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Abstract

The present article is based on the premise that mind is an emergent property of the processes that produce consciousness. Any scientific understanding must necessarily consider the need of an explanation of consciousness. Instead, the non-sense property of traditional scientific modelling appears to hide the phenomenon. In contrast, the explored hypothesis is based on the assumption that the meaningfulness of natural language is the carrier of consciousness. This implies that the concept of natural must be considered as opposed non-natural or constructed concepts of consciousness. In a most fundamental sense, the study is discussing the differences between the nebulous constructs, traditionally classified as mental, and the emergence of consciousness as a property of the Agent-action-Objective (AaO) axiom. The underlying assumption is that consciousness is discoverable. Furthermore, it is assumed that the structural relations, forming the basis of discovery, are covered by textual surface properties, but are approachable with the introduced novelties of the AaO-model. In correspondence with the model, it is shown that a non-linearly working language mechanism is the key to consciousness. Further, the discovered mechanism appears to be responsible for dynamic change, flow and rhythm, which are producing the complex structures of text. It is this complexity and its capacity to reflect synthesis that constitutes the challenge for the establishment of the structural invariants of consciousness. The present article demonstrates that this problem can been solved in geometrical terms. Further, it is demonstrated that the developed method has the capacity to reproduce the spaces of a particular verbal statement and to establish its shapes. Finally, it has been of crucial importance that a test of the basic experimental space-hypothesis builds on an uncovering of those kinds of order parameters that are constraining the production space of a traditional model builder. It is shown that the presented approach has this capacity and that experimentation with a single statement can be based on the manifestation of the corresponding states of knowing. The significance of the experiment lies in the determination of the involved state attractors of intention and orientation.

The psychophysical methods for the study of the brain are founded on the [(p)X] model, where (p) stands for the predicate and (X) for the argument. This model is conceived of as ideal starting point for the exploration of the human brain and the development of a "theory of mind". However, according to the discussion of Edelman & Changeux (2001, p. 2), the approaches to the "mind" are multifaceted and a source for extreme positions. In agreement with the stated model, the construction of a "system" is proposed, which is

"so general, so clear, so comprehensive connected with each other by logical links so unambiguous and direct that the result resembles as closely as possible a deductive system, where one can travel along wholly reliable routes from any point on the system to any other."

Despite the philosophical "non-sense" in the citation, the resulting methodological shortcomings and the uncritical acceptance of seemingly objective physiological measurements, they are taken as scientific underpinnings and apparent precision of the operational definition of the mind-concept . For example, LeDoux (2002) is arguing that "consciousness" is an overrated issue in neuroscience. Davidson (2002), in commenting on the "self" as an alternative notion to consciousness, is emphasising that the "self" is conceived of as a product of patterns of interconnected neurons. But, according to Davidson, it has not been explained how the neural patterns are working together to generate consciousness and in particular "self"-awareness. Other more computational oriented arguments have been that consciousness somehow emerges when the neuronal machinery of the brain executes the proper "algorithmic" functions. Thus, consciousness is conceived of as the result of protein "synthesis". Protein computations, properly carried out, may therefore imply that consciousness arises as a function of quantum measurements.

Psychophysical methods as blinds to lacking precision in measurement and objectivity in approaching the "mind" are especially evident when the phenomenon is measured with questionnaires and abstracted from interviews. When consciousness is made dependent on measures of what people consciously know about themselves (Neisser, 1997), deficiencies in the types of controlling questionnaires concern the nature of knowledge and how knowledge is acquired and used. But most articles are falling short with respect to their discussion of the sources of error. Especially with reference to the representational properties, there are no signs of a critical discussion of the "illusions" communicated with the explanations of the concept of "mind" or its alternative "consciousness".

The task of a strict scientific evaluation of the used instruments is commonly circumvented. For example, in the discussion of "how the mind reads other minds" (Zimmer, 2003), the major part of existing evidence is related to "brain-scanning" techniques. This is typical of the very naïve view of cognitively oriented scientists. This kind of protective prescription cannot substitute for the surplus grain associated with "test", "physiology" and "observations on the apparatus". What these concepts primarily seem to communicate is a state of "alertness" of a normal adult person. With alertness is meant the person's ability to interact with his environment. In this sense, "consciousness" would possibly be equivalent with the higher-order function of "awareness" (Hebb, 1980, p. 20), meaning the social or joint use of knowledge as it gradually crystallises through an evolutionary discourse emerging through the rhythmic and tonal processing of speech.

It was Jaynes (1976/1982), who in his discussion of consciousness as cultural development observed that the concept in the beginning of its scientific use was considered to represent an attribute of substance or matter. But during later periods, consciousness has been associated with learning processes, which has caused a number of different definitions (Natsoulas, 1981) and its use with various social contents. For example, self-consciousness seems to appear when individual variations can be comprehended in that "I-me" relations can be formed and synthesised into an I-function, which is communicated through language.

Since it has been argued that language marks the difference between consciousness and self-consciousness (Eccles, 1980), it is evident that self-consciousness develops only under the condition that an analog "I" can operate in a metaphorical space (Jaynes, 1976/1982, p. 52). This operation would be a function of consciousness and evolving syntax. The means by which consciousness may be tied to syntactic evolution has been theoretically tested in I. Bierschenk (1989). It is argued that the Agent-function of the Agent-action-Objective (AaO) paradigm has developed as a consequence of a shift from object-governed human actions towards the communication of states of consciousness. These states are clearly connected to ways of expressing one's intention in language, which in fact was a revolution, since it paved the way for the potentiality of putting the A- and O-functions into words.

Sperry, Zaidel and Zaidel (1979) have been able to show that both the non-dominant and the dominant hemisphere have the ability of perceptual awareness of sensations. However, if the dominant hemisphere shall be able to conceive a unique "I", it is necessary that the intentional component of language is extractable. With reference to the I-function, it is only the dominant hemisphere that is indicating consciousness. At least since Franz Brentano (1838-1917) introduced the phenomenon of "intentionality" into empirical psychology, intentionality as measure of directedness and orientation towards objects and events is the prominent part of any study of consciousness. It has been demonstrated experimentally, that synthetic concepts, like an "I", are emerging as the result of the discovery of the steering and controlling function of the A-component (I. Bierschenk, 1987).

However, this mechanism could only be discovered, because the construction of a language expression gives space for the symbolisation of the I-function. Moreover, Pattee (1977, 1980, 1982) discussed the fundamental fact that all living systems are self-referential and thus contain their own descriptions. Further, if there is no discoverable I-function, a verbal expression cannot be recognised as an intentional act in Brentano's sense, and logically, cannot serve its purpose of providing meaningful information either.

Since Sperry's discussion of a formula for "mind-brain" interactions, in the mid 1960's (Sperry, 1952, 1966, 1968, 1969, 1975, 1976, 1983) a number of experimental studies (Cook, 1986, pp. 120-135) give evidence to the overall importance of the Kantian Schema concept (Kant, 1975, 1977; Cassirer, 1970) as the methodological tool and conceptual framework for the "logic of discovery" (Hartman, n. d.). As the a priori principle of all living systems, it is the foundation for the establishment of meaning.

The Schema Hypothesis

The hypothesis of the "Schema" as primary means for a study of the "knower" and the "known" (reality) was first utilised by Immanuel Kant, who during the 18th century tried to formulate the principles for the foundation of "knowing". Kant's main argument is that knowing should be seen as a cooperative act between a "knower", organising intuitions, i.e., sensations, on the basis of categories and the "known" giving context to the process of perception. The notion "Schema" refers to a cognitive mechanism, which Kant postulated necessary as mediator between such functions as categories on one hand and information input from the environment on the other. Notice: The notion "cognitive" here is used in a technical sense, to indicate the higher-order function that allows the organism to "know", the result of its behaviour in a given environment. Kant labelled this function "schematisation". Accordingly, the product of this function is "imagination" ("Einbildungskraft"). Moreover, the Schema has been used to mark an abstraction (Bartlett, 1932; Caramelli, 1987), which implies that it is treated differently, compared to the notion "representation". Even though this term is very often used synonymously with cognition, the Schema-hypothesis implies that the brain has the capacity to build and rebuild anew those mental structures (i.e. "Gestalts") that are necessary for the postulation of the Schema as valid a priori principle.

