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PREFACE

TWLT is an acronym of Twente Workshop(s) on Language Technology. These workshops on natural language theory and technology are organized by Project Parlevink (sometimes with the help of others), a language theory and technology project conducted at the Department of Computer Science of the University of Twente, Enschede, The Netherlands.

The first workshop (TWLT1), was held on 22 March, 1991, with the title *Tomiia's Algorithm: Extensions and Applications*. It was attended by almost fifty Dutch researchers from industry and university. The proceedings contain invited papers on several aspects of the generalized LR algorithm ('Tomiia's algorithm'), including theoretical observations, extensions for context-sensitive and type-0 grammars, error-correcting techniques and parallel implementations. The second workshop (TWLT2), was held on 20 November, 1991, with the title *Linguistic Engineering: Tools and Products*. It was attended by more than seventy Dutch researchers from industry and university. The proceedings contain invited papers on spelling and style correction, information retrieval, grammar workbenches, machine translation, natural language interfaces and information extraction. The third workshop (TWLT3), was held on May 12 and 13, 1992, with the title *Connectionism and Natural Language Processing*. The aim of the third workshop was to feature current connectionist natural language research. The speakers were from the USA, Great Britain, Ireland and the Netherlands. About eighty participants from different European countries attended the workshop. The topics in the papers of the proceedings include syntactic and semantic analysis, grammar learning, idiom representation, syllable segmentation, models for human word recognition and speech synthesis.

These proceedings contain the papers that were presented at TWLT4, held on 23 September, 1992, with the title *Pragmatics in Language Technology*. The aim of the workshop was to bring together several approaches towards this subject, starting from a more general basis of pragmatics and semiotics. Papers in these proceedings deal with semiotics, epistemology, grammar formalisms that deal with functional aspects of language use, concept formation, situation semantics, the use of Peirce's existential graphs for a theory of communication and belief contexts in human-computer dialogue. Fortunately the broad coverage of topics was met with an as broad interest of about fifty participants of the workshop.

We are grateful to the Linguistic Research Foundation (Stichting Taalwetenschap) and PTT Research, Leidschendam, for their financial support of the workshop.

A workshop is the result of a concerted effort of many people. Obviously, we are grateful to the authors and the organizations they represent for the efforts that made the workshop successful. Charlotte Bijron, Alice Hoogvliet-Haverkate and Joke Lammerink took care of organizational tasks. The workshop took place at the Logica Building of the University of Twente. We thank the participants for being there and contributing to the discussions. We hope that TWLT5, the fifth workshop in the series, with its topic "Natural Language Interfaces", on June 3 and 4, 1993 will be as successful as this one.

April 21, 1993

Doede Nauta
Anton Nijholt
Jan Schaaeke
CONTENTS

Pragmatics in Language Technology: Introduction  
D. Nauta, A. Nijholt & J. Schaake (University of Twente)  

Workshop Papers:

Session 1: Pragmatics and Semiotics

Semiotics, Pragmatism and Expert Systems  
J.C.A. van der Lubbe (Delft University) & D. Nauta (University of Twente)  

Semiotics, Epistemology and Human Actions  
F. Vandamme (University of Ghent)  

Separation of Powers and Semiotic Processes  
H. de Jong & W. Werner (University of Twente)  

Session 2: Functional Approach in Linguistics

Pragmatics in Functional Grammar  
C. de Groot (University of Amsterdam)  

Systemic Functional Grammar - Some Remarks on Strengths and Weaknesses Relative to Other Approaches  
E. Steiner (University of Saarbrücken)  

Concept Formation and Understanding: An Overview  
R. Bartsch (University of Amsterdam)  

Session 3: Logic of Belief, Utterance, and Intention

Enriching Answerhood: An Approach to Questions within Situation Semantics  
J. Ginzburg (University of Edinburgh)  

The Logic of Peirce's Existential Graphs  
J. Schaake (University of Twente)  

Belief Contexts in Human-Computer Dialog  
H. Bunt (University of Tilburg)
PRAGMATICS IN LANGUAGE TECHNOLOGY: INTRODUCTION

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The three sessions of the workshop are introduced in the following three paragraphs by the three editors respectively. These introductions have the twofold function of explaining the general theme of each session, thereby furnishing at the same time a frame for positioning the papers contributed to the session in question. As is done in editing each paper, the references are added at the end of this editorial introduction.

1. PRAGMATICS AND SEMIOTICS

The theme of the introductory session to this workshop on language technology presents the broadest possible frame for studies in the field of linguistic engineering. The latter, as must be noted from the start, is indissolubly connected with the problematic of ‘knowledge and reality’ in all its complications. For, any message that might be expressed, transmitted and processed in linguistic form is pregnant indeed with such cognitive associations as are inherent in presuppositions, expectations, contentions, conceptions, valuations and hypotheses. Note, that this is even the case for casual conversation, nonsense dialogues and poetry. Stressing this is for making the reader ready for realising that those approaches to linguistic engineering that are still in vigour today are reductionist in character. Wishful thinking may be accounted one of the main factors in determining the habit of framing knowledge simply as a semantic issue; viz., wishful thinking focused on the attainment of a well-organized operational research-territory. Actually, as will be explicit in this first session, knowledge and cognition are something of the order of a pragmatic structure or process.

As to pragmatics, since Peirce [1] who conceived it as a scientific version of traditional rhetorics, and since Morris [2] who coined the term, adapting it from Peirce, and who mediated its acceptance through Wiener Kreis circles, it is generally accorded the philosophical position of the comprehensive approach to a specific language- or communication-system.

The occasion of this workshop on pragmatics in language technology may be considered as an indication that the tide for reductionism is getting low at last. As is well known, the formal approach inherent in syntaxes and grammar has since long been exclusively paradigmatic in linguistics and language technology. Gradually, however, semantic aspects have been added willy-nilly. The fruitfulness of such a mixed semantic-syntactic approach will be apparent where we may dispose of software, learning networks and robots, that prove competent enough in handling rather complex standard-dialogues, e.g. processing lingual information within standard contexts. Note, however, that life-communication between human beings cannot properly be translated according to fixed standards, rendering it in the form of standard dialogues issued by standard speakers having standard purposes within standard contexts; and, that saying this has more to it than a mere trivially.

The triviality here might be that it applies - in a sense - to everything, to every standard and every model. Therefore, it is not properly characteristic of life-communication, that it cannot be standardized, as it is not to be identified with its models. What makes this note more than trivial, however, is that semantic standards cannot be fixed apart from their pragmatic contexts; worse, the fixation of pragmatic standards is in turn dependent on semantic issues (circularity). For short, pragmatics represents all those aspects of communication that are irreducibly relevant for a proper rendering of the functioning of language and that are not accounted for by semantics.

For the language engineer the practical side of all this is, that some minimal aspects of pragmatics will have to be dealt with in his technical design. As a first-order problem comes up here the question how to select the relevant minimal aspects connected with such diverse pragmatic characteristics as normativity, purposefulness, knowledge- or context-dependent meaning construction, and
intensional constrainedness or conceptual interrelatedness. This long-listed characterization of linguistic pragmatics could be abbreviated by using as a key-term functionality; if only the latter would not again be biased into reductionism, considering a tendency among functionalists to render the triadicity inherent in pragmatics in terms of (a concatenation of) bipolar relations that are again semantic in character. The structural differentiation between semantics and pragmatics may be explicated indeed (as is done to some more detail in the first paper) to be of the order of the difference between linear word-object relations and triadic word-object-conception relations. It is to be noted in this context, that Peirce has established as one of the main tenets of his pragmatism, that triadic interrelations cannot be rendered by a concatenation of binary relations without a considerable loss of structural quality; viz. without reducing circularity to linearity.

Here is where semiotics comes in. Underlying all relevant relating is the notion of semiosis. The word 'semiosis' (adopted from Greek, meaning sign-process) has been coined by Peirce to indicate the universal process in which something is functioning as a Sign. More specifically, as is outlined in the first paper, it indicates the omnipresent process in which an emergent First or information-vehicle, functioning as a Sign refers to an objective identity or fact (the referent or Second) through the intermediary of a law or norm by which the reference is guided (the Third). Semiosis, for short, is the process realizing the integration of Sign, Fact and Norm. Semiotics, then, is the all-embracing study of certain types of semiosis, such as symbol-semiosis, and of semiosis in general. More specifically, semiotics is the universal study of signs, sign systems (including as such linguistics), and their meaning-creating contexts. Thus it represents the comprehensive frame for integrating the syntaxics, the semantics, and the pragmatics of any specific sign-system and for interrelating communication phenomena of any kind with notions from epistemology and design methodology.

Finally, pragmatism as specified by Peirce, may be imagined now as semiotic pragmatism i.e. as the general, epistemology- and ontology-based, methodology of meaning. In Peirce's own terminology: pragmatism is the methodic (i.e. methodic-hermeneutic) counterpart of semiotics. One of its maxims is relevant enough to be stated here. It is implied be the universal character of semiosis: as we are thinking and acting, we are thinking and acting in and through science, i.e. information vehicles (3).

The three papers of the first session may be positioned now as follows, fitting them in the above framework:

VAN DER LUBE & NAUTA treat to some detail what Peircean pragmatism as a general methodology is about, and how it relates to semiotics, pragmatics, and cognition. Semiosis is further explained as the process, studied by semiotics, that is at the basis of whatever might come to expression. Accordingly the authors declare the triadicity inherent in this process to be elucidative of Peirce's three universal categories that are at the basis of semiotic pragmatism. The use of this is illustrated by applying first-order and second-order categorical tripartitions to expert systems. In doing so, the cash-value of semiotic pragmatism is made explicit, especially with respect to the representation of expert inferencing under uncertainty. The relevance of introducing abduction as a complement to deduction and induction (thus obtaining circular inferencing) is considered more in particulars.

In the next two papers the theme of discussion is expanded to embrace culture and society. Focusing pragmatic analysis on the evaluation of institutionalized research (pure as well as applied) and the fabric of the legal state respectively, the discourse exemplifies culture and society as manifestations on the macro-level of ever the same semiotic process. VANDAMME, considering the scope of discourse he is in charge of, differentiates between a short- and a long-term approach within the all-embracing field of meaning attribution. Thus partitioning what is called pragmatics by the other contributors to 'pragmatics' (short-term approach) and 'discourse theory' (long-term approach). In line with Vandamme's contentsions, it is to be noted in this context that semiotic pragmatism is designed not to narrow down to propositionalism, i.e. taking the sentence as the ultimate unit of informational analysis. For, the (information-vehicle functioning as a) Sign is defined by Peirce to apply just as well to one gesture or word as to a whole discourse or encyclopaedia. The holistic approach inherent in semiotic pragmatism is affirmed by Vandamme, where he stresses the prevalence of the design - order over the presupposition - order. According to this prevalence, pragmatics comes first, semantics
next, and syntactics ends up as the finishing touch. Having explicated the interrelations between epistemology, semiotics and logic, and the place of scientific research and human action, c.q. communication, within it, Vandamme resumes an issue that has been left unsettled by Peirce due to his platonistic predilection for pure understanding, viz. the controversy between pure and applied research. This issue is elucidated by Vandamme's inventory of elements featured by the pragmatics of institutional communication between scientists.

De Jong & Werner expound the pragmatics of the legal state. In doing so they resume as a main theme an issue shortly referred to by Vandamme, viz. designing non-repressive, non-authoritarian, societal institutions. As this is understood as a task belonging to semiotic pragmatism as a scientific methodology, it is apt to remind here of two things. First, as is documented for instance in 'Peirce and Law' [4], pragmatism originated around 1872 from discussions in Cambridge's (Mass.) 'Metaphysical Club', where Peirce since 1863 formed his pragmatic ideas in debating most of all with juridical professionals like Holmes and Chauncey Wright. Peirce's pragmatism, especially as far as its futurism, its communalism, and its Thirdness-idea are concerned, has ever since been pregnant with interiorized juridical ideas, as appears from such pragmatist key-notions as 'law', 'reasonableness', and non-authoritarian 'self-control'. Second, realizing the methodic counterpart of semiotics it belongs to the very core of the tasks of Peircean pragmatism to realise methodologically the integration of signs, facts, and norms.

Clearly, this is a post-Kantian undertaking. Accordingly, de Jong & Werner start their discussion with Kant, adopting from him as a principle the normative design of institutions in view of the future. In the mean while the authoritarian and fixationist character of Kant's transcendentalist logicism is exposed. Subsequently the problem of ordering the trias politica, i.e. the separation of legal powers, is re-interpreted in terms of cybernetic (governmental) functions instead of in terms of ratified, more or less autonomous, bureaucratic branches. This makes for a more semiological instead of ontological conception and constitution of legal powers and, accordingly, for a pragmatic analysis and a cybernetic design of the legal state as a system of signs [5].

Note, that the theme language technology as such is not treated in this session. This introductory session to the workshop is indeed designed to be an eye-opener for realising to what extent the scope of relevant language philosophical discussion is broadened and to what extent new complexities are introduced into the field of language engineering as soon as pragmatics is accounted indispensable for language technology.

2. Functional Approach in Linguistics

It is of central import to the whole undertaking of pragmatics in language technology to have a clear overview of functionality in language, and more specifically, of the functional approach in linguistics. The latter refers especially to the Prague school of linguistic analysis. During the first half of this century the Prague school was rather dominant within the field of formal linguistic analysis, but later on this dominance faded by both the difficulty for Czech scholars to communicate with other scientists after World War II as well as the impact of Chomsky's structural approach in linguistics. Among others in western Europe the development of Simon Dik's Functional Grammar was inspired by notions of the Prague school. An overview of more recent developments in the Prague school itself can be found in [6]. What differentiates the functional from Chomsky's structural approach is that next to syntactic and semantic aspects attention is paid to pragmatic features as well.

In the field of verbal semiotics pragmatics may even be identified with the functional approach in linguistics. But, as De Groot points out, this correspondence does not mean that something like Dik's functional grammar may be identified with a pragmatical theory. On the contrary, one could say that functional grammar, and the functional approach in linguistics in general, is a formalism in which all three semiotic branches, syntax, semantics, and pragmatics have their own representation. Among others, this means that semantic properties do not depend on syntactic ones and vice versa. Syntactic, semantic, and pragmatic aspects are not derivable from each other by universal rules and they demand their own more or less mutual independent analyzing or parsing process.
The main terms in which functionality and pragmatic aspects overlap are informational topic and focus. That is, the pragmatic or functionalist analysis of a sentence has to distinguish given and new information in a sentence. It is not the case that this distinction can only be made by analyzing the mental states of speaker and hearer, as is supposed within the field of artificial intelligence (cf. [7,8,9]). Not only is discourse analysis a very helpful tool for topic-focus-distinction in sentences, but there are even features in the sentence surface which indicate whether a certain phrase contains given or new information. In [6] Sgall et al point out that the deviation of the word order in a sentence can indicate a topic-focus-distinction. And of course intonation and other ways to emphasize a certain phrase fulfills the same role.

In his contribution Steiner mentions the neglect of the functional approach in the fields of computational linguistics and language technology. This lack of interest was caused by the computational power demanded for by the functional linguistic formalisms. But given the current shape of computer technology this excuse is not valid any longer. Simultaneously with the growth of the abilities of computer machinery, the desires of scientists in computational linguistics increase (cf [10]). Watching this development of the Chomskyan formalisms used in computational linguistics, the difference between these and the formalisms of functional linguistics becomes one of degree, according to Steiner. But of course the difference between the approaches remains more fundamental and important, at least in the perspective of pragmatical analysis.

As said before, in functional linguistics the focus of pragmatic analysis is mainly on topic-focus-distinction. Bartsch emphasizes that given and new information is not the only pragmatic role a concept can play. As a matter of fact, both roles presume the existence of the concept involved. A third pragmatic function, which is far more important and far more difficult, is concept formation. The addition of this, usually neglected third pragmatic function, is related to Peirce's addition of abstraction to the existing notions of intension and extension in the logic of terms. The consequence of this addition was that the logic of terms was no longer a theory of a fixed set of mutually related concepts, the one involved by or involving the other, but a living set containing rules for growth, change, and decrease.

3. LOGIC OF BELIEF, UTTERANCE, AND INTENTION

Pragmatics is defined by Rudolf Carnap as the logic of belief, utterance, and intention and their interrelations (cf. [11]). According to this definition the distinction between semantical and pragmatic meaning has to be drawn between 'meaning' in terms of truth or truth preserving conditions in the so-called Fregean sense and 'meaning' in terms of effects upon the speaker, the hearer, or the discourse community in general, respectively. Where the semantical notion of meaning is formalized in model theoretic logic, many logicians are convinced that pragmatics has to be formalized in modal logic and a corresponding model or sets of models. Doing so, both kinds of meaning are at least interchangeable. In Situation Semantics Barwise and Perry [12] present a definition of meaning that more or less contains both the distinguished notions. In their opinion meaning is a relation between two situations: one situation serving as a sign, the other as the thing or the event assigned by the former situation. The situation of smoke assigns a situation of fire ("smoke means fire"); the situation of uttering "it is raining" assigns a situation in which it is raining ("it is raining' means that it is raining"). The main advantage of this definition is, according to Barwise, that semantical models no longer have to represent the whole world.

In Situation Semantics the (computationally) outranging possible worlds semantics, representing the total sets of possible worlds sustaining the truth of the utterance is replaced into a partial worlds semantics containing only the things explicitly assigned in the utterance. Where in traditional possible worlds semantics the sentences "Joe is eating" and "Joe is eating and Sarah is sleeping or Sarah isn't sleeping" have exactly the same semantic representation (they are true in exactly the same set of possible worlds), they have different semantical representations in Situation Semantics, the first only containing an eating Joe and the second an eating Joe and a certain Sarah of whom it is not known whether she is sleeping or not. Due to this and other examples of plausibility, situation semantics became a highly influential theory in computational linguistics and philosophy of language for the past decade.
Another example of plausibility is explored in Ginzburg’s contribution to these proceedings. The constructed representation of states of affairs, which in combination with a spatiotemporal entity and a truth value, compose the representation of a situation, can serve very suitably as a tool modelling the way in which questions can be resolved. In this case the pragmatic meaning of a question (a situation containing unresolved states of affairs) is the relation between this question and the set of situations in which the assigned states of affairs are resolved.

Of course, in the case of language utterances the ‘meaning’ relation is more complex than it is in the case of the physical law governing the fact that smoke has to be produced by fire. Writing the utterance “it is raining” as done in an above example, obviously does not mean that it is raining here and now. Its meaning is in the presentation of an example. The different types of these meaning relations, of which Ginzburg’s answer is just one, are not formalized by Barwise and Perry, and right in these variants of meaning pragmatics comes in vision. In the contribution of Schiike this omission in Situation Semantic is related to the ontological status of meaning and situation in Barwise’s and Perry’s theory. Recognizing that the distinguished components of the meaning relation (sign, reference, and meaning) have different ontological status will resolve this omission. The system of Existential Graphs, developed by C.S. Peirce, provides for this demand and, moreover, its syntax is recognized by Barwise & Cooper [13] and Sowa [14] to be isomorphic with the syntax of Situation Theory. Thus, its semantics can serve as an important extension of Situation Semantics.

The variety of different communicative functions we have to deal with, is presented in the contribution of Bunt. In this contribution the point is emphasized that these functions are not just a trivial extension of linguistic theories. Communicative functions do not operate on linguistic expressions themselves, but on their interpretations or pragmatic meanings. Moreover, communicative functions are not simply to be identified with single operations on belief, knowledge, intention, or the discourse process, but contain mostly a mixture of different operative aspects. Bunt’s remarks lead to the conclusion that in order to deal with both situations and attitudes, the mainly semantically motivated formalisms need a thorough extension in the direction of representing attitudes as well.

References

SEMIOTICS, PRAGMATISM AND EXPERT SYSTEMS

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1. INTRODUCTION

In the present paper attention will be paid to semiotics and pragmatism and the role, which they can play with respect to the understanding of the structure of expert systems as well as to the development of those systems.

Although the paper is mainly related to the meaning of semiotics and pragmatism with respect to the rather technical field of artificial intelligence and expert systems, the discussion is also of importance for (computational) linguistics. For, generally speaking, the implementations of computational linguistics are just as paradigmatic for artificial intelligence as expert systems are. More specifically, there is a fundamental connection between computational linguistics and expert systems in that both are dealing with the rational aspects of the use of a particular sign-system. Still more in particular, the relevant consonance between linguistics and expert systems lies in what may be called the pragmatist's conviction (cf. the maxim of pragmatism as is to be found to be a universally valid maxim of logic connected with the validity of inferences, in e.g. Peirce, 1931-1958, Vol. 5, section 9 and section 402, and Vol. 8, section 191), viz. that all the meaning aspects associated with any specific natural language utterance are rendered by drawing such inferences as make sense to the (competent) native speakers of that language. For, this means that understanding language is making inferences that are validated by the competent user of that language. And this is exactly what one is doing with expert systems; making valid inferences but now with the help of machines.

Using the terms semiotics and pragmatism, primarily the semiotics and pragmatism of the American philosopher Charles Sanders Peirce (1839 - 1914) are meant here. One may ask: what makes Peirce relevant for today's research in language technology, artificial intelligence and expert systems? Answering this question rhetorically, it would suffice to indicate that Peirce as a logician and methodologist presents the most remarkable case of neglect and belated recognition in the history of philosophy. As a logician, for instance, he is second to neither Aristotle nor Frege. Any specific answer, however, that goes into what matters to the engineer, could be summarized by remarking that Peirce's philosophy represents the very blend of pragmatism and logic that any technician occupying himself with innovative design and research in the field of knowledge- and language-technology is in need of. This is what the explicatives of this paper purpose to make explicit.

For that very reason, a brief introduction to Peirce's philosophy should not be wanting in this paper. In Section 2 those characteristics of his philosophy are introduced that are definitive of (Peirce's blend of) pragmatism. Semiotics being basic for it, Peirce's pragmatism will be indicated as semiotic pragmatism; and this in view of its differentiation from ordinary as well as vulgar notions of pragmatism. Special attention is due to what qualifies the overall structure of semiotic pragmatism as well as its universal applicability, viz. the semio-logical based categorical framework invented by Peirce. This is summarily treated in Section 3. In Section 4 Peirce's categorical framework is applied to expert systems and their internal structure, with special attention to the inference mechanism. The representation of the characteristics of inference processes under
uncertainty, the main problem in the development of non-trivial expert systems, is studied in Section 5. Finally, some conclusions are given in Section 6.

2. PEIRCE'S PRAGMATISM

Before specifying the cash value of pragmatism for contemporary technology, especially for the intelligent design of "intelligent" machines, we specify what is typical of the Peircean conception of pragmatism; thereby distinguishing it from vulgar conceptions of it that have only eyes for the effect of "cash" (bipolar thought models) instead of defining the latter in terms of the effect of "value" (triadic process-models). The very conception of what could be "intelligent" or "cognitive" in machines (in a more intelligent way than the way in which a telephone book is cognitive) has to do with this very distinction.

We restrict ourselves in the first place to some introductory specifications. Next, in 2.2, some interrelated epistemological notions are introduced that are necessary for a clear understanding of what will follow. Here the founding function that semiotics has for pragmatism will become evident. Semiotics has itself no foundation without the common understanding, and has been developed nearly from scratch by Peirce.

2.1 PRACTICISM INTRODUCED

Basically the history of Western philosophy can be characterized by a continuous sequence of attempts in order to answer the question concerning the relation between on the one hand the words and concepts we are using and on the other hand the reality we try to conceive and to talk about with these concepts and words. A most radical answer was given by Descartes. For Descartes there was not only a clear distinction but even a gap between the reality and the image we have about this reality; there is no direct relation between them, only a correspondence. Furthermore, this correspondence is not the result of some process like e.g. experience but is a priori given and has its ground in some Supreme Being, which also guarantees the truth of our image of reality. Descartes' philosophy is basically bipolar, as is evidenced by this distinction between reality and its image, as well as by similar Cartesian distinctions such as 'matter' and 'thought', 'object' and 'subject' etc. Moreover, the entities are considered as standing in and from themselves.

Charles Sanders Peirce's triadistic methodology, instead of opposing this bipolar-isolatist way of thinking (and thus recreating a zero-sum way of conceiving and redesigning the world), comprehends it and relates it to its broader context where it may stand on its own. In making emerge his methodology, his triadistic way of conceiving, doing and re-designing, Peirce became the inventor of the word as well as the idea of pragmatism. The latter is related to the diversifications of Cartesianism in modernism, say semantism, as pragmatism is to semantics: where semantics comprehends syntactics in its self-containment to the formal study of sign-sign relations by including bipolarities like: sign-referent, referent-meaning, meaningful map-actuality, pragmatism comprehends the latter again by adding the dimension of Design (including normativity, i.e. value-use-plan as guiding-principle). Pragmatism, as Peirce might say, is connecting the Past with the Actual by relating both to the Future. Thus far, i.e. nearly 80 years since his death in 1914, Peirce has been by far the main developer of the idea of pragmatism, developing it into a methodological framework for the universal realisation of 'connectivity'. Everything we can feel, dream, think with (including our intuitions, emotions, our purposeful acts etc.) is interrelated, i.e. is related (directly or indirectly) to what might be called 'reality'. Peirce reduces the idea that there are entities which exist in and from themselves, ab-soluted, say, from the commonsensical world of subjective and inter subjective experiences, to the idea of objectivity as that which makes a community of researchers - realising to what extent their concepts have the status of dreams - (re)design their conceptions. The objective world, say objectivity, could not stand in and by itself, but is related (in whatever way) to our experiences. For the empirical scientist (Peirce himself was originally a chemist) this is a matter of course. For logic and philosophy, however, this meant a revolution and is still very much so: everything whatever, being no-thing in itself, has sign-character.

2.2 SEMIOTICS AND PRAGMATISM

Here is where semiotics comes in as the universal theory of signs and sign systems, and as such a methodological generalization of linguistics, also appropriate for the analysis of non-verbal signs. The universal sign-process, in which anything
present is identified (fulfilling a specific criterion or norm) and through which anything not immediately present is made identifiable and may be identified, is the underlying notion. It is called *semiosis*. It is defined by Peirce and by Morris as the process in which something, some presentation, is meaningfully functioning as a sign. According to semiotic pragmatism, anything: any idea, objective identity, or idol, appearing between heaven and earth, i.e. identifiably partaking in the worlds of dreams, public reality or imagination, is (at least, potentially) a Sign. This is to say, that anything whatsoever that might ever be relevant is (at least) of the order of an information-vehicle, i.e. is something that has the power to function meaningfully as a Sign. We dream, feel, act, know and think in signs. This is what Peirce's pragmatism teaches us, and what is curiously enough at the heart of what makes Peirce's philosophy so relevant for today's engineering: knowledge is not something static, resting in itself, it is of the character of designing and doing. For, knowledge - like thinking - is a realisation, something that may only be manifest - as a design e.g. process of designing - in semiosis, i.e. as part of processes, in which a knowing subject gives meaning to what is taken to be the event by way of signs.

Due to the process aspect of semiosis, the concepts in Peirce's philosophy are not fixed contentions, but only guidelines; knowledge is fallible. As semiosis is in fact subject-dependent, knowledge is only possible by existence of some social group or communication community which realizes the co-ordination of interpreters and the conduct of rules for e.g. the use of signs, etc. Therefore, in a given context universality is something that can be realized only provisionally (in and through signs). However, according to Peirce the sociocentric method of pragmatism will ultimately lead to its Destination: universal Truth.

Summarizing now what is new in Peircian pragmatism as compared to those characteristics of traditional philosophy that still have a stronghold in the scientific and technological habits of contemporary research, we find:

1. Process is substituted for substance (semiosis or sign process being the key concept).

2. There is no static logic of certainty, but probabilism and uncertainty are integrated in every piece of knowledge and in every inference-process (the belief-doubt duality being the key-concept here).

3. Pragmatism is relationalistic; it is a heuristic of heuristic processes, and as such it purports to be in its very fallibility the self-improving method of methods (Kevelson, 1987, especially Chapter 2). This pretension is sustained by the fact that Peircian pragmatism is the very methodology professing the irreducible integration of pragmatics (this all-encompassing complexity for which linguistic engineers have caught a phobia or a dyslexia witness most contemporary research in linguistic technology).

4. Triadiotic design is substituted for secular Cartesian lineairism, as is inherent in bipolarities like: body-mind, opposition-synthesis, object-subject, matter-form, extension-intension, expressed reality-expression, reality-model, realism-idealism, actuality-potentiality.

The way this bipolar lineairism is comprehended within triadic (re)presentations and (re)constructions is explicated in the next section.

### 3. Peirce's Categorical Framework

#### 3.1 The Three Categories

The methodology inherent in semiotic pragmatism can be clarified more deeply by considering Peirce's categorical framework. As has already been explained in the foregoing a main tenet of Peirce's philosophy is that all that exists, all there is to talk or think about, is participant in semiosis, i.e. is part of a sign-process. Constitutive of the universal signprocess three categories play a role simultaneously, viz. signhood, actuality and designhood (the latter is meant as a contraction of: conception, destination and realisation). Thus semiosis is to be understood as the universal process in which a second category, viz. some potential Actuality, is mediately taken account of (Morris, 1938, Chapter II Section 1); the mediation, originating from some thing that in and through the process is functioning as a Sign, is actually realised by a mediator, called Interpreter by Peirce; this third category is realising some wholeness by design. These three categories are indicated by Peirce in their most general abstraction as Firstness, Secondness and Thirdness.
These categories are so interrelated that the
First is involved in and presupposed by the Second
and the First and the Second in and by the Third;
something like a triadic hierarchy exists: a
triarchy. The interrelation between the categories
is dynamic and cyclic: the triarchy is a tri-an-
archy. The position within the scheme can change;
what is actually functioning as a First in one
context may be a Second in another context etc.
The characteristics of the three categories can be
summarized by the following typifications.
Distinction is made here with respect to the
different modes of being defined by Peirce (1),
Peirce's categorical definitions of the three as
primaries (2), the tri-an-archy inherent in semiosis
(3) and the dimensional plurality inherent in the
very conception of each of the three (4).

FIRSTNESS
1. Possibility/potentiality; what might be; what has
the character of a premise; signhood. "Mere
quality, or suchness, is not in itself an occurrence,
as seeing a red object is; it is a mere may-be"
[1.304, where 1.304 denotes Peirce (1931/35),
Volume 1, paragraph 304]. "The idea of Firstness is
predominant in the idea of freshness, life,
freedom" [1.302].
2. "Firstness is the mode of being of that which is
such as it is, positively and without reference to
anything else" [8.328]. The tenet of pragmatism
implied here has a substantial philosophical
import: the mode of being of substantiality (being
a self-sufficient or autonomous entity) is restricted
to mere possibility.
3. Sign. That on which any reference is based. A
sign is more or less self containing. It is any
presentation or point of depart: a sensation, a
quality or suchness, a feeling, an intuition.
4. Monadicity (e.g. being such), unrelatedness,
punctuation.
Self-containment (absoluteness, autonomy).

