The design, analysis and interpretation of repertory grids

MARK EASTERBY-SMITH
Centre for the Study of Management Learning, University of Lancaster, Lancaster, U.K.

This paper is intended for those with some knowledge of the repertory grid technique who would like to experiment for themselves with new forms of grid. It is argued that because the technique is quite powerful and the basic principles of its design are easy to grasp there is some danger in it being used inappropriately. Inappropriate applications may be harmful both to those involved directly, and to the general reputation of the technique itself. The paper therefore surveys a range of alternatives in the design of grids, and discusses the factors that are important to consider in these cases. But even if a design has been produced which is inherently "good", any applications based on this will be of doubtful value unless prior thought has been given to the availability of analytic techniques, and to the means of interpretation of the results. Hence the paper outlines a number of approaches to the analysis of grids (both manual and computer based), and it also illustrates the possible process of interpretation in a number of cases.

1. Introduction

Repertory grids are seductive. They are so because they promise accurate measurement of subtle perceptions, while being based on a technique which appears to be quite simple. They are also extremely easy to modify and adapt, which has encouraged many people to design and develop their own applications.

Those who have gained some experience in using grids will realize that it is not all as easy as it appears to be. The design and elicitation of a grid can be a very delicate matter requiring considerable skill and sensitivity. It is quite easy to design new forms of grid, but unless these are done appropriately they will not yield any useful information. In addition the design should also take account of the way the grid is to be interpreted, and the forms of analysis that are available.

There is a great deal of advice about these points in books which are aimed mainly at clinical applications (Bannister & Fransella, 1971; Fransella & Bannister, 1977, are among the best), but there is a surprising shortage of advice about applications outside the clinical field. This paper aims to fill that gap by making some basic and practical points about the design and interpretation of non-clinical grids. It is aimed at those people who are generally familiar with the components of a grid and the basic elicitation process, but who would like to experiment with their own designs. (I have described a range of possible applications, and some of the theoretical ideas underlying grids in an earlier publication: Easterby-Smith, 1980.) The paper is divided into two sections, considering design, and analysis and interpretation, respectively. It is illustrated where possible by examples from management development and training in organizations.
2. Alternative designs of grids

The repertory grid is undoubtedly a very fertile instrument. It allows great flexibility in design and application, and this flexibility is often very stimulating for the user. But it does have its dangers, and therefore this section will begin by examining some of the areas of flexibility in the design before discussing some of the do’s and don’t’s that have been gleaned from practical experience with the technique.

A full repertory grid contains three components: “elements”, which define the material upon which the grid will be based; “constructs”, which are the ways that the subject is grouping and differentiating between the elements; and a “linking mechanism” which can show how each element is being assessed on each construct. It is in the different permutations within these areas that the main flexibility in designing a grid lies.

2.1. ELEMENTS

We shall begin with a summary of the main ways that the elements may be determined. Since the remainder of the grid will be derived from these elements, appropriate selection is obviously critical. The elements determine the focus of the grid and it is important that this is as specific as possible.

There are two general points to emphasize about element specification. Firstly the elements should be homogeneous. That is, they should all be drawn from the same category. Acceptable categories might be: “people who have a critical influence on my performance at work”; “my subordinates”; “the main activities in my job”; “jobs that I might apply for”; “types of training event”; “Nineteenth-century painters”, etc. In most cases it is not acceptable to mix categories in a set of elements, as for example in, “Subordinate A, Subordinate B, My Boss, Attending Meetings, Talking on the Phone . . .”. The reason for this is that the constructs that are generated from elements in one category are not likely to be applicable to those in another category. For example, the construct honest–dishonest could be applied to most people, but it would be difficult to describe “attending meetings” in terms of honest versus dishonest—certainly not without some stretch of the imagination.

Secondly, the elements should provide representative coverage of the area to be investigated. A grid about “significant people in my life” which did not include spouse or parents might be rather suspect. Similarly it is important to include good and bad dimensions, and one way of doing this is to include contrasting pairs of elements: “A Colleague You Like”; “A Colleague You Dislike”; “A Manager Likely to Get On”; “A Manager Not Likely To Get On”. There are however some problems with this approach since it can influence the nature of constructs elicited towards the dimension chosen for contrasting the elements. Also many managers find it very difficult to name someone whom they dislike, so this could be softened to “Someone You Like Less”.

In addition, if the same grid is to be completed by a group of people, it is important to ensure that all the people are able to relate directly to the elements specified: a research chemist asked to name five subordinates may not actually have any subordinates; a graduate trainee asked to rate his reactions to “Chairing Meetings” may have no direct experience of chairing meetings, whereas the Works Manager may base his ratings on the very direct experience of chairing two meetings a day for the last five years.

What is the ideal number of elements in a grid? For industrial applications the answer is: as few as you can get away with. If the grid is to be analysed on a computer, it is
probably unwise to have less than six or seven because below that number the analysis
can easily become distorted, but it should be possible to provide adequate coverage of
the chosen topic with no more than twelve elements. Most of the grids suggested by
Kelly, and those used by clinical psychologists, have 15–25 elements—but this is rarely
necessary for organizational applications.

