(Conference Papers)

[ŜI-NJyƛyƎ a2NJŜ ōề 9NJNJ2NJ űKI-y' ¢NJƛI-fY

¢KŜ !NJǑKƛűŜǑűqă /2yᾶűNJdzƛyƎ 2Ŧ {LJI-ǑŜ

t l-LJŜNJ LJNJŜăŜyűŜŘ ű2Yπ
¢KŜ {ŜǑ2yŘ LyűŜNJyl-űƛ2yl-f /2yƎNJŜăă 2y' tŜNJă2yl-f /2yᾶűNJdzǑű ¢KŜ2NJềΣ hỀŦ2NJŘΣ мфтт

wI-yʊzfLJK DfI-yØƛffŜ

Centre for the Study of Human Learning
(C.S.H.L) Oxford. UK

CENTRE FOR THE STUDY OF HUMAN LEARNING

Learning More by Error than Trial:
the Architect's Construing of Space

Ranulph Glanville AA Dipl., PhD.

Paper presented to the Second International Congress on Personal Construct Theory, Oxford, 1977

ABSTRACT OF PAPER

The limitations of verbal labelling are highlighted in an account of several attempts to use Kelly Grids, both manually administered and using PEGASUS, to elicit spatial constructs from architecture students. Examples are given of exceptional differences in meaning structures within an experimental group handling common materials which are resolved using graphic representations. Further experiments are recounted that suggest not only ways of extending techniques akin to the Repertory Grids in their range of usefulness, but also that the Grid has clearly discernible limitations, and an outline is given of the mechanism for distinguishing such limits.

PERSONAL INTRODUCTION

I am not a psychologist - I am an architect, a cybernetician, a teacher. It is important to say this because it is the basis of the motivation behind the work described here. This work has gone on for 4 years now, and this is its first true public presentation. It started when I tried to find ways of getting people to express their views in a manner that would let them see that they did have real individual differences. A little later I came across Laurie Thomas and his colleagues in a joint cybernetics and psychology seminar on learning. Through them I discovered the techniques of George Kelly and thence some of the content of his theory. Through using and extending various grid techniques I have, been able to see the sort of world view they must impose and hence some of their limitations. This paper attempts to describe the experiments, the techniques, and the implied limitation of their world view.

THE FIELD OF STUDY

The normal assumption made by those who are interested in learning is that that which is to be learnt can and will be discussed, and that there is an adequate vocabulary with which to do this, allowing topics to be named and their interconnection to build up the subject area to be defined.

Architects would claim to deal in space. They incidentally deal in many other things - structure, servicing, site management, law - but their main material is space. Much architecture now-a-days seems to be rather bad. The discussion of space is currently a problem, for no one seems to have an appropriate and meaningful vocabulary. It seemed a reasonable thing to try and persuade people to describe the experience they had of space, in order then to develop a social vocabulary.

This approach is in contrast to most others, in that it asks people to describe their own experience, and it does not define in what terms that experience should be had and described. Most experiments are (intentionally) highly prescriptive. But looking for an appropriate

vocabulary in which to describe experience requires that no vocabulary is offered beforehand, and that nothing should get in the way of the experience and then of its description. A review of the work done on describing space [*1] will show that the general approach is to assume that which is important, and a means of description of it, is known. The validity of this assumption is not (and as far as I know has not been) tested. But it is that assumption which is the major question.

THE PRELIMINARY EXPERIMENTS [1]

During the academic year 1973-4, some preliminary experiments [2], concerned with the description of understandings of urban space, were carried out. In one, students were asked to locate parts of London on a blank GLC area map (Fig.1). They failed with singular consistency (Fig.2), and yet they have all survived in the city. This seemed to indicate that knowing where different parts of the city were was not an important factor in our understanding. If it is not the location of the parts of the city within it that matters, is it the relational structure? The students were shown various archetypical structures (Fig.3) and asked to draw what they thought was London's structure: they could accept, reject or combine the archetype. All students managed this, but their results were quite different, and repeating the experiment during the course of the year, their results changed. Many of the results were organisationally mutually exclusive, (Fig.4) and, when asked to provide evidence to support their opinions, each used different evidence. So that, although there were relational structures, each student's was quite different. However, the individual changes that took place over the course of the year seemed to reflect the opinions that were held by the teaching staff of each student's learning ability and strategy (Fig.5).

One further experiment, carried out by one of the students, (Annetta Pedretti), confirmed these findings in a particularly elegant way. Students were given a 'compass' form [*5] (Fig.6), and, given the centre (Centre Point) and one edge point (Camden Town tube station), were asked to name the other points. The named points were then traced off an Ordnance Survey map, and their cartographic location compared to their mental location. The extremely distorted 'compass' maps thus generated showed that, although the structural sequence of parts of the city may be known, their location is not (Fig.7).

The background, described all-too-briefly above, is in studies of Urban Space. Many people from many disciplines have examined this [3]. The perhaps not un-surprising position was that, in terms of London, students understood the structure and relationships, each one quite differently and using quite different information, but that the parts themselves were neither important nor significant.

THE FIRST YEAR: FINDING CONSTRUCTS TO DESCRIBE SPATIAL EXPERIENCE

During the academic year 1974-5 it was decided to try and isolate a vocabulary within which students' understandings of space could be expressed. The scale was no longer urban, the means of description was to be verbal, but the experiments were still looking for the qualities that allowed a structure to be developed by the student. The tactics and the scale were changed, and use was made of Kelly's techniques [*7], with elaborations by Thomas et al at the Centre for the Study of Human Learning. (C.S.H.L.)
A very large collection of slides (180) of Alvar Aalto's Tuberculosis Sanatorium at Paimio, Finland, were shown to the students, and they were each asked to choose 5 of them, which

they felt were spatially interesting. These slides were isolated and the students then negotiated which 3 each would contribute to a pool. (The initial selection of 5 was because it was inevitable that several slides would be chosen by more than one student). [4]

The students divided into groups of 3, each group having 9 slides, which were used as elements. Selecting 3 slides randomly from the collection, each student in the group arranged the triad in a pair and differ, and placed them on a 5 point scale [*20]. The other slides were arranged on this scale, and the poles were named. These names labelled the construct being used, and were taken to be words by which spatial experience could be described. On each occasion each student showed his construct scale to the other 2 in the group, and each tried to explain his construct to the others. Whenever similar construct scales were produced, an attempt was made by the students to equate them.

As the students became more familiar with each other's construing, they were asked to guess how others would construe, using elements taken from the collection. This followed from work by Laing [*8] and Pask [*11] on Conversation Theory - an idea since explicitly adopted by Thomas. Its principles are explained in Fig. 6. It is closely related to Kelly's sociality corollary. One student's construing of another's construct would be checked against the other's actual construct, and agreement was negotiated over any considerable differences, after which the poles and the whole construct were named. (The naming of the construct was unusual. The intention in doing so was to say what the construct was about).

When the groups felt that they were able to successfully construe the constructs of each member of the group, they were re-arranged. Fortuitously, there were 9 students at that time, so that one member of each of 3 groups could be re-grouped, i.e. the new groups had 1 member of each of the old groups. These new groups repeated the entire procedure, but each individual was asked to construe as he felt his old group would, i.e. using the sort of construct that his group would have arrived at as an agreed and mutually understandable construct. This was to allow the constructs of each of the old groups to be explore by the other groups, so that the polarities and names would be construed and used similarly and could thus be used to communicate the experience each student had from the slides of space by using a similar vocabulary that was known to have arisen from common elements similarly construed. Fig. 9 shows the process so far, in case it is hard to follow.

When each of the three original groups had thus interacted with each other group, all the students came together, with the construct they had named and all the original 180 slides were re-shown. The students were asked to name any construct that seemed particularly relevant to the description of each slide (but they were not asked to say where on the construct's scale the slide would go or what slide might occupy the pole position). This generated about 80 construct names, which seemed to be rather large, and so the numbers were reduced in two very prolonged and heated sessions at which the students argued how to compress the list. Because of the extremely long time and considerable computing [5] needed to confirm the compression of the long list into the short one, there must be some doubt as to its adequacy. Certain constructs were excluded altogether (as being either relatively unimportant or as hard to grasp and agree). However, while there were distortions and omissions, it is probably fair to believe that, with all the inter-personal and inter-group construing, the 15 named constructs which are the result of the experiments and appeared on the compressed list were shared and were reasonable, being perhaps somewhat narrow. The named constructs (i.e., the descriptions of spatial experience) were:

1.	Axis	:	verticality/horizontality/depth
2.	Surface	:	hard/soft
3.	Containment	:	closed/open
4.	Scale	:	small/large
5.	Mechanical	:	parts can move/parts can't move
6.	Building as a setting	:	dominant/subordinate
7.	Space's feeling for users	:	human/non-human
8.	Core being pointed to	:	hierarchical/anarchic
9.	Symbolic reading	:	suggestive/iconic
10.	Opening in boundary	:	transparent/opaque
11.	Diversity	:	complex/simple
12.	Movement	:	continuity/discontinuity
13.	Where I am	:	inside/outside
14.	From where I am, what I feel	:	inside/outside
15.	Context	:	important/weak

THE FIRST YEAR: USING CONSTRUCTS

The students had by now developed a compressed group of named constructs (or 'terms') with which to describe spatial experiences, using personal construct theory highly interactively in order to do so. The point of this lengthy procedure was to be able to describe experiences of space so that we could communicate clearly, precisely and with little ambiguity [(*9)].

The students were shown, once again, the 32 slides that had been chosen as elements and from which the 15 terms had been generated, and they were asked to say which terms they would use in describing each. Since the terms had been generated not by isolated individuals, but highly inter-actively as some sorts of group constructs, the idea was that students might use the same terms [(*23)]. Analogically, when we use a natural language, most of us might call the thing ‘  ’ by the name 'hat': this doesn't mean we have the same experience or that other descriptions are not possible but it is the basis of de Saussure’s 'semiotics' and my 'Logic of Descriptions' [(*3)].

The results of this experiment were interesting. Some students used most of the terms most of the time, while others were very selective (Fig.10): there seemed also to be no correlation between the terms used, the slides and the students (this has not been checked on a computer, but it can nevertheless be seen from a large number of tables and charts). Taking term use for one slide as an example, the variety can be clearly seen (Fig.l1).