SECONDNESS
1. Actuality; what happens to be; anything that
can truly be said to exist as a particular spatio-
temporal object or event. The mode of being of
an occurrence c.q. experience. Secondness is
"predominant in the ideas of causation and of
static forces" [1.325].
2. "Secondness is the mode of being of that
which is such as it is, with respect to a second
but regardless of any third" [8.328].
3. Object (in its broadest sense). That on which
the collective goal-directed usage of signs is
based; in Peirce's terminology: Ground. A
referent is the object or actual occurrence
referred to by the sign. There is no Ding an sich.
A referent presupposes a sign.
4. Polarity (e.g. action-reaction), relatedness,
concatenation of binary relations, linear extension.
Zero-summation (either/or, more/less).

THIRDNESS
1. Generality; what (necessarily) would be under
specifiable conditions; what is destined to be in
the long run. Unlike might-be's (mere
possibilities), would-be's, c.q. rules or cognition,
are habits and laws of nature (habits of nature)
that can "only be learned through observation of
what happens to be" [6.327]. It is predominant in
"generality, infinity, continuity,... intelligence"
[1.340].
2. "Thirdness is the mode of being of that which
is such as it is, in bringing a second and a third
into relation to each other" [8.328].
3. Interpretant. The interpretant is the conception,
design or guiding principle, i.e. the cognitive,
functional or rule-governed context, relating a sign
to its referent or application. It is of the character
of a general order or regularity.
4. Complementarity (e.g. part-in-whole comple-
mentarity), interrelation, trianarchic circularity.
Synergetic exchange (both/and, even the weakest
link is fed forward).

3.2 LINGUISTIC-COGNITIVE APPLICATION OF THE
THREE CATEGORIES
The reader's relevant conception of the three
categories may be expanded now by applying
Peirce's frame more specifically in the field of
verbal communication (linguistic semiosis). As
applied to language in use and information theory
Peirce's three categories represent the triads
word-object-concept and information vehicle (data) -
situation referred to (actualization, application) -
interpretant (meaning allocator) respectively.

A Sign in itself does not (re)present existence;
there should be a connection with a referent.
Something functioning as a sign succeeds in
triggering the referent-interpretant relation.
Referring to Figure 1 (see for Figure 1 to Figure 5
the end of this paper), the concept apple
(Thirdness) cannot be real without materialization
in a particular apple (Secondness). Both are
presented in the word 'apple' (Firstness). There is,
however, no direct relation between the word
'apple' and the object apple as is expressed by the
dotted line in the figure; words are related to
objects via concepts. Conventionalised habits play a role here. Linguistic communication is conventional in character, making use of symbolic signs. In animal communication non-symbolic or natural signs are used. Here sign and object are more directly coupled, although a mediator or interpretant is never lacking even there (cf. Morris, 1938). Now let us try to see what it means to say that linguistic signs (symbols) are primarily related to concepts. A word or symbolic expression such as 'apple', 'unicorn', 'this is red' is always used in an actual context. Given this context, the symbol in question may be related to an actual (or actually imagined) apple, unicorn, or situation. This process of existential realisation is mediated by concepts (conceptual realisation), viz. the idea of, or criteria for, an apple, the image of a unicorn, and the purport of the proposition in question. Concepts are habits or combinations of habits that have been formed and are being formed on the basis of contextual experience with occurrences of apples, parts or images of unicorns, contents of propositions, etc. Apparently the mediation process is circular (cf. Figure 5). Generally speaking, i.e. relating not only to linguistic semiotics but to semiotics in general, the interrelations between object, sign and interpretant are dynamical. Objects can only be known through signs, signs will always be developed by interpretants. The Interpretant is the meaning aspect that presupposes a sign and reference relation. However, it should be noticed here, that the meaning of a sign is always tentative (for the time being) and capable of change. This holds for interrelations in general.

It is clear that it is exact the dynamical and circular interrelation between object, sign and interpretant by which the bipolar way of thinking of Descartes is surmounted.

Within the broader context of culture and society (the verbal expressions of) perceptions, reasoning processes and social conventions or agreements can be characterized as a typical sequence of linked semiotic triangles within an infinite field of possible semiotic triangles. Compare Figure 2. During perceptive learning, whatever functions as an object on the one level, can become a sign on the next level. As reasoning processes and the configuration of agreements proceed interpretants on the one level can function as signs e.g. objects on the next level.

Finally, it is relevant to stipulate here that the well-known semiotico-linguistic tripartition: syntactics, semantics and pragmatics, is directly related to Peirce's notions of Firstness, Secondness and Thirdness. Syntactics is related to the combinations of and relations between signs and is as such related to Firstness. Semantics is related to the reference of signs, with emphasis on referents, i.e. Secondness. Pragmatics is related to Thirdness as being the study of the interpretant; the guiding principle relating signs to references.

4. **PEIRCE'S CATEGORICAL FRAMEWORK APPLIED TO EXPERT SYSTEMS**

4.1 **Pre-Conditions for Application**

The categorical framework being introduced, it is now possible to apply it in the field of artificial intelligence; more specifically, to relate Peirce's tri-an-archy to the structure of expert systems. Considering the universal character of the three categories, it may be concluded that kind and number of application of Peirce's scheme are unlimited. The fundamental question here is whether his triadic scheme applies to all tripartitions whatever, including all tripartitions of components of expert systems. It is inherent in the Peircean framework (though not stated as such by Peirce himself) that the following three preconditions for appropriate application should be satisfied:

1. **The condition of completeness.**

The three components should belong together and constitute a whole. There should be no category mistake, comparing sheep with goats (e.g. 'land', 'sea' and 'apple').

2. **The condition of semi-autonomy.**

According to this condition, the presupposed or included component, i.e. the First as related to the Second and the Second as related to the Third, should still have a certain independence, a certain autonomy or identity of its own. More precisely, a component should neither be completely defined (context-freely implied) by the next component, nor have a completely independent status: each should be semi-autonomous.

3. **The condition of hierarchy.**

The order of the three components should not be random, but hierarchical. This means that the Third should imply, presuppose or include the Second, just as the Second should imply the First (or find its forebodings in it).
Relating Peirce's categories to expert systems these conditions should be taken into account. Before doing this, first some remarks about expert systems.

4.2 EXPERT SYSTEMS
In general expert systems can be considered as computer programs that have been made apt for support in complex decision making situations at a level comparable to that of human experts. Their applications are manifold. Expert systems exist, which diagnose medical diseases, which help short term weather forecasting, which advise geologists with respect to mineral exploration, etc. What all these systems have in common is that they simulate allegedly human reasoning, at least with respect to the input-output performance. For this reason, the main challenge in expert system development is to build systems that are apt to handle decision making under uncertainty conditions adequately.

The key parts of an expert system are a global database, a knowledge base and an inference mechanism. These three elements can be distinguished in any expert system. Their defining characteristics are as follows:

1. Global database: that part of the expert system which contains the relevant data with respect to the problem application domain, as well as intermediate results.

2. Knowledge base: that part of the expert system that contains a fixation of the relevant knowledge of the expert. It can be considered as a model of the knowledge of the expert. In most expert systems this knowledge is represented in the form of so-called "if-then" rules, e.g.: "if ice is heated, then it will melt".

3. Inference/control mechanism: that part of the expert system which contains procedures in order to make inferences on the basis of the knowledge base and the state of the global database and performs the reasoning process.

4.3 FIRST-ORDER APPLICATION
Taking into account that the conditions of completeness, semi-autonomy and hierarchy are fulfilled, we now try to apply Peirce's categorical frame to the three elements: global database, knowledge base and inference mechanism relating them to Peirce's Firstness, Secondness and Thirdness, respectively. The reasons why we consider this mapping to be fitting may be specified as follows.

The global database contains un-interpreted data: these function as signs, which are still open for interpretation. The data at this level express 'potentiality' and as such the global database is typically related to Firstness. The knowledge base presents a model of the experience of the expert; this is clearly related to Peirce's Secondness. Furthermore, if-then rules also correspond to Secondness in the sense of 'polarity' and 'action-reaction' relations. Finally, the inference/control mechanism exhibits a rational control function on the basis of a routine-interpretation of a priori given data and expert knowledge; such a guiding principle for relating a First to a Second is typically what Thirdness is about.

A conclusion of this mapping is that the three distinguished parts of an expert system: global database, knowledge base and inference mechanism, are not independent, just as it is not the case in respect to Peirce's three original categories. Until now, this fact was not perceived within the field of expert system development. Inference mechanisms are usually developed independently of the types of knowledge and data.

4.4 SECOND-ORDER APPLICATION
Peirce's categorical framework can also form the basis for a further distinction between the relevant elements within the global database, the knowledge base and the inference mechanism. With respect to the latter, this leads to a tripartition that was already introduced by Peirce himself. As already mentioned, the elements of the categorical framework are semi-autonomous. This implies that each category includes elements of the other category. This makes it possible to apply the categorical framework also to what will be called here 'lower' levels. Lower-order application means the application of the categorical scheme to the analysis of what was the outcome of previous applications of the scheme. Hence, one winds up, e.g. what can be described as a Firstness of a Third, the Secondness of that Third, and the Thirdness of that Third, etc. A comparison with fractals and fractal theory forces itself here.

THE GLOBAL DATABASE
With respect to the global database a distinction
can be made among three types of data or information vehicles, which - following common usage (see Nauta, 1972) - may be designated as signal, sign and symbol. These emphasize the potential, referential and interpretable aspect, and thus a predomination of Firstness, Secondness and Thirdness, respectively. Note that 'sign' in this context is used as a specific term to be distinguished from Peirce's general sign. The specific terms, 'signal', 'sign', 'symbol', correspond to Peirce's terms "icon", "index", and "symbol", respectively.

THE KNOWLEDGE BASE

With respect to the knowledge base, Firstness is related to 'descriptive knowledge', identifying and describing the relevant parameters within some application domain. This part of the knowledge base thus represents the relevant parameters, i.e. those features that are taken to present the building stones for the type of knowledge in question. For instance, in a meteorological expert system for weather forecasting, features like 'temperature', 'humidity', 'cloudiness', etc. are assumed to be relevant within the application domain, i.e. forecasting the weather.

The 'relational knowledge base' specifies the relations between relevant parameters. Usually this knowledge is represented by means of a semantic network that can be considered as a graph, in which the nodes represent the relevant parameters and the lines between them the existence of some relation. With respect to the meteorological expert system the relational knowledge states e.g. that 'cloudiness', 'humidity', etc. are related to the occurrence of 'rain'; 'temperature' is related to the occurrence of 'thunderstorms', etc. Due to its indicative or bipolar character this part clearly pertains to Secondness.

Finally, Thirdness corresponds to that part of the knowledge base that contains 'heuristic knowledge'. This refers to, e.g. rules together with the conditional qualifications of relevant parameters like 'high temperature', 'low humidity' and with the strength of the relation between the conditioning part ('high temperature') and the concluding part ('thunderstorm'). This does not pertain to knowledge in the form of formal if-then rules (which, being bipolar, belong to relational knowledge) but to interpreting knowledge in the form of pragmatic if-then rules; where it is understood, in accordance with semiotic pragmatism, that pragmatics implies interpretation processes (including heuristics) under uncertainty and on the basis of experience.

THE INFEERENCE MECHANISM

If the inference mechanism of the expert system is considered in more detail, then in fact we obtain Peirce's well-known types of inference: abduction, deduction and induction. Abduction is related to Firstness as potentiality, deduction is related to Secondness as actuality, and induction to Thirdness as generality.

It is a characteristic of each inference that it is basically related to three propositions, usually indicated as major and minor (the two premises), and conclusion (the result). According as the third proposition (i.e. the conclusion or result of the inference) has the status of an actuality (including general actuality in case the second premise or minor is a general, where 'all these' has been substituted for 'this' in the following examples), a rule, or a hypothesis we have deductive, inductive or abductive inference respectively; and these are of the character of Secondness, Thirdness and Firstness respectively.

The differences among the three types of inference can be illustrated with the help of the following examples.

Deduction:
First: Red apples are sweet (rule or major, i.e. general premise)
Second: This apple is red (minor or factual hypothesis)
Third: This apple is sweet (actuality)

Induction:
First: These apples are red (factual hypothesis)
Second: These apples are sweet (sampled actuality)
Third: Red apples are sweet (rule)

Abduction:
First: This apple is sweet (actuality)
Second: Red apples are sweet (rule)
Third: This apple is red (hypothesis)

Clearly, these three types of inference have different starting points. In the case of deduction, one comes to a conclusion by applying a rule to a specific case through the intermediary of a specific premise. Induction comes down to the generation of a general rule on the basis of a specific premise, that guarantees the relevant condition, and evidence from well-conditioned samples. Finally, abduction, starts from considering how a given queer actuality (e.g. this apple being sweet, where
- according to the experiential context - most apples are not sweet) might be explained through the intermediary of a rule that fits the actuality, thus arriving at a hypothesis that is explanatory indeed of the actual situation.

These three types of inference will be considered in more detail in the following section. At the end of this section we summarize by way of Figure 3 the first- and second-order applications of Peirce’s categorical scheme to the internal structure of expert systems.

5. REASONING UNDER UNCERTAINTY

5.1 CERTAINTY FACTORS

In the foregoing section, it was mentioned that a characteristic of expert systems is that they are thought to imitate or represent human reasoning; at least with respect to the input-output performance. The latter means that, given the application domain and given the particular problem to be solved, both the human expert and the expert system should come to the same conclusion on the basis of an identical input. However, there is more complication than actually is accounted for in many models. Common sense tells us, for instance, just as Peirce’s critical commonsensism does, that reasoning is not simply reasoning in signs, but is so under conditions of uncertainty. As for Peirce, his pragmatism was designed as a methodology for coping with uncertainty as something inevitable in the context of the continuous struggle for belief against an impressing chaotic-creative background of doubts (see Peirce, 1877).

The types of inference exampled in the foregoing section are primarily related to situations that justify a flip-flop mapping of truth values on to the propositions in question (100% true or 100% false). However, in the present context the definitions are extended to situations in which some degree of uncertainty presents itself in the inference process. Although it can be the rule that red apples are sweet (assuming that we have a clear idea about 'red' and 'sweet!'), in practice it is not always clear to what degree an apple is really red: an apple can be a little bit red, yellow red, fiery red etc. What about the sweetness of the apple in that case? Moreover, assume that we have indeed an apple that is really red (without discussion), then still it is not sure that it is sweet; there is a possibility that some red apples are not sweet at all etc.

One way in which these types of uncertainty can be incorporated into expert systems is by means of so-called 'certainty factors'. Certainty factors express the degree of belief or certainty etc. with respect to observed phenomena; e.g. the redness of an apple. Certainty factors can also be attached to e.g. if-then rules as a whole, hence expressing the certainty of the conclusion part (result) if the conditioning part (fact or actuality) of the if-then rule is completely certain. As such the certainty factor of the rule 'red apples are sweet' expresses the certainty that a red apple is sweet, if there is complete certainty about the redness of the apple.

In general, the certainty factors take values on the continuous interval [-1, +1], where +1 corresponds to complete certainty with respect to the truth of a proposition concerning facts or results, -1 to complete certainty with respect to its falsehood, and 0 to complete uncertainty or ignorance. It is remarked here that certainty factors can be related to different types of (un)certainty: e.g. a priori probability, statistical certainty, credibility, reliability, distinctness, fuzziness etc. Referring to the example, the (un)certainty connected with the correlation between redness and sweetness may be defined as a statistical issue, but also as an issue of credibility. In practice these different types of uncertainty will lead to different calculi dealing with representation of (un)certainty and procedures for the combination and propagation of (un)certainties through inference processes. Here, we will not pay attention to the different calculi: our intention is to illustrate in quite general terms how the problem of modeling reasoning processes under uncertainty, proceeding along the three lines of inference as defined by Peirce, may be tackled.

5.2. DEDUCTIVE RULE INFERENCE UNDER UNCERTAINTY

In the case of deductive reasoning under uncertainty, a conclusion is arrived at on the basis of a specific premise and by application of a general rule. Therefore, this type of inference is also called 'deductive rule inference'. Here it is assumed that both premise and rule are coupled with uncertainty in terms of so-called certainty factors.

Let the degree of certainty of the minor be
denoted by cf-premise. Analogously, cf-rule and cf-conclusion are the certainty factors of the major and the actuality, respectively. In practice, in human reasoning an estimation is performed of the certainty of the conclusion on the basis of the certainty factors of both the premise and the rule. In order to guarantee human-like reasoning, there should be a mechanism in the expert system which expresses the certainty of the achieved conclusion as a function of the certainty factors of the premise and the applied rule. This means that the calculus should be such that cf-conclusion can be determined on the basis of cf-premise and cf-rule, and this in such a way that the computed cf-conclusion corresponds with the degree of certainty ascribed to the conclusion by a human expert, who is considered to be an expert as well in adjudging the right degree of certainty.

One such a calculus issues from the SB-model introduced by Shortliffe and Buchanan (1975). According to this model the certainty factor of the conclusion is the product of the certainty factors of specific premise and rule:

\[
\text{cf-conclusion} = \text{cf-premise} \times \text{cf-rule.}
\]

Complete uncertainty concerning one of the premises means ignorance about the truth of the conclusion, i.e. value zero. As the rule represents expert knowledge cf-rule cannot have a negative value in practice, the upshot being that cf-conclusion will not have a positive value due to the product of two negative factors. In the case that the premise consists of several or-connected clauses, the certainty factor of the premise equals the maximum of the separate certainty factors of the clauses according to the SB-model. The underlying idea is that in practice the most likely clause may be substituted for a whole series of or-connected clauses. Consider the following example, which is an extension of the earlier example:

If an apple is red or soft then its taste is sweet

Let the certainty factors relating to 'this apple is red' and 'this apple is soft' be given by 0.3 and 0.7, respectively. According to the SB-calculus, the overall certainty factor of the relevant specific premise now equals 0.7. This corresponds with the traditional logical conception of or, according to which (un)certainty is not associative over or-connected clauses (for reasons specified below it would be better to add to the maximum an associative sum of absolute values of the certainty factors of the other clauses). Let the certainty factor of the rule be equal to 0.9; that means that if there is no doubt with respect to the predicates red and soft that then the degree of certainty that the apple will be sweet is 0.9. The certainty factor of the apple being sweet in this particular case becomes then:

\[
\text{cf-conclusion} = \text{cf-premise} \times \text{cf-rule} = 0.7 \times 0.9 = 0.63
\]

Analogously, it seems plausible that if a premise consists of and-connected clauses, the overall certainty factor of the premise is the minimum of the certainty factors of the clauses. Accordingly, in our example the cf-conclusion for:

If an apple is red and soft then it is sweet

is calculated to be:

\[
0.3 \times 0.9 = 0.27 \text{ (SB-calculus)}
\]

However, we think it more plausible to take the product value instead of the minimum value. The underlying idea is that the case of two and-connected clauses corresponds to the case of combining two separate premises. In our example, this would mean that cf-conclusion is to be calculated as:

\[
0.21 \times 0.9 = 0.19
\]

This corresponds with an (un)certainty-associative conception of and; of course, if the minimum is negative (e.g. -0.3 instead of 0.3), some kind of product over absolute functions is to be taken. In practice the same conclusion may be achieved along different paths; so-called co-concluding rules. In that case the scoring results of the different rules should be combined to just one certainty factor. Without giving details, it is mentioned here that the SB-calculus includes procedures for this case.

5.3 Inductive Rule Generation and Classification Inference Under Uncertainty

In the foregoing paragraph, it was assumed that the expert knowledge can be expressed in terms of general rules along with some certainty measurement. However, depending on the application domain, it can occur that the expert knowledge is at first available only in the form of pieces of knowledge (samples), e.g. apples,
preselected to be red (to a specific degree of certainty), samples of which have been testified to be sweet without exception (to a specific degree of certainty).

INDUCTIVE RULE GENERATION

In inductive reasoning general rules are generated on the basis of such sampled information, related to a preselection or specific premise. Strictly speaking, inductive reasoning is always subjected to uncertainty due to the fact that the general rule is generated on the basis of a limited number of samples. Moreover, the uncertainty also depends on the fact that the information from the samples can not be per se certain.

In the so-called 'inductive rule generation', on the basis of uncertain and incomplete knowledge, a general rule is generated together with the corresponding certainty factor. In Ho et al (1988) some methods are presented. As a matter of fact, the rules which are the result of this inductive rule generation process can again be used in a deductive reasoning process as such leading to conclusions about new samples.

INDUCTIVE CLASSIFICATION INFERENCE

However, sometimes the generalization from samples to a general rule is not performed. Then the samples are directly used for making conclusions about new samples: the so-called 'inductive classification inference'. Although classification inference is not induction in the pure sense, it can be considered as a type of inductive reasoning, since the generality of the samples is assumed in the sense that the correlation between the preselected variable (red) and the sampled information (sweet) applies as well to a set of samples that goes beyond the pre-given context or original learning set.

Assume n samples (e.g. n apples), where the certainty factors of the factual hypotheses (e.g. being red, being soft) and of the actualities (e.g. being sweet) are given for each sample. Let \( ^r-cf \) indicate the relevant certainty factor as related to sample \( r, r = 1, ..., n \). With respect to the relevant characteristics of apple \( r \) the certainty factors of factual hypotheses and actualities can now be denoted by \( ^r-cf\text{-premise}_1, ^r-cf\text{-premise}_2 \) and \( ^r-cf\text{-conclusion} \), respectively. Assume a new apple for which the relevant degrees of certainty are given by \( cf\text{-premise}_1 \) and \( cf\text{-premise}_2 \) and for which the certainty factor \( cf\text{-conclusion} \) that that specific apple will be sweet should be determined. Then the problem can be formulated as follows:

Given certainty factors of n known samples:

\[
\begin{align*}
1\text{-cf-premise}_1, & \quad 1\text{-cf-premise}_2, \quad 1\text{-cf-conclusion} \\
\vdots \quad \quad \vdots \quad \quad \vdots \\
0\text{-cf-premise}_1, & \quad 0\text{-cf-premise}_2, \quad 0\text{-cf-conclusion}
\end{align*}
\]

Determine with respect to new sample:

\( cf\text{-conclusion} \) on the basis of \( cf\text{-premise}_1 \) and \( cf\text{-premise}_2 \).

In fact, inference is now reduced to a classification problem. For each sample the certainty factors connected with the two premises can combinedly be represented as a point in a 2-dimensional space. The corresponding certainty factor of the result can be considered as a 'label' to that point (see Figure 4). Also the combined certainty factors relating to the information about the apple for which a conclusion should be made can be represented as a point (see point • in Figure 4). However, for this point the label \( cf\text{-conclusion} \) should be determined.

For cases like this, classification methods as used in statistical pattern recognition can be applied, e.g. the m-nearest neighbour classifier. The m-nearest neighbour classifier searches for the m-nearest neighbours of the new sample in the 2-dimensional space and determines the certainty factor of the conclusion with respect to this new sample. This is done e.g. by taking the average of the certainty factors of the conclusions of the m nearest neighbours. Thus, if \( m = 1 \), the certainty factor of the conclusion for the new sample is uniquely determined by the certainty factor of the result of the nearest point. Referring to Figure 4, this implies that, for \( m = 1 \), \( cf\text{-conclusion} \) of the new sample is equal to that of sample i, expressing to what degree the new apple is expected to be sweet.

Aside it is mentioned here that in some sense neural networks can be considered as supporting a form of inductive classification inference.

5.4 ABBDUCTIVE RULE GENERATION AND INFERENCE UNDER UNCERTAINTY

Above abduction was introduced as inferring a hypothesis on the basis of a rule and an actuality. As such, this corresponds to the inverse process of deduction; actuality and hypothesis having
changed position. Abduction is the only type of reasoning which can extend knowledge by taking together the known and unknown. If we see somebody trying to open the consecutive house-doors in a street (puzzling actuality), the conclusion can be that presumably that person is a burglar. The underlying conceptual assumption (rule) is that people who try to open house-doors are burglars. The creative element in this abductive reasoning process is that trying to open doors and being a burglar are related to each other. However, this association is not per se true; it is possible that the person who tries to open doors suffers from forgetfulness and does not remember his house precisely. Thus, the result, as is the case with all types of abductive inference, is uncertain and has the status of a hypothesis. This type of inference is also called 'abduction to a hypothesis'.

In addition, there is also 'abduction to explanatory rules' or 'abductive rule generation'. Both types of abduction have in common that they are related to finding the relevant hypothesis for explaining puzzling phenomena. In the case of abductive rule generation the order of the second and the third proposition has been changed: both premises of the inference are actualities, the conclusion being a rule. As an example we have:

First: This apple is sweet (queer actuality),
Second: This apple is red (selected actuality),
Third: Red apples are sweet (hypothesized rule).

**ABDUCTIVE RULE GENERATION**

Sometimes abductive (explanatory) rule generation is confused with inductive rule generation as mentioned in the foregoing paragraph. However, whereas induction is based on a large number of instances/samples, in abduction a rule is hypothesized on the basis of some puzzling information and some actuality (or minor rule); as such it may be restricted to two single instances. This is because, in the latter case, the inference is intensional in character, relating concepts to each other; whereas, in the former case, the inference is extensional in character, being based on quantitative correlations.

The problem of abduction in general, and of abductive rule generation in particular, is defining a relevant (i.e. rule-pregnant) connection between a puzzling actuality (a first) and a factual hypothesis, that has to be selected as a second, in such a way that the latter may function as an explanatory actuality for the first. In fact, the number of candidate connectors is indefinite, and in a sense even infinite. However, within a given application domain usually there is some consensus among experts about that indefinite class C that is supposed to include all commonly accepted phenomena that need no explanation. This is to say, that any phenomenon in the domain not belonging to C (being considered exceptional or uncommon) actually belongs to the class P of potentially puzzling actualities. In our example 'sour' as concerns apples belongs to C and 'sweet' to P. Now, in order to find the relevant connection, the expert has to search selectively for another P-characteristic of the given sweet apple(s)-in-context, e.g. being red or being imported from an uncommon region. As long as such an additional P-characteristic does not enter his mind there is no key for explaining the queer sweetness of the apple. Two consecutive stages of difficulties come up here. In the easier type of cases the preliminary problem of the first stage has been solved already via linguo - perceptual habit. In these cases C is already definite with respect to the relevant second P-factor. What is common in this respect has already been given a name, for instance, 'green'. The problem is now to frame the relevant non-greenness as 'red' or maybe as 'orange' or 'speckled', etc. Here a potential infinity of shades presents itself, from which the solution might be selected. In the double problematic cases the preliminary problem is how to make C definite where it is still not clear to be relevantly indefinite. The differentiation between apples from common/uncommon regions as related to sweetness is a creative act from which may originate concept formations like 'apple from Spain', 'apples from India', etc. The resultant abductive rule might be that all red apples from India are sweet. For artificial intelligence the problem to be faced here is that 'red', 'from India', etc. should already have been defined a priori: C and P have to be definite already in all aspects that may still to be faced. It is clear that, in practice, this hinders building expert systems with a performance compatible with human-like reasoning. Where the human being is superior with respect to the generation of new associations, the expert system should a priori include well-defined relations and associations of all possible kinds.

Another unsolved problem is the assignment of certainty factors to rules generated by abduction. In general, they cannot be based on a large number of instances as already mentioned above. Certainty
factors can be related here to degree of credibility; this means circularity, because the latter can only be based on induction (expert experience) and deduction. At the level of abductive rule generation, expert judgement is decisive in view of furnishing the necessary expert experience as well as (creating c.q. designing) the guiding concepts.

**ABDUCTIVE RULE INFERENCE**

A similar problem concerning the determination of certainty factors occurs with respect to abduction to a factual hypothesis. Even if the certainty factors of the queer activity in question and the selected rule are known, this does not give per se information about the certainty factor of the resulting hypothesis. Here also we have to realise, that only in well-defined situations abduction to a hypothesis can be performed in such a way that the corresponding certainty factors can be computed. Peng and Reggia (1990) gave a method for the case that the certainty factors with respect to the actuality to be explained take as value only the two extremes of the interval (sure to be true and sure to be false). The method generates a set of specifications that together form the best explanation for the observed actuality. What should be understood as 'best' explanation is defined in terms of

- minimality: the set should be minimal; Ockham's razor,

- covering degree: the consequences of the explanatory set should include the actuality to be explained,

- optimal distance (in a Popperian sense) between the explanatory set and the actualities to be explained according to a likelihood function, related to the actualities to be explained and those results, which are also a consequence of the explanatory set, but which did not actually occur.

**5.5 Relation Between Deduction, Induction and Abduction**

In the foregoing, three types of inference under uncertainty were considered. Cognitively, deduction, abduction and induction differ in the type of knowledge they use as well as with respect to learning aspects. Summarily, this can be put into formula as follows: whereas learning is implicit in the explicit use of deductive rules, induction is the explicit learning by way of samples without use of explicit rule-directed knowledge. Clearly, in deduction a guiding principle in the form of explicit rule covering knowledge is used, whereas such guidance is primarily absent in induction: it is the very function of induction to generate the kind of explicit rule covering knowledge that is used in deduction. This means with respect to induction (including classification inference) that the knowledge used there is of a factual kind, extending over actual samples, which form the ore for explicit learning; and, with respect to deduction, that its learning is implicit in rule inference, where only the results of learning, i.e. the rules, are dealt with. With respect to the results of abductive rule inference, both knowledge and learning are neither explicit nor implicit, but only potential, due to the hypothetical character of the results.

In practice, in reasoning processes all the three types of inference play a role together. This is in line with Peirce's pragmatism, according to which the three types of inference are indissoluble (see Figure 5). By means of abduction the relevant factual hypotheses are selected, including those general ones that are fit for determining the sampling. The results of abduction can be generalized by induction and this, in turn, can be tested by deduction, etc.

Also from an implementation point of view, a combination of deductive/abductive rule inference and inductive classification inference is attractive. In the case of rule inference the utility of the computational approach is usually lower than in the case of classification inference; in the latter case, we are dealing with a large amount of samples. However, classification inference has the advantage of learning capability by the possibility of adding new samples to the sample set. In operational environments, initially samples can be used for rule generation. On the basis of the generated rules deductive rule inference can be performed for new samples. The rules are updated only periodically on the basis of new samples. New rules and new relations between hypotheses and actualities result from abductive reasoning.

**6. Conclusions**

It may be concluded from this paper that Peirce's categorical framework can help to clarify human reasoning (or more general semiosis) and to give
new insights into the internal structure of expert systems. The first- and second-order applications of the categorical framework illustrate that expert systems are Peircean in all their facets.

Furthermore, until now all realized expert systems support just one type of inference; usually deduction or induction, sporadically abduction. Since according to Peirce's pragmatism the three types of inference are very closely interrelated, implementation of all the three types within one and the same expert system seems inevitable in order that expert systems can do what they are expected to do.