Generating elements
In the discussion above, it has been assumed that elements will normally be indicated by
the investigator in the form of role descriptions (i.e. “An Effective Subordinate”), and
the person completing the grid then fits a real person to that role description (“Ah yes,
John Stewart is an effective subordinate”). Thereafter he thinks of John Stewart
specifically when he generates his constructs and when he provides ratings of “An
Effective Subordinate” in the rest of the grid. It is perhaps worth re-emphasizing the
point that unless the subject can think of a specific person or instance to fit the role
description, the results of the grid will not mean much. This method of providing role
descriptions is one of several ways of establishing elements, which vary from those
where the subject has a great deal of choice, to those where he has virtually no choice.
The various methods are summarized below:

(i) Supply elements: a list of named individuals is provided; several specific incidents
on a videotape are pinpointed; six abstract paintings are displayed, etc.
(ii) Provide role or situation descriptions: a number of types of people at work are
specified or some typical experiences at work are indicated. The subject must
provide his own specific examples to fit these general descriptions.
(iii) Define a “pool”: the subject is asked to “name five subordinates”, to “name
three effective managers”, or to “list five leisure activities that you have indulged
in”, etc.
(iv) Elicit through discussion: investigator and subject discuss the topic of interest.
The investigator may have prepared a number of prompts to help the subject,
but as a result of this discussion, a list of specific elements is drawn up jointly.

2.2. CONSTRUCTS
Strictly, there need be no difference between the nature of the constructs and the
elements employed in a grid. This stems from wider definitions of what constitutes a
grid, for example, Bannister & Mair (1968, p. 136) define one as:

“Any form of sorting task which allows for the assessment of relationships which
yields these primary data in matrix form.”

However, it makes the design and interpretation of grids somewhat easier if a
distinction is made, and one such distinction is to think of elements as being the objects
of people’s thoughts, and constructs as the qualities that people attribute to these
objects (Smith, 1978).

Generating constructs
There are four distinct methods of generating constructs in a grid, and a few minor
variations and combinations.

† For purposes of clarity the person administering the grid will be called the investigator, and the person
completing the grid, the subject. With a self-administered grid, the same person will be both subject and
investigator.
(i) The quickest way to generate constructs is simply to supply them. Thus a participant on an interpersonal skills course may be asked to rate the other members of the group (elements) on such dimensions as listens well—doesn’t seem to hear; supportive of new ideas—inhibits new ideas, etc. In effect the grid is being used as a semantic differential (Osgood, Suci & Tannenbaum, 1957) since the subject is not being asked to contribute his own descriptions of these elements. However this approach can be useful in some situations provided that the constructs supplied are known to be representative of the ones that the subject would have produced spontaneously, and he already has an adequate understanding of what they mean.

(ii) The classical approach to generating constructs is to elicit them from triads. This method involves selecting groups of three elements (triads) from the full list of elements, and the subject is then invited to say in what way two of the elements are alike and in what way the third element is different from the other two. This procedure is intended to produce two contrasting poles for the construct, although it is sometimes suggested that the poles should be opposites. However, the difficulty with requesting “opposites” is that it tends to produce logical opposites rather than opposites in meaning. The logical opposite of ambitious is not ambitious; but the subject may think of the real opposite of ambitious as being does not trample on colleagues. Clearly, the latter, contrasting, approach indicates far more about the meaning of the construct.

The selection of triads may also affect the final grid. Successive triads should either be chosen on a genuinely random basis or by the investigator deciding which combinations will bring out the greatest contrast in the elements available. It is important that elements are given roughly equal chances of appearing in triads, otherwise some elements will tend to dominate the type of constructs being produced, thus distorting the overall grid. Also the elements in successive triads should be changed quite rapidly...
(don't repeat two elements in successive triads), otherwise people may have considerable difficulty in thinking of new constructs.

It is also possible to elicit constructs from dyads (see Keen & Bell, 1980). This method is normally used when the subject finds it too hard to generate constructs from triads—and it is quite common when the elements themselves are complex, such as relationships between pairs of people. Two elements are selected at a time and the subject is asked to say whether they are alike or different, and what it is that makes them alike or different. The main reason for not using this method in preference to triading is that the resulting constructs tend to incorporate logical opposites, rather than opposites of meaning (as discussed above).

Another variant on the triading theme is to combine elicited and supplied constructs in a grid. Providing that the supplied constructs are selected carefully this can be a useful way of focussing on some important dimension to be investigated. (In screening managers as potential members of assessment centre panels, the construct effective-not effective is supplied in addition to a list of constructs elicited about junior managers.) If several constructs are supplied, this will enable direct comparisons to be made between individuals' grids which are otherwise totally different. However, there are two caveats when mixing constructs. Firstly, the supplied constructs should be given after constructs have been elicited, otherwise they will influence the type of construct that the subject thinks of for himself. Secondly, the investigator must be confident that the supplied constructs will be used as diversely as the elicited constructs. If the supplied constructs group too closely together (say five constructs are supplied and they are all closely linked around the dimension good performance–bad performance) they will dominate the other constructs in the grid and make it appear that the whole grid revolves around this dimension.

(iii) Some people criticize the grid for being unnecessarily verbal. This criticism is not justified when the grid is designed correctly. Verbal labels are not particularly important, indeed it is possible to design totally non-verbal grids based on card sorts. The elements are written onto cards and the subject is asked to sort the cards into piles of similar cards. He may then be asked to say what the similarities are within each pile. Alternatively, the position of each card is noted and the subject is simply asked to repeat the procedure using some other basis for sorting—thus a normal matrix can be built up which enables element relationships to be examined (this procedure has been used with children and dumb patients). This approach may be of particular use when the elements are things such as objets d'art, or manufactured products which are being subjected to quality control inspection.