This was very strange. In spite of the hard work and the methodology, the students had developed terms that didn't get used similarly. An experiment was carried out to see if the students understood their own use of their own terms. Each student prepared a ranking of his use of the terms starting with the most used and ending with the least. This ranking was compared to each student's actual use of terms (the number of times a term was used was counted from the slide description tables), which were ranked in order. The student's actual use ranking was found to be substantially different from the believed use ranking (Fig. 12). It appeared that the students' understandings of the terms were uncertain, at least as far as their uses were concerned.

Reverting to the argument already made for Urban space, that relationships may be more important, the students built descriptions of the relationships they saw between the different terms. The theory of knowledge representation {called CASTE [*12]) developed by Pask provided the background for this. The parts of the theory that are relevant are the idea of a cyclic entailment net (pruned to a hierarchical entailment structure), in which all topics (i.e. terms) within a description of a defined knowledge area are finally linked to each other, and in which all links are logical connectives in which two or more topics go to make (or can be made from) another.

The students were asked to build entailment structures, personal to them, out of their terms. In order to let this happen, a special form (Fig.13) was devised [6] in which the terms were arranged in a circle [7]. Students were asked to show which other terms each term could be derived from, given that derivation was always from the interaction of least 2 other terms (otherwise, in this formulation, terms are the same), and terms could be derived in more than 1 way (or, less). In other words, the relating of terms was showing personal knowledge structures.

The forms were reorganised to show each student's hierarchical structure [8]. In order to see if students were deriving terms similarly - that is if the terms were similarly related to each other. As Fig. 14 shows, there were very few similar derivations: out of a total of 1920 possible derivations, 98 were made, of which only 12 used the same terms to produce the same term.

It seemed every experiment was supporting the initial finding that, in spite of the care used in generating the terms, every student used and understood them differently.

However, there was a useful side to these structures: for, just as the London's structure drawings earlier seemed (to the teachers) to show learning strategies and competences so did these. Thus, a hierarchy with few top nodes portrayed a straightforward learner, while one with many portrayed a student who didn't know what to aim for and was not too well motivated. Where several terms were required to generate each other, the student became indecisive and unable to act: this could happen at the base of the hierarchy or part way up. In fact, it could happen so strongly that no hierarchy could be generated (Fig. 15). These findings are not final or precise, but they look potentially valuable.

At the end of the year, we seemed to have produced nothing of direct value to our aims. The students tried drawing the terms as they understood them. The resulting diagrams showed remarkable similarity (Fig.16) (the students could not be consulted about this because the year had ended). It appeared that the failure of the terms was maybe due to the inappropriateness of verbal language in describing spatial experiences.

THE SECOND YEAR: DRAWING BUT NOT SEEING

One of the limitations that is inherent in Personal Construct Methodology is the need to label. This is not an absolute limitation, but it comes very close. The poles of a construct have to be labelled - and in the earlier approach of the students, so were the constructs themselves. Labelling, if it is to work as a method of comparison and extra-personal communication has to aid the memory and be meaningful. Yet the previous experiments seemed to be suggesting that verbal languages were not very meaningful as ways of describing spatial experience. The

problem of depicting non-verbal labels is well known and there is a reasonable position that labelling requires a verbal type of structuring, anyhow.

In attempts to get subjects to construe non-verbally, the elements have either to be labelled (which is unacceptable) or to become their own labels (which does not lead to a common means of communication, but rather to a way of generating agreement). It seemed, therefore, not to be a case for the use of a straightforward repertory grid.

If we are trying to elucidate those qualities in a thing by which people understand it, and gain meaning, what we are looking for is the cognitive model onto which they map such qualities and which makes them look for and recognise them. If the verbalising which the labelling that constructs seem to require makes them inappropriate and hard to handle as a technique, we need an alternative.
Assuming, perhaps not unjustifiably, that the main sense through which space is perceived is sight [*6a], the removal of sight from a sighted subject requires that the subject use his other senses to compensate for the lost sight, in order to try and visualise the space. But visualising is the putting together of a whole, by the action of the cognitive model [*6]. That model will, therefore, have to direct the other senses in their search for information as well as piecing the information together so the space can be visualised, for, without relevant information the model will not function. (Visualising always implies a translation of medium).

So the blind survey technique used in the academic year 75-6 arose, blind-folding subjects and putting them into an unfamiliar space, which they were asked to visualise and draw [9]. The first 2 times it was used, the same group of students were involved [10]. The first survey was in part of a disused warehouse in Covent Garden which was being converted into an Art Gallery. Students came in one or two at a time and were encouraged only to pay two visits. They then drew up their visualisations of the space. The next day, and then once week for several weeks after, they tried to extract from their own and each other's drawings significant basic elements. In doing this, they carried out non-verbal conversations with each other, and they also tried modelling each other's thought processes predicatively, as had been done early in the First Year experiments (Fig. 17). They then went back to the space to see it and were astonished. They sketched what they saw, and then tried to isolate the difference between the blind and the seeing drawings.

This work was in preparation for a second survey. It was a 'dry-run' so the students could familiarise themselves with the technique, and consider whatever were their basic elements. In the second survey, of the hall off which the editing cubicles are arranged at the London Film School, they were all in the space at once and could enter and leave at their convenience. The survey lasted 3 hours, [11] and students were asked to keep a record of how they tried to build up their visualisations, and of what they were looking for. After the survey, the students spent 2 or 3 sessions drawing the space, isolating elements, discussing strategies and trying to find if they could make any sense of the terms the previous group had generated (Fig. 18). They isolated search strategies which referred to the manner in which they tried to build up an overall picture by relating different stimuli (Fig. 19). Interestingly, though perhaps only co-incidentally or for structural reasons, these strongly resembled the Archetype Structures (Fig. 3) in the London's structure experiment. However, the elements they isolated didn't convince them, and they still had great difficulty with non-verbal conversations. Somehow, it appeared that they were not visualising clearly, and that, when they put some sort of depicting picture together, they could not isolate parts from it.

After this, in order to test the memorability and wholeness of the visualisations, the student did not work on the project for several weeks. Finally, they were asked to draw the space from memory. The attempts were dispirited and feeble, and no student felt he could visualise clearly enough to produce a reasonable drawing. One student commented 'I can't remember, and I could if I'd seen it'. So they went back to see it, and felt the same sense of astonishment at what they saw, as in the earlier blind survey. They noted things like 'It hit me at once' and 'I couldn't have imagined anything like this'. They reworked their search strategies and their elements, but it was obvious that the instantaneity of vision was the overpowering effect. Three hours of search left no clear impression, while one look hit them. The question became why; and how can this be examined?

One further experiment was carried out, again by Annetta Pedretti, over the summer. The subjects were children at a London adventure playground. The children were set a sort of treasure hunt in which they looked for coal-hole covers, brass plates, etc. of which to make rubbings. The clues given were of various sorts, ranging from the sort of direction 'Take the second left out of the gate and cross the road. Then…' to route maps, location maps and landmark references. The children had only to get rubbings from approximately 60% of the places for which there were clues so they could select. They recorded the order in which they searched and said how hard they found the clues to be. The experiment was repeated with variations, twice.

The results were fascinating. Few verbal clue places were tried, and any that presented us information as a string of directions was shunned. When attempts were made at such clues, the children's time in completing the treasure hunt was particularly long and the clues were described as difficult. This probably reflects the sort of difficulty I, at least, have such directions as one is often given when asking the way in a car: something about using and understanding space in the city seems to grate against verbal description.

THE THIRD YEAR: THE LONG DARKNESS AND THE FLASH OF LIGHT

It had appeared that words, no matter how carefully chosen, were not a good means by which to describe space. Words, as used, are serial parts: that is, word occurs physically after word, and understanding lies in an ability to piece together the meanings of collections of words (meanings) and then collections of collections, etc, until the whole is understood. Blindfolded searching, surveying a space, is also serial. Characteristic after characteristic, is 'read' off, and an image is built - and summarised (in the drawings) - with the same sort of return – to reconfirm characteristics found in reading experiment [*19,*22]. Drawings are, by contrast, holist. The contrast is not new: it is an inherent part of Gestalt theory (although many mathematical compressions have long preceded that), a basic tenet of cybernetics and has been elaborately reworked by Pask in his work on learning [*13]. Even the production of a drawing, necessarily serial as far as its manufacture is concerned, is holist in intention [13]. Miller [14] has noted how, in drawing a face, subjects invariably begin with an outline - as opposed to drawing a nostril, then an eyebrow. The students who drew the experimental spaces gave me the impression that they began by setting up the spaces - drawing outlines, no matter at which scale they were working. There are plenty of experiments which show that, when drawings are examined they are examined from general (whole) to detail (part). Neither of the series of experiments trying to get at parts were conducted without a serial element in the process: in one case, the structure of the describing was serial, partial; in the other, the means of perception was. Perhaps the serial and holist contrast works for more than cognitive style?

It was decided to examine this possibility, while repeating blind surveys (in one of which, arranged for C.S.H.L., I took part, and was even more astonished at the visualisation gap than had believed I could be). The new experiment (for which only preliminary analysis currently exists) was to take students blindfolded, to a new space, and to allow them to remove the blindfold and see the space for 2 secs, 10 secs, 1 min, 5 mins and as long as they liked (in practice 5-20 mins)[15]. They replaced their blindfolds, were lead out, and asked to draw the space. Their drawings were then pinned, anonymously, on a wall and each student guessed how long a look at the space each drawing represented. There are inherent errors here - the incomplete analysis of the data, the difference in drawing ability (tho' that may be a minor problem), the spatial ability of each student (if that exists). Nevertheless, the impression came over quite forcefully that each student's guess was very inaccurate - and this was reinforced by casual questioning of other staff. It appears that the time of viewing a space has no effect on the student's understanding (or his ability to memorise, tested by a re-drawing 10 days later).

What does that mean? My interpretation is that it indicates that, when we look at a space, we look at it as a whole, and we then develop detailed impressions (one can never fail to be amazed at the discovery of something new in a room one knows well). In that case, there will be the objection; the longer viewer should have more detail. This would be so, if we did not have a recognition mechanism that allows us to recognise space (which we must do when we draw from memory [*40]).

If we recognise space, we have some sort of cognitive model of it, which includes variations. We can consequently invent the parts we didn't take in back from this. We appear to perceive space holistically, and then, reading from the top down, to perceive or invent the parts. But the critical thing about it is that we perceive it as whole, and that is why the approach of parts is so useless. The similarity of this to the idea of a chunk is obvious.

