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Abstract

On the basis of the Agent-action-Objective (AaO) paradigm, it will be shown how the transformation of a word model to a geometric space description can be made the foundation for an approach to informational invariants. In particular, it will be demonstrated that the word model of a Causal Loop Diagram (CLD) can be used for simplifying the involved procedures. Since the explanation of a causal loop requires a verbal description of what is in the links, this kind of discourse is necessarily dependent on its producer's intention and orientation. Both can be discovered through the functional geometry of non-linearly working language mechanisms. Although covered by textual surface properties, corresponding language spaces are approachable with VERTEX, which is a new version of Perspective Text Analysis (PTA). Moreover, reproduced order parameters are the result of the strict dependencies, which are characteristic of the entangled [AaO] units of the (AaO) model. Relative phase stability in the developing variables (α) of the A-component and (β) of the O-component of the model has revealed that VERTEX has the capacity to manifest the structural symmetry of the emerging (α) and (β) strands. Furthermore, the overall symmetry of the ($\alpha\beta$) strands is a consequence of apparent super-string disparity, which has important theoretical implications.

Traditionally, the use of natural language expressions in modelling "general dynamics" and the study of "systems behaviour" presupposes that text can be broken into pieces, which can provide the elements for the construction of word models like Becker's (1973) model for the encoding of experiential information. One of the main reasons for naming its boxes and the links between them has been to abstract essential relations and to provide the foundation for a modern statistical treatment as well as the establishment of a universally valid quantification. Based on classical psychometric hypotheses and multidimensional scaling, it is assumed that this kind of approach carries "context-independent" and consequently commonly valid properties. However, two sources of error are corrupting this kind of multivariate analyses.

The first kind of errors appears in the construction of propositions and concerns the attribution of semantic-philosophical values to human behaviour, especially language behaviour. Hence, seeking the most precise description of a behavioural model, the words used may look the same. Still disagreement on the empirical meaning of the deductively derived propositions appears to invalidate the usefulness of their semantic import. In particular, the problem of constructing psychometric models and to abstract, compare and communicate their "essence" is deeply ingrained with linking of algebraic models and stochastic mechanisms to behavioural expressions and in particular to natural language expressions.

The second kind of errors is bound to the use of stochastic mechanisms. Models with many levels can be used to construct behavioural indices, to factorise them and to perform tests of significance. But the psychometric approach fails to reveal anything about the behaviour of single individuals. This failure must be attributed to the absence of methods, which can be used for the precise measurement of small time-intervals as well as biological timing. It follows that neither the conclusions drawn on the basis of statistical theories, nor the result of mathematical modelling can accommodate the richness and variability in human behaviour. Classical multi-level models and multidimensional scaling require not only simplified but also complete state-spaces.

In conclusion, the basic assumption is that multivariate models provide the foundation for a *factorisation of mind and behaviour*. It follows that "individual state spaces" as well as "aggregated spaces" are treated as if their structures were based on a few variables and only approachable on externally provided frames of reference. Furthermore, the mechanisms for treating the changes in a state space are kept simple. Hence, if behavioural changes are established, they have become manifested on the basis of simple stochastic mechanisms and transition probabilities. But the applied rules have also influences and relations to the framework of the macro-states of their environments (or contexts). Nevertheless, expected are comprehensive empirical evaluation studies, which can be used to predict the outcome of certain strategies of action.

The Constructionist at Work

Literally speaking, a Constructionist is a person, who construes his understanding of the world through more or less successful manipulations of logical formulas. Typical for him is that he is expressing himself rule-bound and syntactically, which means that everything is presented in discrete and computational terms. In agreement with his conduct, he sets up rules for the construction of classes of indices (sometimes called formulas) on which "proofs" can be built and used as framework for testing. He seems to be asking himself the following kind of questions: Are there properties in the real world that are suitable for processing in a specified and artificial way?" Affirmative answers are presented as "the objective knowledge of the world", whose justification is founded on "universal quantification", which leaves no room "to remember the intricate details of an individual life" (Laubichler, 2004, p. 1747).

The Constructionists proposed in the beginning of the 19^{th} century the possibility that a "universal machine" could be manufactured, which would have capacities for "intelligent structuring" and "flexible organisation" of any kind of information. But what do these labels denote? It seems as if the former is labelling an expression of a constructed isomorphic relationship between symbolic logic and arithmetic. The other appears to reflect the construction of a theoretical machine, which in principle would be self-replicating. The assumed cooperation between the two constructs was taken as pretext for the possibility to simulate "self-knowledge". Despite successful simulation of space-time patterns like the pigment of snails (Meinhardt 1999, pp. 161-163), it has, however, not been shown that it is possible to build a "universal machine" that has the capacity to reproduce "copies of itself" (Seife, 2003), i.e. a machine that would have self-knowledge.

To solve certain problems of complexity, the research effort of the Constructionist has to a great deal been hampered not only by the principles of predicate logic and association but also through differences in logical construction. Dependent on various high-level computer codes, computed constructs entail different variables of import to various degree. Therefore, characteristic of his generated constructs is their dependency on the accessibility of the particular code for structuring and the organisation of information. It follows that the Constructionist can explain knowledge only with reference to the "frame" hypothesis of Minsky (1975). He proposed the frame for supplying a Turing machine with "context". This particular kind of "contextual approach" should, however, be regarded only as a prescription of the Constructionist's way of looking at objects and events in the real world, i.e., his way of manipulating knowledge.

In conclusion, in his comprehension the Constructionist is "construed" by a normative frame. It follows that constructed knowledge must refer to constructs of the same type. Thus, constructs can be used only to compute "comprehension" that is modelled on the basis of already known facts (e.g. Becker, 1973). Moreover, when constructs consist of non-ordered variables only associative links relate them as in any other network, marked with non-directive-ness.

With reference to "objectivity" as the cornerstone of science, the Constructionist is assuming that nature's objectivity appears through the imposition of frames. However, this is an idealisation of the state of affairs at least with reference to the standard model of the social sciences (Nett, 1968; Pinker, 2002, p.17). Furthermore, obstacles, contributed to this model, are due to its extreme dependency on natural language. In its context, everybody is speaking about the importance of language, but nobody knows what that means in practice. Language, conceived of as a non-evolutionary phenomenon, has made it impossible to study its evolutionary properties (Holden, 2004). Furthermore, since association is neither known on the cell level of organ nor on the level of the organism (Grier Miller, 1978, p. 1029; Kinosita, 1999), there is no reason to believe that the associations of the Constructionist can form the principle for the establishment of the "shapes of mind".

The Deconstruction of Constructionism

The "unreasonable success of mathematics with respect to physics" and the fortunate invention of an optical vehicle called the lens made it possible for physicists to look into the "universe" (Wigner, 1967). This incredible success, at least as what seems to be the case at a first glance, has led biologists (e.g., Sommerhoff, 1950) and psychologists (e.g., Brunswik, 1956) to take the scheme of a convex lens as model for "apparent purposive-ness" and "value constancy" respectively. Other psychologists have adapted the "lens" in order to shape "images" with the intention to account for "objectivity" in the non-verbal as well as "verbal" assessment of object constancy, distance and size (Becker, 1978, p. 27).

Furthermore, the philosophers of language fostered the generally held belief that natural language is an insufficient instrument in understanding and discovering the true nature of the world. Therefore, they, together with logicians and mathematicians had to invent a universe, pure elements, and relations holding between them, that is, relations detached from any real meaning. Still, many modern scientists are convinced that symbolic logic and formal semantics pave the way for the construction of sets of rules for the generation of "symbol strings", which can be used as frame of reference for the scientific analysis of language.

Hence, a fundamental and commonly accepted scientific assumption is that the composition of a text and other surface oriented properties are its structure and consequently the markers, which make its dynamics perceivable. Against this background it is not too difficult to imagine a conservative conduct, which would pretend that it is inconceivable to expect the development of a theory of dynamic patterns in a language space. However, only if text is treated as proper expression of rotational movements, a methodological foundation can evolve that allows for the crystallisation of what is unique in the single person's verbal behaviour.

