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Sketch of an Imaginistic Grammar for Oral Narratives*

1. Mental Representations and the Construction of Imaginistic Grammars

If a theory of language and cognition contains the term "mental representations", we can be sure that this is either a metaphorical term or a highly abstract, theory-bound notion (or both). Metaphorically, we may speak of mental representations if we refer to the experience of image-like impressions in our memory of persons, objects and events, to the experience of thinking in space-time and to the solution of geometrical and mechanical problems. In a more theory-bound context, a mental representation is some entity, device or process which lies in the cognitive black-box between perception and motor-activity (our relatedness to the external world) on one hand and linguistic output on the other.[1]

This conception of mental representation, which may be described by mappings with feature extraction, cross-classification, synesthetic integration etc., is further complicated by the social, i.e. superindividual nature of language (in a specific language of a specific community). The social dimension of language which has a historical evolution as its background, cannot be understood as a process of mapping, feature selection, combinatorial integration etc. Moreover the cultural and social background of human communication is a very important reference domain of language and cognition, i.e. we rarely speak about an independent world outside social and communicative networks; this world is at the same time the main topic of discourse. This central aspect of language and cognition may be called self-referentiality.

In this article, the social self-organisation of individual cognitive and linguistic skills will not be treated.[2] Rather, we shall concentrate on basic individual processes which contribute to a representation of external experience and to its encoding in language (the specific language is presupposed but not described).

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[1] Linguistic output is also somehow related to the peripheral body processes and via these processes to the external world, but this relation is much more indirect than in the domain of reference and sense.

[2] We think that a synergetic approach could be significant in this domain, cf. Wildgen (1989b).

The method of our model-building is two-fold:

1. We try to connect our model to the perceptual and motor-programme level of cognition (which may be called sub-symbolic). In this sense, our model is related to the psychophysical models of Turvey, Kelso and others (cf. Wildgen, 1987 for an application of their theoretical proposals to semantics). This methodology is akin to catastrophe-theoretic semantics (cf. Wildgen, 1982)
2. The output of the model should lead to a linguistic description of the structure of texts and sentences, i.e. it should reach the symbolic level.

Our model will primarily consider texts, especially spontaneous narratives, which refer to personal experience. We assume that the personal experience is memorized in such a way as to show some relation of mapping to the original perception of and action in the events recalled. The units of "imaginistic representation" correspond to narrative units (i.e. propositional or higher units) rather than to phrases, words or morphemes in the utterance. This assumption is supported by psycholinguistic findings which show that 'imaginistic' representations are processed more slowly than words, but that their recall is more stable. The proper time scale of these entities is thus beyond that of words and a correlation with narrative units should be a realistic point of departure.

A first decision in our model concerns the proper level of abstraction and its position on the scale between sub-symbolic and symbolic processes. It is clear that we cannot start with concrete external pictures of the references in a text (the photographs of actors, the film of the event). Furthermore we cannot select one specific perceptual input or output. If we use the term 'imaginistic' (cf. Kosslyn, 1980), we refer to a fairly abstract level, which does not distinguish the different channels of perception and action and which is rather qualitative (irrespective of metrical specifications).

A second bacic decision concerns the scientific (mathematical) language in which the model will be formulated. We decided to use a very simple vector notation and to discretize the dynamics. This introduces a dramatic simplification in relation to continuous dynamic models like catastrophe theoretic semantics. This simplification is, however, restricted to the syntax of the system. In Wildgen (forthcoming) we sketch a local semantic interpretation of the parameters and units defined in the syntax.

This strategy is different from that applied in logical semantics. Our syntax is global and discrete (it is combinatorial or Fregean) whereas our semantics is local and continuous. Thus the semantics interprets only basic notions of the syntax and is not its mirror-image. The philosophy underlying this strategy cannot be discussed here, but we assume that this is the natural way of model-building in the sciences, where partial and local semantic interpretations are sufficient (sometimes the semantics even remains implicit in the sciences).

The vector notation has the advantage of combining (abstract) space and time aspects in one notion: the vector. The immediate effect is that instead of two dimensions, one for space and one for time, we need only one dimension (and the vector notation). One could argue that this device is too simple as vector models are insufficient for the purpose of describing complex, integrative models beyond simple motion schemes. A richer type of model would be tensor-analysis. As our vector-notation is the 0-level of tensor-notation we ignore this criticism and hope that a later version, which would be linked to further data on psychophysical coordination and mental integration, will elaborate the model. For our purpose it is sufficient that qualitively we have chosen the good kind of formal language, such that our results may be used in further steps of the development. For the purpose of presentation we make use of pictures and not of mathematical formulas. However, this is only a practical decision.

The system to be described may be called 'simple' for several reasons:

1. The "real" speakers and hearers and the linguistic community which are modelled as dynamic systems are in general dependent on space and time. On the level of the linguistic community, timedependence is considered in diachronic linguistics, space dependence in geographical linguistics. On the level of the speaker or hearer, time dependence is the topic of developmental linguistics and of sociolinguistics (cf language change and language variation); space dependence is related to social and interactional space (f.i. in face-to-face communication). These global space-time embeddings will not be considered here, instead we shall concentrate on systematic facts and processes valid for all these space-time variations, i.e. we consider invariants of historical, areal and situational variations. This simplification is very radical but nevertheless necessary in order to arrive at a system which may be handled mathematically. The simplifications considered do not eliminate space-time (this would destroy the whole enterprise) but reduce it to a background for schematic and classificatory units.
2. Processes in space-time must basically be considered as continuous. In order to allow an easier formal treatment we may segment this continuum conventionally or naturally. In our system, instabilities (catastrophes) are used as natural segmentations and the space of regular (not catastrophic) points is segmented by appropriate conventions (which lead to maximal simplicity). We may distinguish different levels of segmentation. Given a continuous segment (between two natural borderlines), we can divide it into $2, 3, 4, \ldots, n$ pieces. If we start with a unit length of 1 we get fractions of $1/2, 1/3, 1/4, 1/5$, etc for the segments of the unit.

   If we reduce the dimensionality of space-time to a minimum, we arrive at one dimension of time and another of space. If we choose a vector representation we can even represent the motion on one dimension by a one-dimensional vector-field and dispense with the dimension of time. Throughout this article, we shall therefore work with vectors on one space-dimension (either textual or reference space).

3. The process of narration is one which relates text-progression (movement in the textual space) and the movement referred to by the narrative, which has its origin in real situations (in space-time), but which is remembered or imaginated in the narrative. Thus the minimal representation of textual processes is one with two space-dimensions (one for the textual space and one for the event space) and two vector-fields on these one-dimensional space representations. In the case of discrete (digital) dynamics we get for every unit:

   one dimension of textual space and one unit vector or n partial vectors of length $1/n$ on the textual space,

   one dimension of "real" or "imagined as real" space and one unit vector on the "real" space or the space of reference.
4. Complex dynamical systems like language communities or the body/ the mind of a speaker/hearer are organized in the form of parallel subsystems and subprocesses (distributed in social and mental space), i.e. many subsystems are simultaneously active and we must consider synergetic (cooperative) processes in this system of subsystems (cf. Haken, 1983). Nevertheless, for our present purposes we shall ignore cooperativity and distributed processing and consider our system as one with one process in every time segment. Although this simplification is a dramatic one and should be the first to be abandonned, the resulting system is still richer than traditional generative grammars, which are discrete, deterministic, non parallel dynamical systems with special restrictions imposed on the basic operations (the rewrite rules).

The above mentioned simplifications will be made more moderate by the fact that we consider three levels of description and correspondingly three levels of abstraction:

1. Syntax (or in general syntactics). It mainly considers the (temporal) combinatorics of linguistic units and the construction of larger units. In our bi-dimensional syntax, the units are bi-dimensional and so is the syntax. If some kind of parallelism is introduced, the syntax may become a type of cellular automaton. From a semiotic point of view syntax is an investigation in the organization of sign-forms.
2. Semantics. Semantic processes are basically related to cognitive, perceptual and motor processes; via perception and action they are related to the external world. This level still represents a methodological simplification but the simplification is less dramatic than in (a). At this level, continuous and parallel (distributed) processes are basic. If the distributed character is neglected, we have a local semantic model. Catastrophe theoretic semantics is such a local semantic model (cf. Wildgen, 1982, 1985). As the mathematical treatment of global dynamical systems is very complicated, and still at the developmental stage we may restrain the continuous caracter of the model to cells of a discrete dynamical system. With this restriction we lose the

immediate contact with cognitive organization, which has a huge amount of degrees of freedom and approaches continuity, and we consider a shallow level of semantics. Contemporary linguistic theories of meaning are at this shallow level. However, in Wildgen (forthcoming) we shall develop local continuous models and thus a deeper level of semantics.

3. Pragmatics. If one considers the actual space-time of language processing (in the brain), of communication (in face-to-face interactions), of language acquisition and individual change (in the linguistic biography of a speaker) and of historical and geographical/social language change (in geographical/social and historical space-time), one arrives at the level of a fullyfletched theory of language (comparable to theories in the natural sciences). This may be called pragmatics in the tradition of Morris. In the context of narrative analysis the term "pragmatics" refers primarily to the context of narration, i.e. to the discourse in which a narrative is embedded (cf. Wildgen, 1987b) and to the purpose (intentionality) of this linguistic activity.[3]

In a methodological perspective the levels (a) (=syntax) and (b) (=semantics) are empirically underdetermined (as they are abstracted from reality in a way not strictly controlled). However, to this methodological stratification may correspond some ontological stratification. Intuitively, one can say that specific cultural techniques such as writing produce specific real objects, which are linear and discrete. Thus, in the analysis of these "objects", one can do without the operation of abstraction, which was constitutive for level (a) (in a certain sense, this abstraction has been realized by the history of the writing systems). In a similar way, one could call semantics a discipline which classifies and organizes certain data produced by psychosemantic research, or call pragmatics a discipline which analyzes data produced by observations and experiments in social psychology and sociology/ethnology of language. We shall make the weaker assumption that the methodological levels of syntax, semantics and pragmatics have some natural correlation to subdivisions present in the natural, dynamic system itself.

[3] Peirce in his article of 1905 'What Pragmatism Is' (Peirce, 1966; 183f) relates the term pragmatic to Kant's distinction between 'praktisch' and 'pragmatisch';"the latter expressing relation to some definite human purpose". The central message of pragmatism in Peirce's conception was that it consisted in "an inseparable connection between rational cognition and rational purpose" (ibidem: 184). See Wildgen (forthcoming) for the elaboration of the idea.

2. The Basic Vocabulary of an Imaginistic Grammar

2.1. The space of imaginistic units and the notion of a unit vector

The simplest space for imaginistic units has two dimensions:

– one dimension for the progression in the text, the linear succession of units,
– one dimension for the content of the unit and, globally, for the thematic development in narrative texts.

On the basis of these two dimensions, which are specified at the semantic level, we can define the cinematics of our imaginistic syntax:

1. One type of motion occurs relative to the text sequence. The text progresses from unit to unit but we shall also introduce fractions of discrete motion on t. The unit motion has the domain $(0, 1)$ and the fractional motions have $(0, 1/2, 1), (0, 1/3, 2/3, 1)$, $(0, 1/4, 2/4, 3/4, 1)$ etc. In practice, we shall stop at the first level of differentiation.
2. Another type of motion occurs in the content space. We distinguish several subtypes:
   ▷ zero motion: a state
   ▷ steady motion: a stable displacement
   ▷ bordered motion: beginning, ending, ingression, egression
   ▷ transition between two or more states.

