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A PROGRAMME FOR THE DEVELOPMENT OF A SYSTEMS METHODOLOGY OF KNOWLEDGE AND ACTION

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ABSTRACT

In this paper we outline a research programme for developing a systems methodology that can form the foundation of a systems technology for knowledge acquisition and action. Our overall objective is to create man-computer symbiotic systems for knowledge acquisition and action that utilize the full capabilities of all the sub-systems involved. To do this involves both practical work on actual man-computer systems and foundational work on the logics and system theories underlying knowledge and action. We see a strong convergence between theories based on Spencer Brown's calculus of distinctions and practice based on Kelly's personal construct theory. We present here a wide ranging integrative formulation of the research programme that shows how many aspects of our previous work and that of others combine together to give foundations for a very powerful systems methodology. This paper is intended to be the first of a series developing this methodology in detail.

1 BACKGROUND

1.1 In this paper we join with many others in putting forward a systems methodology for the process whereby we shape, and are shaped by, the world.

1.1.1 "Human knowledge and human power meet in one; for where the cause is not known the effect cannot be produced. Nature to be commanded must be obeyed; and that which in contemplation is as the cause is in operation as the rule" (Bacon, Novum Organum Book 1, III).

1.1.2 "A theory binds or determines the events which are subordinated to it. It is not determined by the events themselves; it is determined by the superordinating point of view of the theorist. Yet it must conform to events in order to predict them. The number of alternative ways of conforming are, as far as we know, infinite, but discriminable from the infinite number of ways which do not conform". "A theory provides a basis for an active approach to life, not merely a comfortable armchair from which to contemplate its vicissitudes with detached complaisance. Mankind need not be a throng of stony-faced spectators witnessing the pageant of creation. Man can play active roles in the shaping of events". (Kelly 1955 p.18-19)

1.1.3 "a universe comes into being when a space is severed or taken apart". "The act is itself already remembered, even if unconsciously, as our first attempt to distinguish different things in a world where, in the first place, the boundaries can be drawn anywhere we please. At this stage the universe cannot be distinguished from how we act upon it, and the world may seem like shifting sand beneath our feet". "Although all forms, and thus all universes, are possible, and any particular form is mutable, it becomes evident that the laws relating such forms are the same in any universe". (Brown 1969 p.v)

1.2 Our overall objective is to create man-computer symbiotic systems for action that utilize the full capabilities of all the sub-systems involved.

1.2.1 We use the general term "action" to encompass a range of more specific terms such as: "judgement", "prediction", "advice", "decision making", as well as forms of direct action upon the environment.

1.2.2 We include in the range of systems of interest all combinations including: abstract methodologies from which any originating human component has been meticulously removed; human individual and social systems in which computers play no direct role; simple man-computer interactive systems; groups of people and groups of computers interacting together over extended time-spans.

1.3 To create such systems involves both practical work on actual man-computer systems and foundational work on the logics, methodologies and systems theories underlying knowledge acquisition, decision making and action.

1.3.1 We see a strong convergence between theories based on Brown's (1969) notion of a calculus of distinctions and practice based on Kelly's (1955) notion of personal constructs.

1.4 The notes forming this paper are an outline of some salient points.

1.4.1 They are intended to index some of our

past work, indicate the directions of its future development, and provide some overall framework for a systems methodology of knowledge and action.

1.4.2 They are presented in the form of short numbered sections in order to allow for them being developed and refined, particularly with the addition of cross-references and explanatory commentary.

1.4.3 The first version was presented as "Decision Foundation & Practice II" at the IVth European Conference on Decision Making in Complex Systems, organized by Gordon Pask in Richmond, England, December 1979.

1.4.3.1 The current version has been extensively modified and extended in the light of comments at that meeting and later developments.

1.4.3.2 We would welcome critical comments and suggestions for additions and amendments with a view to issuing a further revision for the IFSR/SGSR meeting in Washington, January 1982.