In conclusion, since no one ever has been able to "look into a language space", the modern theories of language are in their development still in the Ptolemaic state, which means that concerned theorists continue to treat natural language as a non-evolutionary, flat and motionless body. Likewise, once upon a time it was inconceivable that Earth would have a geometric sphere. But Nicolaus Copernicus insisted that the Earth rotates on its axis and with other planets in the solar system revolves around the sun. He established the theory of the universe for which Tycho Brahe contributed with precise observations of the stars and planets, while Johannes Kepler formulated the law of motion in the orbit.

Thus, a basic assumption in science has been that the study of the phenomena of nature requires observations on movements before formal rules can be established. However, without the fortunate invention of the "lens", it would not have been possible for physicists to look into the "universe". This success has led William Huggins' to invent the "stellar spectroscope" (Becker, 2003), without which it would have been inconceivable that the many important discoveries of the 19th century would have been made, e.g., the successful determination of solar and stellar parallax. What this means to the "body of language" is obvious: It cannot be treated as space-less and motion-less.

Further, another important observation concerns the "texture of a body". When the German geoscientist Alfred Wegner in 1915 suggested the theory of "continental drift" that is the land masses of the Earth are floating across the globe, according to Malakoff (2001), his colleagues laughed. However, in the 1950s indisputable facts emerged, which showed that Wegner was right. Likewise, to suggest that the apparent "texture of the language body" is floating and shows high-strain-deformations as a result of simple shear deformation and displacement may appear alien to nearly everyone in the scientific community.

To reiterate, the invention of the "lens" made it possible to observe the motions of planets in the macro world as well as the motion of particles in the micro world. These observations generated the foundation for the establishment of the laws of matter. Moreover, the successful application of the rules of mathematics allowed the establishment of the laws of motion. But until recently, the more complex phenomena of living systems such as "Fliessgleichgewicht" (Bertalanffy, 1950/1969), have remained outside the scientific scope of inquiry. Moreover, observations on "true" rotations in living systems had been absent.

But in 1973, it was established that bacteria accelerate forward through the clockwise rotation of their flagellar filaments and change direction through counter-clockwise rotation of the filaments. Furthermore, in 1981, it was proposed that a single molecule may possess a self-sustained rotary motor, which suggests that one or more subunits rotate against the others.

However, at that time, few scientists believed in this theory. Nevertheless, the theory of rotation in molecules, as discussed in Kinosita (1999), became realistic in 1993.

Method

Based on the observation that all "living things" (Foster & Kreitzman, 2004) are dependent on inherent rhythmic driving forces, the goal of all scientific approaches to biological systems must be to discover their intrinsic coordinates. For example to discover the intrinsic coordinate system that governs natural language production requires that language must be conceived of not only as a self-organising system but also as self-referential, which means that it develops on the basis of the Agent-action-Objective (AaO) axiom. The AaO-model, developed on the basis of this axiom, works with a complementary steering and control mechanism, which is anchored in the A-O-dependency. Further, as the a-priori principle of all living things, it is the foundation for the establishment of "synthesis" and consequently meaning. Plainly, this axiom is responsible for the dynamic changes, flows and rhythms, which are generating the complex structures of language production. However, even more important is the human ability to reproduce the morphogenesis of text with every new generation cycle (B. Bierschenk, 2003).

Through Perspective Text Analysis (PTA), it has been made possible to demonstrate the dynamics of verbal pattern movements and to visualise their textual expression through functional geometries. Since (PTA) has been anchored at the biological-physical level, it follows that only verbal articulations can provide for the observation of discontinuities and the establishment of a sound scientific basis. Angular articulation and an evolving morphogenesis cannot be read out from the surface of a produced text, but the VERTEX version of PTA gives expression to structural stability (Bierschenk & Bierschenk, 2004).

Hence, textual movement patterns should come into existence and give important clues to textual wholeness and the implicate order. Furthermore, in binding its intentional dynamics to processes at the kinetic level of text production, it is expected that this procedure at the kinematic level is manifesting an effective operation for the establishment of corresponding fitness landscapes. VERTEX has been shown to produce detailed kinematic trajectory information (Bierschenk, 2001). But the structurally significant aspects of this information can be captured conceptually only in the sequential naming of the attractors of a particular state space. The process of naming the attractors is expected to provide a sound theoretical basis for the comprehension of the modelling task. Hence, what "comprehension" exactly is, will be established and made visible through the naming of the convolutions in the obtained fitness landscapes.

Participant

In his studies, the participant of the present study is expected to produce a language space, which is adapted to his particular way of modelling environmental problems. In the present experimental context, a doctoral student at Lund University, who comes from the Department of Chemical Engineering, has been asked to construct a causal loop diagram of a fundamental environmental problem. According to his view on ecological problem solving strategies and his writing-reading-re-writing capacity, it is expected that he can contribute to the characterisation of a "biological system" that performs the task according to natural law.

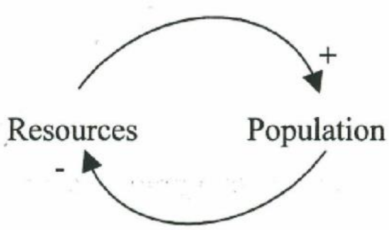
Material

Approaching the verbalisation of a constructed model must be based on non-linearly working language mechanisms, which implies the establishment of the textual basis for self-organisation and self-reference together with the establishment of an algorithm for automatic processing. In modelling, ecologists have studied environmental properties computationally and with the aim to analyse behaviourally complex systems. Thereby, they have focused on information feedback (Ford, 1999, p. 69). The technique of diagramming "information feedback at work" with causal loop diagrams (CLD) describes the special role of information feedback. Of import for understanding this technique is the fact that the attribute "causal" refers to the construction of a linearly dynamic cause-and-effect relationship, while the attribute "loop" is addressing the phenomenon of a "closed chain". The seriousness and fundamental import of this causal relation has been emphasised through a special section of the Science Magazine, which Kennedy (2003) devoted to the problem of "Sustainability and the Commons".

Increasing demands for natural resources underlines the crucial importance of the interrelation between resource consumption and growth in human population. Therefore, it is expected that the behaviour of the underlying individual sub-systems may generate serious conceptual difficulties. Garret Hardin drew already in 1968 attention to the diagrammed relation of Figure 1.

Figure 1.

Sustainability and the Commons



The problem, underlying Figure 1, was entitled: "Tragedy of the Commons". In modelling a corresponding (CLD) it is expected that constraints must be determined conceptually. Hence, the links of Figure 1 have been expressed with the following wording:

> Natural resources is the driving factor in population increase, while population increase is responsible for resource depletion.

In building a link between model and theory, the coupling configuration underlying Figure 1 is believed to circumvent traditional ambiguity. Thus, the experiment is focusing on the conceptually determined links and consequently on the geometric description of the involved textual movement patterns. Furthermore, when the text of Figure 1 is considered as context, the productive cooperation between intention and orientation is no longer the objective of physical conditions. Instead, it is the metaphysical determination of the expressed links that comes into existence. Thereby, new constraints are produced, which pass the limits of reality. As a consequence of transcending physical reality, abstract (hyperbolic) spaces are evolving, which have this metaphysical property.

The evolution of "metaphysical properties" (Bierschenk & Bierschenk, 2002) through the generation of text, presupposes the presence of an A- and O-function, which are governing information synthesising processes during natural language production. Furthermore, rhythmic and clock-like rotations within an individual component imply that every single component within an [AaO] unit is following its own rhythm. Since the system is running on two autonomous clocks, namely the A-clock, governing the A-component and the O-clock, governing the O-component, asymmetry can be expressed and individuality can be captured.

Hence, the clocking mode of the responsible functions accounts for the unfolding of α- and β-strands as well as for the folding of their spaces. Thus, dynamical patterns are producing thermodynamic trajectories, which differ in direction and orientation. Through individual variations in textual growth, trajectories and the variations in their nesting manifest structural stability. Hence, an evolving morphogenesis is generating the space of information invariants. These invariants are pointing towards the presence of a structurally determined interplay of the strands.

