CHAPTER 1
MEANING AND REALITY[♣]

1 Concepts of meaning

1.1 Historical background

Plato states the fundamental question about the nature of words and their meanings in his dialogue "Cratylos". He advocates a partially naturalistic conception of the meanings of words, as something which includes their non-arbitrary, instrumental character. The metaphysical positions of Plato and Aristotle establish basic paradigms for the interpretation of the relation between 'ideas' and 'individual forms' as correlates of linguistic signs. Aristotle's list of categories was the first classification of primary types of meanings, and distinguishes nine sorts of secondary substances (quantity, quality, relation, where, when, position, possession, effected, and affected). The topic of a universal architecture of meanings is thus introduced and Aristotle's work constitutes the beginning of a tradition of work on meaning in which a parallelism between ontological and conceptual categories is postulated.

The existence of universals was the subject of a debate in medieval times in which the realists (universalia sunt realia ante rem) and the nominalists (universalia sunt nomina post res) opposed each other. A radical nominalism, which doubts the fundamental fitting of concepts to ontological structures, is, however, a modern development. Following the advances in mathematics and

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natural philosophy made by Galileo, Kepler and Newton, empiricist philosophies of mind and language were developed by John Locke (1632-1704) and Étienne Bonnot de Condillac (1715-1780). Locke postulated a fully fledged system of ideas pre-existent to language, which is transported between individuals by the technique of signs. Condillac acknowledges the constitutive role of signs, which allow a level of cognitive organization beyond that of animals. The dependence of the mind on language and the social character of the latter lead directly to Humboldt's linguistic relativism (a precursor of the so-called Sapir-Whorf-hypothesis). In general the 18th century gave rise to a broad range of approaches from naturalistic (biological and genetic) theories to cultural theories of meaning.

1.2 Modern theories of meaning

Modern theories are extensions of these traditions. Thus empiricist theories have been continued by the neo-behaviourists such as Osgood (a strict behaviourist would eliminate the term 'meaning') and by logical empiricists in the tradition of Frege. The latter eliminate the cognitive or psychological aspects of meaning and propose instead a formal ontology of objectivized meanings as the basis for the referential function of linguistic signs. Later, intensional logic introduced an ontologically very poor concept of conceptual meaning (= intensions), and in situation semantics the holistic interpretation of sentences by means of truth-values (as in Frege) was reduced to a type of partial, situational interpretation (see Barwise and Perry, 1984). The Platonism of logical semantics is also characteristic for representational theories in the domain of artificial intelligence. A radical wing even maintains the identity of minds and machines. For these theories, formal or computer derived considerations have absolute priority and no relation to the outer world and the categorization imposed by it, or the functional dependence on it, is considered (except a general utilitarian relation to possible applications of the models proposed). The subjacent ontology remains implicit and metaphysical questions are mostly ignored.

A new, innovative development, arising from the consideration of proposals taking systematic contrasts (oppositions), field-like interdependencies,

prototypes and metaphorical processes as basic mechanisms, has revealed a rich self-organization inside the world of meanings. Internal self-regulatory mechanisms thus play a prominent role, whereas external (biological and social) factors define the domains and limits of meaningful signs.

Applying recent results of dynamical systeÿÿms theory (catastrophe theory, synergetics, chaos tory), the morphological continuity between physical, physiological and symbolic processes and entities can be formulated. This semantics may be considered as an alternative or possibly a complement to situation semantics, as both assume some continuity between the external and the internal world in the sense of psychophysics. The connection of topologico-dynamic semantics to the tradition of logical semantics, however, needs further elaboration. A synthesis of both traditions, the topological and the logical one, may lead to far deeper insights into the nature of meaning, which is one of the most fundamental concepts for our understanding of the world and ourselves.

2 Meaning and imagination

The idea that the outer world sends pictures which enter our visual system and establish the link between our mind and the world stems from antiquity. For Descartes the process was an optical-nervous one. He conceived the activity of the nerves as a mechanical and pneumatic system where the nerves act like cords which open small channels. These openings reconstruct the shape of the external objects. Images and imagination are thus the classical field for the interaction between mind and world. In Descartes' dualistic system images and imagination lie just on the frontier between extended matter (subjected to the causal laws of physics) and the ideas which are innate (and ultimately refer to God). Imagination is the (occasional) cause which can make innate ideas pass from potency to actuality. Thus imagination has only a heuristic value. Descartes' general tendency was to exclude all concepts related to images or imagination and to reduce physics to mathematics, and geometry to algebra.[1] This Cartesian strategy still has weight in the sciences, but it is also clear that the dualism between mind and body cannot be resolved in a pure study of the mind that excludes empirical, i.e. perceptually controlled, knowledge from the

sciences. Computer science which follows directly in the intellectual tradition of a Cartesian mechanics has led to two different branchings which reproduce the basic dilemma. Artificial intelligence in the more traditional (post-war) style presupposed programmes, organized knowledge systems, and formal grammars for language parsing and production, i.e. an extended set of presupposed mechanisms. The neural net models argue that they can dispense with this mass of blue prints and do the same job using 'neural' connection machines, which apply very general learning/adjusting strategies. These connectionist machines are opposed to supposedly innate, prewired, programmed devices. An *imaginistic*[2] model which takes mental images, imagination, as its basic topic refers rather to something we may intuitively experience but which fits neither the theoretical 'machines' of artificial intelligence nor those of connectionists. Thus images are at some intermediate level, between the sensual input on one side and the linguistic account of it on the other. They can be constructed from both sides. This intuitively plausible domain of cognition was neglected or even ignored (supposed to be a subjective illusion or after-effect) in many contemporary theories.[3]

The situation has radically changed since Cooper and Shepard were able to measure experimentally the speed of rotating shapes in mental representation (cf. Shepard, 1984 and Cooper and Shepard, 1978). It became clear that at least for visual percepts an internal image-like representation exists. The question arose of how this internal representation of objects was related to language understanding and linguistic memory. It was straightforward to assume that words, sentences and texts with rather concrete, experiential content could be related to and profit from internal image-like representations. An early stage of discussion and experimental testing of this hypothesis was Paivio's dual coding theory.

The controversy between the adherents of a *simple coding theory* of the memory of words, phrases, sentences and texts, in which all representations are only propositional, and a *dual coding theory* as proposed by Paivio and others, where imaginistic and (abstract) propositional coding procedures coexist, was decisive for the construction of a cognitive model of language in this book. My position is akin to that of the *dual coding theory*, although I believe that the

relation between imaginistic and propositional representations is very rich and variable.[4] The transitions between a propositional and an imaginistic coding allow the coding of propositional content in gestalt-like forms; in another domain a propositional representation can be more effective as a representation of imaginable material in memory (see Anderson and Bower, 1973: 452) and an image or an imaginistic representation can be coded as a hierarchical structure using a linear technique (a linear scanning of an image). The important consequence of the controversy between defenders of a propositional and an imaginistic representation is that we have to abandon the reduced notion 'meaning' which we inherited from behaviouristic theories. Chomsky's criticism of Skinner and his stimulus-response theory allowed the consideration of 'mental' objects, but it did not open the way for research into the cognitive (or social) nature of meaning. Imaginistic theories are an attempt to come closer to the phenomenon called 'meaning'.