It is clear from the writings of Head (1920, p. 831) that he found the Schema-hypothesis suitable for designating a dynamic structure conserving the observed relations between continuous changing posture and the integration of fresh arriving sensory input into the cortex. Accordingly, Head concluded that the brain has to create a "presentation of reality" but this cannot be a re-presentation, because it has no direct access to the environment. Only a decade after Head stated that it is the existence of the Schema that gives humans "the power of projecting the re-cognition of posture, movement and locality beyond the limits of the body" (Head, 1920, p. 606), Bartlett (1932) extended the Schema. He integrated "self-reference", though this aspect was already present in the writings of Head.

Self-reference implies that there is no "master interpretation" existing in the brain. "Self" is itself a construct, and not a "constructor", as LeDoux (2002) proposed lately. But it was Melzack and Bromage (1973), who produced with their study of phantom limbs the experimental evidence for Head's Schema-hypothesis. The properties of experimentally induced phantoms suggest that a "body-schema" is active. Contrary to the general assumption of random cell activities and a memory representation of all possible positions of the limb, the phantom is based on only a view orderly active cell assemblies. The same observation applies to limb movements. Moreover, under the condition of "open eyes" the phantom fuses with the real or tracking limb. Finally, after experimental blocking, the phantom disappears as soon as sensation and active movement have returned. Virtually in agreement with Kant, Head, Bartlett, Melzack and Bromage, it can be concluded that the operation of the Schema is fusing analytic with synthetic concepts. Against this background, it can be emphasised that the generative capacity of the Schema is producing the higher-order functions, which are needed in the processes of extraction or abstraction and the formation of a Gestalt.

Hebb (1980, p.18) noticed that the Schema is not changing the perception: "What one is aware of in perception is not a percept but the object that is perceived; what is given in imagination is an illusory external object, not an internal mental representation called an image". When Gibson (1966, 1979) reconsiders the notion of the Schema, he argues in the Kantian way, when he makes sure that experience of reality is immediate and not mediated. From the perceptual point of view, he claims that perceptual experience is direct and flows immediately from what he conceives of as higher-order functions. According to Gibson, the brain differentiates perception and behaviour on the basis of invariants, which make possible that the behaving organism can observe itself through immediate information pick-up. This is Gibson's definition of the Schema.

Gibson agrees that stimulation is necessary for the activation of the perceptual system. But stimulation of the receptors in retina, he points out, cannot be seen. Instead, the function of the retina should be thought of as a means of registering "invariant structures" (Gibson, 1979, p. 56). This hypothesis is intended to close the gap between "perception and knowledge" (Gibson, 1979, p. 258). The organism "knows" by means of the Kantian Schema if it has been influenced by an event in the environment or if it itself influences the environment by causing an event. Therefore, the Schema is the device for successful coping with reality. In this sense, the Schema can be conceived of as a priori determination of time, which Kant calls "Segmente einer Zeitreihe", or as Gibson (1979, p. 178) aptly is expressing it: as the progressive determination of "formless invariants under transformation". For, as Shaw and McIntyre (1974, p. 309) put it:

> "If (…) ecologically significant informational invariants exist only over time, then it is not surprising that theorists, who study discrete cross sectional segments of the

information processing fail to find them, and therefore deem them to be of little import."

It is to notice that Gibson (1979, p. 3) seems to mean that he does not at all build on the Kantian approach. However, this appears to be a misconception of the Kantian position and may be the result of the Gibsonian assumption that perception depends on the detection of invariants. Furthermore, Leibnitz (1646-1716) appears to have advanced the Kantian Schema assumption in his reply to John Locke's proposal to treat the mind as "white paper" As cited in Pinker (2002, p. 34), Leibnitz wrote that "there is nothing in the intellect that was not first in the senses", and then added "except the intellect itself".

The same kind of insight into the necessity to make a distinction between the conceptual and phenomenological dimensions of information processing has led Lorenz (1935) to pick up the invariance of explosive events, which gave rise to the assumption of an "Innate Release Mechanism", i.e., a Schema in the Kantian sense (Lorenz, 1941). Moreover, from the implied ecological point of view, it is important to separate the invariant structure of objects and events from the perspective structure, if one wants to study the organism's reaction to its environment. Finally, the distinction in Lorenz's language concerning model and phenomenon shows that his concepts, like energy, storing, flow, overflow, and explosion, are theoretically unambiguous and well anchored in hydromechanics (Hinde, 1955).

The unifying aspect in the discussion of the Schema-hypothesis from Kant to Gibson seems to be the authors' agreement on the Schema as the "teleonomic" (Monod, 1971) tool for "integrating temporarily separated events" (Frisch, 1967), and their conception that the roots of the Schema are to be sought in the behavioural endowment of the organism. In fact, it was Piaget, who pointed out that the Schema is conserved in the behaviour of the organism itself. He restates Monod's teleonomic concept clearly when he writes that the "roots of such schematism are innate whichever way you look at them" (Piaget, 1978, p. 254). Originally, he explored the Schema, as an existing device before any idea of "self" had been established. His basic argument is that the preservation of a Schema has no need for a memory, because the Schema of an action is "the quality in the action" (Piaget, 1978, p. 187).

In addition, Kant, Piaget, and Gibson assume that perception of reality is possible only by means of a space-time coordinate, although Gibson has in mind a terrestrial environment, that is processes and changes of sequences, and not, as is the case of Piaget, who is building on Newton's concept of space and time. However, both, Kant and Gibson claim that the objective reordering of information picked up (subjective successions of space-time segments) actually is a synthetic reorganisation, which is an a priori act of human mind. Therefore, it seems unwarranted to accuse Kant of having developed "a rigid and resolutely static framework" as Piaget does (Piaget, 1978, p. 314). (See further B. Bierschenk, 1981).

The schematism of language. However rigid and static, or flexible and dynamic a notion of Schema the authors had in mind, it must be granted that humans act on higher-order functions and that their actions, especially their verbal behaviour, express a high degree of schematism (I. Bierschenk, 1984, 1989). Thus, there is very little reason to doubt the preciseness and completeness of natural language when used in a natural context. Moreover, there is every reason to believe in people's ability to use their language in specifying unambiguously their perception and conceptualisation. As will become obvious at the symbolic and conceptual levels, the environment is not only reacted to and acted upon, but is understood through the processing of information picked up from symbols.

Observing the production of natural language expressions in a meaningful environment is hardly possible without the producer's expression of intention and orientation. To be able to observe the intention and to separate it from the orientation presupposes the axiomatic expression [int(A) a ort(O)], which has been proposed in B. Bierschenk (1984).

Conceived of as system, the AaO-formula is manifesting the fundamental fact that natural language constitutes the biological expression of intention and orientation. Since intention must emanate from the individual, singularity constitutes the frame of reference and the textual embodiment of orientation is realised through the production of individual textual objectives. Furthermore, the first bracketed expression denotes that intention (int) operates, which is necessary in order for the textual embodiment of the A-component to be adaptive through cooperative actions (a), which are textually embodied through the verb-function. The second bracketed expression marks the importance of one's ability to orientate (ort) towards the objectives, carried by the O-component.

In conclusion, language conceived of as "biophysical system" for the embodiment of consciousness, must be treated as a self-referential system, which is organising itself. This system is characterised by an innate mechanism, which is developing on the basis of the AaO-formula of the given expression. The states of the involved language mechanism are determined by mutual dependencies of its constitutive components. It follows that any self-referential property implies the Kantian Schema, which marks the structural aspect of graphical as well as symbolic expressions (B. Bierschenk, 1991). It incorporates also the assumption that motivation or interest of the acting individual governs the choice of viewpoints, which means that a perspective is latent in the verbal flow. When the purpose is to analyse various individual intentions, it becomes important to make the Kantian Schema operational.

Language as Carrier of Consciousness

A prominent aspect, common to all living systems, is the rhythmic driving force, underlying biological mechanisms and the primary goal of all scientific approaches is to discover the coordinate systems of nature. For example, based on the Schema approach, Frisch (1967) has discovered the coordinate system that governs the "dance language" of bees. According to Frisch the "characteristic" of the dancing bee can be discovered only after the dance. Thus, the evolution of the informational dimensions through the generation of a dance presupposes a bio-kinematic mechanism, which is governing the information synthesis of the observing bee. Frisch has been successful in demonstrating experimentally that this mechanism builds on the AaO axiom, which has the capacity to capture emergent [AaO] units. As shown in Figure 1, an unbiased specification of the movement tasks during production of the dance language can be achieved on the basis of the AaO-formula.

