with the other facets.

Many applied problems do not reveal themselves as a clearly defined set of facets. Indeed, as discussed earlier, policy questions are frequently of the form: 'What are the critical issues here? On which entities should I focus?'. The social psychologist is called upon to describe observations so that effective distinctions between elements of facets are revealed. Traditionally this is done by the analysis of variance, to establish 'significant' effects. This approach not only has a number of theoretical weaknesses (as discussed, for example, by Guttman, 1977) , but it also has difficulty in dealing with the non-metric, multivariate data with which applied research must so often contend.

To illustrate a facet approach to these issues I draw upon a recent study of prisons (Ambrose and Canter, 1979). This study was oriented towards the development of procedure for the evaluation of prison buildings. On the basis of previous work in other institutions, to be discussed later (Canter and Kenny, 1979; Rees and Canter, 1979), it was considered feasible to develop, together with other procedures, a standard questionnaire which could be completed by inmates and staff. As part of this development task it was also important to establish that there were consistent differences between prisons, which could be revealed from user responses to the questionnaire.

Questions about the development of an evaluation tool can be expressed in facet terms, as to whether two distinct facets can be identified. In this case, one would be a facet distinguishing responses in terms of the prison which a respondent is describing. The other would be a facet distinguishing respondents independently of their prison. The most obvious elements of the second facet would be derived from a distinction between prisoners and prison officers. However, these are not facets which we expected to operate in the abstract. They are facets which we wished to explore within the context of user responses to their surroundings.

Environmental role

I now introduce briefly some issues of a more theoretical nature which help to

clarify the directions in which the empirical observations will be explored.

The first point is that in examining the reactions of individuals to the place in which they live or work, it can be assumed that their mode of interaction with that place will be a significant source from which their response will be derived. This idea has been developed elsewhere (Canter, 1977, 1979) in relation to the concept of 'environmental role'. In essence, it is proposed that it is the use to which people put their surroundings, the extent to which their environment enables them to achieve what they want from it, that determines their evaluation of it.

Prisons which have differing purposes (catering for short as opposed to long prison sentences, for example) may be expected to give rise to differences in the reactions of staff or inmates. Furthermore, it is important for methodological as well as administrative reasons to establish whether prisoners and staff hold distinct conceptualisations of the prison. It is certainly possible that the totality of the institution is such that, together with the time spent within it, the distinction between institutions is greater than the distinction between individuals, even when they perform such different roles within it.

If these differences among people were to be explored by means of a standard questionnaire then there would be a grave risk that, by presenting ready-made concepts for use by the respondents, only a pale reflection of their own conceptual system would be obtained. A number of people have elaborated upon this idea, drawing frequently on Kelly's (1955) personal construct theory, and this led us to develop a procedure which allows individuals to reveal their own concepts while still enabling comparisons between individuals and groups to be made. We have called it a multiple sorting task (Groat, 1979; Groat and Canter, 1979), derived from Sherif and Sherif's (1969) own-categories procedure and Vygotsky's (1934) sorting task.

Method

Forty-six staff and prisoners in three institutions were each presented with 23 cards. On these cards were words describing places in which people might reside, such as 'hotel', 'hospital', 'night shelter'. One card had 'this prison' written on it. Each of the respondents was asked to consider each card and think of a place they knew to which the description applied. They were then asked to sort the cards into as many categories as they wished so that all the places in any given category had some important quality in common. Notes were taken of their description of what it was that the places had in common.

Our concern here was for respondents' conceptualisations of their particular prison. We wished to examine how that institution was related, in their sortings, to all the other places listed. In other words, a matrix can be created for each person indicating whether or not his or her current prison was put in the same category as each of the other 23 places. It is this profile of yes/no associations which provides the account of the respondent's conceptualisations of their establishment. We thus obtained a set of responses, provided by the sorting task, which can be incorporated

with descriptions of the people and their institution for analysis. Returning again to the formalities of facet theory, a mapping sentence for the research question can be presented:

Mapping sentence 2

Conceptualisations of prisons. Whether or not respondent (x), where (x) is an individual describing the place in which he or she is resident or works,

being a	[(*A*) 1. Prison officer] in a [2. Prisoner]	[(*B*) 1. Local prison] [2. Training prison] [3. Borstal This)]
indicating his or her present prison to be	[(*N*) 1. Similar to] [2. Different from]	{each of 23 }[a] {other places}

[Does] → [Does not] indicate his prison to be similar to each of 23 other places

[a] The 1 indicates that N is a facet composed of 23 subfacets, one for each card in the sorting task.