In order to produce a theoretical basis for modelling and comprehension as well as for tracking changes in a changing perspective, the coupling between text kinematics and the model must be controlled. Through the presentation of an invariant formulation of the [AaO] kinematics, it will be demonstrated that the direction in textual movement patterns and their rotational angles carry ecological validity. Here, the term "invariant" refers to the "coordination-free" establishment of structure.

Design and Procedure

Emergent [AaO] units have the capacity to capture and to track functional complexity and evolutionary growth. As a minimum, an [AaO] unit is an expression of both displacement functions and firmness in development. The first level of processing concerns the textual level, while the second level is directed towards "messengers", e.g. small patterns, which mark the existence of local properties in the syntax of the "Functional Clause" (I. Bierschenk, 1999). These are corresponding to the verb (ω) and the conditions before and after the verb. Since the texture of a textual surface constitutes the input level, every textual segment has to be marked with a directed number (expressed in radians) and a position (θ) or (ϕ). This implies that both denote the areas that separate different slices of the surface. Furthermore, the angle ($i\theta$), which is followed or preceded by a rotation through another angle ($i\phi$), is equal with the rotation through $[i(\phi+\theta)]$.

In specifying the spin structure within and between sequences of [Aa(AaO)], rotation and displacement of particular segments of texture proceed in either counter-clockwise or clockwise direction (B. Bierschenk, 2002). That this process can operate in either direction means that a selective pattern dynamics is manifesting itself in the form of a wave function. Thermodynamically conceived, this implies that a "wave" comes into existence whenever a dummy ($\varnothing$) is generating a "channel" (McMahon, 2003). A wave in backward direction may sweep out the vertex of ($\varnothing$) or in its forward direction may produce a ($\varnothing$) vertex. However, it is not the height of a barrier at any ($\varnothing$) (= the point of refraction) that is dominating a wave. Instead, it is the width of the barrier that has a decisive effect on the production of magnitudes.

The slicing of texture. To begin with the A-component of the [AaO] unit, any segment of texture may be conceived of as a one-dimensional "slice". The latter will be treated as a "string". When associated with this pattern, graphemes can be expressed as "slices" of the textual surface and addressed unequivocally. Moreover, their physical length means nothing. What matters is their spinning behaviour. The spin in the behaviour of a slice is specified by the direction through its rotation axis. In addition, multiple spins interact without direct measures on string interaction. Since any magnitude or orientation of a spinning string can be conceived of as the outcome of its behaviour on an invisible symmetric sphere, the magnitudes will be used in tracing the spinning behaviour of a string on the "event horizon". In order to exploit a string's spin-orbit entanglements, combinations of its up and down states have to be registered. It follows that the spin-effect on the moving of a string has to be made evident with the winding trajectory of the corresponding strand. Finally, the helical properties of folded strand rotations will be indexed with Connes' binary operator function (Connes, 1994).

The entanglement of strands. Localising pairs of ($\alpha\beta$) variables through entangled states requires that their relative position space can be made known. Through measures on interacting "variables" entangled strands can be made evident. Thus a measurement-induced relative position localisation through progressive entanglement gives rise to a robust and topologically stable state of well-defined variable separation in a dissipation-free state space. The operation is thereby providing a natural description of the relative position of a variable. An invariant property in the form of ($\varnothing_A$) and ($\varnothing_O$) dummies corresponds to strings in propagating positions or cells. However, within a particular unit, the circular property ($\varnothing$) of a string cannot remain, because of its exchange interactions with the textual context during variable production.

Differential local rotations appear to operate under the condition of spherical dependencies. As a result, mono- and multi-layered composites become recognisable, which makes it possible to take into account existing non-linear relationships and consequently the development of the "magnitude" (Murakami, Nagaosa & Zhang, 2003) of a composite. A magnitude refers to the chiral factor of spinning and thus to the factor that becomes dominant of the short distances between incomplete [$\varnothing_A a \varnothing_O$]. Since every tiny slice can be characterised by its "magnitude", it follows that "smaller than small" (Miltat & Thiaville, 2002) can be defined operationally. Moreover, a magnitude gives empirical meaning to unfolded spaces and the concept of neighbourhood.

Results

The directional measures of rotations in the A- and O-strand are binding their variables to a restricted number of possible angular positions. The strands are always composed of wound strings, which carry distinct physical variables. The transition from directional rotation to the irreversible production of compounds is determining the effect of locally operating kinetic processes on the development of composites. The process of calculating the radians and supplementing the placeholder ($\varnothing_A$) has been described, for example, in Bierschenk and Bierschenk (2004, Tab. 1-5).

Although placeholders are locally defined, intermittent phase transitions appear as the result of physically uncoupled A's or O's and thus as non-commutative geometries at high levels of resolution. This implies that the functional aspect of a coordinated displacement of segments can be identified with non-linear dynamical processes. Produced neighbourhood conditions of speed and acceleration in individual rotations are responsible for the observed dynamical couplings. It follows that the exactness in textual movement coordination is dependent on "ability" in the formulation of a CLD-link as well as on rotational variability.

The Layered Composites

For example, a sequential rotation in the O-strand may manifest itself as the composite (β_1) with the refraction angle [$\Phi = \theta_1 - (\sqrt{\phi_2} + \sqrt{\theta_2} \ldots k)$]. The corresponding local constraints are enforcing (β_1) to carry the magnitudes of the α_2- and β_2-effects as "shades", which requires the processing of at least one incomplete [$Aa\varnothing_O$] unit. Physically uncoupled A' and O's would simultaneously imply the absence of any interaction between them. Moreover, if covalent A's and O's would also be uncoupled dynamically, it would mean that they are operating in a context, where coupling would have little or no effect on the dynamics. In the context of Table 1, the A's and O's are however operating in "mixed states" (Wójcik, 2003).

Table 1.

Production of the α- and β-variables

Strings	Radian	Sum	Strings	Radian	Sum
.					
Natural	0.533800		increase	0.696600	$O=\beta_3=5.805000$
resources	0.596600	$A=\alpha_1=3.799400$	,	0.345400	
is	0.376800		while	0.471000	
the	0.408200		population	0.628000	
$\varnothing_O$	7.065000	$O=\beta_1=-1.799630$	increase	0.565200	$A=\alpha_3=5.149600$
[that]			is	0.376800	
$\varnothing_A$	5.50	$A=\alpha_2=3.433505$	responsible	0.628000	$O=\beta_4=4.144800$
driving	0.533800		for	0.715000	
factor	0.502400	$O=\beta_2=4.176200$	resource	0.990000	
In	0.464400		depletion	1.050000	
population	0.774000		.	0.605000	$O=\beta_5=8.855000$

One goal with the study of the produced variables is to see how different rotations are influencing their composition. As can be observed in Table 1, the differentiability of local segments is made dependent on their intrinsic spacing and timing. Topologically conceived, the production of composites implies the generation of distinct variables. Hence, the underlying [AaO] couplings are explainable on the basis of their curved (hyperbolically shaped) configuration, even though any physical coupling may be non-observable or absent.

The Control Parameters

Sequence-dependent timing in single A's and O's is an integral component of VERTEX. The purpose with their time-dependent layout has been to demonstrate the processing of the intervals of relevance for a particular variable. An exact characterisation of the speed of transition in the developing path is dependent on the magnitudes of the composed segments. While Table 1 has shown how the variables are produced, Table 2 shows the produced magnitudes together with the corresponding control parameters.

Table 2.

Interval-dependent Pairs of Magnitudes

Pair	A-strand	O-strand	Interval	Case
1	4.270400	-1.799630	1	1
2	3.433505	4.176200	1	2
3'	3.433505	5.805000	1	3
4	5.149600	4.144800	2	1
5'	5.149600	8.855000	2	2

Duplication (') in Unfolding α- and β-spaces

The special character of the A-strand is the result of duplication ('). This is a particular kind of rotational fading, which appears in response to the number of objectives in a particular Functional Clause. Since the substantiated textual agents (2) and (4) first are copied and thereafter duplicated through a procedure that re-iterates copies, it can be concluded that the process of copying at each re-iteration step leaves an identity mark (‘) behind itself. The rotational effect of this process appears in the identical radians.

