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Abstract

This article presents the geometric foundation and quantification of the Agent-action-Objective (AaO) kinematics. The meaningfulness of studying the flows in verbal expressions through splitting and splicing the strings in a verbal flow relates to the fact that free parameters are not needed, since it is not required that the presented methodological development fits one or the other empirical context. The major aim is to make evident that natural language employs its own intrinsic system of coordinates. These coordinate systems are transforming kinetic energy into discoverable verbal flows. It is demonstrated that language must be conceived of as a natural system that becomes structured through rhythmic driving forces. In particular, the presented results give weight to the hypothesis that rotational dynamics is basic to the effects that selective textual movement patterns have on the evolution of texture, i.e. a text surface. Since the experimental procedure has been focused on the manipulation of text translation, asymmetries, and phase transition, it has been possible to show that the translators meet the same functional requirements in different ways, but are producing multiply stable trajectories of similar kind. The studied text example shows that the dynamics, induced through translations, is producing a deeply ingrained commonalty. Relative phase stability in the developing strands has revealed that the mechanism is generating symmetries. Since the symmetries are the consequences of processing, apparent contour similarity has important theoretical implications.

It is shown that a biologically rooted synthesising mechanism exists which is controlled by the clocking mode of the discovered regularities. These regularities have made evident that the functional aspects of the clocks can be identified with the strict dependency, which is characteristic of the discovered AaO-mechanism. Since the mechanism is working on the basis of two clocks, namely the A-clock, governing the pattern dynamics in the A-component, and the O-clock, governing the pattern oscillations in the O-component of the paradigm, it has been possible to extract the morphological consequences of the involved rotational dynamics. Relative phase-stability in the developing α- and β-strands has revealed that the discovered mechanism is generating overall strand symmetries. Furthermore, it has been shown that the axiom (B. Bierschenk, 1984, 1991) presupposes a dual steering and control mechanism, which is anchored in the strict A-O-dependency. Further, it has been possible to develop an invariant formulation of the A-O-kinematics. The notion "invariant" means that the establishment of the A-O-kinematics is coordinate-free. It follows that the A-O-dependency is established independent of any particular coordinate system. Moreover, it is made evident that natural language utilizes its own intrinsic system of co-ordinates as foundation for the production of space. Hence, the basic splitting and splicing hypotheses imply that a space will become evident only if the writing style of a particular text producer can be brought under experimental control. How the writing style operates is assumed to emerge in the coupling of the A- with the O-kinematics. From the precision in the working of the involved clocks, important consequences of textual movement production can be extracted and related to space development.

Until recently, abstract and high-dimensional spaces have been the domain of theoretical physics (Bayer, et al., 2001; Cho, 2000; Greene, 1999; Wal, et al. 2000; Wheeler, 1999). But researchers in the natural sciences as well as researchers in the social sciences are in full swing to introduce the concept of space into their special areas of research (e.g., Ebeling, et al., 1999). However, applying the space-concept to the study of language not only requires that the existence of a language space can be hypothesised, but its existence must be demonstrated empirically.

Geometric Foundation

In order to make the import of the production of "strings" evident and to catch their fundamental implications for evolving natural spaces, it is mandatory to put string production into a geometric perspective. In paraphrasing a statement of John Wheeler in an interview, which was carried out by Brian Greene in 1998, this test concerns on one hand the way in which the strings at the surface level grip the space of a texture by telling it how to curve, and on the other hand, how the space of a texture grips the strings by telling them how to move (Greene, 1999, p. 72).

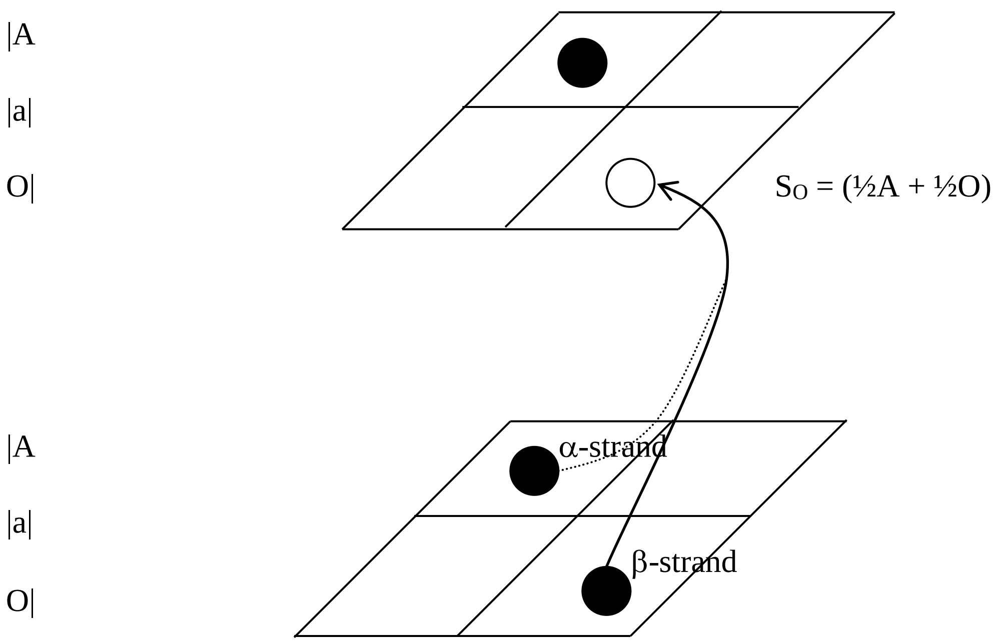
In demonstrating empirically the existence of a language space, the followed strategy is based on a few important steps. The first consists of the observation that neither the perspective nor the structure of the objectives of a complete text can exist in latent form in the brain. Both must be built up during text production. A second step is related to the establishment of a bookkeeping procedure, which can capture dynamic changes, flows and rhythms of strings in the fabric of a space and the development of its morphogenesis. The third step concerns the complexity of the produced structures. It is the complexity of the evolving structure and its overwhelming capacity to reflect synthesis that has been the challenge for "Perspective Text Analysis", which has been developing over a period of more than nearly three decades. Plainly, many of the prominent aspects and the introduced novelties, which have formed the basis in the development, must be bypassed. But they have been covered in previous reports (e.g., Bierschenk & Bierschenk, 1993; Bierschenk, Bierschenk & Helmersson, 1996; I. Bierschenk, 1999). What is in focus, however, is the empirical demonstration of the existence of a "real physical geometry" (Hestenes, 1986/1993, p. 583) and a powerful mathematical system called "geometric algebra" (Hestenes, 1994, p. 65), which has the capacity to reproduce the space of a particular text even though the text has been translated into different languages.

The String-Hypothesis

In departing from the fundamental hypothesis that nature is the producer of language, this hypothesis requires that the mechanism that steers and controls string movement becomes recognisable. But to be able to recognise Nature's construction of a language space, a bookkeeping procedure is needed, which has the capacity to keep strings in order and to control their compounds and compositions. The bookkeeping will make explicit that the mechanism can keep track of the components in the splitting of the strings of a verbal flow. The discovered splitting mechanism will be explained with reference to the configuration of Figure 1.

Figure 1.

Splitting into Componential States



The essential first step in the splitting concerns the operational distinction to be made between the two kinds of dots. This kind of operation is absolutely necessary, if one state of a dot shall be distinguished from another state. In associating relaxed and non-relaxed states with the dots, it becomes possible to make the state of a particular kind of components knowable. For example, if a component carries a non-relaxed string and this state is associated with a filled dot a distinction can be made in relation to a relaxed string, associated with an unfilled dot.

Now, if the context for string-production is conceived of as part of a resulting synthesis, related text generation may be viewed as the outcome of variableness, and the coordination of variables must reflect lawful regularities resulting from the splitting. The demonstration is significantly simplified by using the string-vectors directly. This means that "un-normalised" string-vectors are "eliminating the computational cost of normalisation"

(Hestenes, 1994, p. 72). It follows that the basis of these regularities can be determined directly at the ecological level through the A- and O-spinors, representing particular rotations. From a kinematic point of view, it can be stated that the A's and O's at the left-hand side of Figure 1 allow for the determination of the "orientation" in the rotational behaviour of the dots. Whenever two borders are defining the orientation in a rotational transition, the dots are operating in areas. Since the areas of an AaO-unit are incorporating definite borders, the AaO is embracing spherical properties. But the determination of the orientation of the dots' rotation within the spherical space of an AaO is only achievable through their bonding to the A's and O's.

In Figure 1, the shifts in orientation concern a specific messenger, namely (ω+∅+CM), which is a unique second order structure (I. Bierschenk, 1999). In the first place, (ω+∅+CM) is initiating a work cycle of (1spin). This operation is producing a strict measure on the spherical dependency of composite at the vertex of the O-component. In essence, a change in the movement dynamics of the dots deforms the "sphere" of an AaO-unit. As can be seen from Figure 1, their operations involve a twining in the β-strand. The meaning of a curling operation is as follows:

The O-clock first moves one turn clockwise and is thereby establishing the degrees for unity, which has the magnitude of (1spin). However, the placeholder indicates that a complete (AO) composite is needed, which would close the "hole" with a sheet of texture. Therefore, the supplementation (S) function is starting the displacement mechanism, which is initiating the O-clock and a counter-clockwise move with a spin of (≈½) is closing the hole, however only partly, since the component on the β-strand would be associated with a segment of insufficient cover. To complete the displacement operation, the S-function requires the A-clock to make the same kind of move and to return its outcome. Since the component on the α-strand would be associated with the missing part of cover, the latter operation would close the entire hole. In the context of Figure 1, the hole at the textual level would have to be mended with a two-fold layered sheet of texture. It follows that the magnitude of the produced rotations is the result of two states of spin. Since [≈½α-spin + ≈½β-spin] amounts to (U = ≈2*½-spin) this magnitude can be equated with the displacement of the roots of a unity (U), i.e. the roots of an AaO-unit, namely the A-root and the O-root.

