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Reflections on the form of a "protolanguage" and the format of an "evolutionary grammar"♣

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1. The idea of a protolanguage and the methodology of reconstruction

The idea itself is as old as are reflections on language. One encounters it in the concept of the "adamic" language, i.e., the language God gave to Adam and by which Adam was able to give names to all beings. In the pre-Darwinian theories of the origin of language, which were not creationist (Condillac, Rousseau, Maupertuis, Herder, a.o.), some basic capability, a language of action and gestures (Condillac), a musical form of expression for passions (Rousseau), the imitation of natural sounds in onomatopoetic words and the capability of reflection (Besonnenheit: Herder) constituted a point of departure from which specific human forms of communication and language could be further elaborated. Since Darwin's theory of evolution (theoretically even since Lyell's "transformationalism" against Cuvier's "catastrophism'") the basic idea behind descriptions of a protolanguage has been that of a continuous evolution (i.e., moving by infinitesimal steps). Applied to language, it derives linguistic capacities in a continuous series of steps from communicational habits and intellectual capacities of mammals (and animals in general). In this perspective, the concept of a protolanguage looses its theoretical foundation, as no specific and stable intermediate level can be assumed. After Darwin, the "protolanguage" can only be a construct for an intermediate stage which helps to fill the gap between animal communication/cognition and human communication/cognition. All hypotheses, even contemporary ones, which assume a sudden "creation" of human language by some mutation popping up risk falling short of the Darwinian revolution.

Recently Derek Bickerton has made proposals for understanding protolanguage. I shall shortly comment on Bickerton's proposal from a methodological perspective. He assumes an internal stratification of human language capacity, which recapitulates (and thus indicates) an evolutionary stratification.[1] Basically he presupposes an additive effect of evolution, i.e., early developed forms of behavior persist and constitute the stable platform on which later forms rest.[2] He formulates his methodology as follows:

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[1] This type of argument may be associated with Haeckel's law of a recapitulation of phylogenesis in ontogenesis (which is highly controversial) and with theories of regression in psychoanalysis.

[2] This assumption is roughly plausible for brain architecture but it neglects the (relative) loss of older structures, the interaction between neural structures and change of functions.

> "If there indeed exists a more primitive variety of language alongside fully developed human language, then the task of accounting for the origins of language is made much easier. No longer do we have to hypothesize some gargantuan leap from speechlessness to full language, a leap so vast and abrupt that evolutionary theory would be hard to put to account for it." (Bickerton, 1990: 128)

The author uses data from Pidgin- and Creole studies (cf. his bioprogram-hypothesis developed in earlier work, e.g., Bickerton, 1981), data in primate and child language acquisition and the Kaspar Hauser cases (he discusses the case of Genie, a thirteen year old girl from California, who was "found to be incapable of speech"; Bickerton, 1990: 115).

Although such a comparative analysis can give interesting insights,[3] I shall not adopt it here. Basically the analysis of human evolution is not harder to account for than other cases of morphological and behavioral evolution (cf. Bickerton's argument above) and any analysis of the evolution of language should strictly follow the general strategy and methodology of post-Darwinian theories (as they are the only theories which survived the progress in this field). I will consider the traces of semiotic activity of hominids and early man until the emergence of writing systems as data for the reconstruction of intermediate forms of human language. This *direct* strategy has two consequences:

- Insofar as the contours of early semiotic capacities can be reconstructed from artifacts and art, one can only infer the semantics (perhaps the pragmatics) of an earlier language capacity, not its lexicon or syntax.
- As the artefacts point rather to the cognitive level than to the level of linguistic expression, the reconstructed semantics must be a type of *cognitive* semantics (although it differs from those cognitive theories which have no evolutionary dimension)[4].

The term: "protolanguage" has under this methodology a different profile (and content). As the evolutionary process is in principle continuous, the term designates a zone between the linguistic capacities of hominids and modern humans (whose

[3] In the analysis of language change this strategy would correspond to the comparison of age-groups in a synchronic analysis, instead of a real-time analysis. The difficulties of such an "apparent time analysis" are discussed in Labov (2001: 76).

[4] Evolutionary question are only discussed in the "blending"-theories of Fauconnier and Turner (2002)

language is documented). In any case we do not assume that a small zone (say some 10,000 years) of "synchrony" existed in which a specific "protolanguage" was used. If discrete steps separating one or more proto-levels show up in the data, they should be explained either by the dying out of intermediate species and by rather sudden ecological changes which triggered the realization of some genetic reserve in the chain which reads out, realizes the genetic information of a species.[5] In general the existing empirical evidence is used to make an informed guess for *one* possible intermediate stage.[6] The assumption of *one* stage is purely methodological; it follows from the fact that the empirical evidence is too scarce to separate a series of intermediate states.

2. An informed guess at the form of protolanguage

I shall try to respond to the following questions:

- What is the most plausible evolutionary era in which a protolanguage existed?
- Can artifacts such as stone tools, engravings, paintings tell us something about the cognitive basis of a protolanguage (i.e. as one semiotic form among others)?
- Does the anatomical change of hominids give hints as to the shape of a protolanguage?