When strands are allowed to overlap and to produce intermittent phase transitions, the coordination of textual movement patterns remains only as a tendency, i.e., as a shadow, and not, as was shown in Table 1, as a manifested dependency relation. Shadows emerge as the "entangled states" of (β_1), which cannot be "factored into the product of two subsystems, but must be described within the same single wave function" (Rarity, 2003), which means that language employs its own intrinsic system of coordinates.

It follows that only certain conditions namely those, which are shadow-like and self-referential, are reproducing themselves. In this case, shading is qualitatively different from the previously described copying process, since no duplication is involved. Copying in the latter case means the establishment of the roots of a particular O-component. The demonstrated shading operations concern the critical changes in the degree of rotation, which suggests that shadowing achieves the expression of "implicitness" in a formation, which simultaneously is slowing down its rotational speed. Furthermore, the process of equilibration is also controlled through the border, which is constituted by the interval (,). Together, the subtle differences in the variables of the first and the second interval have profound effects on rotational speed and acceleration of the involved "waves".

The Establishment of a Phase Space

According to the space-tearing hypothesis (Greene, 1999), the first step in the establishment of a phase space requires that the pairs of Table 2 become divided. At a first glance, it may seem, as if this measure would destroy the strictly controlled dependencies in the spherical space of an [AaO] unit. Furthermore, this would consequently imply that the production of separate A- and O-spaces would lead to results that are either incomprehensible or not easily explainable. However, if the production of separate phase spaces in a second step can be shown to lead to a successful manifestation of evolving "Intention" and "Orientation" spaces, this step would indeed be the expression of a very radical test.

A convenient device for visualising the configuration of a phase space is to rule a coordinated grid on the measures of Table 2 and to examine the shapes of the resulting spaces. As shown in the Figures 2 and 3, the Y-axis represents the naturally occurring intervals, while the X-axis shows the number of produced variables. Their magnitudes have the task to determine the flow dynamics of the involved "rolling" and "surfing" waves. The coordinated grids of the two spaces have been generated with the SigmaPlot (2002, version 8) for Windows. Its inverse distance method has been used for the conversion of the produced plots, which means that the coordinated grids have been interpolated (i.e., smoothed) with the weighted average of the values at neighbouring variables. In computing the applied weight function ($1/u^p$) to the (X, Y) coordinates, the function has been set to the standard ($p=3$).

In comparing Figure 2 with Figure 3, it becomes immediately obvious that they differ in their sliding, which implies that the operating A- and O-functions entails the concept of integrated space and time as the expression of increasing and decreasing magnitudes. This operation opens a new perspective on the reproduction of intermittent phase transitions. For example, that the observable instabilities can vary within and between the shapes is communicated through the evolving shapes. Thus, demonstrated are differences that concern crucial changes in the phase transitions. In comparison, when slowing down to the speed level of an initial phase, larger increases in acceleration require a longer time for the process to relax from the critical speed. Thus, whenever a depicted process is advancing from one phase into the next, the established "flow" is a measure on the degree of "directness", which is driving the system toward the intended pattern.

Figure 2.

Angular Articulation in the Phase Space of the O-component

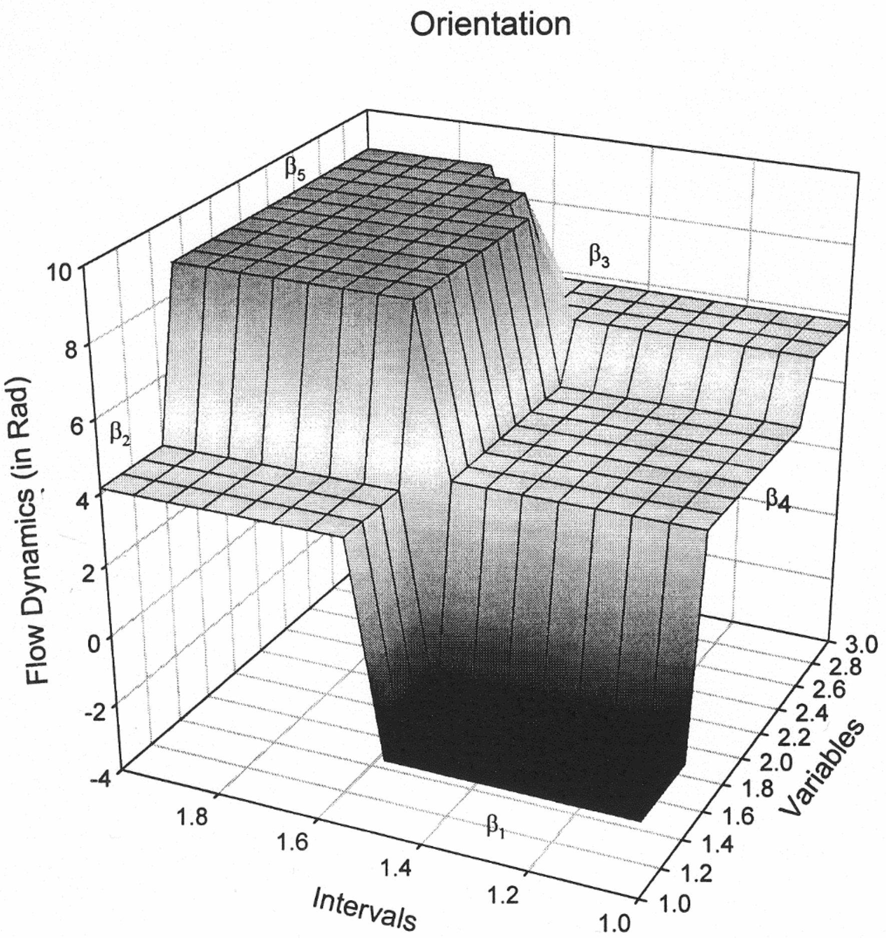
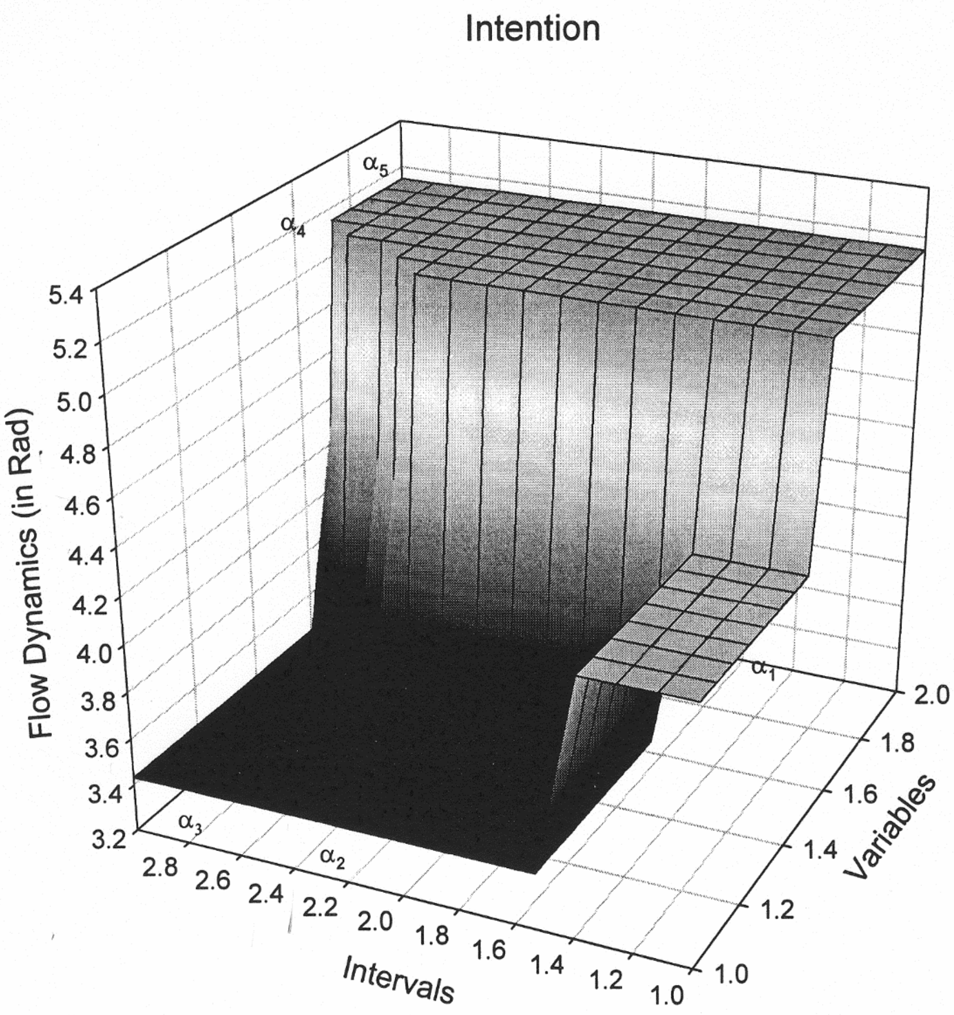


Figure 3.