Figure 1.

AaO-axiom within the Context of the Honeybee

Bee	**A**			
observes	**a**			
that	$\varnothing_O$	← **A**	**a**	**O**
		Bee	dance	food place

However, what is even more important is the ability of a biophysical system to reproduce the morphogenesis of its language with every new production cycle. The major goal, reported in "The dance language and orientation of bees", has been to discover the generative codes employed during language production. It can be shown that this task is facilitated by an invariant and consequently geometric formulation of the involved body kinematics. But the behavioural tasks must be solved in order to generate an accurate and efficient description of the observed movement patterns.

Figure 2 makes explicit that the AaO-units incorporate intention on the basis of the A-function, which governs the choice of viewpoints, giving expression to orientation, captured with the O-function. This orientation comprises some intriguing intertwined logics, one is related to structure, the other to form. As reported, the "round-dance" is performed to inform other bees about sources of food nearby the hive, while a "tail-wagging dance" is produced when food sources are at a farther distance. The function of the AaO formula in synthesising knowing can now be summarised as shown in Figure 2.

Figure 2.

Knowing as Outcome of a Synthesising Process

Bee	**A**(1)	the knower
observes	**a**	action
	$\varnothing_O$	the known (integrated experience)
that		
Bee	**A**(2)	the experiencer
dances	**a**	action
food place	**O**	the environment

The relation between the two A's is asymmetrical in the sense that A(2) is experiencing an unknown environment, while A(1) has already integrated this kind of experience: "Those that have been collecting from the same kind of flower often give attention to one of their fellows from a distance of as much as 2-3 cm hasten to her" (Frisch, 1967, p. 43). The experiencer-environment relation is known. Consequently, in Frisch's observations, the knower is always in the known. Whenever a knower intuitively knows the unity, it appears as consciousness.

Since it is the "dancing event" that contains the ecologically significant information that becomes available, the dancing bee performs a series of actions. For example it is using its own body to communicate integrated information and is thereby transcending a discontinuous space-time system. Any movement, such as wing-strokes without the intention to fly is a ritualised expression by which the bee creates a "language space" for an "analog I" (Jaynes, 1976/1982, pp. 62-66) to transform its awareness of distance to food places into synthesis (Note: consciousness) and to communicate its abstraction of "Life-sustaining Support" to a fellow bee. Thus, it can be argued that consciousness, i.e., "knowing together" has emerged for participating bees while others remain non-conscious, i.e., uninformed about the existence of this kind of places.

For years, bee biologists have tried to find out, whether the dance communicates anything more then general direction of the nectar source. However, as reported by Pennisi (2001), recent experiments have revealed that the bees are aware of how far they have gone. Evidently, the bees use "passing landscapes" to click off the meters, which they are communicating to other bees. It follows that communicated distance implies "order", which is discoverable. Making knowing something that emerges out of discovered environmental order presupposes the possibility of tying the effects of "discovery" to a related activity (i.e., body kinematics) instead of attributing it to some unrelated brain mechanisms.

If one with Gibson (1979, p. 52) may assume that expressive behaviour manifests itself in "informative light", this implies that the structure of an object or event can be studied through change. But "regularities" in change can be sensibly measured only with reference to a participating organism. Otherwise a demonstration of what is known becomes sense-less. In any case, observed changes demand a theoretical explanation, which can provide the foundation for a simultaneous description of individual action at the kinetic level and order at the kinematic level. For example, the topic of the Visual Cliff can be treated textually as coupling between the A- and O-kinematics that must be controlled in order to produce a comprehensive text of the "synthesis" of a child's orientation on a virtual cliff. The format for the generation of the proper AaO-relationship is shown in Figure 3.

Figure 3.

Development of Synthesis in the Context of a Virtual Cliff

The researcher	**A**(1)	the knower
observed	**a**	action
	$\varnothing_O$	the known (integrated experience)
that		
the infants	**A**(2)	the experiencer
crawled	**a**	action
on the cliff	**O**	the environment

Gibson's (1979, pp. 156-158) AaO-thesis is that environmental information pick-up is the result of an active inquiring organism (the knower), whose perception rests on the extraction and abstraction of perspective as well as environmental invariants. Further, as illustrated with the Visual Cliff experiments (Gibson & Walk, 1960), it is proposed that order in the form of a depth relation is not a learned third dimension, but it is discoverable. Hence the AaO-formalism transforms the involved line function through a twist into the sphere of abstraction. But, as shown in Figure 3, the observations on the Visual Cliff manifest themselves in a series of AaO's.

If one assumes that the infants do not represent the objectives of study but instead the phenomenon of development, then the study would be concerned with their behaviour. The phenomenon, the scientific focus is being elucidated through the infants acting toward certain specified objectives. In this context, the researcher is the "Agent", who performs a series of actions, for example the action of observing. The infants, on the other hand, are the ones, who function as the "Objective" of the observation in the study. The relation between "The researcher" and "the infants" is then given in the asymmetric relationship holding between the A- and O-function of the AaO formula.

The Model of Hidden Consciousness

The traditional "nonsense" assumption is that stimulus-response pairs can be studied with respect to computation of intensity or power of resistance to change. According to this line of reasoning, the associations, performed by a "theoretical machine", are treated as synonymous with cognition. It may be worthwhile to mention that McCulloch and Pitts (1968) have tried to produce a formal identity between neural nets and the Turing machine. Moreover, it seems to be tempting, especially in the perspective of the brain sciences, to view "knowledge" as a result of its "flip-flop" mechanism (Young, 1978) and to postulate an "on-centre off-surrounding" system (Grossberg, 1980). For example, Simon (1981, p. 72) states that knowledge is defined by the tasks that are mastered by "the most central parts of the central nerve system". Assuming that this system performs its tasks like a Turing machine, it works in agreement with natural laws, which according to Simon, are exclusively founded on logical form.

In principle, then, knowledge cannot be known but gives meaning to otherwise empty symbols or words. It follows that knowledge can best be studied by means of inference logic and geometric formalism. Recently, Pinker (2002, p. 31) is echoing this idea when he states "that the mental world can be grounded in the physical world by concepts of information, computation and feedback". So, this position is widely accepted and therefore, has far-reaching consequences for theory construction. Most conspicuous of this orientation is the use of concepts such as information, storing, flow, and overflow as well as combinatorial explosion. These are discussed as if they were well anchored in theory and generally understood. In theories of information processing they are made use of as self-evident denotations of operations whether machine or organism specific.

The assumption that propositions have to be represented on the basis of logical symbol systems has led to a shift from simulation of perceptual systems on the Turing machine to the construction of knowledge systems. The operations within these systems are likewise characterised by procedures, which Newell (1981) and Simon (1981) take as evidence for a safe foundation of naturally developed symbols on natural law, such as it is formulated in classical mechanics. Their hypothesis is that a manipulation of primitives through the central processor of the Turing machine is equivalent to the brain processes, operating on naturally developed symbols.

The fundamental problem with this machine-hypothesis evolves out of the fact that the processing of generalised symbols requires a "universe" and processing without any reference to their ecological significance. Knowledge representations of this kind are specified by the control mechanism, constructed for a particular system. Thus, what is characteristic of these systems is not only that "the meaning of a sentence" is conceived of as the "essence" of underlying propositions but also that meaning is the result of the processing of a priori selected language attributes, which have been formalised in purely semantic-logical terms. An advanced example is Becker's (1973) "model for the encoding of experiential interaction".

When prototypical names are abstracted from textual elements, experience and imagination of the designer form sets of elements into a conglomeration. The results are analytical concepts whose expressions are determined by the names, which make up their semantic import. "Clouds of intensions" (Hartman, 1967, p. 34) are surrounding every derived and named "semantic" concept. These "clouds" give the concept its analytical meaning. Logically, the independence between a semantic concept and its manifold of analytical interpretations constrains its scientific power. Only through a continuously repeated process of abstraction can semantic concepts be analytically refined and possibly purified. What is lost in this process is meaning. Hartman (1967, p. 34) writes: "The analytic definition seen in analytic purity is like an iceberg whose larger portion, the process of generalisation, is submerged."