2.1 The plausible time span of a protolanguage

In a classical analysis of mitochondrial DNA by Stoneking and Cann, 1989, two lines were distinguished: one leading to genetic variability inside Africa and one leading to all other populations of humans outside Africa. The common ancestor was dated between 142,500 and 285,000 BP (assuming a divergence of 2% to 4% per million years),[7] making 200,000 years a good guess at a plausible time span. This guess fits well with the archeological data. Bräuer (1992) sees the beginning of the line of

[5] Such ecological changes could be the ice ages with their dramatic change of the climate, the fauna and flora or higher concentration of population in specific ice-free areas of Europe or in wet areas of the corresponding pluvial ages in North Africa. Both factors can be applied to the evolution of anatomically modern man between 50,000 and 18,000 (Würm ice age) years and to the emergence of homo sapiens between 200.000 and 130.000 (Mindel ice age).

[6] The derivation of language capacity directly from physical or chemical base structures without the impact of Darwinian principles as favored by Chomsky is rejected by all biologists (cf. Maynard Smith and Szathmary, 1996, and from a philosophical perspective Dennett, 1995: 395).

[7] Even a range between 50,000 and 500,000 seemed possible, but less plausible (cf. Stoneking and Cann, 1989). Meanwhile more genetic loci have been studied: Y chromosome, Xq13.3, β-Globin, ACE, LPL. The Y-chromosome which is transmitted from father to sons is the natural complement to the mitochondrial DNA transmitted from mothers to their children. Pääbo (1999: M14) summarizes: "However, the studies that have been performed tend to arrive at dates for the earliest variation of less than 200.000 years similar to that of mitochondrial DNA".

anatomically modern man around 200,000 years. As the linguistic capacity is a common heritage of all existing human populations, the date of 200,000 B.P. (before present) could be the beginning of language in recent man.

An earlier stage and thus a further candidate for populations with a protolanguage is the Homo erectus: early African Homo erectus is dated around 1,6 my; the separation of African and Asian Homo erectus may be dated to 1,0 my. In one of the evolutionary scenarios the Neanderthals, the archaic Chinese and the Archaic SE-Asian Homo erectus died out and were replaced by modern man.

These considerations leave us with two candidates of populations equipped with a protolanguage:

- Ancestors of modern man (~ 200,000 y).
- Homo erectus populations distributed in Africa, Europe and Asia (~ 1 my)

The first could be too near to modern man to show significant differences, the second could be too far from humans to have had a comparable language capacity. It is plausible that the ancestor/population (~ 200,000 y) was genetically near to modern humans and only a kind of genetic assimilation could have produced changes in language capacity.[8] If the ancestor population is too modern to fit the idea of a protolanguage intermediate between the separation of chimpanzees and humans (a minimum of 5 my) then the populations of early and advanced Homo erectus (1,6–1,0 my) is a better candidate.[9] If one goes further down to Homo ergaster and Homo habilis, one reaches roughly a period of 2,0 my and one is in the middle of the evolutionary period since earliest hominids (~ 4,0 my). A basic argument for the language capacity of Homo erectus populations refers to his usage of tools and fire. Therefore, I shall assess the second question, keeping in mind that the date of a protolanguage could be 2,0–1,0 my.

2.2 Can artifacts tell us something about a protolanguage?

[8] Cf. for the possible scenarios of a quick evolutionary change Wildgen, 2002: chapter 2. The change could alternatively be an assimilation process (cf. the concept of 'Baldwinian evolution' in Bickerton, 2000: 264) or a long-range language change (affecting basic types of organization).

[9] Recent results in genetic comparison between humans and other primates show a 5.5-fold acceleration in the level of gene expression in the brain of humans (not in blood and liver) which is exceptional for mammals with a comparable overall genetic distance (primates were compared with rodents). Enard et allii (2002: 341f) say: " these results […] supports the notion that changes in gene expression levels in the brain have been especially pronounced during recent human

In fact, the first stone axes were produced around 2, 0 my (the so-called pebble culture). Chimpanzees may use a stone to open a nut or fit a branch for the “fishing” of termites.[10] The pebble culture requires the use of a stone or bone to chock another one, in order to produce a sharp edge on the pebble, i.e., the tool is used to produce a specific shape and is fitted to a large number of uses. Probably other materials (bone, wood, and fur) were again shaped using the primitive stone axes.

If fire had to be conserved[11] the process of fire had to be controlled. In both cases a control of causation and instrument use (with an iteration of processes of cause-effect control) and as its precondition a *representation* of possible effects, possible shapes and functions had to be mastered. The “Homo Faber”, as Bergson called man at this stage, had the cognitive abilities for symbolic representations. The question is: Did he use phonetic language to express these representations or gestures, or neither of these? Some authors favor a motoric origin of language, and thus stand in the tradition of Condillac’s “language d’action” (cf. Hewes, 1976, who distinguishes a gestural/semantic and a full vocal language, and Quiatt and Reynolds, 1993: 266 ff.). In this perspective the protolanguage of Homo erectus populations would have been gestural (with holistic phonation as supplement). Lieberman (1989: 409) argues that the rapid evolution of the supra-laryngeal tract in Homo erectus makes an “entirely gestural language unlikely”.