(iv) The final method of construct generation to be considered here is known as laddering, and this is normally used in conjunction with one of the other methods. Thus a few constructs may have been elicited by triading, and the subject is then asked to look more closely at the first construct. He is asked which end of the construct is preferable and why this is so. For example in a grid based on people the construct extrovert–introvert might have emerged. The subject indicates that he would prefer to be "extrovert".

The conversation between subject and investigator might then proceed as follows:

Investigator: "Why would you prefer to be extrovert?"
Subject: "Because people respect 'extroverts'; introverts are disregarded".
Investigator: "Why is it important to be 'respected'?"
Subject: "Because this indicates that you are a valuable person; people who are 'disregarded' are worthless . . . ."

In this way a series of new constructs can be generated from any of the original constructs, and they will tend to be increasingly fundamental (superordinate) for the person producing them.

In this process the question why tends to produce constructs of greater generality, while the question what or how tends to produce more specific constructs. With the above example the investigator might have asked the subject if he could say a little about what he meant by extrovert or introvert. To which the answer might have been keen to talk to strangers against avoids talking to strangers. This construct is at a lower level of generality and would therefore be described as "subordinate" to the original construct.

**Types of constructs**

Three main types of construct can be distinguished according to how they are used. For example, the construct trade unionist-company type might be used in such a way that this was the only construct that a line manager could apply to members of Trades Unions. Where he regards them as nothing but trades unionists, he is using the construct in a pre-emptive manner. This rather extreme usage might occur when the manager is particularly angry or frustrated; however the constellatory manner of using a construct is more common. This occurs in stereotyped thinking where the manager will immediately associate the trade unionist with a number of other labels: uncooperative, reactionary, short sighted, etc. He probably will not differentiate clearly between these other constructs and will tend to apply them to anyone who is a trade unionist, whether he knows him as an individual or not. The third usage of a construct is in the propositional manner. Here the manager might be saying to himself: since we are currently faced with a recognition claim from ASTMS it is convenient to think of some people as if they were trade unionists and others as if they were company types—but in normal working routine this is a distinction which is of little practical value.

In many cases, the usage of a construct can be inferred without much ambiguity from its labels. There are a number of construct labels which it is wise to avoid. Taking as an example some constructs about people:

- **situational constructs** (lives in Brighton; has two children) are not useful unless they are seen as important indicators of people’s natures;
- **excessively “permeable” constructs** may be of limited value because they can be applied to almost everybody (is a man—is a woman), and therefore tell you little new;
- **excessively “impermeable” constructs** are applicable to a tiny range of people (copes well with weightlessness—panics under weightless conditions), and therefore have limited general value;
- **vague or superficial constructs** (is OK—not so good) rarely add much to a grid;
- **constructs generated by the role title** (is an effective manager—not so effective) would add little when they are simply repeating something which is already incorporated into the selection of elements for the grid.
In all these cases, the investigator should try to probe further by asking questions such as: "In what way does living in Brighton have an effect on him?" or "Can you say a little more about what makes these two managers effective, and this one less effective?". Wherever possible, the investigator should push towards evaluative constructs which express how the subject feels towards the various elements he is considering.

**Social context of elicitation**

With the exception of introspective grids, all applications of the repertory grid involve one person trying to persuade another to cooperate with his wishes. This is true whether the subject is following written instructions, completing a grid in a classroom in parallel with a number of other students or having a one-to-one discussion with the investigator. Clinical psychologists may disregard the power relationship between themselves and their clients, because the client is essentially a captive audience who is there to be helped—and who probably accepts the authority of the psychologist without question. This is patently not the case with managers. The problem is not so much one of biasing the results—since repertory grids are very difficult to fake, even by people who understand how they work; it is more one of maintaining goodwill and cooperation. Murphy (1978) has found this to be a major problem when using the grid to help internal organizational consultants examine their roles. After a successful initial administration of the grid to these consultants, they showed signs of losing patience on a subsequent occasion. On reflection this seemed to be because the consultants needed to feel in control of the overall process and able to accept or reject any particular methodologies. The investigator should offer himself as a resource to the client rather than as a trainer or researcher—thus involving the client in the design of any application in order to develop the maximum ownership.

This places the investigator in something of a dilemma. On one hand the grid requires some skill and experience in order to use it to full advantage; on the other hand managers on the receiving end will rapidly become alienated from the process unless they can be involved in its design from the start. Given the normal constraints of time and resources, perhaps the best solution to this is to ensure that applications of the grid are as short as possible, and that the design is as simple as possible—so that managers can understand how conclusions are drawn from the raw data. With regard to the number of constructs that are elicited, these should again be as few as possible (eight constructs should be enough)—particularly if it is hoped to obtain grid data on a second occasion from the same people.

### 2.3. LINKING CONSTRUCTS TO ELEMENTS

Certain applications of the grid stop short of establishing links between constructs and elements. Although this may be appropriate where the labels of constructs are being elicited simply as an input to a group discussion it does miss an important part of the grid—because it is the way the construct is used in relation to the elements which indicates the meaning of the labels given to each pole. The normal method is via some kind of rating scale. These rating scales can be seen in a continuum ranging from dichotomous scoring to ranking, involving increasingly fine differentiations in each case as indicated below.
Dichotomizing:

If the element is closest to the left pole of construct, place a tick in the relevant box; if closest to the right pole, a cross. To avoid skewed distributions, subjects are sometimes instructed to make sure that the elements are divided equally between ticks and crosses on each construct.

Ratings:

The above case would be seen as a rating scale with only 2 points; more normally rating scales would have 5, 7 or 11 points. It is assumed that the points on the scale indicate equal gradations between the two poles of the construct. The choice of the number of points is largely a matter of personal preference. (I prefer 5 or 7 points.)