> "As it stands the account of linguistic meaning seems to be clearly naive and over simplistic. The addition of mental imagery as a second major cognitive representation within Paivio's model serves to relieve this impression and to make the total system more flexible and more plausible." (Richardson, 1980: 109)

My model is primarily image-orientated at the textual level, at the sub-sentential level, however, I assume a more schematic structure mainly for constituents which are the basis of cognitive and syntactic valences (see Chapters 3 and 4) [5].

In opposition to the dual coding theory of Paivio I consider 'meaning' as *one* phenomenon (cf. the criticism of Paivio's naive retention of a submodel of symbolic representation in Richardson, 1980: 109). The main conclusion I have drawn from the discussion in theoretical semantics since Bloomfield, Chomsky, Fillmore and many others can be stated as a general *strategy* (programme), which will be substantially elaborated and concretized in the following chapters.

The general hypothesis underlying imaginistic modelling

I assume that an imaginistic level of representation underlies the phenomenon called 'linguistic meaning'. This level is intermediate between sequential (linear) organization in language production and the holistic (and distributed) character of those cognitive activities which contribute to meaning.

These cognitive activities encompass:

- higher perceptual activities, where different channels are co-ordinated,
- higher motor-activity, which contains plans and scripts for complex behaviour,
- memory and imagination as internal cognitive activities which create an internal framework for quasi-perception and quasi-action.

Models of mental representation which establish a link between the symbolic output and the complex cognitive activities mentioned above are called models of *cognitive semantics*. The representations at this level are called *imaginistic*. This term, which is taken from Kosslyn (1980), is opposed to *imaginal* as it covers more than perceptual processes and goes beyond visual perception and corresponding schemata.

Empirical consequence

Imaginistic schemata must have a space-time interpretation and must be qualitatively different from purely sequential systems. As they integrate three basic levels: perception, motor-programmes, and imagination, they must be more qualitative (considering only important features) and more classificatory than physical or perceptual processes.

The terms 'imaginistic' and 'image' may be misleading if not further specified. In everyday life we tend to consider a picture, a pictorial image, as the prototype of image. If we consider the different steps of visual representations, this type is rather secondary. Wade (1990: 229) presents the relational network between different types of 'images' as that shown in Figure 1.1.

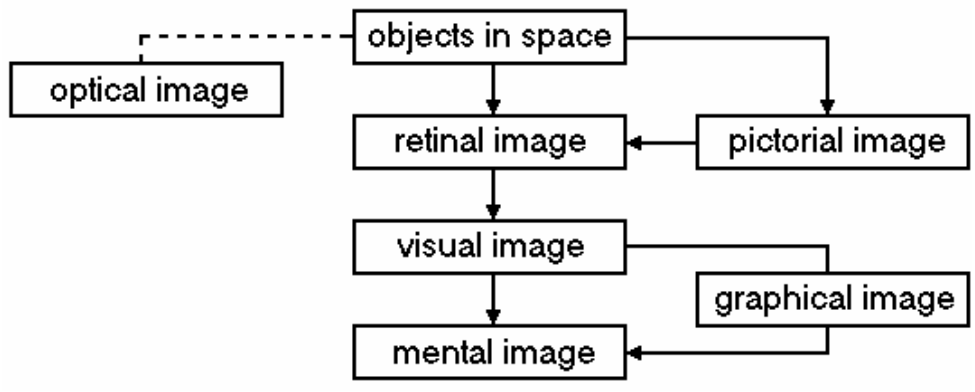


Figure 1.1 *Relational network of 'images'. From Wade (1990:229)*

The direct line of perception contains 'images' in a metaphorical use of the term, since the representations are continuous and dynamic. The side-lines on the right lead to specific artefacts: the optical projection on a screen, in a camera, and the pictorial and graphical products related either to the objects in space or to the visual image. Here we are only interested in the *cognitive* line of visual (and, in general, sensorial) processing. The process schemata in Chapter 3 may be interpreted as graphical images which catch characteristic features of mental 'images'.

3 Meaning and the impact of dynamical systems theory for semantics

The observations in Section 2 lead to a number of consequences for the scientific strategy to be followed.

Formal consequence

The general mathematical framework must allow for space- and time-dependent descriptions and must be primarily tuned to the modelling of processes (it must allow for dynamic models). These criteria point to dynamical systems theory.

As the mathematical theory of dynamical systems is a huge field and the basis of many different models, we must specify possible choices in this field.

For this purpose I will give a rough architecture of dynamical systems (see Gilmore, 1980: Chapter 1).

For the description of the dynamics of some well-known physical system (e.g. the solar system, falling bodies, etc.) a system of differential equations can be used. For computational purposes these equations may be approached by a system of difference equations (we only need to introduce a discrete grid for the space parameters and a fixed step-length for the time parameter). Thus *continuous* and *discrete* dynamical systems can be considered in parallel. The continuous systems allow for generalizations (general theorems, the search for invariants), the discrete systems are easier to calculate (to implement). The strategy for the search for good models is to find the simplest system which can still represent important processes and features of the 'real' system. If we gradually simplify the dynamical system (the system of differential or difference equations) we finally arrive at two very simple models which will be used in this book.

Table 1.1 *Two basic types of dynamic models*

discrete dynamical systems	*continuous dynamical systems*
- systems of unit-vectors	- catastrophes (types of stable processes)
- two-dimensional cellular automata	- bifurcations (generalized catastrophes)

The use of continuous dynamical systems in semantics has been developed in Wildgen (1979, 1981, 1982, 1985, 1990a, 1993). In Part One of this book continuous dynamics are favoured, in Part Two priority will be placed on applying discrete dynamics because they fit the demands of textual analysis particularly well.

The question of how to analyze motion and change in time is one which puzzled philosophers since antiquity. The answers which were finally found are still interesting as natural steps in the solution of the problem. We can distinguish three phases (see Thom, 1990: 314-331):

a. The mathematics of *time*. The Pythagorean school in ancient Greece considered musical (and celestial) ratios, i.e. harmonic proportions and rhythms. The rational numbers (e.g. 1/2, 1/3, 1/5, etc.) were taken as the arithmetic

analogue of harmony and natural laws in general. The background notion was, however, a continuous flow with discrete subdivisions, like a cord which is shortened in order to produce harmonic tones.

b. The mathematics of simple *geometric* objects like triangles, squares, circles, etc. Conceptually this concern introduced two (or three)-dimensional abstract entities. The rational numbers became insufficient; irrationals like $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ and, for the calculation of the circle, the number π had to be considered.

c. The third and last phase is directly related to the concept of motion. In the paradox of the arrow, Zeno argued that motion was impossible. If we suppose, as he did, that during one single instant (t_i) motion is equal to zero, then the arrow must always be at rest (because even a huge number of such instants and corresponding zero-motions add to zero-motion). Zeno concluded that motion is only an illusionary concept. The basic conceptual problem in this dilemma is the analysis of continuous processes and their relation to discrete pieces of space and time. Since Kepler (1571 - 1630) and Galileo (1564 - 1642) this conceptual problem has become a basic one for the explanation of celestial and terrestrial kinematics. The differential calculus introduced by Leibniz and Newton paved the way for a systematic solution of the problem of motion within the framework of modern mathematical physics.