The cinematics may be the effect of forces with different sources. With the introduction of forces and their effects we enter the domain of DYNAMICS. We distinguish:

positive (global)forces: protagonists
negative (global)forces: antagonists

Locally (i. e. in the units), forces appear which are only positive or negative relative to some dominant force. They are the support of emission, capture and transfer. Theses forces have no global orientation.

The syntax is defined by a vocabulary (a limited set) of imaginistic units and by local and global principles for the combination of cells in a matrix (which represents the text). As in categorial grammar, the syntactic potential of every unit is already built into its notation, such that the syntax may exploit or restrict the syntactic (combinatorial) potential of the units. The syntax under consideration is elementary. At a further level of analysis we could classify domains of the matrix by applying criteria of space-time or thematic continuity. This would eventually lead to a constituent structure of the narrative as a secondary result of our analysis in terms of an imaginistic syntax.[4] If we regard our syntax formally as a type

[4] The fundamental question if these groups or clusters are stable and recurrent entities or whether spontaneously organized. In the second case, a general IC (immediate constituent)-component would be misleading. For the level of textual organization we tend to assume the latter.

of finite state automaton (with two dimensional state space), every unit is considered as a current state by the automaton and gives rise to a new state. The more complicated case of interdependent changes in several or all cells of a two-dimensional matrix (the representation of whole texts or their parts) will not be considered in this article although it could be applied in the context of an analysis of text-reorganizations (cf. STADLER AND WILDGEN, 1987).

Empirically, every imaginistic unit classifies the content of the predicative centre of ONE narrative unit. Narrative units are defined heuristically as those clauses that contain ONE finite verb (or a construction classified as functionally equivalent) and that have a fixed place in the temporally ordered sequence of units (they constitute the referential skeleton of the narrative). The later criterion was first specified by LABOV AND WALETZKY (1967) and formally elaborated in WILDGEN (1977a: 241–247). The details of the heuristics of our approach and of its empirical application are described in the doctoral dissertation of LIEDTKE (1990). We shall not discuss these empirical techniques and their results in this article but shall concentrate on the formal aspects of the model.

The space-time matrix consists of two-dimensional unit-cells[5] with the parameters: t: time and r: space. We shall first describe these units and then the vectors on it (the cinematics of the text). As our cinematics are discrete, we introduce steps in the evolution of the parameters t and r: We decide (by convention) that all intervals on the parameter t (time) and r (space) should have the same length. We can consider the following steps which differentiate the unit-interval $(0, 1)$ of t:
First differentiation on t: $(0, 1/2, 1)$
Second differentiation on t: $(0, 1/3, 2/3, 1)$
Third differentiation on t: $(0, 1/4, 2/4, 3/4, 1)$

The parameter r is defined on the positive and the negative rationals, i. e. the basic interval unit is:
$r : (-1, 0, +1)$
First differentiation: r: $(-1, -1/2, 0, +1/2, 1)$
Second differentiation: r: $(-1, -2/3, -1/3, 0, +1/3, +2/3, 1)$
Third differentiation: r: $(-1, -3/4, -2/4, -1/4, 0, +1/4, +2/4, +3/4, 1)$

The domain $(0, 1)$ is valid for ONE entity on r. If we have n entities simultaneously active on r, we need a unit interval: $(n, \dots + n)$. We shall only consider the case of $n = 2$, and there are good reasons to assume that in general $n < 3$ (with one intermediate entity) if the interaction space is two-dimensional as in our

[5] Locally every unit is a two-dimensional Euclidian space. Every vector has two components. The basic vectors have one of the components zero, the other is equal to one. The zero-vector has both components equal to zero. The scale is in general $(0, 1)$ and allows for discrete fractions $(1/2, 1/3, 1/4, 1/5, \text{etc})$.

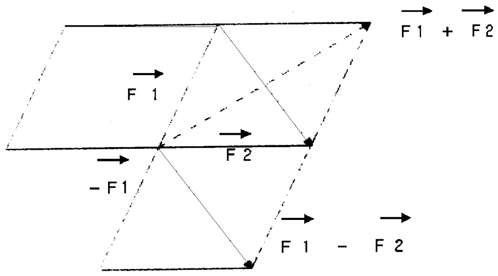

Fig. 1: The rule of the parallelogram for vector addition

system. In a semantic model of the sentence, this would lead to three basic deep cases e.g.: agent/object/patient, or source/ path/ goal (compare WILDGEN, 1985).[6]

The vectors in the discretely subdivided space $t \times r$ are defined either as addition to primary vectors on t AND r (these are called secondary vectors) or as addition to secondary vectors etc.

As vector calculus is not a general tool in linguistics, we start with some basic notions. Vectors are used as a notation of FORCES, MOTION, ACCELERATION, etc. F may be a force at a point with a certain amount N and a certain direction. We write $\rightarrow F$ for the vector of the force F. Graphically, $\rightarrow F$ may be represented as an arrow, the length of the arrow being the amount of the force N.

In physics, the displacement s, the velocity r and the acceleration a are described by vectors and their relations are formulated in terms of vector calculus. The simplest operations are those of vector addition and subtraction (the addition of a negative vector); negation changes the direction of a vector by 180°. In Fig. 1, these basic operations are shown.

The rule of the parallelogram for vector addition is represented in Fig. 1 by the long diagonal line (for addition) and the short one for substraction.

If more than two vectors are added, we can graphically represent the sum by adding every vector to the endpoint of the preceding one and by connecting their extreme points. In the special case of identical vectors, the sum of n vectors corresponds to the multiplication of a vector with n. Fig. 2 shows these two cases.

As the primary vectors in our system are defined on t and r and have an angle of 90°, the length of the secondary vector may be computed by the formula of Pythagoras. In Fig. 3 we show the inventory of vectors at the basic level and at

[6] If the interaction space is three-dimensional with one time (process) parameter and two internal parameters $n < 4$. See also section 2.3.

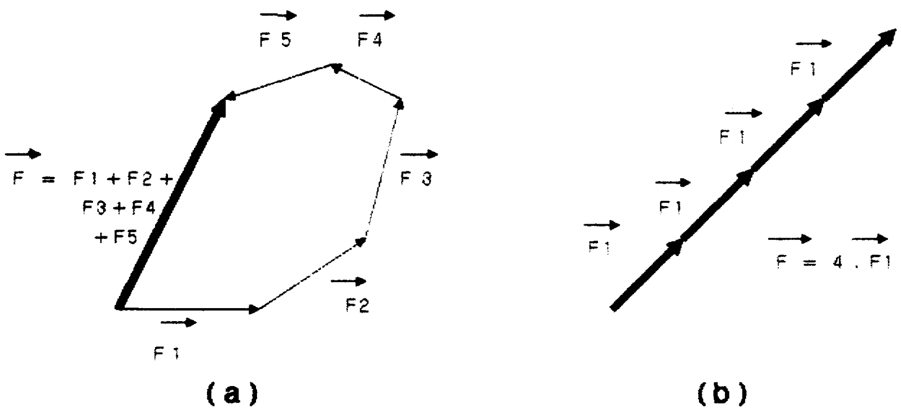

Fig. 2: Multiple vector addition

the first level of differentiation of t and r into equal segments. The basic vector t is assumed to be always greater than zero.

At the intermediate levels of (t, r) : $(0,5,-0,5), (0,5,0), (0,5,0,5)$ we place the transition, which reflects this level of differentiation. It is marked by a small circle (a zero-vector) and is added to our notation. In our semantics, the points of junction (the zero vectors at the intermediate levels) will be assigned a specific interpretation (in terms of instability, conflict, catastrophe).

2.2. The set of basic monovalent imaginistic units

If we start with the set of vectors in Fig. 3, we can define an exhaustive set of basic imaginistic units (the first stratum of the vocabulary of narrative syntax).

All units will occupy a unit cell (length 1×1). For this purpose we choose quadratic fields with a vector length on t and $r = 1$. For t we can only choose the interval $(0, 1)$ or $(0, 1/2, 1)$; for r we have the following choices (trivalent units have a double range; cf. section 1.3.):

a: $r : (0, +1)$
b: $r : (-1/2, +1/2)$
c: $r : (-1, 0)$

This leads to the vocabulary of basic imaginistic units represented in Fig. 4. As a zero vector on r means no change (semantically), only vectors with a non-zero component on r receive an arrow. We will comment on these units; their explicit interpretation is the objective of the semantic component developed in Wildgen (forthcoming).

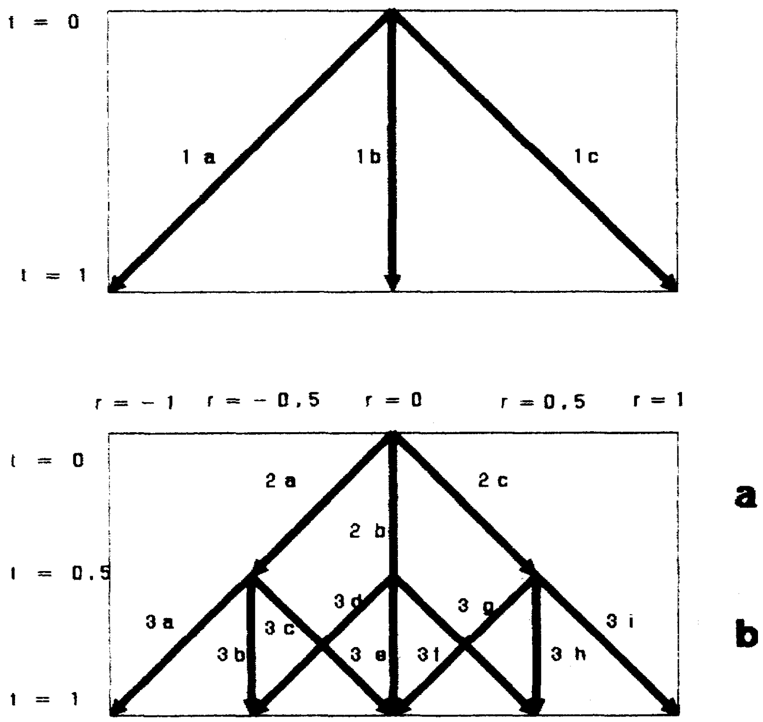

Fig. 3: The set of unit-vectors
a) basic level
b) first level of differentiation

Comments:

ad a: Unit interval on $r : (0, 1)$

Unit 1: Continuous, positive motion r; cf. vector 1c (in Fig. 3).

Unit 2: Transition (cf. the zero vector at $t = 0,5$) from a continuous positive motion to a stable state; cf. the vectors 2c and 3h.

Unit 3: Transition to an opposite direction; cf. the vectors 2c and 3g.

Unit 4: Transition between two partial, positive motions; cf. the vectors 2c and 3.

ad b: Unit interval on $r : (-1/2, +1/2)$

Unit 5: No motion on r, a stable state; cf. vector 1b.

Unit 6: Transition from a state to a (positive) motion; cf. vector 2b and 3f.