Semantic concepts are analytically independent of each other, i.e., without interrelated dependencies. From the empirical point of view, they show only vague relations with their respective clusters. Since semantic concepts are the analytical results of sorting the surface features of a text or any other texture of natural phenomena, i.e., content, they are experienced to be easily scrutinised and comprehended. Therefore, the essence of clustering within the context of the analytical approaches can be summarised as the process of assigning prototypical names to "natural groups" (Sokal & Sneath, 1963; Anderberg, 1973). However, the concentration of textual elements into groupings requires an empirical definition of a "group". Two premises have been decisive in the taxonomic approaches of the 60's and 70's: (1) There is an obvious break in the configuration (Wishart, 1982), or (2) the significance criterion $[P(t>T)]$ for the t-test has a value of about (0.05), which is Ward's (1963) criterion.

Applied to the clustering in biology as well as in psychology, the results give evidence of taxonomies. But their prototypical character and the variations in naming the established groupings have caused doubt on the validity of the methods (Raff, 1996).

Traditionally, the use of natural language expression in dynamical modelling and the study of systems behaviour presuppose that text can be broken into pieces, which can provide the elements for the construction of "word models" (Jeffers, 1978, p. 164). This kind of segmentation is assumed to guarantee the generation of the proper basis for systems analysis, which seems to provide a framework for modelling of propositions. Hence, in the traditional context, dynamic modelling and computer simulation have been designed to help the model builder to choose a desired course of action. Furthermore, it is believed that dynamical modelling is capable of pinpointing complex interactions and that this kind of modelling can be used to predict the outcome of a strategy of action. One of the main reasons for constructing dynamical models and carrying out simulations is probably to abstract and express "essential" elements in the form of links between boxes, designated by words.

Further, it is assumed that words, conceived of as "primitives", carry commonly valid textual properties, which may be framed deductively into logically sound interconnections. Nevertheless, there must come a time at which the "logically sound" propositions have to be evaluated, since a choice is to be made of the number of alternative solutions, which are to be carried through for the purpose to set up rules for the construction of indices (called formulas) on which "proofs" can be built and used as framework for empirical testing. However, in seeking the most precise verbal description of a model, the words used may look the same, still disagreement on their semantic import may be both striking and difficult to resolve.

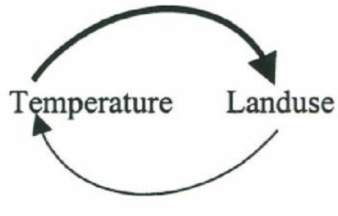
Conceptual Modelling

In building a link between model and theory, the coupling configurations of computer models are believed to circumvent traditional "word-model" ambiguity. When symbols are considered as carriers of information, abstracted from expressive behaviour, it is implied that they signify "regularised meaning". As was demonstrated with the Figures 2 and 3 above, motor adaptation to visual stimulation is nothing that occurs automatically but requires experience. Moreover, it should be clear from the formulation of the examples that the experiences of a "bee" a "child" or a "model builder" are underlying conceptual development, tying the development and use of symbols directly to the individual organism's own predisposition. Thus, symbols depend on continuous transformations and therefore are empirically founded. This kind of transformations has led numerous scientists to attempt to establish the cognitive ground of their modelling.

In search for a comprehensive solution to natural science problems, the Causal Loop Diagram (CLD) has recently been proposed as proper conceptual modelling tool. Thereby, it is expected that obtained "simplicity" would capture and reveal the underlying nature of complex ecological conditions. This proposal was tested experimentally with a CLD-construction. The resulting diagram is shown in Figure 4.

Figure 4.

CLD: Conceptual Modelling



This CLD has been constructed with the purpose to manipulate a fundamental ecological condition. Computation and simulation has been based on two unidirectional links. In the first case, a link is conceptualised, which has the major or dominating function in the simulation and is proposed to work in the West-East direction. The other link has been set up as minor and consequently non-dominating, which works in the East-West direction. On the other hand, what is in the links has not been made explicit. Further, the constructor's emphasis seems to have been placed on a broad view. Factorial interrelationship and interconnectivity between the two semantic markers are in focus rather than a collection of complex variables and the set up of lists of indicators.

Thus, the "concepts" of temperature and landuse are those whose intensions consist of implied predicates, which may be defined further as associated "a set of words or symbols" (Craik, 1943, p. 29). The CLD is analytic since the mechanism of the closed loop is based on symbolic logic. Therefore, it is conceived of as "a theoretical machine", which has the capacity to compute the associated connotations. This capacity lies in the computation of associated "properties", which are the generated abstractions. Information input in the form of graphemes becomes organised on the basis of mathematical-logical propositions about associations between variables.

In departing from the assumption that higher-order functions cannot be considered to be of any value in the explanation of "knowledge", the CLD-approach to the understanding of ecological relations builds on syntactic models, which require the processing to take place according to rules for additive combinations of simple and discrete units. By definition, these are structure-less and timeless. Further, the concept of independence is basic within this kind of models, which has as its consequence that the processing is based on the rules of association.

Clearly, the tradition in science asserts that the frame of a theoretical machine is closely linked to understanding. However, Winston's (1975) studies of computer vision and computationally accessible geometric primitives has made evident that the "essence" of geometric figures is not computable. The same kind of incapacity has been observed with respect to the "Visual Cliff". Computer vision cannot extract or abstract the line function of the depth relation. Furthermore, what is typical when a graphical or verbal expression is processed through "semantic markers" has been demonstrated with Ouillian's (1968) semantic nets. It may be noted that this kind of nets deals with methods for determining object features and relations, which are the result of a coder's manual efforts to mark semantic relations and to connect them in agreement with rules of predicate-logics.

However, a variety of experiments, carried out with different orientations, have shown that the classical scientific approach of feature analysis and the assumptions of associations of the universals of logic within a physical universe will not shed any light on the problem. For example, Sperling (1963) already found some evidence against the assumption of perceptual analysis of features. He concluded that information does not exist in any form that could be made conscious. Wickelgren (1975) emphasised further this non-physical or immaterial character.

Hence, the essence of a modelled phenomenon is not easily expressed with a CLD, a formal definition, or a photograph. It follows that "essence" cannot be pictured. In agreement with Kant's assertion, it can be concluded that "essence" must be presented in the form of a discourse (Brodsky, 1987). In order to show that "essence" in this sense has escaped the attention of the model-constructor, the next step in the experiment required the production of a verbal statement. Since understanding is bound to language production, one of the major obstacles in the layout of a corresponding strategy seems to appear at the edge where the natural sciences meet society. The following statement was produced, which would have to contain the most fundamental mechanisms of ecological import:

> Temperature is by far the most limiting factor in relation to landuse, and landuse is from the continental point of view influencing temperature.

From a geometrical point of view, this verbal statement is contributing with a conceived set of specifying link-relations. This implies that the position of more than one textual agent or objective can be identified, measured and used in the processing. The question to be answered will be addressing the kind of structure that has been established during text production.

What sets the present approach apart from the working with the artificially constructed classes of a CLD and their arrangement into "word models" is its concentration on rotational dynamics and on the geometric foundation and quantitative description of the results of textual pattern movements (B. Bierschenk, 2001). Described in terms of the AaO-formula, a perfect writing-style control is an essential prerequisite to the understanding of how the rotational dynamics operates in a verbal expression. The primary concern is directed towards the measurement of "text building behaviour" in the context of a CLD. What makes this approach unique is its focus on the dynamic properties of the corresponding statement. Further, the approach differs from the classical studies of propositions since it allows the formulation of the following hypothesis:

> Multiple stable states of knowing are organising themselves into several different state attractors through which a "unified concept of knowability" can emerge.

Common to the description of multiple stable states of knowing is the observation that conservative self-organising processes appear in the neighbourhood of thermodynamic equilibrium states. At a distance from these states are behavioural phase transitions dependent on the non-linear working of language mechanisms. Thus, studying these mechanisms is expected to provide the key to mental structures. Equilibration of non-linear and thus dissipative operating processes guarantee the establishment of order. In contrast to the classical understanding of propositions as closed systems, a verbal statement conceived of as a dissipative system must constitute an open sphere. Hence, the states of knowing will be described as future states, which are non-linearly dependent on the present state of knowing and a control parameter.