Artefacts are not only hints at the cognitive level of humans, they are also linked to social life. In order to produce artifacts and to keep fire, a socially organized exploitation of the environment, a division of labor and a mode of social distribution of products must be in place. This requires rules of collective behavior, and language as a kind of rule-governed social behavior not only helps to represent and enact social behavior, it is *the* symbolic representation of social behavior per se.[12]

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evolution”. As Australopithecines were still rather ape-like, the change in expression level could have occurred in the stage of Homo habilis or Homo erectus/ergaster.

[10] In chimpanzees one finds extensive nut cracking using different sizes and qualities of stone tools which may even be transported from one place to another. The places are normally under the tree which delivers the nuts and the roots surfacing are used as anvils. Cf. Current research in the group directed by Prof Boesch at the MPI "Evolutionary Anthropology“ in Leipzig: table 1 in Boesch and Tomasello (1998: 593) classifies the “semiotic” behaviors in six chimpanzee populations. The group specific learned behaviors are called a “culture”.

[11] Even in modern times populations were found in Tasmania and Australia which rather conserved than reproduced fire.

[12] That language is the prototypical form of a (cognized and communicated) social structure is assumed in Habermas’ “theory of communicative action” (cf. Habermas, 1981). In the context of sociobiology altruism is a behavior which points to the existence of a system of social exchange

2.3 Anatomical evolution and the shape of a protolanguage

The classical measure, brain size normalized by body weight, reached a critical level necessary for higher cognition with Homo habilis. Brain size is correlated with the size of social groups (cf. Dunbar, 1992). Social cognition is linked to a degree of self-other distinction, to a theory of mind, to the possibility of strategic control of action, and control of the social perception of oneself by others. Such an evolution creates the pragmatic capacities which can be worked out and represented in language. The control of a larger area, the use of centers for communal life, the systematic expansion into new areas presupposes high ecological flexibility and a global spatial orientation. It seems therefore highly plausible that the advanced Homo erectus who migrated to Europe and Asia had the cognitive and social capacity for symbol use, i.e., for a language which probably was organized vocally with gestural cues. The power of motor imitation in the learning of techniques, gestures and phonations was already given to higher primates (as the existence of mirror-neurons in some primates including man shows; cf. Rizzolatti and Arbib, 1998). Thus the cognitive, social and behavioral requirements for language were given. The basic question: Did they speak a language? can only be answered probabilistically: As all conditions were given, they probably did.

In the next section I shall argue in a less informal way and make use of dynamic system theory to propose a specific format for an evolutionary grammar.

3. The format of an evolutionary grammar

An “evolutionary grammar” necessarily has a temporal dimension, i.e. the proper dimension of the evolutionary processes. The question of the adequate format of such a grammar encounters similar problems as developmental grammars (cf. Klein and Dittmar, 1979), grammars for linguistic change (cf. the work of Labov,), diachronic grammars or models of grammaticalization and grammar-genesis. A system of rules and even one with basic categories, modules and principles is not able to map the inherent (and not just parasitic) developmental, historical and evolutionary processes. The same is true for interlanguages, Pidgin and Creole languages, contact varieties, social varieties, and their context dependent registers.

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and common values. It exists in wolves and similar animals and possibly this parallelism to humans prepared the later symbioses of dog (domesticated wolves) and man.

The grammatical tradition of normative grammars, school grammars, competence grammars, falls short of these demands, but no adequate alternative, in which changes and the forces which control them were fully integrated, has been forthcoming,.[13]

In a more radical move I reject the algebraic, logical models and instead use formalisms stemming from dynamic system theory, as they have a genuine dynamic dimension. Nevertheless, the integration of linguistic arguments will have priority in my presentation and philosophical or mathematical arguments will be neglected (cf. Wildgen, 1982, 1985, 1994 for the elaboration of the dynamical paradigm).

3.1 The semantics of space and time in a protolanguage

One can distinguish two sub-aspects: processes in space, such as spatial orientation and navigation, and temporal classifications and rhythmical patterns.

The representation of *space* has to do with frontiers (their transition) and perspectives. A first perspective is centrifugal, i.e., starting from the self and its basic bodily motions an 'experienced' three dimensional space is cognized: in front of – behind (go), above – below (climb, fall), left – right (grasp with the left hand or the right hand). This space of bodily motion with feet and arms defines the immediate space, where objects may be reached and manipulated. The intermediate space depends on man's ecology; it can be the housing (the cave, abri) or the village; the distal space contains roughly all possible itineraries (of hunting/gathering). The second perspective is centripetal, i.e., the self is seen as the place of effects triggered by external causes. The sky, the horizon (typical points where the sun sets or rises), the favored direction of winds, the ridge of mountains may be the external locus of orientation for the self, who is at the center of a force field or gradient implicit in these delimitations. Many myths and religions refer to this extreme locus of orientation as they interpret the fate of humans as standing under the control of such

[13] Labov (1972) tried to adapt his empirical data to modified versions of a generative grammar, as Klein and Dittmar (1979) did. Developmental studies adapted the generative paradigm in its Principles & Parameter version (which in turn responded to comparative and developmental issues). Bickerton (1990: 199 f.) starts from eight modules of a current (Chomskian) model and he cooks it down to two principles: phrase structure (X-bar-theory) and verb-argument clusters. These two principles are then used to distinguish the protolanguage of Homo erectus and neanderthalensis which would be structurally limited insofar as neither complex phrases nor verb argument complexes could be mastered. I shall give an alternative formulation of these two features (cf. Bickerton, 1990: 189-197).

distant (and often invisible) forces. In Fig. 1 the topology and dynamics of such a cognized space are illustrated.