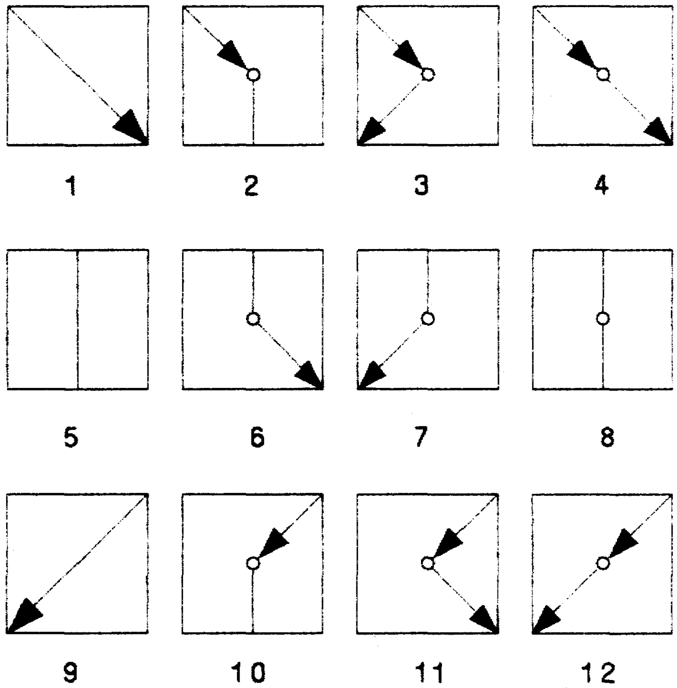

Fig. 4: The set of basic imaginistic units

Unit 7: Transition from a state to a negative motion ; cf. the vectors 2b and 3d.

Unit 8: Transition between two stable states (not on the same scale in a quality space) otherwise it would be unit 4, 12; cf. the vectors 2b and 3c.

ad c: Unit interval on $r : (-1, 0)$

Unit 9: Continuous, negative motion on r; cf. the vector 1a.

Unit 10: Transition from a continuous negative motion to a stable state; cf. the vectors 2a and 3b.

Unit 11: Transition from a negative motion to a positive one; cf. the vectors 2a and 3c.

Unit 12: Transition between two partial, negative motions; cf. the vectors 2a and 3a.

The set of 12 basic imaginistic units is exhaustive for the specific stage of differentiation of our space-time matrix. It is obvious that every further step of differentiation will dramatically augment the basic set. In our system we have

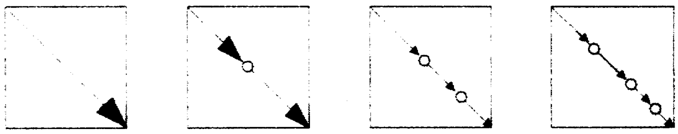

Fig. 5: Successive differentiation of unit 1

3 units at the basic level (the units 1, 5, 9) and 9 units at the first level of differentiation. To illustrate the effect of a further differentiation. Fig. 5 shows successive stages for unit 1.

In all these cases, one entity (e.g. objects, agents etc as specified by the semantic component) adopts states or motions, changes the direction and passes through points of transition. If we consider this entity as being expressed by a nominal phrase, we can see immediately that we need further units which describe several entities in interaction. The transition to several entities, which act on each other, is a transition from cinematics to dynamics and is therefore theoretically an important step. To avoid the term "entity", which is too neutral, and the terms "agent" or "actor" (actant), which are two specific, (they refer to human beings) we shall use the term "monad" taken from philosophy (cf. the concept of "monad" as it was coined by Leibniz in his monadology). A "monad" in our system is an entity whose internal stability and identity is not problematic in the context. Its shape may be abstracted to a sphere and the forces are considered to act on its "center of gravity", i. e. we consider a point in space as the concentration of the "monad". These "monads" may be objects in space-time; but they can also be prototype centers in a quality space, stable phases of a process, agents, patients; cf. Wildgen, 1982). The reference to Leibniz is important as the units and forces in his system are neutral relative to the Cartesian distinction between mind and body. In physics, solid bodies would correspond to the theoretical term "monad", but the meaning of the term is not restricted to this interpretation in physics.

2.3. The set of bi-valent imaginistic units.

The valence of an imaginistic unit is the maximal number of coexistent monads in one unit (at a time interval of that unit). The restriction of valence to the number 3 is practically motivated by the marginality of simple clauses with more than three basic (obligatory) nounphrases with different functional roles, deep cases, thematic roles, etc.) One could also give a theoretical explanation of this restriction by applying the phase-rule of Gibbs. This is elaborated in WILDGEN (forthcoming).[7]

In order to restrict the set of bi- and tri-valent imaginistic units we assume one principle, which is very general, as it holds for the vast majority of 'real' dynamical systems; they are systematically imperfect i. e., not in perfect stability and order. It is the *principle of broken symmetry.*

Principle of broken symmetry (principle 1)

If a unit (local system) has two or more monads, at least one of these is dynamically inferior (weak).

In our list, we had 12 units whose r-vectors have length $0, 1/2$ or 1. The different units fall into three classes.

r-vector$= 0$	units 3, 5, 8, 11
r-vector$= \pm 1/2$	units 2, 6, 7, 10
r-vector$= \pm 1$	units 1, 4, 9, 12

In order to construct a bi-valent unit two mono-valent units are integrated into an interaction cube. We may call the third dimension $i =$ interaction space. If both planes containing monovalent units have one central point of transition, this point is defined as the point of juncture. In this point $i = 0$, i.e. the two movements meet in one singularity. In the syntactic formalism we 'flatten' the three-dimensional structure thus concentrating on the enviroment of the interaction singularity where $i = 0$ (maximal interaction) and we can form further two-dimensional units, which have vectors with different directions and whose points of transition have two inputs or two outputs (we could call the corresponding bi-valent units positive and negative). Figures 6 and 7 give a simplified picture of the reduction of the cube, which has a frontal and a dorsal plane corresponding to a 'strong' and a 'weak' basic unit. In Fig. 6 the interaction is positive, i.e. the transition point 'receives' two input-vectors and 'sends' one output-vector. In Fig. 7 the interaction is negative.

Two further units may be derived as the combination of the 'strong' units (cf. principle 1) 4, 12 and the 'weak' units 7 and 6.

All other combinations are either trivial (they have one of the twelve basic units as result) or they violate principle 1.

[7] In WILDGEN (1985) we consider mathematical arguments which allow systems with four attractors (monads in the present context) as well as a system with five attractors. The first three attractors and the fourth, however, have different interpretations. Thus the system is stratified: three attractors for simple systems, four attractors for systems with moduls and under highly specific conditions a fifth attractor.

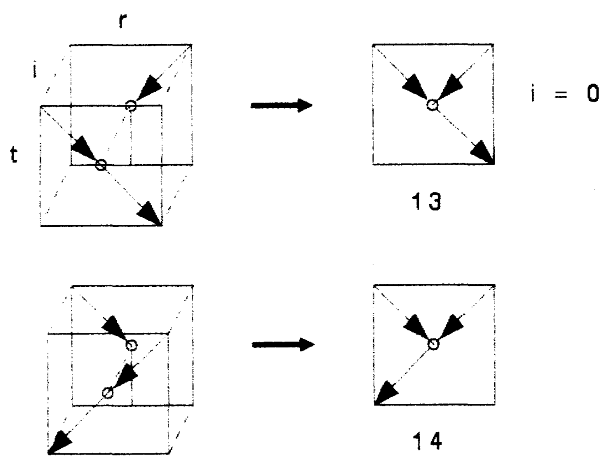

Fig. 6: The construction of bi-valent units

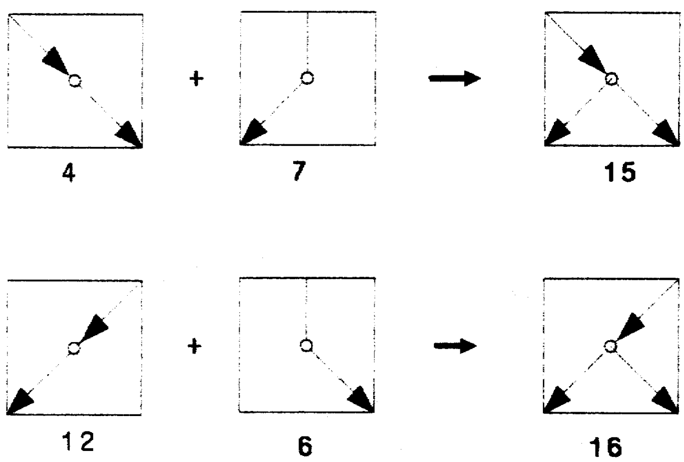

Fig. 7: The construction of the units 15 and 16

2.4 The set of tri-valent imaginistic units

The construction of two-dimensional units which fit our two-dimensional syntax but allows for a multi-dimensional and semantic interpretation is more difficult and we can only sketch it here. We must start from the (basically three-dimensional) bi-valent units, combine them in order to allow for a tri-valent interaction and flatten the results in an appropriate way. The proper way is to start from bi-valent units which are complementary i.e. which are positive/negative. This criterion is valid for the pairs 13/15, 16/14 and 15/13, 16/14. They can form an elementary sequence as Fig. 8 shows.

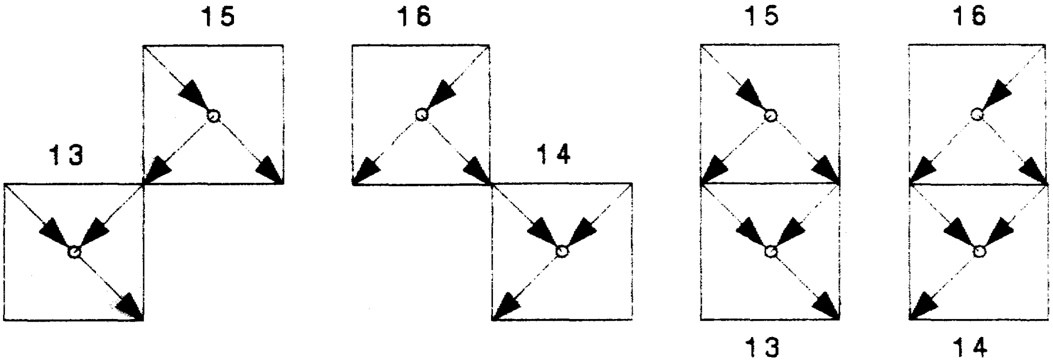

Fig. 8: Elementary sequences of bi-valent units as a background for the construction of tri-valent units

The pairs 13/15 and 16/14 have strong adjacency as the vectors which relate both units add to each other (positively); the pairs 15/13 and 16/14 have weak adjacency as the vectors in contact are in an angle of 90°. The two-dimensional combination of the flattened bi-valent pictures is, however, insufficient to represent tri-valent units. They rather represent a sequence of events (and thus of narrative units). Furthermore the simplification introduced in the construction of bi-valent units should be reassessed for the new construction. For this reason we shall start with a three-dimensional construction of the tri-valent unit and simplify the result of this construction. The more complete construction is later the reference for the semantic component. If we decompose the units 15 and 13 and arrange them along the interaction scale i, we get Fig. 9 with the corresponding projection on the right.