P.C.T. played a part in discovering this. It may again help uncover the parts from the whole, but it was wrongly, if sensibly, applied when it was used. More recently, students have construed their taste in pubs, using Pegasus, and have held that to be an enlightening experience. But they failed to communicate to each other. They probably had a whole view of their own. The problem is, however, when there is no whole understood, and it has to be taught. That problem is as old as Zen.

CONCLUSION: A REPLY TO THE OBVIOUS CRITICISM

It is clear that the data in these experiments has not been subjected to anything like the usual range or techniques of analysis. Multi-dimensional scaling and cluster analysis are both techniques that it can be argued would reveal meanings and values which cannot simply be picked out of the data. I even have some techniques of my own - a construct pole matching technique and a self-programming fuzzy set analysis - that could be computerised. And so I accept the criticism, from the point of view of the (PCT) psychologist.

To me, this is not what these experiments are about. Almost all of psychology assumes just as science does, that things are made up of parts that can be discovered and built into wholes. Gestalt psychology and classical cybernetics do not; they believe that 'the whole is greater than the sum of the parts'. I honestly believed, when I started these experiments, that the parts could be isolated simply and clearly - I don't think I even assumed that the whole was greater

than the sum of the parts. What I believe these experiments show is that something (space) cannot be addressed and understood through its parts. And I don't believe that any amount of clustering and generation of meaning in the part resolves this, because these experiments, which have concerned themselves with how particular students experienced and described and assessed their experience, showed that:

(a) whether there was underlying meaning or not, the student's experience, when translated into words, failed to communicate even to himself, in the manner he imagined it did.

(b) the serial experiencing of space makes the space hard to visualise and impossible to remember.

(c) the briefest glimpse of a space makes the space memorable and recognisable and then allows us to invent/perceive/remember/recognise more and more details.

(d) the way we naturally make a description of a space is to try and express the whole, at first, and then go into the detail (this is distinct from our manner of understanding from a ready-made description, which can be either holist or serial).

Given these discoveries, what I am claiming is that the psychological approach which examines parts - and meanings in them - is initially irrelevant, blinding and dangerous when we face areas which have to be approached from whole to parts (if, indeed, there are any parts). For this we need a new approach, which may have already been theoretically provided in cybernetics, not the bolstering of the approach, the limitations of which we have to transcend. If we do not accept the formal structural limits of the system we use to investigate, but patch it up with band-aid in an attempt to pretend it is without these limitations, we fool ourselves and do a disservice to that system. I am glad that my naivety and lack of hardware did not allow me to take the band-aid option, and lead me to try to point to some limitations, and a new area for a new approach. I learn more from my errors than my trials.

APPENDIX: REPRESENTING PERSONAL KNOWLEDGE STRUCTURES [16]

(Paper presented to the Conference of Operations Section of the British Psychological Society, Uxbridge, 1977).

There is a general problem in persuading people to express their views of how parts of a field relate together (just as there is in getting them to draw a map of how they think areas relate). The problem seems to arise from·3 factors: confusion at what is meant by the question, lack of a technique for answering the question, and belief that they should 'get it right'. In this appendix, a technique will be discussed that makes representing personal knowledge structures within a (topic - labelled) field possible.

Pask argues that in any complete topic-labelled field [17] all topics will eventually relate to all others, and thus the topics will be organised circularly. He further argues that, a field being complete (this is tied up with the argument of circularity), the topics within that field can only give rise to other topics (still within that field), if at least two interact in some (logically definable) manner - for one topic cannot transform into another unless there is something (within the field) that brings the transformation about.

If Pask's argument holds good, and within topic-labelled fields his own work and that of Varela provide very strong evidence in support, it should be possible to show the connections

between topics in any more-or-less complete topic-labelled field. Such a field will be circular, and at least two topics within the field will give rise to any other.

However, that the topics within the field are circularly organised does not mean that they are so organised cognitively. If it was cognitively circular, it would be non hierarchical, non-approachable and non-learnable, through its topics. If a field is approached through its topics, a student will start with some topics and from them generate others. In Pask's system based on his circular theory of the topics within the field, starting topics (normally, of course, thought of as the 'basics') are defined. However, in somewhat ambiguous fields, or in offering a personal explanation of a field, the starting topics may well not be these. But the problem already referred to comes in here: how to explain a subject that his choice of opening topics and his personal hierarchy are as good as any others.
A technique was needed which provides, of itself, no apparent ordering or connections, which allowed all topics to be stated (and extra, external topics keyed in, if needed), from which a hierarchy could be derived. This was achieved in the following manner.

The topics (in our case, the 15 terms) are arranged in a circle (Fig.15) together with an optional extra topic which denotes something forgotten or inadequately described (in our case we call it ‘A’). The use of this term is of value when dealing with an incompletely formulated field. In our case, it was added in as an afterthought and was found quite useful.

Subjects are asked to show how they think each of these terms is derived from (at least 2) others in the circle: as many derivations as wished may be made. They do this by drawing arrows to the term that is derived from those terms from which they are derived, joining the lines together at the arrow head. When each term has been examined, and derived (unless the subject finds this possible), the form is considered complete (Fig.20).

This form can be converted into a hierarchy showing a personal knowledge structure by using the following three procedures, applied in sequence.

Arrange the terms in a straight line, on gridded paper.

Mark, on the first level, all terms that have no arrows entering them. Proceeding up, level by level, mark in all terms that are derived from already marked in terms.

Make all terms from which no arrows emerge, the top level.

There is one graphic sophistication required: where there is more than one derivation of a term, leading to different levels, the term will appear on as high a level as it can. This is excepted in a downwards loop, and by terms which imply each other (See $C).

There is one further subtlety required. Some terms are derived in part or in whole from other terms which have not yet been derived. There are two reasons for this:

> Firstly, a term may be derived in part from a term that is as yet un-derived and which appears higher up the hierarchy. In this case, a downwards loop is formed, and this is represented as such;

Secondly, a term may be derived in part from another term that is itself (possibly indirectly) derived from the first term. In this case the two terms imply each other and are drawn on the same level in the hierarchy.

Using the above procedures [18], the circular forms may be converted into hierarchies (or hetrarchies), which demonstrate the subject's personal knowledge structure of the defined field. The terms at the base level are the basics that provide access to the field, while those at the top are the terminal and goal points. These exactly parallel Pask's conditions in an entailment structure, but they are personal and are not derived by consensus from subject-matter expert's views.

Some examples of such personal knowledge structures can be found in Fig. 15.

Besides the value of the elicitation of such personal knowledge structures to subjects themselves, and in allowing similar term relationships to be seen in terms both of levels and derivations, they appear to have a further, and potentially valuable use. (This is based on very limited experience, and on a combination of opinions as teacher and as experimenter. They are in no way proven or objective, but they appear nevertheless to be of value).

It appears that the personal knowledge structures reflect problems students face in prolonged study tasks. Thus, a hetrarchy with many terms on the top level indicates a student who is too dispersed, and, while almost always pleasing his various teachers, rarely makes really integrated progress: as opposed to the student with one top level term, who is single minded.

Further, a student with many groups of terms implying each other at any level seems to have difficulty in advancing in his studies at a time within the study period related to that level. Perhaps this is because the student cannot differentiate the different concepts, and thus manipulate them, at that level. A student with many terms implying each other at, for instance, the basic level will have difficulty ever advancing, tending always to return with a new idea rather than developing one he has already thought of, while one with such terms at a middle level would start alright, but suddenly loose confidence at the complexity of the problems. Presumably one with many such implications at the top would either not realise that he had got to the top, or would be daunted at getting there, and would never finish work.

At C.S.H.L. we are working on computerising and extending these techniques and procedures, and this should enable us to confirm or deny the above suggestions, and further uses.

LIST OF FIGURES

BIBLIOGRAPHY

*1 Glanville, R. 'Is Architecture Just a Hollow Space, or is it the Empty Set?' aaq; London, 1977.

*2 Glanville, R. 'Experiential Projects: Learning to Perceive and Perceiving to Learn; paper delivered at 2nd International Conference on Improving University Teaching; Newcastle; 1977.

*3 Glanville, R. 'The Logic of Description - or, why Physics won't work'; Proc. 1st International Meeting on Applied General System Theory; Binghamton NY, 1977.

*4 Glanville, R. 'The Object of Objects, the Point of Points - or, something about things'; unpublished PhD Thesis, Brunel Univ, Uxbridge; 1974.

*5 Glanville, R. Pask, G. and Robinson, M. 'Travels with a Calculator'; Wilton House, London; 1977 (in press).

*6 Gregory, R. 'The Confounded Eye', in Gregory, R. and Gombrich, E. 'Illusion in Nature and Art' Duckworth; London, 1973.

*6a Gregory, R. 'The Intelligent Eye' Wiedenfeld and Nicolson; London; 1970.

*7 Kelly, G. 'A Theory of Personality' Norton, New York; 1955.

*8 Laing, R. Phillipson, H and Lee, R. 'Interpersonal Perception'; Tavistock; London; 1966.

*9 Mendoza, S. & Thomas, L. 'The Individual's Construction of his Visual World as predicted by the Repertory Grid'; paper presented at BPS annual conference; 1972.

*10 Miller, G. 'The Magical Number Seven, plus or minus Two'; Psychological Review 63; 1956.

*11 Pask, G. 'Conversation Theory, Applications in Education and Epistemology'; Elsevier; Amsterdam; 1976.

*12 Pask, G. and Scott, B. 'Caste: A System for Exhibiting Learning Strategies and Regulating Uncertainties'; Intl. J. Man. Machine Studies; vol. 5; 1973.

*13 Pask, G. & Scott, B. 'Learning Strategies and Individual Competence' Intl. J. Man Machine Studies; vol. 5; 1973.

*14 Pask, G. Scott, B. & Kallikourdis, D. 'Theory of Conversations and Individuals', Intl. J. Man Machine Studies; vol. 5 1973.

*15 Pedretti, A; forthcoming article for aaq; untitled; 1977.

*16 de Saussure, F. 'Course in General Linguistics'; McGraw-Hill; New York, 1966.

*17 Shaw, M. 'Pegasus'; paper presented at 2nd Congress on Personal Construct Theory; Oxford; 1977.

*18 Simon, H. 'The Sciences of the Artificial'; MIT; Cambridge; 1967.

*19 Thomas, L. 'A Flow Diagram Technique for describing the Meaning Structure of 'A Text'; CSHL; Uxbridge; 1970.

*20 Thomas, L. 'The Tutoring of Art Students: applying an Approach and Technique based on the Repertory Grid'; CSHL; Uxbridge; 1971.