It may also be concluded from the present paper that according to Peirce's semiotic pragmatism inference should be considered basically as inference dealing with uncertainty.

Considering the three types of inference, the implementation of abductive reasoning is still a hard problem in expert systems. Under strongly restrictive assumptions, some form of abduction can be performed. This is not sufficient in order to simulate human-like reasoning in expert systems. For this reason, abduction is one of the greatest challenges for the future development of expert systems.

Another challenge concerns the relation between knowledge and inference. Until now in expert systems knowledge and inference are strongly separated. However, relating Peirce's categorical framework to the three components of expert systems, it may be concluded, that there is no clear distinction between (represented) knowledge and inference. Stronger, according to semiotic pragmatism, knowledge as well as inference is a kind of process; viz. one of the manifold manifestations of semiosis, i.e. the process in which something - becoming a sign - is beget of a meaning. What this means to expert systems and how to deal with it within expert systems and in developing expert systems is still much of an open problem.

References


Morris, Ch. (1938), Foundations of the Theory of Signs, Chicago.


concept APPLE
INTERPRETANT
THIRDNESS

FIRSTNESS
SIGN
word "apple"

SECONDNESS
OBJECT/REFERENT
object apple

Figuur 1. Peirce's three categories.
Figure 2. Reasoning processes within an infinite field of semiotical triangles.
Figure 3. Peirce’s categorical scheme and the internal structure of expert systems.
Figure 4. Inductive classification inference under uncertainty.
Figure 5. The relation between deduction, induction and abduction.
SEMIOTICS, EPISTEMOLOGY AND HUMAN ACTIONS

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Abstract

An overview of the related and interrelated domains of epistemology, semiotics, logics and their main subdivisions, is given. In this overview some attention is paid to the pure versus applied approach. It is argued that attention for the applied approach is today really crucial for giving a new impetus to the pure approach. As a matter of example the problem of the evaluation of scientists from an applied pragmatics and discourse perspective, has been taken. From this basis we stress some perspectives on pure pragmatics and discourse theory.

1. Epistemology, Logic and Semiotics

1.1. Definition(s)

In the French philosophical tradition there has been the tendency to differentiate between epistemology and theory of knowledge (théorie de la connaissance). Epistemology is considered to be the study of the principles, hypotheses and results of sciences, in view of determining its logical basis, its value and objective relevance. It is also called philosophy of science. As such it is seen, in Lalande, as the introduction to, and the auxiliary of, the theory of knowledge, which in turn is considered to be the study of the relation between the subject and the object in the act of knowing. But some authors, also in the French tradition, consider this too narrow a definition. They consider the theories of knowledge to be studies of the nature, the general mechanism, the impact and relevance of knowledge.

This differentiation between epistemology and the theory of knowledge is something of a historical accident, dating only from the middle of the XIX century under the influence of German philosophy in France (Lalande, 1962). No etymological basis exists for this differentiation. But anyway, taking the French notions of epistemology and the theory of knowledge together, we can say we cover the traditional field of epistemology. It includes the study of the nature, the general mechanism and the impact of knowledge in general and human knowledge (technological, scientific and common sense knowledge) in particular.

1.2. The Main Subdomains of Epistemology

Epistemology studies the nature, the general mechanism and the impact of knowledge in general and human knowledge in particular of whatever kind. Study of knowledge requires in the first place study of the presentation of knowledge. For knowledge requires a substrate, requires expression. Therefore a crucial subdomain of epistemology is the study of presentation of knowledge. Presentation requires symbolization. Therefore semiotics will be important here. But knowledge requires much more than only presentation; it requires also that something is done with the presentations: the symbols. The presentation is manipulated. Knowledge manipulation is certainly an important subdomain of knowledge. Logic is here relevant.

But the validity and utility of the knowledge representation and manipulation can only be judged on the basis of the impact of knowledge.

![Diagram](image)

Fig. 1 : Basic domains of epistemology

The impact of the knowledge can be considered concerning the actor himself, concerning the group he belongs to, or his culture, or even the whole ecosphere.

It is evident that one can also restrict the study
of the presentation, manipulation and impact to a
certain type of method; so e.g. in the methodology
of science, one restricts oneself to the study of the
methods of presentation, manipulation and study of
impact in the sciences in general or one or another
science in particular.

Taking all this into account one can easily
understand the main specializations of epistemolo-
ogy (fig. 2).

![Fig. 2: Main specialization of epistemology](image)

2. The Main Semiotic Subdivisions

The main semiotic subsystems are syntax,
semantics, pragmatics and discourse theory. The
traditional characterizations of these subsystems
are still rather useful, even if they can be formu-
lated in a more sophisticated way, if necessary for
certain purposes.

**Syntax**: (the study of) the combinations of
signs in a particular communication system or a
specialization thereof: a language system (S1)

**Semantics**: (the study of) the linking of the
communication or language sign or a combination
thereof to a second system. (a denotation and/or a
reference system) (S2).

**Pragmatics**: the linking of the communication
or language signs combination (with their semantic
value) to a third symbolic system: the actor (A):
purposes, intentions, beliefs, utterances, evalua-
tions, appraisals, etc. can be introduced here.

**Discourse theory**: the linking of the {S1,S2,A}
systems to the situational systems S4, constructing
the environment of the actor or actors.

Some basic comments are useful here.

### 2.2. A Standpoint concerning Symbols and Symbolization as 'Representations' and 'Representing' or as 'Constructions' and 'Constructing'

Traditionally the basic unit of the S1, S2 and
A systems is considered to be the sentence or
related in one way or another to it (propositions).
This is by no means a logical, practical, com-
munication or linguistic necessity. It has proved to be
a very useful and generalized convention. One
needs serious practical or theoretical benefits
before one can change this convention as it is so
generally used and the deviation of it may gener-
ate lots of misunderstanding.

However it is generally accepted that the dis-
course unit surpasses the sentence.

### 2.1. A Standpoint concerning the Basic Unit of Subsystems

With this problem we touch the ontologization
issue. This problem also illustrates that
ontologization is not a pure theoretical issue which
makes philosophers happy, but that on the con-
trary it has crucial and important methodological
and practical consequences. In the realistic, as
well as the idealistic approach, symbols and sym-
'bolic systems are considered to be primary repre-
'sentational even if what is represented is from an
ontological point of view, strongly different. Sec-
dondly from this representational layer, all kinds of
other communication acts, such as questioning,
performing, asserting have to be defined in terms
of this basic layer.

In the strictly nominalistic (Protagorian) or
constructing perspective, the communication
language system is a way of getting a grip on the
environment, of realizing successful action indi-
vidually and collectively through order creation.
The presymbolic level is chaotic. Through action
the chaos is transformed in a symbolic space. In this perspective representation can be defined as a derivative of efficient action. It is individual action in social, cultural coordination which is primary.

2.3. The Dominance Relations between several Semiotic Subsystems

From a theoretical, abstracting analytic point of view, there is a strong tendency to consider the more complex levels as generated on top of the more simple ones. So we get the traditional formal approach with syntax as basic. On top of a syntax level, a semantic level is defined. On top of these a pragmatic and finally a discourse theory.

From an applied and strictly nominalistic or efficiency oriented approach, the approach will be entirely different. Each task, each action has to be planned, viewed, started, executed, evaluated, predicted etc. in and from a discourse perspective.

On this basic layer, pragmatical systems will be constructed to optimize and better master the discourses. The pragmatics will be constructed opportunistically, combined with each other, dependent on the necessities less or more elaborated, systematized, made coherent, consistent. For this matter it can be useful to construct and elaborate if necessary semantics and on top of it syntaxes (cfr. Apostel, Piaget, Martinet, etc.), etc. In systemic functional linguistics (Steiner, 1992) the lexical categories themselves are motivated by the pragmatical discourse level (note 1).

For sure, in practice it can happen that then again a feedback can be triggered from a particular syntax elaboration and construction to a semantic, a pragmatic, a discourse etc. So the impression can arise that it is syntax which is primitive. Even elaboration of formal syntactic systems can be explained and covered in this perspective.

3. Applied Pragmatics and Evaluation of Research (Research Units and Individual Research)

3.1. Introduction

When evaluating an individual or a unit, we have to make several options. We can be product-oriented or we can be process-oriented. In a process-oriented approach the evaluation of an activity, an action, a product will happen in view of its contribution to the global process, in view of the progress it realizes for this process. This progress can happen on several levels:

1. The process-realization
2. The process-life-cycle
3. The process-amelioration

3.1.1. Concerning the Process-Realization

A process has several phases. The evaluation of an action, a product, a contribution, will happen here in view of the phase-realization and the smooth transit of one phase to the other.

In the process-life-cycle view, we have in mind the fact that a process itself is going through an evolution. At the beginning, the actors still have to create a lot of solutions, to solve lots of small problems. In the second phase we have a phase of stabilization. The efficiency and performance gets more and more optimized. In a third phase we have sclerosis. Things are done because it has been done before in the same specific way. In the process-life-cycle it is crucial to recognize very quickly the sclerotic tendency and to go to a revitalizing through a cyclic return to the first phase, based on new mission and target definition.

One also has to be aware that in each phase of the cycle, a danger of development of cancers, exists. Although it is perhaps true that the biggest danger for the development of cancers is in the first and the last phase of the cycle. Under "cancer" we understand the autonomous subprocess development without adaptation to the global process structures, targets, restrictions and without splitting of from this global organization.

The progress on the process amelioration is self-explaining.

In the product-evaluation approach the evaluation will happen in view of a comparison of the end-products of the several processes. This means that an end-product of a poor process can be selected and preferred above the end-product of a better structured global process. Although it will be clear that in general in the long run for the survival and progress of a unit, a group, a culture, it is the overall quality of the production process which should have more weight than the accidental or rare products of a less smooth structure.

Anyway it will be clear that a pure product evaluation approach can be dangerous and that by preference it has to be completed by a process approach.

We also have to remark that the actions which compound a process as well as the products of this process, are symbolic, or even symbols or
have at least also some symbolic features. This means that when making evaluation of products as well as processes, we are in fact evaluating symbols. These symbols will at least partly be language symbols. This is certainly the case when we are evaluating scientific research. The products of scientific research are mainly language products (articles, books, etc.) or at least symbolic (awards, degrees). Also in the scientific research activities, the symbolic activities and more particularly the language signs (language utterances, etc.) play also a crucial role. But it will also be clear that in fact the discourse, the symbolic field which is in construction will determine the function and value of the particular language and symbolic acts, and the attitudes of believe, trust, evaluation, etc.

3.2. The three main narrowly interrelated Knowledge Universes : Industry R&D Education

In our modern society the economic and industrial technical organization (T) of know-how is rather crucial and perhaps even dominant on the short term evolution and progress. Very strongly interrelated is without doubt the Research and Development Universe (R&D). This universe is crucial for updating and adapting the T-universe in function of keeping up in competition and therefore for surviving competition. We are convinced that the R&D-universe is dominant on the medium term level.

But economic Research and Development activ-

![Fig. 4: Main knowledge universes](image)

\[ T : \text{The universe of economic, industrial and technical organisation of know-how} \]

\[ R&D : \text{Research and Development universe} \]

\[ E : \text{Education universe} \]

Fig. 5 : Typology of actors in the R&D Universe

![Fig. 5: Typology of actors in the R&D Universe](image)

1. sellers
2. organizers
3. parasites
4. body : researchers, executors
   points : renovators

searchers, executors and assistants (4). They form the body and kernel of this universe. Besides this body, we have several layers. So we have a layer of actors which are organizers of the research and developers (2). A second layer is the layer of R&D sellers (1). They are sellers in two directions. They are sellers of ideas and results towards actors and organizations in the industrial sphere. They are however also selling needs (real or imaginary) and wishes of actors and organiza-
tions from this industrial universe to researchers in the R&D-universe. We also have a layer (3) of parasites. These are actors who are using and abusing means of the R&D-universe without direct or indirect contribution to the maintenance, the development, the amelioration or the optimization of this R&D-universe.

Finally, we have the innovators. We have presented them as points, distributed over the layers 1, 2 and the body 4. In fact, a time dimension has to be introduced. This in the sense that an innovator is only an innovator at a certain time. This time dimension is relevant for all types of actors. One can be an R&D-actor at a certain time and later on become an R&D-reseller permanently or temporarily, part-time or full-time and vice versa. We must also be very careful in the use of the labels we introduced here, to avoid to trigger naive actions in view of introducing pseudo-optimization and pseudo-ameliorations, which are in fact disastrous interventions. This means that qualitative and quantitative careful and sophisticated productivity evaluation is required, e.g. in order to differentiate between a parasite and a silent modest actor which is very performative and even innovative in the preparative, executive phases of the work, but which is entirely absent in the selling phase of the work: considering publishing as a form of product selling. Our work in the anthropology of genetic biology has proved that this is a realistic problem. This again illustrates how important applied pragmatics are for science-evaluators.

3.4. One-dimensional versus Pluri-dimensional Evaluation of Science: the Parasite or HIV-Metaphor

Each biological or social organization is endangered by the growth of internal parasites. A parasite we define here as a structure which grows at the expense and in the long run at the exhaustion of the host. In other terms in this perspective a parasite is defined organizationally. In an organization, each substructure however big or small, has an autonomous activity which is however integrated, controlled by the global functioning of the organization (organism). This means that the optimization of each substructure can only happen when we take into consideration the global organization in this optimization. In practice we can formulate a general law, that an optimization of the overall organization always requires a sub-optimization of all the substructures. A correlation of this general law is that each substructure which always chooses an optimal solution in terms of its own functioning, inevitably will develop into a parasite (cancer) relative to the global organization. So we can say that the development of parasites is a matter of the self-organization of the organization (organism). In biological terms we can call it a matter of the immune self defensive system (ISS). AIDS, influenza, cancers, etc. all are in this sense matters of the ISS.

The same findings we get in management and more particularly in the domain of quality control and quality assurance. What endangers the survival and the progress of any organization is an explosive or a slowly growing substructure which develops overruling the global equilibrium at the expense of the global "wealth". The naive approach here is the introduction of a one feature oriented quality control: a one feature oriented parasite search.

The HIV-virus illustrates the intrinsic weakness of this approach. We know that the immune system in its search for elimination of "derailed" substructures searches for deviations, through recognition of specific external substructures (epitopes). If a cell has a specific external feature it is accepted. This means that substructures which generate (mimic) this one feature, are accepted and escape repression, whatever their mission and behavior.

The lesson which has been learnt from this in management, is that the best guarantee for global optimization of an organization, this means, between others, eliminating parasites is a dynamic multivariable approach in a quality assurance perspective (DMAP) rather than through repressive post factum quality control. What we mean is the following. The global optimization of a system we can call the optimization of the wealth of the organization or the organism. A vital issue is to define this wealth in a relevant way. This has to be done in terms of the specific organization one is considering and the organization(s) this specific organization is itself a part of. So for a human organization one could define wealth in terms of know-how, know-that, know-what, infrastructures, available and potential input, output, services, etc.

The post factum quality control approach is in the long run dangerous, as it is repressive, comes too late and is too expensive. Lots of substructures, e.g. outputs, will have to be rejected, actors will get blamed and so demotivated, etc. Most and for all it is a dangerous thing for the reason that parasite substructures easily will be able to disguise themselves under the quality control features once they know them. Once these are found and
implemented, a complete escape to the self-defense system is realized.

In fact we argue that the pitfall of the totalitarian political systems (Russian communism, fascism) have been that their repressive systems after a certain time are getting ineffective, for the parasite gets a cover and therefore these systems become totally inefficient. The only effective answer therefore is a dynamic, multivariable, quality assurance process approach to evaluation: DMAP-evaluation. An approach which is made possible but not at all guaranteed by democracy, we have to underline.

Let's elaborate somewhat the main labels. Why is a quality assurance approach that important? Through quality assurance, an early guidance and adaptation to the main targets and mission of the group: the wealth of the organization, becomes possible.

Why multi-variable? It is vital that one is aware that a one-dimensional approach is always dangerous. It leads to wrong oriented optimization. A slight misunderstanding, misconception leads easily to enormous distortion. In a multi-variable approach the inevitable errors in judgement, characterizations, can more easily be balanced. More importantly, the covering of wrong optimization becomes at least more difficult, if not impossible.

Why dynamic? "The evaluating parameters constantly have to be evaluated in terms of their dependency on the environment, the actors and the effects they produce, at short as well as at long notice. If this effect isn't beneficial the parameters have to be questioned and eventually fine tuned, if not radically changed."

3.5. The Contribution of Applied Pragmatics to the DMAP, the Scientific Unit Evaluation

The naive approach towards the evaluation of a scientific unit is well-known. It consists of a quantification of the publications of this unit in the general accepted leading international journal and through the assessment of its impact through the quantification of its quotations in other articles appearing in the same journals and second rated journals which are nevertheless covered by the main commercial citational index agencies.

From an applied pragmatic point of view, we see that we have here evaluation through two types of privileged written language utterances. One type of privilege is related to the medium of publication of the utterances: the privileged journals (U1).

The second type concerns the quoting utterances inside these privileged journals: U1.1.

However it is clear that these types of language acts are only a very limited subset of the total language acts which are used and needed to maintain and develop a scientific unit (fig. 6). For maintenance and development, the integration is vital too in the T-universe to get new motivated skilled collaborators. We can also try to describe and analyze the language acts, needed therefore. We also have to judge how crucial these U1 and U1.1. are for the innovation, the development and the expansion of the scientific research itself and for the transfer and imbedding in the technological and economical universe and its products.

<table>
<thead>
<tr>
<th>1. Maintenance of scientific unit</th>
<th>Motivating manpower</th>
<th>U2</th>
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<tbody>
<tr>
<td></td>
<td>Attracting new manpower</td>
<td>U3</td>
</tr>
<tr>
<td></td>
<td>Quality assurance</td>
<td>U1</td>
</tr>
<tr>
<td>2. Development of scientific unit</td>
<td>Training present and new manpower</td>
<td>U4</td>
</tr>
<tr>
<td>3. Transfer: selling results</td>
<td>To peers</td>
<td>U1/ U1.1</td>
</tr>
<tr>
<td></td>
<td>To services</td>
<td>U5</td>
</tr>
<tr>
<td></td>
<td>To general public</td>
<td>U6</td>
</tr>
<tr>
<td>4. Innovation of scientific unit</td>
<td>Innovating process</td>
<td>U7</td>
</tr>
<tr>
<td></td>
<td>Innovating products</td>
<td>U8</td>
</tr>
<tr>
<td>5. Transfer to the T-universe</td>
<td>U9</td>
<td></td>
</tr>
<tr>
<td>6. Imbedding in the T-universe products and methods</td>
<td>U10</td>
<td></td>
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</tbody>
</table>

Fig. 6: Language acts basic for the maintenance and development of the R&D universe

A first rough classification of vital language acts is the following:

1. Transfer of knowledge acts
   1.1. To peers
   1.2. To peers in spe
   1.3. To the general public

2. Innovation: creation of new knowledge. According to R. Jacobson, poetics and literature, play a crucial role here through metaphors. We like to add humor and metaknowledge language acts too.

3. Embedding in product supporting language utterances.
From an applied pragmatical point of view (a) how to recognize these different types of language acts, (b) how do they integrate, (c) how do they function, (d) how to combine them? From an evaluation point of view, it is clear that for a research unit, a minimal level of each of these types of language acts are vital. What is the minimum, what is the optimal? What are the dependency relations between them? Are these dependency relations culturally dependent on the future perspectives of the actors? Anthropology and history of science prove that there is an important tendency towards specialization in (1), (2) and (3). If only utterances in 1.1. are recognized and retracted and the actors non-active in 1.1. penalized, if not eliminated does this not endanger productivity of the scientific units.

Is the 1.1. utterance really that important in the development of science? Are the vital changes and progresses in science made by people with 1.1. utterances or are these activities much more peripheral in the progress of science? Here again history, anthropology and sociology of science have to inform us on this, and on the cultural dependencies. To accept however 1.1. utterances a priori as the moving force, is a dangerous and anyway unscientific approach.

Also we must take care that correlations which existed in the 18th century, are not necessarily relevant in the 20th century. Even stronger, in view of the changing hierarchy of value, in the future the correlations may become even more different. So the predictive value of past correlations have to be questioned too. Anyway if we are convinced that other symbolic actions are more crucial e.g. U8: innovations or U10 em-bedding knowledge in new products or methods, then we have to ask seriously whether U1 and U1.1. have real trigger value here, instead of being most of the time just loosely related post hoc phenomena. In the latter case, we have to pay attention to what the mediators are for realizing U8 or U10. Are metaphors here crucial as R. Jakobson argues?

4. New Perspectives on Pure Pragmatics based on Applied Pragmatics

4.1. Category Labeling and Appraisals

From the applied pragmatic point of view, it became clear that crucial aspects of actors are beliefs, intentions, but also appraisals. Belief and intentions can perhaps be seen as specific ways of appraisal. Appraisal being a general method for constructing hierarchies, to base actions and behavior on. In appraisal we remark that labeling utterances is very crucial. Through labeling an order, a topic and focus is constructed. Labeling in fact acts as a motor for structuring. Although, we have to add that its importance is not only local but we see that it has also impact on discontiguous regions of activities through several symbol manipulation techniques. In this respect we have to add that in most cases we do not only have a choice between labeling or not labeling, but also between several types of labeling: each type introducing different structurations and even levels of structuration. The structuration realized through labeling can be governed through different mechanisms: frequency of in-terrelation, attitudes or motives, logical integration: deduction, in-duction, abduction, analogy, etc. So for applied pragmatics the specific labeling in a specific domain is rather crucial to determine, to ameliorate, to justify and to apply. For pure pragmatics it is vital to introduce a general theory and strategy of labeling.

4.2. Metaphors as Social Inhibitors, Releasers, as well as Signals

Metaphors are crucial in innovation. Metaphors are strongly actor as well as domain dependent. In applied pragmatics they are important as releasers and inhibitors of labeling behavior of actors as well as signaling labeling patterns of actors. Accordingly, applied pragmatics, in focusing on the study of specific metaphor use and strategy in specific domains. We are convinced that a general theory and a general strategy on metaphor has to be the kernel of pure pragmatics.

5. Notes

Note 1: Steiner also stressed that in his view the degree and type of syntaxis elaboration will depend on the discourse one is targeting. This again illustrates the Martinet/Apostel point of view.

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SEPARATION OF POWERS AND SEMIOTIC PROCESSES

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ABSTRACT

In this paper we will discuss the relations between the doctrine of the separation of powers and processes of semiosis. On the basis of an example of constitutional change in the Netherlands (1983), we shall try to illustrate the usefulness of semiotics for legal and political science. The lesson semiotics teaches us is that we must not try to exclude ambiguity and processes of change from the basic structure of political society, but that we need to incorporate them and try to deal with them rationally.

The change in the Dutch constitution can be interpreted as a change from a Kantian model of separation of powers to a concept that results in a system of checks and balances. Before 1983, the separation of powers was based on a separation of branches and the superiority of the legislative branch; notions in accordance with the Kantian conception of separation of powers. After 1983, the separation of powers has been based on a separation of functions and a declining power of the legislative branch; notions closer to the conception of checks and balances as expressed by the American federalists (the Madisonian model). These changes can be made intelligible by reconstructing the theories of meaning underlying both concepts. It goes without saying that this reconstruction must not be understood in an empirical, psychological sense, as if the drafters of the constitution were actually aware of the theory of meaning underlying both conceptions. Neither do we intend to say that the drafters consciously designed the constitution following the examples of Kant and Madison. What we are trying to do is to reconstruct both the conceptual models underlying the successive constitutions and the theories of meaning implicit in these models in a rational way, by means of ideal types.

The theory of meaning underlying the Kantian concept expresses the idea of fixed meaning of statutes, guaranteeing a strict separation of powers as well as the superiority of the legislative branch. Semiotics however, challenges this theory of meaning by demonstrating the fundamentally changeable and ambiguous character of all signs (including words). The conception of checks and balances can be seen as a realistic alternative to the Kantian model. It incorporates the ideas of change and ambiguity and offers possibilities to deal with these phenomena rationally.

SEPARATION OF POWERS

Liberal-democratic political theory is a normative theory (theory of justice) on the requirements the basic structure of a political society should meet. Its object is the traditional tension, resulting from the fact that human beings are both distinct individuals and part of social classes and groups. Specifically it aims at the realization of individual freedom. An important means in order to achieve that goal is the design of a legal state ("rechtsstaat"), which can, to a certain extent, be interpreted as the constitutional translation of liberal-democratic political theory. The idea of the legal state stands for two requirements concerning the structure of the relations between citizens and their government. First of all in a legal state governmental actions ought to be based on law. This is the principle of the rule of law. Secondly (and strongly related to the rule of law), powers ought to be divided between several power-holders. This is the principle of the separation of powers.

In this paper we concentrate on the second principle, but it should be quite clear that it cannot be analyzed without being aware of its connection to the first. The idea of the separation of powers is primarily concerned with legal powers. In this first paragraph we will analyze the concept of separation of powers by looking at its three analytical parts: the legal nature, the constitution of different types of legal power and the separation of those types of legal power. However, before doing this we will go back to the original meaning of the idea of the separation of powers and create two ideal types for using (interpreting) the original idea.
1. CLASSICAL DOCTRINE

The idea of the separation of powers is traditionally linked with the work of Montesquieu. As every so often in scientific discourse it is not quite true to think of only one person as the sole inventor of a theoretical framework. The insights Montesquieu refers to were already known from the work of e.g. John Locke.

However, Montesquieu's work is important in two ways. Firstly, he was able to develop a system of concepts with which it was possible to think of political power as a kind of power within specific boundaries. Secondly, he used his concepts to describe the political system of a super-power such as Great Britain, by which it became clear that limited government is not only an ideal, but also quite realistic.

Montesquieu's framework is simple (figure 1). He distinguishes between the four functions of governance: legislation, execution, "prerogatives" and administration of justice. Each function should be executed by a specific body. The executive and "prerogative" function must be performed jointly, because they both refer to the same sort of activities. This means that, in order to realise the ideal of limited government ("political liberty"), every government should be divided into three branches: a legislative body, an executive body and a judiciary.

**FIGURE 1: SEPARATION OF POWERS**

<table>
<thead>
<tr>
<th>BRANCHES</th>
<th>LEGISLATION</th>
<th>EXECUTION</th>
<th>ADMINISTRATION OF JUSTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEGISLATIVE</td>
<td></td>
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<tr>
<td>EXECUTIVE</td>
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<td>JUDICIARY</td>
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</tbody>
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The coherent and realistic conceptual framework of Montesquieu was widely accepted as an instrument in the struggle against despotism. On the European continent it became an unavoidable theme since Kant accepted it as the hard core of his theory of the state.

1.1 KANT

With regard to its impact the importance of Kant's use of Montesquieu's theory cannot be underestimated. He introduces it like this:

"Ein Staat (civitas) ist die Vereinigung einer mengen von Menschen unter Rechtsgesetzen. So fern diese als Gesetze a priori notwendig, d.i. aus Begriffen des äußeren Rechts überhaupt von selbst folgend, (nicht statutarisch) sind, ist seine Form die Form eines Staats überhaupt, d.i. der Staat in der Idee, wie er nach reinen Rechtsprincipien sein soll, welche jeder willkührlichen Vereinigung zu einem gemeinen Wesen (also im Inneren) zur Richtschnur (norma) dient. Ein jeder Staat enthält drei Gewalten in sich, d.i. den allgemein vereinigten Willen in dreifacher Person (trias politica): die Herschergewalt (Souveränität) in der des Gesetzgebers, del vollziehende Gewalt in der des Regierers (zu Folge dem Geset) und die rechtsprechende Gewalt (als Zuerkennung des Seinens eines jeden nach dem Gesetz) in der Person des Richters (potestas legislatoria, rectoria et judiciaria) gleich den drie Sätzen in einem praktischen Verhaftingschluss: dem Obersatz, der das Geset jenes Willens, dem Untersatz, der das Geho des Verfahrens nach dem Gesetz, d.i. das Princip der Subsumption unter denselben, und schliesst, der den Rechtspruch (die Geset) enthält, was im vorkommenden Falle Rechens ist.""
and judicial branches that make up the structure of that constitution, but the legislative, executive and judicial functions. This shift from branches to functions is important and not just a superficial, technical change in the document.

In order to understand the nature of the shift it is useful to look at an alternative way of interpreting Montesquieu's conceptual framework. For that purpose we may go to the constitution of the United States of America, as it was discussed in the Federalist Papers.

1.2. THE FEDERALIST PAPERS

The Federalist Papers are a collection of eighty-five contributions to New York City newspapers. They were published with intervals from October 1787 until August 1788 and written by Alexander Hamilton (1755-1804), James Madison (1751-1836), and John Jay (1745-1829), as reflections on and justifications of the constitution, that came into force in 1787.

In one of his contributions Madison refers to the work of Montesquieu, agreeing with him in his idea that the accumulation of power in one branch of government would result in despotism. This leads him to reject the British system of representative democracy, the system of parliamentary sovereignty. According to Dicey this principle of the sovereignty of parliament implies three doctrines: (a) Parliament has the right to make or unmake any law whatever. (b) No person or body is recognised by the law of England as having a right to override or set aside the legislation of Parliament. (c) The right or power of Parliament extends to every part of the Queen's dominions.

According to Madison a system of parliamentary sovereignty is a threat to the individual freedom of the citizens, because it makes legislative power the superior force in the state. Four institutional measures are thought to be necessary in order to prevent a system of democratic despotism from arising: a federal system of government, democratic legitimation for all branches of government, recruitment of representatives from the "moral community" (Fuller) or moral elite and statutory review by the judiciary. Apart from the elitist thoughts on representation, the most important shift in the idea of separation of powers here is that Madison scatters the simple structure as we have seen in figure 1. The theory becomes what Vile calls a theory of mixed government. The concept refers to a complex system of checks and balances:

"The theory of mixed government was based upon the belief that the major interests in society must be allowed to take part jointly in the functions of government, so preventing any one interest from being able to impose its will upon the others, whereas the theory of the separation of powers, in its pure form, divides the functions of government amongst the parts of the government and restricts each of them to the exercise of its appropriate function."

It is important to note that Madison (as one of the authors of The Federalist Papers) does not incorporate the democratic ideas of Rousseau into his theoretical framework but goes around them in order to secure the more fundamental values that make up individual freedom. This is why the work of Madison is often related to the idea of natural rights as implied by Locke's theory of consent. Consequently there is a fundamental difference in looking at governance between Madison and Kant: the latter conceives governance as the activity of a superior organism in the state, while the first sees governance as the public sphere of the social realm of private persons living together. In the public sphere various actors play their separate roles, without assuming a hierarchical relationship between them.

1.3 IDEAL TYPES

Our assumption that the idea of the separation of powers refers primarily to legal powers, means (as announced in the introduction to this paragraph) that the concept consists of three analytical parts: legal, powers and the separation of those powers. In order to achieve a clear picture of the difference between the Madisonian and the Kantian interpretation of the separation of powers it is important to distinguish between these three parts.