Since text production must develop on the basis of a co-operative interaction between the "proprio-specific" and "extero-specific" processes (Holst & Mittelstaedt, 1950) of perception, repeating themselves more or less regularly, rhythmic returns through seeing and saying cycles is the comprehensive principle, which suggests the coordinative expression of points of observation and points of view. In associating the former with the A-component and the latter with the O-component, a text producer's direction of focus and statement of objectives is expected to be observable in his style of writing.

Manifestations of Structure

The essential function of making the distinction between the direction of focus, which concerns one's intentions, and the statement of objectives, which relates to one's orientation, is to secure the foundation of borders (||) between both during the establishment of a structure. When the borders embrace a non-relaxed string, they indicate its absolute value in the form of "resonating" properties (Greene, 1999, p. 143; Seife, 2001, p. 823). But in order to be able to observe the development of structure and the evolution of space, the orientation in a string's movement must be related to the crossing of borders. Therefore, it has been necessary to determine the direction in a movement through the rotation of the dots.

For example the arrow ($\rightarrow$) in Figure 1 makes evident that the vertical coupling of resonating strings with a vibrating and fluctuating string at the preceding level is initiating their co-linear move in the direction of the "attracting" dot in order to make the latter resonating. The essential aspect of any propagating string is that it is "virtual" and that all virtual strings behave in "non-resonating " manner (Greene, 1999, p. 146). Hence, in the presence of virtual strings, unfilled dots are turning counter-clockwise with a spin of (-1). This condition determines the "virtual" string formally as a placeholder ($\emptyset$). Thus, whenever a virtual string is inferred, a "hole" has to be marked at a textual surface with ($\emptyset$). Hence, ($\emptyset$) will be used to indicate the holes in a texture to notify the places, which have to be mended with proper segments of the surrounding con-text.

A structural difference is arising when a filled dot is turning, since the associated string at this moment is resonating. In this case, the dot is exhibiting a forward orientation in its movement. In a sense, the presence of a resonating string has operational implications, since the turning of the dots lower the tension around the holes in the texture. When related to the illustrating dots, it becomes evident that each and every filled dot must turn clockwise. Further, resonating strings are initiating the ticking of the respective clock, which implies that the magnitude in the resonance of a particular string needs to be taken into consideration. From an operational point of view, this means that a vibrating and fluctuating string is turning into a resonating string, whose resonance corresponds with its degree of bending or winding.

Since it is assumed that contextualised strings are resonating within the AaO-environment, it follows from a kinematical point of view that turning implies a rotation close to a spin of (½). But differences between resonating strings are arising when the magnitude of a resonating string becomes dependent on its surrounding context. For the exact measurement of the dynamics of differently contextualised strings, it means that differences in the contextualisation of a virtual string appear as differences in the magnitude of its context dependency. Thus, their behaviour at the textual level means that resonance differences can be determined through the structure of the surrounding textual context. At the textual level, the context structures are producing segments, which are mediated through flow-fields. Maintenance of their non-equilibrium properties through symmetry-breaking operation during text production allows the AaO's to reflect the structure of the context together with their own internal dynamics. Hence, the self-referential property of the AaO's can be tested, measured, and integrated through mending operations.

Moreover, Figure 1 provides, with flow-fields as intermediaries, the basis for mending operations through variable displacement. Hence, successful mending is dependent on the proper channelling of variables through the ($\emptyset$). For example, the arrow ($\rightarrow$) in Figure 1 has made evident, that the S-function has initiated a replacement procedure, which has solved the equation [$S_O = (½A + ½O)$], however, the solution requires always the presence of a structured textual context. It follows that only certain conditions of self-organisation, namely those, which provide the "channels" for the displacement of variables, are supporting the differentiation of the dynamical A- and O-states.

Peepholes into the Space

A further step in the displacement of variables and the establishment of the strands has to be addressed. It concerns the dynamics at the dorsal/ventral, and consequently the A/O-intersection, which appear always in pairs. Once again, contextualised strings can be updated and the changes in their resonance sensitivity can be related to the pairing of the components. In the presence of a placeholder of the A-component ($\emptyset_A$) together with the presence of a placeholder of the O-component ($\emptyset_O$), this demand for pairing means the presence of a perpendicular flow-field. It follows that the vertex on either site of the flow-field is expressing the fact that the S-function has encountered a place of height or depth. This condition implies that the components are standing in a perpendicular relation to one another.

When expressed as displacement operations, a spin of (-1) in the A-part of the flow-field, which is determined by the upper border, and a corresponding spin of (-1) in its O-part, which is determined by the lower border, are establishing the magnitude of (-2) as a definitive expression of the pair-wise presence of an ($\varnothing_A$) and an ($\varnothing_O$). It follows that placeholders involve in both cases vibrations and fluctuations at the kinetic level, which however from a kinematical point of view are producing implicit flows.

What shall be communicated is in fact appearing as an undercurrent. And that, which indeed is a current, constitutes the stream in a verbal flow. It follows that the spin of the corresponding dot is producing a “vertex”. But equally important is the observation that the Latin verb (‘verto’) implies the process of “becoming” (in German ‘werden’; in Swedish ‘varda’). Furthermore, the second meaning of this Latin expression involves a whirl in something flowing (‘flumen’). Since the A- and O-strings are firmly fixed with their tails in the a-component their rotation must revolve around the (a). But their winding and twisting transforms the strings in that they are “becoming” strands. Strands appear at the kinematical level and are constitutive of their contextualisation as well as of the helical property of an entire AaO-configuration.

By letting the bookkeeping device update the effects of the rotating dots, cyclic and rhythmic or clock-like movements can be captured. Hence the developed procedure has the capacity to calculate if and to what extent there is something for the (a) in the AaO-unit to operate on, i.e., to bring a string-vector into a forward movement through a clockwise rotation. The self-referential property of the AaO’s is integrating the results of clockwise and counter-clockwise rotations as particular kinds of textual appearance and its updating is thereby generating a manifold of novel symmetries. Since they are the consequences of the processed vectors, with respect to the emerging space, these symmetries have important theoretical implications.

Clocking Mode

Any formal inquiry into the cycles of “writing-reading-rewriting” in text production has to be concentrated on an adequate synchronisation of the rhythmic, clock-like working in the mending operations. At the textual level, it has been demonstrated empirically (I. Bierschenk, 1999) that the strands in their phase transitions are governed and controlled by nine different second order structures. From a geometric point of view, second order structures have the function of messengers, which refer to the direction and length of a continuous portion of a clock’s work. Hence, each clock has its own nine messengers, which are determining the turning direction of the strands and the speed in the displacement of the produced variables.

For example, it is an established empirical fact that the O-clock initiates required displacement operations from down and leads the course of cyclic returns to the placeholders upward. In contrast, the A-clock initiates the required displacements from the top and steers the work of the corresponding S-function in downward direction (Bierschenk & Bierschenk, 1986). In a straightforward application of these operations to Figure 1, it is possible to derive the dynamical properties of (S_O) as the roots of a variable composite from the recombination range of the involved components. Since the resulting integration is a function of variable movements, the locally constraint replacement of a ($\varnothing$) through the displacement of a segment of text can likewise be evaluated on the basis of locally constraint accelerations in the rotation of the dots. This measure allows for the coupling of the rotations of individual dots at the micro-level with the trend in the dynamics of the involved variable composites. Moreover, since evolutionary changes can appear only in the roots of a variable composite, this kind of integration generates the layers, which constitute the basis for the root production of a many-folded composite. Thus, the roots of a composite are establishing themselves through self-organisation and "self-reference" (B. Bierschenk, 1984).

Emergence of Ring-structures

Whenever messengers are influencing the resolution of a specific language equation, its evolutionary properties are observable as emerging ring-structures. The concept of a ring-structure must be separated from the notion of an area, since an area consists as a set of points of zero-dimension, standing in definite relation to one another. However, the ring is founded on the premise that neither strings nor strands at its foundation can be point-like or zero-dimensional (Greene, 1999, p. 14). Hence a ring-structure might be extremely flat and appear to be two-dimensional, but it is definitely not two-dimensional (Winfree, 1980; Hardison, 1999; Kurths, et al., 1999). Each and every configuration of AaO's must contain a ring at its centre, which means that the basic interaction between participating A- and O-strands is preserved in the belt of a ring.

Since the work at the kinematic level of the AaO's is producing winding (W) strands, (W) can be used to indicate the particular mode of transforming kinetic energy into ring-structures. The magnitude of transformed kinetic energy can be determined topologically through the length and articulation of wound strands on which variables are moving. However, the variable composites of the A's, and O's, have contrasting as well as multiple functions. For example, when the formation of layered variable-composites is taken as a significant expression of energy transformation, processing must be related to the "key"-function of the "AaO-ring" in the study of dynamical variable movements. This means that the process of equilibration must arrive at a "Fliessgleichgewicht", i.e., overall symmetry at the kinematic level is the consequence of kinetic processing. In the context of the AaO-rings, these symmetries are resulting from the requirement that the A's and O's must come in pairs. Hence, pairs, which become enclosed through the "operational closure" of an AaO-ring, lead to qualitative statements about emerging symmetries.