In our context the three basic concepts, which have been expounded in their historical perspective, are systematically important. We need a notion of time, of space (different types of spaces will be considered) and of motion, and we must answer the question of how the discretized notions of time-interval, of spatial domains and of units of motion are related to the corresponding, more basic continuous concepts. If Galileo and, in a more radical way, Descartes considered only quantitative processes, changes in 'extended' matter, I shall apply the basic notion of kinematics and dynamics to qualitative processes and changes as well (thus I shall try to reintegrate parts of the Aristotelian heritage discredited by modern dynamics since Galileo).[6] The theoretical background for this extension is provided by modern qualitative dynamics.

The relation between discrete and continuous mathematics is not only a philosophical question. Modern dynamics (in physics, chemistry and biology) makes use of (continuous) differential equations, but many calculations are made with the aid of computers, which operate on the basis of discrete algorithms. Thus the problem of continuity vs. discreteness is a very general scientific problem, because many (basically) continuous systems are simulated with the help of discrete (linear) processes. As the continuous model (e.g. equations of motion in physics) interprets the discrete calculations of a machine implementation, we can say that the syntax (the algorithms for calculation) is discrete and the semantics (the differential equation) is continuous. This leads to my distinction between the *syntax* of a cognitive model, which is discrete, and the *semantics* of the cognitive model, which is continuous (cf. Chapter 5, Section 1). In Chapter 7, Section 2, I shall introduce the notion of a vector and a two-dimensional vector space and define the notion of a two-dimensional cellular automaton.

4 Ecological realism and cognitive 'meaning'

As the last section has shown, the mathematical background of the semantics of natural language is not Fregean, it is not based on Carnap's programme of the logical structure of the world, it is not 'objectivistic', it does not refer to a reality that "is structured in a way that can be modelled by set-theoretical models" (cf. Lakoff, 1987: 159). Contrary to Lakoff's programme, which lacks or rejects any mathematical backing, we presuppose the mathematical tools which have been successful in the analysis of nature (in physics, chemistry, biology), and which can (with some philosophical caution) be applied in the domain of cognition and language. The 'realism' of the semantics developed in this book must be specified relative to two other programmes to which it partially refers:

- ecological realism (in the vein of Bernstein's and Gibson's ecological psychology, and the work of Turvey, et al.).
- psychophysical holism, which assumes that some abstract information is transmitted (transformed, filtered, etc.) from physical events (in the environment of man) via perceptual processes to cognition (categorization,

memory, language). This view was advocated by Dretske, who called the underlying principle the "Xerox principle". "If A carries the information that B carries, and B carries the information that C carries, then A carries the information that C carries" (Dretske, 1981: 57; Barwise and Perry, 1984: 111).

4.1 Ecological realism and Fodor's critique

'Ecological realism' is mainly associated with the work of James J. Gibson. The central term in Gibson's theory, which encapsulates this basic relation between the organism and its (physical) environment, is 'affordance'. The 'affordances' define an intermediate domain between the external world, as it is described in physics, and the internal world described by the physiologist and the psychologist. In short it refers to a moderate 'scientific realism', halfway between a phenomenological and a realistic (Aristotelian) position. Gibson argues against a psychology which is directly rooted in notions taken from physics and mathematics (geometry).[7]

"But a direct explanation of the perception of the properties of the visible environment may be possible if these properties are taken from concepts of ecology instead of from mathematics and physics. (Perhaps they are ultimately 'reducible' to the latter, but the psychologist cannot wait for such a reduction.)" (Gibson, 1982: 401)

"Not only objects but also substances, places, events, other animals, and artifiact have affordances. We might begin with the easy-to-perceive components of the environment consisting of surfaces and surface layouts. And we should assume a human animal as observer, to start with, since the list of affordances will be somewhat different for different animals.

I assume that affordances are not simply phenomenal qualities of subjective experience (tertiary qualities, dynamic and physiognomic properties, etc.). I also assume that they are not simply the physical properties of things as now conceived by physical science. Instead, they are *ecological*, in the sense that

> they are properties of the environment *relative to* an animal. These assumptions are novel, and need to be discussed." (ibid., 1982: 404)

Other terms for 'affordance' would be valence or invitation-character ('Aufforderungscharakter') as coined by Kurt Levin, or demand-character as proposed by Koffka in his "Principles of Gestalt Psychology" (1935). Based on Gibson (1982: 404 ff.), the following types of affordances have to be considered:

1. Surfaces and structures of the ground (stand-on-able, walk-on-able, climbable, get-underneath-able).
2. Surfaces that reveal or conceal.
3. Objects affording manipulation and related activities (portable, graspable, etc.).
4. Substances that afford pouring (liquids), smearing (viscous substances), being shaped, resisting change of shape, affording nutrition, illness.
5. The affordance of injury or benefit (it can be avoided, escaped, averted or on the contrary be sought after, if perceived).
6. In an environment where we perceive other people who also perceive, the perception of the other is a type of affordance and leads to a generalized perception (we can perceive an object or event from our own perspective *and* imagine how it could be perceived by other people). This leads to a level of social perception (every person participates in an environment of common perception).

This sets the stage for a new concept of meaning:

> "The notion of affordances implies a new theory of meaning and a new way of bridging the gap between mind and matter. To say that an affordance is meaningful is not to say that it is "mental". To say that it is "physical" is not to imply that it is meaningless. The dualism of mental vs. physical ceases to be compulsory." (ibid., 1982: 409)

It is immediately clear that such a notion of meaning is very useful for research in animal communication, bio- and neurolinguistics. The question, however, of whether it can replace traditional concepts of linguistic meaning (of words and sentences) has led to a controversy which will be discussed later.

The linguistic consequences of Gibson's theory of affordances and ecological 'meaning' are developed in Chapter 3.

In the centre of Fodor's criticism stands the *intentional* character of meaning. The important thing in perception is the fact that we see something *as* something, e.g. we see Venus as the Morning Star or as the Evening Star; we distinguish two different properties; being the Morning Star or being the Evening Star. The term 'seeing as' is decomposed by Fodor into: *seeing* and *mentally representing*. In order to recognize the Pole Star *as* the indicator of North, we must know a lot about astronomy and such knowledge only develops very late (historically and ontogenetically). In Fodor's view Gibsonian ecological psychology can only dispense with the construct of mental representation by neglecting intentionality. However, *property* is an (intensional and) intentional notion.

