ART AND MUSIC

PAST, PRESENT AND FUTURE PERSPECTIVES

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THE DYNAMICS OF HUMAN SYMBOLIC BEHAVIOR: LANGUAGE, VISUAL ART AND MUSIC

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ABSTRACT

Symbolic behavior lies at the heart of human nature. Language and art (visual and musical) make up the core of the human capacity for sign creation and usage (semiogenesis). The dynamics concern first the ongoing unfolding and changing of this capacity and second the internal organization of symbolic behavior insofar it is able to map the dynamics of action and emotion in semiogenesis. On behalf of language, the chapter considers some archetypes of human behavior and their cognitive schematization, which allows for an elaborated lexicon of verbs, prepositions, cases etc. and for the construction of basic sentences (valence patterns). Examples are the GRASP- and the GIVE-models. The rapid evolution and further unfolding of linguistic capacities may be explained by a hypercycle of pragmatic situations, their interaction and strong selective effects. In the domain of visual art, archetypal models dominate figural construction. This is demonstrated in relation to some paintings by Leonardo da Vinci. In the domain of music, an intimate relation exists between music and bodily motion, gestures, and emotional processes. Basic kinematic and dynamic laws applying in music are mentioned and the dynamics of melody construction are analyzed in some detail.

1. INTRODUCTION: SYMBOLIC FORMS AND THE DYNAMICS OF LANGUAGE, ART AND MUSIC

The philosopher Ernst Cassirer introduced his *philosophy of symbolic forms* in a conference at the Warburg Institute in Hamburg in 1921. The aim of this philosophy was to consider the expression of something in the mind ("Geistiges") by signs accessible to the sense ("sinnliche Zeichen"). In the twenties, from 1923 to 1929 he developed this philosophy in three volumes: (1) Language, (2) Myth and (3) the Phenomenology of Knowledge (science). In the following, I shall consider three symbolic forms: Language, Visual Art, and Music in order to pinpoint some common features; the focus will be on the underlying dynamics, i.e. the semiogenetic principles which determine all these forms and their genesis.

Two highly relevant transitions after hominization had a major impact on the development of human symbolic media and languages:

a) The culture of painted caves in the late Paleolithic is documented between 37,000 and 16,000 y. BP. A rich corpus of paintings, drawings, sculptures, and abstract (quasi-writing) symbols illustrates this period, which extended over Central and Eastern Europe under the conditions of the last ice age.

b) The new technologies of farming and cattle breeding led to many cultural innovations, e.g., urbanization and writing. It produced the first large-scale societies in Egypt and Mesopotamia (beginning around 5,000 y. BP).

A recent transition to a so-called "morphogenic society" in the Late Modernity is advocated in Archer (2014). Prior societies were rather morphostatic, as a negative feedback to social changes dominated and evinced rapid changes. In morphogenic societies, changes receive a positive feedback. At first, innovations in the social relations and architectures are realized in sub-cultures and social niches and, after this

experimental stage, some of them are rapidly generalized to the whole society or even in a global manner. In a morphogenic society, symbolic media will also change rapidly and either lose their relevance and the number of adherents or be diffused exponentially. At the same time, the rhythm of changes increases followed by a quick change of values. In encounters with people from other groups or newly built networks, the values and norms become unpredictable.

1.1. The Impact of Individuation

The processes of survival and selection operate on the level of the individual. This is clearest in Darwin's favorite example: sexual selection. It occurs in a situation where both sexual partners meet. They either reject or accept one another and the transfer of genes is blocked or enabled. This scenario presupposes *individuation* and a *context* (time span, place and the presence of other agents like rivals).

An individual is defined by the natural limits of life (i.e., birth and death) and the forces, which sustain its life. If life is endangered, there exist appropriate mechanisms to recover, to repair damages and to avoid death. In this perspective, individuation has an implicit finality: survival under danger and risk. A tribe or family group may disappear, if its reproduction rate is too low. Thus, in small and separated groups, a scenario characteristic for Neanderthals, the loss of some younger females may drive the group to extinction; if this occurs often and becomes a trend, the species may be extinct after a number of generations (particularly, if the overall population is small).

By these dynamics, individuation can drive the evolutionary process, i.e., avoid or allow extinction of a group or even a species. If individuals and groups of one species or subspecies share the ecology with others, their success may enhance the extinction of the other species, if mixture is genetically or behavior ally excluded or rare (dangerous). Individuation is also the bridge for innovation either biological or cultural. For biological innovation, the individual, who shows new features due to some biological

change, must first survive in the environment of individuals without this change and then be successful in reproduction. These conditions decide if the new capacities of the individual survive and finally change the characteristics of a group or even a species. In the case of cultural innovation, other individuals must perceive it as positive; imitate/learn it, such that it becomes part of a cultural heritage. In each case, the change must be perceived, evaluated in order to trigger a new kind of behavior, i.e., the effect relies on semiotic (sign-related) factors. The evolution of symbolic behavior is enhanced by processes of individuation and by the propagation and socialization of semiotic innovations.

1.2. Tradigenetic and Ratiogenetic Processes

One can distinguish tradigenetic and ratiogenetic processes (cf. Tembrok, 2004). In the first case, socio-cultural values, standards, techniques are transmitted and conserved inside a social group (e.g., a family, tribe, and a geographically connected set of tribes); they establish a tradition as a system of habits. Ratiogenetic processes enhance such events by distinguishing individuals or professional groups for their directive function. These persons may be elder men or women, priests (shamans), elected chiefs, etc. They do not only incorporate the heritage of the group (in their life memory), but can plan and direct specific innovations or dramatic changes which have a deep influence on the fate of a population. Thus, the figure of Moses, who led the people of Israel out of Egypt, the prophets and founders of religion or significant statesmen (see Alexander, Augustus in antiquity) and their helpers (a small subpart of the society) can rationally move a given society into a specific direction. Since industrial revolution (England 18th century), the French revolution (end of the 18th century) and socialism (19th century) technological, scientific and political innovations have influenced the development of humanity. Insofar as ratiogenetic processes refer to individual minds, i.e., the imagination and planning of individuals, they are part of individuation. In the process of transmission, the traces of this origin may disappear as many people

contribute to its elaboration, transmission and the establishment of new standards. The importance of individuation becomes obvious in societies, which suppress individual creativity and pay this default with a slower growth of science, culture and economy.

2. THE SEMIOGENESIS AND DYNAMICS OF LINGUISTIC (SYMBOLIC) MEDIA

The semiotic base line is the level of bodily signals expressed by movements (of the tongue, the hand or other body parts). The specificity of humans is their preference for the phonic channel and the enhancement of phonic capacities in terms of speed in articulation, precise control of articulatory targets and high auditory resolution.

The organization of linguistic utterances in the first stage of the evolution of language (cf. Wildgen, 2004) was either holophrastic or comparable to two-word-utterances in early child-language (with one pivot term as center and a variety of occasional second terms). In Wildgen (2004: 168) I have formulated the (first) restriction of valence complexity, i.e., utterances were either holophrastic (value 0) or had maximally one additional (facultative) argument. The relevant and recurrent categories of the perceived and practically used flora and fauna and kinship relations were phonetically coded and thus became part of shared knowledge.

