INTEGRATIVE DIMENSIONS OF CONCEPT SETS

- transformations with minimal distortion between implicitness and explicitness of set representation according to constraints on communicability

Explores the problem of minimizing loss of significance when a concept set is considered too complex to be communicated comprehensibly to a particular audience. In such a case the set must be transformed, possibly by collapsing some distinctions, so as to reduce the number of conceptual elements in the set by a factor of 2, 3 or more. If collapsed in an orderly manner, maintaining integrative dimensions, some of the original distinctions are present implictly rather than explicitly.

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1. INTRODUCTION

Sets of concepts, such as principles, problems, issues, propositions, programme priorities, characteristics or properties of some entity, values, human needs, and human rights, are fundamental to the organization of research, policy-making, programme management, and education, for example. This paper is concerned with the means whereby severe distortion can be minimized when a given concept set has to be transferred from a communication environment tolerant of high connectivity (i.e. integration) between the elements of the set to one in which such connectivity is neither acceptable nor perceptible without distortion.

Typically this is the problem of communication between the world of research and that of policy formulation or political decision-making. It is also characteristic of the different levels of the educational process and of communication between different research disciplines, or even between different schools of thought within the same discipline.

The question is therefore how best to "compress" a concept set for communication within a connectivity-insensitive environment. The compression should ideally be such that the set can be subsequently "expanded" to any appropriate degree by a receiver whenever this is considered appropriate. The structure of the compression should suggest possibilities of such an expansion and provoke interesting questions in connection with it.

In any development process characterized by the co-presence of actors of very different levels of connectivity-sensitivity, the compression/expansion procedure is of considerable importance if distortions, confusion, and associated abuses are not to be repeatedly introduced. To the extent that the development process is characterized by multi-level action, where the levels are not independent, careful attention is required to communication between such levels.

Some aspects of these concerns have benn partially explored in earlier papers.

2. REPRESENTATION OF INTEGRATIVE DIMENSIONS

An "integrated" concept set must clearly have several dimensions of commonality linking the concepts. If there was only one such dimension, the set could be considered a string or unstructured list. If there were two, it could be considered as a 2-D matrix. Because of the inadequacy of such forms in the face of real-world processes, as discussed elsewhere (1), this paper is primarily concerned with the case of three or more such integrating dimensions.

Now in a connectivity-sensitive environment it is presumably possible to associate each set element with a distinct and <u>explicit</u> feature of the structure which is used to map their interlinkage. For those in that environment, the interconnections between the set elements in terms of their commonalities will carry significance rather than act as a barrier to it. But in the case of the connectivity-insensitive environment, these explicit interconnections must somehow be "rolled up" and "packed into" whatever structure is used to represent the set (a kind of "reverse ontogenesis"). They have to become <u>implicit</u>, or else they will act as a barrier to the transfer of whatever significance can be communicated under the circumstances.

An incidental but very important aspect of this explicit/implicit transition is that clearly in the explicit form the concept elements are well-defined. Whereas in the implicit form any such articulation is potential (or "embryonic") rather than actual. There is an "undefined" quality to the significance which can then be communicated by the set representation. This is discussed further in a later section.

The unpacking/packing stages, therefore need to be mapped onto a set of interrelated structures (each corresponding to a different level of connectivity-sensitivity). As a series, such a set would represent the steps by which "logical forms" acquire a separate existence from their inter-embedded, "primordial" origin in the process of conceptualization.

3. REPRESENTATION OF SETS BY REGULAR POLYHEDRA

Clearly the connectivity between the elements of a concept set could be represented by a suitable n-dimensional matrix. This can be expressed geometrically as a multidimensional polyhedron. Polyhedral structures of this kind are significant to such important areas as citation analysis (of research articles), linear programming (for resource management), and Q-analysis (as applied to complex organization communication patterns).

In none of these cases is the communicability or comprehensibility of the set as a whole of special importance. Results are effectively achieved by computer analysis of complex polyhedra essentially incomprehensible to the human mind because the sets which they represent have few integrative dimensions.

If comprehensibility is considered a basic constraint on the types of polyhedra which can be used to represent sets, the question is then what makes polyhedra comprehensible as a whole. A partial response from educational research is the occurrence of mutually reinforcing elements in the structural pattern. Such essentially "memorable" features depend upon the the presence of interlocking symmetries in the polyhedron.

Two additional constraints can be usefully imposed in this initial investigation. Unless the polyhedron is convex it cannot easily be used to represent a closed, self-contained set. Furthermore, unless internal connections are avoided through the body of the polyhedron, the structure cannot be easily scanned for comprehension.