Ranking:

If there are, say six elements in a grid then all the elements are put in order from 1 to 6 on each construct. This is exactly the same as a 6-point rating scale where no score may be repeated.

Dichotomous (2-point) scales tend to be more useful if hand analysis is required, or if the grid is to be used for discussion purposes. Ratings on 5- or 7-point scales allow for slightly more discrimination on each construct and it may be quite important to allow the opportunity to make these finer distinctions. Ranking scales provide very much greater discrimination, but this may force the subject to indicate differences between elements where he really sees no difference. There is also a tendency for the rankings to be made in relation to the emergent pole of the construct, without taking much account of the contrasting (latent) pole. This means that the construct may only be partially incorporated in the grid—and this is increasingly likely if there are more than eight or ten elements.

The choice between rating and ranking methods depends largely on the purpose for which the grid is designed, but Shaw (1980) notes that about 70% of published studies use rating methods. One important aspect of rating scales is that they provide an opportunity to check whether the elements really are in the range of convenience of all the constructs—and thus if the grid has been constructed correctly. Although the subject should be asked to complete ratings for all elements on all constructs, he can also place a mark, such as an asterisk, in any box where he feels that the construct is not really applicable to that element. If many of the elements are felt to lie outside the range
of convenience of the constructs there may be a fundamental fault in the design of the grid.

2.4. SOME ADVICE

This section has provided an overview of the main alternatives in the design of grids. Several more may be found in some of the clinically-oriented writings on repertory grids, and there is constant innovation amongst users. For those wishing to devise their own designs I would give three pieces of advice:

(i) Keep the grid small. A grid containing ten elements and ten constructs may take two hours to complete. Larger grids may take substantially more time.
(ii) Ensure that the elements are specified clearly and are well understood.
(iii) As far as possible, avoid putting words into the subject's mouth, either through the design of the grid or through the way constructs are elicited.

3. Analysis and interpretation of grids

It is very attractive to think that we now have a technique that can quantify the subjective data from which human judgements and decisions are taken. The potential for quantification tends to emphasize the numbers in the grid, and these can exert an almost mesmeric influence upon the would-be psychologist-statistician. This has led to two common misconceptions about the grid: firstly, that it cannot be analysed adequately without a computer; secondly, that if a computer analysis is conducted this will provide answers to any questions asked about the grid.

In answer to the first point, it is quite possible to draw conclusions from the raw matrix of a grid without conducting any computations at all. In some circumstances it is not even necessary to complete the matrix (as when construct elicitation is used as an input to group discussion); therefore there will be no figures to work on anyway. Where a rough analysis is required, and the grid is reasonably small, it is possible to conduct this manually. It is only necessary to use computers when the grid is large, when time constraints are limited, or when there is a need for very precise measurement. In this part of the paper I shall begin by discussing manual analysis of grids before illustrating the range of computer analyses available.

With regard to the second misconception it should be noted that the interpretation of grid data is very much an art and not a technology. In grid terms the investigator must develop a personal construct system which allows him to relate to the grid that has been produced, and the purpose for which it was designed. This will only develop as he gains experience in finding that the meaning he attributes to the grid is similar to the meaning that was intended by the person who produced it. In cases where the subject plays a major part in interpreting the grid a sophisticated computer analysis may provide a barrier between his initial grid and the subsequent output, and therefore will make it very difficult to interpret this output at all.

3.1. TECHNIQUES FOR MANUAL ANALYSIS

A certain amount may be understood from a grid simply by looking at the ratings of the elements on the constructs. By inspecting the rows and columns of the matrix, and examining the relationships between constructs and elements, it is possible to infer
quite a lot, but this process can be helped by various forms of analysis which rearrange or summarize the grid data in order to make them more comprehensible. When the grid is relatively small, and particularly when it is important for the analysed output to be linked closely to the original grid, manual techniques are very suitable.

Several forms of manual analysis will be presented below based on the simple grid illustrated in Fig. 2. The elements at the top are those selected by a female manager who completed the grid. The five constructs written down the sides of the grid were derived from triads of these elements. In the matrix each element is given a tick (✓) if it is judged to fall at the left-hand end of a construct, and a cross (x) if it is judged to fall at the right-hand end.

<table>
<thead>
<tr>
<th>Elements</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(✓)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 “Myself”</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2 “Boss”</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3 “Best Friend”</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4 “Person Disliked”</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5 critical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Fig. 2. Simple introspective repertory grid. (A dot in a cell of the matrix indicates that the element above was one of the “triad” that produced the construct for that row.)

One approach to the analysis of this grid is to rearrange the rows and columns so that similar constructs are positioned close to each other, and then so that similar elements are positioned close to each other. In practice this means reversing the directions of constructs C and D, which changes the crosses into ticks and vice versa. Construct A is moved to a position between C and D since it is quite closely related to each of them (only one cell is different in each case). Similarly the elements and their respective columns are rearranged so that the numbers of matches between adjacent columns are maximized. The resulting grid is shown in Fig. 3.

<table>
<thead>
<tr>
<th>(✓)</th>
<th>4</th>
<th>1</th>
<th>3</th>
<th>2</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(✓)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B moving</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>C open</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A driving</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>D intellectual</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>E accepting</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Fig. 3. A focussed grid.
This process is known as focusing and forms the basis of the cluster analysis programs developed by Shaw & Thomas (1978). A more extensive illustration of how to focus a grid manually is provided by Shaw (1980).