*21 Thomas, L. and Shaw, M. 'Focus'; computer programme manual; CSHL; Uxbridge; 1976.

*22 Thomas, L. Harri-Augstein, S. 'Can Students Learn to learn for Reading?'; paper presented to BPS annual conference; 1972.

*23 Thomas, L. McKnight, C. & Shaw, M. 'Grids and Group Structure'; paper presented to BPS annual conference; 1976.

FOOTNOTES

(1) These experiments are reported briefly and to set the scene. A fuller report can be found in my thesis work.

(2) The experimental subjects were students of mine at the Architectural Association School. All experiments, unless otherwise stated, were carried out there.

(3) I have written a general review article on some of this work [*1].

(4) Eleven students chose the slides, one of which got lost. There were thus 32 slides. Altogether 14(?) students took part in the experiment, although they were rarely all present at once. 8 or 9 students at ended every session during the year.

(5) We do not have a computer in the school, and I have no programmer. Several extensions of the results given here could be made, if we did have.

(6) After many false starts, this form was arrived at by a student, Kathryn Findlay.

(7) After the form was printed, but before use, an extra term was invented. Called 'A', it simply meant 'the right term is missing from the set' and was used to allow for incompleteness in the set. (See Appendix).

(8) The technique for doing this is elaborated in the appendix and CSHL is currently developing a computerised version. Pask [*11] has since adopted the technique and uses it extensively. His method of transforming the filled in form to a hierarchy is slightly different.

(9) In fact they were lead into the space, sometimes separately and sometimes together. They were allowed to leave the space to un-blindfold themselves in order to draw and sketch and they were allowed except in one case to see each other's sketches and to talk.

(10) But not the same group as in the First Year.

(11) Although this was an organisational limit, no student indicated he would have liked to go on longer, when asked.

(12) Her report on this is due to be published shortly in aaq. I cannot therefore report it in full, and I will give only an outline of the method and the results [*15].

(13) So, one may reasonably argue, is the intention of a sentence specifically describing a room. But the argument we are interested in is not about manufacture, it's about interpretation.

(14) Reported by Simon [*18].

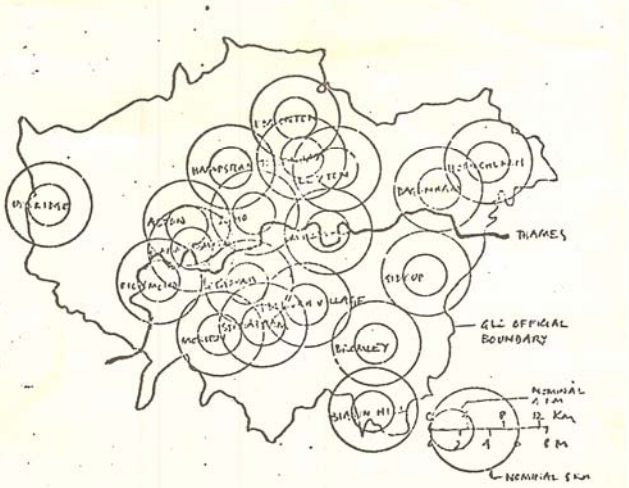
(15) It was not possible to stop them listening etc., but the assumption is that they gained little visual idea from this.

(16) The techniques reported here are preliminary, although Pask has developed them for use in his learning theory.

(17) Pask does not, in his work, consider any non-topic-labelled fields – I doubt that he accepts that such things exist.

(18) The procedures are copyright (c) Ranulph Glanville.

FIGURE 1
The places to be located within the G.L.C. area, together with the 4 and 8 km marking circles.



Student	No. of Places Located	No. within 4 Km	No. within 8 Km	% Places Located	% Correct 4 Km/ Total Places	% Correct 8 Km/ Total Places	% Correct 4 Km/ Places Located	% Correct 8 Km/ Places Located
a)+	15	0	0	78.9	0.0	0.0	0.0	0.0
b)	18	4	6	94.7	21.0	31.6	22.2	33.3
c)+	3	1	1	15.8	5.3	5.3	33.3	33.3
d)	14	2	3	73.7	10.5	15.7	14.3	21.4
e)	17	2	6	89.5	10.5	31.6	11.8	35.3
f)+@	10	0	0(7)@	52.6	0.0	0.0	0.0	0.0
g)+	5	2	2	26.3	10.5	10.5	40.0	40.0
h)	12	2	5	63.1	10.5	26.3	16.7	41.7
i)	15	3	10	78.9	15.7	52.6	20.0	66.7
j)	3	1	2	15.8	5.3	10.5	33.3	66.7
k)+	8	0	1	42.1	0.0	5.3	0.0	12.5
l)	15	6	7	78.9	31.6	36.8	40.0	46.7
m)	18	1	5	94.7	5.3	26.3	5.5	27.7
n)	7	0	2	36.8	0.0	10.5	0.0	28.6
o)	6	0	1	31.6	0.0	5.3	0.0	16.7
p)+	18	3	12	94.7	15.7	63.2	16.7	66.7
q)	7	2	2	36.8	10.5	10.5	28.6	28.6
r)+	14	6	11	73.6	31.6	57.9	42.9	78.6
s)	11	0	4	57.9	0.0	21.1	0.0	36.4
t)	5	1	2	26.3	5.3	10.5	20.0	40.0
u)	10	2	4	52.6	10.5	21.0	20.0	40.0
v)+@	10	0	7(0)@	52.6	0.0	36.8	0.0	70.0

FIGURE 2
Table of results in test of ability to locate places within London

+ student's work included as example.

@ student f) is student v). In the case of v), an Eastwards distortion was allowed on the 8 Km measurements.

FIGURE 3
Archetypical structures for London

Student	Test 1	Test 2	Test 3	Test 4	Test 5	Change 1-3/4-5?
a)	L	-	-	RC	GRC	yes
b)	L	CL	C	-	-	N/A
c)	W_2	-	-	W_2	-	yes
d)	RC	L	L	-	LC	yes
e)	L	Z	Z	Z	Z	no
f)	R	R	R	RL	-	yes
g)	CL	RCL	-	-	RC	yes
h)	-	RCL	-	RCL	RC	no
i)	T	L	L	GCR	T	yes
j)	LC	LC	LC	-	ZLRC	yes
k)	L	RC	RCG	W_1	W_2	yes
l)	CL	L	L	-	Z	yes
m)	L	L	W	T	-	yes
n)	T	W_1	W_2	W_3	T	yes
o)	-	CL	-	W	-	yes
p)	G	GW	-	-	X	yes
q)	L	ZG	ZL	-	-	N/A
r)	L	-	-	-	LG	yes
s)	LC	L	L	-	-	N/A
t)	-	RLC	ZL	LZRC	W	yes
u)	C	-	-	C	CR	yes
v)	R	RLG	RLC	-	LGC	yes
w)	RC	RCGL	RCGL	X	X	yes
x)	RCGL	CW_2	CW_2	-	-	N/A
	Introduction	Before main course		After main course		

Key to Table

C	Concentric prototype used
G	Grid prototype used
L	Lattice prototype used
R	Radial prototype used
Z	Zone prototype used
T	Trivial (i.e. not observed)
W	Special Language
X	Unexpressed

FIGURE 4
Table of results in a series of London structure tests

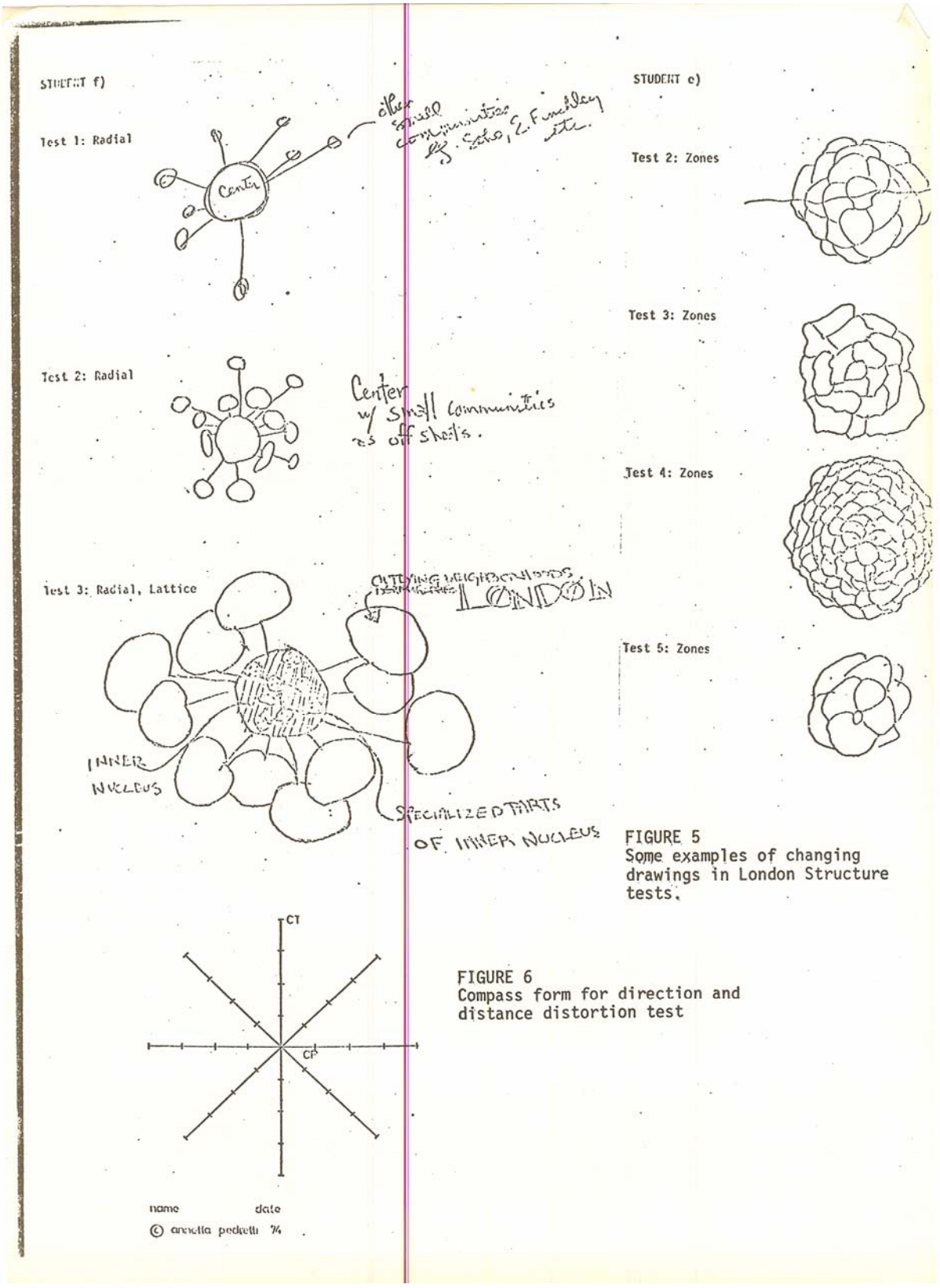


FIGURE 5
Some examples of changing drawings in London Structure tests.