Disclosure of a Model Builder's Shapes of Mind

In general, if all three constitutive components of the AaO-formula are present, any string of graphemes or part of a Functional Clause can be processed. In principle, an A-dummy is supplemented with the immediately preceding textual agent $[A_{n+1}]$-dummy. The O-dummy is supplemented with the immediately succeeding clause $[A_{n-1}+O_{n-1}]$. Table A1 of the Appendix constitute the starting point for the establishment of entangled states and connected rotational pattern dynamics. The principles of computation have been outlined in B. Bierschenk (2001). In amplifying the dynamic character of the patterns, their dynamics (as measured in radians) is demonstrated as well as the channelling function of the dummy ($\varnothing_A$), which means that (A_1) is reiterated at (A_2). The same kind of fading appears also with respect to (A_3), which is reiterated at the position of (A_4). Both cases imply local shadowing activities. That an inhibition is controlled through boarders, marked with the intervals, becomes evident when the behaviour of (A_4) of the second interval is contrasted with (A_1) of the first interval. Thus, the shade of (A_2) in the first case and (A_4) in the second is competing with the material expressions of (A_1) and (A_3) in the perspectivation of a particular part of the textual surface. In the development of a gradient, shadowing is achieved through reiterative copying.

The Unfolded Space of Involuted Textual Agents

Exactness in the textual movement coordination is dependent on one's "ability" to formulate a CLD-link as well as on rotational variability. Thus, the unfolded special character of in-depth perspectivation appears partly in the reiteration, partly in the duplication of variables as shown in Table A2. It follows that their common causal determination can be conceived of as the functional definition of "adaptation". Fundamental to adaptation is the provision that the trace of these measures can be taken as an account of the configuration of an achieved articulation. Such an account gives expression to the dynamics of the statement. The states of the resulting A-space (Fig. A4) have produced a slightly asymmetric shape. Since the verbal account is meant to state an asymmetry, it can be concluded that this aim is reflected in the unfolded space of the textual agents. Therefore, it can be concluded that the unfolded configuration is pointing toward the presence of a process-determined asymmetry.

The Unfolded Space of Involuted Textual Objectives

In contrast to Figure 2, the O-component of the example contains no shadings since no angles of refraction have been produced. Table A1 makes clear that the prepositions render a more direct attraction of viewpoints. The demonstrated differences in the O-component concern the critical changes in the shape, as shown in Figure A3 of the Appendix. The most atypical silhouette appears where the process is enforcing a rising formation. Thus, whenever the depicted process is advancing from one state to the next, the established distance is a measure on the degree of "explicitness", which is driving the development of the gradient through both intervals. Relative to this formation, the major part of the landscape appears to be dominated by lowlands. The complementary property of the unfolded A- and O-spaces suggests that different functional requirements have influenced the operations and changed the development of their trajectories in subtle but nontrivial ways.

How the differences in the degree of articulation have constrained the behaviour of the individual variables is demonstrated in the Appendix, Tables A3 and A4. Through the establishment of the geometric shapes of involuted textual flows, the fusion of a variable is generating the basis for the psychological interpretation of their convolutions. If the fusion of the values of the variables is continuous from a spatial point of view, the integration of their associated strings can be used to communicate the transformed meaning of the involved folding operations.

The Folded Space of the Convoluted Textual Objectives

Figure A5 of the Appendix is showing the O-space, which has been computed on the basis of Connes' fusion-operator (Connes, 1994). The entire folding process of the β-configuration is spiralling around seven state attractors. These attractors are describing the essence of the CLD in the form of a thermodynamic trajectory. The variable of the initialising terminal state (S_1) of the O-space is actively contributing to this transformation process, which becomes apparent when the process is passing the second state (S_2), whose variable implies that a limiting factor is in focus. When the limitation concerns a particular relation, this leads to a specific form of order, which the second transformational step implies at (S_3). When the process is passing through this state, it determines a certain constitutional prescription. The prescribed circumstances, referred to at (S_4), determine the kind of compelling physical forces that are at work. An implied scale at (S_5) determines the severe ness of living conditions.

At this stage in the development of the path, a hysteresis shows up in the transformation process and a new path is initiated with the next following state. The designated outcome of the transformational step from (S_6) to (S_7) is capturing the examination of a Divide. As distinguished from the Sea, any raised portion of a grooved surface, which is exposed to forceful changes, becomes altered, which implies that locally defined inequalities are determining texture and structure of the surface layout. Thus, when alterations exist in the form of profiles, which at (S_8) are transformed, this step implies that the degree of hotness or coldness of an environment comes into focus. Thus, the dividing line is the specific degree of hotness or coldness, as indicated or referred to by a standard scale. It follows that a thermal gradient marks the direction of the heat flow between any two areas of systems, which are in thermal contact.

Through the differences in temperature, flow layers are emerging and consequently, order becomes definable as the particular pattern in the flow of equilibration processes. Circular closure of cause and effect determines that part of the world that becomes enclosed through the closure of the driving loop. Therefore, a scalar quantity, independent of the size of the system or area, transforms the effect of alteration into a difference between profiles for air, water, and land. This demonstrates a phase transition, which is captured through the second path. When the established second path is crossing the first, the essence of the CLD emerges in the final state attractor. Hence, the process is settling in an attractor, which concerns the growth or movement of plants or other organisms in response to heat. Thus, appearing is a global thermal-tropic effect.

A convenient device for visualising the convoluted configuration of the rotation dynamics has been generated on the basis of Figure A1 of the Appendix. This operation implies that the corresponding grid has been used to generate Figure A5 of the Appendix. The latter is representing the shape of the space on the basis of "Strain", which is marked on the X-axis and Shear, which is specifying the Y-axis. These functions are forcing the aggregated measures on the Z-axis to create a fitness landscape, which is characterised by two outstanding attractors. The first one is described with the terminus "Thermo-tropism", while the second one stands for the "Severe Living Restrictions", which appear to have governed the orientation. With respect to the resulting landscape it can be concluded that the dividing line appears to be an abstraction of the relationship between biotic and a-biotic conditions.

The Folded Space of the Convoluted Textual Agents

Differences in articulation can be expressed experimentally in two distinct ways. One way concerns the introduction of new textual agent variables. The other specifies the degree to which a particular variable is readdressed or duplicated during the course of verbalisation. It is a kind of repeated self-indication. A major advantage of the illustrated processing is its transparency concerning the causal relationship between the A- and O-function. As demonstrated in Figure A6 of the Appendix, the duplications in the controlling function of the A-component have generated a divergent pathway. For assessing the joint causation, it is essential to concentrate on the emergent attractors. Since the order of composition is the result of the asymmetric relationship between the spaces, the emerging "attractors" and their order, determine the direction in intention. That the direction has changed in an important way has been made evident. Environmental circumstances in the form of "Compelling Physical Forces" have been demonstrated as being part of the determination of intention.

The minor attractor of the intention space is different from the evolutionary development of life-sustaining support of the O-component. From the ecological point of view, the intention of the statement seems to have captured a boarder-line condition, which has been caused by differences in the order of thermal flow-layers. Consequently the concern has been with physical and chemical frame-conditions. But at the edge of living and nonliving systems the focus has to be oriented towards the formation and development of highly complex organisations of biological information. Furthermore, in the transition from biophysical to ecological or social organisations are appearing biological phenomena, which are exhibiting periodic behaviour. The term "landuse" in the CLD implies a coupling of emergent life with the maintenance of living systems, which however require the observation of further conditions.

Validation and Verification. In contrasting the manifested causal loop relation between temperature and landuse, with the model builder's ongoing research project, it can be concluded that the pictured awareness differs from the kind of consciousness that can be validated and verified. Therefore, it is important to note that actual modelling and computer simulation have been carried out with the purpose to reconstruct "temperature". Moreover, in the section "results and discussion" the model builder is concentrating on vegetation cover and changes in vegetation and forest cover during the Holocene. What the work in fact is validating is "a modelling framework for diagnosing the influencing factors that might lead to land degradation. As the model builder states in the abstract to this work, "the presented framework aims at classifying the complex interaction between biotic and a-biotic influencing land cover changes in sub-arctic landscapes".

From the verification point of view, it can be concluded that the attractors in the established landscapes coincide with the known mechanisms. In assessing the behaviour of the attractors, it can be stated that the word "Landuse" in the diagram emphasises pressure, grazing potential and the carrying capacity of an ecosystem, which however has no covering. Since thermo-tropic processes have emerged in the dominating state attractor, it is proposed that the terminus "Land" would be more in line with the actual study of land degradation.