Finally, the language capacity of our species was developed. Beyond a higher phonic competence (precision and speed, longer utterances), the critical transition concerns valence patterns, i.e., the consolidation of the bipolar sentence structure (case-frames with one argument: subject–predicate or ergative–predicate constructions; cf. Wildgen, 2002 and 2017). The complexity of argument structure was further increased by the introduction of secondary arguments leading to sentences with valence two and three (e.g., transitive and ditransitive constructions). The fact that in current languages valence-one patterns dominate statistically, followed at some distance by valence two-patterns is a trace of this evolutionary

sequence. Some linguistic communities still prefer very primitive patterns (cf. the "minimal language thesis" by Gil 2006). This means that the corresponding complexity at the sentence level is not a prerequisite of human communication; other semiotic techniques (gestural, contextual visual cues) can fill the gap.

In the following, I shall put into parallel two types of "unfolding" of dynamic "germs", with the aim of explaining the second via the first one:

1) The unfolding of process schemata is mirrored in the hierarchy of elementary catastrophes (cf. Wildgen, 1982 and 1994). They abstract a type of real processes into a schema, which becomes the basis of cognitive and linguistic gestalts.

2) The complexity in the world (insofar it is experienced and enacted) is projected into a parallel or at least similar complexity in language (and linguistic cognition). This emulation of real world features by linguistic (and other symbolic) structures is the reason for their efficiency in human cognition and behavior and therefore had a high selective advantage in human evolution.

2.1. Sketch of the Dynamic Basis of Linguistic Gestalts

The basic real life "morphologies" abstracted by elementary catastrophe theory furnish a universal set of perceived or enacted situational schemata, which are exploited by human languages as minimal scenarios for utterances. If we consider linear paths in an unfolding, i.e., in the phase spaces sketched in Figure 1, we can classify a basic set of processes (cf. Wildgen, 1982 and 1994 for the elaboration and critical analysis of the list of archetypal scenarios proposed by Thom).
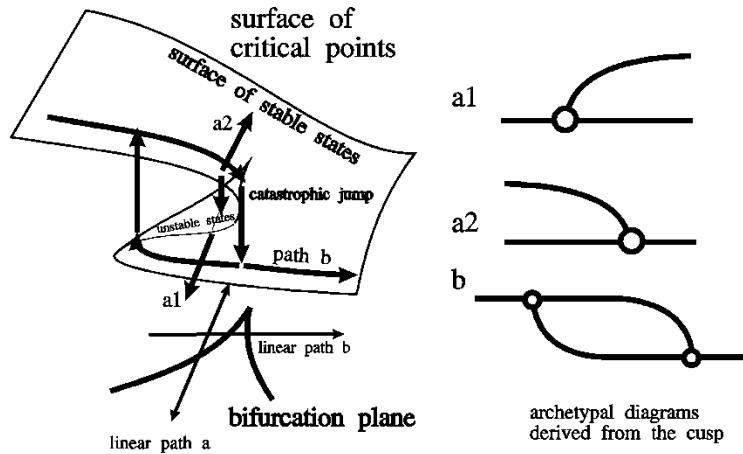
Figure 1. The derivation of archetypal diagrams from the "cusp".

Thom's Conjecture

Given a dynamic situation, the analysis of structural stability cuts out pieces of the continuous process:

    a) in the neighborhood of singularities (catastrophes),
    b) These segments have a maximum complexity of 3 (with one component) or 4 (with two components).

If we consider Thom's conjecture and the list of process-schemata derived from elementary catastrophes, we come to the following conclusions:

- A finite (small) list of formal process scenarios can be derived by considering states, continuous processes, and transitions/changes along linear paths in elementary catastrophes.
- The static stable points, lines and surfaces correspond to mental attractors and linguistically to nominal entities, specifically nominal roles in minimal sentences. The stable process types of changes, processes, events (actions) correspond to mental

scenarios and linguistically to predicative centers of minimal sentences.

The lexicon of verbs with its valence patterns is in many languages a very systematically organized field, and the starting point of every model of the sentence is the main verb (or the predicative center) of the sentence. If the basic problem of verb valence, i.e., of the gestalt-patterns (constructions) represented by verbs and their arguments is solved, then the question of how the meaning of sentences is organized in minimal utterances can also be solved.

The only systematic and law based explanation exposed up to now (beyond simple narratives about possible origins) refers to a dynamic measure of schema complexity (cf. Wildgen, 2004). In order to define such a complexity measure, I shall use the basic catastrophe theoretical analysis shown above and interpret it in the light of evolutionary theory. I shall take grasping (with the hand) as the starting point.

2.2. Grasping as Basic Intentional Cognitive Schema Semantically Coded in Language

The action-concept GRASP involves two stable entities: the body (the hand) and the object. Every point on the lines in Figure 2 is an attractor. The schema is called the GRASP-schema and may be translated into sentences like:

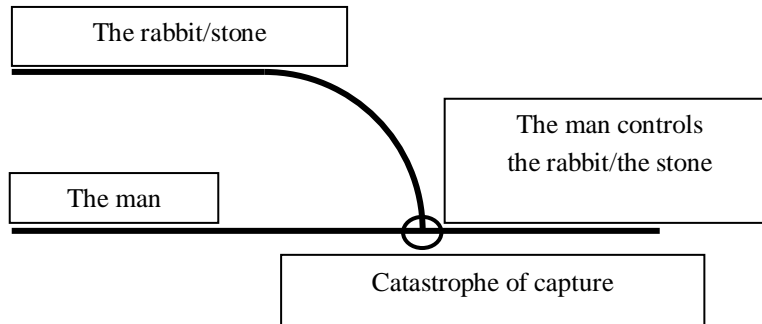*The man catches/grasps the rabbit/stone*

Figure 2. Catastrophe schema of GRASP.

Predecessors of humans already had a hand with the opposition of thumb and fingers, but some features referred to climbing (as in gorillas and chimpanzees). Homo erectus had a hand, which was adapted to strong grasping (as places on the bones, where muscles are attached, show). The distinction between several types of grips lead to more elaborated schemata as soon as precise manipulations on objects and instruments showed up. This concerns mainly manner-distinctions, which surface in the lexicon of verbs or in specific adverbial attributes. The fact that a cognitive bivalent schema and a manner component can be cognized does not necessarily mean that it was transformed into phonic signals. If we assume a frequent vocalization (inferred from the evolution of the sub-laryngeal tract) 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 pre-adaptations for the evolution of verbal phrases or valence patterns in sentences. Thus, in order to represent important and recurrent actions verbally the cognitive schema of grasping could be used as a kind of ground for iconic/metaphorical transfer to all kinds of manipulations on objects. As soon as instruments were used, this schema could be iterated.

(a) The man/women (A) takes a hand-axe (B) to move/change/kill ... object (C).

(b) The man/women (A) takes a stone/bone (B_1) to hit/shape the pebble (B_2) which enables the killing or butchering of an animal (C).