1.5 We commence with an abstract discussion of the role of making distinctions in the study of methodologies.

1.5.1 We continue with notes on calculi of distinctions and systems of logic; levels of distinction and the epistemological hierarchy; choosing distinctions and the modelling process; comparing distinctions and the analogical process; worlds of distinction and Popper's (1968) 3 worlds; valuing distinctions and the problem of induction; passive and active distinctions, knowledge and power; operationalizing distinctions and the role of the computer; changing distinctions and the dialectical process; conflicting distinctions and P-Individuals.

1.5.2 We complete the paper with an initial sketch of the development of these notions within a calculus of distinctions.

2 MAKING DISTINCTIONS

2.1 A methodology is defined by the distinctions it makes.

2.1.1 To make a distinction places a value upon that distinction.

2.1.2 To make a distinction may change oneself.

2.1.3 To make a distinction may change the world.

2.1.4 To make a distinction may communicate with others.

2.2 The primitive operation in observation, communication and action is making a distinction.

2.3 To refuse to allow a distinction is also a meaningful action.

2.3.1 It does not allow the changes in oneself, the world and others.

2.4 Thus there is structure in the value system of distinctions. Some of the distinctions defining a methodology are concerned with those distinctions it requires, those it allows and those it refuses.

2.4.1 That is, a methodology is defined in its structure by the distinctions it makes between distinctions.

2.4.2 In general these will be preference orders requiring one distinction to be made before another.

2.5 In systems theory we study such systems of distinctions.

2.5.1 In studying them we create further distinctions.

2.6 There is no level of distinction at which the process of making distinctions ends and hence no "general" systems theory.

2.6.1 No greater generality can be achieved than by making no distinctions, doing no actions, and communicating nothing.

2.6.2 Generality as an objective leads to nihilism.

2.7 Only non-existence is neutral.

2.7.1 All other objectives lead to change in the world and may be ascribed purpose through the changes they bring about.

3 CALCULI OF DISTINCTIONS

3.1 The structures of distinctions give rise to calculi of distinctions. However, no adequate calculus of distinctions yet exists.

3.1.1 The early Greek philosophers were concerned primarily with those general classes of distinction from which others could be derived and treated the derivation itself as secondary.

3.1.2 Hegel (1929) in his "Science of Logic" is concerned primarily with the processes by which we come to make distinctions.

3.2 It is only in very recent times that calculi of distinctions have been formalized, and anomalies still exist in these.

3.2.1 Frege's (1879) formalization of a calculus of predicates through which distinctions can be expressed was the first full calculus of distinctions.

3.2.2 Russell's (1900) discovery of a paradox in this calculus undermined its generality.

3.2.2.1 The paradox arises if any distinction is allowed to define a legitimate predicate. Certain distinctions amongst distinctions when used to define predicates lead to anomalous results.

3.3 Attempts to rectify these anomalies have generally been based on restrictions as to which forms of distinction are allowed to define a predicate, i.e. are legitimate.

3.3.1 This is in itself a distinction amongst distinctions and leads to a theory of types of distinction (Copi 1971).

3.4 Brown (1969) has put forward a calculus of distinctions which he claims overcomes these problems.

3.4.1 Varela (1975,1979) has used this to analyse certain self-referential systems that make unrestricted distinctions amongst distinctions.

3.4.2 The relation between Brown's work and classical calculi has not yet been established. Maydole (1975) has demonstrated that a wide range of classical logics give rise to the anomaly in predication and eliminated all but certain Lukasiewicz and Post logics as candidates.

3.4.3 Gaines (1976) has shown that Varela's approach extends to give an infinitely valued logic related to Zadeh's (1965) "fuzzy set theory" and Lukasiewicz's infinitely valued logic (Rescher 1969).

3.5 White (1979) has recently shown that the Lukasiewicz infinitely valued logic gives a consistent predicate calculus with no restrictions on the distinctions defining predicates.