Discussion

Fusion and foliation is dependent on the degree of differentiability of the textual elements. However, when a clustering algorithm of the traditional type is used, it requires that the grouping is based on a linear separation of grapheme properties. But there is a risk involved since slightly differentiable elements may lead to identical groupings. In this case, it would become fairly obvious that the resulting differences are caused through the spacing of the elements in the corresponding data-matrix. This kind of problems can be circumvented partly through the introduction of relatively complex properties, which implies a kind of "typing" of elements. But this precaution is of limited usefulness, since classifications are disposing information on the position of a particular element on its way from the first over the second to the third level of processing. The resulting loss of information on the exact positioning of a textual element is producing ambiguity. In contrast, entangled configurations, related to neighbourhood, prevent ambiguity, because time-dependent coupling, speed and reversible covalent interface smoothness are generating novel fitness conditions for the production of the landscapes of the source spaces. As demonstrated, this novelty is the result of the phase-dependent dynamics, which is superior when compared with the functional architecture of classical trees.

Moreover, when text is considered as context, the cooperation between intention and orientation is no longer the objective of the physical conditions of making experience. Instead, it is the metaphysical determination of a natural language expression that comes into focus (Bierschenk & Bierschenk, 2002). Thereby, new constraints are produced within hyperbolic spaces, which pass beyond the limit of reality. As a consequence of transcending physical reality, fitness landscapes are evolving, which have hyperbolic properties. However, to establish this kind of landscapes, the transcendental function must generate shapes like those of the unfolded and folded spaces shown in the Appendix. Thus, time-directed processing is generating properly incorporated state-paired termini and remarkable overall effects. As a result, it can be concluded that this thermodynamic approach provides a proper description with respect to the disclosed consciousness, which has important implications for model building and theory construction.

In particular, it has been possible to show that something else is in focus compared to the awareness of the "content", covered with the CLD. "Landuse" appears not to be the major "aim-point". What is in the links and actually more in line with the disclosed states of knowing is the study of compelling physical forces and thermo-tropic processes. It follows that the validation of the outcome has been approachable in a direct and obvious manner, namely by observing that the purpose of the model builder has been to study "thermo-tropism" through real data collections on temperature.

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Appendix

Table A1.

Spherical Dependency of Layered Composites

Strings	Radian	Sum	Strings	Radian	Sum
.			,	0.345400	
Temperature	0.659400	A_1=3.799400	and	0.408200	
is	0.565200		landuse	0.533800	A_3=4.427400
by	0.565200		is	0.464400	
far	0.612300	O_1=6.452700	from	0.541800	
the	0.408200		the	0.503100	
most	0.439600	O_2=3.987800	continental	0.812700	
$\varnothing_A$	5.50	A_2=3.633077	point	0.580500	O_6=6.772500
limiting	0.533800		of	0.464400	
factor	0.502400	O_3=4.176200	view	0.541800	O_7=4.876200
in	0.464400		$\varnothing_A$	5.50	A_4=3.395861
relation	0.696600	O_4=5.031000	influencing	0.659400	
to	0.464400		temperature	0.659400	
landuse	0.657900	O_5=4.992300	.	0.345400	O_8=4.804200

Table A2.

*Paired Textual Agents and Objectives**

Pair Number	Radian α-strand	Radian β-strand	Interval Number	Case Number
1	3.799400	6.452700	1	1
2'	3.799400	3.987800	1	2
3	3.633077	4.176200	1	3
4'	3.633077	5.560200	1	4
5'	3.633077	3.379243	1	5
6	4.427400	6.772500	2	1
7'	4.427400	4.876200	2	2
8	3.395861	4.804200	2	3

*The Concept of Duplication (') in Unfolding α- and β-spaces

Table A3.

Folded Trace of the O-component

Variable	Radian
No	β-strand
.	
2	3.987800
3	4.176200
4	5.031000
5	4.992300
1	6.452700
,	
6	6.772500
7	4.876200
8	4.804200

Transformations of the Folded O-component

2	3.987800	the most
3	4.176200	limiting factor
T_1	**8.164000**	**Absolute Confinement**
4	5.031000	in relation
T_2	**13.195000**	**Constitutional Prescription**
5	4.992300	to landuse
T_3	**18.187299**	**Compelling Physical Forces**
1	6.452700	by far
T_4	**24.639999**	**Severe Living Restrictions**
6	6.772500	from the continental point
7	4.876200	of view
T_5	**11.648700**	**Examination of the Divide**
8	4.804200	influencing temperature
T_6	**16.452500**	**Thermal Gradient**
T_4	*24.639999*	*Severe Living Restrictions*
T_6	*16.452500*	*Thermal Gradient*
T_7	**41.092499**	**Thermo-tropism**

Table A4.

Folded Trace of the A-component

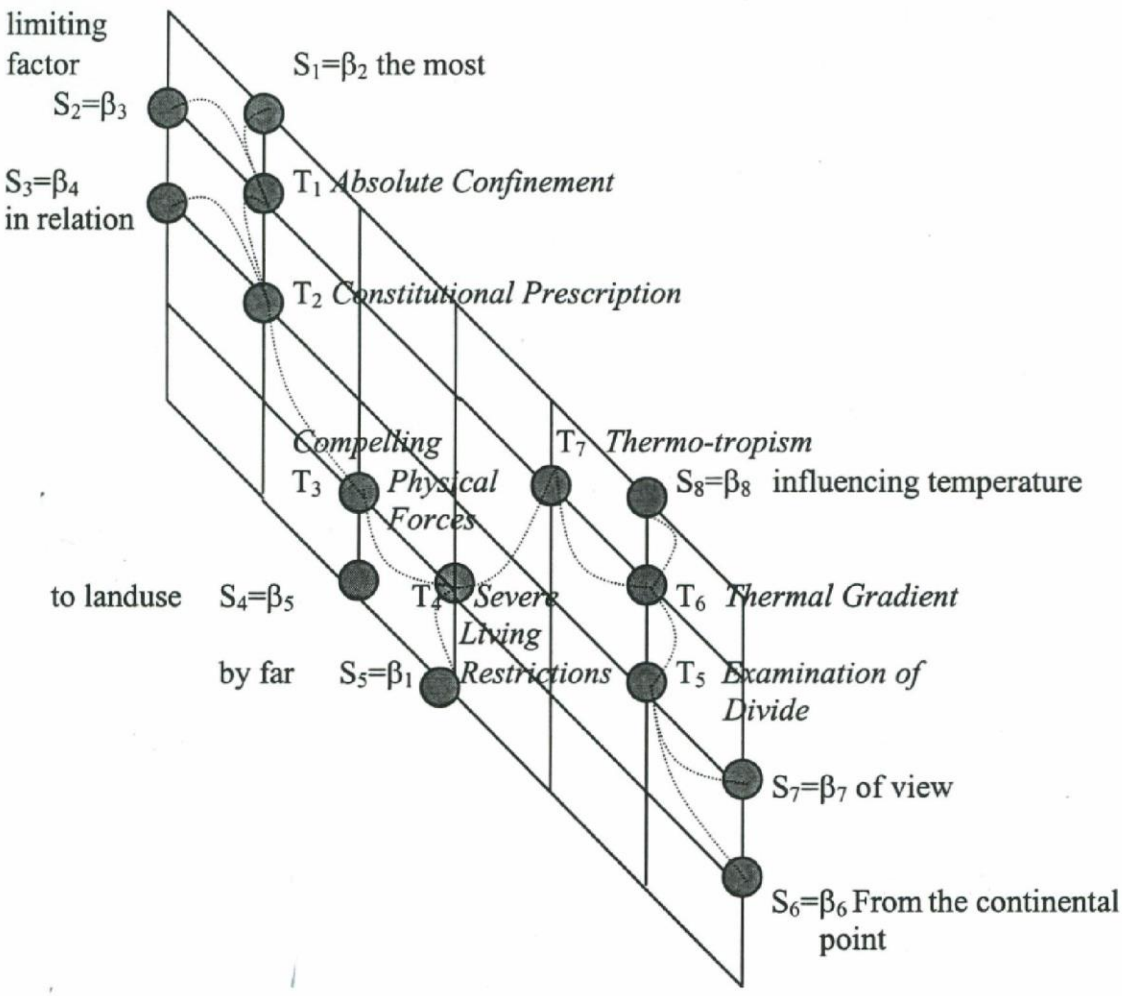
Variable	Radian
No	α-strand
.	
1	3.799400
2	3.799400
3	3.633077
4	3.633077
5	3.633077
,	
6	4.427400
7	4.427400
8	3.395861

Extraction of the Descriptors of A-attractors:

A-component	O-component
$T_1: 1 \rightarrow 2$	get T_1 Absolute Confinement
$T_2: T_1 \rightarrow 3$	get T_1 Absolute Confinement
$T_3: T_1 \rightarrow 4$	get T_2 Constitutional Prescription
$T_4: T_2 \rightarrow 5$	get T_3 Compelling Physical Forces
$T_5: 6 \rightarrow 7$	get T_5 Examination of Divide
$T_6: T_5 \rightarrow 8$	get T_6 Thermal Gradient
$T_7: T_4 \rightarrow T_6$	get T_7 Thermo-tropism

Figure A1.