2.3. 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 (cf. Wildgen, 2004: chap. 4). 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 (cf. the Levalloisian technique). 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 Figure 3.
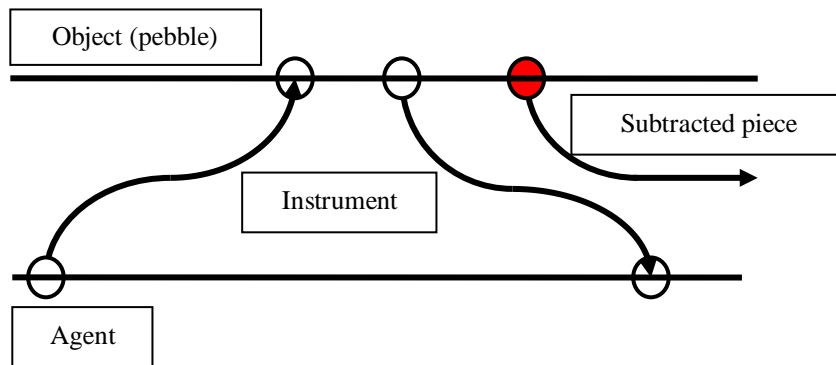

Figure 3. Schema of shaping an object with an instrument via excision

This schema contains four symmetric "grasping/emitting" sub-schemata (simple instrumental action) and one further "emitting" schema (dark circle; the extracted part). The first four are integrated into the (double) transfer-schema.

3.4. The Configurational Structure of "Giving"

Beyond the field of instrumental action and tool production, which was the major center of collectively standardized, rule governed behavior and as such a model for the linguistic tool featuring as sentences/propositions in actual languages, we must consider schemata which organize social action and its equilibration. The exchange of goods, presents, the distribution of food, etc. was at the origin of human societies and cultures. Marcel Mauss based his theory of society on the relevance of presents and counter-presents (without money or equivalents) and called them "total social facts" (cf. Mauss, 1973). Saussure categorized language ("langue") as a social fact in a similar spirit. These reflections point at a social origin of linguistic tools (grammar, lexicon, phonetics) beyond a behavior al one.
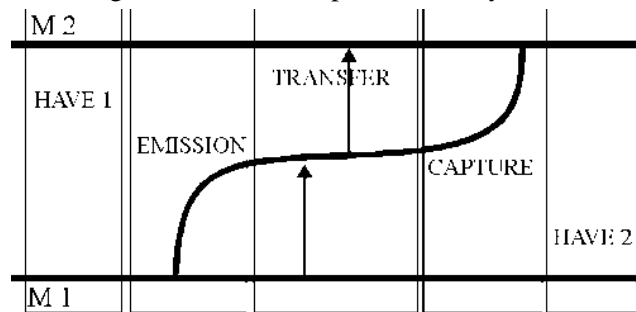

Figure 4. The phases of the TRANSFER schema

The basic schema or prototype of "giving" is configurationally the structure of basins, where each basin represents the specific positions of sender, receiver and object. At the beginning and at the end of the series one observes two basins (i.e., *attractors/minima* in catastrophe theory). At the center of the series, a third attractor appears, grows and finally disappears. The intermediate, symmetrical scene is the most unstable one. Both agents concentrate their control on one target, and their control must be coordinated in order to secure the smooth exchange. Thus, if A releases his control before B takes the object, or if A holds the object tight, although B seizes it, the character of the process is dramatically changed

and degenerates to "A loses, drops the object" or "A and B compete for the object C". Thus, the unstable state of exchange is the "junction" of the process, the point of maximum coordination of the controls. In Figure 4, five major phases are distinguished applying the catastrophic schemata called EMISSION, CAPTURE and TRANSFER (transition) between HAVE1 and HAVE2. The phases can be further subdivided in view of the dominant perspectives (from M1 or from M2). The line of TRANSFER separates HAVE and HAVE NOT for M1 and M2.

The concept of dominance in a dynamical system can also be used for the modelling of topicalization and passive transformation. The exchange of goods implies a specific force, i.e., the *value system* which allows for a satisfying exchange. This system may be qualitative, e.g., there are generalized goods (feathers, salt, gold, silver, copper, etc.) which establish a tertium comparationis (a medium for exchanged goods).

2.5. Individuation of Language Capacities

In order to learn a language children need a proper linguistic environment. As Kaspar Hauser phenomena show, there is a critical zone for this individuation. If the child does not acquire basic linguistic skills in the early period (up to 4 years) and elaborate it until puberty (11 to 15 years old), a proper skill can only be acquired under severe restrictions. In a self-referential loop, the acquisition of linguistic skills and their elaboration (e.g., by linguistic art like singing, poetry, narration, argumentation) set the context for the next generation of speakers and their communicational achievements and standards. In the opposite direction, linguistic skills are downgraded, if the transition of skills between parents (in appropriate social contexts) and children is very poor or even disrupted. This was the case in historical slavery, where young slaves were separated from their families and grew-up in a multilingual and linguistically very poor environment (e.g., selection camps in Africa, slavery ships and artificially disrupted social groups in the context of plantations). The pidgins and creoles, which resulted, show not only the loss of original

linguistic patterns (mostly West-African idioms) and dramatic simplifications in the acquisition of the colonial language (Portuguese, Spanish, English, French, etc.); they demonstrate also that the underlying species typical language capacity can recreate a fully functional language (a creole-language) even after such dramatic losses. This means, that individuals in deteriorated and disordered linguistic contexts are able to "invent" human language repeatedly. Human language is, therefore, more than a tradition or a chance invention. Human societies can under minimal conditions of social contact and information exchange, compensate the loss of a linguistic tradition and initiate new traditions which gain stability and after a period of consolidation can even fully replace the languages lost. The possibility of individuation is therefore a major stability factor in human languages.

3. SIGN FUNCTIONS AND
THE PRAGMATIC SPACE OF LINGUISTIC SIGN USE

Bühler (cf. his *Sprachtheorie*, 1934) distinguishes three major functions of signs: *representation* (Darstellung), *expression* (Ausdruck) and *appeal* (Appell). In his view, the function of *representation*, i.e., systematically organized reference to the world (including sign users) is only achieved by human language, whereas the two other functions are already realized in animal communication. For him, functions (aims, intentions) are kinds of vital needs and thus presuppose the level of life (more specifically that of animals). Bühler's original triad is the product of a cyclic process (cf. the comparison of the semiotic cycle with biological hypercycles in Wildgen, 2008). The last two functions, *expression* and *appeal* are strongly linked, because the use (meaning) of expression asks for some receiver and appeal is without effect if no content can be expressed. We can use the label 'social communication' (social calls, grooming, body postures, etc.) as a cover-term for both and distinguish it from functional reference, which appears in the alarm-calls of, e.g., velvet-monkeys. This simplifies Bühler's triangle to a binary opposition.