> "To say that Gibson has no theory of intentionality is to say that he has no answer to that question [what is it for an event (a configuration of the light, etc.) to specify a *property*]." (Fodor and Pylyshyn, 1981: 192).

We shall respond to this criticism immediately, but must first ask how Fodor and Pylyshyn distinguish the two properties; being 'Morning Star' or 'Evening Star'. The answer is trivial: they consider the different linguistic reactions expressed by the nouns 'Evening Star' and 'Morning Star'. When they say (ibid.) "Where the Establishment line offers anyhow, a pious hope, the Gibsonian offers only a dead end" we believe that this is comparable to the case of two engineers who want to build a tunnel. One of them composes poems about the wonderful world on the other side of the tunnel and blames the other that his tunnel is a 'dead end', the second one continues digging in the direction which, in his view, allows him to break through the rock.

The fundamental problem of intentionality (the force field linking the individual to some goal) is solved at a more basic level in ecological psychology than it is in a theory of representation. The ecological realist starts from a relational structure in which an organism is linked to the environment (ambient energy). The relation already contains intentionality. The representationalist first neglects the environment (reality) in his search for a central place where all processes of perception converge (the brain, some

specific 'organ' in the brain, an assembly of neurones, the grandmother cell). Later, intentionality reminds him that he has lost a major part of the functional whole (cf. Turvey, Shaw, Reed, and Mace, 1981: 292-298). Thus it is not ecological psychology which is inadequate for not considering intentionality, it is representationalism, which treats intentionality as a purely internal (solipsistic) phenomenon.

The reason why ecological realism is appealing to semiotics is that its premise is more natural and less artificial. A consequence of these deeper roots is, however, that it is easier to treat linguistic meaning in terms of specific linguistic manifestations (giving a shallow account of meaning) than to link linguistic meaning to fundamental laws of biomechanics and biology. In Chapter 3 I shall try to further dig this tunnel which leads to a promising country beyond the rock.

The new paradigm, which uses laws governing the external world (physical, chemical laws) and the organism (biomechanical, biological, neurodynamic laws) in the construction of a model of meaning, is called 'realistic semantics'. The adjective 'realistic' is specified by the elaborations of the view in ecological psychology and in semiophysics.[8]

We shall discuss the use made by Barwise and Perry (1984) of these basic positions and its criticism by Lakoff (1987) in order to specify the contours of the programme of *realistic* semantics.

4.2 The philosophical position of situation semantics

Barwise and Perry (1984) make only a few comments on ecological psychology. In their introduction the authors state the central assumption of ecological realism: "There is much more meaning and information in the world and less in the head than the traditional views of meaning assumed." (ibid.: X) This does not mean that everything relevant for meaning is in the world outside, nor that this 'meaning' is projected with high fidelity and without choice, loss, mixture, addition, etc. into higher cognitive structures. As in a typical case of a paradigm change, one is forced to see all the known facts under a new basic assumption: *physical and ecological information is a possible source and explanation of meaning*.

The major problem with this kind of realism is the answer to the sceptic who asks: What is reality (environment)? How can we know (without doubt) what reality is? Does our understanding of reality (categorization, linguistic description) follow from reality or rather does it constitute reality?

It is the answer to precisely these questions which defines a specific type of realism. In the case of Barwise and Perry their realism can be judged by the way in which they define 'situations' (real, abstract), 'situation types', and 'structures of situations'. The term 'situation' refers to static situations, called 'states of affairs' and 'more dynamic situations, called events' (ibid.: 49). The term 'more dynamic' is revealing. In fact neither kinematic nor dynamic aspects are preserved in the core of the model, as will be shown.

a. The primitives of the model (cf. ibid.: 50f.) include:

- Individuals and collections of individuals.
- Relations (0,1,...,n place relations) and collections of relations. As in logical semantics verbs are interpreted as relations (it is raining: 0-ary relation, being asleep: 1-ary relation, kicking: 2-ary relation).
- Space-time locations and collections of space-time locations.

Changes in space-time are defined by relations between space-time locations associated with situations or situation types. The 'kinematics' are, therefore, reduced to statements about precedence, overlapping, inclusion. Stability, motion, acceleration, the basic ideas of Archimedes and Galileo, are not existent in this framework. In this sense situation semantics can be said to have no statics and no kinematics (on the theoretical level established by the work of Archimedes and Galileo).

b. One can only call a model 'dynamical' if forces, causes, processes are the central concern. Kepler introduced dynamical considerations into physics and Newton established the classical paradigm of dynamics.

The model proposed by Barwise and Perry (1984) maintains that the relation between real situations and abstract situations is a metaphysical one; in fact only abstract situations are relevant for the model and the "belief in one big situation" called "Reality" is "all that is required" (ibid.: 60). Abstract situations (states or events) are simply set-theoretical constructs.

> "An abstract state of affairs or course of events is a set. It is not perceived, does not stand in causal relations to other abstract situations, and does not occur in nature ... Real situations are not sets, but parts of reality. They are perceived and stand in causal relations to one another. They comprise what might be called the causal order" (ibid.: 58).

On the one hand it is trivially true that models and descriptions are not causal in themselves, on the other hand, if forces, causes, and processes are constitutive for the reality modelled, the organization of the model must match this basic feature (not peripherally but directly in the basic structure of the model). This is just what Copernicus did when he replaced the geocentric system with the heliocentric one. As Kepler made clear later, the sun is the central cause of the stable and regular motion of all planets. In this sense situation semantics cannot be called 'dynamical'; it remains in logical semantics' universe of discourse even if Frege's holism is partially dropped.

In order to be fair in our criticism we should add that the merit of situation semantics is that it has preserved the general framework of set-theoretical semantics and introduced some 'realistic' aspects. The model developed in this book is not integrated into this classical framework but constructs a new paradigm rooted in classical dynamics and the mathematics successfully applied to this field since Leibniz, Newton, Euler, Poincaré, and others. My model does not claim to preserve the philosophical framework of classical logical semantics and to give an adequate answer to all the questions dealt with in this framework. I assume that many of these questions are only relevant within the specific framework and that the new paradigm also changes the priority of questions which have to be answered by a model of meaning.[9]

In Chapter 2, Section 6 the limited descriptive power of situation semantics will be shown. The examples analyzed there show that situation semantics not only lacks adequate dynamics, but it is also incapable of treating topological aspects of natural meaning in a straightforward way.