It is clear that with these constraints the most memorable polyhedra are those in two interrelated series, the so-called Platonic and Archimedean polyhedra. To these may be added at a later stage the semi-regular polyhedra with looser symmetry and patterning constraints than the above.

4. LANGUAGE FOR REPRESENTATION OF CONCEPT FACTORS

The term "concept factor" has been discussed in an earlier paper (2). It is used to denote the properties shared in different combinations by each element of a concept set. Thus one element may be a combination of 4 factors: p, q, r, s.

The integration of the concept set may then be considered as based upon:

- the presence of factor p in some other elements,, introducing a pattern of connectivity
- the factor p being itself part of a set of factors of a similar kind: $p_1\ p_2\ p_3 \ldots p_n$

The problem is to find a useful way of mapping concept factors onto selected polyhedra. This calls for special attention to the manner whereby significance can be carried by the features of the polyhedra. Aspects of this have been extensively investigated by R Buckminster Fuller (3).

(a) Edge: An edge of a polyhedron can be usefully considered as a vector (of which only a portion may contribute to the formation of the polyhedron -- the remainder continuing beyond the constraints of the polyhedron). This follows Buckminster Fuller's argument that "Lines are vector trajectories" (3 , para 521.201). The dynamic quality of the vector suggests that it is preferable to associate with it a concept factor understood in its dynamic sense, namely as a process or as a verb (rather than as a noun, for example), as has been argued elsewhere (1). Associating a non-dynamic sense with the edge tends to render the concept prematurely explicit, precluding transitions to more richly articulated representations. In the language of Q-analysis, such an edge marks the presence of connectivity between vertices, with the associated possibility of some form of "communication traffic".

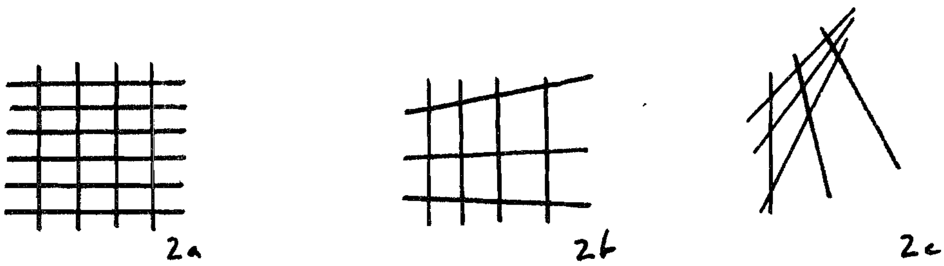
(b) Vertex: The vertex of a polyhedron is defined by the intersection of at least 3 edge/vectors. It requires at least 3 such vectors to give existence to the vertex. This may be more clearly seen by comparing:

- points on a line: whose positions (e.g. in the case of a list of concepts) remain unfixed in relation to one another except in terms of ordering on the line. Conceptually they may be irregularly "bunched" together, for example, although numbering them creates the erroneous impression that they are equally distinct and separable (see Fig. 1)

- 2 intersecting vectors: which cannot be used to fix a point adequately, as is evident from the need for "triangulation" in surveying and navigation. Unfortunately the widespread use of 2-D matrices (e.g. of concepts) creates the superficial impression that the relative positions of the cells is fixed by the matrix context. The absence of any third vector allows any such matrix a degree of freedom (and associated possibilities of distorted interpretation) as represented by the following:

Fig 1.

Fig 2



The vertex, defined by 3 vectors, may usefully be associated with a well-defined concept. It is then appropriate to associate it with a concept in a more static sense, namely as a noun.

(c) Face: The face of a polyhedron is bounded by at least 3 edge/vectors, with intersections between pairs of these vectors at at least 3 vertices. Such a face can be used to represent a necessary degree of non-closure or ambiguity in the concept with which it is associated. Thus in Q-analysis each such face is a potential "hole" which engenders "traffic" in the edges surrounding it, although it may be perceived as an underdefined "object" around which traffic must pass. "Generally speaking it seems to be confirmed that action (of whatever kind) in the community can be seen as traffic in the abstract geometry and that this traffic must naturally avoid the holes (because it is quite impossible for any action to exist in a hole)" (4 , p. 75). This corresponds to points made by Buckminster Fuller: "Areas as (polyhedral) "faces", are inherently empty of actions or events....Euler's topological aspects have to be altered to read...."areas" = openings (i.e. where there are no trajectories or crossings)" (3 , paras 524.21-524.31). "What Euler and all professional topologists and mathematicians called "areas" are only windows in polyhedrally conceptual systems. You look out the window at the nothingness of undimensional night..." (3, para 261.02)

It is therefore useful to associate a face with a concept in its underdefined, controversial or problematic sense. Alternatively, the face may be associated with a conceptual ("frontier") domain which, although as yet essentially undefined, is nevertheless well-defined as an area of current investigation by the concepts (as vectors and vertices) which surround it and through which it must be approached.