In a further step one may assume that representation emerges from ecological cognition (categorization of ecology) and expression/appeal from given emotional/social processes in the group (primitive, non-conscious social categorization of behavior). This leads to three inclusive levels, where the inner circle is reached by all animals with a social organization and specific reactions (perception/motor control) to their environment, the middle circle concerns animal communication with a minimal reference to the context and encompasses humans (and possibly some primates with self-awareness). The outer circle mentions specific elaborations in human cultures.

Post-language symbolic functions

Representation

Ecological categories

Socio-emotional categories

Expression/Appeal

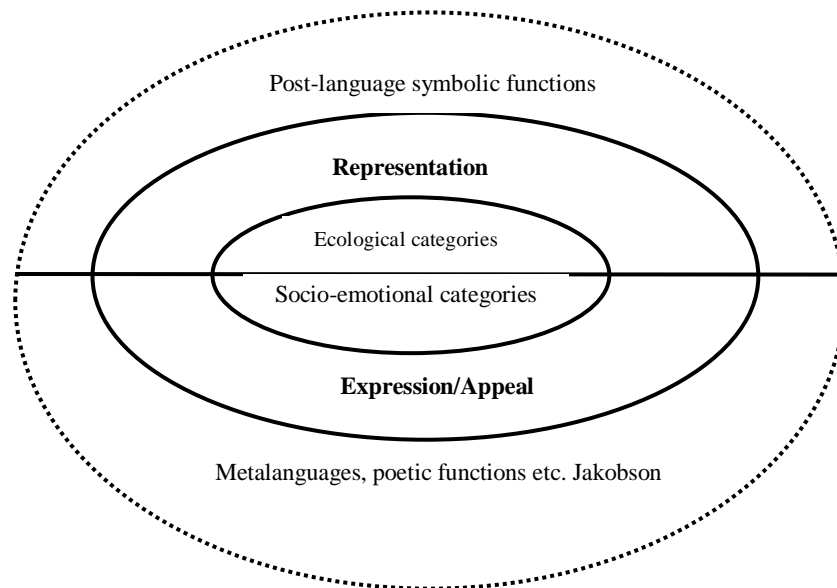Metalanguages, poetic functions etc. Jakobson

Figure 5. Three levels for the emergence of pragmatic functions

The functions in Bühler's triad emerge from ecological categories and from social categories already apparent in animal behavior. The function-triad advocated by Bühler points to a cyclic process, in which basic functions of ecological adaptation and social organization emerge. Language and other symbolic forms latent in Homo sapiens populations were further evolved via cultural evolution. We presume that this pragmatic morphogenesis is going on and actual developments in the area

of computer languages, robotic cognition and electronic media may by the forerunners of post-language symbolic devices.

3.1. The Dynamics of Spatial Cognitive and Symbolic Categories

This space of bodily motion with feet and arms defines the immediate space, where objects may be approached, reached and manipulated. The intermediate space depends on man's ecology; it can be the housing (the cave, shelter) or the village; the distal space contains roughly all possible itineraries (of hunting/gathering). The last space has a centripetal dynamics, 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 distant (and often invisible) forces. In Figure 6 the topology and dynamics of such a cognized space are illustrated.
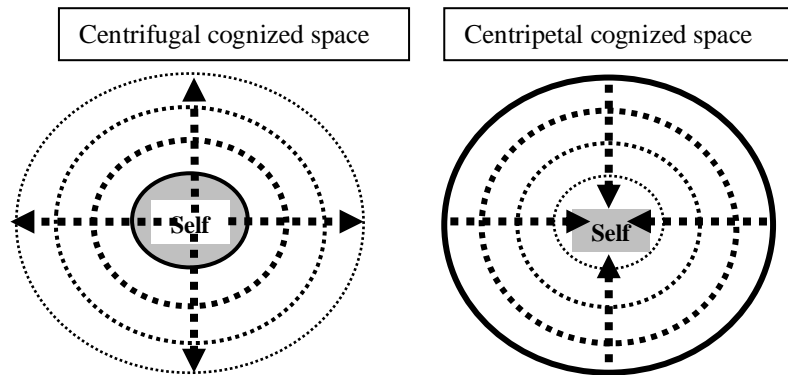

Figure 6. Force fields with centrifugal versus centripetal orientation of the Self

The cognizing of such schemata for orientation shows up in behavior (as it does in many animals), it can be gestured or be deictically organized in a phonic language (cf. Levinson, 2001: 317 ff.). As the orientation

system cannot be genetically coded, it has to be learnt, adapted to changing contexts and socially shared. Language is one possible solution to this problem, be it gestural (behavioral) or phonic. As humans have chosen the path of phonation, it is plausible that our ancestors began to proceed further into this direction. Deictic morphemes and demonstratives in current languages are a kind of "fossil" of this evolutionary change; cf. Tomasello (2008, chapter 5.3.2.).

3.2. From Ecological to Cultural Pragmatics

The background of these processes is given by the ecological/ situational context. Some objects or context features become *culturally significant*. The relevance of places (in space and time), of spatial orientation and categorization are of primordial importance for the semantics of natural languages as the tradition of localistic case models shows. The spatial networks are a precondition for migration patterns, contact with neighbors (trade exchange) and the local stratification of human habitats. The micro-spatial categorization is relevant for goal-oriented manual activities like throwing, hitting, but it is also the basis for the manufacturing of tools (cf. Wildgen 2004: Chapter 4). Bodily motion in space and the coordination of spatial locomotion in a group of individuals is the precondition of cooperative chasing and other types of cooperative activities. Finally external, perceivable processes become the recipients of internal content (in dance, music, gestures, and language).

In the two periods, in which new behavior surfaced (at the stage of Homo erectus and of Homo sapiens) a dramatic co-evolution and selection in the socio-cognitive evolution must have occurred, which has selected humans for symbolic competence. We can establish the following hierarchy:

- Already for the last common ancestor of humans and chimpanzees (LCA) contextual space was an external memory of affordances, represented by paths of social locomotion and predator/prey-locomotion, harvesting locations (and times), places of danger, for

sleep, courtship, housing, frontiers of territories, etc. These places were a medium of social action, insofar as they enable the coordination of social perception and action.

- The space organized for social use unfolded in a cycle of social "investment"; such as architecture and the spatial organization of a village (or later a town). This organized and cognized space had a cyclic structure in which different functions cooperate. Figure 7 sketches such a cycle (cf. Wildgen, 2008).
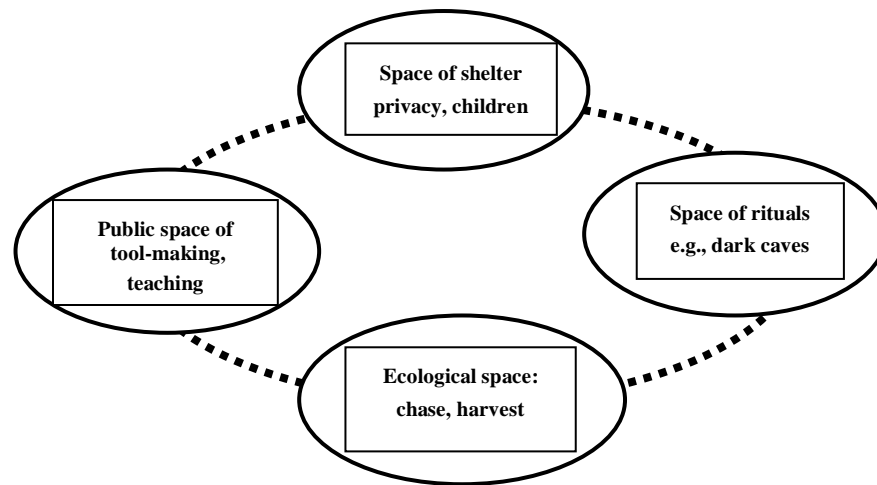