Angular Articulation in the Phase Space of the A-component



It follows that a current below zero corresponds operationally with a certain degree of "in-directness". However, independent of the kind of flow, it can be concluded that relational numbers are an ingrained property. Furthermore, it has been made evident that the magnitudes have generated differences in the degree of depth. This result underlines previous observations concerning variations in integrative depth. In order to fit a particular clocking mode, certain objectives have been articulated and rotated in the remoulding of integrative depth.

In a fundamental sense, a comparison of the shape of Figure 2 with that of Figure 3 is of interest, since it shows that a directed number makes sense only in relation to other directed numbers (Hestenes, 1993, p. 14). It follows that the relative depth in the flow of intention is marking "disparity" when considered in relation to the depth in the flow of orientation. In addressing this fact, "phase space disparity" is the new and essential property of the present approach. Finally, if the application of Greene's "space-tearing hypothesis" would have turned out to be a misconception of the ideas behind the space-hypothesis, there would be according to Greene (1999, p. 278), "no reason in the world to expect anything but a random collection of digits".

The way in which the spaces have placed restrictions on the wave functions marks their theoretical significance. To restate John Wheeler, it means that space and time grip the strings by telling them how to move, while the strings grip space and time by telling them how to curve (Wheeler, 1998, p. 235; Greene, 1999, p. 72). Furthermore, the observed tendency toward an overall phase space synchronisation suggests that different functional requirements have produced symmetry. Erich von Holst (1935/1973) explains this as "relative coordination". A modernised discussion of his conclusions and the application of the termini "maintenance tendency" and "magnetic effect" to the phenomenon of symmetry as the consequence of processing may be found in Turvey (1990) and Kelso (1995, p. 129).

The Zipper Function

Based on the "binary operator function" which has been suggested by Connes (1994) and has been discussed by Mackenzie (1997), the "Zipper function" is producing the conditions for the production of state spaces. Basically, the conditions of the Zipper function concern the degree of rotational changes, which is reflected through differing variables. The function determines the numerical structure of a configuration of variables and is thereby governing a process, which is generating binary groups (G).

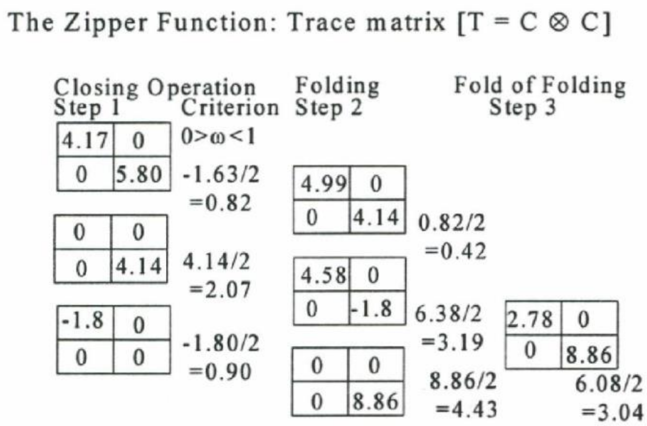
No matter what the value of the initial variable is, closing (G) is realised by inserting a zero value in the upper left cell of a fourfold table. Since the contrasting value is always inserted in the lower right cell, all other cells of the resulting connection (C) matrix have to be filled with zeros. The next following pair of values is entered in another (C) matrix. As a result, the fusion dynamics appears immediately in the trace matrix $[T = C \otimes C]$ as "folding" process, which makes evident that a state space develops on two simple (C) matrices. Thus, the Zipper function consists of the ordinary space-time product, manipulated by a very tiny discrete two-point space (Connes, 1994, p. 176), which is superimposed at a second step.

At the first step of calculation, however, the procedure may produce trivial structures. Though, it is always instructive to consider a second step in the processing, and consequently the possibility that a sequence of intervals may contain at least one singularity. A significant singularity is present whenever the deviation in a particular (G) exceeds the critical value ($\omega_{\Delta/2} = 1.00$). If this is the case, it can be concluded that (T) contains a significant discontinuity.

The operations of the Zipper are demonstrated in Figure 4. A shown, the procedure is closing all open (G's), which implies that any operating value has been enveloped.

Figure 4.

Demonstration of the Zipper Function



The corresponding second-order fourfold table contains the values, which are governing the foliation over borders. Based on the C-matrices of Figure 4, the resulting trace matrix is shown in Table 3.

Table 3.

Border and Dummies in the Trace of the O-strand

Variable	Trace
No	Radian
.	
2	4.1762000
3	5.8050000
,	
D	0
4	4.1448000
(D)	0
1	-1.7996300
D	0
5	8.8550000
.	

D = Dummy

When borders (,) require the insertion of dummy variables (D) the corresponding numerical values are zeros. Since the difference of the values in the second interval of Table 3 exceeds the stated criterion, this border becomes transitable, however only after (G) for the value of variable (4) has been formed. A sufficiently small deviation guarantees that the first (G) of the second interval can be integrated with (G) of the first interval. After transition, the process of integration is thereafter changing in its development, since the second and the third (G) of the second interval are succeeding the criterion value and thereby manifesting two significant discontinuities. The distances between both are observable as a significant discontinuity, i.e., a hysteresis.

> Note: the hysteresis has visually appeared in the centre of Figure 2 and manifested itself in the form of a "parallelogram".

Obviously, something happens every time a new (G) has been formed and considered for integration. The reflection of the relationship between any two G's at the local level requires that any governing interval will be taken into account. Hence, neighbourhood and timing demand that the two values of the second interval, namely (4) and (1) of Table 3 are fused first, while variable (5) is joined first in the final step.

As a result, the Zipper function is emphasising the central role of Connes' distance operator. If a difference between any two variables appears to be below the stated criterion, the trace would reflect continuously developing state spaces. But a continuously developing space demands also a decision on "variable priority". This situation is summarised in Table 4.

Table 4.

Border in the Trace of the A-strand

Variable	Trace
No	Radian
.	
1	4.270400
2	3.433505
3	3.433505
,	
4	5.149600
5	5.149600
.	