FIGURE 6
Compass form for direction and distance distortion test

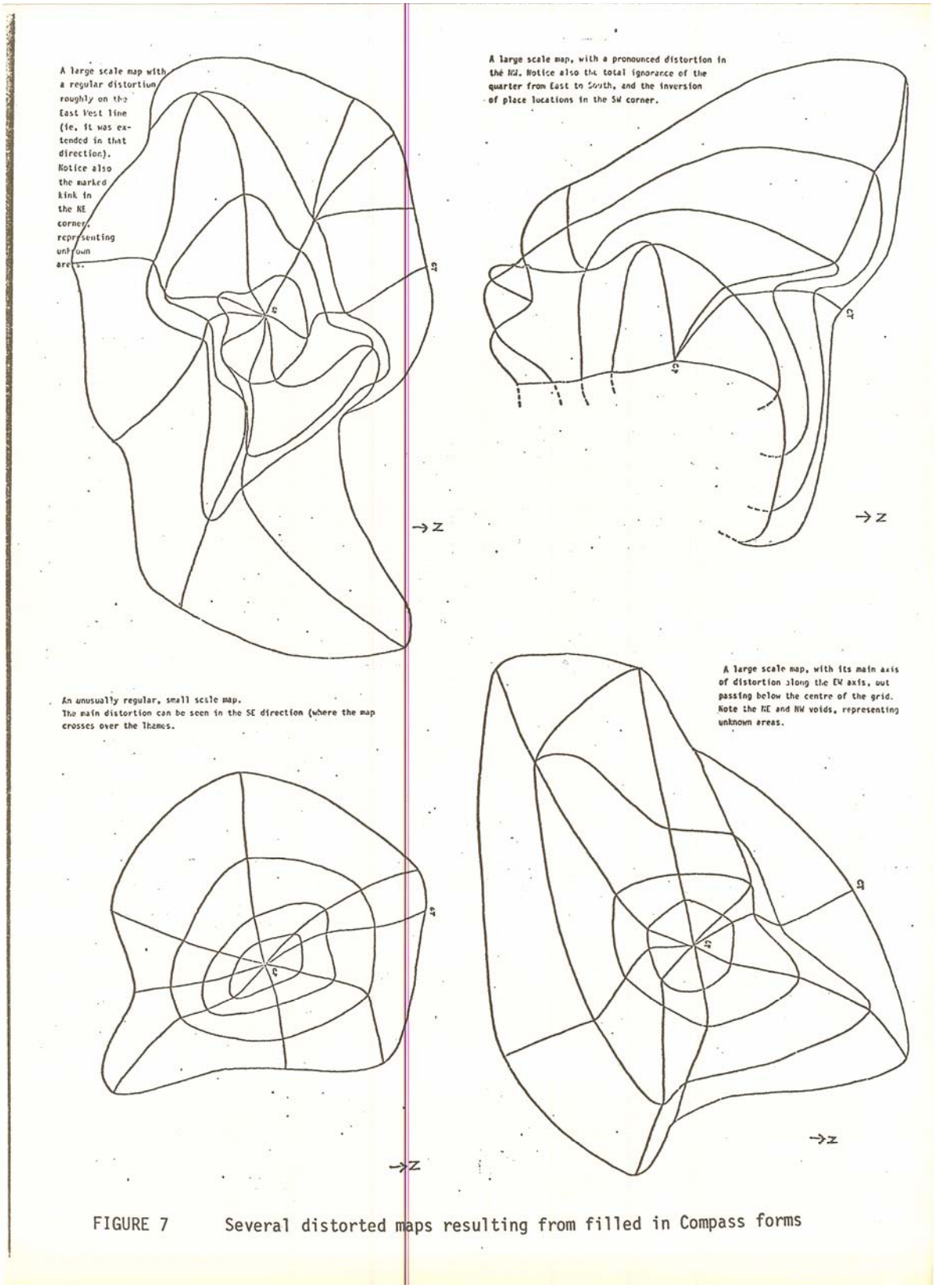


FIGURE 7 Several distorted maps resulting from filled in Compass forms

A observes 

A equates  with 'hat'

B observes equation of ( with 'hat) and equates them

B equates equated ( and 'hat') with 'châpeau'

A observes equation of ( and 'hat') with 'châpeau' and equates them

A compares  with 'châpeau', to see if they equate 

If they do, A assumes B has understood A's observation of

If not, A attempts the process again.

FIGURE 8
Conversation Theory: principles

pre select 5 slides each

select 3 slides each (call each bu chooser's name and subscripts x, y, z)

form groups

Group A	Group B	Group C
A_1 A_2 A_3	B_1 B_2 B_3	C_1 C_2 C_3

thus Group A has elements

A_{1x} A_{1y} A_{1z} A_{2x} A_{2y} A_{2z} A_{3x} A_{3y} A_{3z}

when groups find they can predict the construing of other group members, groups reform

Group 1	Group 2	Group 3
A_1 B_1 C_1	A_2 B_2 C_2	A_3 B_3 C_3

Group 1 has elements

A_{1x} A_{1y} A_{1z} B_{1x} B_{1y} B_{1z} C_{1x} C_{1y} C_{1z}

of these, A_{1x} A_{1y} A_{1z} are common to Groups A and 1

when groups find they can predict the construing of other group members, groups are disbanded and all slides are re-shown

(A B C) $(1\ 2\ 3)_{(x\ y\ z)}$

FIGURE 9
Summary of Interactive construing process

FIGURE 10
Descriptive terms; use by students

STUDENT TERM USE FOR 32 SLIDES

			Ha	Rn	Ho	Rr	Ch	M	K	N	A	Ca
1.	Axis	: verticallity/horizontallity/depth	14	14	12	13	9	14	12	25	10	7
2.	Surface	: hard/soft	15	9	3	26	6	15	7	25	13	3
3.	Containment	: closed/open	14	15	9	12	5	23	11	21	16	5
4.	Scale	: small/large	13	9	4	17	5	10	2	14	12	6
5.	Mechanical	: parts can move/parts can't move	1	10	7	4	5	5	3	7	14	7
6.	Building as a setting	: dominant/subordinate	16	14	9	6	4	12	6	18	20	10
7.	Space's feeling for users	: human/non-human	7	8	8	9	1	17	4	14	10	12
8.	Core being pointed to	: hierarchical/anarchic	7	6	/	2	2	3	6	13	6	3
9.	Symbolic reading	: suggestive/iconnic	13	2	/	1	3	4	/	11	13	3
10.	Opening in boundary	: transparent/opaque	14	8	3	2	4	8	16	16	15	2
11.	Diversity	: complex/simple	10	17	/	8	7	7	1	13	15	3
12.	Movement	: continuity/discontinuity	12	9	6	6	4	3	3	13	13	9
13+	Where I am	: inside/outside	8	8	5	16	5	10	/	20	17	4
14+	From where I am, what I feel	: inside/outside	7	3	6	15	4	/	6	21	14	5
15+	Context	: important/weak	19	8	3	4	8	14	1	16	11	1
		TOTAL USE	170	140	75	141	78	145	78	247	189	80

FIGURE 11
Terms used in describing ten sample slides

	TERMS USED			SLIDE NUMBER: P123	P34	P81	P38	E1	Z2	E18	P17	P4	P8	TOTAL USES FOR ALL SLIDES
				NUMBER OF USES FOR SELECTED SLIDES										
1.	Axis	:	verticallity/horizontallity/depth	9	1	4		10	2	7	3	4	3	138
2.	Surface	:	hard/soft	3	3	3	6	4	7	5	7	4	3	122
3.	Containment	:	closed/open	4	5	5	7	3	3	3	5	5	1	136
4.	Scale	:	small/large	1	1	3	1	3	4	3	6	4	1	91
5.	Mechanical	:	parts can move/parts can't move			7	3	1	2	1		1		52
6.	Building as a setting	:	dominant/subordinate	7	6	5	1	6	3	6	6		5	111
7.	Space's feeling for users	:	human/non-human	3	3	2	9	1	6	4	2		2	98
8.	Core being pointed to	:	hierarchical/anarchic	1	3	2					1	2	1	51
9.	Symbolic reading	:	suggestive/iconnic		2		4	3	3	1	4	2	4	50
10.	Opening in boundary	:	transparent/opaque	4	4	5	2	3	3	4	4	1	4	89
11.	Diversity	:	complex/simple	4	2	2	3	1	2	5	3	1	1	74
12.	Movement	:	continuity/discontinuity	1	1	5	1	2	1	1	1	1		87
13+	Where I am	:	inside/outside	4	5	5	5	2	3	3	1	3		100
14+	From where I am, what I feel	:	inside/outside	5	5	5	2	3	2	3	1		1	83
15+	Context	:	important/weak	3	3	3	2	6	3	3	3	5	4	89
			SLIDE TOTAL	48	44	56	46	48	44	49	47	33	30	

RANKINGS: BELIEVED (B) and ACTUAL (A). NUMBERS REFER TO TERM NUMBERS, SUBSCRIPTS TO RANK DIFFERENCES.