The principle of contiguity

One property of the cumulative scale, not mentioned when it was illustrated (Figure 1), is that it can be regarded as a representation of the relationships among profiles in a spatial configuration. In the preceding example, the most similar institutions (or profiles) were next to each other in the list, the least similar furthest apart. Interestingly, contours can be drawn across the list of profiles corresponding to each of the original facets. *Figure 2* illustrates this by showing how each profile can be represented as a point in a space and that space can then be 'partitioned' to reveal regions associated with elements of the facets. *Figure 2* does, of course, represent a very simple example, because only one dimension is really needed to represent a cumulative scale. However, it does reveal the general principle that regions of a space can provide evidence for facet structure. This is a principle, as will be seen, which can be generalised to a space of any number of dimensions. Thus one of the general tests employed in facet theory is to establish whether a spatial representation of the observations can be created such that the similarity between profiles is directly reflected in their closeness in space. This has been referred to as Guttman's principle of contiguity (Lingoes, 1979, p. 38). All multidimensional scaling procedures are ways of providing geometrical representations of relational data (Lingoes, 1968), but it is the use of the principle

of contiguity and the examination of differences between profiles which are derived from facets which distinguishes the facet approach.

In the data from the prison study each profile represents a *respondent*; therefore a spatial configuration is sought such that the more similar the pattern of sorts made by any two people, the closer together they will be in that plot. In other terms, the empirical question posed by mapping sentence 2 is whether or not contiguous regions can be found in an appropriate spatial configuration which correspond to the elements of the facets. At present we focus on facets *A* (role) and *B* (location), and wish to know whether a space which accommodates all 23 subfacets of *N* as well as *A* and *B* would indeed reveal areas identifiably related to *A1* and *A2*, or to *B1*, *B2* and *B3*.

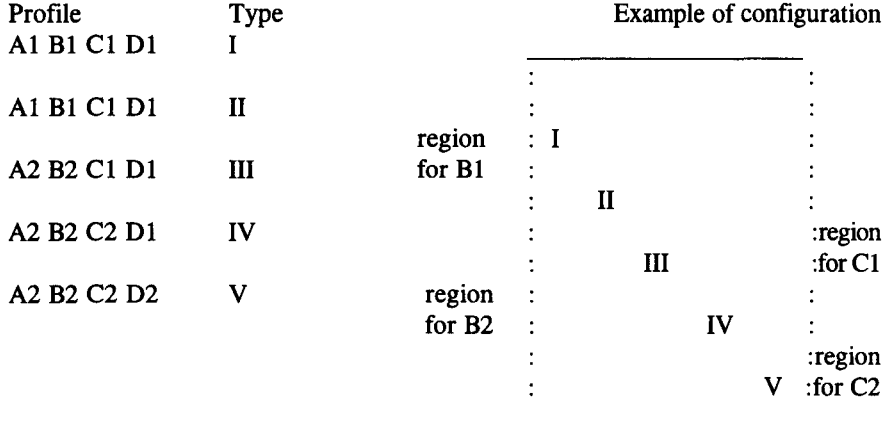

Figure 2 The relationship between the cumulative scale (from Fig. 1) and the spatial representation of individuals. Two ways of partitioning the configuration of profiles are indicated, for Facets B and C (see mapping sentence 1 for key).

Multidimensional scalogram analysis (MSA)

In order to create a configuration of respondents it is necessary to use a procedure which will operate on the dichotomous categories and which, while representing each of the respondents as a point, will nonetheless allow an examination of the regions associated with each facet. Multidimensional scalogram analysis (MSA) is a procedure uniquely suited to these requirements. It operates entirely on categorical differences. Full details of the algorithm have been provided by Lingoes (1968), and other examples of the procedure in use have been published by Jordan (1978), Guttman and Guttman (1974) and by Bloombaum (1970).

The procedure creates a configuration of points, where each point represents a respondent, and the regions of the space reflect the categories of each variable (in the present case, the variables correspond to the facets in the mapping sentence,

including both the description of the person and his or her location as well as his or her sorting of places). MSA creates an optimum configuration of points which satisfies as many as possible of the regional limitations set by each variable. Inevitably, for some data, a configuration cannot be found in which for each variable there are regions of the space corresponding to the categories of that variable. In other words, in many cases not all variables actually give rise to regions within the configuration, especially if a two-dimensional configuration is specified. However, the computer program does provide plots for each variable. These can be used to establish whether contiguous regions of the space can be found for any given variable and hence whether it is functioning as a facet in a particular set of data. MSA, then, is a general solution to the problem of representing individuals as points in a space for which each of the variables is a way of partitioning that space and each of the categories of a variable is a region of that space. A cumulative scale is a special case of MSA, as illustrated in Figure 2.

One further advantage of MSA as a general computing procedure is that facets from different domains can be readily accommodated in the same analysis. In the present case it is possible to include the classification of the people, their prisons, and their sorting responses all in the same analysis, and thus establish whether the people (*A*) and prison (*B*) facets do indeed lead to partitions of the total configuration, which is also constrained by the sorts (*N*). In effect, the MSA printout can be examined for direct evidence for the mapping sentence. In the present example we focus on facets *A* and *B*, so only the partitions for those two facets are presented.