3.5.1 Currently one can conjecture that the appropriate logic for a general calculus of distinctions is that of Lukasiewicz, now often termed "fuzzy logic".

3.5.1.1 There are close relations between these logics and weakened forms of probability logic (Gaines 1978).

3.5.2 One can also conjecture that it is the forms of distinction amongst distinctions which are made, giving rise to types of distinction, that most characterize any particular calculus.

3.6 It is the distinctions between distinctions that we study in a systems methodology.

4 LEVELS OF DISTINCTION

4.1 The study of distinctions between distinctions leads to the notion of levels of distinction.

4.1.1 We say that a "distinction amongst distinctions" is at a level 'above' the distinctions themselves which are conversely at a level 'below' the "distinctions amongst distinctions".

4.2 This corresponds to Klir's (1976) notion of a hierarchy of systems epistemological levels.

4.2.1 Klir defined the levels originally in terms of the "identification of generative structures in empirical data" and his terminology reflects a state-determined systems approach.

4.3 Klir's notion becomes more neutral and widely applicable if the emphasis is changed to generalize the terminology in places.

4.3.1 For example, the lowest level is seen as a "source of observable data" and "a source system is defined by a set of variables, a set of potential states associated with each of the variables, and some way of describing the meaning of both the variable and their states in terms of some real world attributes." (Klir 1976)

4.3.2 We would wish to generalize this to note that a "source system" has two components: a data description language and a methodology for making statements in that language.

4.3.2.1 We are here using "language" in a formal sense such as 'a set of symbols and rules for their allowed combinations'.

4.3.3 The existence of two such components applies at every level of the hierarchy.

4.3.3.1 The first consists of constraints upon the structures at that level which may be called syntactic.

4.3.3.2 The second consists of constraints upon how those structures may be used and may be called semantic.

4.3.4 The levels may be seen as resulting from a process of selection semantically amongst syntactically available structures at one level giving rise to an extensional definition of a "system" at the level above where the language used to represent it gives an intensional definition of that same "system".

4.4 The generalized levels are:-

META SYSTEMS	Relations between relations at level below
STRUCTURE SYSTEM	Relations between models at level below
GENERATIVE SYSTEM	Models that generate data of level below

DATA SYSTEM	Actual observations described in language of level below
SOURCE SYSTEM	Data description language

4.4.1 These levels actually form a somewhat more general structure than that of a hierarchy since when we consider multiple elements at a level, for example a number of generators in a generative system, we can usually find single elements in the levels both above and below that relate to this multiplicity, i.e., in the example given, a data system related to two differing generators and a structure system comparing two different generators.

4.5 Klir's terminology has the advantage of abstractness. There is an alternative, more humanistic terminology, that we have found useful in expressing the significance of these levels:-

TRANSCENDENCIES	Accounts of correspondences outside the frameworks below
ANALOGIES	Correspondences between the rationalizations below
HYPOTHESES	Rationalizations of the experiences below
EXPERIENCES	What happens to us and what we make happen in terms of the distinctions below
CONSTRUCTS	The distinctions which we make and their labels

4.6 Each of these levels can be studied in its own right.

4.6.1 However, we note that the relation between levels is one of making distinctions between the distinctions at the level below so that there is some commonality at all levels.

4.7 We can also study the relations between levels.

4.7.1 For example, between constructs and experiences there is a mutual coupling whereby the constructs determine the way in which we describe experiences. However, they therefore also determine the forms of experience we can describe. Hence the experiences determine the need for constructs.

4.7.1.1 We can see this as a general syntax-semantics coupling where the constraints at the syntactic level gain their utility by their effectiveness in expressing the semantic level.

4.7.2 The coupling between hypotheses and experiences is one of the modelling process and is considered in detail in section 5.

4.7.3 The comparison of hypotheses through analogies is considered in detail in section 6.

4.8 Although this hierarchy is denoted "epistemological" is applies equally to action and interaction.

4.8.1 At the level of experience we may restrict ourselves to "observations" and obtain a theory of observational science.