Magnitude of a Strand

From an evolutionary point of view, the production of a string appears in the presence of a small kinetic potential (v_p). Since the v-function of a string represents the energy needed to produce a signal of "intent", it is controlled by a stepping function (i), which governs the materialisation of a kinetic potential in the form of a signal (σ). Moreover, kinetic energy is generating the flow-field in which produced strings can vibrate and fluctuate. However, when strings are resonating ($\Delta\sigma$), they are producing a spectrum for the expression of ($v \wedge \sigma$), which leads to the bi-directional grapheme-vector ($|g|$). Hence, the outer product ($\wedge$) provides a unique relationship, which constitutes the foundation for a distinction between direction and orientation as a function of states. Hence the expression of "uniqueness" in the form of (g) has simultaneously to be contrasted with the property of "pureness".

The significance of this definition of the strings, operating in a flow-field, is founded on the hypothesis that distance is a function of rotational acceleration and that "spinors" (Hestenes, 1986/1993, p. 30) have the capacity to carry string-configurations of varying complexity. Thus, any phase transition from a virtual (v) state to a material (σ) state must result in an increase in rotational distance and spinors offer a control of the involved attitude change or transformation. Furthermore, spinors have the capacity to establish rotations at the textual level in the form of a prismatic textual surface and to represent graphemes as oriented surface segments.

Hestenes (1986/1993, pp. 66-68) asserts that the angle ($|\theta|$) represents the magnitude of a spinor. This magnitude is just twice the directed area of the circular sector between two vectors. This relation is determined by the simple proportion of an “area of a sector”, when put in relation to its “arc length” ($\pi i/2\pi$). Since the circumference of a circle is proportional to its radius (Greene, 1999, p. 238), this relation can be used thermodynamically in the determination of ($e^{i\pi/2} = i$), which is expressing the degree to which vector (σ) can wrap vector (v) through “curling” (Greene, 1999, p. 188). Hence, the directed area between the vectors (v) and (σ) represents the magnitude in the orientation of the spinor $|g|$. It follows that twisting and bending is determining the minimum state in the rotation of a segment of texture. However, in their relaxed states, vibrating and fluctuating strings are looping, which can be expressed geometrically as the zero displacement of (g).

In an attempt to make the strings of (g) operational, it is assumed that kinetic energy is stored in folded sequences of (g). Furthermore, the bending of sequences is assumed to be the sufficient condition for the functional expression of contextualised (g) in the form of strands. In building on the relation ($v\bullet\sigma = \cos\theta$) and ($v\wedge\sigma = (i)\sin\theta$), the inner product ($\bullet$) of (v) and ($\sigma$) can be used to express the condition of a “non-resonating” string through the symmetric scalar-relation [$(v\bullet\sigma) = 0$]. Based on the extraordinary capacity of the AaO’s to control the angular folding of strings into strands, as well as to express their specificity, this capacity has been manifested operationally in the reformulation of (g). By pre-multiplying the spinor with the vectors (α, β), the result can be used to associate a certain orientation with a particular configuration of (g). This measure transforms a g-configuration through two kinds of scalars that generate the orientation dynamics in the strands.

The first corresponds to the rotational angle in the A-component, which is indexed with the alpha-vector ($\alpha = e^{i\phi/2}$). The other concerns the angular articulation in the O-component, which is indexed with the beta-vector ($\beta = e^{i\theta/2}$). Hence, both are variables, which are uniquely identifying the orientation in the displacements at each site. In spinor terms, it can be stated that the expression [$(\alpha\beta) = e^{i(\phi+\theta)}$] is taking into account the coupling of the rotational movements in the strands. Accordingly, multiplicative couplings can be expressed as [$(e^{i\theta}\, e^{i\phi}) = e^{i(\theta+\phi)} = e^{i\phi}\, e^{i\theta}$], which follows from de Moivre’s theorem [$(e^{i\theta,\phi})^n = (e^{in\theta,\phi})$] as explained by Hestenes (1986/1993, p. 68).

But coupling and winding through multiple states can be made manifest only through the establishment of the strictness in the bonding operations. It follows that variable movement through the strands must be captured through a stepwise processing. Since a stepping function is underlying the establishment of the magnitude of a particular displacement operation, selectivity in the movement dynamics at the kinematic level can be captured and expressed by spinors of mixed grades.

Intermittent Phase Transitions

Intermittent phase transitions are constraining the rotational speed of the variables on a particular strand. This kind of constraints is producing splicing through twisting and twining strands on which the movement of the variables can be observed as accelerations. Further, as shown in Figure 2, in using the clocks in the determination of the degree of twisting and twining of a composite on a particular strand, it is made evident that phase-dependent displacements are responsible for “phase drifting” in the splicing.

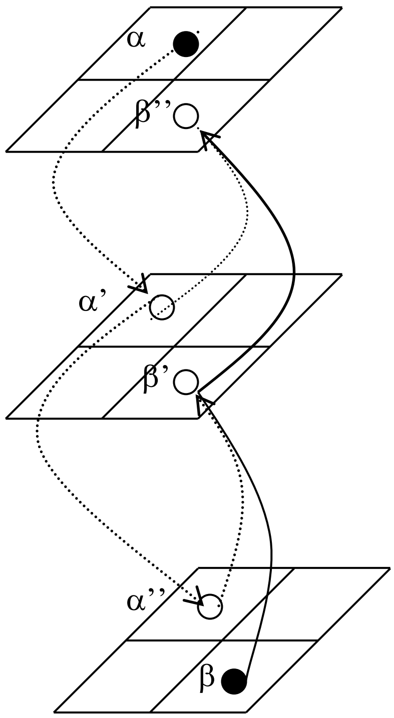
A definite outcome of the processing is the detection of the mono-layered composite in the position of (A_1) and ($\varnothing$) in the positions of (A_2) and (A_3), which are initiating the necessary channelling operations. The corresponding second order structures are initiating the processing cycles of the variable on the α-strand. The corresponding stepping function is associated with the text segment (‘Most people’). In turning to the next following position, it becomes necessary to activate the S-function. Its task is to copy the text-segment and rotate it into the position of (A_2). This action results in a twist in the α-strand, which however leaves the grapheme pattern unaffected.

Figure 2.

Splicing in the Production of an Expanded Ring Structure

Evolution	*Development Text*
A_1	Most people
a	would
O_1	$\varnothing$
	,
A_2	$\varnothing$
a	like
O_2	$\varnothing$
to	
A_3	$\varnothing$
a	go
O_3	home

Change in Twisting *Twining*



Hence, duplication implies a sliding in the path of the moving variable, which is indexed with (α'). Moreover, as shown in Figure 2, it is obvious that exactly one value is associated with each step in the splicing of a strand. The course of the movement shows that rotational distance is increasing with growing W-numbers. As demonstrated through the developing path, the thermodynamic work is performed according to the following relation:

[$A_2 = W_{\alpha'} - (\sqrt{A_1})$].

When the same kind of operation is applied to (A_3), it becomes evident that (α'') is maintaining the course over the involved flow-fields. Corresponding changes in the depth of sliding on the kinematic path are developing into a forward-oriented shade. But the twisting in the strand appears in the relation:

[$A_3 = W_{\alpha''} - (\sqrt{W_{\alpha'}} + \sqrt{A_1})$].

Besides marking the twisting in the expression, re-iterative copying of the original (α) implies a decrease in magnitude, which is expressing a certain degree of "fading". At every step in the re-iteration, the function is responding with the output of a magnitude, which may change its sign with an increase in fading. As represented by the (α) variable, a moving "point of observation" is contained in the kinematic path and determined by the specifying shadows. Moreover, stable (i.e., solid) as well as non-stable (i.e., shadow) points, as demonstrated by the re-iterative copying operations, are reciprocally specified. By means of the copying process, it is made evident that self-reference is a natural part that can stretch over several flow-fields, which makes the involved clock to tick slower the heavier the twisting becomes. Without this kind of self-reference, it would be impossible to determine the involved transformations. It follows that single composites are organising themselves in a twisting space which is negatively curved. By definition, negatively curved spaces are "hyperbolic at any level" and require that ordinary geometry is replaced with what has become known as non-commutative geometry (Connes, 1994; Greene, 1999, pp. 379-380; Hestenes, 1994, p. 66).