Results

Figure 3 presents the configuration of points derived from a two-dimensional MSA. Each point represents an individual respondent, coded to indicate whether the respondent is a member of staff or an inmate. *Figure 4* shows the same configuration, but in this case the points are coded to indicate the prison in which the respondent was.

The intriguing thing about Figure 3 is that there are no clear regions of the space which can be identified with whether a person was an inmate or not. By comparison, in Figure 4 there are clearly defined regions for each of the different prisons.This lends support to the role of facet B in the mapping sentence, but no real support for facet A. One consequence of this finding is that the development of separate evaluation instruments for each set of respondents might not be necessary. Indeed it is possible that the staff share quite closely with prisoners their views on the purposes of the establishments. On the other hand, it is clear that reactions to prisons occur against the background of exactly what type of prison is being studied. Any evaluation, therefore, is meaningless unless it incorporates an understanding of the goals and purposes of each *particular* institution.

MSA has been used in this example as a way of identifying which facets are

operative in a given context. It has thus enabled us to move a step further in the direction of using the facet approach for generating a category scheme which has functional utility. It has also illustrated a direct facet theory parallel to the conventional quest to establish which variables have a 'significant' effect. In the present case 'significance' is revealed by the existence of non-controversial partitions of the multi-dimensional spatial representation of the similarities between individuals in their card-sorts.

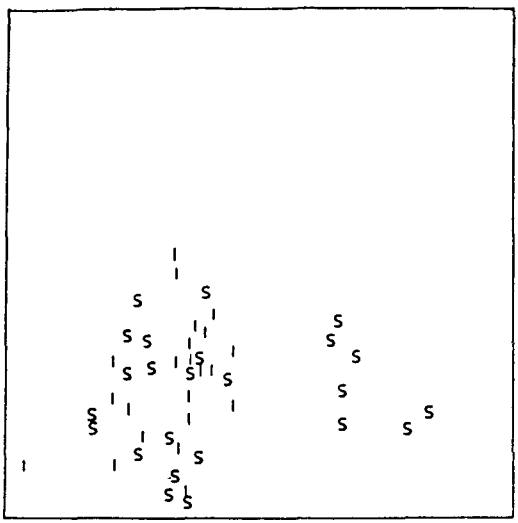

Figure 3 MSA1 of staff (a)[b] and inmates (i) based on their card sorts[c].
[a] Points represent people. [b] This is coded for Facet [A] of mapping sentence two. (s is A1, i is A2). No clear regions for these elements can be found, hence no support for facet [A] is provided by this plot.

An example from housing satisfaction: portraying multivariate structures

So far facets have been identified as part of the definition of the research question and few actual facets have been dealt with at any one time. We have also been concerned mainly with the differences between individuals in the population being studied (universities or inmates). All these limitations to the examples so far are present because we have ignored the structure of the relationships which exist *among* the 'content' variables. In dealing with universities, prisoners and prison staff, it has been assumed that each of the ways of categorising the observations (i.e., the actions and the different sorting categories) could be given equal and qualitatively similar weights in the description of the population for which data were available. Yet we had no information concerning the relationships among the descriptions (their structure). The third example illustrates this most widely utilised aspect of facet theory.

The quest for a facet structure can be seen as the problem of identifying the most

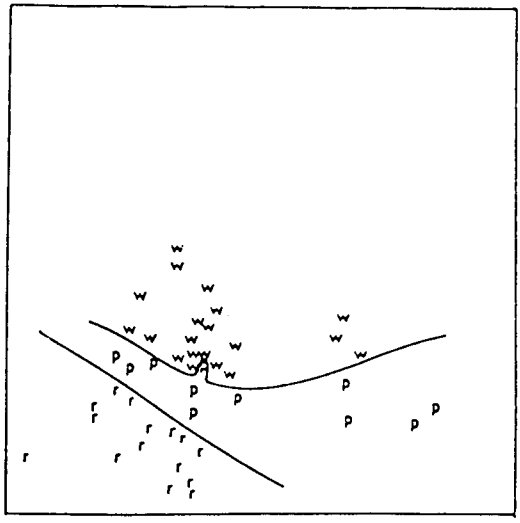

Figure 4 MSA1[a] of respondents showing the prison[b] they are from.
[a] The configuration is the same as for Fig. 3. [b] The plot is coded for facet [B] of mapping sentence two (B1 is p, B2 is w, B3 is r). The regions in which these elements are found have been drawn in by hand.

pertinent classification of variables: the one which will best portray the pattern of correlations among them. One situation in which it is essential to understand this pattern of correlations among variables and identify a facet structure is when using questionnaires. To illustrate this I draw upon a study of the satisfaction people have with where they live, derived from the work of Rees and Canter (1979). *Table 1* presents a set of 13 questions which were asked of 1102 people. Each of these questions was answered separately by husbands and wives, who were each sent an identical questionnaire through the post, as described by Canter et al (1980). Thus, for each *family* responses were obtained to 26 questions.