The intermediate new combined unit is characteristic of tri-valent units. If we look at them more closely, we notice that an internal processual order exists in all tri-valent units. First, a process of emission (positive bifurcation) takes place and later a complementary process of capture (negative bifurcation) closes the overall movement, i.e. the two units 10 and 7 of the intermediate domain have an internal order. Unit 7 (egression) comes before unit 10 (ingression) and this does not correspond to the projection on one unit plane but rather to an adjacency of two units. In order to construct one basic tri-valent unit we must not only flatten the three-dimensional structure as in the construction of the bi-valent units (generalizing the point of interaction, where $i = 0$), but consider an internal sequential pattern which puts units 7 and 10 into continuity; instead of interaction

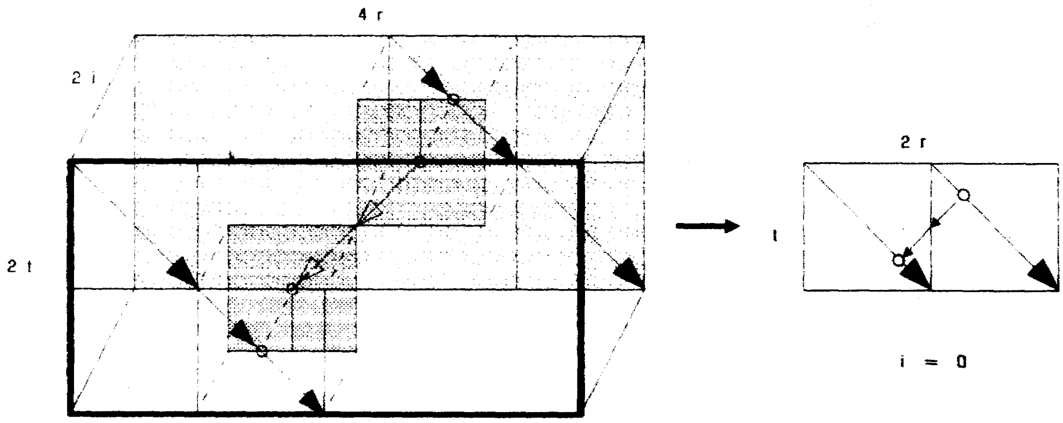

Fig. 9: The construction of a tri-valent unit with the help of mono-valent and bi-valent units and their "flattening"

in one point we get continuity in one point. If we flatten the processual continuity in the enviroment of this point, we arrive at a continuous vector of type 9, which relates the bi-valent sub-parts. These three constructions have to be integrated into one two-dimensional vector representation.

As a consequence of principle 1 the unit 9 (as a result of the continuity of the combined units 10 and 7) is a weak unit. In one representation it is transformed to the size 1/2. The fact that two strong units (4 and 12) coexist, necessitates a doubling of the unit-space either on t or on r. This doubling means that these units have a scale on $r : (-2, 0)$, $(0, +2)$, or on $t : (0, 2)$. In the narrative sequence, however, they are considered as one unit and the space reserved in the matrix does not mirror any gain in importance or temporal and processual weight. As Fig. 10 and 11 show, the bi-valent sub-units are still present at the 'microscopic' level. We may distinguish two groups of tri-valent units.
(a) double-spaced on r : $(-2, +0)$ or $(0, +2)$
(b) double-spaced on t : $(0, 2)$

The results are the four units: 17, 18, 19, 20, which are shown below.

(a) Parallel motion of two strong 'monads' and interaction/transfer between them. The interaction/transfer involves a third monad which is weak. This monad can be made explicit in the sentence(text) or be implicit in the meaning of the verb or in the context of the sentence.

(b) Two monads in opposite motion and interaction/transfer between them (cf. above).

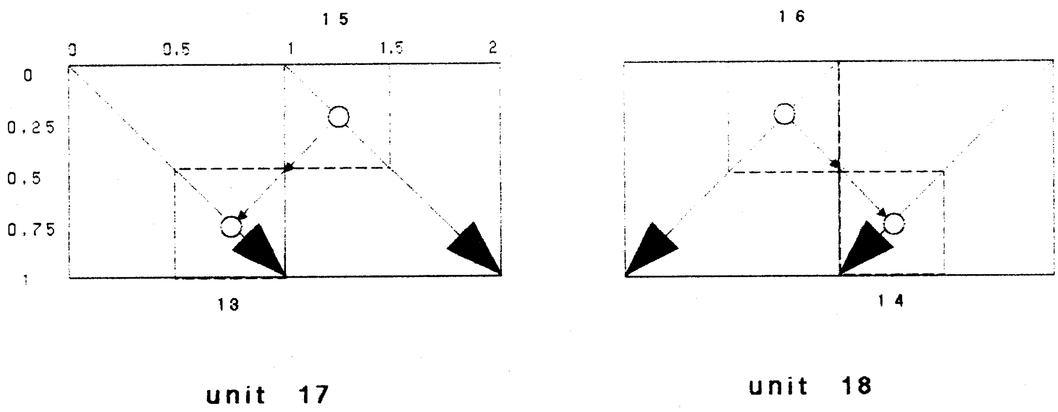

Fig. 10: The composition of two bi-valent units with parallel motion of the strong units and their local structure

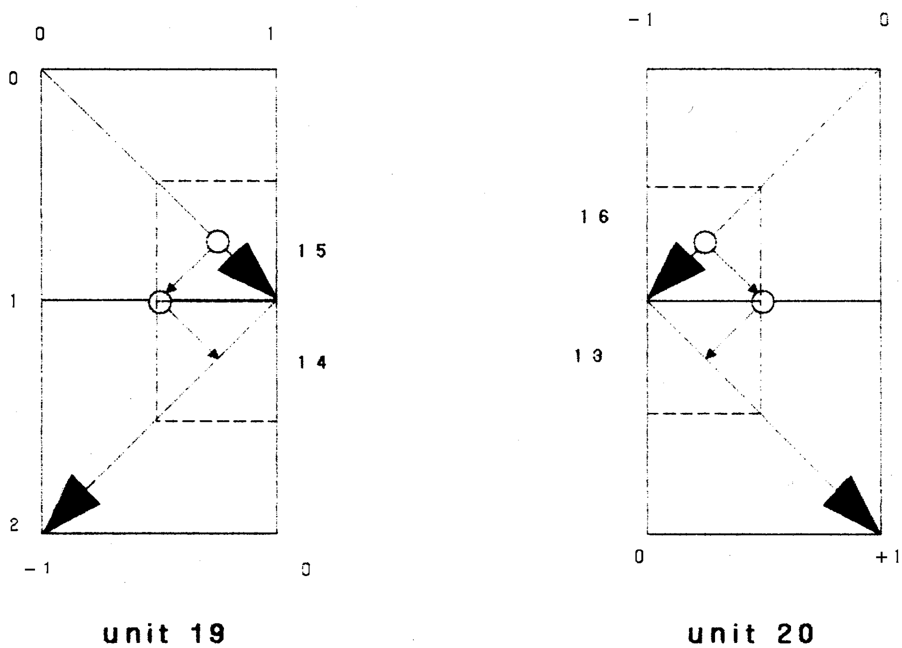

Fig. 11: Interaction and transfer between protagonist and antagonist (opposite motion)

The economy of the syntax and the embedding of simpler units in more complex ones, reflects the cognitive architecture found in propositional schematas (Wildgen, 1985). The units 19 and 20 are arranged vertically because the r-parameter in the units is inverted (from $(0,1)$ to $(-1,0)$ relative to $r = 0$). Thus t_i is one time unit with length 2. As a consequence all tri-valent units have unit-character, but one scale is doubled.

3. The Basic Syntax of Imaginistic Units

The construction of a system of imaginistic units was mainly motivated by our aim to build a discrete combinatorial system, a narrative syntax. The two features 'discrete' and 'combinatorial' are related, and the whole tradition of structuralist and computational linguistics has exploited the possibilities of this type of model-building. Its major methodological principles may be formulated as follows:

1. Choose a limited set of rather independent discrete units (a finite vocabulary).
2. Consider the set of combinations which are mathematically possible (e.g. the free monoid on a set).
3. Find specific rules which restrict the free combinatorial system and define a natural sub-set (a 'language' in the terminology of algebra).
4. Interpret the specific structures shown by the application of the 'syntactic' rules.

In catastrophe theoretic semantics (Wildgen, 1982, 1985) we had followed a methodology rather opposed to the principles above. In our methodology basic dynamic 'gestalts' were mathematically derived and the aim was primarily to find a set of cognitively and evolutionary rooted archetypes, which were holistic entities. The theory presented here is hybrid, in the sense that its syntax is discrete and combinatorial (generative) and thus parallels the traditional models. The difference between imaginistic grammars and traditional models is, however, that our syntax:

- ▷ is two-dimensional (with one space- and one time-parameter),
- ▷ is a syntax of texts (based on narrative units) rather than of sentences (based on morphemes, formatives, words or similar subsentential units).

We distinguish between two levels of syntactic analysis (in the sense defined above):

1. The local level; in this case the immediate neighbourhood of a narrative unit is governed by a principle of local syntax.
2. The global level; larger sequences of narrative units and matrices of narrative units which are larger than one unit (center) and its immediate neighbours are governed by a syntactic principle.

3.1. The local syntax of imaginistic units

Every imaginistic unit in the two-dimensional text-matrix may be considered a cell with eight adjacent neighbours. The construction of every cell selects those neighbours which are dynamically adjacent. The notion of dynamical adjacency is given by principle 2.

Principle of dynamic adjacency (principle 2)

Two units are dynamically adjacent if they contain two adjacent vectors. Vectors are adjacent if the end-point of one vector touches the source point of the other one. They are strongly adjacent if both vectors have the same direction and weakly adjacent if the corresponding vectors form an angle of 90°.

We shall first develop a local syntax with strong adjacency. The neighbouring cells of every unit may be numbered 1 to 8, as Fig. 12 shows. The unit itself is called center and has the label 0.

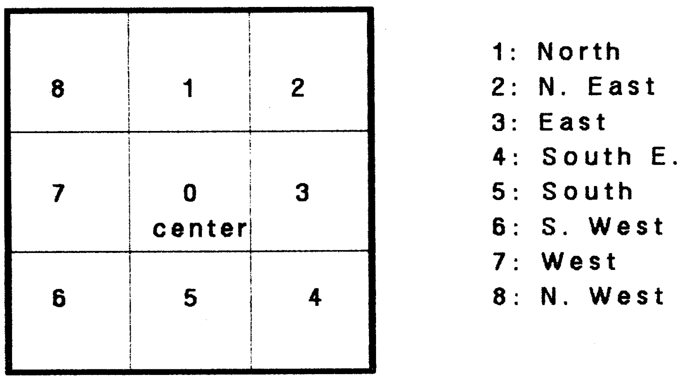

Fig. 12: Neighborhood of the central cell 0 and names of the neighbours 1 to 8

The names for the neighbours in Fig. 12 are taken from Toffoli and Margolus (1987: 20). The state of the neighbours, i.e. in our case their relevance for the process may be noted by a row-vector, the 8-SUM (in terms of Toffoli and Margolus, *ibidem*).