4.3 The experiential realism of 'cognitive semantics'

Lakoff (1987) develops Putnam's (1980) argument against 'objectivistic semantics' in Part Two, entitled "Philosophical implications". In Chapter 16 he

outlines "A new realism" (ibid.: 260-268)[10]. It is not our concern here whether Lakoff's (and Putnam's) criticism of the so-called 'objectivistic paradigm' is valid, we shall ask instead if the programme of 'experiential realism' is sufficient and how it is related to the 'ecological realism' of the semantics developed in this book. Let us first examine Lakoff's description of 'experiential realism':

> "The experientialist approach is very different to attempts to characterize meaning in terms of *the nature and experience of the organisms doing the thinking*. Not just the nature and experience of individuals, but the nature and experience of the species and of communities. "Experience" is thus not taken in the narrow sense of the things that have "happened to happen" to a single individual. Experience is instead construed in the broad sense: the totality of human experience and everything that plays a role in it - the nature of our bodies, our genetically inherited capacities, our models of the physical functioning in the world, our social organization, etc." (ibid.: 266).

This statement makes it clear that 'experiential' realism is objective and not subjective. The main point is that meaning is not just a mapping of utterances onto (meaningless) formal representations of objects, situations, etc., but a mapping of meaningful utterances onto meaningful pre-linguistic, sub-linguistic structures (Lakoff calls them 'preconceptual'). But where do these (preconceptual) 'meanings' come from? In order to avoid 'objectivism' they must come from other meaningful structures (in the environment) and these come from meaningful structures which are evolutionarily deeper, and finally we must accept some cosmological meaning in the big bang. If Lakoff prefers to avoid this regression, he must introduce some act of creation of meaning, which would take us back to the 18th century controversy about the heavenly or natural origin of language.

Since Lakoff accepts neither a cosmological regression nor an act of God as being responsible for the creation of meanings, he has to postulate some other plausible origin. He decides that this point lies beyond perception, as his criticism of ecological realism shows: "Part of Gibson's ecological approach is absolutely essential to the experientialist approach that Johnson and I have proposed: his stress upon the constant interaction of people with their

environment ... But in the realm of cognition, ecological realism cannot account for most of the examples in this book" (ibid.: 261f).

Consequently, the psychological zone, which is below perception and *a fortiori* the objective structure of the world around us (the environment), is below the threshold where meaning starts.

But where is this level below *linguistic* meaning, this level of preconcepts, and how can it be empirically assessed? Is it really different from the linguistic level or is the semantics of a word, a sentence, a text in one language just a mapping onto words, sentences, texts of another language, i.e. a translation e.g. into English or into an artificial language, inductively construed by considering the grammatical distinctions in some typologically divergent languages?[11] In each case such a position is open to Lewis' (1972) criticism that Fodor's semantics just translates one set of symbols into another. Lakoff (1987: 205f) accepted this criticism but denied its applicability to experiential semantics:

> "What keeps the Lewis critique from being applicable to cognitive models is *embodiment*. Cognitive models that are embodied are not made up merely of items in an artificial language. In experientialist semantics, meaning is understood via real experiences in a very real world with very real bodies. In objectivist accounts, such experiences are simply absent" (ibid.: 206).

Lakoff says 'real' three times in his last sentence, but how does he empirically get in touch with this 'reality' (remember that it is not individual, subjective 'reality'). The Case Studies in his book show that he contacts this reality only by applying his personal intuition to linguistic expressions. This is just the method which every semantics cannot avoid applying. There is no new 'reality' in experiential realism, there is just a new technical lexicon for intuitive semantics. The question asked above: "Where is the level below the linguistic level?" receives a trivial answer: The intuition of the linguist is this level. Is this level 'really' below the level of normal communication by language users? Can this 'reduction' to preconceptual structures explain meaning? It could, if non-linguistic evidence were constitutive for empirical analyses conducted under the heading of experiential semantics. The fact that Lakoff decided to stop the regression towards non-linguistic meaning at a very shallow level

means that his programme, which is appealing, does not move 'semantics' out of the range of language-internal, purely introspective descriptivism.

If semantics is defined as a model which maps utterances onto something different, ontologically prior, experiential semantics is only an internal description of language use and not semantics at all (historically it follows in the tradition of structural semantics which started with field-theories in the twenties and does not really go beyond this paradigm). In Chapter 2 we shall critically assess the descriptive techniques developed in the field of 'cognitive semantics'.

4.4 The programme of realistic semantics

The semantics developed in this book share some features with both programmes discussed in the previous sections:

a. It is 'objectivistic' in the sense that the knowledge accumulated in major sciences like physics, chemistry, biology, neuropsychology, and the strategies of these disciplines for contacting 'reality' are considered as fundamental to any theory of meaning. They are able to specify how the world (in its stable and regular, i.e. knowable aspects) really is. This objectivism is by definition experiential, it has assimilated the experience of millennia and of all societies which developed a scientific concern with the world. Since Lakoff defined 'experiential' as supra-individual and trans-societal, scientific knowledge is just collective experience.

b. It is 'realistic' in the sense that it is anti-sceptic. Philosophically it is not possible to refute scepticism, which doubts 'reality', but scientifically 'scepticism' is not productive. Thus, if no definite security about reality can be attained, a scientific endeavour must start from the best knowledge that we have about the world. Following Penrose (1990: 197) one can distinguish between SUPERB, USEFUL, and TENTATIVE theories. SUPERB theories would be good candidates for an outline of reality and should be used by a semantics labelled 'realistic'. Penrose specifies the category of SUPERB as follows:

"To qualify as SUPERB, I do not deem it necessary that the theory should apply without refutation to the phenomena of the world, but I do require that the range and accuracy with which it applies should, in some appropriate sense, be *phenomenal*. The way that I am using the term "superb", it is an extraordinary remarkable fact that there are any theories in this category at all!" (ibid.: 197).

Penrose enumerates:

1. Euclidean geometry (as a theory of physical space and rigid bodies),
2. statics (Archimedes, Pappos, Stevin),
3. Newtonian mechanics (the development of Galileo's dynamics),
4. Maxwell's electrodynamics,
5. Einstein's relativity theory,
6. quantum mechanics,
7. quantum electrodynamics.

The theories (3) to (7) are all dynamical theories and they presuppose the theories (1) and (2).

A realistic model of meaning should at least be based on the knowledge about the world contained in 'superb' theories. If semantics as a scientific endeavour is rather 'tentative' it can also presuppose the view of the world contained in 'useful' and 'tentative' theories. It should, however, be aware of the different degrees of security in its assumptions about the world. As these theories are the product of human intelligence and labour, the world-view which they contain is *ipso facto* experiential.

The advocates of experiential realism could object that the scale of excellence of theories is inversely related to their relevance for language, i.e. 'superb' theories are about cosmic laws and all theories pertaining to biology or psychology are either at the level called 'useful' (such as the theory of evolution) or 'tentative'. Consequently, the semanticist would have to choose:

- either to be *realistic* and connect meaning phenomena to the world as described by 'superb' theories,
- or to be *relevant* and accept the risk of having no realistic foundation.

We shall show that both goals can be reached. However, the goal of realism has priority as 'relevance' is a very subjective criterion. I suspect that 'relevance'

often corresponds to the proximity to trusted views and if one gives priority to this vague criterion one ends up in worthless repetitions of current prejudices.