Figure 7. Functional subspaces and zones of transition (dotted lines)

In each subspace specific symbolic media are rooted and co-evolve with it: The painted Paleolithic cave (in the Franco-Cantabric culture) is a specification of the mythical/ritual space and is connected by its illusionist paintings to the outside space of hunting. The dark painted cave is opposed to cave openings, shelters and huts where people live. The open space in front of the cave or huts is a public space where the production of artifacts and the distribution of shared food occur. This public space is the border to the open field of chase and harvesting. Human action patterns occur inside a specific space or make the transition from one space to the neighboring one. In rituals, the core of these action patterns is fixed. The coding of action patterns by rituals goes on par with linguistic conventions and rules (cf. grammars).

Hypercycles in the sense of Eigen and Schuster (1979) are characterized by high selectivity. Features which enhance the cycle are strengthened and positively selected. All deviant features which do not contribute to the working of the cycle are cancelled. This allows for a very quick evolution into a specific direction (as long as the cycle is stable). In our case, the different scenarios of community life in human contexts enhance symbolic communication (mainly in the phonetic mode) and quickly go beyond simple imitation (iconic devices) and causal attributions using indexical signs. A proper and stable realm of symbolic communication emerges from such a hypercycle.

In the further development when symbolic modes (e.g., languages and myths) of different populations meet, e.g., in the large Neolithic societies of Egypt and Mesopotamia, a new level of symbolic consciousness is reached. The single fields in Figure 7 reorganize in a further hypercycle which produces a new, institutionalized symbolic system, e.g., a codified religion and a written language.[1] Possibly, the Franco-Cantabric culture (35,000 to 15,000 y. BP) and later the Sahara cultures had already reached this level. As the code of their abstract signs is not deciphered, this hypothesis cannot be substantiated.

In the further historical development, human languages not only diversified due to migration and the separation of linguistic groups, they have also modified their functional profile. This was due to the introduction of writing and institutional instruction. This further unfolding of human symbolic and communicative skills is basically *ratiogenetic*, insofar as artificial linguistic tools: writing systems, languages of science and other special purposes, mathematics, computer languages are first rationally designed and secondarily change everyday communication. Such processes reintroduce the aspect of finality which had been cancelled by Darwinism in order to get rid of creationist "explanations". The new type of finality is due to the rise of civilizations and man's will to shape his own

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[1] Hypercycles in the sense of Eigen and Schuster(1979) have a strong selective and stabilizing effect and thus can explain the rather rapid evolution of coordinated features in an interactive field.

future. The aspect of creativity and symbolic innovation is characteristic for the symbolic form of art, and I shall first consider some dynamic aspects of visual art (cf. Wildgen, 2010, 2013, and 2015) for basic principles, subdomains of visual semiotics, and specific examples.

4. BASIC DYNAMICS IN THE DOMAIN OF VISUAL ART

Culture, media, the arts are often considered to be very abstract if not spiritual entities and fields. In a Cartesian ontology, they are referred to as "res cogitans". They seem to have no real substratum, accessible to scientific methods like measurement, experiment, statistical analysis and mathematical modelling. Inspired by René Thom's morpho-dynamic analyses, we have first considered the interaction between biological entities, e.g., human beings, and ecologies, contexts of life ("Lebenswelt") and scenarios. Complex living systems have a kind of systemic telicity, i.e., a goal-orientation. In the context of its fight for survival, the organism creates its own way of stability and a kind of projection into a possible future, thus choosing and channeling possible evolutions. In the interaction with its environment it is able to modify its life context and thus to evince selective pressures. This telic dimension is the background of consciousness, which aims to control the interaction of humans with their environment. Rational strategies are the outcome of this strategy, although their impact is limited to choices left by stronger factors, which govern the overall evolution of the system. Art is also telic and it applies principles of rationality (e.g., minimal means for maximal efficiency). However, its proper realm is intuitive creativity, which enables the appearance of new, astonishing shapes, constructions and contents. In many instances it overthrows established habits and contradicts the rules of art academies (e.g., in the nineteenth century) and it reacts to sudden political and societal shifts (e.g., after wars and economic crises).

4.1. Concepts of Visual Art and their Evolution

Major figures in the history of art, e.g., Leonardo, Picasso and Beuys have even changed or modified the proper concept of art and its function. Leonardo opened his art to scientific and philosophical thought and introduced mathematical and technical aspects; Picasso made extensive pictorial experiments with new, fractal and multiple visual perspectives and Beuys questioned the idea of artist (everybody is an artist) and extended sculpture to political and social form-giving, actions in public and political programs (cf. Wildgen, 2010, 2013, 2015). Morphogenetic processes are prominent in such zones of transition in art history, where habitual and conventional ways of form giving are abandoned and new solutions for human symbolic expression show up. Leonardo takes natural processes of bodily motion (and equilibrium), geometrical and dynamic configurations of agents in a scene, irregularities of shape (pouring water, tempests) and technical inventions as models for his paintings and sculptures (machines). Picasso decomposes human bodies and spatial scenarios into cubic constructions or multi-perspective compositions and Beuys enacts symbolic scenes without language and with a minimalistic visual message, e.g., the silent explanation of his drawings to a dead rabbit or his cohabitation with a coyote in a display-window in New York City. These innovations in art demonstrate multisensorial and unstable perception/cognition and the (changing) limits of human communication. As such, they are a reflection of the precarious foundation of human thought and emotion, the partial and broken (fractal) experience of our external and internal world. It shows the necessity to find a door or a window to it with means of new ways of representation and new semiotic (sign-generating) tools. This process can be called a symbolic morphogenesis, because after the rejection of ritualized and emptied forms it shapes, stabilizes and regularizes the amorphic, chaotic background of human experience and leads to a new understanding. The communication, the social sharing of individual symbolic inventions is perhaps the most difficult phenomenon to explain.