In contrast, channelling through the ($\varnothing_O$) means that the reiteration process leaves the trace of a sinking text-segment. Applied to Figure 2, channelling shows that the S-function has detected a mono-layered segment, namely ('home') in the position of (O_3). In capturing the consequences of the gating of the β-strand, the variable must be lifted into the neighbouring position, which requires a counter-clockwise rotation into the immediately preceding position. This capacity of the S-function is related to backward shading. In turning to (O_2), it can be made obvious that a copy of the text segment is required as filament. Since the needed complementary part of the filament is associated with (α''), the variable must change site in order to co-operate and become an integrated part of variable (β'). This kind of functional change appears as twining, which results in the following expression:

$$[O_2 = W_{\beta'} - (\sqrt{O_3} + (\sqrt{W_{\alpha''}} + \sqrt{W_{\alpha'}} + \sqrt{A_1}))].$$

Obviously, the shades of a "point of observation" are manifesting changes in the direction of focus. The S-function is merging the result with the shades of the "point of view". However, winding the "shadow", associated with the resulting variable-composite, into the position of (O_1) is not sufficient, since the operational condition calls for the "shadow" associated with (α'). This condition is captured in the following expression:

$$[O_1 = W_{\beta''} - ((\sqrt{W_{\beta'}} + \sqrt{O_3}) + (\sqrt{W_{\alpha''}} + \sqrt{W_{\alpha'}} + \sqrt{A_1}) + (\sqrt{W_{\alpha'}} + A_1))))].$$

Hence, splicing makes the overlapping shadows of the (β'') variable two-fold dependent on the α-strand. Furthermore, (α) is crossing several times which accentuates the shadow-like appearance in the O-component. The result corresponds very naturally to the computation of different kinds of changes in direction and orientation, which develop on the basis of shadow-like (i.e., soft-moulded) overlaps and repeated couplings of the β- strand with the α-strand. These phase-dependencies constitute the basis for the operational definition of the concepts of "speed" and "acceleration" in the expression of geometric distance.

As shown in Figure 2, splicing in the transformation of variables implies that the composites move always in the counter-clockwise direction. Thus, the composites are operating in flow-fields, whose significance is founded on the hypothesis that their geometric distance on the path between the flow-fields is determined at the vertex. It follows that local and interval-dependent interactions with the surrounding context can be demonstrated through the changing magnitudes of the W-numbers of the involved strands.

Further, it is showing that the involved cyclic returns move the associated text segments counter-clockwise and in the same direction even though several flow-fields may become involved. However, these operations require heavy copying. Tracing the number of copies means tracing the number of times a particular text segment has been copied. For example, the variable of the β-strand, representing the original pattern rotation in the O-component may change its sign, despite the fact that the rotation brings its β-strand back into the condition where the rotation displacement was initiated, namely at the vertex of (β’’). The rotation at the involved vertex can be expressed in numerical terms by the equation of the S-function:

$$S = [\Phi - (\sqrt{\phi} + \sqrt{\theta} + \ldots k)].$$

Hence the S-function is calculating height or distance as the magnitude of (Φ) minus the roots of magnitudes in the rotation of the moving variables. Furthermore, the copying process indicates shadow-like movements, which have to get their expression through the reduction of the solidity in the original text segments. Additionally, in tracking generated copies, it can be demonstrated that “channels” have come into existence, which lead to a coherent gating of the involved movements. The concept of “channel” allows for the introduction of the concept of “neighbourhood” as foundation for the definition of “sliding”. Since it is the result of overlapping phase transitions, both concepts have been shown to be of import for the demonstration of phase drifting.

Quantification of a Verbal Expression

Strings in Nature’s fabric of a language space of in fact unknown dimensionality become materialised in the moment when a verbal flow becomes manifest in the form of text. Since individual strings are the elements of text production, the relation between the flow, the individual strings, and their textual context needs to be addressed and made operationally accessible through quantification. The introduced geometric formalism allows for the quantitative control of individual string rotations on the micro-level and their coupling with the helical trend in the strands evolving in the language space, and therefore pattern rotation can be expressed as the gradient dynamics of the involved strands. Moreover, the evolution of strands and the production of variables is not only the result of self-organising processes but require the concept of self-reference as synthesising mechanism. While self-organisation can be observed in the neighbourhood of a thermodynamic equilibrium, the self-reference mechanism is pushing toward equilibrium and is thereby producing space. From a kinematical point of view, this process of equilibration continues until all parts are in balance. Hence, balancing the processes of string production guarantees order, and consequently the quantification of the flows in verbal movement patterns.

Non-linear relations are indicating the mode of producing sequences of bonded A’s and O’s. Further, it has been made evident that this systems approach is addressing variable dynamics as rotational operations, which lead to graded spinors. The work done by a particular configuration of AaO’s is resulting in the winding paths on which produced composites are moving. From an evolutionary point of view, winding can be conceived of as a particular mode of variable concentration, which appears in wound strands. This kind of systems measure has been established on the basis of the following sequence: [$Aa\varnothing_O$, $\varnothing_A a\varnothing_O$, $\varnothing_A aO$]. The illustration in Table 1 makes evident that its manifestation is based on the expression of two trivalent components. The manifested sequence shows the production of mono- and multi-layered composites, rotating on wound strands, which leads to a physical measure of neighbourhood and phase transitions. These are related to Sentence Markers (‘.’) and Clause Markers (‘,’ ‘to’), which are indicating intervals. For example, when a Clause Marker like (‘,’) is involved, it means that any variable rotation is confined by the corresponding interval.

Table 1.

Spherical Dependency of Layered Composites

Textual Surface	Integration Case	Winding Value (1/1)	Curling Value (1/10)	Valve Value (1/100)	Vertex Radians[1]
.					
Most	Case 5		0.314	0.314*0.04	
People	α_1	$\phi = 3.14$	0.314	0.314*0.06	*3.7994*
Would	Case 9	(ω)	0.628	0.628*0.05	
∅	$\beta_1 = (+(\alpha_2)[\alpha_3\beta_3]))$	$\theta = 6.28$			*- 8.9238*
,	Case 8		0.550	0.550*0.01	
∅	α_2	$\phi = 5.50$			*4.1063*
Like	Case 9	(ω)	0.628	0.628*0.04	
∅	$\beta_2 = (+[\alpha_3\beta_3])$	$\theta = 6.28$			*- 1.8157*
To	Case 8		0.550	0.550*0.02	
∅	α_3	$\phi = 5.50$			*1.6061*
Go	Case 5	(ω)	0.314	0.314*0.02	
Home			0.314	0.314*0.04	
.	(β_3)	$\theta = 3.14$	0.314	0.314*0.01	*3.7868*

[1]the exponential function and its series expansion require that angles become measured in radians. The tilt of strings is [(arc $(\phi,\theta) = (2\pi/360)$] (Hestenes, 1986/1993, p. 75).

As made explicit in Table 1, the latter circumstance relates to the coupling function as well as to the steering function of the second-order structures. Geometrically conceived, the share in the prismatic textual surface of a particular variable is related to the folded specificity of neighbouring grapheme-sequences. In computing the developing ring-structure, bookkeeping of the involved rotations is carried out in the following way:

The winding magnitude of a strand is taken as basis (1/1). Every folded segment of this strand is treated as an expression of the variable's resonating property. Since it is an expression of the strand's contextual circumstances, its surface-oriented "curling" plays a complementary role, which is accounted for by adding the fraction of (1/10) as "curling-value" to the basic "winding-value" of the strand. Thereafter the contextual fitness-value is added as a "valve-fraction" of (1/100) of the winding-value, but multiplied with the number of folded graphemes. This procedure is reiterated for every segment of the strand. If a strand is growing, this lowers its short-distance sensitivity and thus is increasing its folding capacity.

This measure allows for the numerical representation of "rotational distance". It follows that "intention" is mediated through an exchange of strand properties by means of the flow-fields. Since the flow-fields themselves are made up of resonating as well as non-resonating strand-segments that mediate different kinds of orientation, the directional turn of a winding strand must take into account all deviations from surface uniformity. In conclusion, the dynamics in a ring-structure resides not in the physical reality of a segment, but in the hypothetical fraction or "share" it has in the transformation of string-compounds. As shown, the quantitative solution of the given AaO-sequence requires the existence of at least two differently materialised components. This condition has been illustrated with the text example: ('most people would like to go home'). The numerical solution is based on the condition that the materialisation appears in the first and the last position.

Finally, if the bonding of the A's and O's in the expression would appear to be dependent only on linear relationships, its reconstructed text space would appear stationary. However, the strict dependency in the bonding is governing a displacement mechanism, whose work is preventing the production of stationary results. Since, it has been possible to express the overall dynamics of the A's and O's as distance from the thermodynamic equilibrium, it can be shown that cyclic phase-transitions are determining the helical properties of their strands. These transformations proceed over the sequencing space of the locally determined string production.

Extension and Expansion

With the produced flow-fields as intermediaries, messengers and layered composites provide the ground for the establishment of the shapes of a text space. Since materialised strings appear at the textual level as "graphemes", they mark certain resonance properties. This means that text production must be related to string-variety as well as grapheme-variability. In view of the fact that an expression of the individuality of a string manifests itself through the presence or absence of grapheme on a strand, uniqueness in resonance and individual growth appear at the kinematic level as textual surface properties, which are observable as the magnitude of the strands lying in the "texture" of a textual surface.

Moreover, the production of new segments of a strand is a process, which generates the foundation for extensive grapheme folding while strand expansion is marked through the duplication of a previously produced segment of texture. Extension means the production of new mono-layered variables, which is influencing the development of new segments at the textual level. On the other hand, expansion implies the production of "holes" in the texture and consequently an elaboration of the produced approach path through placeholders. The difference between extension and expansion can be expressed experimentally in two distinct ways. One way concerns the duplication of a grapheme configuration. The other refers to the degree of reiteration, which specifies the degree to which a particular configuration is readdressed during the course of writing. Whenever the evolutionary process requires the integration of a variable into composites, rotational transformations perform the transition from the expression of strings to the evolution of a complete numeric structure.