Of course, these questions can be taken strictly at face value and percentage differences or whatever can be examined for each question across various response groups. However, this avoids the issue of what definitional framework can be provided which will allow a fuller understanding of what these satisfaction questions are about. For example, consider question 1 in Table 1. This may be thought of as a question which has to do with 'neighbourhood', as well as a question which has to do with 'convenience'. In other words, considering all questions, each can be assigned to a category scheme which distinguishes between, say, house questions and 'neighbourhood' questions, a facet of 'environmental scale'. What, then, are some of the facets which can be used to classify the questions in Table 1?

Method of analysis

In the MSA for the prison example it proved very useful to have the observations represented in some spatial form so that, following the principle of contiguity, regions associated with elements of facets could be identified. Thus the partitioning of a spatial representation of the relationship between variables holds many heuristic advantages as a way of portraying facets. In a case such as the present, the size of a correlation between two variables will reflect the similarity of their facet constituents. Hence the pattern of correlations between variables will be examined in order to see what facets it suggests.

To provide an account of a pattern of correlations it turns out that a procedure which represents the size of the correlation between two items as the inverse of the distance between them has much to recommend it. This is precisely what many multidimensional scaling (MDS) procedures do, the major difference in the present case being that we wish to examine the resulting spatial configuration of variables by considering partitions of the space (its 'regional structure') rather than by identifying clusters or dimensions as such. The particular computing procedure used to create a spatial representation of the correlations among the 26 house satisfaction items was SSA1 from the Guttman-Lingoes series of non-metric MDS procedures (Lingoes, 1979). This procedure is now described in a little more detail.

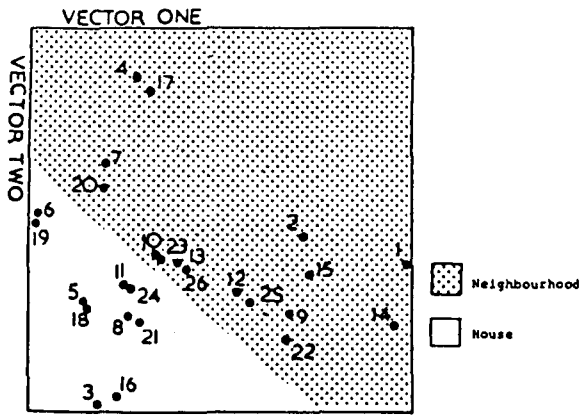

Figure 5 SSA1[a] for 26 questionnaire items showing regions[b] for house and neighbourhood items.
[a] Points represent items. The axes are arbitrary, hence unlabelled. [b] The regions are identified from item content (see Table 1) and drawn in by hand.

SSA of housing questionnaire

Figure 5 represents the 26 questionnaire items as points and the correlations between items (across the sample of 1102 households) as the inverses of the

distances between those points. In essence, the computing algorithm rank-orders the correlations between all items. It then generates a spatial representation of those items, with points representing items, and rank-orders the distances between the

Table 1

Questions from Housing-Satisfaction Questionnaire (from Rees and Canter, 1979)

Reference number in Figs. 5-7		Item
Husband	*Wife*	
1	14	How conveniently located are the shops in your neighhourhood?
2	15	Is your neighbourhood friendly?
3	16	Are you happy with the decor in your house?
4	17	How convenient is it for visitors to park near your house?
5	18	Do you feel satisfied with your house when you have visitors?
6	19	Are you satisfied with the spaciousness of your kitchen?
7	20	How happy are you with the distances between houses near you?
8	21	Is the heating system in your house satisfactory?
9	22	Generally, how convenient is your neighbourhood?
10	23	How pleased are you with the style of houses in your neighbourhood?
11	24	Generally, how do you feel about your house?
12	25	Generally, how convenient do you find your house and the area in which you live?
13	26	All things considered, how would you rate your house and its location?

points. An iterative procedure is used which compares the ranks of the correlations with the ranks of the distances, altering the configuration until the best fit is achieved between the two sets of ranks. A limitation is set by the researcher on the dimensionality of the space in which the configuration is generated. In the present case a four-dimensional configuration was found to be adequate.

A direct comparison of the results of the SSAl computation with those of a factor analysis is presented later. For the purpose of understanding the following discussion it should be borne in mind that, unlike the case for factor-analytic procedures, the axes of the configuration are arbitrary. Because the plot is developed from the relationships among the items, not from their relationships to

some notional 'dimension' or 'factor', the pattern of points (their regional distribution) can be examined directly.