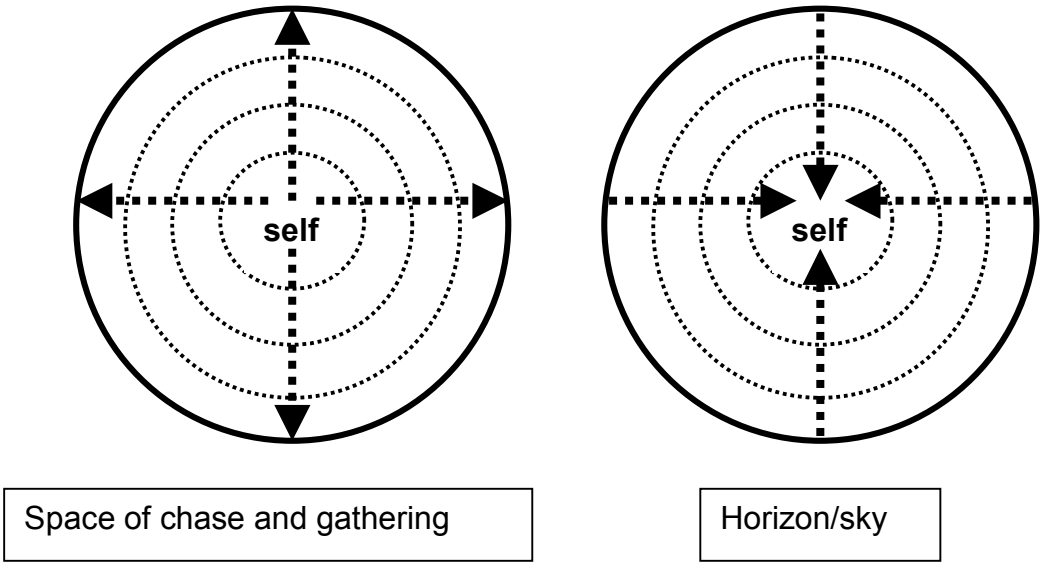

Fig. 1: Force fields of centrifugal versus centripetal orientation.

The cognizing of such schemata for orientation may only show up in behavior (as it does in many animals), it may be gestured or it can be deictically organized in a phonic language.[14] For the Homo erectus the cognizing seems clear. The inner space is defined by the use of hands and instruments, the medium space by the choice or construction of dwelling-places (to which the group could return). The centripetal organization is involved in long-range excursions and migration. As the orientation system cannot be genetically coded (as in bees after millions of years of evolution) it has to be learnt, adapted to changing context and socially shared. Language is one possible solution to this problem, be it gestural (behavioral) or phonic and as humans have chosen the path of phonation it is plausible that our ancestors began to proceed into this direction. (This is an application of the principle of continuity in evolution).

[14] Cf. the research on types of orientation in different ethnic groups, e.g., research conducted at the MPI of psycholinguistics by the group of Prof. Levinson; Annual Report, 2001: chapter 6.

The representation of *time* is rooted in the classification of multimodal sensory inputs using specific temporal rhythms (clocks). Pöppel (1997) proposed two temporal windows for multimodal integration:

- The window of 30 msec. Only after a stability of 30 msec does an event become an object of (multimodal) perception; it can be classified, labeled, compared, etc., i.e., further processed.
- The window of 3 sec. A sequence of events can be understood as a structure. In this window the smaller units (30 msec) are correlated as: before – after, cause – effect, etc. This is the point where a notion of structured temporality is born.[15]

A protolanguage must categorize events and actions (by proto-verbs) and must discriminate stable entities (by proto-nouns). The question arises as to whether temporal, dynamic, quantitative, qualitative *relations* between them can be mastered and if so, to what degree. This question brings us to the two basic delimitations of a protolanguage discussed by Bickerton: phrase structure (X-bar-structures) and government (case-frames). I will argue in the next sections that there are intrinsic complexity barriers which could have blocked the elaboration of a protolanguage for a long (evolutionary) time-span, say 0,5 my.

3.2 Representation of actions and events

In order to have access to a complexity measure I shall introduce a model of event-schemata using catastrophe theory (which is a classificatory subfield of dynamic systems theory). One can take grasping (with the hand) as the basic scenario (cf. Piveteau, 1991, for the relation between hand and hominisation and Wildgen, 1999, for a dynamic model of the lexicon of HAND and EYE)[16]. The action-concept GRASP involves two stable entities: the body (the hand) and the object. Every point on the lines in Fig. 2 is an attractor, i.e., the perception of a stable entity in the 30 msec window (cf. above). The whole schema should fit into the 3 sec window, e.g., in the sentence

(i) The father took the book (from the table)
A B

[15] Bickerton (2000: 275) refers to a „higher level signal coherence“ as a precondition for hierarchical structuring and tries to explain the "catastrophic“ transition to syntax along this line.