Correlation matrices can also be obtained for elements and constructs simply by counting the number of matches in pairs of columns or rows. Thus for elements 1 and 2 there are three matches and two mismatches. The number 3 will therefore be entered into the appropriate cell of the matrix (see Fig. 4). There are five matches between elements 1 and 3, three matches between elements 1 and 4, and so on.

<table>
<thead>
<tr>
<th>Elements</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 “Myself”</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2 “Boss”</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3 “Husband”</td>
<td>3</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 “Best Friend”</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 “Person Disliked”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIG. 4. Correlation matrix for elements.

From this matrix it is possible to see at a glance how close the various elements are described as being to each other (5 being total similarity, 0 being no similarity).

The correlation matrix for the constructs is shown in Fig. 5, based on exactly the same scoring method.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (driving)</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>B (moving)</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C (rigid)</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D (intellectual)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E (critical)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIG. 5. Correlation matrix for constructs.

One point to remember here is that the constructs are bipolar and therefore a score of 5 would be a score of 0 if the poles were reversed. Hence a low correlation is indicated by scores in the middle (2 or 3).

Up to this point, nothing has been said about interpretation of this grid, and one might be tempted to ask whether focusing, or the extraction of correlation matrices, adds anything to what might be deduced from looking directly at the ratings in the original grid shown in Fig. 2. The answer is that they add nothing new, but they make it easier to identify the patterns that are already there. Thus by looking at the columns in Fig. 3, it is immediately obvious that the ratings for “Myself” and “Husband” are identical on all five constructs, and that “Person Disliked” was different in all respects. These features are also apparent in the original grid (Fig. 2), but they are not quite so clear. In looking at the rows in the focussed grid it will be seen that two pairs of constructs are being used in the same ways. Thus, for example, in this grid intellectual
people are always seen as accepting, and non-intellectual people are always seen as critical.

These associations can also be spotted quickly from the correlation matrices. Thus the high association between “Myself” and “Husband” (elements 1 and 3) is indicated by the correlation coefficient of 5 in Fig. 4. The low associations between these two elements and “Person Disliked” (element 5) are indicated by the 0’s in the matrix.

The nature of these similarities and differences can also be examined by looking at the patterns in the grid. Thus the relationship between “Myself and “Boss” is indicated by comparing columns 1 and 2. She sees her boss as being similar to herself in all respects, except that she regards her boss as being non-intellectual and critical rather than intellectual and accepting. This is useful information if she wishes to develop a good working relationship with her boss since these dimensions are likely to be the touchy features in the relationship. Thus she might make allowance for the fact that she will tend to construe her boss’s comments as critical, when in fact this may not have been her boss’s intention. If she does judge this to be her boss’s intention then she might choose to confront her boss with these specific perceptions.

If these results are to be put to constructive use, the focussed grid will be more helpful than the correlations in this case. Since the grid is intended as an introspective grid, the only person likely to gain any benefit from it is the person who completed it, and this will help her to spot the important parts.

As it is, the grid provides a representation of how she classifies some key people, but these perceptions could be extended by asking further questions around the grid. Thus our subject might explore whether she always saw intellectual people as being accepting. Is this always true, or can she think of any individuals whom she would consider to be intellectual, but critical? In this way further elements may be added to the grid. However, she might also wonder about the correlation between “Myself” and “Husband” over all five of these constructs. Does she always think of them in identical terms, or can she think of any other important constructs on which these two elements would be rated differently? If she can, she now has another construct in her grid—and she can continue this process of building up the grid and exploring specific avenues for as long as she likes.

In cases where grids are larger, the rating scales more extensive (i.e. 5 or 7 points), and a number of grids are completed concurrently, the correlation-type analysis becomes more useful (as a manual technique). Honey (1979) describes a number of applications using a partial analysis, and which require that the grid is designed closely around the topic to be examined. One application is intended to provide a pre-post course evaluation of a sales training course by looking at salesmen’s perceptions of what differentiates effective from less effective salesmen.

For example, the trainee is asked to generate a number of constructs by triading, based on a set of six salesmen known personally to himself. He is then asked to rate all six salesmen on each construct, regarded as a 5-point scale, and also on an additional construct:

most effective–least effective.

Honey’s interest is to identify how closely each of the constructs generated by the trainee are linked to this supplied construct of effectiveness. This is done by comparing the numbers in each row in turn with the numbers in the effectiveness construct. The
difference between each pair of numbers is totalled for the full row, giving a difference score for that construct. The lower that score, the closer the construct to the dimension of effectiveness. This process is illustrated in Fig. 6.

<table>
<thead>
<tr>
<th>Salesmen (Elements)</th>
<th>Difference score</th>
<th>Reversed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct 1</td>
<td>4 3 2 1 1 5</td>
<td>10 12</td>
</tr>
<tr>
<td>Construct 2</td>
<td>2 5 1 3 2 5</td>
<td>4 14</td>
</tr>
<tr>
<td>Construct 3</td>
<td>1 4 4 1 3 4</td>
<td>11 9</td>
</tr>
<tr>
<td>Most effective</td>
<td>3 5 1 4 2 3</td>
<td></td>
</tr>
<tr>
<td>Reversed effectiveness ratings</td>
<td>(3 1 5 2 4 3)</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 6.** Simple correlations between elicited and supplied constructs.