In the Kantian tradition the legal relations between the various branches of government are primarily determined by the sovereign, the legislative branch. This means that the legislator determines the content of the legal system. Law is positive law: "Die Normen einer Rechtsordnung müssen durch einen besonderen Setzungsakt erzeugt werden." The "Setzungsakt" or declaration can only be legitimately performed by the legislative branch of government. Thus Kant takes a more restrictive view on law than Montesquieu.
Montesquieu accepted the "prerogative" as a natural part of the executive branch: there are certain powers of the King that cannot be infringed upon by parliament.

Madison was concerned with a republican system of government. "Prerogatives" in the monarchical sense of the word did not fit in. On the other hand Madison seems to recognize the possibility that law is more than just statutory law. This insight is an assumption of the dynamic system he creates, by putting different branches in the context of mixed or balanced government. For every branch there is a special kind of responsibility for the execution of its function and this may go further than just doing what the legislative branch orders them to do. The scope of law is wider than the wording of a statute suggests.

Legal powers are powers of a special kind. They are powers within the context of the law; powers to create legal facts. Within the Kantian framework the abilities to create norms are provided by the legislative branch. Consequently, law becomes a hierarchy of norms. The norm that provides validity for another norm is relatively "higher" than the latter. This, however, introduces the question of the boundaries of the legal system. Kelsen puts it like this:

"Aber die Suche nach dem Geltungsgrund einer Norm kann nicht, wie die Suche nach der Ursache einer Wirkung, ins Endlose gehen. Sie muss bei einer Norm enden, die als letzte, höchste vorausgesetzt wird. Als höchste Norm muss sie vorausgesetzt sein, deren Kompetenz auf einer noch höheren Norm abgeleitet, der Grund ihrer Geltung nicht mehr in Frage gestellt werden. Eine solche als höchste vorausgesetzte Norm wird als Grundnorm bezeichnet." 14

The system of law in the Kantian tradition is for a large part static, that is grounded on a "Grundnorm" or basic norm. The Madisonian tradition, on the other hand, is primarily based on a dynamic concept of law. The dynamics result mainly from the important role of the judiciary in the system and the primacy of case law over statutory law.

Legal powers refer to an agent, to what the agent is able to do and to the way in which the agent is able to execute its ability. The separation of legal powers may be based on each of these parts. As we have seen in an earlier part of this paper, separation is traditionally based on the autonomy of agents, on the basis of the type of their abilities. There is or ought to be a separation between a legislative, executive and judicial branch of government. The difference between the Kantian and the Madisonian tradition is that the former does not provide a procedure by which the legislative branch may be controlled, whereas the latter does.

1.4 CONCLUSIONS

In this paragraph we have drawn a succinct picture of the idea of separation of powers. We have seen that the Dutch constitution until 1983 was based on a Kantian interpretation of Montesquieu's Trias Politica. We can now conclude that the change in 1983 towards a functional approach to the separation of powers may be interpreted as a shift from a Kantian interpretation of the Trias to a Madisonian interpretation. In paragraph 2 we will try to make this shift intelligible, using the concepts of semiotics in order to show a fundamental tension in the Kantian concept. In paragraph 3 we will, again from the standpoint of semiotics, evaluate the Madisonian concept of checks and balances.

2. TENSION IN THE KANTIAN CONCEPT

How can we understand the shift in text and structure of the Dutch constitution in 1983? If we look at the Kantian concept of the legal state it becomes clear that this classical constitutional framework refers to the separation of powers. This concept leads to a constitutional design in which three branches of government are involved in one single process, the expression and execution of the will of the people. The role of the legislative body in this process is the enactment of general and abstract rules, whereas the role of the administration and the judiciary is restricted to the application of these rules to individual cases (figure 2).

FIGURE 2. LEGAL PROCESS

\[
\text{legislative} \rightarrow \text{general process} \rightarrow \text{administrative process} \rightarrow \text{individual decision (concrete norm)}
\]

\[
\text{judicial process} \rightarrow \text{individual decision (concrete norm)}
\]
The passive role of the executive and judicial branch was never actually realized in existing constitutional systems. Especially with the unfolding of the welfare state the administration and the judiciary acquired discretionary powers. These empirical arguments, however, cannot serve as an explanation of the shift that took place in the Dutch constitution. Given the logical gap between 'Is' and 'Ought', one could argue in favour of changes that would make the facts fit to the norms. Therefore we will have to demonstrate that the shift from the Kantian model is not the consequence of mere empirical developments, but results from a fundamental tension within the Kantian concept itself.

The core of the Kantian model is that statutes are viewed of as a means of expressing an authoritative meaning. It is presupposed that statutes have the same meaning for both the branches of government and the citizens. No modifications or alterations of that meaning should or must take place. If such modifications or alterations do occur this means that there is a problem which has to be solved in accordance with the idea of the primacy of the legislator.

Any challenge of this presupposition would destroy the Kantian concept. It is necessary, therefore, to reflect on the possibilities and impossibilities of a fixation of the meaning of law. In order to be able to do so, we shall now turn to the semiotics of Charles Sanders Peirce.

2.1 SEMIOTICS

One of the questions dealt with in the work of Peirce is how we constitute the meaning of the world we live in. He argues that we can only know the external world through (a system of) signs, defined as:

"something which stands to somebody for something in some respect or capacity. It creates another sign, the interpretant. The sign stands for something, its object in reference to some idea, the ground."15

A sign has three functions: representation, relation and quality. It is a sign to some thought which interprets it, a sign for some object to which in that thought it is equivalent and it is a sign in some respect or quality.16 The three functions (correlates) of a sign match with the three general mo-

des of being that Peirce distinguishes: law (thirdness), actual fact (secondness) and possibility (firstness).

This means that an object is represented by a sign with regard to a so called ground or quality. A sign is not an objective mental representation for this would imply that the object has a definite meaning. Peirce rejects the idea that the external world manifests itself as a meaningful structure to a passive observer. Meaning is created in the process of semiosis: the constitution of meaning by way of interplay between object, sign and interpretant. Whereas the object is represented by the sign (in some respect and for somebody), the meaning of the sign itself is expressed by another sign, its interpretant. As little as the sign is a neutral representation of the object, the interpretant is a sign that simply copies the former sign. The interpretant will in some way or other interpret and develop the sign it is connected to. Object, sign and interpretant interrelate in a dynamic way. Objects can only be known through signs, signs will always be developed by interpretants, the latter being signs in their turn. As the interpretant is itself a sign, it can be explicated by yet another sign developing the interpretant etcetera. This process of semiosis goes on until we reach the so called ultimate or final interpretant. The ultimate interpretant Peirce calls a habit or a habit-change17:

"It can be proved that the only mental effect that can be so produced and that is not a sign but is of general application is a habit-change; meaning by a habit change a modification of a person's tendency towards action [...]."18

The quote shows that Peirce's semiotics are essentially a philosophy of action. The interrelationship between (conceivable) action and meaning marks the difference between Peirce's philosophy and other philosophies of knowledge. Being closely related to action, the meaning of a sign (like the words of the legislator) is ambiguous and capable of change. It would nevertheless be a mistake to conclude from this ambiguous and changeable character of signs (words) that the constitution of meaning is arbitrary.19 Although signs lack an unchangeable basis, they can not be changed at ones own discretion (see also section 2.4). To the very concept of a sign belongs the idea of consistency. Peirce again:

"Consistency belongs to every sign, so far as it is a sign; and therefore every sign, since it signifies primarily that it is a sign, signifies its own consistency."20
Let us try to understand this phrase by looking at legal reasoning. An example is the meaning of the word "King" in Dutch constitutional history, e.g. in the provision "Executionary power is vested in the King" (art. 46 Constitution 1972). In the successive constitutions since 1813 the word referred to the man who was asked to be the sovereign leader of Dutch political society: William the first, or descendants of this person. A King or sovereign possessed all legal powers that were not explicitly endowed to other agents. Owing to an increase in the political power of parliament the word "King" was reinterpreted: it no longer referred to the King as a person, but to this agent and the ministers in the cabinet (government).

The meaning of the word "King" and the sentence in which it was used changed, but it changed in a consistent way. This consistency is of little surprise when the behavioral background of semiosis is kept in mind. The final interpretant of the sign is a habit-change, a change in the way of dealing with the world. These habits are relatively stable and therefore cannot be changed at random, but only by turning back to the sign system and the other habits that exist at a certain point of time.

The example of the meaning of the word "King" in Dutch constitutional history does not only provide us with an idea of coherence. It also teaches us that the concept of a habit as an interpretant has a specific meaning in constitutional law. In a legal state, habits are formed within a specific context, prestructured by legal or constitutive rules (see par. 1). The classical form of a constitutive rule is: "X counts as Y in context C". A violation of a constitutive rule results in a failure of the intended action (e.g. an invalid enactment of rules). Constitutive rules do not just regulate existing forms of behaviour; they create a context in which certain acts have institutional meaning (like marriage, purchase, enactment).

The importance of constitutive rules for the creation of meaning can hardly be overestimated. Agents will interpret each others actions and gestures according to existing constitutive rules (and by doing so also develop these rules themselves). The constitutive rules serve as a conceptual scheme relating the subsequent phases of the social act.

This way of expressing the importance of constitutive rules is related to the work of George Herbert Mead, one of Peirce's successors, on institutions. Mead writes:

"The institution represents a common response on the part of all members of the community to a particular situation. This common response is one which, of course, varies with the character of the individual."22

In this frame of reference meaning is related to three elements:

- gesture of organism A, directed at organism B (e.g. an enactment of a statute);
- adjusting gesture of organism B (e.g. rule following behaviour);
- social act in which both gestures are embedded (e.g. valid law).

In semiotic terms we can say that the gesture of A becomes an actual sign for B against the background of the institution 'law', having as its interpretant the conception of the possible adjusting responses of B. For the social act to succeed, A and B must reciprocally conceive of each other's gesture as having the same meaning (within the same social act).

The foregoing provides a better insight into the meaning of the remarks made before, concerning the consistency of the sign. On the basis of Peirce's semiotics we are able to understand both the stability and the changeability of the meaning of signs. It shows the impossibility of fixing the meaning of signs (see par. 2.3) for signs are always interpreted further by other signs. On the other hand it shows that signs are not fully arbitrary but rest on ways of dealing with the world, on habits (institutions). Change always takes place against a background of stability.

2.3 FIXATION OF BELIEF

We noted that semiosis is ultimately founded on a habit. Closely related to the idea of a habit is Peirce's notion of (individual or collective) "belief": the ideas upon which man is prepared to act.23 Habits are not mere responses to stimuli, but founded on (common) ideas, beliefs. The process of semiosis is directed towards establishing these beliefs in order to reduce uncertainty and doubt. According to Peirce, belief and doubt are the fundamental existential states under which man has to
live. Belief is the positive pole; it is the "calm and satisfactory state which we do not wish to avoid". It guides our desires and shapes our actions. Belief is the kind of - often implicit - background-knowledge that enables us to develop patterned modes of reactions in certain circumstances. In this indirect way it is linked to action (habits). Doubt, on the contrary, is the "uneasy and dissatisfied state from which we struggle to free ourselves and pass into a state of belief". Doubt motivates action in a direct manner: an actor in a state of doubt will start an inquiry in order to free himself from the confusing situation of doubt.

Peirce distinguishes four methods for arriving at and fixing the satisfactory state of belief: the method of tenancy, the method of authority, the method of a priori knowledge, and scientific method. The aim of our inquiry does not make it necessary to elaborate on all methods. We will therefore concentrate on those which are directly relevant to our problem: the method of authority and scientific method.

The method of authority aims at the protection of the pure doctrine. Deviant behaviour and opposition should be driven out by special institutions (like the inquisition), which also instruct the people and keep the subjects ignorant of other opinions and doctrines. This method of authority gives rise to impressive results (as for example the Saint-Peter in Rome shows), but it only works within a relatively isolated group. As soon as belief is fixed by way of authority an unexpected experience becomes a threat.

The scientific method is also called the rational method or the method of self-control. Its essence is the notion of fallibility, the possibility of learning from our experiences. Its strength is the combination of experience and reasoning, that enables us to deal with frustrated expectations and beliefs. Whereas in the method of authority disappointments are dangerous and can only be dealt with by neglecting the facts, the method of self-control makes it possible to move rationally from one belief to another. The scientific method combines three forms of reasoning: abduction (firstness), deduction (secondness) and induction (thirdness). The inquiry in which these three forms of reasoning are involved starts with an unexpected experience C, that violates the beliefs of the agents. This surprising event is mysterious and brings forth a state of doubt. In order to escape from this doubt, we try to make the event a matter of course by introducing an explaining rule A. Introduction of the rule is the first step in the process of reasoning and is called abduction. Peirce:

- The surprising fact C is observed;
- But if A were true, C would be a matter of course;
- Hence, there is reason to suspect that A is true.

It should be kept in mind that the outcome of abduction is a hypothesis that might be true. Abduction can only give plausible outcomes but can never secure their truth.

The next step in reasoning consists of inferring all conceivable practical consequences of the explaining rule. On the basis of this deduction we formulate our expectations concerning the world. The explaining rule functions as a belief that gives rise to several expectations regarding the conceivable practical consequences of it.

The final step of the inquiry is the verification of the real existence of the conceivable consequences of A. If unexpected events keep happening, our belief is frustrated again. In that case we are back at the first stage of inquiry: the effort to formulate an explaining rule that makes the surprising event a matter of course. It is this circularity that ensures the rationality of the scientific method for it enables us to correct ourselves on the basis of experience and reasoning.

2.5 CONCLUSIONS

In this section we have tried to explain the change in the Dutch constitution, using the concepts of semiotics. We have elaborated upon the tension within the Kantian model resulting from the emphasis on the supremacy of meaning imputed to statutes by the legislator on the one hand and separation of powers on the other hand. This tension can only be solved if the legislator fixes the meaning of statutory provisions.

The Kantian idea of fixation of meaning is closely related to one of Peirce's methods of fixation of belief, the method of authority. Both aim at preventing individuals so that they behave as rational, self-controlling agents. This resemblance implies that the Kantian model suffers from the same inadequacies as the method of authority. In an open and fast changing society it is impossible for a legislator to control the relevant beliefs and the meaning that is given to statutory
provisions. The Kantian presupposition is untenable and the tension in the Kantian concept is unsolvable within the context of Dutch political society. The change in the Dutch constitution can be made intelligible by means of semiotics.

3. SEMIOTIC PROCESSES AND GOVERNANCE: THE MADISON CONCEPT

In this paper we specifically look for a way to make the change in the text and structure of the Dutch (written) constitution in 1983 intelligible, in that way demonstrating the usefulness of semiotics for the theory of (constitutional) law. Until 1983 the constitution was based on a Kantian interpretation of Montesquieu's principle of separation of powers. We have now concluded that the Kantian model is inadequate.

An alternative way of interpreting Montesquieu's principle is found in the work of Madison (par. 1.3). By turning from Kant to the Madisonian model we must answer the question of whether this model is an acceptable alternative from the perspective of the semiotics of Charles Sanders Peirce. Can the Madisonian concept overcome the problems attached to that of Kant?

Comparing the Kantian and the Madisonian framework one comes to realize that both have a lot in common. We are not talking about two different worlds. Both are of a liberal-democratic nature, i.e. manifestations of a normative theory on the requirements that the basic structure of a political society should meet if it aims at the realization of individual freedom. The main difference between the two frameworks is that Kant looks at governance as the activity of a superior agent in the state and designs a constitution that reflects this view, while Madison sees governance as the execution of public duties in the social realm by essentially equal agents and looks for constitutional measures reflecting this perspective. Madison rejects the idea of parliamentary sovereignty and suggests institutional measures which protect the system against despotism: a federal system of government, democratic legitimation for all branches of government, recruitment of representatives from the elite and statutory review by the judiciary. In its effect these measures result in a system of checks and balances. If we relate the central ideas behind this system to Peirce's two methods for arriving at and fixing the satisfactory state of belief - the method of authority and the scientific method - all signs refer to the scientific method as the one that grounds the theory of checks and balances.

In the Madisonian model the role of the judicial branch is essential. The judicial branch has the power to correct the legislative branch as far as it concerns the fundamental rights of the people. This does not mean that the judiciary is able to dictate what should be law. It just means that it has the power to say what is in accordance with fundamental law. The judiciary can neither act as a legislator nor ignore its constitutive role in the formulation of legal rules. One of the highlights of the legal and political debate in the United States at this moment concerns precisely this role of the judiciary. Owing to the fact that the Constitutional Court developed some guidelines for federal legislation on abortion (starting with Roe v. Wade, 410 US 113 (1973)), some groups defend their opposition to the decision with the argument that the Constitutional Court exceeded its powers.

The power of the judicial branch reflects explicitly the more or less equal positions of the branches in the Madisonian model. The executive and the legislative branch play their separate parts, each of them controlled by the judiciary. All positions on the constitutional field are strengthened by the fact that all branches have their own democratic legitimization. Not just the legislative branch. This conjures up the idea of a forum in which different agents should come to terms with one another in solving the problems of the public. None of the agents in the forum are able to control the actions of the others absolutely. This search for a mutually acceptable outcome of debates is typical for the system of checks and balances and is also the core of the scientific method of fixation of belief. This method implies a process of introduction of an explaining rule (abduction), inference and verification.

Given this characterization of the Madisonian model and the resulting constitutional system in the United States of America, those who are acquainted with the situation in the Netherlands will only partly accept the hypothesis that there is a parallel between the two. An important characteristic of the Dutch system is that the independent judge lacks the power to check parliamentary approved statutes against the constitution (art. 120). This is contrary to what we described as the most important characteristic of the Madisonian model. However, we think the hypothesis can be corroborated by looking at Dutch constitutional law.
First of all there is a development towards the articulation of general principles of legislation. As far as parliamentary statutes are concerned these principles cannot be upheld by the judge, but in the constitutional system several other agents have a special responsibility to that effect (e.g. the First Chamber of parliament and the main advisory body of the government, the "Raad van State").

Secondly the independent judge in the Netherlands has developed several lines of reasoning in order to get a greater hold on the discretionary decisions of the executive branch. One of them implies that the execution of discretionary powers is assumed to be based on general (policy) rules. These rules can be explicit, but when they are not, the judge makes them explicit by inferring them from the concrete norms set by the executive branch.

Another important development in the role of the judges is the use of general principles of governance. These unwritten standards are developed and applied by the judiciary branch in order to maintain a certain standard of propriety in the actions of the executive branch. However, not only the judicial branch is of importance here. Since 1982 an important role is also played by the Ombudsman.

One of the general principles that was developed and is applied is the principle of scrupulousness ("zorgvuldigheidsbeginsel"). This principle is used to express several other, more specific standards or requirements for governance. For us the most important one is the standard that all who have a reasonable interest in a decision should be able to express their opinion on it. In this way the lack of influence of the people that results from the absence of parliamentary provisions is compensated.

A final development we would like to mention is the internationalization of national constitutional systems. In Western-European countries the communal legal order is of special importance. Since the European Court of Justice has stated the precedence of European law over national law, the judiciary has the power to check national statutory provisions against European standards, at least as far as they fall within the sphere of the powers delegated to the agents of the European Community by individual countries (Francovich, Case C-6/90).

3.1 CONCLUSIONS

The problem we have discussed in this paragraph was whether the Madisonian model is an acceptable alternative from the perspective of the semiotics of Charles Sanders Peirce. Solving this problem was the last step towards making it acceptable that the change in the text and structure of the Dutch constitution in 1983 was a necessary one. It results from the impossibility to deal with the tensions in the Kantian model of interpretation. As we have shown by reference to three important constitutional developments the new constitutional foundation reflects the idea of a forum in which different agents should come to terms with one another in solving the problems of the public. The discussion on the effects of the Madisonian model on the constitution of the United States of America, made it clear that looking for a balanced outcome of debates is typical for a system of checks and balances and is the core of the scientific method of fixation of belief, which implies a process of introduction (abduction), inference and verification of an explaining rule.

The idea of a public forum and of checks and balances is of course only a necessary condition to secure a rational way of dealing with the problems of governance. However, it would outstretch the scope of this article to elaborate upon further conditions such as the political culture, the distribution of economic powers, racial equality, etcetera.

4. GENERAL CONCLUSIONS

In this paper we have discussed the relations between an essential part of liberal democratic theory, the doctrine of the separation of powers, and semiotic processes. As announced in our introduction it was not our intention to look at the problem as professional philosophers. Our interest in the field of semiotics is primarily based on the idea that semiotics provides tools for legal scientific research. We have tried to find support for the hypothesis that there is a relation between the theory of meaning and the way the separation of powers is structured in the legal system. A change in the system of separation of powers may be made intelligible by theories of meaning underlying the concept of the polity. This was demonstrated by the shift in the Dutch constitution in 1983. This shift from a Kantian conception of separation of powers to a system of checks and balances can be under-
stood by reflecting upon the theory of meaning underlying the Kantian concept. The Kantian idea of the absolute primacy of the legislator is only possible on the presupposition that the meaning of legal statutes can be fixed. However, as semiotics has taught us, signs (words) are always further interpreted by interpretants (ultimately through habits) and their character is principally changeable and ambiguous. These insights from semiotics help to explain why the strict separation of powers together with the primacy of the legislator must fail.

A more realistic view of the state is held by the American federalists, defending a system of checks and balances within the government. Although the federalist model is far from flawless the central idea it expresses remains fruitful for legal and political theory. In the Madisonian model, each branch of government has its own democratic legitimation however none of the branches of government have the power to determine the actions of the others completely. This idea of checks and balances makes rational changes in the meaning of statutes more likely than the strict separation of powers.

NOTES


15. *Collected Papers (CP)*, II.228

16. Morris used these three aspects of a sign to develop what he mentioned the three "dimensions" or three "levels" of semiosis: grammatology, semantics and pragmatics. See C.W. Morris, *Foundations of a theory of signs*, Chicago 1966, pp. 6-7.

17. *CP*, V.476

18. *CP*, V.476


23. *Selected Writings (SW)*, p. 91.

24. *SW*, p. 99

25. *SW*, p. 99

26. *CP* V.189

27. This does not mean that the method of return at another level in perhaps a more
dangerous form. In modern government, some specific fields are regulated by small groups of bureaucratic experts. As the literature on social psychology and public administration shows, these groups tend to develop their own beliefs and with this the ways to prevent deviant behaviour. In extreme cases this can result in what Janis, echoing Orwell's famous double-think, called 'group-think'. (Janis 1972 p. 9).

This idea of a public forum is also put forward by Jürgen Habermas in both his political writing (Strukturwandel der Öffentlichkeit, Neuwied 1968) and in his writing concerning the legal discourse (Recht en Moraal, Kampen 1988). See for the latter also R. Alexy, Theorie der juristischen Argumentation, Frankfurt am Main 1978.

The High Court of the Netherlands (HR) confirmed the meaning of this article in a recent decision. See HR April 14th 1989, AA 1989/6, pp. 578-593.

In this paper we can not deal with other important influences like international treaties on human rights and the control systems that were brought into being with them.

Van Gend en Loos, Case 26/62, Jur 1963 (5); Costa-Enel Case 6/64 Jur 1964 (1199).
PRAGMATICS IN FUNCTIONAL GRAMMAR

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ABSTRACT

This paper is concerned with the pragmatic component within the theory of Functional Grammar as developed by Simon Dik and others. It reviews the model, the location of pragmatics in the model together with the pragmatic distinctions made.

1. INTRODUCTION


1.1. The notion ‘functional’
FG wishes to be a theory of the organization of natural languages which is ‘functional’ in at least three different, though interrelated senses: (i) it takes a functional view on the nature of language; (ii) it attaches primary importance to functional relations at different levels in the organization of grammar; (iii) it wishes to be practically applicable to the analysis of different aspects of language and language use.

1.2. The functional view of natural languages
In the functional view a language is regarded as an instrument which human beings use to achieve certain goals and purposes. These goals and purposes are taken to lie primarily in the establishment of complex patterns of social interaction. A Speaker uses linguistic expressions to communicate messages to an Addressee so as to change this Addressee in a certain way.

From the functional point of view one wishes, whenever this is possible, to understand why languages are organized as they are, in the light of the way they are used. FG therefore seeks for functional explanations to account for structural properties of languages. A functional explanation of a linguistic phenomenon is a statement in which that phenomenon is shown to follow from one or more principles which crucially refer to any of the functional prerequisites imposed on natural languages. It seems that functional explanations are complex and never simple in the sense of directly accounting for a linguistic phenomenon X in term of ‘the’ function of X (cf. Dik 1986).

In this light, the following standards of adequacy are of particular importance for the theory of FG:
(i) TYPOLOGICAL ADEQUACY: the theory should be formulated in terms of rules and principles which can be applied to any type of natural language.
(ii) PRAGMATIC ADEQUACY: what the theory says about a language should be such as to help us understand how linguistic expressions can be effectively used in communicative interaction.
(iii) PSYCHOLOGICAL ADEQUACY: what the theory says about a language should be compatible with (what is known about) the psychological mechanisms involved in natural language processing.

1.3. The status of functional relations
In FG, functional notions play essential and fundamental roles at different levels of grammatical organization. Many of the rules and principles of FG are formulated in terms of functional notions. Three types or levels of functions are distinguished:
(i) SEMANTIC FUNCTIONS (Agent, Patient, Recipient, etc.) which define the roles that participants play in states of affairs, as designated by predications.
(ii) SYNTACTIC FUNCTIONS (Subject and Object) which define different perspectives through which states of affairs are presented in linguistic expressions.
(iii) PRAGMATIC FUNCTIONS (Theme and Tail, Topic and Focus) which define the informational status of constituents of linguistic expressions. They relate to the embedding of the expression in the ongoing
discourse, that is, are determined by the status of the pragmatic information of Speaker and Addressee as it develops in verbal interaction.

The semantic functions are coded in the predicate-frames which underlie the construction of predications; syntactic and pragmatic functions are added to constituents of a predication by later assignments.

1.4. Practical applicability
FG aims at a maximum of practical applicability in the analysis of diverse aspects of language and language use. An attempt is made to reach this goal by (i) maximizing the degree of typological adequacy, while (ii) minimizing the degree of abstractness of linguistic analysis. By degree of abstractness is meant the distance (as measured in terms of rules, operations, or procedures) between the structures postulated for a given language on the basis of the theory, and the actual linguistic expressions of that language which are constructed in terms of these structures. Constraints on the degree of abstractness are:

(i) transformations in the sense of structure-changing operations are avoided;
(ii) empty elements in underlying structure which do not receive expression are avoided;
(iii) filter devices are disallowed;
(iv) abstract lexical decomposition is not applied (instead the semantic relations between words are accounted for through meaning definitions).

2. OUTLINE OF THE MODEL

2.1. The structure of the clause
Clauses are described in terms of abstract underlying clause structures, which are mapped onto the actual form of the corresponding linguistic expression by a system of expression rules. Schematically:

(1) UNDERLYING CLAUSE STRUCTURE
    ↓
    EXPRESSION RULES
    ↓
    LINGUISTIC EXPRESSION

The underlying clause structure is a complex abstract structure in which several levels or 'layers' of formal and semantic organization are distinguished:

(2) CLAUSE → speech act
    PROPOSITION → possible fact
    PREDICATION → state of affairs
    PREDICATE → property/relation
    TERM → entity

Clause and Proposition form the interpersonal level; the other three form the representational level (cf. Hengeveld 1990).

2.2. Predicates and predicate-frames
All predicates, or contentives, of a language are stored in a Lexicon. Predicates are contained in predicate-frames, structures which specify their fundamental semantic and syntactic properties, such as (i) the syntactic category of the predicate (Verbal, Nominal, Adjectival), (ii) the number of arguments, (iii) the semantic functions of the arguments (Agent, Patient, Recipient, etc.).

(3) give \((x_1)_{Ag} (x_2)_{Pat} (x_3)_{Rec}\)

The order in which the predicate and the arguments are given has no direct or necessary relation to the linear order in which these constituents will finally be realised. Predicate-frame (3) could just as well be given in another linear form or in a two or three dimensional form. The representation of predicate-frame (3) is purely a matter of convention.

Predicate-frames can be extended by satellites (non-arguments). The semantic functions of the satellites express the relation between the state of affairs and the satellites, whereas the semantic functions of the arguments express the relations between the predicates and the arguments. Consider:

(4) buy \((x_1)_{Ag} (x_2)_{Pat}\) ACTION \((y_1)_{Act}\)

2.3. Terms and term formation
The variables indicating the arguments in predicate-frames and satellites can be replaced by termis, i.e. the forms underlying NPs. Two types of terms are distinguished: (i) basic terms, expressions which can only function as terms and are given as such in the lexicon (e.g. personal pronouns, proper nouns, question words) and (ii) derived terms, which can be formed by the following general schema:
(5) \( \Omega X; \Phi_1(X); \Phi_2(X); \ldots; \Phi_n(X) \)

Here \( x_i \) is the term variable symbolizing the intended referent of the term; the symbol \( \Omega \) indicates one or more term operators (operators for definiteness, number etc.); each \( \Phi_i(X) \) indicates some 'open predication in \( x_i \)', that is, a predicate-frame all of whose argument positions have been bound except for \( x_i \). Each open predication in \( x_i \) can be regarded as a restrictor specifying some property which \( x_i \) must have in order to qualify as a potential referent of the term. Restrictors are stacked onto each other through the relation indicated by '·' ('such that'). Usually the first restrictor of a term will contain a nominal predicate, and be realized as the head of the noun phrase. Later restrictors will be realized as attributional modifiers or relative clauses. For instance:

(6) \( \begin{align*}
\text{dlx; buyy (xy) buyy (Rx) } & \\
\text{(lx; coaty (xy) newy (xy))} & \\
\end{align*} \)

(6) to be read as: 'the definite single entity \( x_i \) such that \( \text{boy of } x_i \) such that \( \text{buy of } x_i \) and an indefinite single entity \( x_i \) such that \( \text{coat of } x_i \) such that new of \( x_i \) ' (the boy who bought a new coat).

2.4. Predication

Nuclear predications consist of predicats and terms. Terms refer to entities in some world, and predicates designate properties of, or relations between such entities. A nuclear predication as a whole designates a set of States of Affairs (SoAs). The term State of Affairs (SoA) is used in the broad sense of 'concept of something which can be the case in some world'.

SoAs can be divided into different types, according to the values which they can have for a number of distinguishing parameters. These parameters and their different values together define a semantic cross-classification of SoAs. The most important semantic parameters defining the typology of SoAs are Control, Dynamism, Telicity, and Momentaneity. Nuclear predications can be further specified by predication operators and satellites, both operating at Level 1. Operators: e.g. aspectual distinctions; satellites: e.g. terms with the function of Manner, Speed, and Instrument. The result of these extensions is called core predication. For instance (7) in which the Perfective operator applies. Also note the satellite with the function of Manner:

(7) \( \text{Perf read}_v \ (\text{John})_{\text{Ag}} \ (\text{the book})_{\text{Pt}} \)

\( \text{(quickly)}_{\text{Manner}} \)

[John read the book quickly.]