[16] The capital letters refer to the *concept* with different realizations in different languages. In Wildgen (1999) German, French and English are treated in detail, typological studies are discussed briefly.

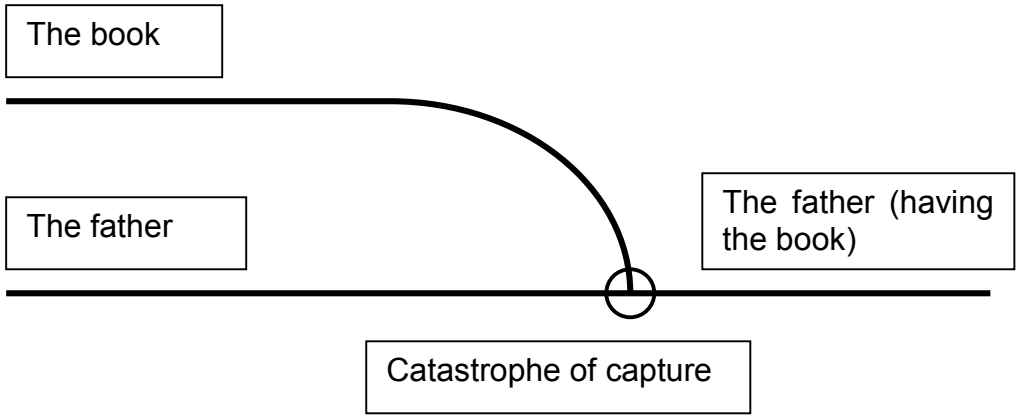

Fig. 2: Catastrophe schema of GRASP.

Early humans (e.g., Homo habilis) already had a hand with the opposition of thumb and fingers, but some features are still linked to climbing (as in gorillas and chimpanzees). The Homo erectus had a hand which was adapted to strong grasping (as places on the bones, where muscles are attached, show, cf. Piveteau, 1991: 74 f.). This was still true for Neanderthals but even in humans, bushmen (San) and Australian aborigines have a shape of the finger deviant in the same direction from the statistical average of modern humans.

One may distinguish three ways of grasping:

- the force grip (e.g., of a branch)
- the precision grip (e.g., of a small tool)[17]
- the refined grip (e.g., of a needle) [18]

The refinement refers to the topology of the capture. In Fig. 4 the first two modes are geometrically abstracted.

[17] In the evolution of pongides the origin of the precision grip seems to be a critical transition which allowed "grasping predation of certain species of insects at the terminal ends of bushes and shrubs" and this "opened a niche for primate evolution" (Quiatt and Reynolds, 1993: 123). It had as consequence the "conversion of active behavior to crepuscular and diurnal phrases of activity (ibidem).

[18] Cf. Piveteau, 1993: 29, who calls it: « préhension de délicatesse ». The other primates; the orangutan, the gorilla, and the chimpanzee did not continue this line of evolution or did it to a lesser degree (ibidem: 31).

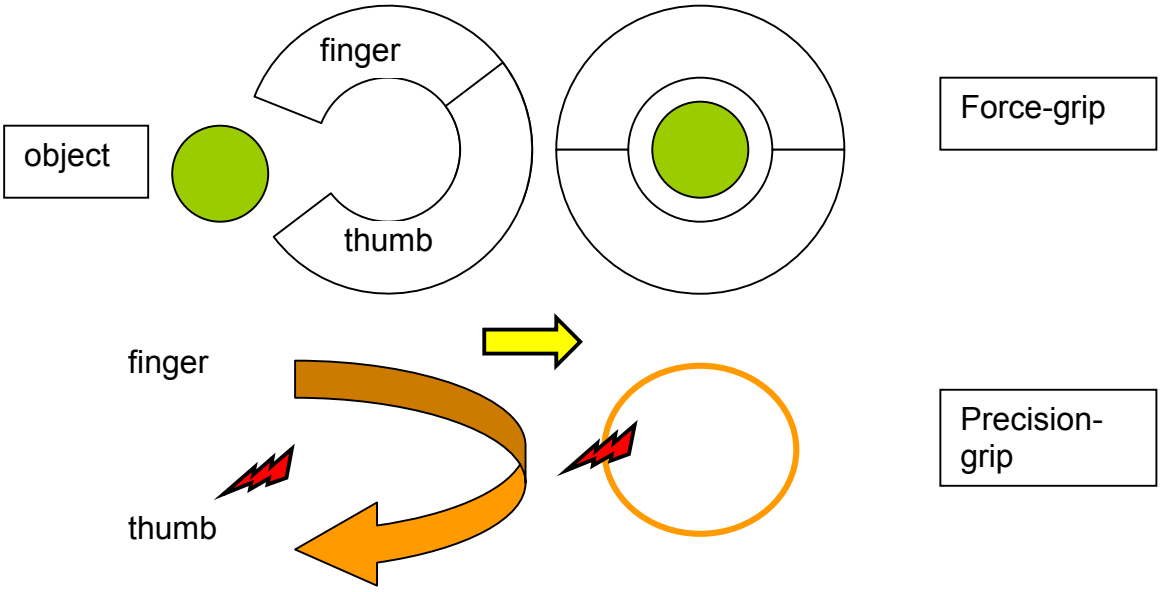

Fig. 3: Topological difference between power grip and precision grip.