The difference scores for each of the three constructs against the effectiveness construct are given at the right of Fig. 6. From this it appears that construct 2 is closest to the effectiveness dimension. According to the difference scores construct 1 would be the next closest, followed by construct 3. However, as noted above, these constructs (and their ratings) can be reversed without making any change to the meaning of the grid, and it is therefore advisable to check the difference scores under these circumstances. This is done by reversing the effectiveness scale (1 becomes 5, 2 becomes 4, etc.), and calculating the difference scores between this and each of the constructs. When this reversed difference score is less than the normal difference score, it should be adopted in the knowledge that it is the reversed construct which correlates with the effectiveness dimension. This means that construct 3 (reversed), with a difference score of 9, is slightly closer to the effectiveness dimension than construct 1, with a difference score of 10.

Honey’s interpretation of these difference scores when evaluating the sales training course is interesting. The lower the average difference scores become over the period of the course, the better he regards it—indicating that the constructs generated at the end of the course cluster more closely around the dimension of effectiveness. This means that the salesmen are increasingly judging each other only in terms of effectiveness, and would be paying much less attention to, for example, the nature of their relationships.

The method described by Honey, for measuring the “distance” between two constructs is known as the Mean Absolute Difference (MAD) metric. The other kind of measure which is sometimes used is based on taking the difference between each pair of scores and squaring this difference, before taking an average for the complete row. The former, and variants on it, is most commonly adopted in manual forms of analysis; the latter, which is obviously more time-consuming, frequently forms the basis for computer analysis.

3.2. GENERAL COMPUTER ANALYSIS

The amount of work involved in analysing a grid increases rapidly with the size of the grid, and with the number of distance, and other measures, that are to be derived from
it. This is why a number of computer packages have been designed to provide general analysis of almost any grid, providing statistics about most features of the grid. However, before considering computer analysis it is worth reminding the reader that this analysis does not add anything to the information available in a grid, nor does it provide any indication of the meaning of a grid; it simply reduces the amount of work required for interpretation by summarizing and condensing the data available. As Kelly himself put it:

"Neither abstraction nor generalisation has ever been computerised . . . . What can be computerised . . is the elimination of redundancy in a construction matrix. The resultant shrinkage in the matrix is sometimes mistaken for abstraction, or it appears to result in the expression of a great deal in relatively few terms. But the contribution the computer makes is to economy of the language employed, not to conceptualisation . . . ." (Kelly, 1969, p. 290.)

There are two types of computer program specifically designed for repertory grid analysis and which are generally available in this country. These are the INGRID packages devised by Slater based on Principal Component Analysis (Slater, 1977) and the FOCUS program based on Cluster Analysis (Shaw & Thomas, 1978). In addition there are a number of standard packages which may be useful, although they are not designed for grids. These include the SPSS factor analytic options PA1 and PA2 (Nie, Hull, Jenkins, Steinbrenner & Bent, 1975) and multidimensional scaling methods (Shepard, Romney & Nerlove, 1972). The advantage of these latter packages is that they are more widely available on computer installations, and the multidimensional methods have the added distinction of not assuming that the ratings in the matrix are based on "interval" measurement. This means that they consider the order in which the elements fall on any particular construct, but not the numerical difference in the ratings between elements (whether absolute or squared). For example, those who support these "non-metric" analytic methods would point out that a gap of three points which occurs around the middle of a 7-point rating scale may be of the same significance as a gap of one point when both elements are near the end of a scale.

The main difference between Principal Components and Cluster Analysis is that the former searches out the greatest variation in the grid and imposes mathematical axes on these; the latter relies on building up a series of hierarchical groups based on the strongest associations in the matrix. An alternative way of considering what these two programs do is to imagine the stars of the sky spread out above one. These stars represent the elements in an individual's mental map—whether they be people, situations or objects. The purpose of the computer program is to find some way of describing all these points. The "Cluster Analysis" approach looks for the patterns in different parts of the sky and identifies the major groupings, like the constellations. Thus the structure of the map is built up gradually from various small groupings. The "Principal Components Analysis" approach contrasts with this by looking at the sky to identify the main overall dimensions. Thus it might note that the plane of the Milky Way is the most dominant dimension in the sky as viewed from the Earth, and it would then describe all other objects in terms of coordinates from this plane. Or it might decide that the Solar System or the Earth's axis, provided the most convenient frames of reference upon which to build a stellar map.
The question of whether Principal Components Analysis or Cluster Analysis provide the best form of analysis, has been the subject of considerable debate at a theoretical level (Rump, 1974; Slater, 1974). In practical terms, the INGRID program has the advantage of enabling a visual mapping of the elements and constructs to be made, and it also demonstrates the linkages between constructs and elements. The FOCUS program provides a very limited kind of map which does not give any explicit linkage between constructs and elements. However, it does have the great advantage over the highly sophisticated INGRID program, in that it is simple and the analysis process can be understood easily by whoever is using the grid. The choice between the two modes should depend on the context in which the grid is being used. FOCUS may be preferable in "operational" applications, where the grid is being completed and interpreted by the subject; INGRID may be preferable in "research" applications where some other person is attempting to interpret the grid data.

The forms of analysis produced by both of these programs will be illustrated below for the same grid.

An example
The following grid was produced by a Group Training Officer (G.T.O.) who was responsible for providing a training service to 12 small companies. He was employed collectively by these companies, but the role was overseen by the Industrial Training Board to which they were "in scope". The grid formed part of an evaluation study for a part-time development programme sponsored by the I.T.B. and lasting 12 months. It was completed before the start of the programme and was intended to give the Course Director an idea of how the G.T.O. saw certain key people at work, while providing a reference point for subsequent evaluation.