4.8.2 We may also restrict ourselves to "actions" and obtain a theory of the action system.

4.8.3 However, in general it is interactions that we have to consider and these are the basic units of experience.

5 CHOOSING DISTINCTIONS

5.1 The selection of a "generative system" to match a "data system" or a "hypothesis" to match "experience" corresponds to the process we generally call modelling.

5.2 In modelling we make a distinction amongst hypotheses at the syntactic level that corresponds to a preference preorder.

5.2.1 This preorder is often termed one of "simplicity" or "complexity". All other factors being equal, we prefer the simpler hypothesis.

5.2.2 However, this preference order is an arbitrary distinction that we make between hypotheses and we need define it no further.

5.3 We also make a distinction between hypotheses at the semantic level that corresponds, for each experience, to a further preference order.

5.3.1 This preorder is often termed one of "approximation" or "goodness of fit". All other factors being equal, we prefer the hypothesis which gives a better fit or approximation to the experience.

5.3.2 However, this preference order is an arbitrary distinction that we make between hypotheses and we need define it no further.

5.4 The decision procedure for modelling is then to distinguish for a particular experience those hypotheses which are such that no other hypothesis is preferred in both preference orders. Such hypotheses Gaines (1977) terms admissible.

5.4.1 Gaines notes that in modelling deterministic systems using this methodology there is a unique admissible hypothesis and it is this which allows the elegant category-theoretic expression of such modelling as an adjunction (Goguen 1973, Arbib & Manes 1974).

5.4.2 Kalescu (1979) has recently noted that for non-deterministic systems the hypotheses distinguished as admissible form a unique set and has used this to give a similar category-theoretic formulation of stochastic and fuzzy modelling as adjunctions.

5.5 The modelling process is that of making a distinction between the admissible and non-admissible hypotheses which match experience.

6 COMPARING DISTINCTIONS

6.1 The comparison between "hypotheses" to determine those distinctions that they have in common corresponds to the process we commonly call "forming an analogy".

6.2 Analogical reasoning is a powerful technique for problem solving in human thinking and the development of science (Hesse 1970, Leatherdale 1974).

6.2.1 The removal of such reasoning from the legitimation of inference is a feature of positivist anti-psychologism in removing all aspects of science peculiar to human reasoning as processing in the human mind.

6.2.2 This requirement is technological rather than fundamental.

6.2.2.1 Tools existed to formalize the ontology of science based on mathematics and to formalize the epistemology of the processes of confirmation and falsification.

6.2.2.2 Tools did not exist until recently with which one could begin to formalize the processes of innovation and creation.

6.3 There is a paradox in the eradication of the notion of reasoning by analogy in the axiomatic approach to science.

6.3.1 By basing science on mathematics and logic the use of analogy became implicit in all aspects of scientific activity.

6.3.2 These ultimate formal abstractions have only a remote relation with the actual world of the scientist and he is taught to use analogical reasoning to map every 'real-world' experience into an analogical experience in the 'world' of mathematics.

6.4 In creating an analogy we are allowed to neglect features of the real world.

6.4.1 "The explicatum is to be similar to the explicandum in such a way that, in most cases in which the explicandum has so far been used, the explicatum can be used; however, close similarity is not required, and considerable differences are permitted." (Carnap 1962 p.7)

6.4.2 Thus we are mapping part of the real world "explicandum" into part of the formal "explicatum" system.

6.4.3 It is this type of partial-partial mapping which we have formally characterized as an analogy. (Gaines & Shaw 1980b)

6.5 Gaines (1975) has given a category-theoretic account of analogy based on 3 postulates:

6.5.1 A system can be represented as a category.

6.5.2 A truth category having a faithful functor to each of a category and its model can adequately represent all that we mean by a "correct", or "significant", or "adequate", or "true", analogy.