Numbers of the neighbours: 1 2 3 4 5 6 7 8

8-SUM, e.g. (0 0 0 1 0 0 0 1)

center: 0

We shall consider the relevance of neighbourhoods and their possible fillings selected by principle 2 for all basic units. The fillings excluded by principle 2 have the value 0, those allowed have the value 1. The set of permitted neighbours is characteristic of every unit and will be notated: F (unit Nr). For every field of neighbours we may calculate the maximal and minimal length of the vectors on the r-axis (by adding the r-components of the vectors in an allowed combination). We can thus associate every unit $U(i) : i = (1, \ldots, 20)$ with L_{max}: maximal length of the rr-vector and L_{min}: minimal length of the r-vector. The alternative fillers of a neighbour j given a center i are notated A_{ij}. $L_{max} - L_{min}$ is called the length DIFFERENCE L_{diff}.
Example:
$U(1) : 8 - SUM : (00010001)$
$F = (4, 8),\ \ L_{max} = 3,\ \ L_{min} = 1,\ \ L_{diff} = 2$

The possible fillers A_{ij} are:

$$A_{1,8} = (1, 4, 6, 11, 13, 15, 16, 17, 19, 20)$$
$$A_{1,4} = (1, 2, 3, 4, 13, 14, 15, 17, 19, 20)$$

The unit 17 has two equidirectional vectors (with possible adjacency) and may be combined with unit 1 in position 4 and 8 in two ways. In order to illustrate the adjacency sets we show the whole list of possible adjacent units of unit in Fig. 13.

In the case of tri-valent units one or two points of adjacency are possible. To provide a more detailed picture Fig. 14 explicitly shows the combination between unit 1 and the tri-valent units: 17–20.

The double spaced units fill the neighbour-cells 8 and 4 only with one half of their cellular structure. The unity of the double space cells is due to the transition phase (interaction, exchange). As the second half is predictable we have not enlarged the neighbourhood to $8 + 15 = 23$ cells: The neighbourhoods defined in Fig. 12 are called LOCAL. If we enlarge the cellular neighbourhoods, we construct GLOBAL MATRICES (cf. section 3.2.).

The mono-valent units (1 to 20) can be characterized roughly by the type of neighbours which must be filled. Table 1 shows this typology.

Group a:	Group b:	Group c:	
U(1) : 8;4	U(5) : 1;5	U(9) : 2;6	identical
U(4) : 8;4	U(8) : 1;5	U(12) : 2;6	cells
U(2) : 8;5	U(7) : 1;6	U(10) : 2;5	
U(3) : 8;6	U(6) : 1;4	U(11) : 2;4	

Table 1

For the basic units the maximal length of vectors (by vector addition) in one neighbourhood is $L_{max} = 3$, the minimal length is: $L_{min} = 0$. Depending on the unit in the center the possible length is restricted to a typical range. Fig. 15 shows some typical cases and their ranges.

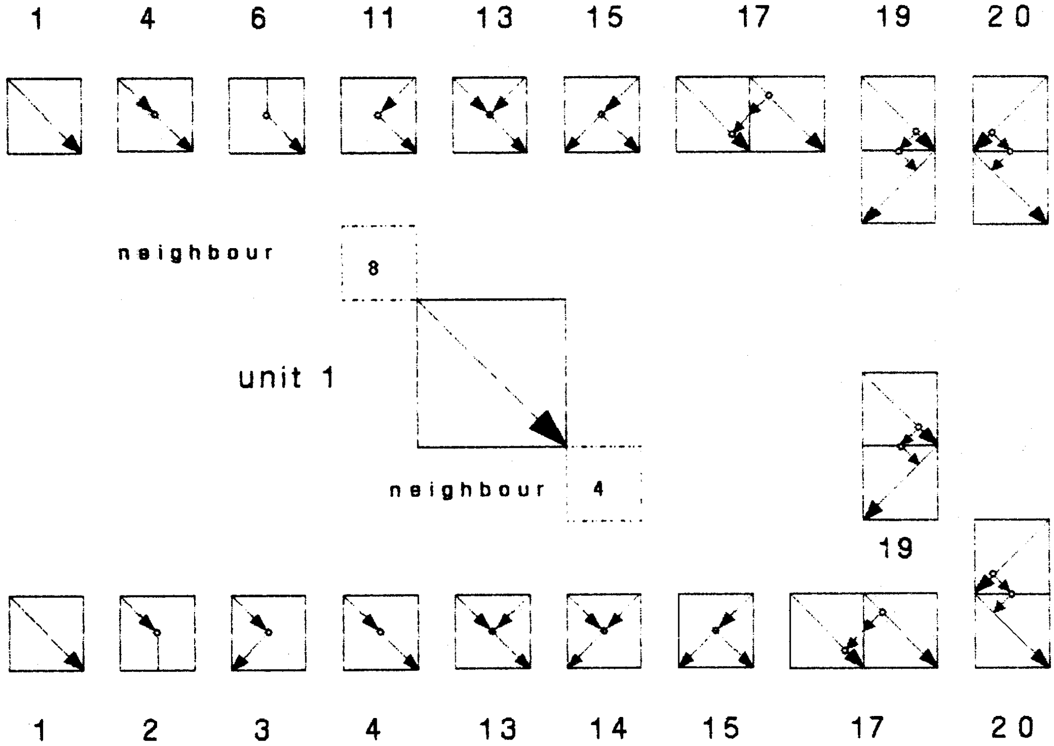

Fig. 13: List of all possible units adjacent to unit 1

The bi-valent units (13 to 16) permit two different measures of length: $L+$: positive length (by addition of protagonistic vectors), $L-$: negative length (by the addition of antagonistic vectors). We illustrate two measures for unit 13.

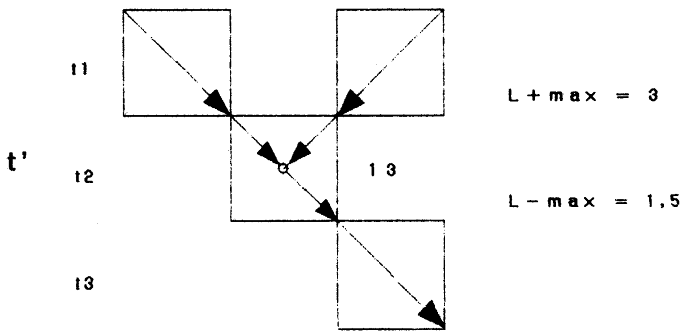

Fig. 16: The combination of a bi-valent unit in the center with adjacent cells

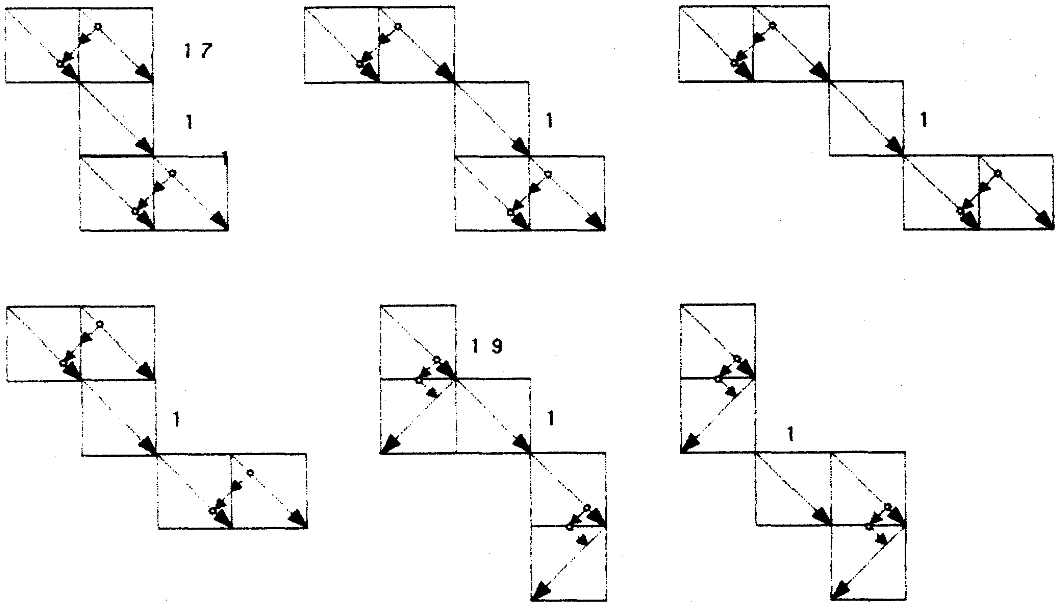

Fig. 14: Adjacency configurations of tri-valent units

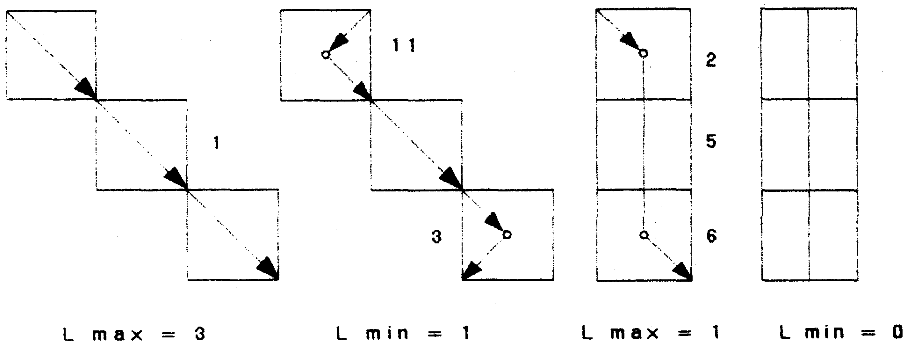

Fig. 15: Maximal and minimal ranges of the units 1 and 15

Although the construction in Fig. 16 fulfills principle 2, it is syntactically not well-formed as it has two independent units for one time interval in the text-sequence. To avoid these combinations we must state a global principle, which applies to matrices of cells and not only to the neighbouhood of one cell.

Principle of temporal uniqueness (principle 3)

To every interval on the time axis t' of the text corresponds only one imaginistic unit.

Comment: Semantically this principle refers to an interpretation of t' as the sequence of narrative units in the text. The referential time intervals are not ordered in this strict manner.

3.2. The Global Syntax of Imaginistic Units and Some Typical Patterns of Narratives

The global syntax is not centered on one cell filled by one unit, it considers matrices defined by n time-intervals and m space-intervals (defining a $m \times n$-matrix). This matrix is, however, only filled by one unit per time-interval (principle 3) and the combination of fillers is restricted by the principle of dynamic adjacency. We shall treat further restrictions and exceptions in order to arrive at a syntax specifically tuned to narratives. Out of the set of more specific restrictions we chose those relevant for the following fundamental problems of global syntax.

a) Parallel developments of protagonistic and antagonistic forces.

b) Global patterns formed by bi-valent units in a narrative.

c) Tri-valent units and the patterns of interaction/transfer.

d) The imaginistic structure of the climax in a narrative.

ad a: Parallel developments of protagonistic and antagonistic forces

If in a text the independent moves of protagonists and antagonists are developed in parallel, the focus changes from protagonistic to antagonistic and vice versa. In this situation, the principle of dynamical adjacency cannot be applied without special conventions. In a certain sense the principles 2 and 3 are in conflict. To solve this conflict we introduce gaps in our matrix which are filled in such a manner that dynamical adjacency may be preserved. While the focus is on another monad, one assumes that the monad focussed on before continues in the same direction without special changes.