The grid, shown in Fig. 7, employed a role title list of eight elements (including three "self" elements), and constructs were generated by triading, using sets of elements indicated by the evaluator; constructs and elements were linked by ratings on a 7-point scale.

Cluster analysis
This grid, when processed through the FOCUS program, appears with constructs and elements rearranged as in Fig. 8.

It will be seen that in addition to constructs and elements being reordered, three constructs (C, D and F) have also been reversed. Additional data is also provided by the program which highlights two main clusters among the elements: 3, 5 and 7; 1 and 8.

The first cluster shows that the G.T.O. has high expectations of the course since he hopes to end up very similar to the "Progressive Manager" and the "Effective Trainer". The second cluster indicates how little he feels he has changed since he started his present job.

Amongst the constructs, the first two clusters identified are constructs C and D, and constructs B and E. The first cluster shows that he sees extrovert people as being self-motivated; the second cluster shows that he considers those people who are committed to the I.T.B., rather than to companies in the industry, to be insensitive as opposed to sensitive. Thus the main patterns are identified and there is nothing mysterious in the way the parts of the grid are rearranged by FOCUS.
In the case of INGRID, which uses Principal Component Analysis (Slater, 1977), there is a much larger leap between the initial grid and the final computer output. The program itself provides several pages of statistical output describing the mathematical structure of the grid. Coordinates are provided for all the constructs and elements, indicating where they are located in relation to the first two components (indicated by the broken axes in Fig. 9). These components are linked to the constructs and elements with the greatest variance (most extreme ratings) and it is assumed that they indicate the main dimensions in which the G.T.O. differentiates between these people at work. There are always additional components which may be extracted from the grid matrix, but these
normally account for a minor part of the person's thoughts in a given area (8% in this case). Where the grid indicates a particularly sophisticated construct system (high cognitive complexity) these additional components may account for up to 30% of his thoughts and consequently, the two components that can be represented on a two-dimensional map will be explaining less than the total picture (Slater, 1977).

Although the components have high mathematical significance, they are not necessarily important when it comes to interpreting the mapping. Here it is more advisable to concentrate on the more concrete features of the map, the positions of constructs and elements, and the place to start is element 1 "Myself Now". It will be seen that the G.T.O. describes himself as not very self-motivated and introverted, he also sees himself as being quite similar to the "Conservative Manager". This might be contrasted with his view of the local "Training Adviser" who is seen to be committed to the I.T.B. and insensitive, or his view of the "Effective Trainer" and "Progressive Manager" who are seen as self-motivated and hard working. By drawing an arrow from element 1 to element 7, it is possible to represent his expectations of the forthcoming programme—

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>introvert</td>
<td>1-7</td>
</tr>
<tr>
<td>extrovert</td>
<td>2 4 3 6 5 6 6 7</td>
</tr>
<tr>
<td>not very</td>
<td>1-7</td>
</tr>
<tr>
<td>self-motivated</td>
<td>2 3 4 6 6 6 5 7</td>
</tr>
<tr>
<td>not needed</td>
<td>1-7</td>
</tr>
<tr>
<td>to work hard</td>
<td>3 5 5 7 7 6 6 6</td>
</tr>
<tr>
<td>practical</td>
<td>1-7</td>
</tr>
<tr>
<td>academic</td>
<td>3 5 5 3 4 4 5 4</td>
</tr>
<tr>
<td>sensitive</td>
<td>1-7</td>
</tr>
<tr>
<td>insensitive</td>
<td>1 2 3 2 3 3 5 6</td>
</tr>
<tr>
<td>committed to</td>
<td>1-7</td>
</tr>
<tr>
<td>companies</td>
<td>1 1 1 1 1 2 5 6</td>
</tr>
</tbody>
</table>
how he hopes he will have changed by the end. It will be seen that he hopes to move in the direction of being self-motivated and hard working, and that he hopes to end up as very similar to the person he describes as a “Progressive Manager”. This expected change is in the opposite direction to how he sees himself having moved since he started his present job.

Since the constructs are bi-polar, the two ends of each occur on opposite sides of the origin. Those upon which the elements have been given more extreme ratings appear nearer the outside of this map. These are assumed to be key constructs in the individual’s map, and it will be seen that the construct committed to I.T.B.—committed to companies emerges as most important. However, the direction of change expected from the development programme lies at right angles to this dimension, and therefore the G.T.O. does not anticipate any further movement towards either of these poles.

Further information can be gleaned from this grid by comparing contrasting pairs of elements. Thus the difference between “Conservative” and “Progressive Managers” is seen along (i.e. parallel to) the dimension not very self-motivated—self-motivated; on the other hand, the difference between an “Effective” and a “Less Than Effective” trainer is construed according to whether they are committed to companies or committed to the I.T.B.

The INGRID analysis of this grid was fed back to the Course Director, and the implications for him were as follows. Firstly, it gave him an idea of whether the participant (and individual grids were prepared for all participants) was expecting to change his approach and his view of himself as a result of the programme. Clearly this G.T.O. had rather high hopes from the programme, and he saw his needs in terms of becoming motivated—possibly through seeing new possibilities in his job. Secondly, it gave the Course Director an idea of how the G.T.O. classified others at work, and what were the important dimensions in these classifications. The commitment construct was obviously a sensitive one (and difficulties had arisen in this area on an earlier pro-
gramme). The construct academic-practical might also have signalled difficulties, since this G.T.O., who was about to attend a development programme at a University Business School, hoped that he would become slightly more practical and less academic. This was another message which was heeded by the Course Director in attempting to reduce the theoretical inputs as much as possible in the programme.