Experimental Validation

When language is conceived as system, it becomes demonstrable that the AaO's of this system carry intentional cues and contain information about the produced orientation in the pattern dynamics of the system. Hence, to speak of shapes of a language space makes no sense in the absence of the responsible originator or agent. In particular, the AaO's have been shown to embed structurally the text producer's point of observation as well as his point of view. This condition pinpoints the dynamical behaviour of the text producer through the AaO-mechanism. Furthermore, this section will present the apparent contour similarity of three spaces, which are the result of a natural text, produced in English and its translation. In a first step, the original text has been translated into Swedish. A second step concerns the translation of the Swedish text into Italian. Hence, this strategy makes it possible to compare the achieved description with the dynamics induced into the original language system through its translation into Swedish and Italian. By extracting the orientation and direction in the identified pattern dynamics, their asymptotic performance provides the basis for a thermodynamic description of the text examples.

Related to the given examples, the established spaces will be compared in a complementary manner. It is expected that the outcome of this evaluation will make evident that the principle of disparity comprises the foundation for the judgement. For example, it is expected that all the main features of the shape of the original O-space reappear in the O-spaces of the translations. With the purpose to establish the overall symmetries concerning form, function and morphological properties, the O-spaces will be contrasted with the A-spaces. Furthermore, symmetries will be made evident on the basis of changing shades, which are expressible as phase drifting. Moreover, multiple rhythms and drifting in the phase relations will be evaluated on the basis of the contour of the corresponding space. It is expected that the observable changes in orientation and direction of focus are partly the result of complementary relationships, partly determined by the generated drifting. Drifting in the phase relations has been shown to govern the expression of successively increasing or decreasing shades in sliding. However, the numeric resolution of a language specific structure is observable only through an analysis of the anti-symmetries, governing the sequencing of graphemes and the symmetries, producing the composites at the kinematic level of production.

The basic hypothesis of the experiment is that a subtle interplay between the oscillating strings and winding strands is creating the language space. It follows that this hypothesis concerns the capacity of the discovered mechanism to handle the subtle distinctions that are created by textured strings in the process of producing space. At the same time the space hypothesis (Wheeler, 1999; Greene, 1999) relates to the fact that the evolving space is restricting string rotation. From the point of view of the experiment, this hypothesis implies that a verbal expression is suitable for processing, provided that it contains cues to its capacity of stretching and straining, and of winding and bending. So, a verbal material has to respond in an elastic way to the dynamics of evolving textual patterns. It is therefore not a coincidence to suggest that a text material must be characterised by flow properties and that these are decisive for the rotational dynamics, and consequently for the textual space being realised.

A consequence of this requirement will be the characterisation of the loss of stability in a text. By this is meant that a scientific study of language as a natural phenomenon must begin with an observation of such losses of stability – in other words a study of discontinuity. Accordingly, an exact characterisation and formal description of cycles of "writing – reading – rewriting" have to be concentrated on a likewise exact characterisation and precise description of the phase transitions connected with the evolving textual space. Finally it is of crucial importance that a test of the basic experimental hypothesis builds on an uncovering and a reproduction of those kinds of order constraints that are controlling the production of a space. The described strategy has this capacity and therefore the experiment can be based on the following methodological properties:

(1) demarcation of controlling constraints
(2) manifestation of the acceleration in a rotation and
(3) identification of the fundamental order constraints

The theoretical significance of the properties, which are governing the production of a space, lies in the determination of the phase transitions involved on the kinetic level and in the determination of the flow morphology of the text at different occasions of change. The changes at different phase transitions are of course influenced by the observations that the text producer has made and communicated. To communicate is a matter of realising both objectives as well as a perspective. In seeking a most precise formulation for communicating a concept, Skinner's citation of the American behaviourist John Broadus Watson (1878-1958) will be made the starting point for the establishment of the conceptual foundation of the Watson-Skinner approach. According to Michael J. Mahoney (personal communication, March 5, 2001) the following quotation comes from Watson:

English Text Example
Give me a dozen well-shaped, healthy children and I guarantee that I can take each one randomly and train it, to become just any specialist you like, doctor, lawyer, artist, yes even master thief, totally irrespective of the child's ability, interest, race, or ancestors.

The example shows that an evolving text requires the integration of the concept of growth, meaning on the ecological communication level, that the interplay between string-compounds is becoming synthesised to a comprehensible text surface. In the actual case the text surface is composed of resonating strings, which generate the kind of English text that B. F. Skinner may have produced.

To pronounce an observation so that a verbal flow appears or to write an observation into text, by necessity requires the interplay between intention and orientation. At the kinetic level of text production, this means that grapheme-compounds must be regarded as the result of a microscopic synthesis. Since the presented approach is proposed to be valid regardless of language, the text example has been translated into Swedish. The translation has resulted in the following surface:

Swedish Text Example
Ge mig ett dussin välskapta, friska barn och jag garanterar att jag ska ta vart och ett slumpvist och träna det till att bli vilken slags specialist som helst, läkare, advokat, konstnär, ja till och med mästertjuv, och det helt bortsett från barnets förmåga, läggning, ras eller förfäder.

Just like the English original the Swedish translation consists of a composed sentence, in which the parts in correspondence with the English text show a rigidly stacked textual surface. From the experimental point of view, it is this property that initially has been judged important in order to prevent the translator from introducing changes in the textual articulation or some other text specific re-formulations, which de facto are not present in the original English version. Since the original and its translation, belonging to the German language family, are fairly close, it is expected that the produced pattern dynamics are similar and that the corresponding textual spaces must have similar contours.

However, during the process of translating the English paragraph into Swedish the translator is providing his "own unique physical context" (Kugler & Turvey, 1987, p. 213) which is introducing new constraints. These constraints come into existence through the translator's way of putting the original text into his own perspective. By necessity, a translator is expected to produce selective changes as a response to the requirement of language-specific organisational adjustments during text production. To be sure, through the translation, a first step is taken to bring the concept of intention under rigorous experimental control and to construct "information laws" that build explicitly on the translator's intention as governor of a textual re-organisation. Moreover, to get a deeper understanding of the process of intentional adjustment and how this process is influencing a translation, that is generating apparent organisational differences at the textual level, a translation of the Swedish translation into Italian language has been undertaken.

Italian Text Example
Datemi una dozzina di bambini sani, e garantisco di poter prendere ognuno di loro casualmente per educarli a diventare specialisti in qualsiasi campo, medico, avvocato, pittore

e perfino un ladro esperto senza considerare la capacità del bambino, il suo temperamento, la razzo o i suoi antenati. [Translator: Swedish Subject Teacher Elisabeth Palazzi, Gymnasium in Lund, Sweden]

In the absence of any specific parametric influence on the reproduction of the Swedish text in the form of an Italian translation, it is expected that important constraints can be identified and that the resulting pattern dynamics can be made visible. However, testing the space-hypothesis (Wheeler, 1998, p. 139) will follow the mirror-strategy, proposed by Greene (1999, p. 278). In a first step, the A-O-pairs have been split for the purpose of establishing the space of the "textual objectives" (carrying the points of view) belonging to the O-component. A second step implies the establishment of the space of the "textual agents" (carrying the points of observation), which belong to the A-component.

At a first glance, it may seem as if this measure would destroy the strict dependency in the coordinative co-operation of the A's with the O's. Furthermore, producing a space this way is expected to lead to results that would be somewhat difficult to interpret. On the other hand, if the separation of the A-O-pairs could lead to a step where the space of the "perspective" can be separated from the space of the "objectives", this step would give expression to a very radical test of the anticipated validity of the AaO-axiom. Finally, if the ideas behind the stated space-"tearing" hypothesis would turn out to be a misconception, there would be "no reason in the world to expect anything but a random collection of digits" (Greene 1999, p. 278).

The Strokes of the O-clock

As a first step in getting hold of the space of the O-component, it is important to reproduce the number of objectives, which the O-component is holding. The number of objectives is a limitation that relates to the strictness in the composition of the variables. To convert the corresponding scatter plots to mesh plots, the SigmaPlot grid (1998, pp. 290-292) has been interpolated with its standard transformation function, which is using an inverse distance method, where the distance weight value (p) has been set as (p = 3). The Y-axis of the mesh represents the naturally occurring intervals in the way they have become manifest during text production, while the X-axis shows the number of objectives, which relate to the sliding within a particular interval. Three spaces have come into view through the Figures 3, 4 and 5. Two of them are closely related while the third deviates in the dynamics characterising its pattern movement. However, a very high degree of similarity in the geometric form of the English, Swedish and Italian spaces can be verified by visual inspection.

Obviously, corresponding unfolding operations entail the concept of time and its expression through successively increasing and decreasing shades in the articulation of the objectives. In this way it has been possible to visualise the dynamic aspect of the shapes in the form of a three-dimensional space. The space determination makes clear the phase dependency in the pattern rotation of the objectives. Ostensive contour-similarity of the shapes implies exactness in the coordinative expression of the objectives on the translation level, which, in itself, is a transition from one macro state to another. The emergence of macroscopic attractor states constrains the text building behaviour of the individual translator (at the kinetic level). But the remarkable contour-symmetry is another proof that multiple rhythms and various delays at the phase transitions are demanding some "order constraints" that are operating in the continued and refined analysis of grapheme-compounds and their co-operation at the physical level. The unique property of the Swedish text becomes obvious by focussing on the dynamics of the developed space.

Figure 3.