In relation to their facet make-up, any items which have facet elements in common will be found in the same region of the space. It follows that if items are not found in the same region of the space there is no evidence for their having facet elements in common. So the fact that a partitioning of the space can be found which distinguishes house from neighbourhood items, as shown in Figure 5, provides empirical evidence for that facet.

Another ordered facet

However crude or refined the facet of environmental scale is taken to be, It does have the interesting property of being 'ordered'. The elements can be seen to move from smaller scale to larger scale. A quite different type of facet ordering has also been found in other studies (Lingoes, 1979): the order produced when one facet modulates another. This other type of ordering derives from the possibility of classifying questions in terms of how specific they are. For example, some questions such as numbers 12 and 13 use the word 'generally', or the phrase 'all things considered'. They can be contrasted with more focused questions. For example, question 3 deals directly with the decor of the house. Hence an ordered facet of different 'degrees of focus' may be proposed.

The spatial representation of this second ordered facet, however, will respond to its being a modifier of some other facet, because generality or specificity must be a variation of some other set of entities. Furthermore, general items would be expected to have higher average correlations with all the other items than would specific items. Putting these two points together, any region relating to the general items would be expected to be central and a region for specific items to be peripheral to them.

Evidence for this second facet can be found in another projection of the multidimensional space produced for all the questionnaire items. *Figure 6* shows this projection. Therein a circle can be drawn around the general items which is in the middle of the configuration. Other questions such as those dealing with decor, parking space and other specific issues are then seen to be on the periphery of the configuration. A further level of this degree of focus facet, between the central and peripheral, can also be identified in Figure 6.

A non-ordered facet

Considering the items in the peripheral regions of Figure 6, three distinct segments can be identified,. For example, questions 4, 6 and 7 all deal with issues relating to space, whether it be of house or neighbourhood. Items 2, 5 and 3 all have a quality which reflects status. The remaining segment relates to the convenience of the services in the house and neighbourhood. These segments are depicted in *Figure 7.*

The three elements of this facet do not have any linear order. They present a qualitative distinction: different *kinds* of focus to the question, rather than different degrees. It is such differences in kind which form the fabric of social discourse and policy-making. Yet it is precisely such differences which are hidden by conventional, dimensional analyses such as factor analysis, as will be illustrated.

Of course, a three-fold division of 'services', 'status' and 'space' would be of little interest or applied value if the only evidence for it came from the questionnaire being considered at present. Replication of it using other instruments and observations, as well as a theoretical explanation, would be necessary. One power of the facet approach is that it readily allows such tests. Those that we have carried

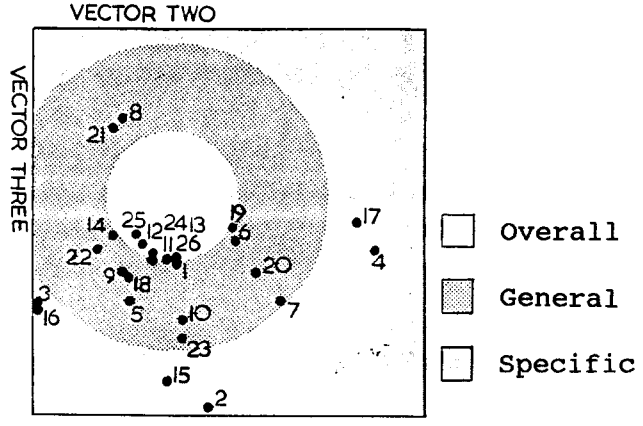

Figure 6 A projection of SSA1 for questionnaire items showing regions relating to generality of the questions (see Table 1).

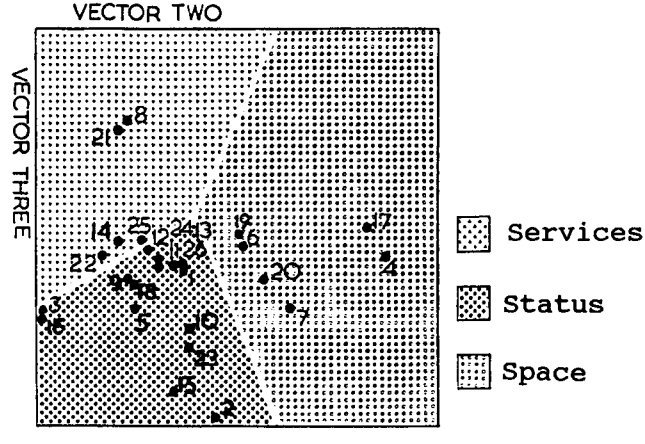

Figure 7 A projection[a] of SSA1 for questionnaire items showing a non-ordered facet (see Table 1). [a] This is the same projection as for Figure 6.

out have revealed a remarkably consistent occurrence of this structure in evaluation data (cf. Canter et al, 1980).