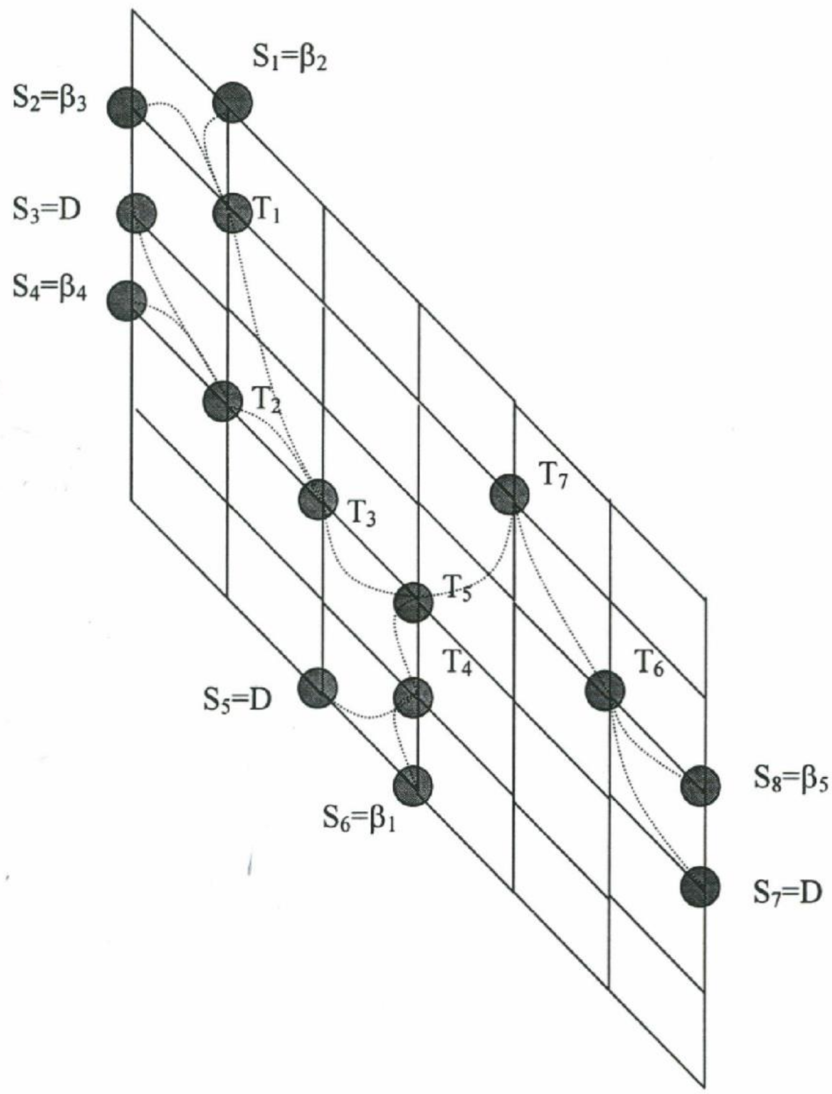
Table 4 is accounting for the absolute differences between the two envisioned intervals. The fusion operation has resulted in two continuously developing sub-structures. But in what way they are influencing the entire process, appears first in joining the two. Both sub-structures concern locally dynamical conditions. However, the global inhibition, i.e. closing the state space, concerns the final operation, which is forcing both to form the global state attractor. Thus, the final state attractor of the A-component appears to be the distinctive outcome of the border (,) restriction in the process of establishing the attractors. Furthermore, strict sequential order and timing of the operations on (T) of Table 4 is disclosing a "discontinuously" developing overall structure.

Holotops and Holophors

When a text is conceived of as a physical "information carrying system", the property "carrying" can be preserved with the suffix ('-phore'), which is addressing that part of a physical system that bears the information. But from the structural point of view, text means also wholeness, which can be captured with the prefix ('holo'), meaning a sequence of discontinuations, but without any intervening textual dissociations. In addition, the suffix ('top') will be introduced with the purpose to describe the topological properties of wholeness. The conditions for the generation of a holotop are given whenever a state space of an attractor has been established. In the following, the focus will be directed towards the discrete properties of a topological space description. By specifying length on the basis of the states in the latticed space of Figure 5, the magnitude of a configuration can be described with a focus on its topographical properties.

Figure 5.

State Attractors of the O-holotop

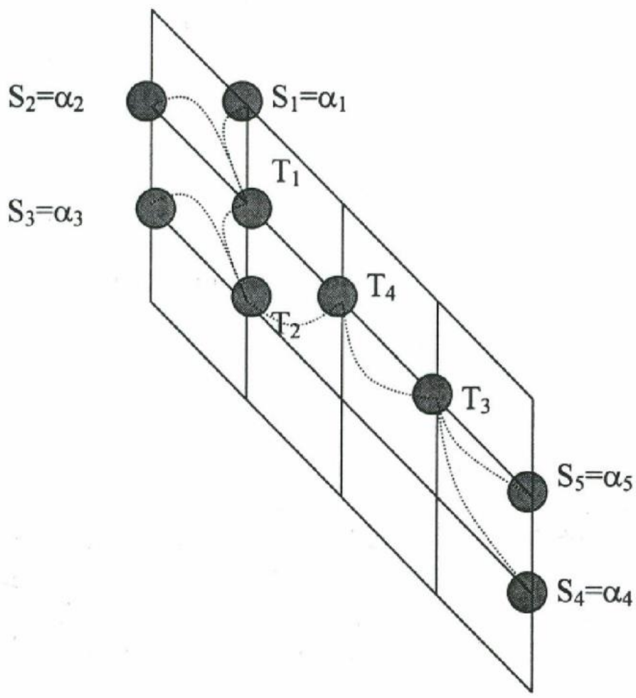


Non-change has been differentiated out with (D) and has to be contrasted with zero-change, i.e., an identity between any two values in a pair. This measure is expanding the needed mesh for the description of the evolving path, but the insertion of (D) does not destroy the measures on functional distance. Though, even more important is the definite demonstration of four microstructures. It follows that a topological trajectory may be deformed by the arrangement of contextual constraints at the borders of a mesh, but the singularities of existing sub-structures can never be destroyed.

Formally expressed, the operation of generating a regularised mesh is associated with the range of pulling and straining. The layout of the mesh system of Figure 6 makes clear that the cooperating stress properties vary considerably.

Figure 6.

State Attractors of the A-holotop



Thus, counting the coordinates through which a topographical configuration becomes sheared and strained is a measure of the effects of stress as well as an expression of topological elasticity. In manifesting the effects of the variables at the borders two kinds of topological "stress" can be observed. The constraining states are associated with stress that is influencing the "shear" effect, which is pulling apart its states, while stress on the "strain" effect is determining the final layout of a configuration. A differential effect is evidently observable.

If certain properties give rise to a topographical configuration of (T's) like the one, shown in Figure 6, this would imply that two continuously developing sub-structures have been integrated into an overall structure. The point attractors of the states at the borders of the mesh systems are always tied to the second law of thermodynamics. Since they carry the kinetic potentials of the attractors of the unfolded phase spaces, they define terminal constraints locally.

Conceived in the perspective of the unfolded phase spaces of the Figures 2 and 3, the point attractors of the folded state spaces have previously operated as variables in the phase spaces. Thus, variable-property has been marked with (β) and (α). The marks give a handle on the interplay between the instabilities on the kinetic level of the unfolded spaces and the stabilities on the kinematic level of the folded spaces. However, as demonstrated with the Tables 5 and 6, their magnitudes contribute to the establishment of a new kind of spaces. Hence, the purpose with the Tables 5 and 6 is to make fused magnitudes evident and to use the grids for the establishment of the state spaces of the Figures 7 and 8.

The folded state spaces show a new kind of "attractors", which are the result of the fusion dynamics of the holophors. The produced holophors open a new perspective, since they contain the generated mountains and valleys of a landscape. It follows that the holophors are manifesting the contours of flowing information. Furthermore, the shapes of the landscapes are manifesting transformational effects at the kinematical level. Therefore, the experimental procedure will now turn to the established state attractors ($T_1 \ldots T_k$) of the holophors.

Table 5.

Magnitude of the O-holophor

00	0.0000	10	4.1762	20	0	30	0	40	0	50	0	60	0
01	5.8050	11	9.9762	21	0	31	0	41	21.17637	51	0	61	0
02	0	12	0	22	0	32	0	42	0	52	8.855	62	8.855
03	4.1448	13	4.1448	23	14.121	33	12.32137	43	0	53	0	63	0
04	0	14	0	24	0	34	-1.79963	44	0	54	0	64	0
05	0		0		0	35	-1.79963	45	0	55	0	65	0

Table 6.