4.2. Visual Gestalts and the Composition of a Painting

If we see a visual object, e.g., a square, we must first focus on the corners and then superimpose these focalizations in order to recognize the object (cf. Petitot, 2008: 386). In a complex image this scanning is much richer, the eye jumps from one relevant point to another and produces a temporal sketch of the image along the line of the scanning process. As Arnheim has shown in his psychology of visual art, there are forces directing such a neural scan: the shape of the frame (rectangular or circular etc.), the diagonals in a rectangular frame the horizontal and vertical middle lines and the center established by these vectors. Arnheim speaks of the *principle of centrality.* The symmetry of this force-field is in most paintings broken. Thus the horizontal line dominates; i.e. the line of locomotion; in the vertical dimension the area below the center dominates, prototypically creating the opposition of land (earth) vs. sky (air). Intermediate zones may be water (cf. pictures of a seaside) or towns with towers. The left-right opposition is also broken; insofar the left dominates (at least in cultures where writing is from left to right). Symmetries and broken symmetries exhibit the process type called cusp in the theory of catastrophes. The Last Supper of Leonardo in Milan demonstrates these vectors of forces and the principle of centrality.
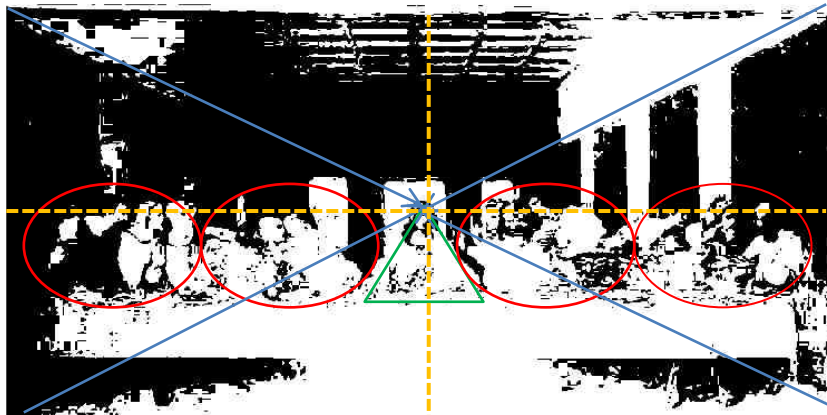

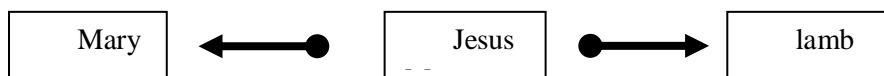Figure 8. Diagonal und straight force-fields and four groups of figures

The group of twelve apostles is first ordered along a straight line (abandoning the natural order around a table) and then separated into four groups; each group has again a center, although all of them show an attraction towards the major center (Jesus). The whole motion pattern implicit in the static image is driven by an utterance of Jesus in the center: *One of you will betray me.*

A figural grouping can also unite a set of utterances, thus realizing a kind of visual narrative. The single sentences have the underlying dynamics we have described in the chapter above. I shall give a short analysis of the thematic composition in Leonardo's paintings of St. Anne. The painting contains a rich geometric and dynamic structure (weights, bar centers, force-vectors, gaze-directions, etc.). A purely static representation would be insufficient for both the pictorial and the narrative aims of the painting. Furthermore, this piece is typical for Leonardo's art which consistently exemplifies the concept of *dynamic valence*.

In the case of this painting, we have on the surface a quaternary constellation: Anne — Mary — Jesus — lamb. If one considers the force fields and actions, one notices that a basic interaction links: Mary — Jesus —the lamb.

- Mary *pulls on* Jesus

- Jesus *pulls on* the lamb

- The lamb *resists*

- Jesus *resists* being pulled away from the lamb

There is a conflict between Mary who tries to prevent Jesus from seizing the lamb and Jesus who notices this (he looks back to her), but resists against her action. This triad constitutes a force field that dominates the message of the painting. A first schematic representation introduces two vector-fields with attractors:

The constellation of forces between Mary – Christ – the lamb corresponds to the basic archetype of transfer. In the center of the catastrophe set three

attractors (=minima) coexist and the change occurs along a path in this zone; for technical details cf. Wildgen, 1982 and 1985.
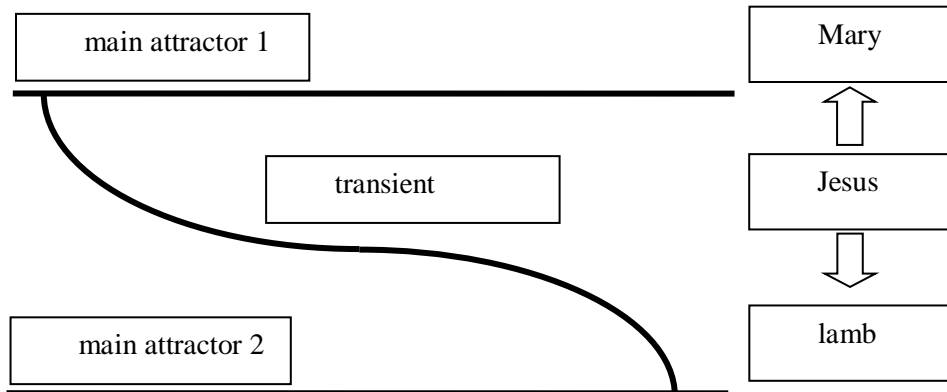

Figure 9. The dynamical archetype of transfer (giving) and a fiber on it (with attributed contents)**.**

The innovation by Leonardo does not break with the tradition of his Renaissance-precursors (cf. the development of the topic of the Last Supper before and after Leonardo in Wildgen, 2010 and 2013); it is rather the climax of this development, which will be imitated in the following centuries. It is followed by the mannerist period and baroque art. Such a climax has a very strong impact on later developments although it is itself unstable and induces rapid changes which show up already in the work of Michelangelo, and more radically on that of Tintoretto and Arcimboldo (cf. Wildgen, 2013: 107-111).

5. THE DYNAMICS OF MUSIC AS A SYMBOLIC MEDIUM[2]

In the semiogenesis and dynamics of music different levels of organization can be distinguished. A rough classification separates: a sub-conceptual, a conceptual and a symbolic (linguistic) level. The first level is

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[2] This part of the chapter summarizes major contents of my book in German: "Musiksemiotik" [The semiotics of Music] (Wildgen, 2018)

based on sensory and cortical (innate) mechanisms; the second requires mental work and learning processes and is therefore culture-dependent. The third brings advanced symbolic systems (similar to the grammar of a language) into play. The dynamics (forces and induced movements) are naturally different at the individual levels, i.e. it is scale-dependent, different in the macro, meso and micro domains. The interlocking of dynamics on different scales (levels) introduces a specific problem, which is often discussed in the context of emergence.