Summary
In this particular case, it seems that the INGRID analysis provides richer data than FOCUS, although there is bound to be a credibility gap if the results of the former are fed back to the original informant. To some extent this can be lessened by talking the subject through the INGRID mapping so that he can see how it relates to the original grid. Thus one might point out that the ratings on construct E have a far greater spread (1-6) than the ratings on construct A (3-5). Because construct E is viewed in strong terms, it appears nearer the outside of the grid mapping. A glance at the columns of the grid will show that elements 3, 5 and 7 are rated similarly on all constructs, which is why they appear in a cluster in Fig. 9. The lowest ratings on construct F are achieved on these three elements, which is why the low pole of this construct (worked hard) is also associated with the group. And so on.

The statistics generated by either of these programs can also be useful in providing "standard scores" for the grid. The most common standard scores are the "distance" measures between particular pairs of elements and constructs. Honey’s manual technique for calculating the distance between two constructs (described above) can be done automatically by general computer programs. Distances between elements can also be extracted (these are roughly equivalent to the real distances on the map in Fig. 9) particularly where grids are to be repeated over a time interval. Thus an increasing distance between "Self" and "Boss" over the period of a year might indicate a deteriorating relationship here; a decreasing distance between "Self" and "Ideal Self" might indicate that the person was feeling more self-fulfilled.

Although such scores obviously can be useful, there are two main cautions for those who would promote them. Firstly, there is the danger that people will become lured by the availability of figures to construct standard scores which are highly abstract and which may have no behavioural significance at all. They should only be generated where there is a clear rationale for their construction, and above all, they should be simple. Secondly, the creation of standard scores from grid data is very close to the purpose of normal psychological tests. These tests are designed from statistical summaries of data gained from large numbers of people; whereas grids are intended to provide meaningful information about unique individuals. Grids are not the most efficient methods for providing statistical information, and therefore this kind of information should only be extracted where it is intended to supplement other forms of analysis.

3.3. COMPARISONS BETWEEN COMPLETE GRIDS
It is possible to compare complete grids, but this can only be done when the elements and/or the constructs are identical for each grid to be compared; where there are no common elements or constructs it is necessary to resort either to content analyses or to one of the structural scores described above. Grid comparisons serve two functions: they either demonstrate the differences between grids, or they identify the similarities—
with the possibility of combining grids. This is definitely the domain of the computer packages and both Principal Component Analysis and Cluster Analysis have provided answers to the various problems, as summarized below.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Program</th>
<th>P.C.A.</th>
<th>C.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of a single grid</td>
<td>INGRID</td>
<td>FOCUS</td>
<td></td>
</tr>
<tr>
<td>Analysis of the difference between two grids with identical elements and constructs</td>
<td>DELTA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis of the commonality in two grids (aligned by elements and constructs)</td>
<td>SERIES</td>
<td>CORE</td>
<td></td>
</tr>
<tr>
<td>Ditto, for several grids</td>
<td>SERIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction of commonality from several grids with same elements but different constructs</td>
<td>PREFAN</td>
<td>SOCIORGIDS</td>
<td></td>
</tr>
<tr>
<td>Ditto, but same constructs and different elements</td>
<td>ADELA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An example of the kinds of output provided by these comparative programs is given in Fig. 10. This is the PREFAN analysis for the grids from all the G.T.O.s in the development programme described above (see Fig. 9 for an individual's grid). For purposes of analysis, all seven grids were treated as one large grid with eight common elements and 54 constructs. It is therefore only feasible to plot out the elements on the principle components map; the axes have been labelled according to which constructs were closest to them. Although this can provide a convenient summary of data from a group of people, it does tend to gloss over what might be very great differences within the group. For example, the two elements “Progressive Manager” and “Conservative

---

**Fig. 10.** Mapping of combined grid from all course participants (using PREFAN).
Manager” appear in the above map. By drawing a line between them and examining its direction, it will be seen that a progressive manager differs from a conservative manager in being: skilled, logical and positive. These three constructs are those that come closest, out of the total of 54, to the first component. (It is in cases like this when there are large numbers of constructs to consider that the components can provide useful reference points for summarizing the main patterns.) But there are dangers in trying to combine a number of individual grids into one composite picture. Because when one refers back to the seven individual grids separately, the following descriptions of “Progressive Manager” are obtained:

- hardworking, practical
- mature, professional
- professional, achiever
- unpleasant manner
- relates well to people, attractive appearance
- impulsive
- driver, works hard

Thus there is quite a lot of diversity which is collapsed into this one picture. Is it legitimate to group such diverse perceptions into what is supposedly a common view? This should be watched carefully when using comparative forms of analysis. See also Slater (1980) on uses of dual grids in conflict situations.

4. Conclusion

This paper has outlined some of the choices and decision points in the design, analysis and interpretation of grids. Some attempt has been made to indicate where one approach may be preferable to another, but in the long run this kind of judgement can only come with experience—which means a lot of trial and error! All of the different approaches to analysis have their limitations, and their strengths vary according to the task required of them. Computer programs are by no means necessary for the analysis of most grids, but if they are readily accessible they can accelerate and simplify the process. Of the two packages illustrated in this paper, the INGRID package may be preferred for research-oriented applications; whereas the FOCUS package may be preferred for “operational” applications. Some would claim that the latter are far more acceptable uses of the grid since they avoid the danger of alienating the subject, and they are also much more amenable to the increasingly popular interactive packages which enable the subject to maintain full control over the elicitation and interpretation of his grid.

References