Postulate of continuity in temporal gaps (sub-principle to principle 2)

Temporal gaps parallel to moves in the opposite direction are filled by a unit vector which has the same direction as that of the last unit before the change of direction (this filling of gaps may be iterated). The vector in the gap unit is called "projection-vector".

Fig. 17 shows a gap (a) and the projection vector (b)

The use of projection vectors may be generalized in order to define the projective goal of a unit. Thus we can multiply the projection unit with the number of cells left on the r-axis and note its interaction with the borderline of the $m \times n$-matrix (m =number of t-segments, n =number of r-segments). This defines the

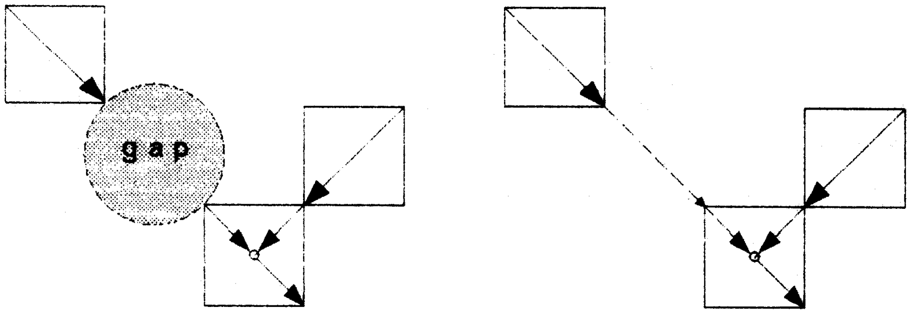

Fig. 17: The filling of gaps by a projection vector

initial goal of the protagonist or the antagonist. The complication phase of a narrative typically deforms this line such that the protagonist cannot immediately reach his 'goal'. The projection vectors in the narrow sense are assumed to fulfill the conditions of principle 2 (dynamic adjacency).

ad b: Characteristic patterns of bi-valent units

The units 13 and 14 which are interpreted as capture in the semantic component (see WILDGEN, forthcoming) show three characteristic patterns illustrated in Fig. 18.

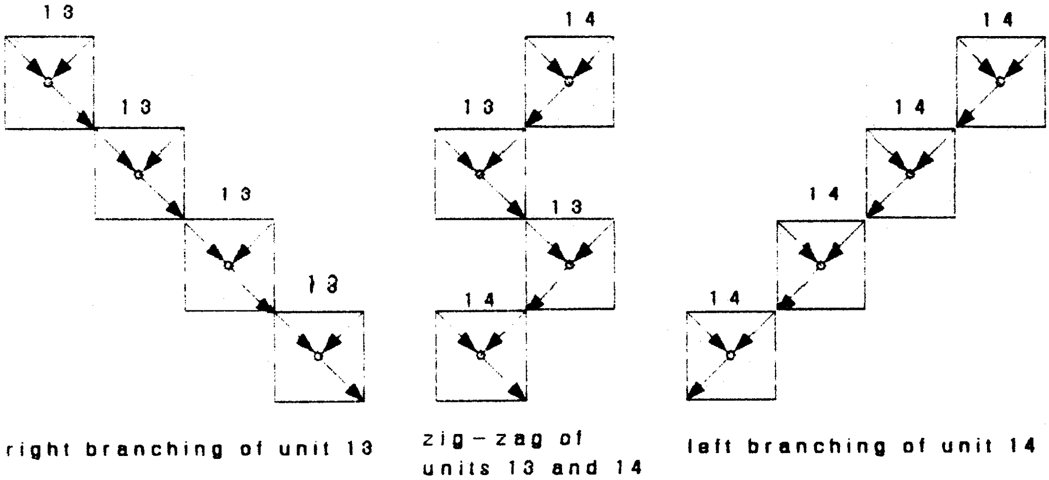

Fig. 18: Characteristic patterns of interaction between protagonist and antagonist in an episode (capture)

The units 15 and 16 (interpreted as 'emission') lead to different diffraction patterns. Similar to Fig. 18 we have left- and right-branching diffraction and centered diffraction patterns.

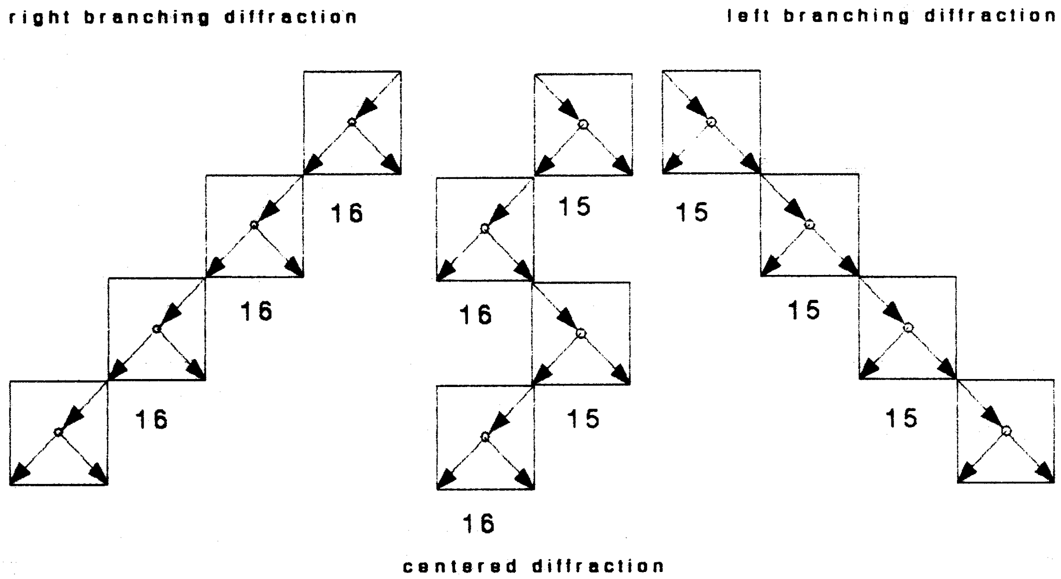

Fig. 19: Right, left and centered diffraction patterns (patterns of emission)

If we mix in a regular manner the 'emission' and the 'capture' units, we obtain interesting patterns of exchange which are globally similar to the units 17 and 18. Fig. 20 shows two basic configurations.

ad c: Tri-valent units and the patterns of transfer/interaction.

We shall choose typical pairs of tri-valent units in order to find out prominent patterns and processes of transfer and exchange. For illustrative purposes we shall fix the interpretation to object-transfer (giving) between protagonists (P,P), antagonists (A,A) or mixed pairs (P,A), (A,P). To abbreviate pictorial representations we compute caracteristic numbers. The process of transfer is a process with losers and winners. We shall compute for every participant (monad) the number of gains and deficits (losses). The four units: 17, 18, 19, 20 allow for 24 pairs fulfilling the conditions of principle 2 (dynamic adjacency) and principle 3 (temporal uniqueness-in a weak sense, which allows partial overlapping in units with $t = 2$). As every unit contains one transfer we number the participants in the order of their effect in the chain of transfer. For instance, if the first protagonist gives something to the

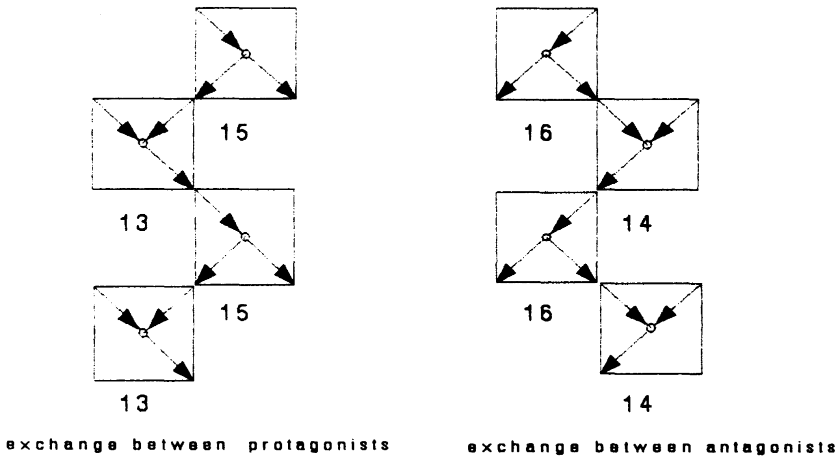

Fig. 20: Configurations of exchange (emission and capture)

second protagonist , the first is called P_1, the second P_2; the same procedure is applied to antagonists. A sequence in time with the units 17 and 20 is notated 17/20. Table 2 shows the characteristic gains and losses.

The sum of values in a line is always zero, i. e. these processes may be interpreted as zero-sum-plays. It is interesting to look more closely at those combinations with maximal gains (the cases with maximal losses are similar by symmetry). We have six cases:
-17/17b, 18/18b
-19/19a, 20/20b
-20/17b, 19/18a

We shall consider those where the protagonist has maximal gains: 17/17b, 20/20b, 20/17b. Fig. 21 shows the different constellations which are commented below.

A) P_1 wins from P_2 (17/17b). This pattern may be continued. If the sequence has n members, the payoff will be: $P_1 : -n, P_2 : +n$.

B) P_1 wins from two antagonists A_1, A_2 (20/20b). This pattern may be continued n-times; P_1 will win n unit-values and n antagonists will lose one unit-value each one.

C) P_1 wins from antagonists and protagonists. If we continue this pattern, the gains are not added but disappear, as P_2 starts with a loss (-1) which is compensated by a win $(+1)$. The maximal win $(+2)$ is only a local maximum, in general P_i wins $(+1)$.

		P_1	P_2	P_3	A_1	A_2	A_3	
17/17	a	1	0	+1				
	b	−2	+2					only protagonists
	c	0	+1	−1				
18/18	a				−1	0	+1	
	b	only antagonists			−2	+2		
	c				0	+1	−1	
19/19	a	−1	−1		+2			
	b	−2			+1	+1		mixed prot./antag.
20/20	a	+1	+1		−2			
	b	+2			−1	−1		
17/19	a	−2	+1		+1			
	b	−1	0		+1			
19/17	a	0	−1		+1			
17/20		0	+1		−1			sequence: P_1, P_2, A_1
20/17	a	0	+1		−1			
	b	+2	−1		−1			mixed units with
18/20	a	−1	0		+1			protag./antag./helper
	b	−2	+1		+1			
20/18		+1			0	−1		
18/19		+1			0	+1		
19/18	a	−1			+2	−1		
	b	−1			0	+1		sequence: P_1, A_1, A_2
19/20		−1			0	+1		
20/19		0			−1	+1		

Table 2

D) A case of cyclical stability is given by the pair 19/20 and 20/19 (this is the only combination of units which permits only one pair in every sense). Inside the cycle every unit has the values +1 and then 0.

The symmetric configuration $(-1, 0, +1)$ is also interesting, especially if it occurs in a group with the same sign (protagonists or antagonists). We shall comment on the possibility of a symmetrical exchange between protagonists (17/17a). The same structure is given in the sequence 18/18. As the participants of the exchange are numbered along the chain of transfer, we can identify source and expedient in a module of two units e.g.: $P_1 = P_3 = P_5 \ldots P_2 = P_4 = P_6 \ldots A_1 = A_3 = A_6 \ldots$. This leads to a cycle of mutual exchange.