Core predications can be further specified by predication operators and satellites, both operating at Level 2. Operators: e.g. temporal and some modal distinctions; satellites: e.g. terms with the function of Time and Place. The result of these extensions is called extended predication. For instance (8) in which the Tense operator with the value of Past applies. Note the satellite with the function of Time:

(8) \( \text{Past Perf read}_v \ (\text{John})_{\text{Ag}} \ (\text{the book})_{\text{Pt}} \)

\( \text{(quickly)}_{\text{Manner}} \ (\text{yesterday})_{\text{Time}} \)

[John has read the book quickly yesterday.]

2.5. Proposition

Extended predications can be built into a propositional structure, in which the extended predication is used to specify a possible fact. Extended predications can be further specified by predication operators and satellites, both operating at Level 3. Operators: e.g. some modal distinctions; satellites: e.g. terms which specify the attitude of the Speaker. The result of these extensions is called extended proposition. For instance:

(9) \( \text{Subjective Mood [John read the book] \)}

\( \text{(in my opinion) }_{\text{Attitude}} \)

[In my opinion, he should read the book.]
(11) a. The man ordered a car.
b. The car was ordered by the man.

Such differences are accounted for by assigning the Syntactic functions Subject (primary vantage point) and Object (secondary vantage point) to certain terms in an underlying predication. Compare:

(12) a. Past order_v (d1x; man_{A} (x_{1}))_{A}^{}_{S}^{Adj} (d1x; car_{N} (x_{2}))_{F}^{Adj}^{Obj}

b. Past order_{V} (d1x; man_{A} (x_{1}))_{A}^{Adj} (d1x; car_{N} (x_{2}))_{F}^{Adj}^{Obj}

In a similar way, Object assignment is used to differentiate between constructions such as:

(13) a. Peter_{A}^{Adj} gave the flowers_{F}^{Adj}^{Obj} to his mother_{F}^{Adj}

b. Peter_{A}^{Adj} gave his mother_{F}^{Adj}^{Obj} the flowers_{F}^{Adj}

2.8. Pragmatic function assignment

Pragmatic functions are functions which specify the informational status of the constituents involved in the wider communicative setting in which they occur. Alternative assignments of pragmatic functions are sensitive to the Speaker’s estimate of the pragmatic information of the Addressee at the moment of speaking. Consider the following two alternative expressions of one and the same underlying predication:

(14) a. Peter gave the flowers to his MOTHER.
b. Peter gave the FLOWERS to his mother

The different intonational contour must be due to a different assignment of pragmatic functions. Consider:

(15) a. Past give_{V} (Peter_{A}^{Adj}^{Top} (the flowers_{F}^{Adj}^{Top} (his mother_{F}^{Adj})))_{R}^{Adj}^{Foo}

b. Past give_v (Peter_{A}^{Adj}^{Top} (the flowers_{F}^{Adj}^{Top} (his mother_{F}^{Adj})))_{R}^{Adj}^{Top}

2.9. Fully specified predications

After the assignment of syntactic and pragmatic functions we have reached the level of fully specified clause structures. On the one hand the structure contains all the information required to determine the semantic content of the expression concerned, and, on the other, it has everything that is needed to trigger the expression rules, which will map the underlying clause structure onto the appropriate form.

2.10. Expression rules

The expression rules form the last component in the model. The Expression rules determine the way in which functional structures are mapped onto morpho-syntactic structures of linguistic expressions. The following sorts of expression devices can be distinguished:

(16) (i) the form in which terms are realized, in particular by: (a) case marking, (b) adpositions, (c) determiners;

(ii) the form in which the predicate is realized, in particular with respect to: (a) voice differences, (b) tense, mood, aspect, (c) illocution, (d) auxiliary elements, (e) agreement and cross-reference;

(iii) the order of constituents

(iv) stress and intonation

Expression rules may be sensitive to operators and also to syntactic, semantic, and pragmatic functions. Semantic and syntactic functions, but especially pragmatic functions are relevant for expression rules concerning intonation and the order of constituents.

The actual ordering patterns found in a language are taken to be the result of a number of principles, some of which I will mention here.

(i) A language makes a basic choice between Prefield and Postfield ordering of the dependents with respect to their Center (= Predicate, Head Noun, or Adjective).

If this principle were the only principle determining constituent ordering, there would be only two language types, with the following ordering patterns:

(17) PREFIELD-type | POSTFIELD-type
NP NP NP V | V NP NP NP
Adj Noun | Noun Adj
Rel Noun | Noun Rel
Adv Adj | Adv Adv

A second principle is:

(ii) The Subject position precedes the Object position

This principle defines the following basic orders for Prefield and Postfield languages:

(18) a. Prefield: S O V

b. Postfield: V S O
Two other principles are:

(iii) There is a universally relevant clause-initial special position P1, which is used for special purposes, including the placement of constituents with Topic or Focus function.

(iv) Other things being equal, constituents prefer to be placed in order of increasing complexity, where complexity of constituents is defined as follows:

\[
\text{Clitic} < \text{Pronoun} < \text{Noun Phrase} < \text{Adpositional Phrase} < \text{Subordinate clause}
\]

The hierarchy given in principle (v) is usually referred to as LIPOC (Language Independent Preferred Order of Constituents).

Given these principles, it is possible to formulate a basic functional pattern underlying clauses. Consider (19) where P2 and P3 indicate the positions for extra-clausal constituents.

(19) P2, P1 (V) S O (V), P3

2.11. Computer implementation

The presentation of the global structure of the FG-model has been given in the form of a language production model. Production is: creating predications by combining predicates and terms, which can be mapped onto linguistic expressions by means of expression rules. A reverse approach would present the model as a language interpretation model. Interpretation is: analysis of linguistic expressions in terms of underlying predications, which can be further analysed as combinations of predicate-frames and term structures.

These two approaches may be representations of (parts of) the mental processes of language production and language interpretation. They may also serve as guiding principles in constructing computer controlled sentence parsers and generators.

One of their aims is to use the computational model as an instrument to check and create formalizations within the FG-model. The translation module is based on the consideration that the structures of predications are largely identical across languages. The level of predication therefore is the best level to carry out the translation from language L1 into language L2.

In order to be able to process natural language data in a communicatively adequate way the computational model has been connected with a knowledge base and a logical component (cf. Dik 1992).

3. The Location of Pragmatics in FG

FG is a theory of the organization of natural language and not of a pragmatic theory of verbal interaction. FG, however, wishes to be a theory which is compatible with, i.e. wishes to fit in, a wider pragmatic theory of verbal interaction. Therefore many explanations for an account of structural properties of clauses are based on notions from such wider theory. This is not done to merely indicate a relation between the model and a pragmatic theory. Many properties of clauses can only be understood and explained as effects of language being an instrument of social interaction. There are two ways in which the instrumental use manifests itself in language. Firstly, a Speaker uses language to instruct an Addressee in a certain way. Secondly, a Speaker uses language to transmit information to an Addressee. The former use is reflected in the illocutional component, and the latter in the pragmatic component of FG.

3.1. Illocution

Speakers may verbally instruct an Addressee in many different ways. A Speaker may want to add information to the pragmatic knowledge of the Addressee, or inquire after some information he thinks that the Addressee has. The following four types of illocution seem to be the basic types of illocution relevant to the languages of the word, i.e. these types of illocution correspond to special sentence types in languages. They are often grammatically marked, e.g. by means of clitics, particles, intonation, and extra clausal constituents.

(20) (i) DECLARATIVE: S instructs A to add the propositional content to his pragmatic information;

(ii) INTERROGATIVE: S instructs A to provide him with the verbal information as specified in the proposition;

(iii) IMPERATIVE: S instructs A to perform the State of Affairs as specified in the proposition;

(iv) EXCLAMATIVE: S instructs A to add to his pragmatic information that S finds the propositional content surprising, unexpected, or otherwise worthy of notice.
Most languages seem to have means by which basic illocutions can be converted into other illocutions. For example:

(21) a. It is a good book (DECL)
b. It is a good book, isn’t it (DECL > INT)

The basic illocution - DECLARATIVE - can be converted into an INTERROGATIVE by means of a (extra clausal) tag. This type of conversion is called ‘grammatical conversion’. Other types of conversion are semantically based (lexical conversion), or pragmatically (pragmatic conversion). An example of lexical conversion is:

(22) a. Will you borrow me that book?
b. I ask you to borrow me that book.

Pragmatic conversion is effected at the level of intention and interpretation, and has no reflection on the linguistic properties of the expression. This type of conversion should be dealt with in a wider pragmatic theory.

3.2. Pragmatic functions

FG distinguishes between pragmatic functions external to the predication proper and pragmatic functions internal to it. Consider:

(23) That new coat, he bought it on the market, Peter.

The constituent That new coat in (23) specifies the universe of discourse with respect to which the subsequent predication is presented as relevant. Peter in the same example presents, as an ‘afterthought’ to the predication, information meant to clarify or modify it. The pragmatic functions of these constituents may be called Theme and Tail respectively. The two constituents are not part of the clause proper, but more loosely associated with it. The relation between the extra clausal constituents and the predication can be best described in terms of pragmatic functionality. Extra clausal constituents may serve a variety of pragmatic functions. These functions seem to concern (i) the management of the interaction, (ii) comments on the content of the clause proper, and (iii) the organization of the content of the expression in relation to the context in which it occurs.

Clause internal pragmatic functions concern the informational status of constituents in the clause in relation to the wider communicative setting in which they are used. Communicative setting is understood in terms of the Speaker’s estimate of the Addressee’s pragmatic information at the moment of speaking.

Linguistic expressions usually contain some given information and some new information. Both ‘given’ and ‘new’ should be interpreted as being mediated through the Speaker’s estimate of the Addressee’s pragmatic knowledge. Partially corresponding to the given/new distinction the dimensions of topicality and focality can be distinguished. Topicality characterizes those entities ‘about’ which information is provided or requested in the discourse. Focality presents those pieces of information which are relatively the most important or salient in a given setting. Topicality and focality have a certain area of overlap, in that certain topical elements may at the same time be focal to the communication. FG claims that the dimensions of topicality and focality are relevant to the organization of linguistic expressions in all languages. But not all languages have the same set of distinctive Topic and Focus functions.

3.2.1. Topicality

A distinction is made between several sub-types of Topic. Relevant sub-types of Topic seem to be (i) Discourse Topic, (ii) New Topic, (iii) Given Topic, (iv) Resumed Topic, and (v) Sub-Topic.

Discourse Topic is assigned to those entities about which a certain discourse imparts information. For instance "the girl Jane" in the following story:

(24) This story is about Jane. One day the girl went to school. She was just about to enter the school when she saw a friend of hers. etc.

The first presentation of a discourse topic is called New Topic. In example (24) the term ‘Jane’ is assigned this function. The terms ‘the girl’, ‘she’, and ‘she’ are considered Given Topic. If the story continues telling something about her friend, and then returns to the girl again, the reintroduction of the girl as topic is referred to as Resumed Topic.

Once a certain entity has been introduced into a discourse as a New Topic, this entity may be a Given Topic, but also a Sub-Topic in the case that it concerns entities which may be inferred from it on the basis of our knowledge of what is normally the case in the world. For instance:

(25) John gave a party last week, but the music was awful.

Expression devices of these functions are for instance the following. For maintaining a Discourse
Topic: (i) anaphoric reference, (ii) syntactic parallelism (see (37) below), (iii) switch reference, and (iv) obviation. New Topic: (i) explicit metalinguistic statement (cf. (24)), (ii) second arguments of predicates, (iii) existential and locative-existential constructions, and (iv) a New Topic prefers a relatively late position in the clause. Resumed Topic: (i) some indication that a shift is made from one Given Topic to another and (ii) strong anaphoric reference.

3.2.2. Focality
A distinction is also made between several sub-types of Focus. Relevant sub-types of Focus are (i) Complete Focus, i.e. the answer to a question:

(26) A. What did you give her?
B. I gave her a red box.

(ii) Expansive Focus, i.e. some addition to the pragmatic knowledge of the Addressee. For instance:

(27) A. Did you give her a red box?
B. I gave her a red box and a blue ribbon.

(iii) Selective Focus assigns in the following context:

(28) A. Do you want a red box or a blue ribbon?
B. I would like to have a blue ribbon.

(iv) Restrictive Focus applies in the following situation:

(29) A. Did you give her a red box and a blue ribbon?
B. No I only gave her a blue ribbon.

(v) Replactivx Focus, finally, is the pragmatic function used in situations like the following:

(30) A. Did you give her a red box?
B. No I gave her a blue ribbon.

On the basis of the examples from English it does not seem necessary to make a linguistic distinction between these types of Focus. In a wider pragmatic theory it does. There are, however, languages for which these types are relevant in the sense that they are grammatically marked in linguistic expressions. I refer to Aghem (Watters 1979) and Wambon (De Vries 1985) for examples.

4. PRAGMATICS VERSUS SYNTAX

4.1. Word order
What we find in many languages is that entities with the function of Topic are in initial position of the clause. This is, however, by no means an absolute language universal. There are languages in which topical elements are always at the beginning of a clause. This is for instance the case in Hungarian. Other languages do not have this property, as for instance English, in which both Topic and Focus constituents are candidates for the clause initial position (see also section 6.2. below). The answer to the question What do you think that John bought? may be (31a) or (31b):

(31) a. \[I_{top}\text{ think a book}_{foc}\]
   b. A book_{foc} \[I_{top}\text{ think}.\]

There are languages which have fixed positions to accommodate terms with particular pragmatic functions. This is for instance the case in Hungarian. Topical elements are in sentence initial position, then follows the position for one Focus term, and then the finite verb. Example (32) - which is a possible answer to the question What did John give to Mary? - shows this structure:

(32) Topic Focus Verb
    Marl-nak könyv-et ad-ott János
    Mary-DAT book-ACC give-PRET,3S John
    'John gave Mary a book.'

4.2. Active/passive
Subject and Topic are not two words for the same thing. The same holds for the notions Object and Focus. The following examples illustrate that Subjects can have Topic but also Focus function. Objects can also have the function of Topic or Focus:

(33) a. A. What is John reading?
    B. John_{subj,top} is reading a book_{obj, foc}
    b. A. Who is reading the book?
    B. John_{subj, loc} is reading \[i_{obj,top}\]

(34) a. A. Who has stolen the book?
    B. The book_{subj,top} has been stolen by Mary_{top}
    b. A. What has been stolen by Mary?
    B. The book_{subj, loc} has been stolen by Mary_{top}

It often occurs that Subject terms have the function of Topic. The examples (33) and (34), however, show that these two functions do not necessarily go together. Therefore, it cannot be argued that in
5. PRAGMATICS VERSUS SEMANTICS

5.1. Pragmatic versus semantic functions
In section 4 it was shown that there is no merge between Subject and Topic function on the one hand and between Object and Focus on the other. This section illustrates that there is neither a merge between Agent and Topic and Patient and Focus. The following examples show that semantic and pragmatic functions are distinctive notions:

(35) A. What did John buy?
   B. John_AgTop bought flowers_ParFoc
(36) A. Who bought flowers?
   B. John_AgFoc bought flowers_ParTop

5.2. Pragmatic versus semantic perspective
In situations in which three participants are involved, i.e. in cases with three-place predicates, languages may have different predicate-frames which each presents the situation (State of Affairs) in a particular semantic perspective. Compare the following examples of Latin and also of English in the translation. Note the different semantic functions. Also note the different expressions:

(37) a. Mensam aqua aspergit
    table_ACC water_ABL sprinkle_PRES.3S
    'He sprinkles the table with water.'
   b. Aquam mensae aspergit
    water_ACC table_DAT sprinkle_PRES.3S
    'He sprinkles water on the table.'

The term 'the table' functions as Patient in (37a) and as Direction in (37b). The term "water" has the function of Patient in (37b) and is more central to the predicate than the corresponding term in (37a) which functions as an Instrument. Bolkestein (1985) demonstrates that in Latin construction (37a) is used in the context in which 'the table' is Given Topic of the preceding discourse. If 'water' functions as Given Topic, there is preference to use construction (37b). Note that the distribution of the two constructions is not conditioned by pragmatic factors. We can say that there is a tendency to use these constructions according to the pragmatic structure. Also note that the Patient/Object in these examples have the function of Topic and not Focus.

6. MODEL OF LANGUAGE OR MODEL OF LANGUAGE USE?

6.1. Word order in Hungarian
In the former sections we have seen that distinctions such as illocutional operators and pragmatic functions are relevant to an account of morpho-syntactic properties of clauses in natural languages. One may, if one wishes, incorporate these distinctions in a syntactic model of a sentence grammar. Such model of language will, for instance, stipulate that the NP preceding the Verb in Hungarian is the Focus of the clause, FG does not support this view. On the contrary. The choice which element is the Focus of a clause is determined by the context. Consider the following three expressions in Hungarian, which are all possible sentences in that language:

(38) a. János könyvet adott Marinak.
    John book_Give gave Mary_rec
    'John gave a book to Mary.'
   b. Könyvet János adott Marinak.
   c. Könyvet Marinak adott János.

Within the context in which A asks B: "Whom did you give a book?" sentence (38c) is appropriate and not (38a) or (38b). Speakers of Hungarian judge (38a) and (38b) inappropriate, i.e. ungrammatical, in this context.

These observations lead to the conclusion that a model of language is not sufficient to account for all pragmatic aspects morpho-syntactically encoded in language. A model of language use, which also takes contexts, the roles of Speaker and Addressee, and pragmatic information into consideration, offers a framework in which the relevant pragmatic aspects can be accounted for.

6.2. Placement rules for P1 in English
Finally, on the basis of placement rules for P1 in English it can also be illustrated that a model of language is incapable to account for word order phenomena in English.

Hannay (1991) demonstrates that the pragmatic functions distinguished in FG are not sufficient for treating English word order. He proposes to expand the framework of FG with a series of mechanisms pertaining to the selection of one of several possible 'modes of message management'. Ultimately this expansion is intended to constitute a step forward providing an interface between the static product-oriented theory of grammar and the dynamic process-oriented theory of verbal interaction with which a functionally oriented framework should be
linked. Hannay distinguishes the following modes of management: (i) All new mode, (ii) Topic mode, (iii) Reaction mode, (iv) Neutral mode, and (v) Presentative mode. I refer to Hannay (1991) for discussion and data. By way of illustration I give Hannay’s overview of arrays of pragmatic function assignment associated with the different modes of message management within the declarative illocution.

<table>
<thead>
<tr>
<th>Mode</th>
<th>PI</th>
<th>Other Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL NEW</td>
<td>-</td>
<td>Foc</td>
</tr>
<tr>
<td>TOPIC</td>
<td>Top</td>
<td>Foc</td>
</tr>
<tr>
<td>REACTION</td>
<td>Foc</td>
<td>-</td>
</tr>
<tr>
<td>NEUTRAL</td>
<td>-</td>
<td>Foc (NewTop)</td>
</tr>
<tr>
<td>PRESENTATIVE</td>
<td>(SubTop)</td>
<td>Foc (NewTop)</td>
</tr>
</tbody>
</table>

7. CONCLUDING REMARKS

"Functional Grammarians" pay a lot of attention to pragmatics. The relevance of pragmatics in the model is undisputed. The power of pragmatics over the model, however, leads sometimes to controversial interpretations. The view that pragmatics is seen as the all-encompassing framework with which semantics must be studied, and that semantics is regarded as instrumental to with respect to pragmatics, and syntax as instrumental to semantics (Dik 1989:7), however, lead to different approaches. The degree of power assigned to pragmatics over semantic and syntax is a topic of discussion. This discussion relates to issues such as valency of predicates, and the distribution of finite and non-finite predications. Another topic relates to the dimensions of topicality and focality: strict dichotomy or overlap?

NOTES

1. FG may fit in a model of ‘the natural language user, to account for the linguistic capacity, opposed to the epistemic, logical, perceptual, and social capacities (cf. Dik 1989:1ff).

2. There is not always a clear distinction between clause external and clause internal pragmatic functions. De Groot (1981a) gave examples of ‘clause internal themes’ in Hungarian. The strong dichotomy of functions is also inadequate for an account of a number of grammatical aspects of many Papuan languages (cf. e.g. De Vries 1992).

3. Extra clausal constituents play also a role in the origine of cross-referential and agreement phenomena in languages (cf. De Groot & Limburg (1986)).


5. Pinkster (1985) claims that there is no significant correlation between Subjects and Topic in Latin.


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SYSTEMIC FUNCTIONAL GRAMMAR - SOME REMARKS ON STRENGTHS AND WEAKNESSES RELATIVE TO OTHER APPROACHES

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CONTENTS

1 Functional vs. Structural Linguistics in general

2 A short introduction to Systemic Functional Grammar

3 Functional vs. Structural Linguistics in natural language processing

4 A case study: an approach to the modelling of translation
  4.1 A grammatical generalization: unification of (clause rank) grammar fragments
  4.2 A semantic abstraction: a sketch of a fragment of an interaction semantics

5 Conclusion

1 FUNCTIONAL VS. STRUCTURAL LINGUISTICS IN GENERAL

The terms Functional Linguistics and Structural Linguistics are ambiguous and vague, and they are used by different schools of linguistics in sometimes not identical ways. While we have to be aware of the inherent difficulties of this situation, we would still like to sketch two different profiles that families of linguistic theories may be said to have if we attempt to group them under the labels just mentioned. Let me try and give such a brief sketch:

Structural theories of language, or rather structure oriented theories

- tend to concentrate on one or at least on a maximally small number of structural dimensions of language. The emphasis is usually on syntagmatic rather than paradigmatic relationships, representations stand for part-whole, i.e. constituency or for linear precedence relations between linguistic units;
- tend to give special prominence to syntax;
- have, as a matter of historic coincidence, often emphasized formal and representational issues over content issues and empirical issues;
- tend to either completely relegate pragmatic and functional issues from linguistics, and/or create special strictly separated neighbouring disciplines for such issues. Where and when pragmatics is allowed a place of interest in the field, it is again in the shape of a narrowly logic - oriented notion of pragmatics.

Functional theories of language, or rather function oriented theories

ABSTRACT

In this short paper, we shall first try to briefly characterize the difference between structural linguistics and functional linguistics in general, taking Systemic Functional Grammar as one example of a functionally oriented school of linguistics. We shall then try to point out more specifically what seems to be characteristic for functional approaches to natural language processing. Finally, we shall try to illustrate a functional approach in an attempt to model core aspects of the process of (machine) translation.
tend to assume a higher number of structural dimensions of language, corresponding to various functions. The emphasis is usually on paradigmatic rather than syntagmatic relationships, representations stand for part-whole, i.e. constituency, for linear precedence, for prosodic, for dependency, and other, relations between linguistic units;

- do not give special prominence to syntax. They will usually not share the assumption of a level of autonomous syntax;

- have, as a matter of historic coincidence, sometimes neglected formal and representational issues relative to content issues and empirical issues;

- tend to completely incorporate pragmatic and functional issues into linguistics.

It should be clear, though, that structural linguistics has never completely disputed the importance of functions of various types, nor have functional theories ever held that linguistics is possible entirely without a notion of structure. The difference is more one of degree, rather than an absolute one.

We shall focus on one particular functional theory here, that of SYSTEMIC FUNCTIONAL GRAMMAR (SFG) (a good discussion of the notion of function in linguistics can be found in [11, 5, 4]). SFG is one of the functional theories with a relatively long history, but is also, I believe, an expression of principles of general systems theory (for which cf., among many others, [13]) in linguistics. I do not want to go into detail about this, but would like to name some basic concepts of general systems theory which seem to me to be embodied, at least to some extent, in SFG:

- System, element, structure, function, environment/context and their interrelationships as basic concepts;

- Change and stability of systems;

- Self-regulation vs. development induced by the environment;

- The dependence of the self-regulating capacity of a system on a certain degree of variation (German Vielfalt) among its elements and relations;

- Dialectic between potential and actual;

- Quantity and quality;

- Interactions between higher and lesser developed systems and elements;

- Irreversibility of developments;

- States of equilibrium and catastrophe.

2 A SHORT INTRODUCTION TO SYSTEMIC FUNCTIONAL GRAMMAR

Before we begin our more detailed discussion, we shall give a brief overview of the concepts of the model that we shall be using in our discussions (cf. [16, i4ff]). The original formulations are by Halliday [7] and Fawcett [6]; Systemic Functional Grammar (SFG) is the grammatical core of the theory of Systemic Linguistics. In SFG, each linguistic unit is classified in terms of a set of features. Combinations of these features specify the form of units in terms of morphosyntactic properties, linear precedence relationships between its constituents and their parts, the functions of these constituents, control and raising properties, lexical insertion etc. The features which are possible for a given unit, i.e. the potential, are represented in the form of a system network. A path through a system network yields a selection expression, which is the actual. The process triggered by a selection expression is called realization, of which there are again several sub-types according to the various types of structural properties of linguistic units. A system network, together with other system networks, makes up a functional component of the grammar, such as the experiential, logical, thematic, or interpersonal components. Each functional component typically determines a particular type of linguistic structure, such as constituency, dependency, linear precedence, intonation and stress. As a notational convention, we shall write selectional expressions such as [mood, interrogative, polarity] in square brackets. All the system networks in the present paper illustrate these basic conventions.

The idea of subcategorizing units of linguistic structure by sets of features is quite common nowadays, although it should be said that src elaborated this idea long before most other approaches did. What may be fairly unique to Systemic Grammar, on the other hand, is the range of features considered, together with the principle of clustering sets of features into networks and components which together determine the structure of a unit.
The term *semantic* is used in SFG in two different ways: In the version of Fawcett [6], features in system networks are referred to as *semantic features*. In a more Hallidayan version of SFG, they would be referred to as *lexico-grammatical features*.

The way we shall be using features, networks and selection expressions in our present remarks is as follows: whenever we discuss linguistic units, such as clauses or words or phrases, we shall want to classify them. This classification will be done in terms of the features made available in system networks, which are almost exclusively lexico-grammatical networks in the general sense of the words. However, even for readers unfamiliar with the systemic literature, the use of features should be largely self-explanatory, because by far most of them designate linguistic properties which are discussed in other linguistic theories as well, so that, even if one has difficulties understanding all of the implications of a particular linguistic analysis suggested here against the background of SFG, it should be possible to follow the general linguistic arguments which we shall be making. We shall also take care to provide discussion linking up SFG concepts with concepts from other theories where this seems desirable.

The following examples illustrate in a simple way the key terms of Systemic Linguistics introduced here:

Linguistic units correspond to constituents on various levels posited by other theories. Grammatical units are thus *clause complex*, *clause*, *phrase*, *group*, *word*, *morpheme*. Each unit is classified in terms of a set of features. A clause, for example, will have features such as [agent-centred, active, non-modalized] and many others - in short, all the features which control its formal properties. A feature [agent-centred], for example, will constrain its head verb to be of a certain class, and it will constrain the role of Agent to be assigned to its Subject role if at the same time the *voice* feature is [active]. Also, and specifically in the present context, clauses will have features such as [addressee, second person, no-Subject, emphasis, no, politeness, yes, urgency, no], classifying them in terms of [mood, imperative] (cf. Figure 1; Figures appear together at the end of this paper.). All the possible features for a given unit constitute the potential of that unit. For example, if we assume that in English the number system for *nominal groups* has only the potential of *singular, plural*, then this is the potential for that type of unit in a grammar of English. If our small system network says that *number* for the nominal group in English is thus constrained, and that number has to be strictly one or the other, *singular, plural* are the only two terms in the *number* system, and they are in a disjunctive relationship, shown by square brackets in *system networks*. Any selection expression from our small number system has only one feature, but usually system networks are more complex and so are selection expressions. A system network, for example, which says for some language that *number* of nominal groups is always either [singular] or [non-singular], and [non-singular] is always either [plural] or [dual], admits the following selection expressions: [singular], [non-singular, dual], [non-singular, plural]. Any such selection expression, or *path* through a system network is an *actualization* of the *potential* of the language. Features of the type just illustrated have one or more of a small number of different consequences, the most important of which in our context is *realization*. The feature [plural] for nominal groups of English, for example, will in most cases trigger -s-affixation on head nouns. A feature such as [unmarked information] on clause rank will assign primary stress to the rightmost fully lexical item, and through it to phrases, etc. A feature such as [active] on clauses will cause a certain participant role to be conflated with Subject. Features and realization statements are in very complex disjunctive and conjunctive relationships in any grammar fragment of even moderate coverage.

Next, let us illustrate the notion of a *functional component*: A Systemic analysis postulates that the structure of any linguistic unit is the product of various functions of that unit along different dimensions. These different functions of linguistic units are *crystallized* in different *functional components* of a language. A sentence and clause, such as *I'll shoot that cat on sight*, will be classified as [action, agent-centred, +affected, overt affected] in terms of *transitivity*, as [+circumstance] in terms of *circumstances*, as [statement, indicative] in terms of *mood*, and as [theme-on-first-inherent-role] in terms of *theme*. Transitivity and circumstance are *ideational*, more specifically, *experiential* features, mood features, such as we shall be concentrating on in this paper, are *interpersonal*, and theme features are *textual*. Each of the components *ideational*, *interpersonal*, *textual* make their own specific contribution to the overall structure of the clause: The *selection expression* [action, agent-centred, +affected, overt affected] classifies the clause as one that has a main verb of the class [action, agent-
centred], the second participant role of the verb is an Affected, it is overt, and it is conflated with the direct Object, if the clause is in active voice. Thus, experiential features control constituency. The other sub-type of ideational features are logical features, in terms of which our sample sentence has a very simple structure, not being tactically linked to any other clause. In terms of logical interdependency, there is only one head at clause rank. Any embedded or projected clauses would be modifiers, yet modifiers of very different types. The interpersonal features [statement, indicative] classify the clause as one that has a Subject, which precedes the Finite element and as a clause which will have falling intonation on its tonic element, if the information distribution is [unmarked] and modality is [non-modalized]. Interpersonal meaning, then, accounts for part of the constituent structure, some syntactic functions, and some aspects of intonation, in interaction with textual and ideational information, as illustrated by the conditions which we have informally attached to our remarks on realization. Finally, [theme-on-first-inherent-role] specifies that the Theme role will be conflated with the Agent role, so that the Agent will appear leftmost in terms of linear precedence.

Our illustrations for some key terms of Systemic Linguistics should in no way be understood as attempts at full analyses: They are meant as illustrations, and nothing but that. Fuller analyses are given in the remainder of this paper. We thus hope to keep these remarks reasonably independent of standard introductions into Systemic Grammar. Quite clearly, though, as with any reasonably complex set of ideas, so in the case of SFG readers willing to go into many of the detailed implications of what is presented here for the theory as such will at some stage want to consult the standard literature, unless they bring some background of their own to this study.