6.5.3 The semi-lattice ordering of analogy categories represents what we mean by one analogy being "more comprehensive", "closer", or "more detailed", than another.

7 WORLDS OF DISTINCTION

7.1 We may make a distinction between the distinction making and that which is distinguished and say that they belong to different worlds.

7.1.1 We could ascribe all distinction making to the "mental world" and all distinctions to the "physical world".

7.2 We may make a distinction between both these worlds and a third "world" in which the distinction in itself is recorded.

7.2.1 That is we are distinguishing between the act of distinguishing, what is distinguished and the noting of the distinguishing made.

7.3 This corresponds to Popper's (1968) notion of 3 worlds.

7.3.1 He notes (Schilpp 1974 p.143) that "thoughts in the sense of contents or statements in themselves and thoughts in the sense of thought processes belong to two entirely different 'worlds'."

7.3.2 He makes the three-fold distinction: "If we call the world of 'things' - of physical objects - the first world and the world of subjective experience the second world we may call the world of statements in themselves the third world (...world 3)."

7.3.3 Whilst it originated in an attempt to de-psychologize epistemology by removing from the theory the concept of a "knowing observer" and ascribing ontological independence to a "world 3" of knowledge, or "statements in themselves", it actually provides a framework for discussing a far wider range of issues.

7.4 In terms of our previous discussion we can see that in Popper's framework "constructs" belong to world 2 and "experience" is assumed to derive from world 1.

7.4.1 For Popper "hypotheses", "analogies", and "transcendencies" all belong to world 3 and

our use of them in world 2 is the way in which the mind interacts with world 3.

7.5 It is useful to generalize Popper's notion so that world 1 becomes characterized only as that from which it is assumed that the distinctions have been derived.

7.5.1 It may not be the "physical world" but any "world" about which distinctions are being made.

7.6 It is possible to refuse to make these distinctions between worlds.

7.6.1 To refuse to distinguish worlds 2 and 3 is extreme materialism.

7.6.2 To give priority to world 1 over the other worlds is reductionism.

7.6.3 To give priority to world 2 over the other worlds is solipsism.

7.6.4 To give priority to world 3 over the other worlds is positivism.

8 VALUING DISTINCTIONS

8.1 Hume's (1888) argument against the possibility of knowledge creates fundamental problems for any systems methodology that takes knowledge as a primitive.

8.2 Taking action as a primitive, however, one introduces notions of value that are not explicit in a theory of knowledge alone.

8.2.1 Values are the presuppositions necessary to make a rational foundation for action possible.

8.2.2 Judgements are the valuations placed on alternative courses of action.

8.3 Humean knowledge then becomes judgements valued according to the accuracy of predictions about the future.

8.4 However, to establish this definition requires notions of 'prediction' and the 'future' which are themselves problematic.

8.4.1 Hume's argument can be shown to be inherent in these problematic definitions and derived tautologously from effective definitions of the direction of time.

8.5 This still leaves time itself as a problem fundamental to any systems methodology.

9 PASSIVE AND ACTIVE DISTINCTIONS

9.1 One distinction that is often made early is that between the passive and the active, between observation and control. It is advantageous to relegate this distinction as of lesser importance.

9.1.1 Making a distinction is itself an act. It imposes a distinction upon the world.

9.1.2 However, distinctions do not themselves come into being without precursors. They derive from the action of the world upon that system making the distinction.

9.2 We contrast <u>prediction</u> as the use of information for <u>passively</u> establishing the future with <u>action</u> as the use of information for <u>actively</u> establishing the future.

9.2.1 The equivalent of passive 'knowledge' is then active 'power'.

9.3 Knowledge and power may be treated within a formal framework of action that makes little distinction between them.

9.3.1 Thus we can see 'technology' as a means of changing the world to make prediction, and hence 'science', easier.

9.5 There is mutual feedback between science and technology that leads both towards a world that is both more predictable and more controllable.