The Polyhedra under consideration have faces bounded by 3, 4, 5, 6, 8, and 10 edges. Clearly the larger the number of edges, the richer and more difficult to comprehend will be the underlying concept with which the face is associated -- at least as it emerges within the concept set represented on the polyhedron in question.

In addition to the classic, explicit, topological features (edges, vertices, faces), Fuller considers a further four implicit features (3 , para 1044.01) which may later prove of relevance to this approach. Of particular interest are the axes of spin or symmetry and the associated concept of the polyhedron centre. Both may be used to represent aspects of the underlying relationship of the observer to the set observed.

In this connection Fuller suggests a potentially significant generalization of the classic Euler equation for any polyhedron:

no. of vertices + no. of faces = no. of edges + 2

as follows:

"The observer and the observed are two ins with one relationship. Euler said V + A = L + 2, but we may now say: The number of somethings + the number of nothings = the number of (most economical) interrelationships + 2".(3, para 269.06)

5. PROGRESSIVE EMERGENCE AND RE-ABSORPTION OF EXPLICITNESS

In considering the argument of the following sections, it is important to trace the progressive emergence of factors into implicitness, through explicitness, to re-expression (or re-absorption) as multiples. This is summarized in the following table, based on the language introduced in the previous section. (See Annex 19)

It is worth reflecting on the impossibility of providing a unique mapping of 2 or 3-classes onto a polyhedron. The minimal polyhedron is the tetrahedron which requires 6 edge/vectors to generate 4 vertices -- 4 being the minimum number of factors that can therefore be mapped explicitly. In Fuller's terms this is a characteristic of the minimum event. Within this tetrahedral mapping the 2 and 3-factor features have already been reabsorbed as multiples (e.g. 3 x 2 opposing edges).

This suggests that it requires a minimum of 6 interrelated classes of information to define a new identity which cannot be absorbed into one of those classes or simply treated as their sum. Below 6 no new information is engendered by interrelating the classes, even though such classes may establish dimensions fundamental to the generation of some new conceptual structure. The establishment is not "achieved" until at least 6 are interrelated.

Within this polyhedral mapping framework, the "new" information engendered by the set as a whole may be associated with the definition of the centre point of a polyhedron through the spherical disposition of its parts equi-distant from that centre. This "virtual" point is not a member of the set and is at another level in relationship to it. As such it may also be considered an implicit mapping of the 1-class factor of the set.

The centre of the polyhedron may be usefully viewed as a kind of observational origin through which the expression of the set is "born" in stages. Fuller, for example, says that it is "the zero starting point for happenings or nonhappenings: it is the empty theater and empty Universe intercoordinatingly ready to accommodate any act any any audience." (3 , para 503.031)

Larger factor numbers first appear implicitly through the centre. At this stage it is as though their significance had not yet been disentangled from the observing process -- there is both confusion as well as embryonic new order. Only when the numbers are "objectified" and anchored in an explicit new set of features (edges, vertices, faces) distant from the centre is this confusion resolved. But once factors have been uniquely expressed in this way, subseqeunt polyhedra of greater complexity re-absorb or re-express these factors as multiples -- an integrated multiplicity that does not provoke confusion in the observer.

Viewed in this way the series of polyhedra map not only the set but how the set may be comprehended:

- confusedly, because of the omni-directional relationships through the centre
- objectively, by sequential scanning of surface features with memorable symmetry features
- objectively, but also subsuming an integrated multiplicity of sub-features

6. APPLICATION TO ORERING A CONCEPT SET (as a potential gestalt)

If research has generated a set of say 100 or more concepts (characteristics, etc), careful consideration will presumably enable each of these to be attributed to one or more "cover-concepts" (cf. the concept of a cover set used in Q-analysis). It is through such concept (categories, classes) that the set of 100 will be comprehended and communicated, if this is possible. Each such concept group may itself belong to one or more other concept groups at a different level. The question is then how to organize and interrelate these different groups so as to represent/describe the set as a whole and to clarify the significance of each element, given the communicability constraints on explicitness.

The problem is to have the number of concept groups small enough to remain comprehensible. As noted elsewhere (1), comprehensibility falls off rapidly if the number exceeds about 6, unless small prime number factors can be used to introduce pattern reinforcement.

The other requirement is of course to be able to use alternative mappings permitting more or less explicitness according to user needs and tolerance of connectivity.

References

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