3 Functional vs. Structural Linguistics in Natural Language Processing

Current formalisms for natural language processing are relatively neutral with respect to particular assumptions of linguistics theories [cf. 14, 8, 2, 21, 22]. Whenever Systemic Linguistics has been applied to natural language processing, the main difference so far to more structurally oriented approaches has not been one of formalization or implementation (but cf. [8, 12, 10, 3] for clear accounts of formal properties of Systemic Grammars), but one of the variety and nature of modules of linguistic organization within the linguistic theory. Systemic work in natural language processing has so far always emphasized the need for several dimensions, or functional components, of organization of linguistic knowledge, and the types of knowledge allowed into the linguistic models have been more varied and more pragmatic than in other theories. In this respect, it seems to me that Systemic Linguistics is very similar to other functional theories of language. The field of natural language processing has most of the time been dominated by structural theories of language, but interestingly enough, some important figures in the field, such as Winograd, Kay, Mellish, Kasper, have been arguing almost from the beginning that functional approaches are at least necessary as a supplement of, or maybe even superior to, structural approaches. Generation, in particular, has from the beginning seen a predominance of functional theories [9, 1], while machine translation and parsing have been structure oriented for most of their history up to now. With the increasing importance of declarative and directionally neutral implementations, though, those boundaries are breaking down fast.

4 A Case Study: An Approach to the Modelling of Translation

We outline an approach to the problem of representing multi-lingual information here which is presented in substantially more detail in [18]. For earlier attempts in the same direction see [20, 16, 17, 19]. We shall first illustrate what a simple unification of grammar fragments for a restricted area, the imperative in English, Russian, and German, yields. Proceeding from there, we want to argue that the factoring out of several types of linguistic information from the resulting multi-lingual fragment, and the re-organization of these types along multi-functional lines, gives a more satisfactory account of linguistic information than would be available in a strictly structural approach.

4.1 A Grammatical Generalization: Unification of (Clause Rank) Grammar Fragments

We leave the ranks of word and group out of account here, although obviously they are relevant ranks for a language which, for example, real-
izes one type of imperative by the insertion of an element of the verbal group. The particles -ka, -te in Russian would be examples, if they were not analysed as parts of the verb they are attached to. At clause rank, then, a grammatical feature such as [imperative] generalizes an entire set of constraints on clauses, constraints involving all or some of constituent structure, linear precedence (order), lexical insertion, morphology, voice, aspect, tense. The networks for commands/imperatives of our four languages at clause rank are different from each other in the same way as those on word rank, only in much more complicated ways. In particular, it is not a necessary condition for a clause to be [imperative], that the word - mood becomes [imperative]. For German and Russian, the verb-imperative, where it is the unique one may be a sufficient condition, i.e. it may percolate upwards. For an illustration, cf. the networks at clause rank in Figures 1, 2, 3 (Figures appear together at the end of this paper).

Given such a state of affairs, what is a "generalization" of these grammar fragments? A frequently given answer is that what generalizes these fragments is another network, or alternative form of knowledge representation, at a "functional/semantic" level of language. In the case of our example, this would normally be rated as part of some "interaction base". It would furthermore be stated that there are "complex pre-selection relationships" that map these two levels onto each other. This answer is a relevant one, and maybe even the best one, provided, one defines the "complex mapping relationships/realizations" with sufficient clarity. I would like first, though, to look at a different generalization, a generalization across languages, and across ranks, but within the level of grammar. This leads us into the area of "inter-lingual grammar fragments", and only through there into semantics.

A possible candidate operation for generalizing grammar fragments from different languages might be "unification", as defined below [14, 34]:

*If A, B, and C are feature structures, we call C the unification of A and B, written $A \land B$, provided C is the least informative feature structure which is at least as informative as A and at least as informative as B. To put it another way, $A \land B$ has all the information of A and B, but nothing more. Mathematically, $A \land B$ is the greatest lower bound of A and B with respect to the subsumption ordering ($\subseteq$), i.e. it is the greatest feature structure which is subsumed by both A and B.*

There are, then, two questions:

- Will unification between some given group of grammar fragments succeed? In the case of the same feature or path of features in different fragments with contradicting dependent features, for example, there would be difficulties, as far as I can see at the moment. In the cases where unification does succeed, we would obtain a fragment allowing all the non-contradictory distinctions made in any one of the languages. Is that what we want, intuitively?

- How, precisely, is a unification of the grammar fragments different from an abstraction into a semantic/functional level?

- unification does not work on cyclic graphs, but there are grammatical phenomena that might require such a description.

Possibly, unification in its usual definition is not what we ultimately want as a description of the generalization even of grammar fragments, because it prevents generalizations that we want (S1(a OR b(c OR d))) (S2(a(c OR d) OR b(e OR f))) (cf. Figure 4). Or is this just a problem of the naming of features, i.e. using different attribute names in our case just given would solve the problem in one way. The point is, though, that we want an explicit way to describe, maybe formalize, what we mean by "generalization". This we believe to be true both of generalization of mono-lingual grammar fragments into multi-lingual grammar fragments, and of the generalization of (a) grammar fragment(a) in one language into its semantic/functional counterpart.

In attempting a unification of the three grammar fragments in Figures 1,2,3, we notice the following:

- Unification will yield a unified fragment which copies finer distinctions from the monolingual fragments into the corresponding places of the more generalized grammar. This presupposes that there is no contradiction between features or paths.

- For the fragments to unify at all in a meaningful way, the grammar writer of the
mono-lingual fragments need to ensure cross-linguistic consistency in naming of features, wherever this seems intuitively necessary. Otherwise, no unification will ever result.

- In the area of [no speaker inclusion], there is a fairly massive clash of features at first sight. However, one could write the mono-lingual fragments in such a way as to ensure the possibility of unification, by re-arranging dependencies and naming of features accordingly.

The resulting multi-lingual grammar fragment would look as in Figure 5. Strictly speaking, we have ignored the problem here that in a unification of our fragments as they are now, the ADDRESSEE system would be doubled in the resulting multilingual system, once being dependent on TYPE, as in Figure 5, but also being a system on the same level of delicacy as DELICACY. This problem could be avoided in various ways, for example first copying the TYPE system into German and English, but we want to illustrate the problem here of simply working on the basis of available descriptive grammars. Figure 5, in this one respect, contains the result of unification of the slightly homogenized versions of our monolingual fragments.

4.2 A SEMANTIC ABSTRACTION: A SKETCH OF A FRAGMENT OF AN INTERACTION SEMANTICS

We shall at this point come back to the other possibility for abstraction mentioned above, which is that of not attempting unification of grammar fragments, but rather that of relating grammar fragments to a semantic level.

The observation which we are starting from in this case is that our grammar fragments encode what seem to be intuitively very different types of information under the general label of IMPERATIVE, thus unnecessarily complicating the fragments. These different types of information include information about:

- mildness vs. hardness of a request

There would seem to be two different types of disadvantage to incorporating all these very different types of information into one grammatical area:

- our grammar fragments are overloaded with many different types of rather incoherent information, and one might be forced to include even more, and more idiosyncratic types.

- we are repeating information in our grammars of imperative here, which seems to occur elsewhere in the language as well.

If we took out all the intuitively non-central information from our networks, we would be left with increasingly leaner versions of our imperative network (cf. Figures 6, 7).

As it turns out, the other types of information can now be integrated in a network for a more semantically oriented interaction semantics, or for the tenor of discourse (Figure 8).

The features under [speaker attitude] will now lead to a grammatical realization only in conjunction and disjunction with features from other networks, as shown in Figure 9.

As is usual in Systemic theory, we capture thereby the fact that a functional category such as [speaker attitude] is not only relevant to one particular grammatical system, such as the [imperative], but that it has implications across the system of a language. Two very important questions remain:

- What motivates the dependencies into which we have now arranged our semantic features? This can only be a model of semantics.

- How do we relate our semantic networks to grammar?

Both of these questions are addressed in [9, :200ff], and work going on in these areas will hopefully lead to more detailed models than we have at present.

5 CONCLUSION

We have in this paper briefly looked at, first, the difference between structural and functional approaches to language, second, and more specifically, at some differences between these two families of approaches within (computational) natural language processing, and third at a case study
in which we tried to exemplify a systemic functional approach to the problem of modelling of translation as one problem of natural language processing. What might be conclusions from all this for people working in language technologies, what may be strengths and weaknesses of SFG relative to other approaches?

The following characteristics may be said to stand out in our discussion:

- SFG is an extravagant model, that is to say it tends to work with partial descriptions of highly complex systems, rather than complete descriptions of maximally constrained/simple systems. Traditionally, this would have seemed to run counter to the basic philosophy of a formal model, but spirits have changed there, and notions such as modularity, parallelism, partial description, multiple constraint satisfaction etc. go much better with an SFG philosophy, than earlier notions.

- SFG has always been oriented towards rhetoric rather than logic, and, correspondingly, more towards generation than towards parsing in NLP. Within the parsing world, and largely also machine translation, this has long been considered to be a typical disadvantage. However, SFG was classically formulated as a directionally neutral theory, strictly declarative in nature, and this nowadays allows an increased contact with all communities within the NLP world.

- SFG is an alternative theory, rather than the linguistic mainstream, but has had a longer and more stable history than most other linguistic theories. It is a consequence of this that, when working with SFG, you have to make a more than average effort to relate your own work to the linguistic mainstream. This is, I feel, largely compensated for by a very healthy historical stability of the model, which, because of its extravagance mentioned above, goes hand in hand with the potential of more than average creativity.

Finally, is the choice between functional and structural theories a strict either-or choice? It is not, and developments have shown how sometimes, especially in NLP, elements from both families of theories can be combined. In the same way, whenever someone chooses to adopt functional approaches either wholesale, or in part, there is always the choice within the family of functional approaches, such as West Coast Functionalism, Simon Dik's Functional Grammar, Prague School Functionalism and a few others. Still, the present paper was written against the background of one of these schools, and I hope that thereby we have gained in transparency and comprehensibility what, maybe, we have sacrificed in representativeness by choosing to do so.

REFERENCES


Figures referred to in this paper

Figure (1): Imperative on clause rank: English

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<table>
<thead>
<tr>
<th></th>
<th>-sing</th>
</tr>
</thead>
<tbody>
<tr>
<td>--first person NUMBER--</td>
<td></td>
</tr>
</tbody>
</table>
|                   | -plur

rank = clause |

mood = IMPERATIVE |--ADDRESS-- |--second --| yes
level = grammar |

class = main |

& |

|--POLITENESS|

|--URGENCY|

The &-sign signifies conjunction of options, otherwise brackets mean OR.

Selected realization statements:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>politeness, yes</td>
<td>lexicalize with &quot;please&quot; in positions x or y</td>
</tr>
<tr>
<td>urgency, yes</td>
<td>add tag with &quot;shall/will&quot;</td>
</tr>
<tr>
<td>emphasis, yes</td>
<td>&quot;do&quot; - insertion</td>
</tr>
</tbody>
</table>
Selective constraints:

-----
| CLAUSEMOOD = IMPERATIVE
| class = main
| Subj = non obligatory
| tag = [head = "will/shall"]
-----

These constraints are combined with the constraints from word rank and group rank. [CLAUSE-MOOD=IMPERATIVE] should be taken as a type enforcing the specified (rather weak) constraints.

Figure (2): Imperative on clause rank: German

-----
| ---first person NUMBER--- |
| -sing
| -plur

rank = clause

mood = IMPERATIVE

level = grammar

class = main

k

-yes

--POLITENESS

-no

-YES

--URGENCY

-NO
The system with the name NEAR is continued from the more comprehensive system immediately above. The [Urgency, yes] option is realized by particle insertion ("doch", emphatic "ja") and similar devices.

Figure (3), part 1
In Figure (3), part 1, the [urgency, yes] type is realized either by [+/- conjunctive mood], although this is not a mood option on word rank in Russian, or the [+/- bij + infinitive] option, or by [+ perfective aspect] in the verb, where that is possible.

Figure (3), part 2: Imperative on clause rank: Russian

---
| --first person REGISTER (cf. Fig. 9,3) |
| |
| |
| --sing |
| |
| --near -- |

TYPE = Aufforderung  
| ADDRESSER  | --second --SOCIAL-- | --pl |
| person DISTANCE --far |
| |
| |
| --neutral |
| --third person --TENOR |
| --ceremonous |

---

Figure (3), part 3

|--yes

---non-formal --URGENCY|
| --no |
| |
| |
| |
| |

REGISTER
(from part 2)  
|---
| |
|--formal |
& --POLITENESS-- |
| --yes |
| --no |
| |
| --addressee > 1 |
|--NUMBER --|
| --addressee 1 |
---
Figure (4): Failures of unification

Grammar fragment 1

\[ \text{System (1)} \rightarrow \text{Attribute}[1] \rightarrow \text{-a} \]

Grammar fragment 2

\[ \text{System (1)} \rightarrow \text{Attribute}[1] \rightarrow \text{-c} \]

Example:

Grammar fragment 1: English

\[ \text{System (1)} \rightarrow \text{Aspect} \rightarrow \text{current relevance} \]

Grammar fragment 2: Russian

\[ \text{System (1)} \rightarrow \text{Aspect} \rightarrow \text{perfective} \]
Figure (5): An exploratory multi-lingual fragment

--- Bitte

--- TYPE ---- |
| --- Aufforderung ---- |
| | --- second ---- |
| | | |
| | | --- Verbot |
| | | |
| | | --- Warnung |
| | | |
| | --- Kommando |
| --- Politeness ---- |
| --- yes |

--- URGENCY ---- | --- yes |
| --- no |

--- social ---- | --- distance |
| --- far |
| |

--- register ---- |
| insert Fig. 3, part 3 1) |

--- near - insert Fig. 2, part 2 2)

1) Russian REGISTER-options dependent on first-person imperatives
2) German options after [social distance, near]
Figure (6): A lean grammatical network (1)

---

| --- Bitte   | -- speaker inclusion |
| --- TYPE    | Aufforderung          |
| --- Verbot  | -- no speaker inclusion |
| --- Warnung | -- third party |
| --- Kommando | |

---yes
-- URGENCY
---no

---yes
-- POLITENESS
---no

---

Figure (7): A lean grammatical network (2)

---speaker inclusion

---no speaker inclusion

Imperative

| Aufforderung | --third party |
Figure (8): Interpersonal and textual information factored out of imperatives

---

| -- formality $\Rightarrow$ dependent networks

---

| $\ast$

| $\ast$

| -- ceremoniousness $\Rightarrow$ dependent networks

---

| $\ast$

| $\ast$

| $\ast$

| mild

| -- hard

| $\ast$

| $\ast$

| $\ast$

| polite

| $\ast$

| $\ast$

| $\ast$

| not polite

---

| $\ast$

| $\ast$

| $\ast$

| $\ast$

| urgency

| $\ast$

| $\ast$

| $\ast$

| not urgency

| $\ast$

| $\ast$

| $\ast$

| social distance

| $\ast$

| $\ast$

| $\ast$

| not social distance

---

| $\ast$

| $\ast$

| $\ast$

| $\ast$

| number $\Rightarrow$ dependent networks

---

| $\ast$

| $\ast$

| $\ast$

| $\ast$

| focus $\Rightarrow$ dependent networks

---
Figure (9): Constraints and realization

---

| speaker attitude : distance |
| Aufforderung : no speaker |
| inclusion |
| language : German |
| [German sub grammar] |
---

---

| speaker attitude : distance |
| statement : indicative |
| language : German |
| [German sub grammar] |
---

---

| speaker attitude : distance |
| class : nominal |
| head : lex"Dame" |
| language : German |
| [German sub grammar] |
---

---
CONCEPT FORMATION AND UNDERSTANDING: AN OVERVIEW

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PART I:
CONCEPT FORMATION: ITS BASIS AND STRUCTURE

The main idea of this paper is that concept-formation is structuring of sets of data by ordering relationships based on judgements of similarity (identity) and difference (especially opposition or contrast) under certain perspectives. These judgements must be made intuitively on a pre-conceptual level, i.e. do not presuppose an analysis by means of features as pre-given concepts. Semantic features as conceptual units of analysis are the result of concept formation, rather than its beginning. Since the set of data available to a learning individual grows, the structures change with the change of data. Concept formation with respect to a certain expression is completed if the structures are stabilized. I distinguish two levels of concept formation, the first, basic level of experiential (quasi-)concepts and the second level of the formation of (linguistically) explicated concepts. Experiential concepts are concepts as far as they are constituted on the experiential level of knowledge, while theoretical and formal concepts are concepts that are explicates on the level of linguistic representation of knowledge. Many 'experential' concepts get explicates as 'theoretical' and 'formal' concepts on the second level of concept formation.

1. THE FIRST LEVEL OF CONCEPT FORMATION: QUASI-CONCEPTS AND CONCEPTS

The experiential data for the formation of quasi-concepts and the concepts, which they approximate, are pairs consisting of an utterance of an expression and its satisfaction situation, i.e. the situation which makes it true that the utterance is satisfied. At first, utterance situation and satisfaction situation must overlap, i.e. the whole satisfaction constellation must be present. Later, utterance situation and satisfaction situation may be spatially and temporally separated. The data are selected under perspectives, which are constituted by pre-established attunement to the surrounding, and by abilities, needs, interests, goals, preferences. Some of the latter are innate on a sub-conceptual level, others will be built up in the course of interaction with the surroundings. In this way concept formation is locally biased. This results in 'locality' of (quasi-)concepts rather than in universality.

1.1 ORDERING STRUCTURES ON SETS OF BASIC DATA

One and the same expression e is used to express different concepts when it is used under different perspectives. Under perspective P1 a subset S' of a set of data S is extended in one way, and another subset S" of S is extended in another way under perspective P2, and with that <P1, S'(<ue, se>)> is a representation of another property, expressed by e, than the one represented by <P2, S"(<ue, se>)>, likewise expressed by e. Concept formation in an individual takes place as laying structures on sets of experiences of satisfaction situations; but there is a parallel reconstruction possible on the sets of satisfaction situations that are experienced. This parallel is the realistic or objective link that provides intersubjectivity in concept formation by interaction between members of a speech community directed towards these kinds of situations. Concept formation of a single individual is thus strung to satisfaction situations intersubjectively referred to: it has to occur in a structurally parallel setting on the level of experiences.

1.1.1 RECONSTRUCTION OF CONCEPT FORMATION ON A REALISTIC LEVEL

On the set S of satisfaction situations of e subsets are formed under perspectives Pi, short: under i. The set [e]i is the realistic interpretation or meaning of e under i. Each set Se,i is a subset of
We perform intersection between situations of \( S_e,i \) with regard to their quasi-parts. These are aspects of satisfaction situations that become distinct under contrastive comparison between these situations. The notion of quasi-part is due to Carnap 1928. With growing sets of data the number of quasi-parts grows. Each \( S_e,i \) is closed under intersection, i.e. for all \( s, s' \in S_e,i \), also \( s \cap s' \in S_e,i \). Each \( S_e,i \) contains a smallest element, which is the intersection of all \( s \in S_e,i \): \( \cap S_e,i \). We extend \( S_e,i \) by new satisfaction situations of \( e \) under \( i \) and thus get an ordered sequence \( \Sigma : S_e,i, S_e,i', S_e,i'' \), ... with inclusion.

Now we can define when such a sequence is stabilized, i.e. a certain \( S_e,i^n \) in the sequence is complete with respect to the concept expressed by \( e \). Such a sequence then is a reconstruction of concept formation on the realistic level.

A set \( S_e,i^n \) in a sequence \( \Sigma \) is complete with respect to a concept \( e \) if

1. For all \( S_e,i \) in \( S_e,i^n \cap S_e,i^n \):
   \( \cap S_e,i^n = \cap S_e,i^n \).
   i.e. their smallest elements are identical under perspective \( i \).
2. For all \( S_e,i \) with \( S_e,i \neq S_e,i^n \), and all \( S_e,i \) with \( i = j \):
   \( \cap S_e,i^n = \cap S_e,i \).
   i.e. their smallest elements are different.
3. For all \( e' \) with \( e \neq e' \), and all \( S_e,i \) with \( e = e' \):
   \( \cap S_e,i^n = \cap S_e,i' \).
   i.e. their smallest elements are different.

Condition (1) expresses that the process of concept formation terminates, i.e. the sequence of quasi-concepts is stabilized and therewith results in a concept. Condition (2) says that different concepts which can be expressed by \( e \) are distinguished by being concepts under different perspectives. i.e. polysemy is taken into account. Condition (3) says that a concept is not overextended under a perspective \( i \); this means that under this perspective \( S_e,i \) is delineated by its oppositions \( S_e,i' \) expressed by different \( e' \).

### 1.1.2 Parallel Concept Formation on the Experiential Level

We have for an expression \( e \): 1. experiences of utterances: \( u_e \), and 2. experiences of satisfaction situations: \( s_e \), short: experienced satisfaction situations. We form sets of experienced satisfaction situations with respect to \( e \): \( S_e \). On them we form similarity circles, i.e. maximal sets such that each member is similar to all others; this can be done by sorting out \( S_e \) into similarity circles, or directly by using a perspective \( i \). The notion of similarity circle is due to Carnap 1928. These similarity circles are subsets \( S_e,i \) of \( S_e \) each harmonized with respect to \( i \). This means: \( S_e,i \in P_i \). A \( P_i \)-harmonized subset of \( S_e,i \), \( S_e,i^h \), is also called a \( P_i \)-similarity set of \( e \). We form a sequence of growing similarity sets \( S_e,i : S_e,i, S_e,i', S_e,i'' \), ... whereby \( S_e,i \supset S_e,i, S_e,i'' \supset S_e,i' \). A \( P_i \)-harmonized sequence \( \Sigma \) of \( e \) grows monotonously by adding only satisfaction situations of \( e \) that conform to harmonization under \( P_i \).

The similarity degree of \( S_e,i \): \( D(S_e,i) > p \), whereby \( p \) is the similarity degree due to the perspective \( P_i \). This means that there are other expressions \( e' \) such that \( S_e,i \) is in opposition to \( S_e,i' \) under \( P_i \). This prevents overextension of a concept under \( P_i \) (see condition (3)).

We consider growing sets of data under perspective \( i : S_e,i < S_e,i' \) then the internal similarity of \( S_e,i' \) is smaller or equal to that of \( S_e,i \). If \( S_e,i < S_e,i' \), then \( D(S_e,i') \leq D(S_e,i) \). The largest similarity set of a \( P \)-harmonized sequence of similarity sets is called "the quasi-concept of \( e \) with respect to the set of data under perspective \( i \)." If with growing \( n \), \( D(S_e,i^n) \) → 0, we say: the quasi-concept stabilizes. A sequence of similarity sets is stabilized; i.e. defines a concept, if there is an \( S_e,i^m \) in \( S_e,i \) such that for all \( S_e,i^n \), with \( m > n \), \( D(S_e,i^m) = D(S_e,i^n) \). All these \( S_e,i^m \) are members of the equivalence class \( [S_e,i^n] \). They are called maximal members of the sequence. The equivalence class \( [S_e,i^n] \) is the constructed concept. It no more depends on the growths of the set of data.

We now formulate, parallel with the realistic reconstruction in 1.1.2., what it means that a similarity set of experienced satisfaction situations completes a concept of \( e \):

A set \( S_e,i^n \) in a sequence \( \Sigma \) completes a concept of \( e = \def \)

1. For all \( m \), with \( m > n \): \( D(S_e,i^m) = D(S_e,i^n) \), i.e. stabilization.
2. For all \( P_i \), with \( P_i \neq P_i \), and all \( k \) such that there is an \( s \in S_e,j^k \): \( D(S_e,i^n \cup \{ s \}) < D(S_e,i^n) \), i.e. \( P_i \)-harmony as distinctive in a polysemic complex.
(3) For all \( c', \) with \( c = c' \), and all \( k \) such that there is an \( s \in S_k^j \): \( D(S_k^j \cup \{s\}) < D(S_k^j) \), i.e., opposition under \( Pl \). If this condition is not fulfilled, \( c \) and \( c' \) are synonymous.

Stabilization implies that instances of satisfaction situations of \( c \) that would change the similarity degree of \( S_k^j \) are not anymore incorporated into the concept, but are either considered to be marginal cases, or are incorporated into a similarity set formed under another perspective \( j \). Stabilization makes it possible to admit some flexibility with regard to marginal cases of use of \( c \) under \( i \), without the concept being affected. They just don't get integrated. This is what normativity amounts to for an individual: stability of established regularities is preferred above breakdown of stability. As long as cases that change similarity degree are permitted into the similarity sets, the quasi-concept is not yet stabilized. Stabilization is a certain state, which can be destabilized again by massive data of satisfaction situations of \( c \) under \( i \) which require a change of concept. Such a destabilisation can also be reached by being overruled by norm authorities who establish other or new uses of \( c \), or by adopting a new convention of use of \( c \) under \( i \). A concept is co-ordinated for all members of a population if it is the same for all of them. Sameness here is equivalence of sequences of quasi-concepts, such that they have a common maximal element. In order to judge about sameness of concepts we have to look into the 'realistic' parallel of concept formation (1.1.1.) and find out whether the sequences converge to a common smallest element. This means that the sequences of different language users can be united in one common sequence without any difference in the common smallest element defined hereby. This means that their concepts are identical. This criterion, of course, implies that identity of concepts can be a matter of degree.

2. The Second Level of Concept Formation: Explicated Concepts, i.e. Theoretical and Formal Concepts

Explicated concepts require a linguistic medium of expression on which the structures are built which define the theoretical or formal concepts. This medium can be a formally restricted part of a natural language or a formal language suited for expressing the relevant relationships.

2.1 Syntagmatic Fields: The Basis of Theoretical Concepts

To begin with, let \( A \) be a lexem which already expresses an experiential concept. If \( X \) is a variable over the sentential surroundings of \( A \), we can define the complete characteristic syntagmatic distribution of \( A, FA \), as the set of sentential complements of ' \( A \) in general', the set of sentential contexts \( X \) representable by \( \forall X \ (\text{GENERAL}(A))(X) \). Whereby \( \text{GENERAL} \) is expressed by every, all, a (sortal), the (sortal), or bare plural in subject position.

If a property \( P \) can be analyzed into a relation \( R \) and a restricting complement \( Q \), then the syntagmatic relationship between \( \text{GENERAL} \ A \) and \( \text{SOME} \ Q \) can be represented on a meta-level by '\( R(A,B) \)', or '\( ARB \)', whereby \( A \) and \( B \) represent the respective concepts on the meta-level, and \( R \)
represents that syntagmatic relationship between them which holds if and only if on the object-level a sentence of the form "A in general stands in relationship R with some B" is true. Examples of syntagmatic fields, which we find in Artificial Intelligence literature and in literature about Lexical Semantics, have to be understood in this way. Prominent syntagmatic relationships are 'part of', 'result of', 'cause of', 'goal of', 'origin of', 'participant of', including special participant relationships such as 'actor of', 'beneficiary of', 'object of', 'locality of', 'instrument for', and all kinds of functional relationships. -- Note that these prominent syntagmatic relationships are also the ones along which metonymic transfer of expressions runs. -- In fact, besides all one-place predicates (in the form of verbs, nouns, adjectives) all two- or more-place verbs and other relationships can be used as object-language basis for corresponding meta-language syntagmatic relationships between concepts.

2.2 PARADIGMATIC FIELDS: THE BASIS OF FORMAL CONCEPTS

Two expressions A and B stand in a semantic paradigmatic relationship with each other relative to sentential context X if each forms together with X a structurally semantically correct, i.e. a semantically acceptable, or possibly true sentence. This means A and B can be substituted for each other in such a sentence salva structural semantic correctness. With respect to a sentence s and an expression A in s we can form the class of expressions that are substitutable for A in s salva structural semantic correctness of s. This class is called the paradigm of A with respect to s. It is an equivalence class with respect to the complement of A in s, and it can be represented by any of its members, relative to s. Instead of a single sentence, we can consider a set of sentences that contain A and with respect to which we form the paradigm of A. It is the intersection of the paradigms of A with respect to all the members of this set of sentences. The bigger the set of sentences is, the smaller the paradigm will be. If two expressions have the same semantic distribution, in the sense defined above, they are semantically equivalent. Then the paradigm of A with respect to its semantic distribution consist of semantically equivalent expressions; these are called the 'synonyms' of A. If the set of data for A increases, the set of synonyms of A decreases, or stays the same. Synonymy is one of the paradigmatic relationships we find in paradigmatic fields.

The paradigmatic relationships between expressions will be defined on characteristic semantic distributions, i.e. on the basis of characteristic syntagmatic fields. Ordering relationships between the characteristic distributions are used for defining the well-known paradigmatic relationships in taxonomies, which are ordered paradigmatic fields. If we want to establish a consistent order without cross classifications, we must not refer to the complete characteristic syntagmatic field of expressions, but merely to a coherent part of it, T, determined by some theoretical point of view P: For a theory T and different expressions X of a paradigm we refer to FX,T. This secures that we can find order relationships among the members of the paradigm.

A paradigmatic field is formulated under a constant perspective, with a fixed set of sub-perspectives inherent in the theory T, that are provided by the governing interest and questions asked. (In what follows, we omit T.)

FX ⊆ FY: Y is hypernym to X, or: X is hyponym to Y.
This means: all properties of Ys are also properties of Xs.
FX = FY: X and Y are synonymous,
FX ∩ FY = ∅: X and Y have a common hypernym, and if FX ∩ FY has a name, this is the lowest common hypernym of X and Y.
FX ∩ FY = ∅: X and Y do not have a common hypernym. I.e. they do not appear in the same T-taxonomy.

'X and Y are in opposition' means that X and Y are not synonyms and that the closest hypernym of X is also the closest hypernym of Y. 'X and Y are contrary' means that X and Y are not in the hyper- or hyponymy relationship and that they have a common hypernym. Opposition implies contrariness.

2.3 DEFINITIONS OF CONCEPTS: IMPLICIT AND EXPLICIT DEFINITIONS, FEATURES

Characteristic syntagmatic fields restricted to theories and paradigmatic fields based on these are the basis for definitions of concepts. A characteristic syntagmatic field restricted to a theory provides an implicit definition of a concept.
The other important type of definition is the explicit definition. It is based on paradigmatic semantic fields. In the explicit definition of a term A, its closest hypernym ('genus proximum') and the differentia specifica are given. In giving the differentia specifica one refers to one or more terms that are in opposition with A.

**Differentia specifica** of A in opposition to n terms X:i, i := 1,..., n, = def. {P | P ∈ FA & ∀X:i: P \notin FX:i}.

We now can define the notion 'semantic feature'. A **semantic feature** of a term A is a subset of its characteristic semantic distribution (CSD) with respect to a theory T. The choice of features for A will be determined by the concepts with which A appears in a taxonomy under T. The genus proximum will be a feature, which implies all the features of its analysis. Further all its differentia specifica will be features of A. A formal concept of A under T is an explicit definition, or feature analysis, for A. The **CSD** can be split up into the specifically characteristic semantic distribution (SCSD) containing the differentia specifica, and the generally characteristic semantic distribution (GCSD) containing the genus proximum. The SCSD will play an essential role in so-called metaphorical language use.