5.2. Music and Movement (Kinematics)

Within ecological psychology (cf. the work of Gibson), music is studied in analogy to movement and gesture ("music as motion"). Kühl (2007: 151) proposes the following mappings:

Rhythm	Motor movement pattern
Melodic phrase	Gesture
Pitch movement	Emotional effect

Table 1. Main areas of musical dynamics (cf. Kühl, 2007)

The processes of physical exercise, e.g., walking, jumping, dancing are subject to dynamic laws that are roughly analogous to physical processes such as free fall, pendulum motion, power transmission of billiard balls, etc. under restrictive conditions. A side effect of this correspondence is that the rhythm can be implemented technically or be controlled by a metronome. The gesture is a particular form of movement that emerges from the field of physical movement and contains an intentional momentum, see: nodding, pointing, or eye-gazing. A melody may be decomposed into a number of gestures, some of which are within the boundaries of beats, sometimes exceed them. Kühl (ibidem: 168 f.) demonstrates a division into musical phrases / gestures based on examples by Mozart (Piano Sonata in A major, KV 331) and Charlie Parker (Bloomdido). The emotional effects of pitches and their movements (high -

low tone, ascending - descending, etc.) have been frequently discussed, but seem to be culturally and individually very variable (see ibidem: 177 f.). In any case, the internal correlate is an emotional movement neurologically associated with a brain area, e.g., connected to the hypothalamus and the limbic system. These "movements" have neurological correlates in the release of messenger substances and the activation of electrical signals. The conceptual level (without symbol structure) can be described as a tonal space. Classical concepts such as scales, keys (e.g. major and minor), chords, tonic levels (I to VII) can be introduced here. The dynamics can be mapped on paths through the tonal space. On the symbolic (quasi-linguistic) level, partial movements (melody phases, motifs, movements of a piece of music) are arranged into a discursive unit. Narrative and rhetorical patterns (such as metaphors, metonyms, etc.) are most likely to become relevant.[3]

5.3. Music and Forces (Dynamics)

Forces are effective when a movement is redirected (direction change), accelerated or decelerated. This can be done in the three areas indicated in Table 1:

1. The rhythm can be doubled or varied (e.g. from 3/4 to 2/4), speeded up, slowed down. Messiaen proposed complex transformations of the rhythm in 1944. The addition of an eighth note or the punctuation of a note produces the modified rhythms: 3/4 → 13/16 or 2/4 → 5/16. Maxima (minima) can be reached and left again. The profile of maxima and minima gives a dynamic profile that is characteristic of the piece of music. Acceleration and deceleration have an indexical relationship to physical and mental movements or affects; the audience is moved (in upward and downward movements), goes along, or is synchronized with the rhythm of the music. Often a balance is sought over a longer period of time; acceleration is followed by deceleration.

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[33] The dynamics are similar. See as an overview of cognitive grammar Wildgen (2008).

This can also be observed in visual art, for example in film (see Wildgen, 2013: Chapter 7.4: 217-233 and 2018: Chapter 5: 81-88).

2. The melodic structure of a song can emanate from the main tonic level and end with it. In the intermediate field, dominant and subdominant transitional fields build a tension of difference. In piano playing the two hands can have different melody lines or one line may have an accompanying or a decorating function. The same applies in the choir (canon or polyphonic singing) and in orchestral music. The art of counterpoint exploits the tension between the main motive (Dux and its variations) and the countermovement (Comes). The iconic reference to gestures (e.g., visible in dance) implies a gestural dynamic consisting of: accelerated / slowed gestures, stagnation, complication phases, and intensity maxima.

3. The pitch movement, which can also be carried by different voices (soprano to bass) or instruments (violin to double bass), iconically refers to emotions ranging from euphoria to depression, from shrill screams to lethargic unison.

The mathematician and physicist Leonhard Euler (1707-1783) had already dealt with the determination of dissonance / consonance in 1739 and set up a sequence of consonances: prime > fifth > fourth > major third / major sixth > minor third / minor sixth / great second > minor seventh > major seventh > minor second and the tritone (see Mazzola, 1990: 57). In general, musical intervals can be described by a potential landscape. Chella (2015: 196) shows a dissonance curve for the scale values of C4 (roughly in the middle of the piano keyboard). The dissonance measure of the pair (C4, G4) is 0.39 (consonant), while the dissonance measure of the pair (C4, Db4) = 2.56 (dissonant). Taking the frequency scale as abscissa, one obtains a sequence of attractors (minima). Melody and pitch movements are paths in this potential landscape, where the dissonance minima are attractors (here the movement stops), dissonance maxima are avoided, moderate dissonances serve as transition zones whose effect may be canceled out by the subsequent consonance, although tensions are generated, which in turn can have a specific meaning character.

5.5. Melody as a Dynamic Phenomenon

In the subjective listening experience of both a song and an instrumental piece, melody plays an important role. It can memorize, stimulate repetition and, as a whole, justify appreciation (see the effect of catchy tunes). In larger pieces of music, the melody is usually limited to one phrase, one motif. Its character as a basic building block becomes clear when the melody is repeated, varied, transposed, i.e. presented in different "dresses". It then acts like a person, a role in a drama. Basic melody curves already show up in the crying of the infant. The simplest building block is the rising and falling fundamental frequency (F0) in the range of 300 to 500 Hz, which forms a melody arc. This structure is further developed in babbling and later forms the basic musical form of two-syllable words. In this context also arise variations of the melody arc and thus the foundations of the musical melody. The melody of a song usually is limited to a vocal range, e.g., to the comfortable tonal space of a male or female voice. This tonal space is specified by the upper and the lower edge, and by the middle, the intermediate zone. The melody can go from the bottom to the top, staying in the middle for some time, progressing step by step or moving variably back and forth. In addition to a general up and down movement, one can also distinguish fast changing variations of the line. The experienced instrumentalist "decorates" the melody line with fast movements and trills. This basic characteristic of melody can be visualized schematically as in Fig. 10.
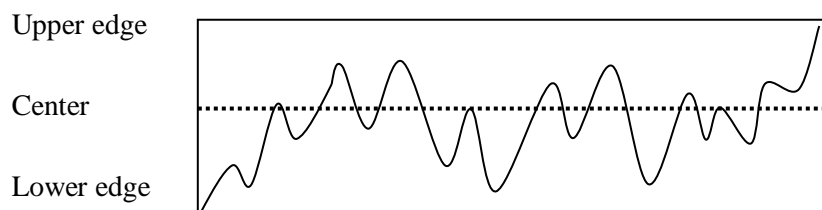

Figure 10. Melody course in tonal space (between the lower and the higher edge)

The melody has a center that corresponds to a zero expectation of melody progression. A specific melody is then a deformation of this expectation and the deformation energy can be determined from the deviations from the center. Some songs in the field of folk music and

songwriters have a very flat melody curve that approximates that of language. The curve then descends towards the end of the line or stanza or increases (as in the intonation of questions). In the analysis of Leyton (2004), this deformation is information about forces that have become effective and have influenced the design of the melody. For the performer, such as the singer, these forces correspond to efforts that the voice must make to produce and control higher or lower notes; while listening, one can assume similar forces. The professional opera singer may indulge in artistic coloratura and amaze his audience; the heroic bass may force his voice into the deepest cellar. But when we look at the catchy hits or the songs that delight a mass audience, we find very flat melodies. The forces that shape the melody, moving it away from a neutral middle tone, can be imagined as in the following figure.
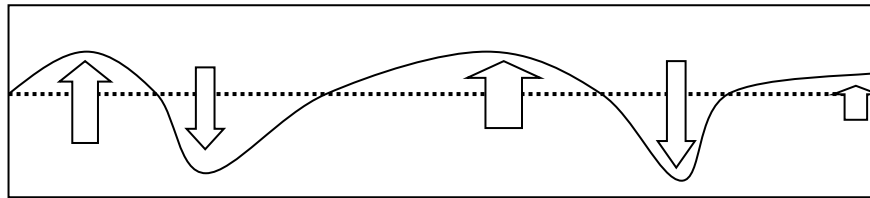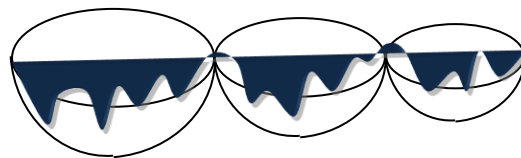

Figure 11. A melody course as a result of forces acting on a medium level

Overall, a melody can be low or high in relation to applied forces. In a song or a piece of music, powerful and low-energy passages can be alternate. In the final result it may come to a balance or alternatively the ascending or the descending forces may predominate. These movements are perceived as sign shapes and associated with a dynamic meaning. Downward movement may, e.g., express sadness or resignation; an ascending movement, on the other hand, jubilation or hope.