For this book we assume:

- a continuity of basic laws and principles valid in the macro-domain (the dynamics of the world), in the meso-domain (the environment of man) and in the micro-domain (the domain of first constituents),
- further, more specific regularities in the meso-domain must still be discovered and should be added to the basic laws mentioned above,
- the experiential domain in the sense of the observer's individual experience is only a partial and momentary view of the experiential totality of man; these pieces can only be understood if we have some understanding of the system as a whole.

In this sense single descriptions such as those put forward in the next sections and chapters are interpretative (hermeneutic). This does not mean that the whole enterprise is *only* an arbitrary construction, a piece of argument without any claim to realism. The realism assumed in this book is founded on three pillars.

1. The pillar of SUPERB theories, which shows that modern dynamics are fundamental for the understanding of the world.

2. Perception is intimately linked to action in a specific environment. The environment itself contains 'affordances' for action and sets the conditions for their success or failure. This is immediately true for locomotion and direct actions on the environment.[12] By evolutionary continuity these affordances have an impact (with some deformations and possible feedbacks) on higher levels of cognition in a human, i.e. a social, interactive world. It is evident that the linking of higher cognition to the affordances of an environment has many degrees of freedom and that the environment inherits features created at the cognitive level. Therefore, by way of self-referentiality (or by 'accommodation' in Piaget's terms) the causal link between environment and mind becomes more complicated. The realistic position assumes only that the control by the *general* type of environment we live in is not lost and that basic organizational properties of the fundamental link between environment and cognition persist. This assumption can explain

the stability of cognitive systems in a world which is only superficially affected (not in its basic laws) by man's cognitive projections (by artificial 'worlds'). It is clear that the above assumption is open to philosophical debate, but a stability orientated analysis should start on this ground. (If we wanted to analyze the stochastic or the chaotic character of human cognition, the opposing starting point could be appropriate.) In the long run both aspects, 'stability control by the environment' and 'diffusion and chaotic constructivity' should together contribute to a unified theory, which only the future can bring (cf. Chapter 4, Sections 2 and 3).

3. Semantic categorization in language is linked to the basic realism, outlined in assumptions (1) and (2) above, on a rather abstract level. Firstly, there are basic domains immediately related to perception and to the control of locomotion, action, immediate, and mediate (instrumental) causation, etc. In Chapters 3 and 4 these domains are, therefore, our starting point. Secondly, more abstract low-dimensional (i.e. 1, 2, 3 dimensional) semantic spaces can be defined in which processes similar to those in the 'localistic' domain can be observed. These derived *semantic* spaces are summarized in Chapter 5 and a hierarchical organization of these representational spaces is proposed.

Some consequences of the underlying dynamics can be observed immediately; we can, therefore, ensure that assumption (1) is relevant for language. In Chapter 4 the basic phenomena of multistability (in an equilibrium system), of chaos in self-referential systems and of diffusion (stochastic dynamics) are shown with reference to the classical observation domains:

- lexical and syntactic ambiguity,
- recursion (cyclicity) in syntax,
- metonymy and metaphor.

In Chapter 7 the rather abstract level of realism in grammar is concretized by an analysis of narratives and of the transformation of personal experience in narratives. In the spontaneous organization of personal experience in a narrative the realistic constraints can be observed immediately. The retelling of narratives and the elaboration of myths show the constructive and fictional dynamics which transform and partially eliminate these constraints. Nevertheless the basic dynamic schemata are preserved. Thus the analysis of

narratives shows, *in vivo*, the dynamics which we have assumed to be operative in the domain of grammar. If we compare the 'becoming' of grammar to the spontaneous organization of narratives it is clear that grammar has a different domain of becoming. A fully-fledged analysis would have to consider historical and sociolinguistic processes. As a look at the results of historical and comparative grammars makes clear, a diachronic explanation of grammar must remain forever sketchy, since for many languages (e.g. the Germanic, Slavic and other Indo-European languages) major periods of 'becoming' are beyond the reach of our historical reconstructions. For Pidgins and Creoles shorter diachronies seem plausible, but the interaction of various languages and contact processes hides the underlying dynamics (cf. Wildgen, 1986 and Bechert and Wildgen, 1991 for the sociolinguistic and diachronic dynamics).

In general the realistic position of this book is limited by the impossibility of reconstructing the historical dynamics in full detail, and by the complexity of dynamical processes with different temporal and spatial extensions and modes of overlapping. These limitations are, however, no argument for scepticism. The realistic programme allows us to overcome (partially) these limitations by the choice of plausible assumptions, which are later evaluated on the basis of their consequences, and by the search for new domains of observation, which allow us to fill the gaps in our knowledge.

The realistic perspective can be called an 'entrepreneurial' perspective, whereas the sceptical (or instrumentalist) perspective could be called bureaucratic, it aims only at an administration of our lack of knowledge (often within the narrow confines of disciplines and sub-sub-disciplines).

5 Levels of analysis in a 'realistic semantics'

There are many traditional and modern suggestions as to how a theory of language and of meaning could be subdivided. The straightforward distinctions are those which consider the spatio-temporal extension of linguistic material. Thus *words* are contained in *syntactic constructions*, which are contained in *sentences*, which are contained in *texts* (etc.). These basic distinctions are used in the separation of Part One, which deals with lexical items, constructions, and

(simple) sentences, from Part Two, which discusses narratives (a specific and important category of texts). It is argued that the different time scales of words, constructions vs. narratives, result in different types of cognitive organization (in memory, imagination, and verbal planning). Therefore, this very rough, binary distinction has cognitive relevance and is more than a technical device to organize a linguistic description. Further distinctions on the spatio-temporal scale are not systematically made.

In many chapters the terms syntax, semantics, and pragmatics are used. Thus the analyses in the Chapters 2 to 6 and 8 to 9 are labelled as semantics, the formal organization of narratives described in Chapter 7 is called a syntax and in Chapter 10 major pragmatic aspects of oral narratives are modelled. We must, therefore, specify in what sense the terms syntax, semantics, and pragmatics, which have led to many controversies in this century, are used in this book.

We distinguish two routes in the separation of syntax and semantics:

- a methodological route, which takes into account different tools for modelling and their range of application,

- a substantialist route, which makes the claim that *form* and *substance* are two basic aspects which must be separated in every semiotic system.