**PART II:**

**CONCEPT FORMATION: THE CONSTRUCTION OF NEW CONCEPTS**

A theory of conceptual semantics, among other objectives, has to explain how creative language use is possible. Here we show how creative use and elaboration of the lexicon is possible and in what sense we can talk about the conceptual impact of syntactic composition of concepts.

The means or vehicle of concept representation are linguistic expressions, whether of a formal or natural language is a matter of convenience. The content of these representational expressions consists in (1) their relationships to (quasi-)concepts and the concepts of the experiential level, and in (2) their structural position in syntagmatic and paradigmatic fields of expressions, restricted to certain points of view, which may be more practical or more theoretical. In the present theory of concept formation, concepts are structurally determined by (1) and (2). (1) provides their experiential content, (2) their structural explications. There are two partial injective mappings: (1) → (2) and (2) → (1), which may change with growing sets of data, though change can be counteracted by normative attitude, which prefers stability.

1. **CONCEPT COMPOSITION AND THE GENERATION OF NEW CONCEPTS**

On the second level of concept formation we have, for an expression A and a theory T, its characteristic semantic distribution FA,T, and, in some cases, also a stereotypical distribution FA,ST. The members of FA,T express properties from the set A_T:= {P | P ⊆ A, with respect to T}, i.e. from the universal generalized quantifier over A restricted to T. On the second level of concept formation, FA,T is the set of complements of 'A' in general' in true sentences, as far as T is concerned. T can be the natural kind theory of A, NK, or some other theory about A, for example about behaviour, or about morphological form, or about the function of things being A. Likewise, FA,ST is the set of complements of 'A in normal cases' or of 'A stereotypically' in sentences held true. With respect to A, there can be different theories T, and there are sometimes "stories" about a member of category A, which by generalization, be it justified or not, become stereotypes or stereotypical stories, i.e. sentences held true of members of A in normal cases.

1.1 **OUTLINE OF THE INTERPRETATION OF METAPHORS**

A sentence like 'Robert is a wolf', or 'This is a wolf' with respect to Robert, can be interpreted on the background of the prominent theory NK about animals, the biological kind theory. The predication is made under the perspective of identifying an entity as belonging to a biological kind. Then the composition that takes place in this sentence just says that about the individual referred to by 'Robert', or 'this', all properties expressed by the members of FwolNK hold. Thus we may expect in case of truth, that Robert will indeed be a wolf, biologically speaking. But the above sentence can also be interpreted on the background of another theory, say E, the ethological theory about the behaviour of wolves, which is less prominent, but nevertheless sometimes at issue. In that case FwolE is a set of behavioural properties, or at
least we can select this set from the theory $E$ under
the perspective of characterizing the behaviour of
an entity. Wolves are known to care for their family
but fight hard while hunting for food, and are fierce
against enemies. Using the theoretical concept of a
wolf according to $E$, restrictions on applying the
term 'wolf' are merely provided as far as the typical
behavioral properties go, which are part of the
SCSD of the term. Therefore, under the perspective
of behaviour, the sentence 'Robert is a wolf' or 'this
is a wolf' with respect to Robert just gives us the
information that Robert satisfies the behavioural
concept defined by $E$, i.e. satisfies the specifically
characteristic semantic distribution $SCSD-F_{wolf,E}$.
Thus we can expect that in case of truth of the sen-
tence, Robert cares for his family and is fierce
against others when competing with or fighting
against them. This can be true about a man called
'Robert', but also about any other entity, including
wolves, which show this kind of behaviour. In the
last case an ethologist would say This wolf is a real
wolf.

The third way of interpreting the sentence
Robert is a wolf is by means of the prototypical
story about a wolf, and the stereotype about wolves
in general based on it. Here the concept, i.e. the
stereotypical semantic distribution $F_{wolf,ST}$ repres-
sents, semantically speaking, all properties which
are stereotypically attributed to a wolf on the basis
of the famous fairy tale. This is the wolf who ate
Little Red Riding Hood's grandmother and the
goats, whereby the stereotypical generalization
from this story is that the wolf is cruel, but not so
very clever. The above sentence is true about
Robert under the perspective of personal character
precisely if he satisfies $F_{wolf,ST}$, i.e. is cruel and
not so clever.

Note that this approach to metaphorical use
does not require a clash between features, for
example between the fact that Robert is a man, and
thus cannot be a wolf because of incompatible
features. Even of a biological wolf we can say, like
about Robert, focussing on his fierce behaviour: Look he is a real wolf, or Look, this wolf is a real
wolf. This then is not a tautology, but expresses that
he is a very typical wolf as far as the stereotype
goes. The pronoun he, or the demonstrative de-
scription identifies the entity as one, which includes
his sortal properties given in $F_{wolf,NK}$, while the
predication is a real wolf is done under the
perspective that characterizes theory $E$, or under
the stereotypical theory $ST$. In those special cases
in which feature clash would occur by applying the
most prominent theory $NK$, it is simply a matter of
preserving conceptual stability that we then have to
choose another perspective of predication than the
one defined by the question 'To which biological
kind does x belong?'. We have to choose the
perspective defined by the question 'What is the be-
haviour of x like?', and with it the ethiological
theory $E$, or the stereotypical theory $ST$, will be
used in interpreting the predication. In speech
situations where the perspective is implicitly or
explicitly introduced in the previous context the
possibility of feature clash does not occur at all.
The interpretation proceeds directly and not
indirectly via a kind of pragmatic accommodation.

According to the theory advocated here,
feature clash and elimination of features is no part
of the semantics of metaphor. Feature clash is
merely the result of the inappropriate application of
one prominent perspective of interpretation in cir-
cumstances in which another perspective is at issue.
Flexibility of perspectives, and the choice a of
perspective by assuming a certain question or
interest implicit or explicit in the situational
context, prevents feature clash to begin with, and
thus elimination of conflicting features is not an
issue. Therefore it is not at all excluded that
metaphoric language use fits into a compositional
semantics. Such a semantics is possible in the way
sketched above, which is related to Black's (1962,
1979) interaction view on metaphors.

The difference of this approach with tra-
tional ones is that concepts are used as 'theoretical'
concepts on the basis of available theories,
including stereotypical ones, which are selected as
interpretational background according to perspec-
tives provided by the context. Thus we select, but
do not cancel features. Of course, we have to know
whether an utterance or utterance part is directed
towards identification of biological kind, or
behaviour, or personal character, or even
morphologioal form. The last would provide a
possible interpretation for a sentence like What a
lion, look at his mane! uttered about a man. We
know the relevant perspective from our attentive
directedness towards a certain topic and a focus-
frame, which can especially be introduced by
questions asked or assumed to be at issue in a
conversation. Presupposed questions or interests
provide the perspectives for interpretation of those
sentences which are taken to be informative as
answers to these questions. If we also take into
account 'formal' or 'analytic' concepts carried by an
expression, we can make use of implicational
relationships and oppositions. Thus, the example
Robert is a wolf can be contrasted with Robert is a
fox on the background of biological kind theories,
or on the background of stereotypical theories. The
last gives the interesting opposition between the
stereotypes of a wolf and a fox under the more
specific perspective of intelligence: with respect to
it, he is a wolf and not a fox, i.e. he is fierce but not
so clever. Here, the differentia specifica between
wolves and foxes, under the wolf-theory ST, are at
issue.

Note that this approach is not one in which
metaphor is based simply on comparison. If we just
compare the human Robert with a wolf, they would
be similar mainly under the properties that are com-
mon as far as the biological relatedness of the kinds
goes: both have a heart, kidneys, liver, ears, eyes,
etc. But these properties are not meant in
metaphorical use of the word wolf. Rather wolf-
specific theories are at issue, and with that wolf-
specific properties, which the other kinds that
contrast with wolf under a common hypernym do
not have. In metaphor, not simply what is common
between a human and a wolf, but what is common
and is a differentia specifica of wolf under a certain
perspective and theory is the property expressed by
the metaphor.

It is not required that the meaning of a word A
is already organized as a polysemic complex of
concepts, say as \{WOLF\NK, WOLFE, WOLFST\},
in a conventionalized way. Rather subsets of
the characteristic semantic distribution of wolf, i.e. of
F\wolf, can be selected at the spot by applying the
perspective 'natural kind', or 'behaviour' to F\wolf
and distinguishing the scientific theory of
behaviour from the everyday stereotypical one. This
application means intersecting the perspective, i.e.
a set of NK-properties, or a set of E-properties, or a
set of stereotypical animal behaviour properties
known from stories, ST-properties, with F\wolf. The
respective intersections are identical with the
'theoretical' or stereotypical concepts that are
members of the polysemic complex. This means, a
conventionally fixed polysemic complex is not
presupposed. Rather the concept at issue can be
selected from the whole characteristic semantic
distribution of wolf by just applying the chosen
perspective to it. And in this way a polysemic complex
of concepts is created.

1.2 GENERATION OF POLYSEMIC COMPLEXES IN INTERPRETATION

In concept formation, a polysemic complex is not
treated as a collection of different conventionalized
meanings of an expression. Rather it is seen as
something that is generated by certain operations
and is not closed, but can, in principle, be extended
if a new perspective, under which the expression
gets used, is introduced.

In Bartsch (1987), a polysemic expression was
semantically treated as a pre-property, i.e. as a set
of properties which are related to each other by
metaphoric and metonymic relationships. By
intersecting a pre-property with a thematic
dimension, which is a set of properties that all can
be predicated under a common perspective, we get
the property expressed by the expression under the
perspective given.

A perspective is a second order property of a
certain kind, i.e. a property of properties, or a set of
properties which can be expressed by predicates
that are possible answers to a common question or
interest, for example: What (kind) is this?, What is
its colour?, What is its behaviour?, What is its
function?, What about his health?, How does he do
economically? etc. To look at something under
perspective P, for example looking for an activity-
property, means to attend to the first order property
'activity' and see in what way it is specified in this
case. This means to look for a property in
opposition to other properties that fall under
'activity-property'. The general method of concept
formation is: Look under a perspective, which
provides an identity of classification, for
differences and classify the differences, i.e. form
subclasses with characteristic properties which
make up the differences to the other sub-classes
under the identity. This means, that simultaneously
one takes into account similarity and opposition
under a perspective.

A polysemic complex is of the same type as
second order properties are; it is a set of first order
properties. But they do not necessarily include a
common property. Rather they are a collection, i.e.
their second order property does not express more
than that they belong to the same collection. The
principles of forming these collections are
metonymic and metaphoric relationships, which
amount to relationships of contiguity and similarity
(cf. Jakobson 1960), restricted by the requirement
of change of perspective.

Recursive definition of POLCOMP(A):
1. \( P \in \text{POLCOMP}(A) \)

2. If for all situations \( s \) in which \( P' \) is realized, the expression \( A \) is taken to be satisfied by \( s \), and there is a \( P \) with \( P \in \text{POLCOMP}(A) \) such that metonymic(\( P', P \)) or metaphor(\( P', P \)), then \( P' \in \text{POLCOMP}(A) \).

The expression \( A \) used under perspective \( P \) then expresses some property \( P \) in the intersection of \( P \) and \( \text{POLCOMP}(A) \):

\[
P \cap \text{POLCOMP}(A) = \{ P \}
\]

Consider the example *this man is a wolf* and assume that \( P \) is the perspective 'behaviour-properties'. Then the demonstrative description *this man* provides a further restriction, namely that the property to be selected belongs to the properties a man may have, i.e. belongs to \( H \), the set of (accidental) human properties, or in other words, the set of properties compatible with being a man, which is the existential generalized quantifier expressed by a *man*: \( \{ P | P \cap \text{MAN} = 2 \} \). - Note that capitalized words are used as names for concepts. The quotes around a concept-name are used to form the name of the corresponding property on the realistic level. - The intersection to which the interpretation of *is a wolf* has to belong is then \( H \cap P \cap \text{POLCOMP}(\text{wolf}) = \{ P \} \). We can also take \( H \cap P \) to be the subperspective 'possible behaviour properties of men'. Of the property which is the interpretation of *is a wolf* in the above sentence context it is thus required that it is an (accidental) human behaviour property as well as a theoretical or stereotypical, i.e. general, typical behaviour property of wolves. For example, the perspective \( P \) selects, by intersection, from the polysemic complex for *wolf* the theoretical behaviour concept \( \text{WOLF}E \), i.e. the concept that is defined by the ethological theory about wolves. It is a partial reconstruction of the universal general quantifier expressed by *a / every wolf*, namely \( \{ P | P \supseteq '\text{WOLF}' \} \). It has to be restricted to the SCSD-part of the ethological theory about wolves, i.e. \( \{ P | P \in \text{SCSD-Fwolf,E} \} \), whereby \( \text{SCSD-Fwolf,E} \) is the set of typical properties of wolves expressed by \( F_{\text{wolf,E}} \).

The polysemic complex of *wolf* on the linguistically explicated level, i.e. the second level of concept formation, consists of a set of theoretic or stereotype concepts, each of which is defined by a theory formulated under a perspective, for example the biological kind perspective, the ethological perspective, the fairy tale perspective, the morphological or external appearance perspective.

In general, for an expression \( A \) the (generatively available) polysemic complex of explicated concepts is:

\[
\text{POLCOMP}(A) = \{ A' | A' = FA \cap P, \text{ for some } P \in \Pi \}, \text{whereby } \Pi \text{ is the set of perspectives that are of human interest when characterizing individuals, events, activities, etc. In this way, the characteristic semantic distribution of an expression A can be ordered into concepts under the respective perspectives. Certain subsets of concepts are selected. The concepts in such a subset together form a coherent set of features, the typical } P\text{-features of individuals characterized by } A.
\]

Another example of generating a polysemic complex for some A by choosing certain subsets from \( FA \) is the case of so-called "privative" constructions, treated in Franks (1989).

We can treat the example *stone lion*, which following Franks (1989) means "made from stone and being a lion as far as shape is concerned", on the realistic level as the union between the universal generalized quantifier {'STONE'} over the property 'STONE' and the universal generalized quantifier over the property corresponding to the theoretical concept LIONSH. This property 'LIONSH' is the intersection between the shape perspective 'SHAPE' with the universal generalized quantifier over 'LION', {'LION'}. This intersection then is an element of the interpretation of the \( \text{POLCOMP}(\text{lion}) \). The concept STONE LION itself is not presupposed to be a member of the polysemic complex for *lion*, although it can be added to it later in a conventional way. Rather the theoretical concept LIONSH, as it is defined by a theory providing a general description of the morphological form of a lion, is a (generated) member of the polysemic complex. The universal generalized quantifier {'LIONSH'} over the property corresponding to this theoretical concept contains all typical shape properties of a lion. This amounts to the following composition on the level of second order properties:

\[
\{'\text{LIONSH}'\} = '\text{SHAPE}' \cap \{'\text{LION}'\} \in \text{POLCOMP}(\text{lion}), \text{and further: } \{'\text{STONE LION}'\} = \{ P | P \supseteq '\text{STONE or LIONSH}' = '\text{STONE}' \cup \{'\text{LIONSH}'\} = '\text{STONE}' \cup \{'\text{SHAPE}' \cap
\]

\{'LION\}'. This means that the property set of STONE LION, corresponding to the set of features, is the union of the universal generalized quantifier over STONE and the universal generalized quantifier over LIONSH.

On the level of concept combination this corresponds to the following set of features which make up the newly constructed concept of a stone lion:

\[ \text{features(stone lion)} = F_{\text{stone}} \cup (\text{SHAPE} \cap \text{Fion}) \]

The difference with Franks (1989) is the following: He takes the modifier stone as a defector of all those central essence properties of the 'lexical concept' of lion, that are not compatible with the features of the concept STONE. From the features of the concept LION only shape properties remain, which then form the 'sense' generated from the lexical concept LION used in this context of stone as a modifier. I rather do not speak of defeat or canceling of properties, but of perspective-dependent selection of features from the characteristic semantic distribution of the head, lion, whereby we receive the theoretical concept of lion shape, which is a member of the polysemic complex of lion. In doing this, I can give a compositional treatment in the strict sense, because I do not cancel anything but use purely Boolean composition.

The concept of a stone lion can be enriched on the experiential level by getting acquainted with situations which contain stone lions. Thereby we can find out that stone lions have very specific typical properties characterizing their surface. If we then form a new term, for example Plastic stone lion, the interpretation of this would mean that we now have \{'PLASTIC' \cup ('SURFACE' \cap \{'STONE LION'\})\} \cup (\text{SHAPE} \cap \{'STONE LION'\})\}, i.e. the set of characteristic properties of a lion from plastic with surface and shape of a stone lion. On the level of concepts, a corresponding set of features can be formed which characterize the concept of a plastic lion. From these operations on sets of properties it follows that a plastic stone lion has a lion shape and a surface like stone. If we would cancel features instead of selecting them, a plastic stone lion would simply be a plastic lion, but not a special kind of plastic lion, namely one with a stone like surface. The process of concept composition is iterative, as long as we have interesting perspectives of characterization.

2. Generating Polysemy on the Experiential Level: Creative Metaphors and Metonymies

The case in which \( A \) is used under some \( P \), but the concept, i.e. a reconstruction of the property expressed in this case, is not yet included in POLCOMP(\( A \)) on the conceptual level, requires generation of a new concept and thereby finding the corresponding property \( P' \) that is a member of \( P \) and can also be incorporated as a member of POLCOMP(\( A \)). Note that when an expression newly is used metaphorically in a true sentence, the property expressed by the metaphor exists. The point is only that it has to be reconstructed on the conceptual level. The principle of reconstruction of the intended property is that concept formation must be based on information available at the time of interpretation. For that we have to assume that \( A \) is uttered truthfully with respect to \( s \) under \( P \). Let us recapitulate what this amounts to in terms of available information.

Data:
1. Expression \( A \) is used with respect to situation \( s \) truthfully, i.e. \( s \) is intended as a satisfaction situation of \( A \).
2. \( A \) is used under perspective \( P \).
3. The property that has to be assigned as being expressed by \( A \) under \( P \) with respect to \( s \) has to be eligible as a potential member of the polysemic complex of \( A \).

Goal:
Find a \( P' \) with \( P' \in P \) and \( P' \) being realized in \( s \) such that it fulfills both conditions for being a member of the polysemic complex of \( A \).

The reconstruction of the \( P' \) that satisfies the above requirements is the concept that has to be constructed from the data available. The data of concept formation are 1. how \( A \) is used up to now, 2. that \( A \) is used now truthfully with respect to \( s \) under \( P \), and 3. the use of \( A \) now is such that it can be connected with previous use by the operations that form the basis of metonymy or metaphor. With these data we can design the following procedure of concept formation, which is a reconstruction of \( P' \), the goal of interpretation.

Procedure of concept construction:
1. Take the set of previous satisfaction situations for
A. Delineate a (new) similarity set for A under P, named: $S_A \cdot P$. Choose $S_A \cdot P$ such that $s = p', i.e. s$ and $s'$ are equivalent under $P$, for all $s' \in S_A \cdot P$.

III. Extend that set with the new satisfaction situation $s$ of $A$ such that this extension obeys P-harmony and opposition to other P-properties, and that we can construct a sequence of growing subsets up to $S_A \cdot P \cup \{s\}$ with a converging decline of the internal similarity degree. If that is not possible for $S_A \cdot P$, then delineate another similarity set for $A$ under $P$ which satisfies these conditions and name it $S_A \cdot P$.

If $S_A \cdot P \cup \{s\}$ is such a similarity set, we have constructed a quasi-concept for the new use of $A$ under $P$ with respect to $s$. It is the result of interpretation. This is how far, at this moment, we can approximate the concept that reconstructs the property expressed by $A$ under $P$ with respect to $s$.

Imagine, for example, $P := \text{'colour'}$, and the term $\text{orange}$ is newly used about a property, and then, according to the procedure above, we have to select a subset $\text{Sorange, COLOUR}$ of the satisfaction situations for $\text{orange}$ which is typical, especially for colour, i.e. we take into consideration situations with ripe oranges and not with green or rotten ones.

There are several points at which an ambiguity or indeterminacy can arise. A clear, but somewhat stupid example is the following from a German movie, where an elderly museum’s director refers to himself as der alte Kater mit dem grauen Fell (’the old tom cat with the grey fur’). He is fairly short, with roundish features, a thick round head, a face with big eyes, and grey hair styled in a crew cut, and he clearly shows his interest in younger women. The interpretation makes use of three perspectives of external appearance, namely appearance with respect to head, eyes, and hair, and of one perspective of typical behaviour of an old tom cat. The description of the tom cat itself suggests which perspectives are relevant in the transfer of the whole expression onto the topic, this elderly man. His appearances in the film, the reference situations $s$ for the metaphorically used expression, contain enough information for constructing the new (quasi-)concept for the descriptive expression at issue.

If we are not informed enough about the satisfaction situation $s$ towards which the use of $A$ is directed, we might construct more than one sequence to begin with, because $s$, as far as we have information about it, may fit with different $S_A \cdot P$, and thus give rise to different quasi-concepts, and with this, of course, it gives rise to different concepts approximated by these.

The point of indeterminateness is that the more we already know about the satisfaction situation for the new use of $A$ the more precise the interpretation can be. In literary texts, more or less information about $s$ is provided in the text around the use of $A$, such that $s$ than can be further elaborated by constructing the concept expressed by $A$ in this case. The concept, and therewith the elaboration, is not necessarily unique. The creativity employed in the interpretation of metonymic or metaphorical language use is nothing more than the generation of the concepts possibly expressed by $A$ in this case. At the same time, this means an elaboration of the satisfaction situations of $A$ which are possible with respect to previous satisfaction situations of $A$ and the context given.

Summary:

The data: 1. how $A$ is used up to now, i.e. the set of satisfaction situations of $A$ up to now; 2. partial information about the new satisfaction situation $s$; 3. $A$ is used truthfully with respect to $s$ under $P$.

Procedure of construction: see above I.- III.

Result: a quasi-concept $S_A \cdot P \cup \{s\}$, approximating a concept which is a reconstruction of a property realized in $s$.

Hereby it has been sketched how transferred language use, i.e. metaphors and metonymies, can take place on the experiential level of concept formation.

In a poem, relevant experience with respect to the concepts carried by a word can be built up by previous context, and partial information about a satisfaction situation with respect to the same expression in transferred use can likewise be built up in the context. In this way a poem can be self-contained, to a certain extent: The concepts expressed by the words of the poem are partly created within the poem itself.

Consider the following poetic text: Where is my love today, is she wandering through the mountains, lonely, as seaweed drifting far from the shore. Here, the predication ‘lonely’ opens explicitly the thematic dimension or perspective ‘loneliness’ within which ‘seaweed drifting far from the shore’ has to be analysed: We take from our ‘theory’ about what seaweed is like if it is drifting.
far from the shore, those properties that are also elements of the perspective consisting of all properties that characterize loneliness. This means that we form the intersection between the perspective 'loneliness' and the characteristic semantic distribution of seaweed drifting far away from the shore. It is based on the set of true general sentences about seaweed drifting far away from the shore. We can formulate these sentences by imagining such a situation and predicating what is typically true of it. The properties in the intersection will be 'uprooted', 'without any hold', 'being driven by external forces', 'not anymore being a part of a larger whole'. If the thematic dimension was not explicitly mentioned, interpretation in this case would be difficult and the comparison could not easily be substantiated; compare: Where is my love today, is she wandering through the mountains, (as) seaweed drifting far from the shore. This, without the perspective of loneliness properties provided, would hardly work in interpretation.

Also individual experience of previous use of an expression can be made use of, if it is intersubjective enough in order to be presupposed as a background for interpretation. Note that stories and linguistically presented situations are "particular" information and as such do not belong to the theoretical, but to the experiential knowledge in a broader sense. But from stories we form general knowledge which contains what the typical properties are of individuals mentioned in the stories, and from the presented situations we form general knowledge which likewise contains their typical properties. These are selected in metaphorical interpretation.

A theory can also be a merely local theory, i.e. a theory about a particular type of situation: Imagine that Mary very much loves her antique tea pot and always reminds people who touch it to be especially careful. One day, after using her friend's bicycle, she throws the bicycle into the corner of the garage in a hurry. He then shouts at her angrily This bike is my tea pot, alright! One possible perspective introduced by the situation is 'ways of handeling things'. It has to be intersected with the set of typical properties of the pot with respect to Mary. The relational property in the intersection is how Mary generally and typically handles her tea pot and wants it to be handeled, namely 'carefully'. Additionally, a second perspective is possible, namely 'attitudes towards ones things'. Applying his perspective to the "local" theory about Mary's relationship with her tea pot, i.e. intersecting it with the set of properties characterizing generally and typically Mary's relationship with her tea pot will result in attitudinal properties that her with her friend claims to have also towards his bicycle.

The main point is that metaphoric use of an expression A about a certain topic happens in structurally the same way on the two levels of concept formation: Let \( \text{TOPIC} \) be the conceptual reconstruction of possible particular properties of the topic, which are given by the kind of topic and specific situational or contextual information about it. Then the concept expressed by A, predicated over \( \text{TOPIC} \) under perspective, or focus-frame, \( P \) is: \( \text{concept}(A, P, \text{TOPIC}) = \text{SCSD-FA} \cap P \cap \text{TOPIC} = \text{SCSD-FA},P \cap \text{TOPIC} \).

3. Lexical Understanding in Concept Composition

Lexical understanding of an expression means relating the whole expression to the (quasi-)concepts of the composing expressions whereby the syntactically possible satisfaction situations for the whole expression must be integrable salva stabilization with the (quasi-)concepts of the negated parts of the expression, while these satisfaction situations must not be integrable with the (quasi-)concepts of the negated parts of the expression. Lexical understanding of an expression thus means collecting these constraints for its possible satisfaction situations. Interpreting an expression with respect to a world-time index means finding out satisfaction or truth of it by finding at that index a situation which satisfies the constraints gathered in lexical and syntactical understanding of the expression.

I use the following terminology: A composite concept is formed if its expression is found to be relatable salva stability to the positively composing concepts, whereby the syntax of the expression defines the kind of composition. To mark a composed expression as being relatable to a conceptual structure means that it is possible that it has a satisfaction situation that is integrable salva stability into the conceptual structure.

The addition of understood sentences and of new knowledge does not change the conceptual structure if it is integrable into (quasi-)concepts salva stabilization. This is so because the maximal equivalence class of similarity sets for a term stays
the same when similarity sets in it are extended synecologically: Every similarity set in it is as good a representative of the class, which is the concept. This does not change as long as fitting data are added; and if some data do not fit and stability is to be held intact nevertheless, a new quasi-concept has to be constructed for the term which thus becomes polysemic, if the condition for that is fulfilled. Otherwise we have merely a homonymy. This way of treating unfit data means that the principle of stability makes possible flexibility in concept formation.

Consider now the expression *unicorn*. A unicorn is like a horse, except that it has got a horn on its nose. If something is a unicorn, it is not a horse, though it is similar to a horse. Therefore it cannot be constructed as 'horse with a horn', parallel with 'horse with a blond mane': the satisfaction situations for *unicorn*, if there were any, would not be a subset of those for *horse*. Rather they would form an opposition with those of *horse* under a common genus proximum, 'horse-like'. What does it mean that we have constructed a concept for the expression *unicorn* according to the above definition? We just have to follow the definition: we insert the expression *horse-like* into our paradigmatic semantic network of natural kind terms and place under it as hyponyms *horse* as well as *unicorn*. Instead of integrating an expression *unicorn* into such a taxonomy, we can simply say: the expression itself is connected to such a taxonomy in the sense that it is possible that it be integrated. This means that its characteristic semantic distribution contains the concepts HORSE-LIKE and HAS A HORN ON ITS NOSE. The taxonomic order just means that there is a set of general sentences that are commonly true of horses and of unicorns, and that there are others that are true of one kind in contrast to being false about the other, in a world in which both kinds exist. In other words: both expressions have a part of their characteristic semantic distribution in common and they each have another part, their distinctive feature, that makes up the opposition.

Now let us have a look at the composition *fake gun*, in the analysis given by Franks (1989) as 'something that is a gun merely in appearance', i.e. it is not a gun, though it is a gun as far as appearance goes. There is constructible a theoretical concept of a gun as far as its appearance is concerned: GUN<sub>AP</sub>. Under the perspective AP, something that is a fake gun is a gun. The theoretical concept GUN<sub>AP</sub> belongs to the polysemic complex of gun. It can serve as a genus proximum for the concepts of the kinds GUN and FAKE GUN, which form an opposition under it. The concept expressed by *fake gun* then is defined as the union of the characteristic semantic distribution of gun<sub>AP</sub> with the differentia specifica, i.e. the set of general sentences about fake guns which forms the opposition to those about guns. Likewise, STONE LION is inserted into a taxonomy with LIONSHAPE as the genus proximum and STONE LION and LION as its direct hyponyms, in opposition. They would merely be contrary if we additionally would have inserted a hyper-category for artificial lions above STONE LION, TALLOW LION, etc.

We see that concept composition provided by explicit definitions is integration of an expression into a paradigmatic semantic network. As far as instantiation of the concept is assumed, these structures can be mapped into the experiential data of the first level of concept formation. Anyway, they serve as constraints on the use of expressions with respect to experiences. This follows from the structure preserving mapping from the second level into the first level, whereby expressions of the second level are related to quasi-concepts of the first. In our example it means that the concept of *fake gun* has to belong to the polysemic complex of gun, and that it has to form an opposition to the concept of gun under the broader concept 'gun-like in appearance' which is the first order result of looking for general properties of guns under the perspective AP. The other way around, *fake gun* can be learned by ostension instead of by explicit definition. That proceeds according to the procedure sketched above for forming polysemic complexes of quasi-concepts, if the learning situations are ones in which simply the word gun is used also for such toy guns, besides the expression *fake gun*. On the basis of experiences and observations expressed in general sentences, the theoretical and analytical concept is developed in the way indicated in the previous chapter.

4. SYNTACTIC UNDERSTANDING IN CONCEPT COMPOSITION

Lexical understanding has to be combined with syntactic-morphological understanding: The two sentences *The snake eats the bird* and *The bird eats the snake* are the same as far as lexical understanding goes, but they differ in syntactic-morphological understanding. The satisfaction
situations of these two sentences are lexically constrained by having to be related salva stabilization, "ss-related", to the concepts of snake, bird, and eat. The syntactic-morphological aspect of interpretation requires to refer to individuals and actions or situations in a world. This has to have a parallel in syntactic-morphological understanding. Only then it is possible to really understand a concept like HORSE and the composed concept BROWN HORSE.

Understanding of an utterance consists in gathering constraints on possible satisfaction constellations for the uttered expression. Hereby, the lexical restrictions have to be aided by those restrictions on satisfaction situations which are expressed syntactically. For expressions like horse on a brown blanket and brown horse on a blanket lexical understanding, as far as it has been treated up to now, is the same; both composed expressions are relatable to the situational concepts of brown, horse, blanket, and on. Only the syntactic construction makes for the difference. With respect to the first expression there has to be a referent which is brown and which is a horse and is on a blanket, while with respect to the second there has to be one which is brown and which is a blanket and on which is a horse.