These distinctions which have a long evolutionary history constitute a kind of manner specification in relation to the schema in Fig. 2. This leads to a first principle of a protolanguage.

First principle of a protolanguage

The GRASP schema constitutes a structured (bivalent) action schema with a long evolutionary history and includes a manner specification categorized on topological cues.

As the distinction between several precision grips shows, more elaboration appears as soon as more precise manipulations on objects and instruments are developed.

The fact that a cognitive bivalent schema and a manner component can be cognized does not necessarily mean that it could be transformed into phonic signals. One could even argue that the teaching of hand skills does not call for linguistic instruction. If we assume a frequent vocalization (inferred from the evolution of the

sub-laryngeal tract, cf. Lieberman, 1989) and a steady increase of memory (due to the growth of the brain) linked to an advance in social cognition it becomes clear that this cognitive schema and subsequent ones are a preadaptation for the evolution of verbal phrases or valence patterns in sentences. Thus, in order to verbally represent important and recurrent actions in a protolanguage the cognitive schema of grasping could be used as a kind of ground for iconic/metaphorical transfer to all kinds of manipulations on objects.[19] As soon as instruments were used this schema could be iterated.

(i) The father (A) takes a hand-axe (B) to move/change/kill ... object (C).
(ii) The father (A) takes a stone/bone B to hit the pebble (C) which should later kill the animal (D).

Second principle of a protolanguage

The topologico-dynamical schema of grasping assembles causal/enabling/intentional meaning components, which are necessarily present in the purposeful shaping of a tool and it also lays the groundwork for force-dynamics in phonic language.[20]

In this development a first barrier of complexity appears. While the schema shown in Fig. 2 is dynamically and topologically simple (it can be derived from an elementary catastrophe of the type cusp), the composition of such schemata is not simple (in a mathematical sense). One needs a specific topology/geometry to restrict the degrees of freedom for such a composition.

First restriction (valence complexity)

The iteration of basic action schemata presents a barrier of complexity as the composition is not dynamically stable. It calls for specific controls of stability.

A second restriction concerns the manner component. The evolutionary old distinctions between forms of grip and manners of locomotion (related to the dynamics of the legs) are topologically basic (cf. Fig. 3) and could belong to the basic constituents of a protolanguage.

Second restriction (manner component)

[19] This could lead to an evolutionary reinterpretation of Lakoff's and Johnson's metaphor semantics (cf. Johnson and Lakoff, 1980, and Lakoff, 1987).

Further elaborations related to type of object, motion and rhythm of objects, their resistance, etc., require very specific techniques of categorization and it is likely that they were therefore not yet part of the semantics (and the lexicon) of a protolanguage.

A set of rather abstract specifications which are often grouped together in Pidgin and Creole languages can be called (after Bickerton, 1981) the TMA-component (T = Time, M = Mode, A = Aspect). They are the next step which could have "evolved" in the protolanguage (made possible by different evolutionary changes).

Third restriction (TMA-component)
The TMA-component of sentences lies at the transition line between protolanguage and true "grammatical" languages.

The order of emergence of grammatical features transcending these restrictions could have been:
(1) elaboration of valence patterns (up to valence 3 or even 4)
(2) elaboration of the manner component
(3) elaboration of the TMA-component

I have started from the grasp schema, but there are simpler schemata. The dynamically simplest schema is that of stable existence. If we apply the 3 sec-window, any entity not changing in this window is a candidate. As the inputs of classification or labeling-reaction are not only spatio temporal events but also qualities, one can assume the slow increase of quasi nominal/adjectival labels as soon as memory capacities and social demands increased. One could imagine that labels for other people, animals, plants, and artifacts were the first candidates for a growing lexicon. This development is also the natural continuation of classificatory capabilities of other mammals (even birds and fishes) and the differentiated warning calls of specific apes[21]. The cries of alarm, disturbance and food constitute a basic lexicon with reference to specific situations and they have distinctive pragmatic values, e.g., as asking for, responding to, informing about, etc.

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[20] The term "force dynamics" was coined by Talmy (1988); cf. Wildgen 1994: chap. 1, for a critical discussion of his proposals.

[21] Cf. Fischer and Hammrschmidt (2001) for a critical discussion and experiments with Barbary macaques. Thanks for a conversation on the topic with Catherine Crockford at the MPI-Evolutionary Anthropology in Leipzig.

Between the bivalent schema of grasping and pure existence the dynamic hierarchy predicts the first type of catastrophe: birth (appearance) and death (disappearance). Therefore, labels of temporal sequence and transition through nonsymmetric barriers: begin/end; enter/leave; come/go could show-up before the grasp scenario is managed linguistically. I presume that the grasp-scenario is already the transition point between a protolanguage and the pathway towards a full-fledged language.