10 OPERATIONALIZING DISTINCTIONS

10.1 The distinction making process can become indefinitely complex and go beyond the processing and memory capabilities of the unaided human mind.

10.1.1 We see the computer as an 'emancipatory' tool enabling people to cope with the complexity of distinction making required in modern society (Shaw & Gaines 1979).

10.1.2 The computer is a source of "energy" for moving about world 3 (Gaines 1979b).

10.1.3 The computer can provide "system forming precursors" (Grey 1979) necessary to the processes of learning and creation.

10.2 We have noted that we can envision the computer as helping the individual in a number of different ways (Shaw & Gaines 1979 p.137):

10.2.1 "Modelling of data within a given framework (confirmation)".

10.2.1.1 Gaines' (1977) ATOM program is a "confirmation machine".

10.2.2 "Indication of search strategy for data most likely to cause a change of model (falsification)".

10.2.3 "Indication of the effects of actions on the state of the model (simulation)".

10.2.4 "Indication of actions most likely to lead to desired model or state of model (decision)".

10.2.5 "Indication of presuppositions underlying the above four processes (paradigm)".

10.2.5.1 Shaw's (1980) PEGASUS program is a "presupposition machine".

10.2.5.2 We have recently (Shaw & Gaines 1980a) put the work on this within the framework of fuzzy semantics.

10.2.5.3 This allows the on-line analysis and feedback of results to be couched in the same terminology as the construct elicitation so that a true dialogue is possible.

10.2.5.4 The user can query the analysis and propose alternatives, and the system can explain from what data the queried analysis arises, or what data prevents the proposed analysis being correct.

10.3 Our current work is concerned with amalgamating and extending our existing programs to cover all these different possibilities.

10.3.1 One important development of the FOCUS construct analysis program arising from this is that it has been extended to derive an entailment structure for constructs rather than just to cluster them (Gaines & Shaw 1980a).

10.3.2 We see this work as leading to a 'database' system that satisfies a far wider range of user requirements than do current systems (Gaines 1979a).

11 CHANGING DISTINCTIONS

11.1 The process of changing distinctions already made is a fundamental one at the lowest level affecting all levels above it.

11.1.1 In the context of computer systems we have noted the desirability of going beyond 10.2.5 above to the indication of a change in presuppositions that would greatly improve applications 10.5.1 through 10.5.4. (Shaw & Gaines 1979 p.138).

11.1.2 This may be termed a paradigm shift after Kuhn (1962) who saw such changes as fundamental to "scientific revolutions".

11.2 Kelly's constructive alternativism models this change, but it is most actively developed in Hegel's dialectical method (Lenin 1914).

11.2.1 Hegel goes from the concept of a general negation to that of a specific negation that has the connotations of 'an opposite'.

11.2.1.1 The specific negation of a thesis is its antithesis.

11.2.1.2 The thesis and antithesis together may be regarded as forming the poles of a construct and it is this construct which is the synthesis.

11.3 We have developed the semantics of this concept of 'opposite' within a fuzzy relevance logic that gives foundations for both Kelly's construct theory and Hegel's dialectics (Shaw & Gaines 1980).

12 CONFLICTING DISTINCTIONS

12.1 Theories of action with insuffient information leading to uncertainty are far better developed than those for action with too much information leading to conflict.

12.1.1 Yet in real-life the conflict of over-determination is more common than the uncertainty of under-determination.

12.1.2 The difficulty with over-determination is that it involves contradiction between information or objectives and this leads to the breakdown of classical logic.

12.2 Multi-sorted modal logics (Snyder 1971) can be used to represent conflicts adequately, and it is now possible to deal with these formally.

12.2.1 However, the computational complexity of such systems is formidable and seems to rule them out as adequate models of human reasoning in conflict situations.

12.3 We are using action under conflict as a rationale for the formation of multiple P-Individuals (Pask 1975) in the same M-Individual.