Layout of the Phase-dependent Oscillations in the Textual Objectives

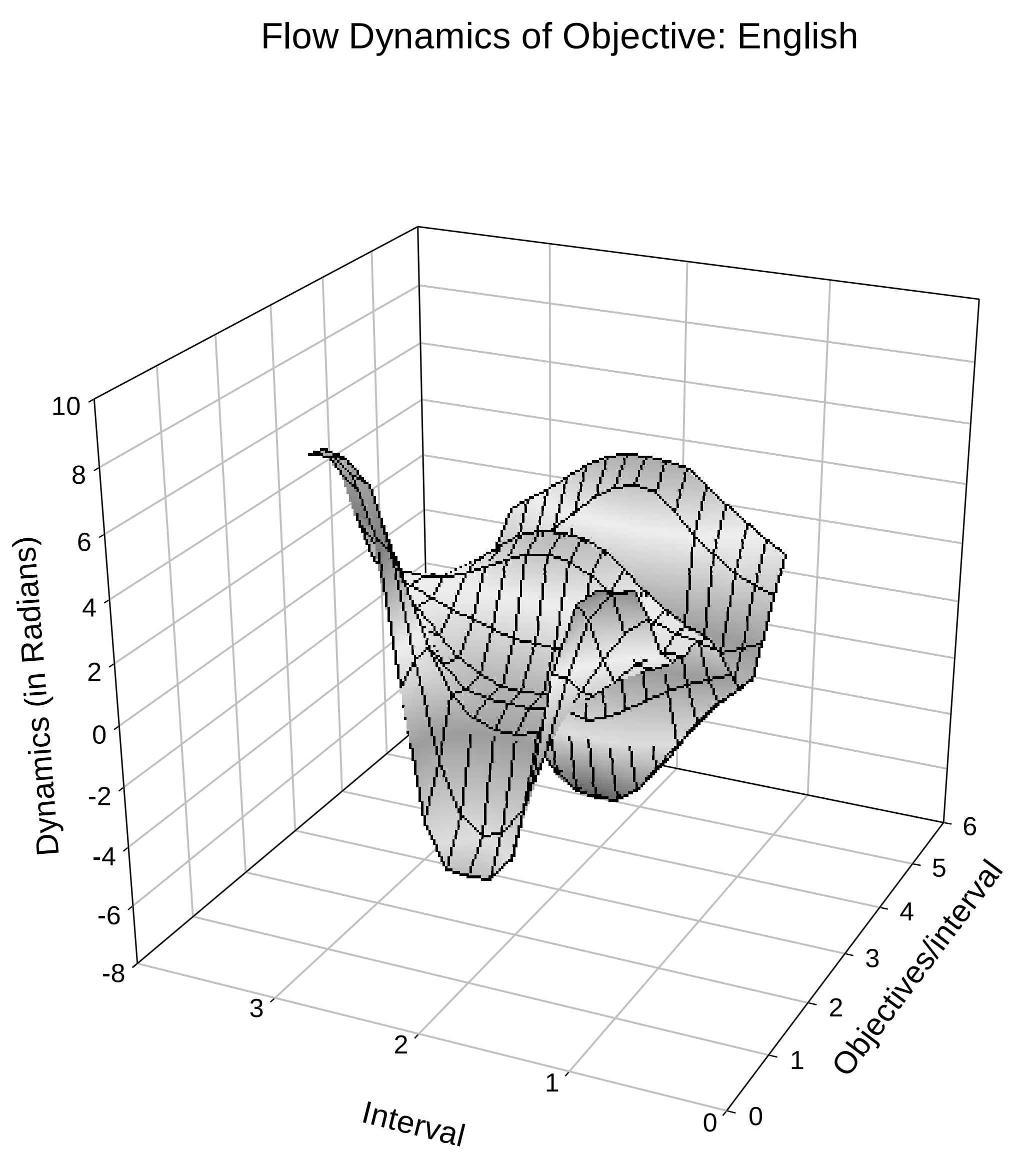


Figure 4.

Translation from English into Swedish

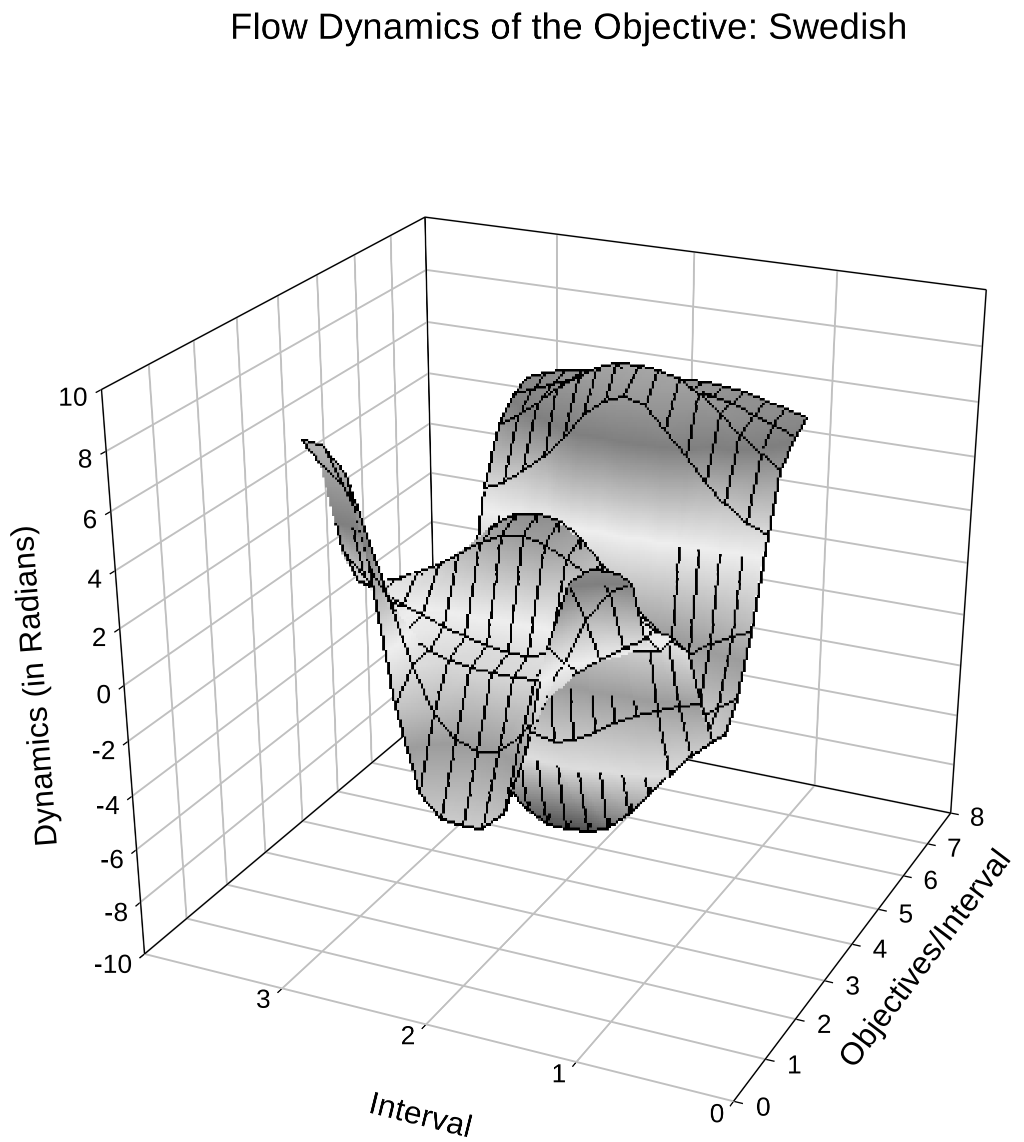
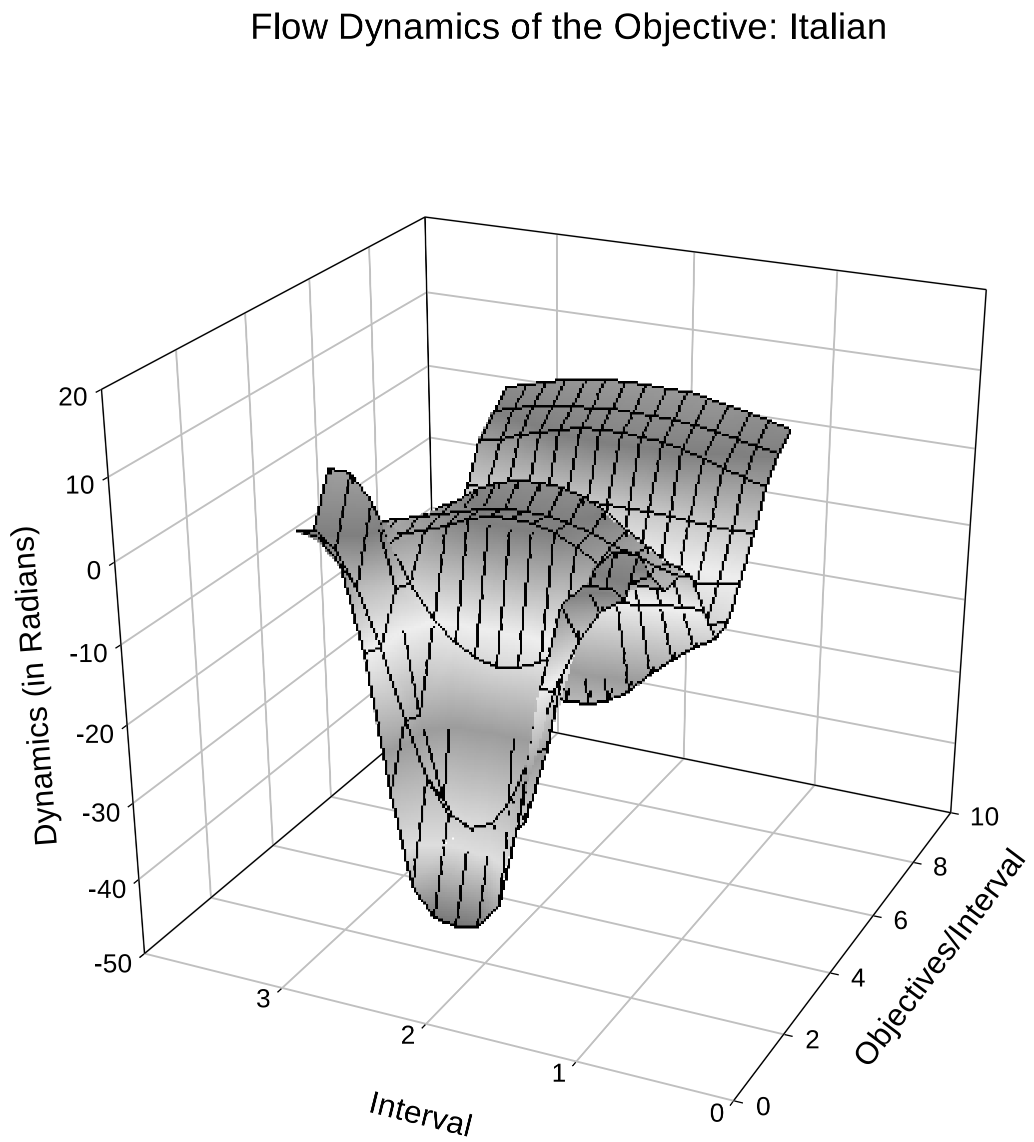