	Sarah		Annetta		Christopher		Robin		Martin		Howard		Kathryn		Carlos		Roger		Hans	
	B	A	B	diff A	B	diff A	B	diff A	B	diff A	B	diff A	B	diff A	B	diff A	B	diff A	B	diff A
1st	6		10	3.5 6	1	0 1	11	0 11	1	3 3	1	0 1	3	2 10	15	14 7	13	2 2	15	15 0
2nd	4		13	0 13	4	1 15	7	9.5 3	7	0 7	7	2 3	10	1 1	3	5.5 6	14	3 4	9	6 6
3rd	11		14	3 3	3	2 11	5	2 1	12	10.5 2	2	9 6	15	9.5 3	6	1 12	2	2 13	8	11 2
4th	7		9	3.5 10	8	11 2	3	2 6	9	8 1	11	10 7	13	10.5 2	1	0.5 1	6	5.5 14	7	9 1
5th	9		6	1 11	11	2 3	12	2 5	13	2.5 15	8	9 5	14	1 6	2	6.5 5	15	6.5 1	13	6 10
6th	1		7	6.5 14	14	3 4	10	4.5 12	14	9 6	6	3.5 12	1	4 8	9	5.5 4	4	1 3	14	6 3
7th	13		3	5 12	13	1 5	4	0 4	2	4 13	3	4.5 14	2	3 14	8	4.5 3	1	2 7	3	1 4
8th	14		4	2 9	15	1 13	2	1 2	15	3.5 4	13	0 13	6	2 7	11	3.5 14	11	0 11	10	3 9
9th	15		1	4.5 2	6	9 14	13	1.5 7	3	9 10	14	2.5 4	8	3 12	10	5 13	7	1.5 12	11	1 12
10th	3		2	1 4	10	1 12	15	0.5 10	8	3.5 11	12	3.5 2	12	0.5 5	12	7 2	8	4 6	12	1 11
11th	2		15	0 15	2	7 10	14	3 13	11	1 5	15	0 10	7	3 4	5	6.5 9	12	2 5	5	4 13
12th	12		12	4 1	5	5 7	1	7.5 15	10	3 9	10	1 15	11	0 11	4	6 8	5	0 15	1	8 14
13th	8		11	9.5 7	12	3 6	6	8.5 8	4	5.5 12	4	4 11	5	3.5 15	7	12 11	3	7.5 8	4	6 7
14th	10		5	1 8	7	2 9	8	1 14	5	3 8	5	9 9	4	3 13	13	6 10	9	1.5 10	2	11 8
15th	5		8	1 5	9	1 8	9	0 9	6	9 14	9	1 8	9	0.5 9	14	7.5 15	10	9.5 9	6	13 5
r_s			0.585		0.471		0.560		0.098		0.288		0.508		-0.288		0.656		-0.300	

significance

N	0.01	0.05
14	.456	.645
16	.425	.601

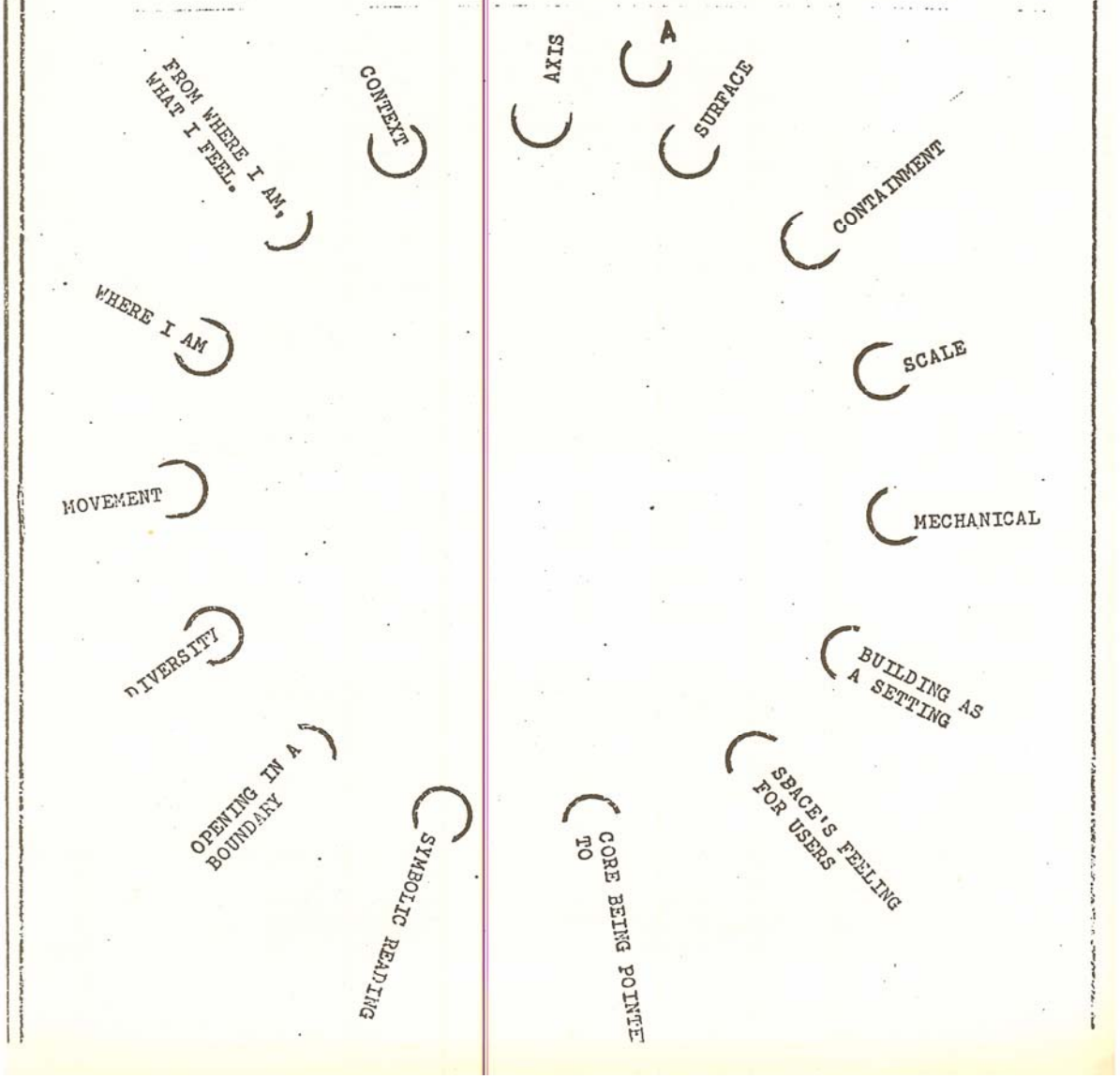
ave r_s 0.286

FIGURE 12
Ranking of believed and actual use of terms

name

FIGURE 13
Unfilled in used to construct
Personal Knowledge Structures

AXIS: verticality/horizontality/depth
SURFACE: hard/soft
CONTAINMENT: closed/open
SCALE: small/large
MECHANICAL: parts can move/ parts can't move
BUILDING AS A SETTING: dominant/ SUBORDINATE
SPACE'S FEELING FOR USERS: human/non human
CORE BEING POINTED TO: hierarchical/anarchical
SYMBOLIC READING: suggestive/iconic
OPENING IN A BOUNDARY: transparent/opaque
DIVERSITY: complex/ simple
MOVEMENT: continuity/discontinuity
WHERE I AM: inside/ outside
FROM WHERE I AM, WHAT I FEEL: inside /outside
CONTEXT: important/weak



SIMILAR DERIVATIONS OF TERMS

DERIVED TERMS ⁴--- TERMS FROM WHICH DERIVED

Scale (2x) ---- axis/surface
Axis/opening in boundary ---- Surface/containment
Space's feeling for users (2x) ---- Containment/scale
Opening in boundary/context ---- surface/from where I am what I feel
Containment (2x)/space's feeling for users ---- Building as setting/symbolic reading
Scale/mechanical ---- space's feeling for users/diversity
Core being pointed to/where I am ---- building as a setting/context
Axis (2x) ---- core being pointed to/movement
Mechanical (2x) ----symbolic reading/movement
Surface/mechanical/diversity/opening in boundary ----symbolic reading/context
Axis/where I am ---- opening in a boundary/context
Containment/space's feeling for users ---- where I am/from where I am what I feel
Containment/building as a setting (2x) ---- from where I am what I feel/context