Mesh-system of the O-component



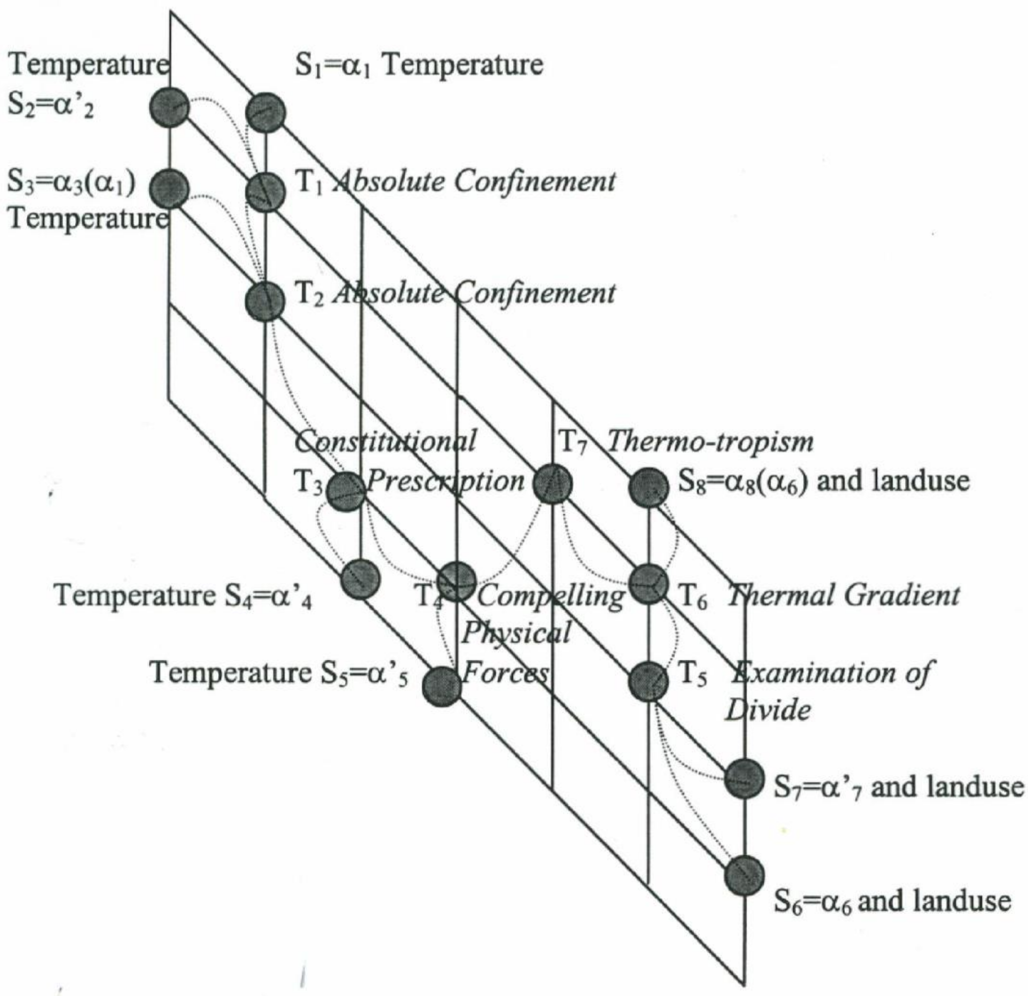
Grid: O-component

00	0.000000	10	3.987800	20	0	30	0
01	4.176200	11	8.166400	21	0	31	0
02	5.031000	12	13.195000	22	0	32	0
03	0	13	0	23	18.187299	33	24.639999
04	0	14	0	24	4.992300	34	6.452700

40	0	50	4.804200	60	0
41	41.092499	51	16.452500	61	0
42	0	52	11.648700	62	4.876200
43	0	53	0	63	6.772500
44	0	54	0	64	0

Figure A2.

Mesh-system of the A-component



Grid: A-component

00	0.000000	10	3.799400	20	0	30	0
01	3.799400	11	7.598800	21	0	31	0
02	3.633077	12	11.231877	22	0	32	0
03	0	13	0	23	14.864947	33	18.498024
04	0	14	0	24	3.633077	34	3.633077

40	0	50	3.395861	60	0
41	30.748685	51	12.250661	61	0
42	0	52	8.854800	62	4.427400
43	0	53	0	63	4.427400
44	0	54	0	64	0

Figure A3.

Fitness Landscape of Involuted Textual Objectives

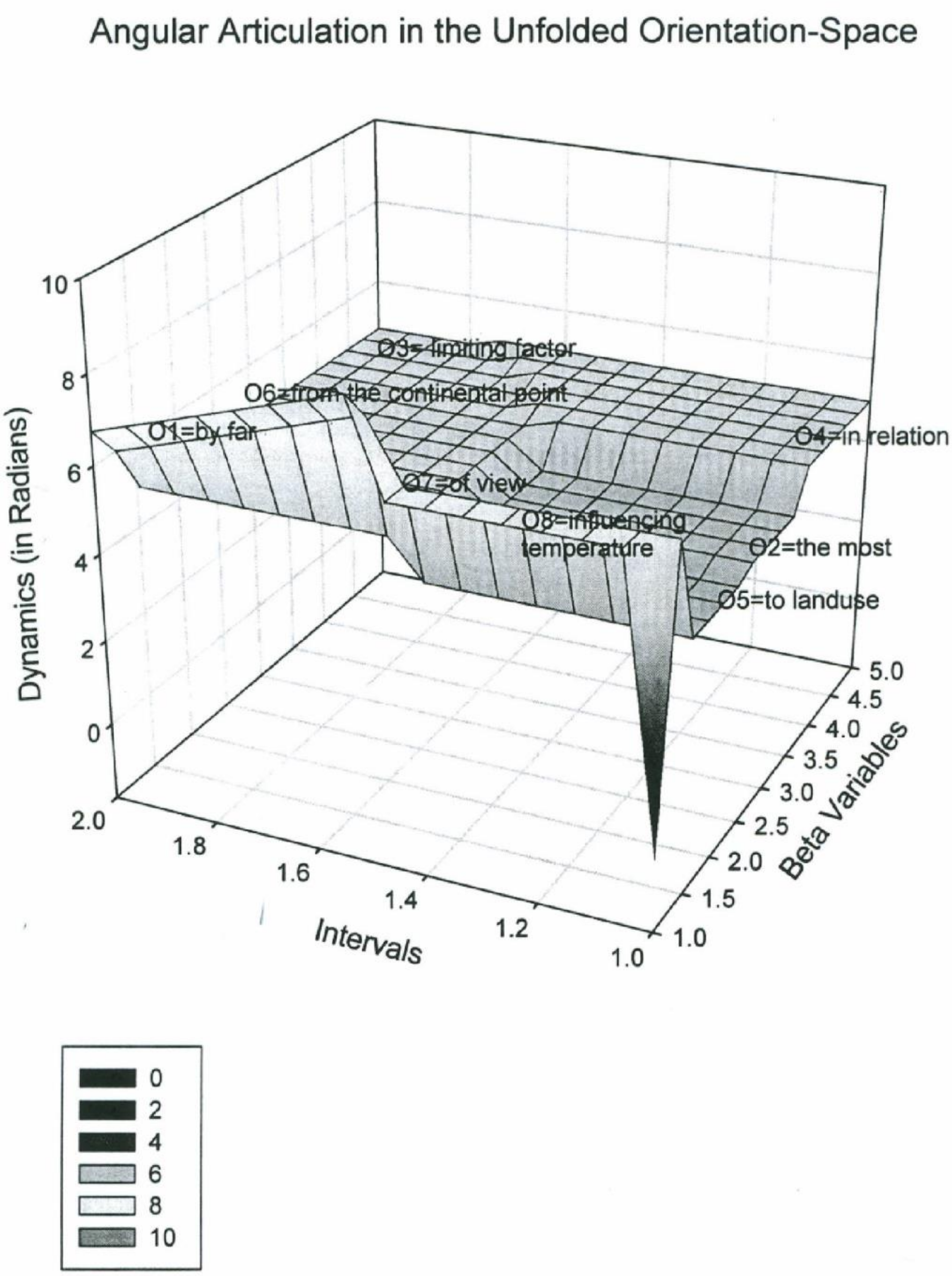


Figure A4.