5.1 The methodological separation of syntax and semantics

If the distinction between syntax and semantics is more a methodological one, we should establish a sound distinction, mainly on the basis of the mathematical languages considered and their specific ability to isolate and represent some aspect of the whole system. In this context the following features are distinctive:

Table 1.2 *The methodological distinction between syntax and semantics*

syntax	**semantics**
- discrete	- continuous
- non-parallel	- parallel (distributed)
- categorical	- probabilistic (fuzzy)

The semantic model may certainly be moved closer to the syntactic one, for example if we consider a feature-semantics which is discrete, finite, non-parallel, non-probabilistic, and we may introduce scales, parallelisms and probabilistic elements such as variable rules into syntax. The opposition proposed above states the extremities of a methodological scale which is more general than the linguistic distinction between syntax and semantics. In general, the syntactic approach in the sciences is tuned to very basic regularities. In the social sciences these regularities amount often to the core of a system of conventions (if variation and vagueness are neglected). The semantic approach aims at uncovering the causal, goal-orientated, functional background; it is more explanatory whereas the syntactic approach is more descriptive. From a methodological perspective the terms *'syntax'* and *'semantics'* have the following content (in the context of this book):

- *Syntax* is concerned with the description of language in terms of discrete units, their inventory and classification and the characterization of constructions which have these units and their classes as elements. If the units are narrative clauses (as in Chapters 7 and 8) the constructions are episodes and texts, if the units are syntactic classes (as in Chapter 9), the constructions are clauses and sentences (units smaller than words or units larger than narrative texts are not considered in this book).
- *Semantics* is concerned with underlying scales (continuous or discrete, but coherent). It seeks for basic dimensions of meaning or order to establish a semantic space (locally for single expressions, globally for a class of expressions or all expressions). Vagueness and ambiguity are basic topics for semantics.

5.2 The separation of form and substance

The classical structuralist view inaugurated by de Saussure and radicalized by Hjelmslev claimed that only the phenomena of form (of expression and content) are relevant for linguistics; substance phenomena are relegated to other disciplines. In his later work Hjelmslev became less restrictive and proposed a schema of linguistic analysis beyond traditional structuralism. In his article of 1954 "La stratification du langage" he proposed the following diagram which described the relational square formed by the distinctions between: expression - content and form - substance and the relations which obtain between these terms.

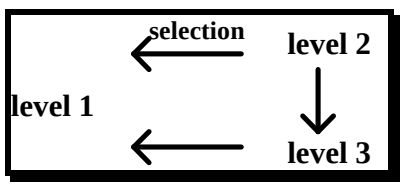
Table 1.3 *The relational square which links form-substance and expression-content*

Form of content	solidarity	*form of expression*
selection manifestation		selection manifestation
substance of content	parallelism	*substance of expression*

The two substance levels are organized into levels which are independent of the substances themselves. This allows for a parallelism between the organization of the two classes of substances: content and expression. Table 1.4 shows the organization of the levels 1, 2, 3 (cf. Hjelmslev, 1954: 93) for the substance of content.

Table 1.4 *The three levels and their connections*

substance-level 1:	level of social evaluation (immediate semiotic substance)
substance-level 2:	socio-biological level
substance-level 3:	physical-physiological level



Hjelmslev's commentary refers basically to expression substance, where level 3 is the acoustic one, level 2 the auditive one, and level 1 the social categorization of phonic substance (based on the levels 2 and 3). But the substance of content should be analyzed in a parallel fashion and Hjelmslev refers to inborn content categories and sensory experiences. Metaphorical processes in meaning are examples of the level of social evaluation. These remarks of Hjelmslev show that he planned an analysis of content substance underlying linguistic analysis proper. He explicitly introduces a stratified ontology based on an evolutionary scale (physical environment, socio-biological organization, mental organization in societal evaluation). I think that he was very close to a realistic position in semantics.

The different levels considered by Hjelmslev are numbered in relation to their proximity to the form of content. In a realistic perspective one must try to first consolidate the levels 3 (physical and physiological level) and 2 (socio-biological level), because in these domains basic natural laws can be found. As this book does not consider the social psychology of language and

sociolinguistics, the first level in Hjelmslev's hierarchy is not systematically assessed (but see Chapter 4, Sections 1.4 and 3.2 and Chapter 10).

Under these premises we can now elaborate the methodological definition of semantics given in the last section.

Semantics does not deal primarily with those questions left by syntax, it goes beyond the (narrow) domain of language and linguistic competence and relates linguistic expressions:

- to sub-symbolic processes in the domain of perception and motor control,
- to external processes, such as the organization and the processuality of the external world, insofar as it is accessible to human perception and action, and can be the motivation for human communication.

The basic laws which one would expect in semantics are thus (a) laws of cognitive processing and storage and (b) laws of the external world to which cognition has been evolutionarily and developmentally tuned. As external dynamics (e.g. in physical laws) and cognitive dynamics (as described by brain models) apply techniques of dynamical systems theory (differential equations) and qualitative dynamics (differential topology), the appropriate mathematics for this type of cognitive semantics are the modern tools of catastrophe theory and synergetics (see Wildgen, 1990a). It is this theoretical frame which suggests that the semantic model should be continuous and parallel rather than discrete and non-parallel. Since the cognitive model at which I aim is rather high-level and does not consider perceptual and motor processes in detail, it can neglect the probabilistic aspect of neural dynamics.

5.3 The level of pragmatics in a realistic model of meaning

Pragmatic *aspects* of language are considered at all levels throughout this book. Thus the 'ecological realism' outlined in the last section is basically pragmatic since human perception and action are considered as the major background of human cognition. In this sense the analyses in Chapter 3 can also be called pragmatic. In particular, speech acts and propositional attitudes are treated in Sections 2.5 and 2.7 and in Section 3 of Chapter 5. The principles 3, 4 and 5 stated in Chapter 5 are called 'semantic-pragmatic principles'.

In the same fashion Part Two, which considers oral narratives as a process of putting into language personal experiences, can be called pragmatic. If we use the term 'pragmatic' in the very narrow sense of goal orientated, functional behaviour,[13] as it is applied in Chapter 10, this restriction is only the consequence of the fact that in a wider sense all analyses in the framework of ecological realism are pragmatic ones.

6 The relevance of Einstein's relativity principle and quantum dynamics for a theory of meaning

In Section 4.3 above Penrose's list of 'superb' theories was accepted as the backbone of 'realistic' semantics. If we look closer at this list we notice two turning points after the Copernican revolution:

- Einstein's general relativity,
- quantum dynamics.

We can ask if these developments in the 20th century have some relevance for 'realistic' semantics or not. At first sight one would say that relativity theory only deviates from classical mechanics at very high speeds (near the limit of light speed) and that quantum dynamics is only relevant for very small constituents of matter. The human mind operates at least at the level of chemical and biological processes and, therefore, the classical Newtonian view would be sufficient. In Penrose's (1990) book "The Emperor's New Mind. Concerning Computers, Minds, and the Laws of Physics" plausible arguments are given that this is not the case; the principles of relativity and quantum dynamics could even be fundamental to a realistic description of how the mind works.

6.1 Relativistic principles in the study of mind and language

Einstein's relativity theory can be seen as a response to a very general question: Is there a general, uniform and neutral framework in relation to which all motions can be described? The answer was negative. If Kepler still considered outer space as a sphere on which all stars were fixed with the sun at the centre

of the whole construction, subsequent physicists had to abandon, step by step, the illusion of such an unchangeable, non-dynamic reference space. Moreover, space and time are not independent but linked by the limitation of motion and acceleration to the speed of light, and by the fact that space can have a curvature. If the physical phenomena of relativity theory do not relate to cognition and language the conceptual innovation triggered by the physical problem does.