Figure 5.

Translation from Swedish into Italian



Some small divergences emerge in the delay of the transition from the fifth to the sixth objective. This delay is caused by the preposition (”till”), which points toward the duplication of a variable composite of the Swedish text, which has not been produced during the processing of the English text. The composite being addressed through the preposition has led to a slight stretching. This means that the phase transition has been somewhat delayed. A further source of divergence is related to the transition from objective seven to eight. The reason is the difference in the translation of the phrase (”irrespective of”). The result is even in this case a stretching, which requires the duplication of an objective.

In contrast to the English formulation, the translator has chosen a slightly more active construction (”och det helt bortsett från”), whose corresponding English wording would rather be (”disregarding”) or (”leaving out of account”). This shade of meaning has also forced a delay in the transition. Hence, both divergences imply a temporary slow-down in the O-clock’s ticking but are simultaneously extending the path through duplication. However, seen over the entire range of the two spaces, these tiny are divergences. Since text production is always a result of breaking the influence of spatial and temporal order constraints or at least reducing their influences, minor deviations are only natural. Finally, in comparing the Italian space with the others, it can be concluded that the internal existence of constraining limitations is placing the rotation of the patterns in the same range of space, however with a markedly higher degree of variation in their dynamics.

The Strokes of the A-clock

The goal of a separate study of the A-component as an autonomous generator of pattern rotation is to show that the production of textual agents relates to the generation of changes in the direction of focus, and consequently a different space-orientation. Therefore, of special interest is the unfolding of the behaviour of the A-clock. In splitting the space, the produced changes in the direction of focus are manifesting themselves in Figures 6, 7 and 8.

As shown, the English and Swedish trajectories are developing identically until they reach the fifth agent-variable. At this point, similarity is broken in that the Swedish trajectory is being somewhat delayed in its course. The delay is an effect of re-addressing a variable composite, which is temporarily delaying the course of the trajectory. However, compared to the English trajectory the involved duplication implies simultaneously that the speed of the clock is slightly increasing, since the path has been extended. But, re-addressing a variable composite several times means that reiteration is temporarily trapping a process, and hence delaying a phase transition. This kind of behaviour results in phase drifting, which is an effect that is especially marked in the course of the English trajectory.

When the Italian trajectory is compared with the Swedish, it appears that the oscillations in the variables of A-component have developed in a very similar manner. The order constraints are temporarily trapped by the “shadows” of preceding attractions. For example, the effects of a change from one system state (variable composite) into another (copy of a variable composite) are determining how the limitation is governing accelerations until the process is reaching the fifth agent-variable. At this point, the course is not only producing delays, and consequently differences in acceleration but also differences in speed, since the Italian trajectory is extending.

As mentioned, in the Swedish case the stretching operation is pronouncing the governing rotation. In contrast, the space of the English text is exhibiting decreasing speed, which is slowing down its A-clock. Hence, a larger increase in distance is primarily a function of rotational acceleration. When compared to the English A-clock, it can be concluded that the Swedish A-clock runs slightly faster. But the Italian A-clock runs even faster than the Swedish.

Figure 6.

Layout of the Phase-dependent Oscillations in the Textual Agents

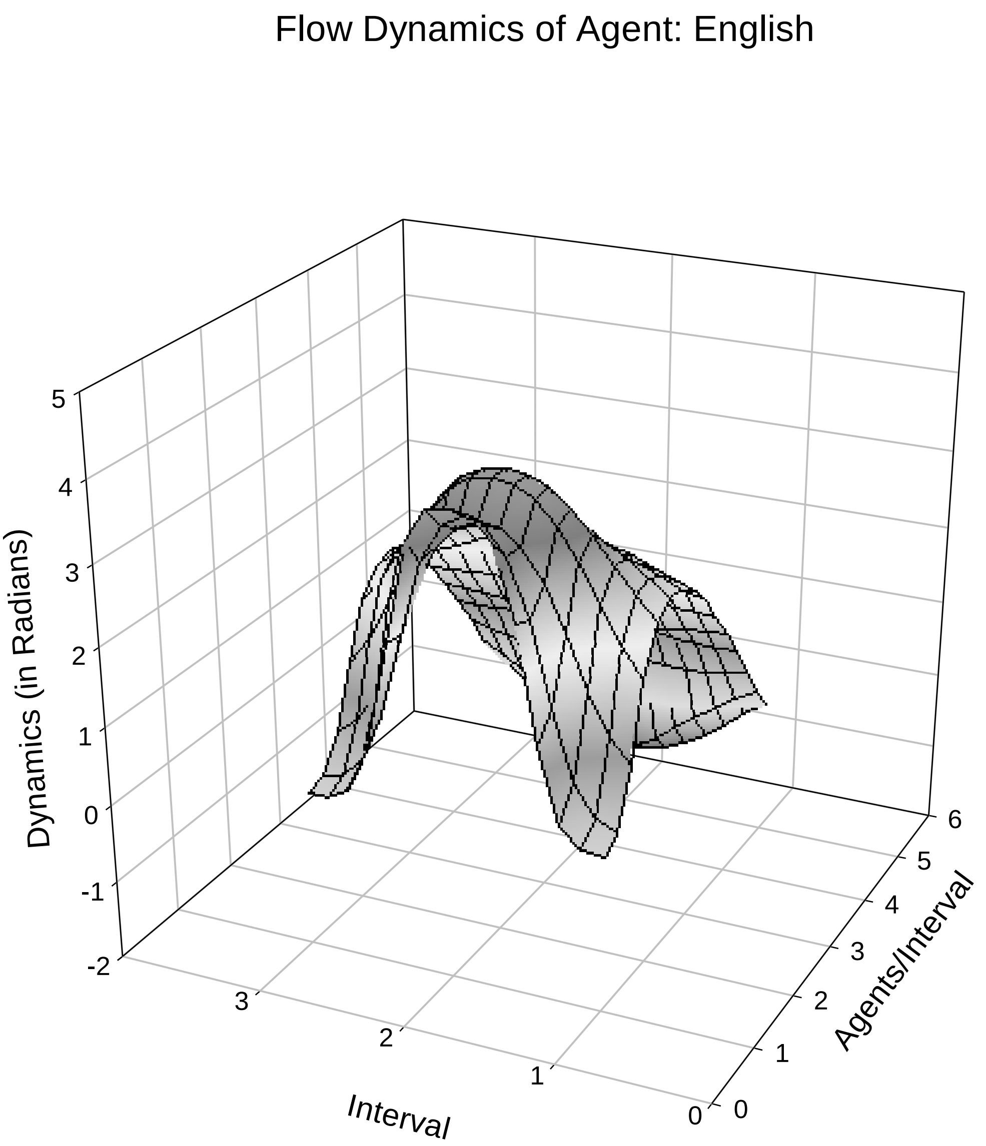


Figure 7.