Magnitude of the A-holophor

00	0.000000	10	4.270400	20	0	30	0	40	0
01	3.433505	11	7.703905	21	21.43667	31	10.2992	41	5.1496
02	3.433505	12	11.137410	22	0	32	0	42	5.1496
03	0	13	0	23	0	33	0	43	0

As will be demonstrated, the experimental design of the present approach has produced multiply stable trajectories. But how differences in the degree of articulation in a particular composite will constrain the "meaning" of an individual fold at the kinematic level can only be demonstrated through the transformations, shown in Table 7.

Table 7.

Transformations of the Folded O-strand

V	Radian	T	Sum	Import
2	4.17620			Factor
3	5.80500			in population increase
		1	*9.9762000*	*Excessive Growth*
4	4.14480			responsible
		2	*4.144800*	*Causation*
	1&2	3	*14.121000*	*Extreme Expansion*
1	-1.79963			[(Natural resources)+ (factor+in population increase)]
		4	*-1.799630*	*Resource Reduction*
	3&4	5	*12.321370*	*Impoverishment*
5	8.85500			resource depletion
		6	*8.855000*	*Draining*
	5&6	7	*21.176370*	*Viciousness*

Naming the relational closeness of participating variables implies the determination of the centrality of a particular higher-order relation. However, naming is also dependent on how the relation between mono- and multi-layered composites has been transformed.

Figure 7.

Resonance the State Space of the β-strand

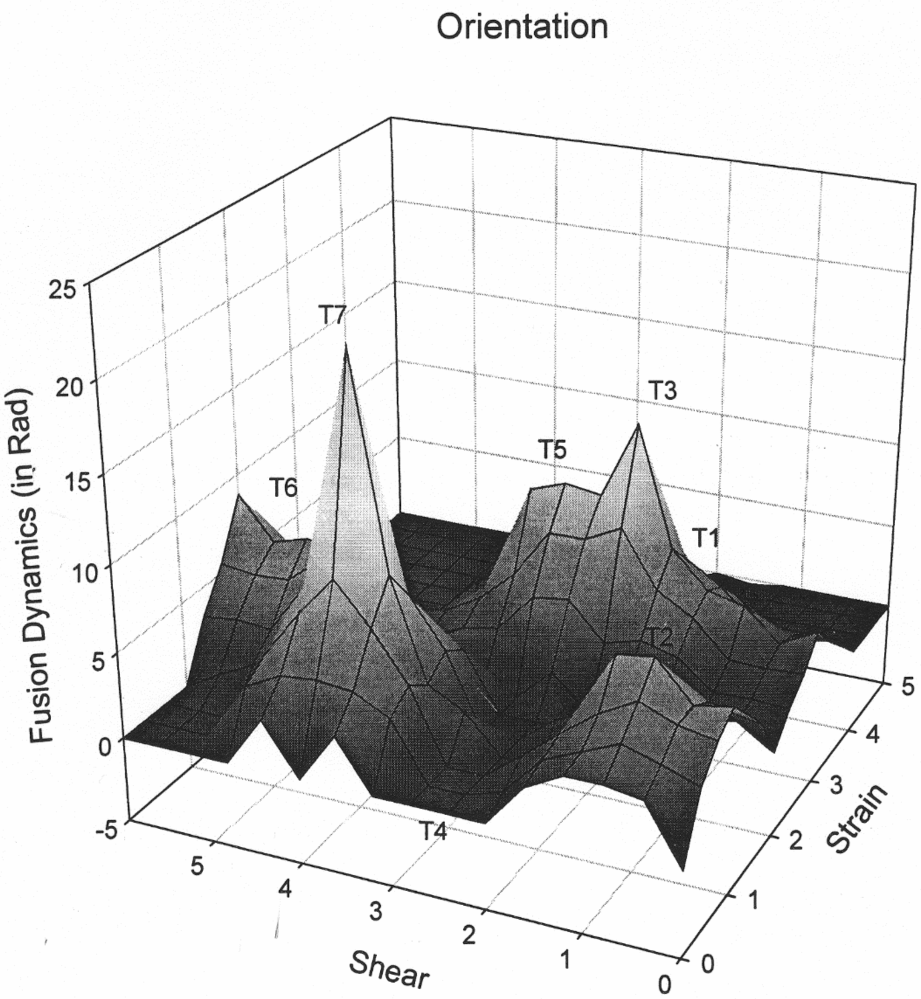
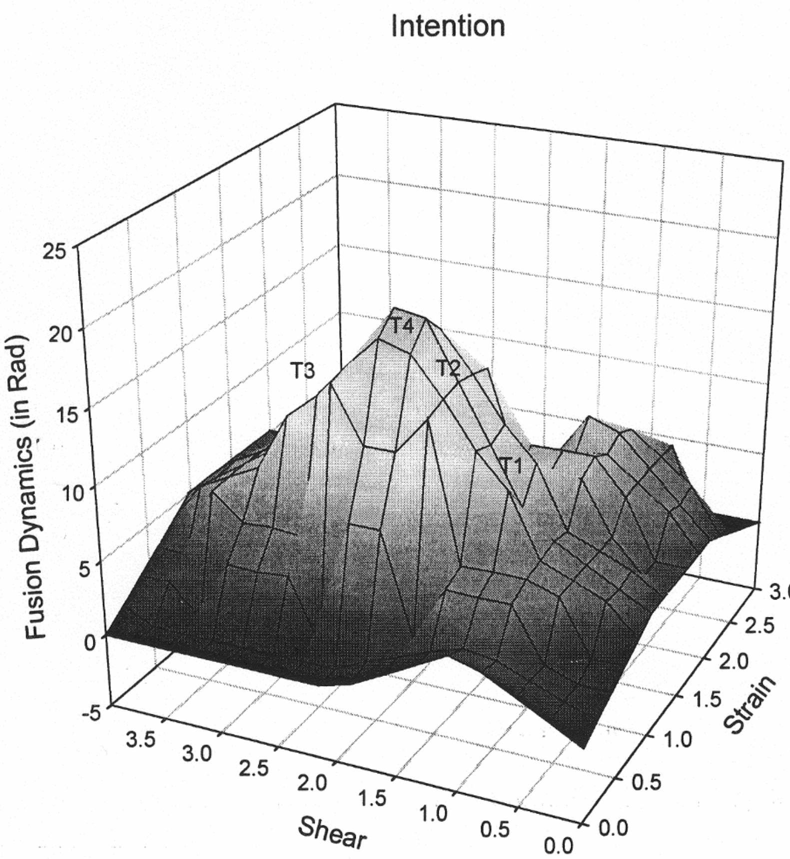


Figure 8.

Resonance in the State Space of the α-strand



It follows that the naming of a state attractor very often corresponds to one's ability to search for and find a single and most typical word for its designation. Moreover, the act of naming requires analytical rigor. Hence, the process of naming is expected to provide a sound psychological basis. The transformation process of Table 7 can be described as follows:

The variable (2) of the initialising terminal state (S_1) is actively transformed when the process is passing the second terminal state (S_2), whose variable (3) marks an awareness of an increase in growth. This growth function is resulting in the terminus *"Excessive Growth"*, which becomes apparent at the moment when this process depicts the effect of multiplication at (T_1). Obviously, the strings of the participating variables are communicating that something is present in the environment that is "responsible" for this kind of growth. This means that state (S_4) is transforming the import, carried by the grapheme string and thereby producing the significance of (T_2).

In designating the second attractor with *"Causation"*, the focus of its substructure is shifting towards the accountability of the growth effect. It follows that the transformational impact of the second state attractor (T_2) on the first (T_1) is turning the developing path in a new direction, which means that sequential and rigorous processing is transforming the naming into the terminus *"Extreme Expansion"*, which is designating (T_3). Thus far, the described crossing makes it possible to explain what is arching under the first saddle point attractor.

A third substructure is developing through one transformational step, which moves the process immediately to the terminal state (S_6) that carries the integrated information of variable (1). Naming this layered composite is covalent with naming the result of the attractor (T_4), which now can be designated with the terminus *"Resource Reduction"*. It is capturing a situation, which appears below sea level and implies that the inhabitants are steadily reducing the quality of their habitat. Something is present or produced by nature that can be turned to for support or help.