A radex

One strength of working with regional structures is that elegant models of quite complex relationships can be developed. By putting the modulating facet of degree of focus together with the qualitative facet, an interesting spatial representation emerges. This model, shown in *Figure 8*, represents the idea that the ordered facet contains a core in which all the different aspects of satisfaction combine to make a general overview. It shows how the degree of focus facet is modulating the different foci of housing satisfaction. This combination of an ordered and a non-ordered facet has been labelled a 'radex' (Lingoes, 1979).

The radex is a potent structure because it summarises both ordered and non-ordered facets. Yet it also shows the way in which the ordered facets are modifying the non-ordered ones. Furthermore, the juxtaposition of these two facets provides a definition of the 'core' of the domain which can prove fruitful in the development of even richer models.

From the decision-maker's point of view, the clarification of any structured set of relationships can be of value. In the present case, for example, knowledge that space, status and services can be effectively distinguished, provided that the appropriate level of specificity is used, can guide both discussion and the establishing of priorities. However, if the research leads towards a radex then there is the added bonus that a psychological focus to the domain can be established, with the consequent policy focus that implies.

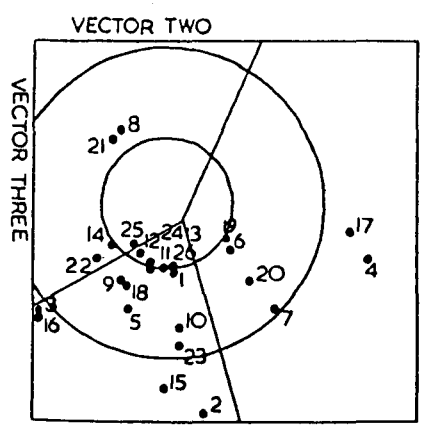

Figure 8 A projection of SSA1[a] showing the ordered and non-ordered facets superimposed - a radex.

A cylindrex

The radex in Figure 8 was represented in the projection of vector **2** against vector **3**. The ordered facet of environmental scale is orthogonal to this, in the projection of **1** against **2**. It is therefore possible to combine these two projections into a cylinder-like model. Each cross-section of the cylinder is a radex, one being for houses, the other for neighbourhoods. Indeed, with hindsight, one projection of this cylinder can be seen in the projection of vector **1** against **2**.

The purpose of presenting the three-dimensional model is to show how it summarises elegantly many aspects of the relationships among the variables and of the structure of the facets. It has also been presented because, like the radex, there are a number of examples of such structures in the literature and, as Canter and Kenny (1979) have pointed out, a number of general implications for applied problem-solving can be derived from such a structure. However, the power of the approach is such that for the present example this model can be taken one step further, by introducing another facet into it.

Higher-order dimensionality

In the study considered, questions were answered separately by husbands and by wives. Yet in all the configurations examined so far the pairs of identical items are typically close together in the space (this can be quickly verified for example by considering in Figure 5 the locations of items 1 and 14, 2 and 15, 3 and 16, and so on.) Nonetheless, common experience would suggest that it would be remarkable if husbands and wives saw eye-to-eye so totally. Some viewpoint could be anticipated from which the differences between them might be apparent. In other words, *Who* answered the questions would operate as a facet. As it happens, in the present data the correlations between the pairs of items are quite high (cf. Rees and Canter, 1979) . Most forms of analysis would therefore not reveal the differences that might be expected. However, using SSA1 higher dimensionality can be considered.

Figure 9 shows vector **2** against vector **4**. There a neat partitioning of the space between the questions answered by husbands and those answered by wives can be seen. Yet it should be noted that this facet is orthogonal to the cylinder which has already been discussed. In other words, a cylinder adequately summarises the structure of the satisfaction of either husbands or wives although Figure 9 suggests that there might be subtle nuances which distinguish them. Interestingly this lends support to the finding of the prison study, which also deemphasised the differences in role, the focus of the conceptualisation.

Although the housing-satisfaction questionnaire has been approached as an exploration, we have, in effect, emerged with a definition of what it covers. It has been seen that this requires a multidimensional model which starts to stretch the powers of our visual imagery, being essentially four-dimensional. Hence the value of summarising the structure of the observations as a mapping sentence, both to

help those who wish to act on the data and for those who wish to develop the theoretical aspects further.