It is also possible to distinguish a "melody in steps "from a "melody in triads ". In the first case, e.g., in Gregorian chant, the melody more or less follows the steps of the scale, in seconds and thirds, rising or falling. The experience of the singers associates the ascension with a (muscular) tension, an effort; the descent to the center is more like relaxation, ease. The same applies to the acceleration or deceleration of the tempo. The progress of a melody by triads uses the different tensions of the intervals in

a melody. Seconds, thirds, fourths, fifths, sixths, sevenths (intervals) each have different tension values. The partial movements of the melody can also be assigned to a chord scheme, i.e. they realize in time the consonant notes of a chord or a dissonant combination of pitches. These movements and tensions (which refer to forces) are thus the possible meanings ("signifiés") of a melody. The duration of the individual notes also plays a crucial role. In the late Middle Ages (13th and 14th century in Europe), the duration of the notes, which were originally based on the length of the syllables (long vs. short), were further differentiated. The mensural notation facilitated the fixation of this innovation. In the polyphonic movement, one voice could be noted in longer note-values (for example, the bass), while the other voices used much smaller note values, that is, they exemplify a faster melodic movement. The chords, to which the steps of the melody refer, are arranged in levels: tonic, dominant, subdominant, etc. (in the context of tonal music). The levels and their transitions behave like attractors of a landscape, i.e. the melody can stay within one level, exploit the possibilities there, and then switch to another level. This has a direct effect on the accompaniment, which is why, for example, the guitar accompaniment for a song is indicated by the key above the text or the musical notation. In many cases, the notation of the keys is a kind of shorthand melody, i.e. the musician can remember the melody based on the chord progression and vary or embellish it in the given scheme. This dynamic conception can also be visualized.

Tonic level> Dominant level> Subdominant level

Figure 12. The dynamics of a melody leadership based on tonal attractors and their change

Within the levels, the possible sequences through the scale and chord structure are specified as triad, four-note-chord, and so on. The effect of

the melody is based on the sequence of stages, on the possibly of a change from major to minor and vice versa, and in the tensions between the individual steps, which can also be varied by different durations, accents and tempi. The relatively simple chord scheme of a song may be elaborated in the further development (e.g., from a simple blues song to jazz interpretations or improvisations).

A central problem of dynamic modeling in the semiotics of music concerns the nature of the space of meanings in which the performer and the listener move. We have already referred to the tonal space, e.g., the frequency range of a voice or instrument. The space of musical meanings does not correlate with the space of the world experienced visually or in locomotion. It rather refers to an inner space, which must, however, be transparent and comprehensible for the other musicians and for the listeners of a piece of music. Since melody is dependent on the respective chords in the chord progression, the temporal structure of the melody is decisive. Furthermore, the types of enrichment or modification are also substantial. Their use makes the melody become more independent from the chord scheme. The melodic line can be enriched or modified in three ways:

1. By a variation of the rhythm. In the development of jazz, a variation of the original marching rhythm in the New Orleans style with an emphasis of the first and third beat in the 4/4 meter to an emphasis of the second and fourth beat can be observed (contrary to the European tradition). This happens especially in the Dixieland and the Chicago style of jazz. In the bebop style, the staccato of the accents is replaced by legatos, creating a kind of continuity. Finally, in free jazz, the fixed meter is dissolved or overridden in fast and changing rhythms. The dominance and freedom of rhythmic design is a trait that jazz has inherited from African traditions, or rediscovered through a return to ethnic music cultures from different parts of the world.

2. By adaptation to individual instruments and situational demands. The musician designs a melody with reference to his instrument (for example: the saxophone, the clarinet, the trumpet, the guitar). Moreover, he may adapt his performance to momentarily

perceived internal dynamics, quasi to the physiological-emotional component of his performance.

3. By adaptation to other musicians, to the performance of the band. The soloist "resonates" with the performance of others. This is often referred to as "swing"; it captures the players and then the listeners. This aspect is especially pronounced in religious gospel, where the (singing) preacher brings the church in ecstasy (see Halle, 2015: 143-152).

The final secrets of a perfect melody are not revealed by this analysis. What makes a melodic line / phrase so memorable that it becomes a catchy tune, or circulates for decades in countless versions in a musical culture? How do the diverse melodic, harmonic, rhythmic tensions combine to form a successful figure that gains cultural significance? At the basis of this problem, we suspect complex cognitive and social (group-specific) coordination processes in the interaction of a band with its audience. The underlying cerebral and communicative processes are still largely unknown.

CONCLUSION

In this chapter, I argued that semiogenetic principles and dynamic laws are operative in the evolution and further development of human symbolic forms, mainly in language, visual art, and music. With reference to very early cultures, e.g., Paleolithic societies of Homo sapiens, the chapter shows how a hypercycle of cultural subdomains drove the evolution of cognitive and semiotic systems and enabled the coordination and the specificity of different types of symbolic forms. Language and other symbolic media, e.g., visual art[4] and music, mediate this dynamic relationship and enable the emergence of new contents and their symbolic representation. Tool usage and symbolic behavior had a major effect on the

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[4] For the semiotics of visual art see Wildgen (2013) (in German)

survival and world-wide expansion of the human species. It opened the door to a universe of semiotic elaborations and conventions, e.g., in the fields standing in the focus of this chapter: language, visual art, and music. Furthermore, symbolic forms mediate effectively between the creativity of the individual, the performance of the group, and the culture to which they contribute.

The microstructure of symbolic forms is also the product of semiogenetic processes and can be described with reference to the laws of dynamic system theory. By using insights of catastrophe theory, mainly René Thom's conjecture on topological dynamics and valence patterns in basic sentences, we could develop a hierarchy of embedded cognitive scenarios for the categorization in experienced space and basic social action (grasping, giving, commercial exchange). This led to a new, meaning based and dynamic theory of human sentence production and can explain the grip language has on reality, as it is experienced by humans, and the capacity of humans to change and control their environment. The basic dynamics of symbolic forms allow for a new perspective in art history and the formulation of basic principles of construction in figural painting. The semiogenetic and dynamic nature of music is the special concern of the last part of this chapter. It summarizes central results of my book on musical semiotics published in 2018 (in German) and introduces dynamic models for the understanding of principles underlying the construction of melodies.

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