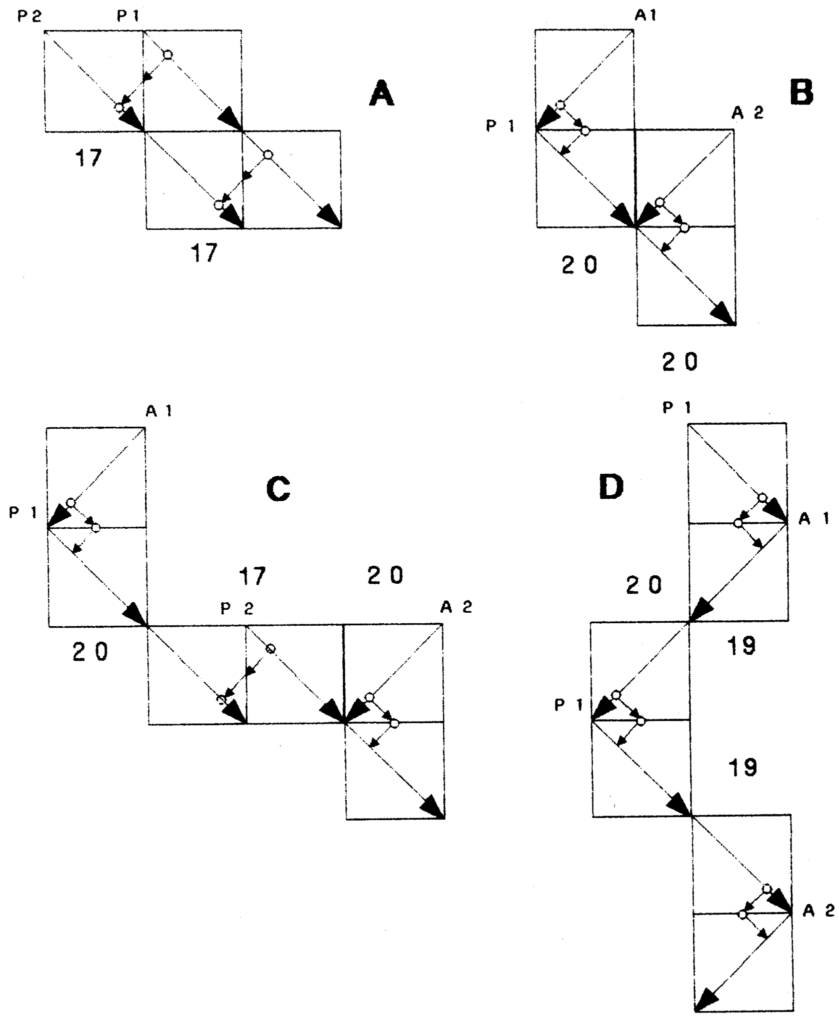

Fig. 21: Sequences of tri-valent units

Instead of a simple cycle of exchanges between protagonists we may consider one with intermediate participants (helpers) as shown in Fig. 23. The intermediate participant is represented by a broken line in the image-sequence.

If the protagonist has a helper (e.g. a secondary protagonist P_2) P_2 may help P_1 in an exchange with the antagonist (with immediate or later reward). This technique may be applied to the description of certain fairy tales like that of Tim-Tit-Tot (Rumpelstilzchen) (cf. WILDGEN, 1989a and WILDGEN, forthcoming).

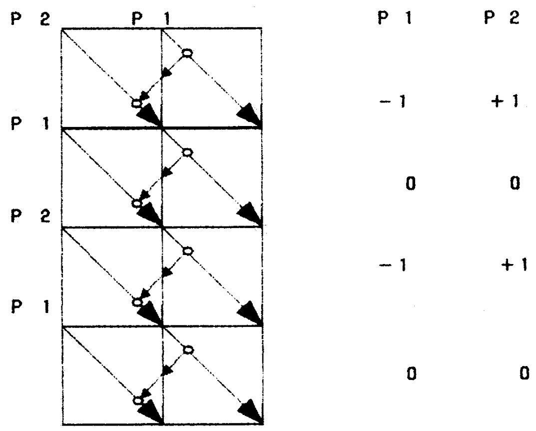

Fig. 22: A pattern of losses and gains in an exchange between P_1 and P_2

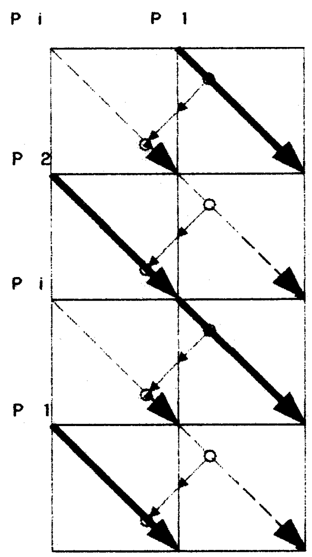

Fig. 23: Pattern of exchange with an intermediate agent P_i

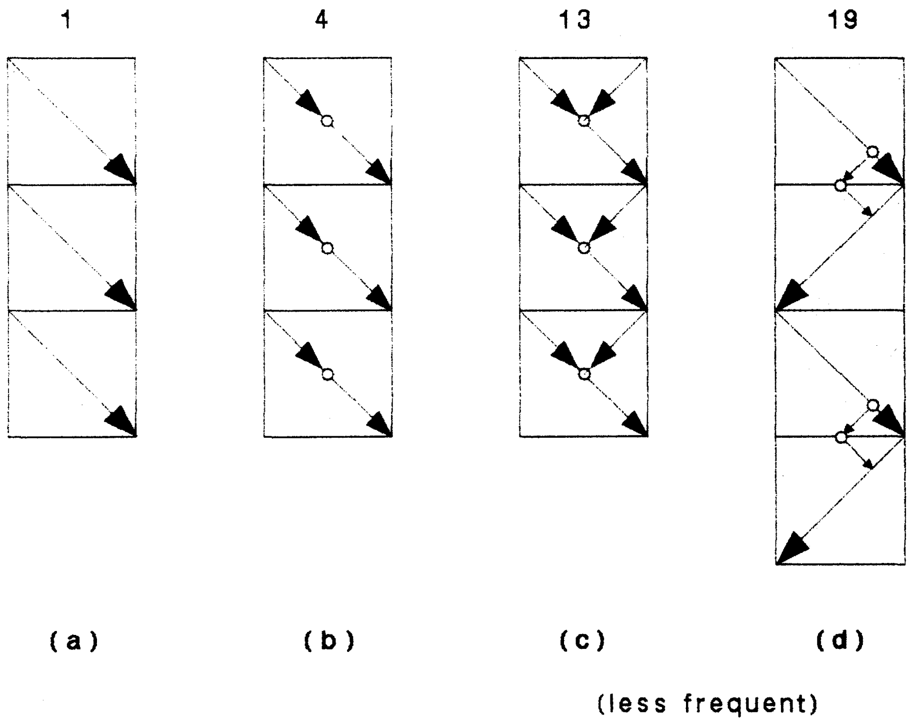

Fig. 24: Four different types of coordinated units which are typical of the text

ad d: The climax of a story and the sequence of simultaneous stories
As Labov and Waletzky have shown, we find frequently at the climax of a narrative, units which repeat a central phase in the story (i.e. which are temporally ordered in relation to the rest of the units, but not ordered in relation to each other). For these cases we may introduce an exception to principle 2 and allow a sequence of identical units without dynamic continuity. Fig. 24 gives some examples.

Types (a) and (b) are non-adjacent. Types (c) and (d) are weakly adjacent.

As it stands the imaginistic syntax is a minimal model which although highly organized accounts for central empirical phenomena encountered in the analysis of oral narratives. We shall analyse an example in the next chapter.

4. Analysis of an Example

The story is taken from a text of narratology i.e. from Labov's article "The Transformation of Experience in Narrative Syntax". In order to spare space and details of analysis we chose a partial version (the characters a,b,c relate to the units in the original version in Labov, 1972: 355f).

```
(1)  And so Calvin say, "Let's have a rock - a rock war". (c)
(2)  And I say, "All right." (f)
(3)  So Calvin had a rock. (g)
(4)  Calvin th'ew a rock. (j)
(5)  I was lookin' and - uh - (k)
(6)  And Calvin th'ew a rock. (l)
(7)  I oh- it almost hit me. (m)
(8)  And so I looked down to get another rock; (n)
(9)  Say "Ssh!" (o)
(10) An' it pass me. (p)
(11) I say, "Calvin, I'm bust your head for that" (q)
(12) Calvin stuck his head out. (r)
(13) I th'ew the rock (s)
(14) An' the rock went up, (t)
(15) I mean -went up- (u)
(16) came down (v)
(17) an' say Ä slap! Ü (w)
(18) an' smacked him in the head (x)
(19) an' his head busted.(y)
```

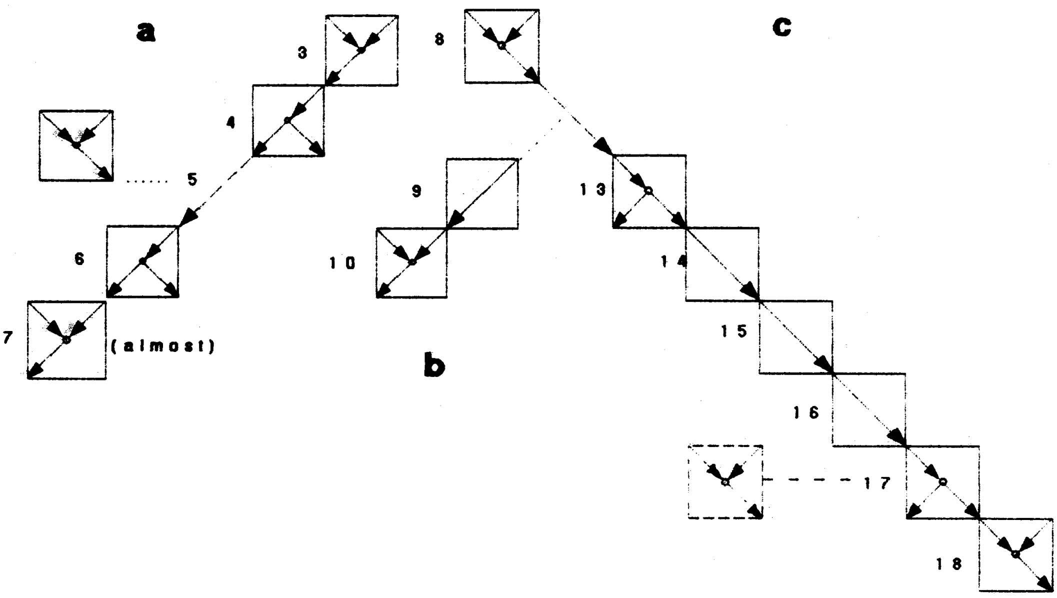

Fig. 25: Representation of the three episodes a, b, c

There are several interesting structures, which may be analysed in terms of the notions introduced a chapter 2 and 3. The central episodes consist of three emissions of rocks by Calvin, which almost hit Boot (the story-teller) and one final shot which hits Calvin. The episodes will be analysed in parallel in order to demonstrate the repetitive analogy of imaginistic sequences.