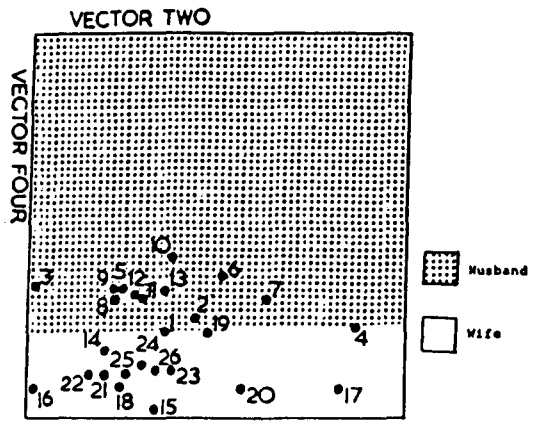

Figure 9 A projection of SSA1 coded for respondent (see Table 1).
A mapping sentence for housing satisfaction

Mapping sentence 3

Housing satisfaction. The extent to which the [Husband] of family (x), where (x) are drawn from

[Wife]

owner-occupiers living in Great Britain,

is satisfied	[Overall]	with the	[Space]
	[In particular]		[Services]
			[Status]

of	[The house itself]	by stating that they are
	[The neighbourhood]	

[Very satisfied indeed]
→ to
[Not satisfied at all]

Comparision with factor analysis

The typical approach to analysing a questionnaire is by use of one of the variants

of factor analysis, or principal-components analysis (Mulaik, 1972). Therefore, to facilitate comparison with SSA1 a principal-components analysis with varimax rotations was performed on the housing-satisfaction data. The relationship of the factors derived to the SSA1 configuration can be seen graphically by indicating on the SSA1 plot, for each factor, those items having a loading higher than 0.50 on that factor. *Figure 10* is the same projection of the SSA1 space shown in Figure 9 with the highly loaded items and their factor membership indicated.

The way in which the factors relate to small regions of the overall space in Figure 10 is typical of the emphasis of factor-analytic procedures on a large number of unrelated factors. In effect, a factor usually corresponds to what we called earlier a 'profile': a particular combination of facet elements. It is for this reason that it is relatively easy to identify a number of factors in most studies, but difficult to define them precisely or to create an overall model to which they all relate.

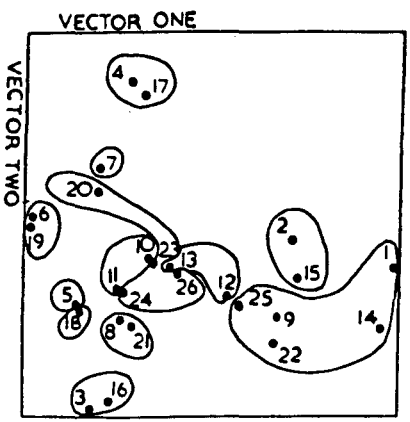

Figure 10 An SSA1 projection[a] of questionnaire items with the results of a factor analysis[b] superimposed. [a] Same projections as Figure 6. [b] All those items which have a factor loading greater than 0.5, on a given factor have a bubble drawn around them. Eight components had eigenvalues greater than unity. Three items (5, 7, and 18) do not load greater than 0.5 on any factor.

Conclusions

Facet theory in use

My own commitment to the facet approach emerged gradually. It was through trying the approach in a number of different studies that I began to appreciate the potential it had. However, it was the consistencies which emerged across different sets of data which turned me into an advocate; the personal discovery, which is a product of its strength, was that its formal properties (the mapping sentence,

regional hypotheses, etc) tend to hide, in publications of research, exactly what it is that a researcher does when using a facet approach. Intriguingly this is a common criticism of the use of 'Guttman scales' made by methodologists. They complain that there is no obvious way of finding items for a cumulative scale during its stages of development. Similarly, the facet literature is vague on how to 'find' facets, prior to data and analysis.

My experience has been that the identification of facets relies upon the same procedure as does the emergence of any other research idea: the literature is studied, pilot data are scrutinised, and lengthy discussions are held about the logic of the facets that are proposed. Two processes speed up this quest. One is the pre-existence of a mapping sentence for a similar domain. For example, mapping sentence 3 above, dealing with housing satisfaction, has been used in evaluations of offices, prisons and restaurants as a first approximation for developing pilot questionnaires. Help in the use of the approach also comes from membership of a group who understand it. The debate on the meaning of facets and their elements, on the exact nature of the common range and so on, is, in the early stages, a very lively one. Because the approach demands the clarification of aspects of the study which are typically left implicit in other approaches, it is difficult for many researchers to do this thoroughly in isolation.

The difficulties of using the approach are compounded by a diffuse and often inaccessible literature. These difficulties have been greatly reduced by two recent books of readings (Lingoes et al, 1979; Shye, 1978), but these still remain rather technical accounts which are challenging to the average social psychologist. The vocabulary of facet theory is inevitably technical (although in the present paper I have deliberately avoided some of the more neologistic terms), yet it seems to me that until it is widely known, authors and editors alike carry a special burden of clarifying the nature of the approach in use.

One further difficulty which has faced the users of the approach has been the uncoordinated range of substantive topics which facet users have explored. The tendency has been for researchers to take one topic, such as worries about job deprivation (Shye and Elizur, 1976), and, after having found an interesting structure, to move on to other issues. There are clearly pressures from within the institution of academic psychology which foster this magpie activity, but it has led to a very piecemeal development of facet theory. However, as more examples amass, consistencies across different topic areas are emerging (cf. Shye, 1978).