In linguistics it has become clear that neither the specific linguistic system ('langue' in de Saussure's terminology) nor some language capacity ('Universal Grammar' in Chomsky's terminology) can be considered as proper reference spaces for linguistic processes. All linguistic processes are basically relativistic. Very deep theoretical questions in linguistics would be: What is the fundamental space of language phenomena? What is its dimensionality, what are its major parameters, does it have a curvature, and what are the universal constraints and limits (like the speed of light) which shape this space? These questions are beyond the concern of this book, but abstract semantic spaces (summarized in Chapter 5) are a first step in this direction. In Chapter 7 a space of narratives and narrative moves is introduced; in Section 4.3 of that chapter a relativistic frame for textual dynamics is outlined.[14]

6.2 Quantum dynamics in mind and language

The relevance of quantum dynamics even for everyday phenomena is stressed by Penrose (1990: 292):

> "The very existence of bodies, the strength and physical properties of materials, the nature of chemistry, the colours of substances, the phenomena of freezing and boiling, the reliability of inheritance - these, and many other familiar properties, require the quantum theory for their explanation. Perhaps, also, the phenomenon of consciousness is something that cannot be understood in entirely classical terms."

The conceptual problem of quantum dynamics was given by the coexistence of field-features and particle-features. How can continuous fields suddenly acquire discrete characteristics and be particles? Max Planck postulated quanta

in 1900; if we generalize the conceptual problem and its 'solution' by Planck, it is the transition from a phenomenon which is field-like, continuous and non-local to a phenomenon which is discrete, compact and local. At a coarser level the discreteness can again disappear. We can say that the superimposition of many discrete phenomena creates a statistical continuum. As a theoretical consequence one must accept that discreteness and continuity are not intrinsic features but dependent on the scale of observation. Therefore, every description of discrete phenomena has to look for neighbouring areas of observation (on the space-time scale) in which the same phenomenon is more continuous and vice versa. In the domain of language two main transitions from continuous to discrete have been observed.

- The transition between acoustic waves (described by continuous differential equations) and the emergence of discrete phonological shapes (with internal statistical fluctuations), i.e. in traditional terms the transition from phonetics to phonemics[15].
- The transition between universal scales (obtained by comparing many languages) and discrete categories in single languages (cf. the work of Seiler and his research group in Köln). If we call these transitions quantum effects, we can state a general principle:

Quantum principle

Quantum effects appear at very specific levels; in linguistics the system of a specific language ('langue' in de Saussure's use) is such a quantum level. By the comparison of many languages (a move towards the macro level) or by a neurolinguistic reconstruction (a move to the micro level) we arrive at a description which is basically continuous.

The quantum principle has implicitly been applied in our distinction between syntax and semantics in Section 5.1 above. As semantics aims at an explanation (a causal reconstruction) it has to leave the quantum level. The underlying (explanatory) domain is typically continuous, non-parallel, probabilistic. Thus syntax is a methodologically motivated island in the description of language, a base camp from which the proper expedition can start and where it can return in case of some misfortune.

In Part One, which analyzes phenomena below and at the level of sentences, we assume that one century of intensive research in syntax was sufficient to consolidate the base camp and that it was time to start the proper expedition. In Part Two a new and more appropriate structure at the quantum level is proposed which, in many respects, is comparable to generative syntax. The fact that the continuous model is inherently stochastic has been neglected; by the choice of qualitative dynamics as the proper formal tool a preference for quantum effects on this deeper level of description is followed. Thus the explanatory domain of semantics can be further separated into:

- qualitative dynamics which describes the emergence of borderlines and basic categories,
- stochastic dynamics which describes the individual processes in speakers or in language groups and subgroups.

In Wildgen (1986) and Bechert and Wildgen (1991) reference is made to the dynamics in sociolinguistic processes and in language contact and language change. Stochastic dynamics (cf. the 'synergetics' of Haken) is the proper framework for such a theoretical development. In this book these types of dynamics are not further considered.

[1] Cf. Boutroux (1900) and Roy (1944).

[2] This term is taken from Kosslyn (1980) and goes beyond visual perception and corresponding schemata.

[3] Spatial representations are documented as early as 40,000 years BC.; one can even argue that the specifically human ability for symbolic representation developed before this date. Human language could have been shaped parallel to this cultural evolution and could have triggered the artistic manifestations found by archaeologists. Cf. Davis (1986) and the comments to his article by E. Anati, R. Bedmark and others (ibid.).

[4] In Chapter 9 I shall propose a model based on the notion of information which does not basically distinguish between the two types of *information* and which allows for different types of coding for the same information.

[5] Johnson-Laird and Miller (1983) argue that the question of whether meaning is pictorial or propositional is unlikely to be settled by psychological experiments. Common sense and experimental results make it plausible that both aspects have a relevant function in linguistic cogni-

tion; I highlight, however, the imaginistic aspect which has received much less acknowledgement in linguistic research than the propositional one (cf. also Sommerhoff, 1990: 214ff.).

[6] The relation to Aristotelian thought is further elaborated in Thom, 1988: Chapters 6 to 8. The subtitle of his book is: Aristotelian physics and catastrophe theory.

[7] This tradition goes back to René Descartes, who proposed the integration of physics and psychology.

[8] A common background is the Neo-Aristotelian approach of Brentano and Thom. A comparative analysis which searches for common roots of both enterprises is lacking. As Thom's programme is primarily motivated by the developments in mathematics (topology) between 1950 and 1970 such a comparison would be very complicated (cf. Wildgen, 1985b).

[9] It is a thorny question, of whether the results of one paradigm can be preserved in the new paradigm. In physics this is often the case, even if it is hard and takes time to integrate relevant solutions of the old paradigm into the new one. In the case of linguistics we assume that only descriptive generalizations are preserved in the new paradigm. Purely technical solutions lose their relevance in the new paradigm.

[10] Adopting a term from Putnam (cf. ibid.: 260), the 'objectivistic' position is called 'metaphysical realism'.

[11] The index in Lakoff (1987) refers to: Atsugevi, Cora, Dani, Djirbal, Fox, Hawsa, Japanese, Ojibwa, Shawnee, Tamahura. (If we assume that there are 5,000 different languages actually spoken, this is a sample of 0.2 %.)

[12] Cf. for a general discussion Section 3.3 in Chapter 3.

[13] Cf. the definition of 'pragmatics' by the International Pragmatics Association (IPrA) "the field of pragmatics in its widest sense ... [is] a functional (i.e. cognitive, social, and cultural) perspective on language and communication." (IPrA Update June, 1993: 1) and Section 5.3.

[14]For more specific applications of relativity theory to fuzziness and semantics I refer to Jumarie's work (cf. Jumarie, 1979a, b, and 1990).

[15] Pike (1967) generalized this distinction by the introduction of the adjectives etic and emic.