Third principle of a protolanguage

The inchoative, resultative, terminal aspects of action were probably represented in a protolanguage, e.g. by intonation or gestured modification.

3.3 Beyond the grasp scenario

The manufacturing of stone tools (and *a fortiori* of tools shaped with the help of stone tools) goes cognitively beyond the grasp scenario as I have shown before. One hand (or one foot) must fix the pebble, the other hand grasps the stone or bone which hits the stone. Finally the planned breaking off subtracts material from the chosen stone and after several strokes the desired sharp edge of the pebble is produced. This scenario involves two objects, two hands and a change in shape of the pebble (the separation of parts from it). René Thom (1983: 182) proposed the *excision* schema which is presented in a modified version in Fig. 4.

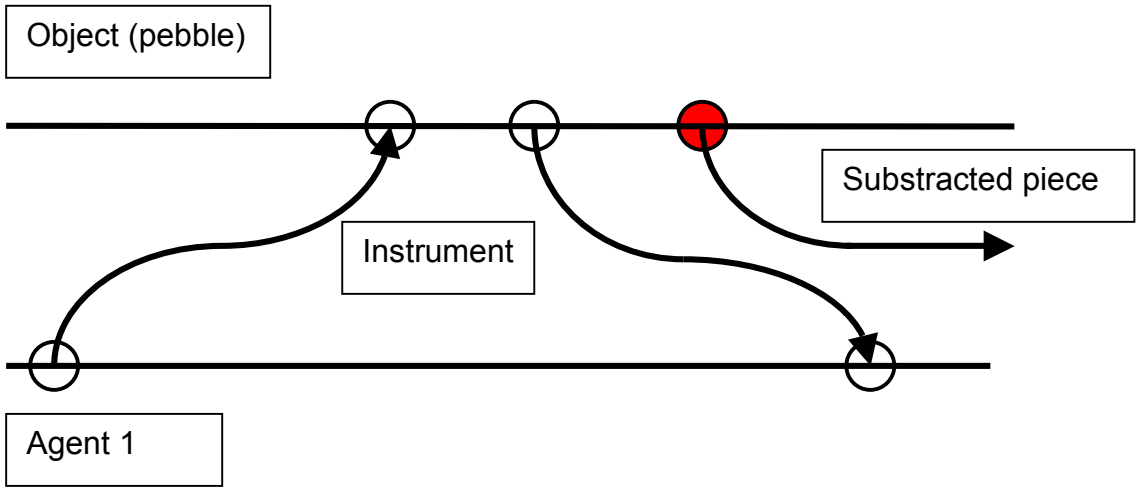

Fig. 4: Schema of shaping an object with an instrument via *excision*.

This schema contains four symmetric “grasping/emitting” sub-schemata for instrumental action and one “emitting” schema. The first four are integrated in the

(double) Transfer-Schema, which may be derived from the elementary catastrophe called: butterfly. The integration of the shaping by the tool is on a higher level of complexity (it has two force dimensions) and has structural stability only under very specific conditions (referring to the compactified umbilic, cf. Wildgen, 1985: 215f). In fact a linguistic description of the action normally requires more than one basic sentence pattern in actual languages.

Fourth restriction (of modern languages)
Schemata with three and more (not linearly arranged) stability centers are at the limit of complexity of human sentence patterns.

3.4 The complexity of (nominal) phrases

Bickerton (1990: 195) suggests that in order to organize a descriptive (nominal) language one needs three structural layers:

> "(a) a generic class, X; (b) the properties peculiar to particular members of that class (large, with a dark red cover, of Mary's) and (c) the specification of the complete individual in terms of abstract relations such as quantity, proximity, familiarity, and so on (a, this, there)"

His proposal reflects again a position typical of generative grammar (in 1990)[22]. I think that there is no need to follow the traditional X-bar-schema in an "evolutionary grammar". The primary reason is that the determiners (a, this, there) refer to a different function than other specifiers (attributes), i.e., deixis or the anchoring of an utterance in the context. This function may be called indexical and it has another evolution linked to traces and to effective binding between language and non-linguistic action. The evolution of the indexical function, although it lies beyond the scope of this paper, represents a vital aspect of 'evolutionary grammar' and is a worthy field for further research.

The head and its attribute (or non-determiner specifier) are of the same basic type (nominal/adjectival) and the restriction is primarily concerned with the risk of blending two or more semantic spaces[23]. If every noun or adjective is associated with a place

[22] In Chomsky (1995) many of the specific features of the P&P (Principles & Parameters) model are abandoned, because they "appear to be computationally irrelevant" (ibidem: 389)

[23] A semantic space may be conceived as defined by a set of independent features, which are either polar oppositions or graded scales. Ideally a semantic space should be homologue to an imagined space, i.e. it should not have more than three dimensions. A very general notion without topological restrictions is used in "Mental space theory" by Fauconnier (1996). I suppose that his theoretical

in a semantic space, then the mapping of one place in space A to one place in space B is a problem insofar as the spaces are different and may not be easily transformed into a conjunct space A x B. This is possible if A is “father” and B is “old“; in this case old + father has a new, well-defined place. It is not the case if one tries to combine “father” and “quadratic” or “fluid”. Moreover if A has n dimensions and B has m, then A x B has n + m dimensions and any increase in dimensionality creates instabilities. Another danger is that the mapping of a space A to another space B under deformation (insecurity, vagueness, variation) easily produces chaotic results as experiments with video feedback have shown (cf. for chaos theory in semantics: Wildgen, 1998). Thus classical X-bar-theory and its application by Bickerton (1990) underestimate the problem of (iterated) attributes to nouns.[24] On the basis of these considerations, a fifth restriction may here be formulated.