12.3.1 Each P-Individual uses a system of constructs that leads to a consistent logic for its reasoning processes.

12.3.2 P-Individuals may have differing types of overlap provided each is internally self-consistent.

12.4 If we look at a population of M-Individuals then we may find them supporting a number of isomorphic P-Individuals.

12.4.1 The construct system common to one such P individual defines a "world" which has all the characteristics of Popper's "world 3".

12.4.2 In this context we may see Popper's emphasis on the ontological status of a "world 3" as being justified in terms of its role in creating a particular form of P-Individual across a population.

12.4.2.1 Thus a 'mathematician' is a P-Individual who has entered 'the world of mathematics' through the literature of mathematics.

12.5 Combining this with Wolff's (1976) evocative terminology in Surrender and Catch we can define a P-Individual as one who constructs a particular "construct system" by which to "surrender" himself to a particular "third world" in order to "catch" its essence (Shaw & Gaines 1981).

13 FOUNDATIONS BASED ON A CALCULUS OF DISTINCTIONS

We are attempting to found our whole enterprise on propositions that are clearly acceptable and which may be translated into formal operational theory. The following section is the initial sequence of a theory based on Brown's "Calculus of Distinctions" up to the point where we introduce the notion of a decision.

0 We will discuss distinctions, systems, hierarchies, valuations, decisions, practice, knowledge, power, action.

0.1 We presuppose that discussion is possible.

0.2 We use words that yet have no meaning.

1 "Making a distinction" is a primitive act.

1.1 There is a logic of making distinctions.

1.2 Distinction making alone is form alone.

1.3 We call the logic of making distinctions alone a syntax of distinctions.

2 Distinctions may be made amongst distinctions.

2.0.1 We call the logic of making distinctions that takes account of "distinctions amongst distinctions" a semantics of distinctions.

2.1 The distinction between distinctions alone and "distinctions amongst distinctions" generates levels of distinction.

2.1.1 We say that a "distinction amongst distinctions" is at a level 'above' the distinctions themselves which are conversely at a level 'below' the "distinctions amongst distinctions".

2.2 We create the levels when we make this distinction.

2.3 Distinctions may be made amongst "distinctions amongst distinctions".

2.3.1 This creates a further level of distinctions.

2.4 The distinction between levels of distinctions generates a hierarchy of distinctions.

2.5 We create the hierarchy when we make this distinction.

2.6 The logic of making distinctions within a hierarchy we call an hierarchic semantics for distinctions.

3 We may make a distinction between distinctions that ascribes some distinctions to a system.

3.1 We create a system when we make this distinction.

3.2 We may make distinctions between systems.

3.3 Systems form a hierarchy.

3.4 The logic of making distinctions within a system we call a systemic semantics for distinctions.

4 We may make a distinction amongst "distinctions amongst distinctions" that describes some as valuations.

4.0.1 We might distinguish "more succesful" from "less succesful" distinctions, or "more acceptable" from "less acceptable" distinctions.

4.1 We create a valuation when we make this distinction.

4.2 Valuations form a system.

4.3 Valuations form a hierarchy.

4.4 The logic of making distinctions within a valuation we call a value semantics for distinctions.

5 A decision is a distinction to which a valuation may be applied.

5.0.1 A valuation is a distinction amongst decisions.

5.1 Without the distinction between "the distinction which is a decision" and "the distinction which is a valuation" decision making is form alone.

5.2 We create decision making when we make this distinction.

5.3 The logic of making distinctions that are decisions we call a decision making semantics for distinctions.

14 CONCLUSIONS

In this paper we have outlined a research programme for developing a systems methodology that can form the foundation of a systems technology for knowledge acquisition and action. We have drawn strongly on Spencer Brown's calculus of distinctions and Kelly's personal construct theory. We hope that the wide ranging integrative formulation of the research programme presented here shows how many aspects of our previous work and that of others combine together to give foundations for a very powerful systems methodology. This theme will be developed in later versions of this paper.

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