Fitness Landscape of Involuted Textual Agents

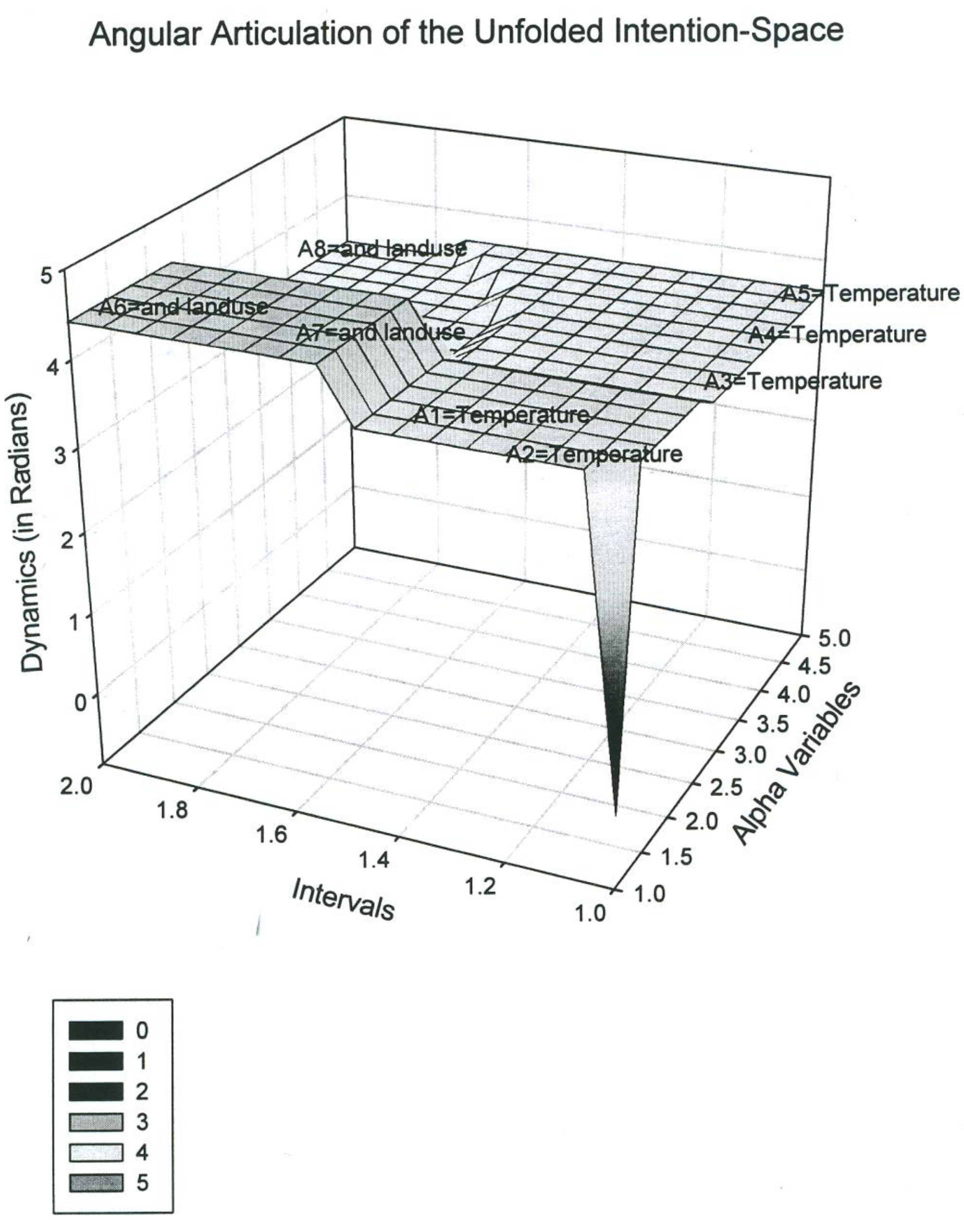


Figure A5.

Fitness Landscape of the Convoluted Textual Objectives

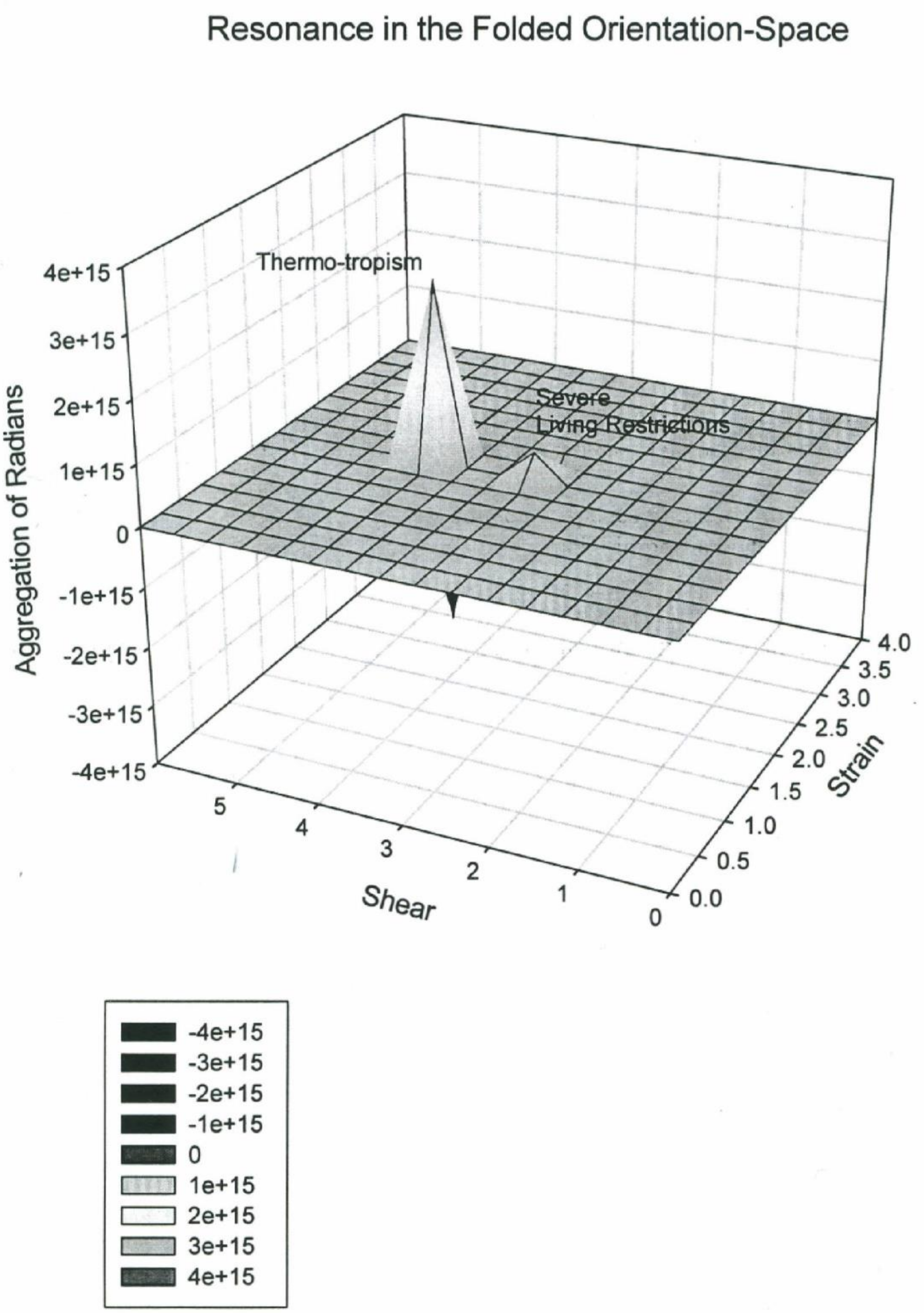


Figure A6.

Fitness Landscape of the Convoluted Textual Agents