Fifth restriction

The semantics of complex noun + attribute combinations leads to complex mapping problems and creates the risk of a chaotic product.

4. The self-organization of a grammatical system

Pinker and Bloom (1990) think that the central human feature of language is *syntax* and that therefore an evolutionary theory of language should explain the selection criteria for the syntactic abilities of modern humans. Contrary to them, Kirby (2000) argues that *compositionality* (and thus syntax) may emerge by a kind of population dynamics based on individual representations. Recent computer models of evolution based on game theory come to a similar result (cf. Cangelosi, Greco and Harnad, 2002). The purely syntactic problem of chaining elements of an existent vocabulary does not therefore require a specific endowment and evolutionary processes enabling it. The deeper problem is that of *semantic* compositionality, because the mapping/blending of spaces with different topology and the account of the dynamics inherent in verbs is crucial for sentential units. This is the tremendous problem which has to be resolved in order to allow for a stable and reliable communication via

intuitions could be integrated with the phenomena discussed in this section, although it is not clear how the topologico-dynamic hierarchy of catastrophe theoretic semantics should fit the logical machinery he presupposes..

[24] In the simplistic view of concatenation without semantic effects this problem was excluded a priori.

phrases and sentences. In order to arrive at a conventionalized system of syntactic behavior early humans had to consider two major factors:

1. The cognitive demands for a stable solution. The basic conditions have been described in the last section. One could call this the *cost* of higher order language capacity.

2. The communicative and social demand for a compositional level of referentiality. This could be called the evolutionary *gain* of the game.

Even if the cognitive capacity was given, and I have described the pathway of cognitive evolution since the Homo erectus in section 2, human society must still have a strong demand for higher order communication. Probably rewarding situations often arose by chance and the evolving species spontaneously used the “dormant“ capacity. I am sure that with the increase of population density and networks of supra-regional communication and exchange in modern humans, such a system became necessary. As soon as it was developed, it brought about long traditions of language usage up until modern times. As language is deeply grounded in human biological constitution, the turning point in the use of cognition for language must lie before the rise of modern man, i.e. before at least 100.000y BP. and probably even before 200.000y BP.. Thus the central question is not how syntax came about, but what made it rewarding to use the available cognitive potential for syntax.

In search of further answers one may turn to the mechanics of sign production, i.e. to phonetic evolution.[25] If the effective control of articulation and precise auditory analysis were evolved via a gradual improvement of phonetic communication just for the achievement of social equilibrium, then the cognitive development and the evolution of social demands for a higher level of a referential language could have triggered the overcoming of the restrictions mentioned in section 3.

5. Conclusions

From the hypotheses (principles) and the restrictions here proposed, a first sketch of the grammar of a protolanguage may be given.

[25] Cf. Wildgen (1995), de Boer (1999) and Studdert-Kennedy (2000). MacNeilage’s “frame/content theory” of the evolution of speech production is presented and commented in MacNeilage (1998). Studdert-Kennedy (1998: 171) states: “Both short- and lang.-term phonetic memory were also

It specifies three hierarchically scaled levels of primary categorization:

- *Stable* entities*:* no change in the perceptual and classificatory time window and recurrence as pattern (statistical relevance).
- *Dynamic aspects* of entities in change and motion ("force-dynamics").
- The *bivalent GRASP*-schema (capture or emission).

This allows for the accumulation of a lexicon of proto-nouns/-adjectives and proto-verbs. The combinatorial possibilities depend on context (in a similar way as ad hoc noun + noun compounds; cf. Wildgen, 1987). The grammar of the protolanguage is based on these proto-classes and their implicit dynamical binding forces (linked to force dynamics).

The restriction principles may explain why further conditions of control on the combinatorial/mapping/blending semantics had to evolve in order to arrive at a more complex and less context-dependent grammar.

I mentioned three basic restrictions which apply to proto-manner adverbials, to a compact TMA-component and to recursive constructions of specifier phrases with a proto-nominal head.

The restriction on higher valences shows that modern languages are still restricted and can overcome those restrictions only by building larger periphrastic and textual structures.

It is important that an evolutionary grammar not only shows how these "wonderful" grammars became possible, it should also consider the fact that the world is still in a process of evolution and that restrictions on linguistic systems continue to exist (and could be overrun in future evolutionary processes).

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essential preadaptations for syntax […] Without a preadapted system for storing phonetic structure independently from its meaning, syntax could not have begun to evolve"

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