FIGURE 14
Similar Derivations of Terms

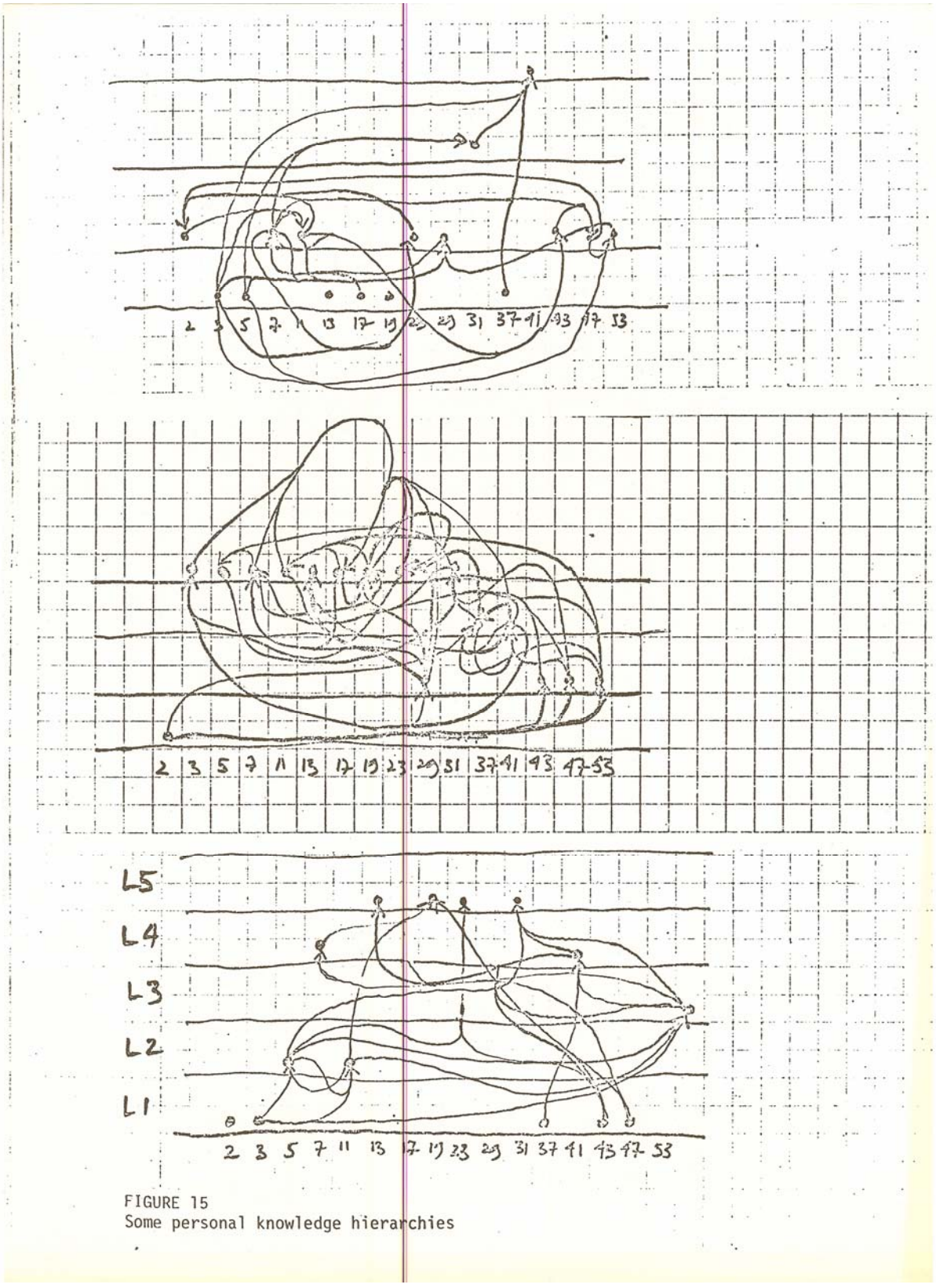


FIGURE 15
Some personal knowledge hierarchies

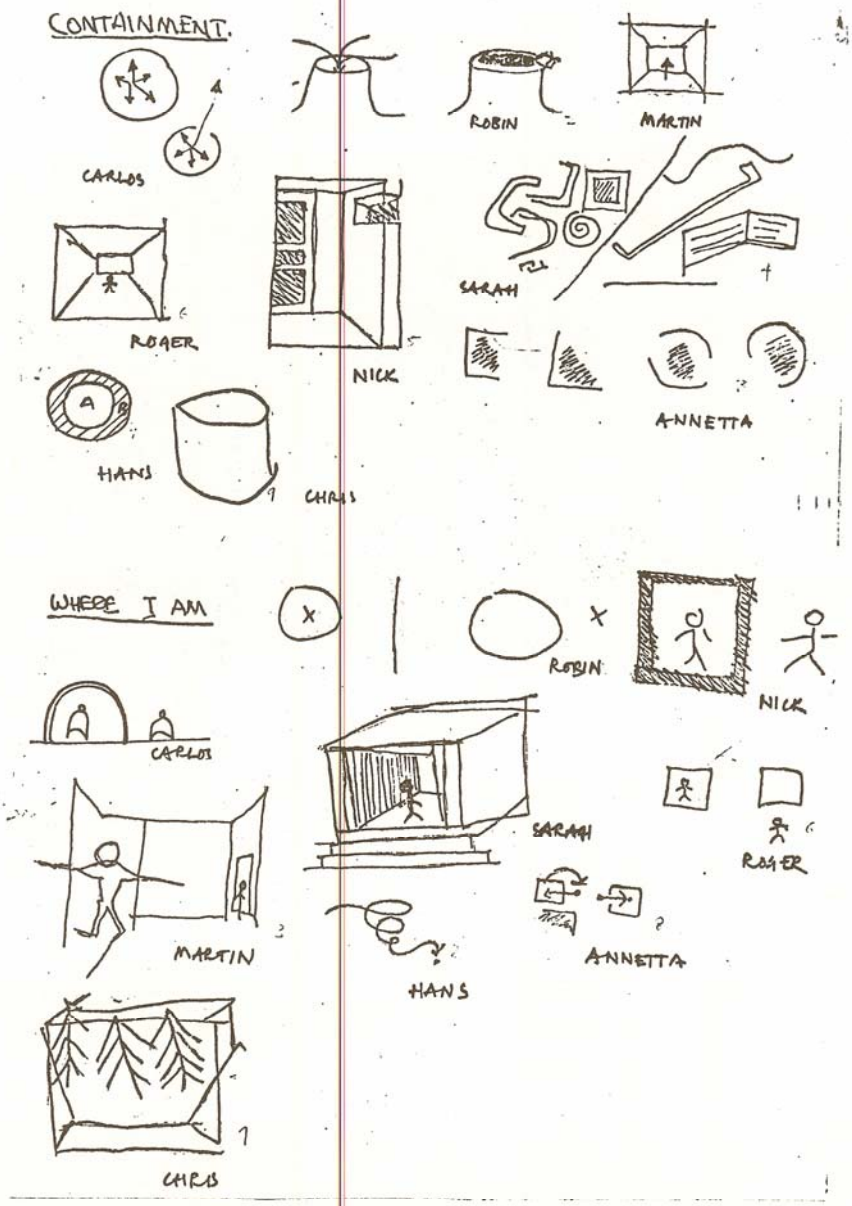


FIGURE 16
Diagrammatic drawings of 2 terms.

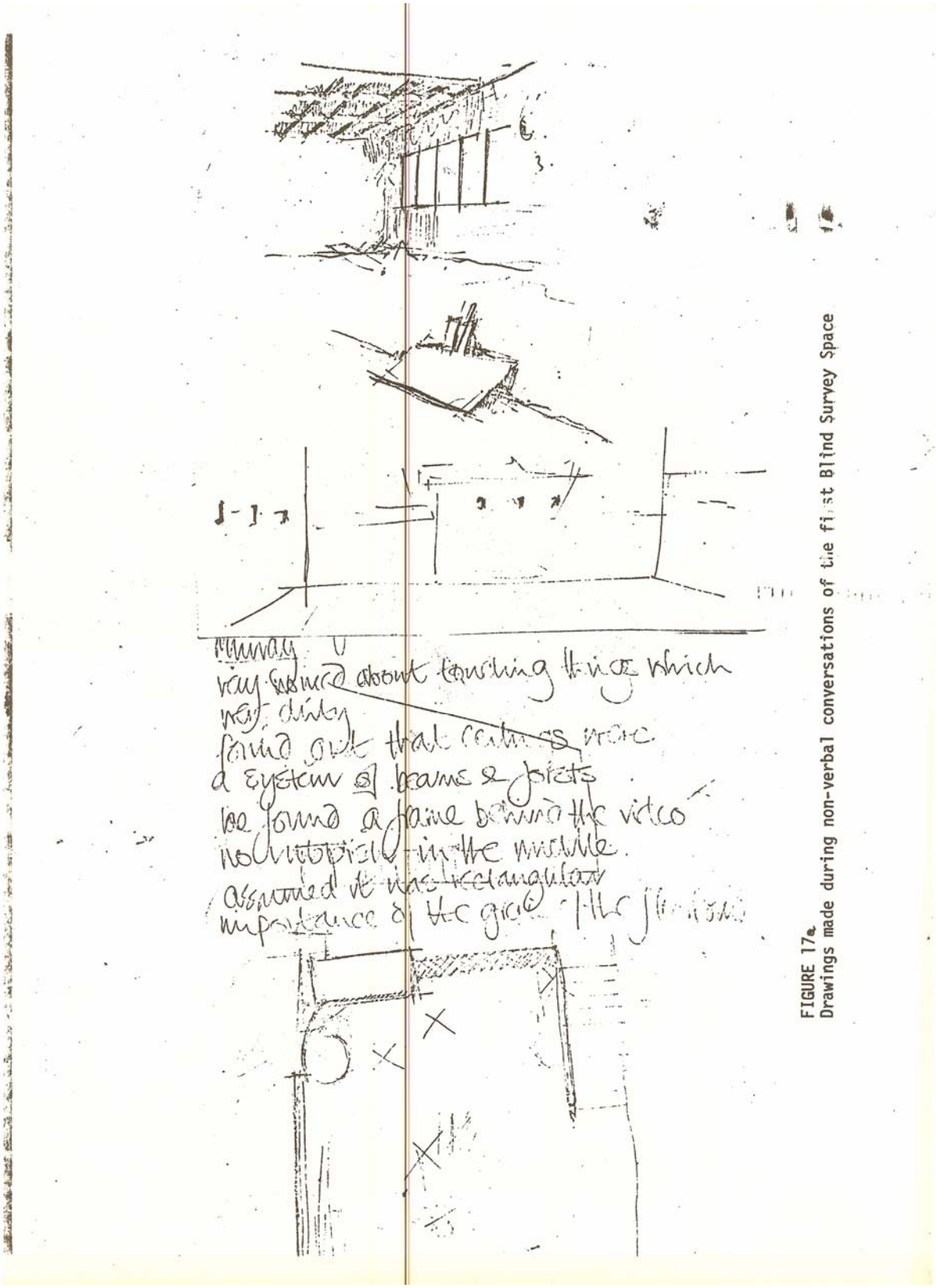


FIGURE 17a
Drawings made during non-verbal conversations of the first Blind Survey Space