Given that a key question is what a researcher actually does when making use of the approach, in the spirit of clarification, I now summarise the major stages involved, using the housing-satisfaction study as a vehicle.

(1) We had decided that we wished to study the basis of housing satisfaction. We therefore conducted a number of open-ended interviews with typical respondents, in the traditions of survey research.

(2) The answers were summarised in terms of the major themes which were present. This summary was influenced by previous research interests and

certain theoretical formulations.

(3) The themes were examined for their potential facet structure. Earlier ideas had made us sensitive, for example, to the environmental scale which a question addressed.

(4) A preliminary mapping sentence was created. From earlier studies we had some ideas as to what form this might take, but in many cases this first mapping sentence is a leap into the dark.

(5) A questionnaire was then developed from the mapping sentence. At this stage a number of things tend to happen at once:
(a) those facets, or facet elements, which are so ambiguous that questions cannot be readily derived from them, are clarified;
(b) the facets, or elements, which seem of least interest are dropped, so that a questionnaire of reasonable length can be produced; if no such priorities are possible then a sampling of facets and elements is made using a specific sampling framework;
(c) the initial questions which are generated from the facets are frequently ponderous and difficult to comprehend. (For example, a [particular], [social], [neighbourhood] question might have started life as:
'to what extent does your neighbourhood satisfy your particular purposes of getting into contact with other people?'
Eventually, we decided to substitute a different form of words:
'Is your neighbourhood friendly?'
Later checks and tests will indicate whether the facet structure of a question has been radically changed in making it comprehensible.)

(6) The preliminary questionnaire was administered to a pilot group and the responses subjected to SSA. Frequently the results of this first analysis lead to a radical reformulation of the facets and to revision of the questionnaire.

(7) Further development depends upon resources and the ultimate objectives of the project. My own experience is that once various internal checks have been made on the pilot data, subsequent questionnaires and data do not usually need radical revision. Instead a process of evolution occurs whereby the facets are enriched, either by adding to the elements or by adding new facets. Because the questionnaire now contains few redundancies this is possible without making it of unmanageable size.

Studies which are based upon categorical analysis of open-ended data, such as the present energy-conservation and prison examples, tend to emphasise the earlier stages in this sequence. Nonetheless, whatever the data source, the use of the facet approach does involve a commitment to a developing, evolving orientation to problem-solving. A process of successive approximations is used rather than the testing of hypotheses which are seen as being in any sense final or definitive. The results are always consciously open to another interpretation if it can be shown to be fruitful. It is possibly this creative ambiguity which has led to the approach taking so long to find advocates.

Facet theory in practice

Two themes have been intertwined throughout this paper. One has been the introduction of a set of research methodologies not widely utilised. The other has been an argument for the practical value of certain ways of doing research and presenting the results. In order to do the former it has been necessary to use varied examples which are simplifications drawn from major projects. Thus although some of the practical implications in these cases have been indicated, it has not been possible to elaborate this aspect of the work. Nonetheless it has been possible to illustrate the way in which the approach leads to an elucidation of the problems being examined and makes manifest the options available.

My personal vindication that policy-makers welcome the approach has come from the reactions I have had to reports of our work. For example, a number of British university energy conservation groups requested detailed copies of our report to distribute to their members. Reactions to proposed or developed mapping sentences have also been encouraging. Non-psychologists have grasped them readily and been prepared to add facets, or elements to facets, as a means of clarifying for us what problems they face. We even had one official research contract specified in facet language. The public review of the work produced by the Israel Institute of Applied Social Research summarises most of its projects in the form of mapping sentences (cf. Gratch, 1973), with official approval.

Of course, many gaps remain to be filled during the further development of the approach. One gap which has most significance for application is the absence of models which combine the power of descriptions of individuals, as in our energy-conservation and prison examples, with the power of the description of content domains, as in the housing-satisfaction example. The development of partial-order scalogram analysis (POSA), as illustrated in the work of Shye and Elizur (1976) or Canter and Brown (1979), appears promising. Nonetheless, there are still major conceptual hurdles to surmount, as well as technical ones, if the approach is to be widely used. Furthermore, the full implications of the multidimensional models which are emerging have yet to be clarified. A start has been made on investigating the practical consequences of a cylindrex model for design evaluation (Canter and Kenny, 1979), but it is clear that some general model of praxis must eventually emerge so that the practical implications can follow with the same elegance as the theoretical ones.

Acknowledgements

The material in this chapter has grown out of the activities of the Environmental Research Group at Surrey University. I am grateful to all my colleagues there for their help and criticism. The comments of Jennifer Brown and Cheryl Kenny have been especially significant. The encouragement given to our efforts by Louis Guttman and his colleagues, at the Israel Institute of Applied Social Research in

Jerusalem, has also been an important stimulus to our activities.

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