The sequences (a) and (b) show the progression of the antagonistic vectors. The episode (a) has a vector-length $L = 4$; episode (b) $L = 2$. The episodes show several repetitions. Thus inside episode (a) 6 is a repetition of 4. In the episode (b) the final stage (compare unit 7 in (a)) is focussed and doubled by a preparatory representation in the sensual mode (in 9).
The protagonistic episode (c) has the same pattern as (a); cf. Fig. 26.

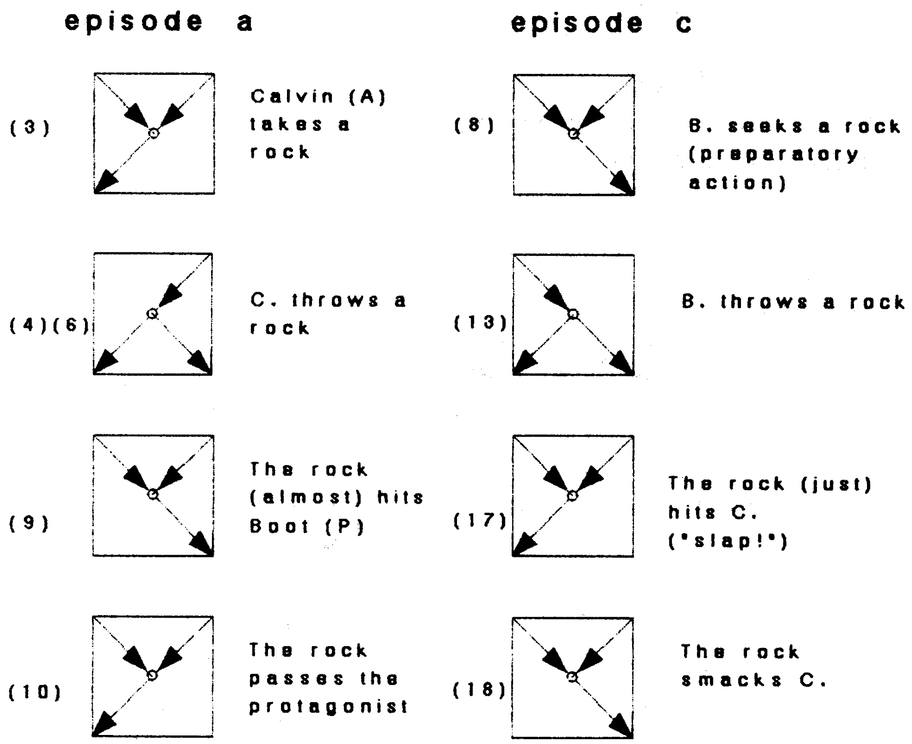

Fig. 26: The antagonistic episode (c) is the mirror-image of the protagonistic episode (a)

Thus the episode (c) is the mirror-image of episode (a) , however, with two important differences:

– the rock in 10 'passes' — in 18 it 'smacks his head'. This makes the victory of Boot (=story-teller),

– this victory is prepared by the suspension of the final result ('pass' vs. 'smack') in the units 14, 15, 16. Normally these phases of continuous movement and the specifications of the directions (up, up, down) would have been irrelevant, the pragmatic goal of postponing the successful result and of augmenting suspence motivate the elaboration.

If we look closer at the units 11 and 18 we may easily reconstruct the missing third force. In 7 it is the agent-source: Calvin (the antagonist); in 18 it is the agent/source: Boot (the protagonist). The complete imaginistic representation would be (if we neglect the modal adverb 'almost' in 7) as shown in Fig. 27.

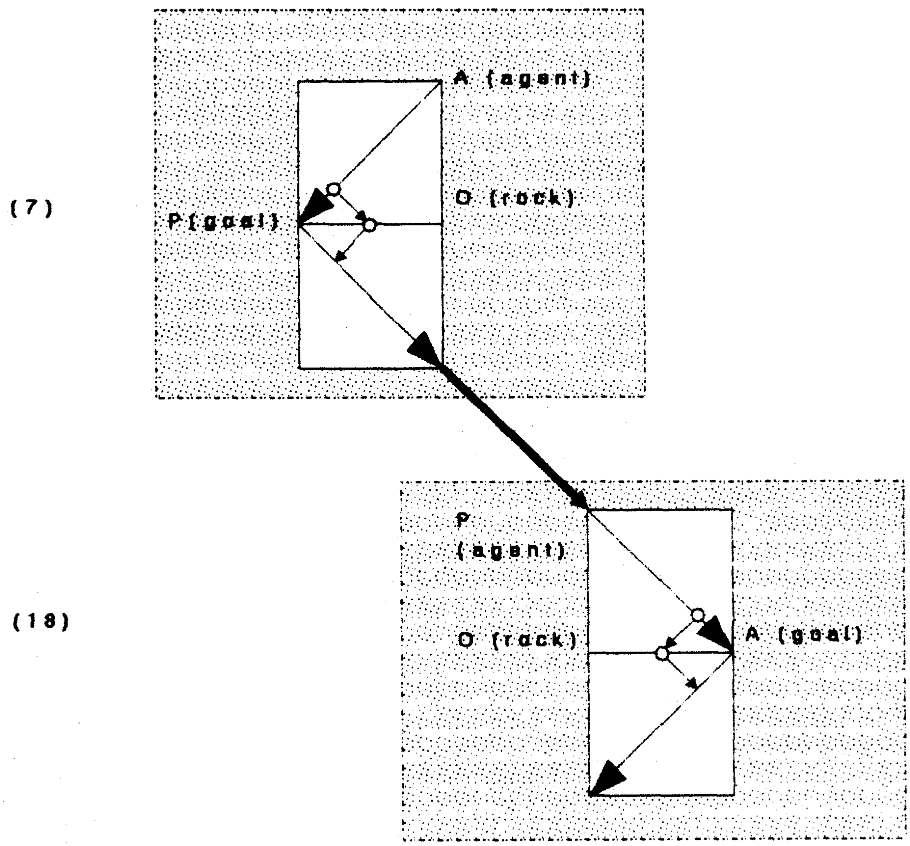

Fig. 27: Basic scheme of the "rock war"

The agents are omitted in the sentences 7 and 18 as they are omnipresent in the story. The concentration point would thus be this basic pair of interactions. It is already prepared on the communicative level in the units 1 and 2. Here the patient/receiver of the communicative act has been eliminated and we may complete the picture as done in Fig. 28.

(1)

(2)

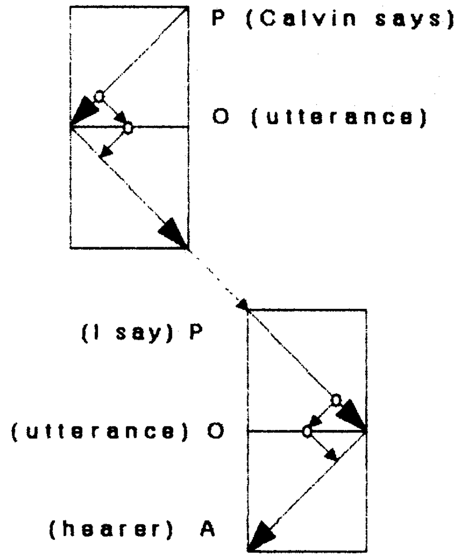

Fig. 28: Preparation of the "rock war" by a sequence of commmunicative actions in (1) and (2)

Unit 18 is prepared by the embedded sentence in 11 "I'm bust your head for that". This threat which prepared the episode (13 to 18) is realized in 18 and reaffirmed as result in 19:" an' his head busted". The unit 12 which followed : the threat in 11 is thematically linked to 18 by "his head"(12) - "in his head" (18). Thus unit 19 closes both lines; the antagonistic one ending in 12 and the protagonistic one ending in 18. In this sense it is the result of the story.

This short analysis was to show, how the imaginistic representation creates a 'gestalt' into which a narrator may organize his story. If we take a second look at the story and include the descriptive units between (3) and (4)
(h) And we- as you know, here go a wall
(i) and for away here go a wall

which introduce the spatial configuration of the 'rock-war', as it is known by the normal hearers in the oral setting (cf. "as- you know") we can easily reconstruct the overall spatial configuration of the scene, which is sketched in Fig. 29.

If we project the process on the horizontal axis, we get the archetype of interaction derived in C.T.-semantics (cf. WILDGEN, 1982: 77f)

The whole process consists of two episodes of type A (which contain a near-by hitting) and one of type B. The continuous process in Fig. 30 corresponds to the sequence of the imaginistic units 19 and 20 characteristic for the opening episode of verbal harassing and to the central units (7) and (18), the centers of the episodes in the complication phase.

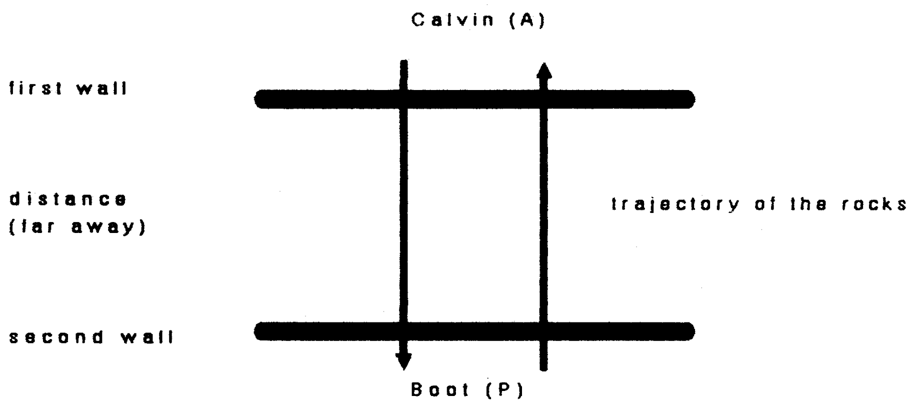

Fig. 29: The spatial configuration of the scene

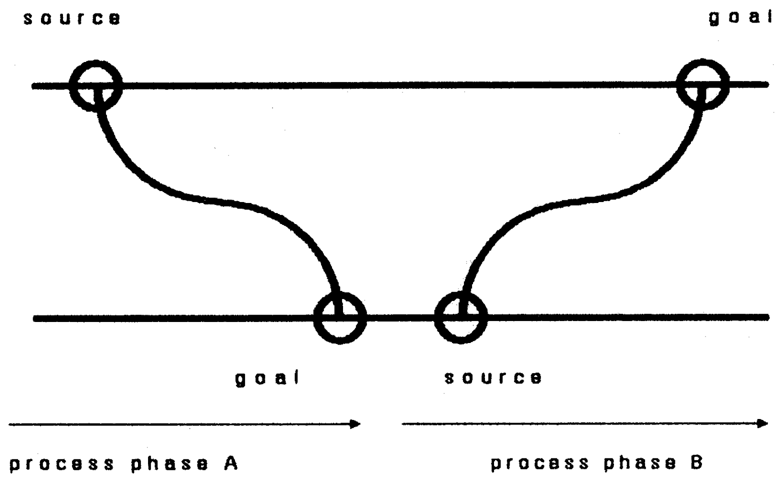

Fig. 30: The archetype of interaction as background of the story and of its constituents

The intriguing result of this analysis is, that the archetype underlies both the central units in the story and is a topological picture of the overall gestalt of what is happening. Thus it really is the invariant of the story and is highly adequate for the description of structures in the long term memory into which the story may be transformed in order to produce a new token of the story at a different occasion.

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