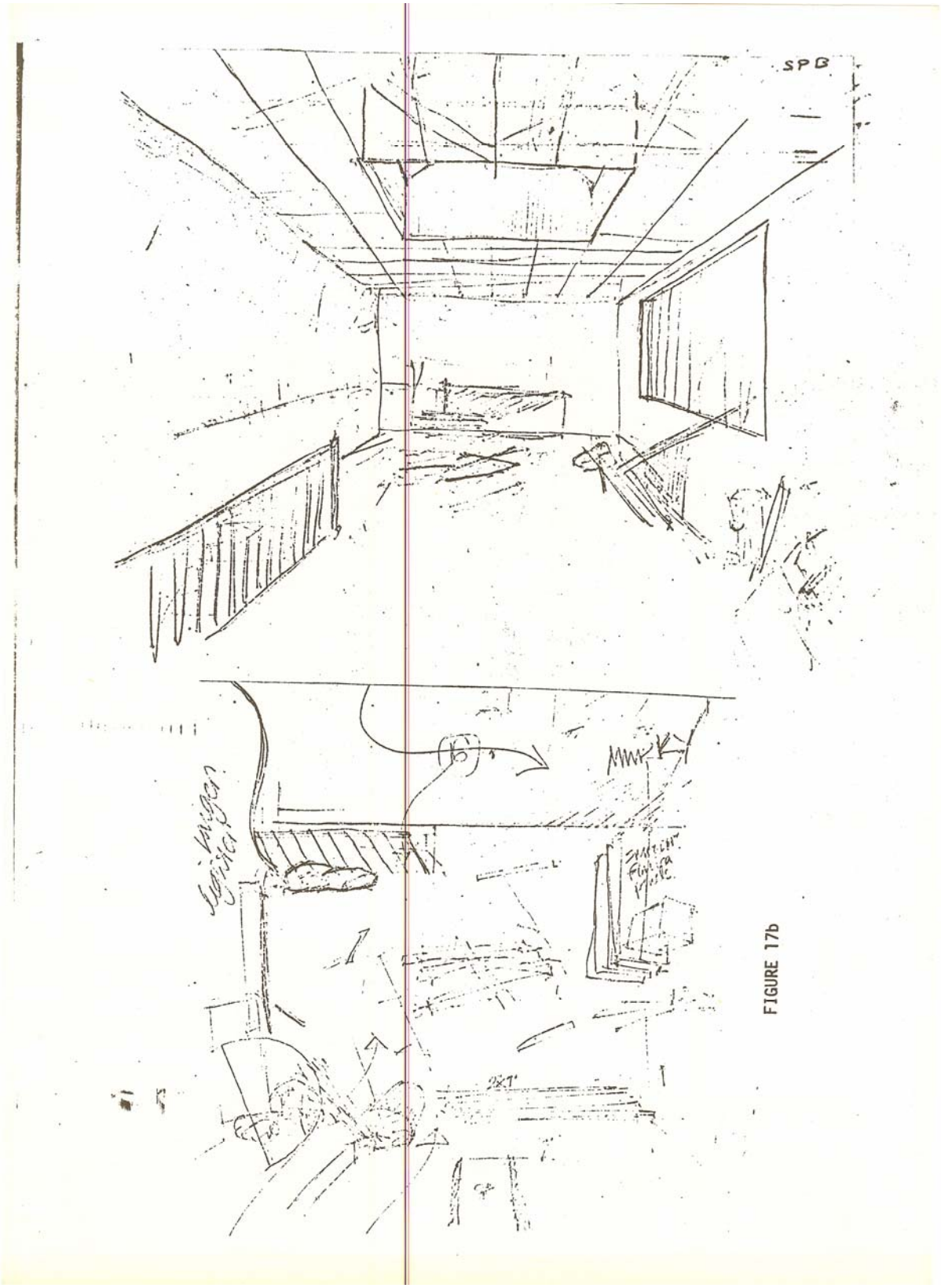


FIGURE 17b

SUMMARY TERMS - USED DESCRIBING SPACE

sensury inputs

- touch
- shape/continuity - edges, corners, planes, surfaces
  - square, round, right angle, angles, all angles, parallel, butterfly shape
- texture (materials suggestiong function)
  - metal screen, netting, brick, chipboard, plywood, glass
  - hard, soft
- scale/size - constrict, open (domestic size)
- quality - dark, dirty
- sound, smell
- uncertainty - weird, funny, hole, lump something (fear)

FIGURE 18
Useful terms related to drawings of the second Blind Survey space.

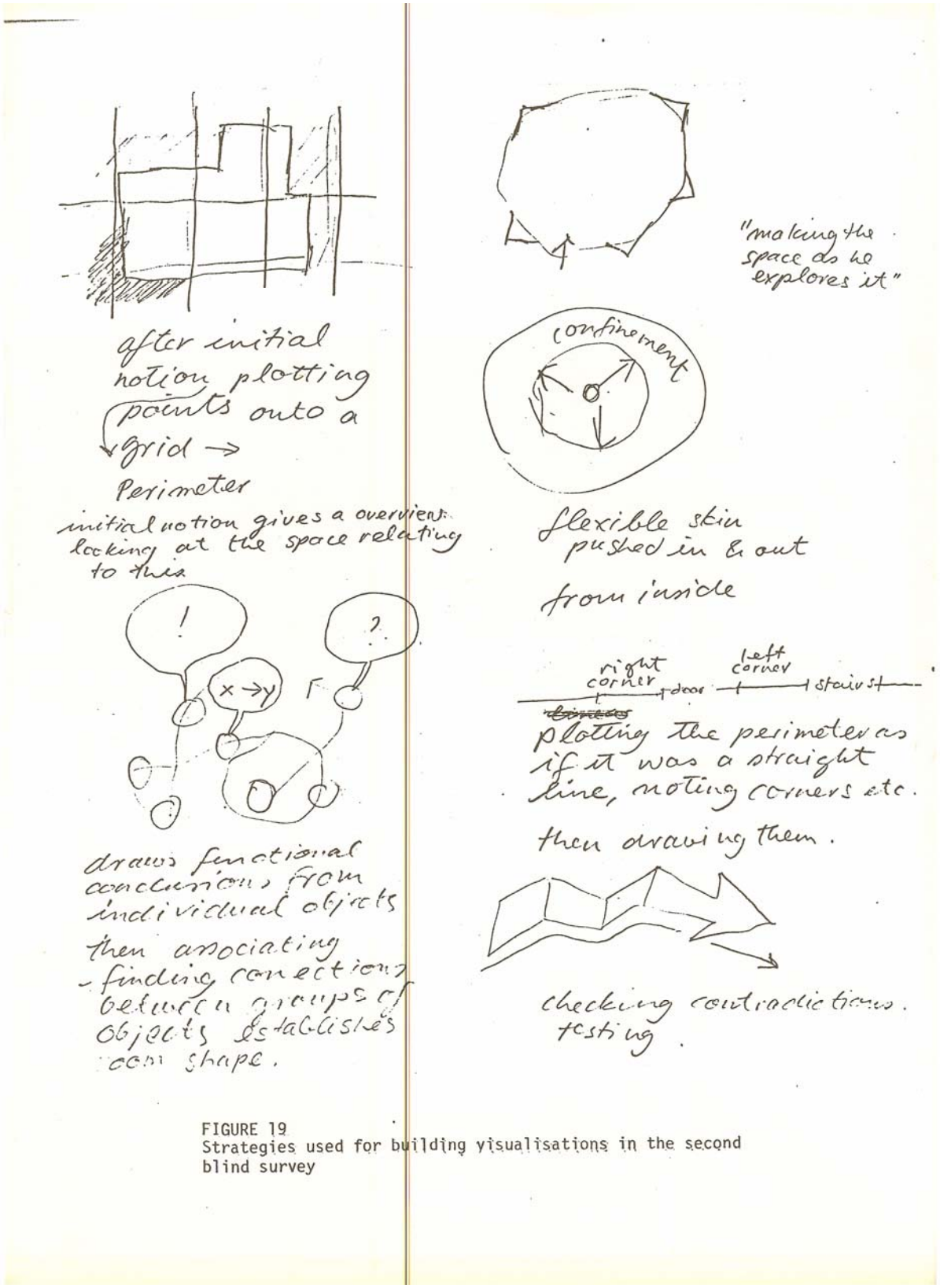


FIGURE 19
Strategies used for building visualisations in the second blind survey

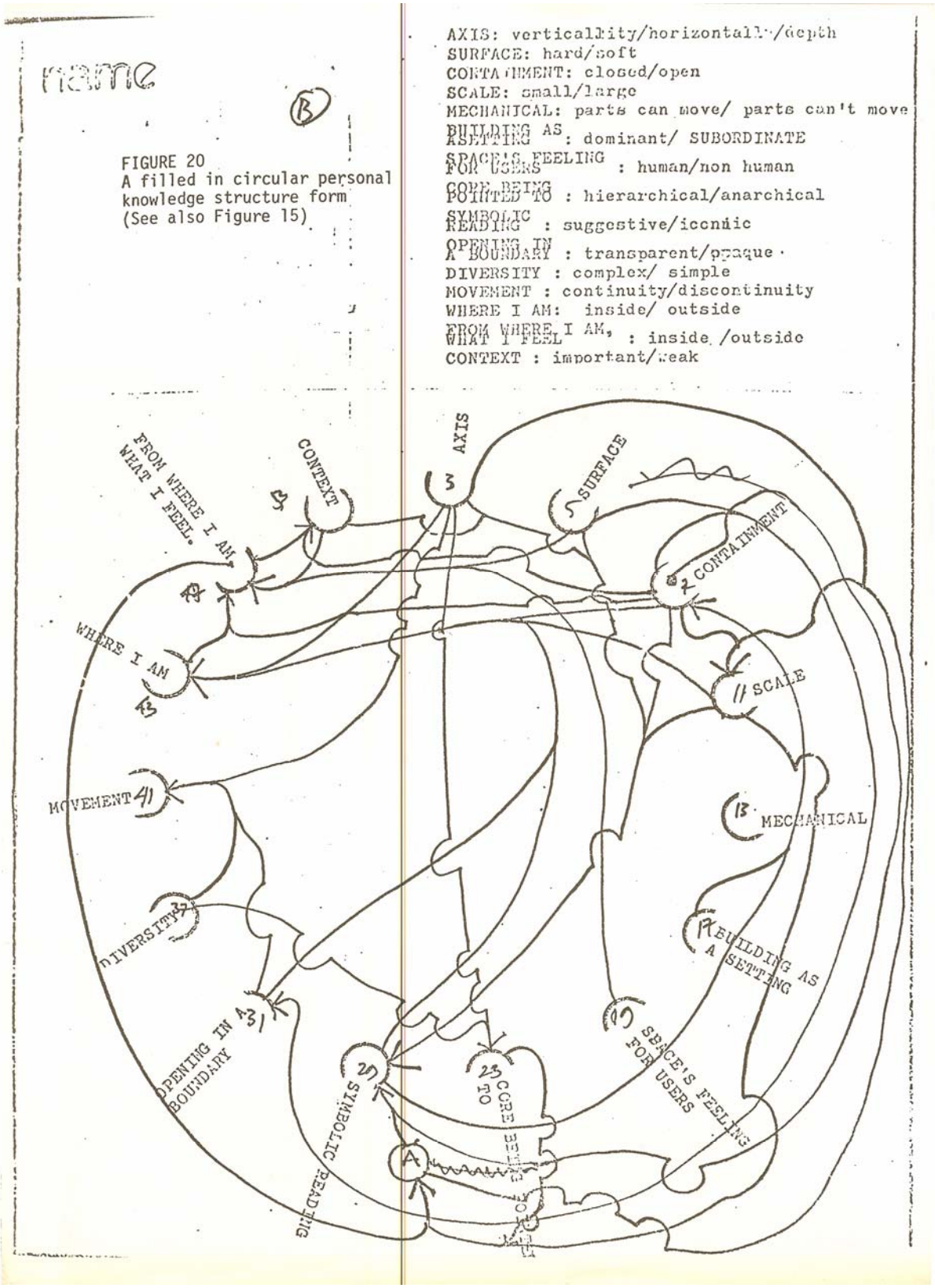


FIGURE 20
A filled in circular personal knowledge structure form
(See also Figure 15)