Translation of English into Swedish

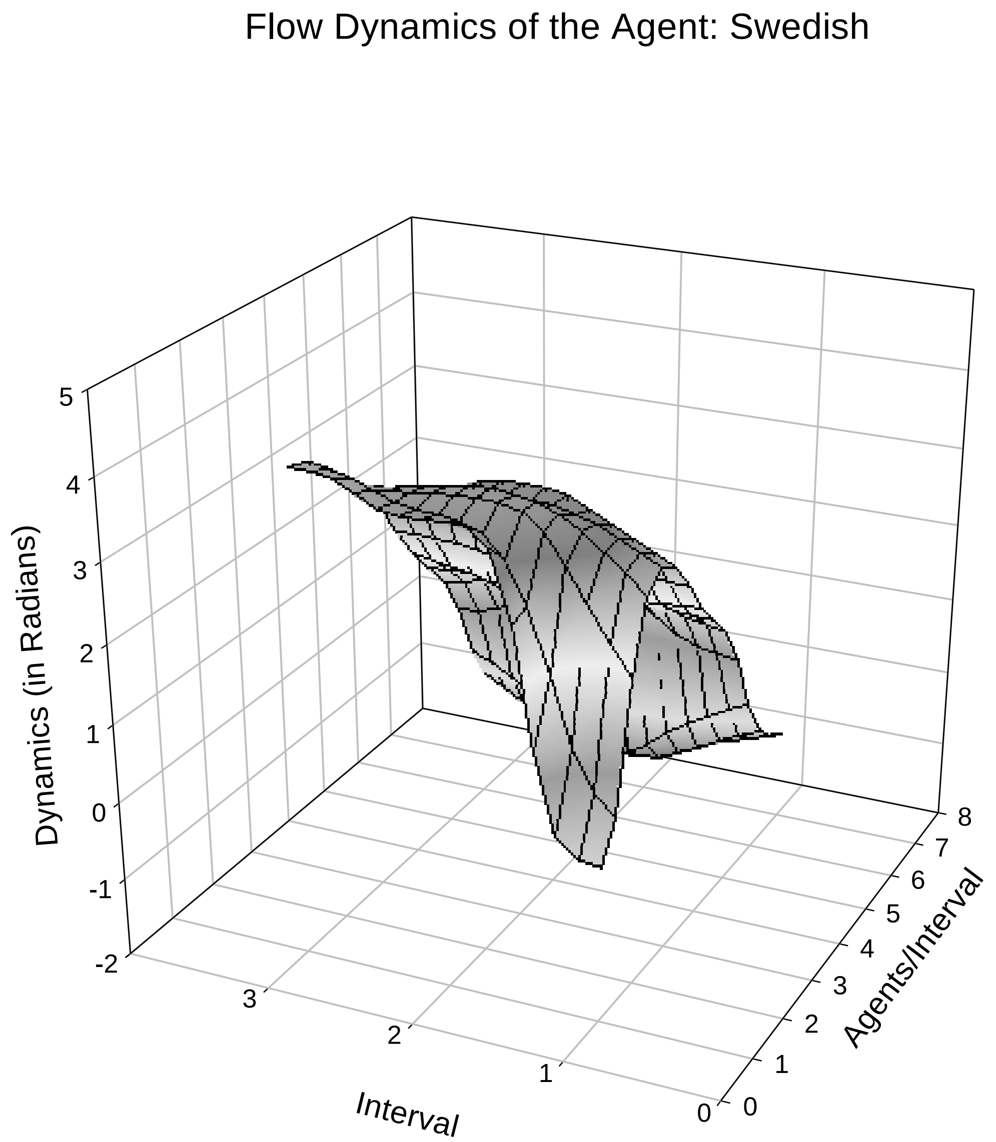
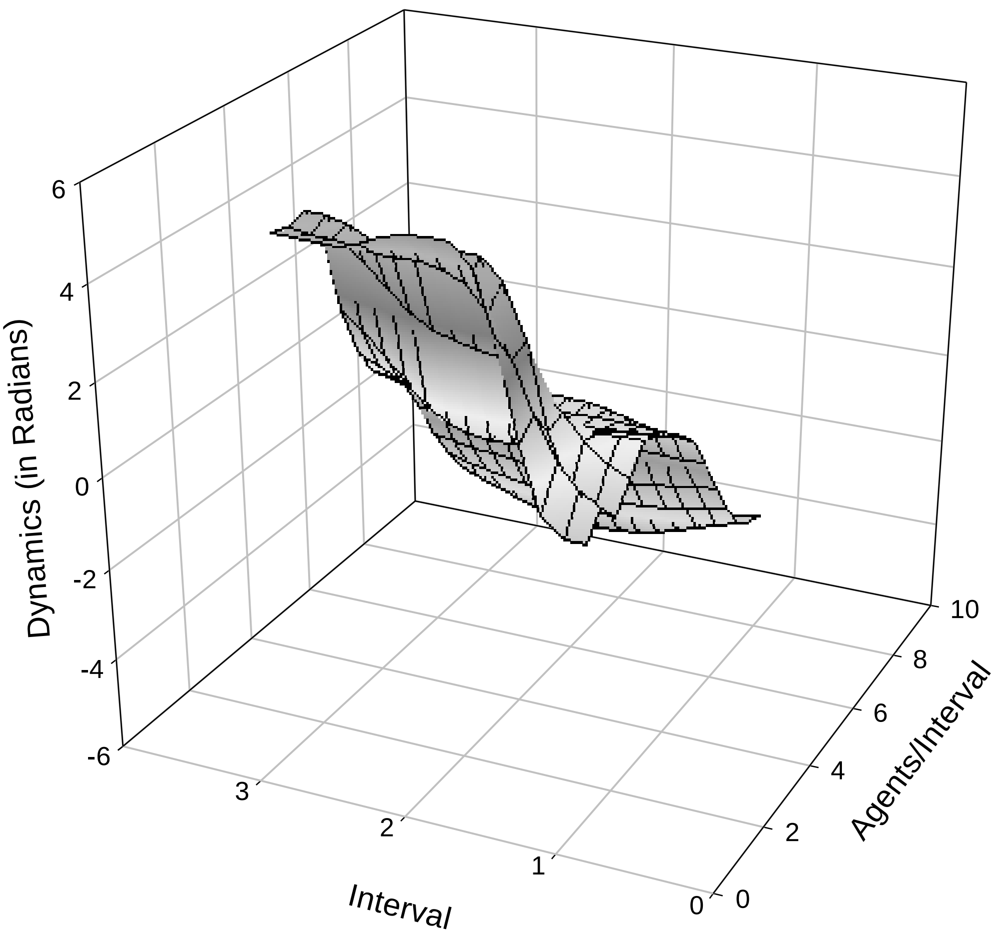


Figure 8.

Translation of Swedish into Italian

Flow Dynamics of the Agent: Italian



However, a combined effect of length, speed and distance is particularly noticeable in the Italian space. Extension, through introduction of new variables, and expansion through partly duplication, partly re-iteration has generated a more elaborated trajectory.

The reason for testing the A-component with respect to its sliding has been to get hold of the changes in the direction of focus. Shifts of shading around some preferred phase relations have been determined in order to demonstrate the kind of change that can be observed within and between the periods and the fractions of a period that are critical in the production of a changing focus. In the comparison, it has been made evident that the clocks have their own specific ways of striking. Specificity in striking is producing the geometric properties characteristic of each single space. In the English case, a steep slope has developed, which is a result of a working toward a successive augmentation in the limitation of the possibilities of the A-component to fluctuate. This successive limitation does not leave until the process transits to its final phase. A highly wound formation is to hand. Further, the steep slope depicts some shading, which is not present in the Swedish and the Italian spaces. The critical moment that has caused this difference in winding is a slightly lesser disposition toward delay. This property co-operates with instability in the phase transition of the third period and creates slight contour-differences. Thus, a comparison of the spaces opens a new perspective on the dynamics of text building as implied by the discussion of the dynamics in a changing focus.

When the outcomes of the naturally occurring oscillations in the uncoupled components are mapped onto a three-dimensional space, the shapes of the spaces are really crucial for a consideration of the theoretical value of shades in sliding. Since the three pattern oscillators, when coupled through the translation function are not loosing their individuality, it is suggested that the co-ordinated rhythmic states exhibit a deeply ingrained commonalty. However, each language specific oscillator seems to prefer to stay at its own tempo. Relative phase stability remains and the cyclic clock-like mood of functioning of the oscillators is revealing the existence of a symmetry requirement that has been guiding the individual translations. In essence, the rhythmic driving of textual dynamics is gating the text building behaviour and producing constraints, which are linked to the individual translator's background and capacity to apprehend text.

Discussion

With the capacity of the AaO's to reproduce the morphogenesis of a verbal flow with every new cycle of an AaO-generation, its operational closure is producing the necessary shape of the AaO-system with respect to its textual context and provides also for the formation of structure within a system of AaO's. Its closure allows only certain conditions, namely those, which are covalent. It follows that the covalent A's and O's within a system can appear in a manifold of forms. Which form of an equilibrium becomes realised is dependent on the form of the non-equilibrium at the borders of the AaO's and this form becomes determined by the structure of the surrounding textual context. Furthermore, these structures produce the resources for the maintenance of non-equilibrium. It follows that the order of the system reflects the structure of the textual context as well as the internal dynamics of the AaO's.

As shown in the Figures 1 to 8, timing and spacing in the development of a verbal trajectory at the kinetic level has significance at the kinematic level. On the kinetic level of verbalisation it means that increasing depth implies increasing implicitness and consequently increasing angular displacement of textual agents as well as textual objectives. Moreover, the longer the path of displacement becomes, the larger is the distance to be covered through the displacement operation and the more implicit is the processed text. Angular articulation is developing during the generation of the "Shapes of Time", which however depends on the constraining effects of timing. This is equivalent with saying that deviations from surface-uniformity can be captured through developing constraints and demonstrated at the kinetic level through radians that differ in magnitude. Therefore, the experimental procedure of fusing has been focused on the way in which the calculated radians are reflecting the functional requirements of timing textual elements.

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