Since no other information is accessible at this point in time, the crossing of the trajectory of the third substructure with the previously formed saddle shaped formation is bending the process in a new direction and is thereby arriving at (T_5). From the information point of view, it follows that a new crossroad transformation is emerging, whose import can be captured with the terminus *"Impoverishment"*. When needed, people are drawing on available supply and are using it to their advantage. But the transformation process is jumping into the development of a new substructure. The information, carried by the involved strings of graphemes, is steering the process towards the consequences of *"Impoverishment"*.

Since this very short path is covalent with the transition through (S_8), the significance of variable (5) is transforming the process at (T_6) and the naming procedure is resulting in the *"Draining"*. At the moment, when the process is responding to this fourth step in the transformation, the crossing with (T_5) is bending the developmental path towards nothingness. It follows that the final step is the result of a degrading property, which means that the new saddle point attractor is communicating the effect of a *vicious circle*.

Thus, the "Swiss Roll" effect (Tenenbaum, Silva, & Langford, 2000) of the transformational steps is at (T_7) communicating the property of "Viciousness" as the outcome of a circular sequence of depraving circumstances, which are generating increasing difficulties. Thus, in naming the "root" of the structure, its evolutionary impact on all of the organisms of a population as well as its damaging impact on the environmental value can be communicated.

Just by comparing the obtained results of the A-holotop with the results of the O-holotop, Table 8 gives a vivid account of the involved rotation-translation through which the information in the folds of the landscape of the A-holophor has changed.

Table 8.

Extraction of the Descriptors of A-holophor:

Figure 6	Figure 5
Path of the A-holotop	Path of the O-holotop
T_1: 1 $\rightarrow$ 2	get T_1 Excessive Growth
T_2: $T_1 \rightarrow 3$	get T_2 Excessive Growth
T_3: 4 $\rightarrow$ 5	get T_5 Draining
T_4: $T_5 \rightarrow T_2$	get T_3 Extreme Expansion

The process depicted in Table 8 implies cyclic operations, which are associated with the emergence of new relations. The coupling of differently running trajectories means a reworking that generates rebound information. The necessary function has the task to extract the "descriptors" from the Orientation space for the designation of the "attractors" of the Intention space. This peculiarity has effectively contributed to a refinement of the characteristic quality of the holophor of Figure 8.

For extracting the descriptors of the informational invariants of the Intention space, it is essential to follow up the cooperative interaction, characterising the configurations of the holophors. For example, in advancing the phenomenon of "looping" in the text producer's argumentation, Table 8 shows that it is an intentional phenomenon, which is producing reappearing descriptors. A single descriptor can follow itself and reappear on the same dimension. But a descriptor can also reappear on different dimensions and at different levels of the path of the A-holotop. Thus, the differently determined configurations of intention are the result of potential redistributions. Cyclic and rhythmic extraction of relational information requires that an extraction pendulum is initiating swinging operations, which are producing different informational developments in the single trajectories.

The folding path of the A-holotop can be described as follows: In order to obtain the disparity relation of the A- and O-holophors, one more step has to be taken. This step consists of the coupling of the corresponding trajectories, so that the coupling can give expression to their coordinative cooperation. In contrast to the naming of the attractors of the O-holophor, the "descriptors" of the attractors of the A-holophor show that the constraining states of the latter have produced a highly symmetric mountain. On one side appears the effect of excessive growth and on the other side is the draining of resources dominating, while the top of the mountain is designated by extreme expansion.

The most striking difference appears as a perspective translation. Though the description of the first two attractors is in fact identical, the other two are reflecting different descriptions. However, through the causal relation between the underlying configurations, informational specificity makes evident that a perspective translation can be determined and used to demonstrate uniqueness in the information concerning the formation of intention.

Verification and Validation

As demonstrated in Table 8, the operations have made it possible to specify the informational value of the A-holophor by relating it to the O-holophor. The psychological interpretation of local as well as global dynamical conditions has been reproduced above in Table 7. In the naming of the state attractors, the structurally significant aspects of the conditions responsible for the emergence of folded landscapes have to be captured conceptually. Hence, an attractor suggests irreversible changes in the information flow, i.e., "a morphogenesis" (Thom, 1989), which signifies stability as well as changing states. It follows that a macroscopic examination of a morphogenesis and a local and global study of the associated magnitudes have been shown to provide the condition for the establishment of comprehension. In addition, the invariants, which have produced the complex configurations of the Figures 7 and 8, have informational significance (Thom, 1989, p. 145).

Since the emphasis in the formulation of the main hypothesis has been put on the model constructor's ability to express his links verbally, it has been expected that multiple stable states of their verbal realisation would organise themselves into different state attractors. They can be comprehended as the informational invariants of a particular morphological configuration. However, whether the evolving information invariants are reflecting reasonably well the state of model building depends entirely on the conditions of that part of the real world that has been modelled and been investigated through reading of literature, simulation or empirical study.

The teaching material "The Lonely Planet Easter Island" is stating the basic condition. According to history, the population grew continuously, but because of a shortage of trees, the population was sloping deeply into misery. Finally, the entire civilisation disintegrated. In relating the story to the established attractor spaces, it is evident that the outcome is in agreement with the development. In this sense, validation means that space variations must have required a novel way of changing during the integration of the basic patterns into properly formed geometric shapes. As stated in the source material for the design of the causal loop diagram, the fate of the islanders validates the outcome, since the designated roots, namely *"Extreme Expansion"* of the intention space and *"Viciousness"* of the orientation space agree with the causal circularity in the behaviour of their civilisation.

Discussion

The present article has outlined an entirely new approach to comprehension, which above all has shown that the roots of the produced structures can be discovered. According to the stated space-tearing hypothesis, a distinction has been made between the state spaces of the A-function and the corresponding state spaces of the O-function. Thus, the structural expression of an objective is representing a certain orientation, while the structural expression of the A-function is representing a particular intention. As mentioned in the Material-section, the ecologist Garret Hardin proposed the need for a fundamental reformulation of the approaches to the study of the environment. He wrote for example that an analysis of the problem with the "invisible hand" had uncovered the not generally recognised "principle of morality", namely that *"the morality of an act is a function of the state of the system at the time the act is performed"*.

To concentrate on the ethical dimension means that morality has to be conceived of as a system-sensitive property. Making its degree present is the definitive responsibility of the produced [AaO] units and their cooperation. Since the A-component is representing not only autonomy but also responsibility, interacting chains of [AaO] units are producing "morality". Hence, morality is not only a natural but also a necessary part in any verbal productions. That responsibility in this sense has escaped the constructionist's attention can be summarised as follows:

In taking the links of the constructed model as point of departure, the population is modelled as integrated layers of individuals, which are dependent on their access to natural resources. Looked upon the model the other way around, access to natural resources is influencing the behaviour of a population. The model has in both cases to be conceived of as Darwinian, that is, the absolute expression of a particular type of organism-environment interaction. But only a non-Darwinian approach to individual action, i.e., the action of complex biophysical systems, can promise successful modelling of the perceived or conceived interdependency of population development and intrinsic processes. However, this requires a differentiation between system and environment. Hence a system is differentiating out itself from its context.

Therefore, the decisive question is whether and to what extent the study of non-linear and system specific processes would make evident that the circular dependency between population growth and intrinsic processes is qualitatively different, compared to simply considering the reciprocal relationship between organism and environment. Therefore, it is worth noting that a validation of the import of the graph of Figure 1 necessitates the suggested methodological approach. As Hardin noticed, the "essence" of a system cannot easily be expressed through formal definitions, graphs or photographs. "Essence" must be presented in words.

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Author's Note

The reported experiment has been carried out in cooperation with the Centre for Environmental Studies at Lund University. Further, the used background material "the lonely planet Easter Island" (January 15, 1998) has been produced by the Systems Analysis Project 4 and was used in 2001 in the "Systems Analysis Course" of Lund University's Master Program in Environmental Science.

The tutorial to Perspective Text Analysis: VERTEX, presented in the article, has been discussed with research colleagues in Poster session I at the 65th AEPF-Tagung at the University of Erlangen-Nürnberg, September 20-22, 2004 in Nürnberg, Germany.

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