Concept formation had as its basic data situations and not entities. Whole situations are what we experience first, and an analysis of these takes place as the result of applying certain formal operations. Objects, conceptually, are constructs over sets and sequences of situations according to some, probably innate, adaption of orientation towards identity of objects across space and time and across changing properties. We recognize a certain object through space and time. But the concept of horse, to begin with, is determined by sets of horse-situations, rather than by sets of horses. We need now a conceptual reconstruction of an individual horse and of sets of horses. This we achieve by using a second kind of ordering principle besides classification by similarity and difference. This second principle is ordering by contiguity. Applied to situations in temporal order it attains to another point of view of identity than the one for forming similarity sets, namely to the identity of an object or individual as a sequence of situations in time and space, united by the constancy of realization of a sortal concept in a contiguous way through space and time, while permitting continuous change in the realization of quality, quantity, and local and other relational concepts. - For the role of sortal concepts see Van Leeuwen (1991). The two principles of identity, identity by similarity and identity by contiguity have a.o. been formulated by Husserl (1913) as the identity of a class and the identity of an object. - To speak of a horse, and understand what a horse is, then means to connect the expression horse not only to the stabilization constraint with respect to sequences of similarity sets of satisfaction situations, i.e. situational (quasi-)concepts, but also to constraints with respect to sequences of space-time restricted sets of satisfaction situations which approximate possible objects.

A partial object is a subset of experienced situations or time and place specified satisfaction situations of predications belonging to the same individual history. This implies that all partial objects that approximate an individual must contain the sortal characteristic of the individual and must have a continuous connection to its origin. Partial objects are conceptually equivalent if they are part of the same object, i.e. all their extensions are possible histories of the same individual. We can then think of an individual concept as an equivalence class of partial objects. The equivalence class does not change with changing individual histories in it, as long as origin and sortal concept is not affected.

An individual concept of horse is the E-intersection between the situational concept of horse, the approximation by sequences of (quasi-)concepts of horse, with the approximation of an object, i.e. with a thing-history. E-intersecting a situational concept and a thing concept means that there can be constructed a non-empty intersection between an extension of some quasi-concept which approximates the concept, and an extension of a partial object that approximates the thing concept. For sortal concepts A, each partial object approximating an individual contains an A-situation, but for quality, quantity, and most relational concepts A (those which do not express the origin of an individual) only some (possible extensions of) partial objects contain an A-situation. The E-intersection cuts out that part of a possible history of a thing which is an A-part. For a sortal term A the maximal A-part is the whole individual. The general concept of horses as individuals, i.e. the general concept of a horse-individual, then is reconstructed as a maximal similarity circle the elements of which are individual concepts of horses.
An individual can be involved in a situation in different ways: it can be an active participant, a directly affected participant, an indirectly affected participant, a carrier of the property realization that make up the situation, etc. These so-called 'roles' are expressed morpho-syntactically in composed linguistic expressions and are part of a situational concept expressed by a sentence. The above example brown horse on a blanket versus horse on a brown blanket has to be treated on this level: Though a situation from the maximal similarity circle of brown appears in the history of a horse and in the history of a blanket with respect to each of the two expressions, it does so in different ways. The first expression says that a brown-situation is part of the history of a horse and also of a blanket, but in such a way that the horse shows the property 'brown', while the second expression says also that this property is realized in both histories, but that the blanket shows or carries the property 'brown'. This can be expressed by the requirement that in the first case the satisfaction situation has to have a part which is a horse and is brown, while in the second case it has to have a part that is a blanket and is brown.

In order to provide a conceptual correspondent to a nominal term in a case, relative to a certain kind of verb, we can construct an E-intersection between the role concept, expressed by the case with respect to the verb, and the individual concept and the verb concept. That is: for each of the components, the concept for the noun, the concept for the verb, the partial history of an individual restricted by the noun, and the concept of the role, we check whether it permits to integrate a situation which is also ss-integratable into the other nonnegated components. This is a test for compatibility of the restrictions that are defined by the requirement of ss-integratability into a maximal similarity set of each component of the complex expression. For the concepts expressed by the noun, verb, and case, conceptual integratability means that addition of a satisfaction situation to a maximal similarity set is possible salva stability; for the individual concept, conceptual integratability means that addition of the satisfaction situation is possible observing spatial, temporal, and sortal contiguity. This last constraint means that there is a partial object constructible in the individual history to which the satisfaction situation can be added. This construction can be such that a suitable partial object is just found, or, if one is found which includes a situation that is not compatible with the one of the the expression considered, a new partial object has to be constructed by eliminating that contradicting situation. This means that the new situation can be simply included or can be included counterfactually.

What does the construction of a situational concept amount to? How is it related to the corresponding situational property, or the situation type? Constructing the situational concept expressed by a sentence means to collect the set of constraints on situations which can serve as possible satisfaction situations of that sentence. For the sentence The snake eats the bird there are first the lexical constraints explicated above. These are put into conjunction with those which can be derived from morpho-syntactic information: there must be two referents the reference to which was previously indicated in the discourse, or to which the speaker refers demonstratively, such that one satisfies the concept SNAKE and the other the concept BIRD, and the situation satisfies the concept EAT, whereby the snake-referent is the agent-participant of the eat-situation and the bird-referent is the directly affected participant of the eat-situation. The basic semantic notions of reference and satisfaction function in the truth conditions. On the conceptual level, i.e. in understanding what these semantic notions are, 'reference' is relating the expression to an approximated individual history, 'satisfaction' is E-intersecting this with the role-concept and with the concept of the verb. In order to be able to understand such a sentence, one has to be aware of the role-concepts of 'agent participant' and 'directly affected participant' in actions, or more generally, in situations. Reference to individuals means conceptually connecting linguistic expressions to possible individual histories. Understanding a sentence, i.e. constructing a possible satisfaction situation by gathering its constraints, means realizing that the possible satisfaction situation must be such that it can be a member of an E-intersection of all general and individual concepts expressed by the unnegated parts in the sentence; to understand it and accept it as possibly true means realizing that an E-intersection including the possible satisfaction situation can be constructed without counterfactually eliminating a contradicting information or situation. To hold a sentence true, additionally means in fact integrating it into the set of data, by which we get a non-empty E-intersection that contains these new data.

We have distinguished the knowledge base from the conceptual structure erected on it. There
are changes possible in the knowledge base which do not change the conceptual system. All changes in knowledge that do not affect stability of general concepts and identity of individual concepts are of this kind. Conceptual stability with changing knowledge is possible because the conceptual structure is not dependent on specific similarity sets and specific individual histories, but rather on equivalence classes of these. Within these classes members can be changed or new ones added, as long as the equivalence relationship is not affected. Because of the distinction between knowledge and conceptual system, we can make a distinction between on the one hand side 'understanding' as 'conceptually acceptable' and on the other 'acceptable as possibly true'.

On the other hand, there can be changes in the knowledge base that require changes in the conceptual system. If some experience is not integratable into the conceptual system, one either can take a conservative stand and hold up stability of existing concepts, but adding new ones, even at the expense that after that some old concepts have no cases of applicability in the world, or one can destabilize concepts that were stable up to that point and transform them into new concepts. Both finally leads to the same result, when old concepts that are not of use anymore disappear.

PART III:
CONCLUSION

In the beginning of this essay I assumed satisfaction situations as data, which were unanalyzed wholes, ordered in similarity sets according to similarity between experiences of these integral wholes. The data came in utterance-situation pairs, whereby satisfaction or truth was the basic relationship between the utterance and its (satisfaction)--situation, and more general, satisfaction-constellation. We have constructed (quasi-)concepts for (quasi-)parts of unanalyzed situations and concepts as their stabilized limits and, additionally, we have constructed the concepts of individuals and of roles with respect to actions, and we have reconstructed conceptual equivalents of the basic truth-relevant semantic concepts of reference and satisfaction, namely forming non-empty E-intersections between partial objects and sets of situations. Situations can be analyzed in these terms as belonging to certain E-intersections and thereby their situation types can be described. New situation types can be constructed as possible situations on the conceptual level. All operations were expressible in terms of laying structures of subsets and ordering on sets of satisfaction situations, whereby situational and individual concepts were formed as certain kinds of equivalence classes. Operations on these, conceptual operations, could be explained by set theoretical operations on members of these equivalence classes or on extensions of these members that are likewise members.

We have taken as basic the notions of 'evidence' and 'truth', pragmatically revealed by asent and dissent to either Quinian observation and occasion sentences on the first level and to general sentences on the second level of concept formation. Thus we have started with data that are whole, unanalyzed sentences with their whole, unanalyzed satisfaction situations, i.e. the situations which make the sentences true. This kind of holistic approach we find in the work of Quine (e.g. 1960) and Davidson (e.g. 1984). We have structured (1) the sets of basic data (satisfaction situations) by similarity sets and sequences of these in order to delineate quasi-concepts and define concepts as limits of sequences of these, have (2) constructed partial objects within individual histories, such that individual concepts are constructed as equivalence classes of partial objects, and have (3) included a conceptual version of the basic semantic notions indispensable for understanding syntax by providing a conceptual correspondent for Tarski's definition of truth. Thereby we were able to explicate the notion of understanding, which amounts to including a parallel of compositional semantics into concept formation and composition. Concept composition has been described as a conceptual reconstruction of compositional semantics, based on the role of the semantic notions of reference and satisfaction in assigning truth. Understanding expressions systematically connects them to general and individual concepts, and hereby gathers the constraints on their possible satisfaction situations. Understanding presupposes that certain classificatory structures and topological structures have been layed on sets of experiences of situations, and that these get extended, preferably salva stability. Understanding consists in performing set theoretic operations on stability preserving extensions of these, especially non-empty intersections. Preservation of equivalence relationships in integrating new data, and hereby stabilisation of conceptual structures, means analyzing these data within our conceptual framework, as it is built up in learning our
language.

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Enriching Answerhood: An Approach to Questions within Situation Semantics
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1 Abstract
The paper considers the properties of the relation of answerhood in natural language queries. It argues for a need to recognize that the range of answers conveyed by felicitous responses to queries is intrinsically richer than assumed and built in to most contemporary frameworks for the representation of queries. A proposal is put forward wherein questions are seen as describing informational voids, using (a generalisation of) the situation theoretic notion of state-of-affairs. This view of questions allows for an appropriately rich notion of answerhood that is simultaneously not cognitively implausible.1

2 Introduction
There exists an influential tradition within semantics and logic that has analysed questions, where questions are used as a term that refers to the descriptive content of queries, as specifications of choices which the query presents to the responder to choose from, or, epistemically, as the alternatives still open to her. For instance the content of the use of the following interrogative sentence would be analysed as some semantic construct built from the various instantiations of the subject argument role:

(1) [[Who left the party]] = f( left-the-party(j), left-the-party(b), left-the-party(m), ...)

There are various alternative ways to make this idea precise, whether the choice is directed to a maximal proposition determining the extension of the queried predicate or revolves

around weaker options.2 The current paper is not concerned with evaluating these proposals, but rather concentrates on the conceptual basis for such a conception insofar as it relates to queries.3 In this paper I present some problems for the choice conception and present an alternative view of questions. I will suggest that if one takes account of some basic pragmatic facts about the minds of queryers and about the goals that they can bring with them into query contexts, we need to enrich our conception of answerhood, while thinning the weight of the semantic object that the queryer has to have access to when posing his or her query. Questions will be viewed as specifications of informational gaps, which are described by singular propositional entities dubbed unresolved states-of-affairs.

The paper is structured as follows: in section 1 the notion of answerhood is motivated as explanatory of observed human competence in discourse interaction. Section 2 focuses on queries using unary wh-questions. I attempt to characterise the answerhood relation for such queries. In section 3, I provide a formal account of such an answerhood relation using situation theory.

3 Queries and Answerhood
One of the basic facts about queries in natural language is the following: the felicity of a response to a given query is determined in a rule governed, recursively productive way. That is, speakers have solid intuitions about whether or not a response forms a coherent discourse with a given query quite independently of its pragmatic appropriateness. This is illustrated

1This work was supported by the Information Technology Promotion Agency, Japan, as part of the R&D of Basic Technology for Future Industries "New Models for Software Architecture" sponsored by NEDO (New Energy and Industrial Technology Development Organisation) and by the HCRC under a grant from the ESRC. My thanks to both bodies.

2See e.g. the works of Hamblin, Karttunen, Groenendijk and Stokhof cited below.

3See Ginzburg 1992a, 1992b for extensive discussion of the various specific proposals and also for a semantics for embedded questions.
by the following pair of examples which, plausibly, can be used with equivalent pragmatic goals:

(2) a. Is there any reason that could explain Jill’s annoyance?
   b. Probably.
   c. # Because Mary doesn’t live here anymore.
   d. # For an unknown reason.

(3) a. Why is Jill annoyed?
   b. Because Mary doesn’t live here anymore.
   c. For an unknown reason.
   d. # Probably.

By asking the question, then, the querier changes the context in a way that restricts severely the range of felicitous follow-up acts, locutionary or otherwise. A schematic depiction of this view is this: if we denote with \( QUE \) the illocutionary force of a query, \( q_0 \) the descriptive content of the query (the question asked), the query restricts responses in a certain way via a relation characterising the competence of natural language users which we might call \( Response\-about \). The range of responses is further restricted by certain pragmatic considerations:

(4) a. Semantic Content of query: \( q = QUE(q_0) \)
   b. Paraphrase: please provide a response \( r \) that satisfies \( Response\-about(r, q) \).
   c. Pragmatic bolstering: please provide a response \( r \) that satisfies \( Response\-about(r, q) \), which is true, brief and helps realize my current pragmatic goal.

The task ahead is to provide a characterisation of the relation \( Response\-about \) posited to hold between an information providing act \( r \) and a query \( q \) whose descriptive content is \( q_0 \) such that \( r \) counts as a felicitous response to \( q \).

Some, but by no means all, felicitous responses have the following property: they cause a proposition to be asserted which stands in a context independent, semantic relation to the question asked, which we call \( Answer\-hood \), in other words, these responses convey an \( answer \).

Some examples should make this distinction clear:

(5) a. Who does Bill like?
   b. Mary. (conveys:) ‘Bill likes Mary’.
   c. He likes some friends of Mary’s. (conveys:) ‘Bill likes some friends of Mary’s.’
   d. (points at Mary). (conveys:) ‘Bill likes Mary’.
   e. I haven’t got a clue. (Felicitous response, but does not convey an \( answer \).)
   f. Hmm, good question. I’ll have to think about it. (Felicitous response, but does not convey an \( answer \).)

So, the class of felicitous responses can be partitioned according to whether they \( convey \) answers, in a sense which is to be made precise, or explicitly \( opt\ out \) of conveying an \( answer \). This latter class of responses are not, to a first approximation, influenced by the particular content of the query. That is, in broad outline, they are applicable as responses to any query. In what follows, I disregard this class of responses.*

I would like to suggest that in understanding why certain utterances are felicitous as responses to queries and can be reported by disquoting of interrogative sentences, we need to project away from the \( way \) an answer gets conveyed. That is, whether an answer is conveyed directly as a consequence of the literal content of a response or indirectly via implicature is tangential to understanding what it is about questions that makes for a rule governed system underlying the notion of response felicity. This is illustrated by the fact that all the responses in (6) can be disrupted by (6e):

(6) a. Who does Bill like?

---

*Echo queries (e.g. Speaker A: Bill left the house early. Speaker B: Bill left the house \( WHEN \)). used to express miscomprehension of a prior utterance, do not satisfy this characterisation: a responder cannot, felicishly, opt out of conveying an answer.
b. Jake: Mary.

c. (Context: Two available candidates, Mary or Jill.) Jake: (winks:) It’s not Jill.

d. (points at Mary).

e. Jake indicated to me who Bill likes.

What is crucial is working out the general rule linking a question to the propositions that constitute its answers. I will call the relation underlying this $\text{Answer}(p, q_0)$.

Simplifying away from some problems introduced by indirect or non-linguistic answers, we have

Response-about $(r, q_0)$ holds if and only if either

- $r$ conveys (directly or via implicature) a proposition $p$ s.t. $\text{Answer}(p, q_0)$.
- $r$ explicitly opts out (of conveying an answer).

In summary, then, we can view a query as introducing a template which possible responses must fit into. Notice that this already imposes an important constraint on any query object we may postulate: it must be one that is accessible to the querier, and the querier cannot be assumed in general to be cognitively connected to the range of possible answers. So any choice conception of query objects must either renounce the hope of being cognitively plausible or come up with an alternative construal that does not require access to individual answers.

4 What Answers Can Be Given?

What answers can be given? In what follows I restrict my attention to unary wh-questions, although analogous points can be made with respect to other types of wh-questions as well as yes/no and alternative questions. It is often assumed that the range of answers that can be conveyed through felicitous responses is exhausted by the instantiations of the open sentence associated with the wh-question, perhaps even the maximal such that is true. In other words, the proposition determining the extension of the queried predicate. It is this quite crucial assumption that I would like to dispute. Thus, my claim is that although queries are frequently made with the intent of determining the extension of the queried predicate, this is a defeasible tendency. Moreover, even when this intent is manifest, responses that do not provide extension-determining answers, either in terms of factuality or exhaustiveness, are not viewed as incorrect linguistic behaviour, rather they are viewed as uncooperative.

A related point is the following: a question can be used to specify lower order information (properties of and relations between entities), and higher order information (properties of and relations between relations/properties). In other words, responses that convey answers that are intrinsically quantified are an entirely acceptable manifestation of rule-governed linguistic behaviour. The conclusion this would suggest is that the semantic nature of a question should be able to reflect this by being fairly symmetrical between these two options.

Making both these points requires a little care: I have no wish to imply that in all contexts the desires of the querier would be equally met by conveying, say, an intrinsically quantified answer rather than an instantiated answer. It is easy to refute this claim. Frequently, it is indeed the case that a (wh)-query is posed because of a desire to find out the extension of the queried predicate. Responders identify this desire, and adhere to the norms of maintaining communicative cooperativeness. Hence, answers are implicated, perhaps even as generalized or default implicatures, to be true and exhaustive. This means that ceteris paribus (cooperative) speakers are under an obligation to provide implicit or explicit indications when exhaustiveness is not intended to be conveyed:

(7) a. Who has worked in the past on this problem?

b. I know Hughes and McClair have.

In this example, the responder cancels any pretense of providing an exhaustive answer by relativising the force of the assertion to his own knowledge.

So the claim is that the considerations that often bias a querier to prefer exhaustive answers can and should be explained on a pragmatic level, by reference to basic principles of communication.
Let us observe, nonetheless, that there certainly do exist contexts for queries, where both quantified and instantiated answers are equally and simultaneously acceptable. Consider the question in (8) uttered after a sudden financial crisis:

(8) Well, I'm sure we're all keen to understand the following: who supported the Prime Minister's moves?

Plausibly, the interviewer is not interested in either a full or explicit characterisation of the set of supporters. What he is interested in are general trends, describing both the make up of the set of supporters and of its complement, and references to select members of either of these sets. Responses such as the following, the first of which is non-exhaustive instantiated, the other two of which are quantified, would be typical:

(9) a. Senator Johnson and Representative Smith, two powerful representatives of the tobacco lobby, definitely did.

b. Surprisingly enough most naturalised Javanese did.

c. Well, few people from the West of the country did.

Consider now the question in (10) made as a request for a plan of action for two people standing at a crossroads, waiting for a traffic light to change:

(10) Which way shall we go now?

The addressee can pick one specific way, and point at it, as in (11a), or she can choose a less optimal strategy, implicit in the quantificational answer indicated in (11b). Both responses are equally felicitous, it seems:

(11) a. That way.

b. Any way that's not blocked at present.

Similar remarks apply to the following example. One can supply a list, partial or complete of prospective buyers of a new product, but typically that would be uninteresting information to the querier:

(12) a. Who is going to buy this product?

b. One thing’s for sure: only the most pretentious of my acquaintances will.

c. Various nouveau riche types, presumably.

d. I can think of a number of people in my department...(long list).

It is worth noting that posing a wh-query does not carry with it a presupposition that the queried predicate is instantiated. Responses conveying negative answers can be felicitous. Once again, it is important to emphasise pragmatic/semantic distinctions: using a wh-sentence to query often carries with it an implicature that the set of instantiators is not empty. But this implicature can be cancelled explicitly, does not always arise and is calculable:

(13) What, if anything, should I buy at the store?

(13) can be uttered felicitously and does not obviously suggest that the querier believes the set of ‘things he should buy at the store’ is non-empty.

(14) Who is in favour of devaluation?

The Prime Minister can felicitously utter the sentence in (14) before a vote without a necessity that she believe anyone supports the devaluation.

The existential implicature is calculable: roughly, a hearer can reason: ‘Why use (14), for instance, when the neutral ‘Is anyone in favour of devaluation?’ could have been used? The speaker must have had grounds for using a form in which the role of ‘person in favour of the amendment’ is focussed. Hence, he must suspect that, indeed, that role is instantiated, etc.’

Lest anyone be worried that this richer view of which answers can be conveyed depends on the pragmatics of query contexts, it is worth noticing that these facts persist in embedded contexts. Thus, (15b) and (15d), which can be used to convey quantified answers to (15a), can be disquotted by (15c) and (15e) respectively:

(15) a. Who is going to buy this product?

b. Jill: One thing’s for sure: only the most pretentious of my acquaintances will.
c. Jill indicated to me to a certain extent who (she thought) was going to buy the product.

d. Jill: Various nouveau riche types, presumably.

e. Jill indicated to me who (she thought) was going to buy the product.

It is, nonetheless, important to point out that there are certain intricacies involved in disquotation using interrogatives. Thus, an important and prima facie plausible motivation for assuming that responses conveying information that determines the extension of the queried-predicate, complete-factual answers, are privileged and should be part and parcel of the specification provided by the query derives from the semantics of certain embedded interrogatives. Considerations of space preclude me from entering into a discussion of this and other related issues, see Ginzburg 1992a, 1992b for discussion. Two basic points for which I argue there are the following:

- There is a need to distinguish the complete-factual answer from information that concerns or is pertinent to the query: The contents of all felicitous responses to a given query can be characterised using the latter notion, whereas the former is a property that is tangential to the felicity of a response.

- The possibility to disquote an interrogative sentence under a predicate such as tell, report or guess cannot be used as a diagnostic for the felicity of a response.

In fact, there is strong evidence that supports distinguishing the class of interrogative meanings embedded by propositional complement predicates such as tell or report from the class of predicates such as ask, wonder or QUEST.5 It is the latter that concerns us here and to which I return now.

It has been argued in this section that there are no convincing grounds for thinking that instantiated answers have any particular priority as answers specified by or concerning the question asked. Similarly, I have argued that the tendency for answers to be viewed as exhaustive is a defeasible, pragmatic effect, which does not persist in all contexts.

Schematically, the answer space of a unary wh-question \( q(x) \) can be characterised as follows:

\[
q(x)(x \rightarrow \text{referent}). \quad (\text{Referent supplied by referential act using a referential NP, deixis etc})
\]

Quantificational-answer:
Quantificational-Force \( x(q(x)) \)

The conclusion this points to is that conceptions in which questions are viewed as specifying choices, which for wh-questions comes out as a choice between all possible instantiated answers or, more strongly, a specification of the proposition determining the extension of the queried predicate intrinsically underdetermine the notion of answerhood.

5 Enriching Answerhood: Unresolved States-Of-Affairs

Combining the results of the previous two sections, a plausible conclusion to draw is the need for a richer notion of answerhood without at the same time hoisting on the querier a heavier cognitive object. The strategy I will propose which answers this need involves generalising a conception of propositions that has been around since the days of Russell. I will be appealing to Situation Theory (See e.g. Barwise and Perry 1983, Barwise 1989) as the background logical framework.

Our starting point is a theory of singular propositional entities or states-of-affairs (SOA’s), built out of pairs of relations and assignments of entities to argument roles. One can think of these as basic units of information, which can be used to report observations or make claims about the world. We associate with these units a notion of factuality, for instance (17a) is factual if Jill likes Bill, relative to some world or situation. But now consider that we sometimes make observations and get results that are incomplete in some way, incomplete to an extent that we can’t even existentially quantify away the missing dimension.

\[\]
In terms of SOA's we can capture this by allowing for SOA's in which some argument roles are not assigned entities\(^6\). In other words, the argument role to entity assignment function is strictly partial. For these SOA’s, which I call unresolved, no notion of factuality is associated, rather they are objects without descriptive power. Examples of SOA’s, the first two resolved, the latter two unresolved are the following:

(17) a. \(\langle\text{LIKE}, \text{liker}:{\text{jill}, \text{likee}:{\text{bill}} }\rangle\)

b. \(\langle\text{HOT, location: cordura-hall, time: 3:45 pdt }\rangle\)

c. \(\langle\text{ANOYED-AT, annoyed-person:zhang, object-of-annoyance:-- }\rangle\)

d. \(\langle\text{GIVE, giver: ming, recipient:-- ,object-exchanged:-- }\rangle\)

I assume, then, that questions, the descriptive contents of queries, are unresolved SOA’s. Metaphorically these can be seen as the representation of an informational void. It is important to emphasize that any choice situation can be represented as an informational void conjoined with a disjunction over the members of the choice sequence. Conversely, one can conceive of voids as setting up a choice to a limited extent, since by parametrising an argument role, information is carried about the potential fillers of this role via the implicit domain of candidate fillers. The crucial difference, however, is that an informational void can be specified by providing an unresolved SOA together with some domain, without having any information about the fillers or even their existence. One can straightforwardly define a relation of answerhood over this class via the relation of resolution:

\[\text{RESOLUTION}(\sigma, q) \text{ iff the argument role to entity assignment function of } q \text{ is extended by } \sigma \text{’s argument role to entity assignment function, which is total.}\]

Some examples:

(19) a. \(\langle\text{LIKE, liker:bill, likee:--HUMAN }\rangle\)

b. \(\text{RESOLUTION(\langle\text{LIKE, liker:bill, likee:jill }, \langle\text{LIKES, liker:bill, likee:--HUMAN }\rangle) }\)

(20) a. \(\langle\text{LEFT, leaver:--HUMAN, departure-time:-- }\rangle\)

b. \(\text{RESOLUTION(\langle\text{LEFT,leaver:millie,departure-time:12 am, 12 Feb 1992 }, \langle\text{LEFT, leaver:--HUMAN, departure-time:-- }\rangle) }\)

Notice that binary operations such as conjunction, disjunction and conditionalisation can be defined on all SOA’s a priori, resolved and unresolved. Resolution can be extended to them in a fairly obvious way:

(21) \(\text{RESOLUTION(BINAR\text{-}CONNECTIVE, }\sigma_0, \tau_0 ), \text{BINAR\text{-}CONNECTIVE, }\sigma_1, \tau_1 \}) \text{ iff } \text{RESOLUTION}(\sigma_0, \sigma_1) \text{ and } \text{RESOLUTION}(\tau_0, \tau_1)\)

Some examples that illustrate this definition:

(22) a. \(\text{RESOLUTION(}\Lambda, \langle\text{LIKE, liker:bill,likee:-- }, \langle\text{HATE,hater:--hatee:jill }\rangle; \rangle, \langle\Lambda, \langle\text{LIKE, liker:bill, likeeminnie }, \langle\text{HATE,hater:mary, hatee:jill }\rangle; \rangle\rangle\)

b. \(\text{RESOLUTION(}\rightarrow, \langle\text{LIKE,liker:bill, likeeminnie }, \langle\text{HATE,hater:--hatee:jill }\rangle; \rangle, \rightarrow, \langle\text{LIKE,liker:bill, likeeminnie }, \langle\text{HATE,hater:mary, hatee:jill }\rangle; \rangle\rangle\)

Answerhood, then, can be defined in informational terms as a relation between unresolved and resolved SOA’s in a way that boils down to either instantiating or quantifying over any unassigned argument roles. The instantiated case is simply
(23) INST-ANS(σ, q) if and only if RESOLUTION(σ, q).

QUANT-ANS is intended to relate an unresolved SOA to each of the quantifications over the SOA's unfilled roles. The basic idea is this: quantificational answers are SOA's that entail either a positive (i.e. instantiated) resolution of the issue raised by the unresolved SOA, or a negative resolution of that issue, or in the case of monotone decreasing quantificational forces, compatible with both positive and negative resolutions. Formally, the relation can be defined using SOA's from the informationally ordered lattice of SOA's that can be generated over the given unresolved SOA:  

(24) QUANT-ANS(σ, q0) if and only if (σ ≥ NEGATIVE-RESOLUTION(q0) ∧ σ ≥ EXIST-RESOLUTION(q0))

Thus, for a unary wh-question (content) q(x), QUANT-ANS ends up being (equivalent) to the following definition:

(25) QUANT-ANS(σ, q(x)) if and only if (σ ≥ ∀x¬q(x) ∨ σ ≥ ∃xq(x))

The view of a query we obtain, then, is this: an unresolved SOA q0 is introduced into the discourse, and the responder is supposed to convey a response, one whose content conveys directly or via implicature a proposition whose descriptive content stands in the answerhood relation to q0. No requirement that the answer be true or exhaustive is specified via the semantics of the query:

(26) a. q(interrogated-role → –):

b. Response-Concerning (p, q) iff
   INST-ANS(p, q) ∨ QUANT-ANS(p, q)

So, simplifying somewhat, we have, for example:

(27) a. Who did Bill invite?

b. (INVITE, inviter:bill, invitee:–)

c. Jill

d. Conveys: (INVITE, inviter:bill, invitee: jill)

e. Several friends.

f. Conveys: (SEVERAL, FRIENDS, λx( INVITE, inviter:bill, invitee:x ))

6 REFERENCES


For details see Ginzburg 1992a.
THE LOGIC OF PEIRCE'S EXISTENTIAL GRAPHS

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ABSTRACT

This paper describes the logical system developed by Charles S. Peirce at the beginning of the 20th century. Contrary to other, more common, logical systems Peirce's Existential Graphs are inspired by human reasoning and not by arithmetical. Therefore the system of Existential Graphs could be very useful in representing natural language discourses. In the first section of this paper the need for formal systems within language technology is analysed. In the second section the definition of the Existential Graphs is presented. Finally, in the third section the application of the Existential Graphs to language technology will be sketched.

1. FORMAL ANALYSIS OF LANGUAGE

It is only too obvious that language technology needs a formal representation. If we want to compare the way in which the representation is manipulated by the computer with the discourse processes we are used to, a logical form serving as formal representation would be convenient. Using a logical form, the problem arises which aspects of language have to be represented by it to make the desired comparison possible. Related to this question is the question which aspects of language are dealing with the notion of understanding. Understanding language I will define in accordance with Wittgenstein as the ability to summarize a natural language text, the ability to answer questions about that text, and the ability to translate this text into another language. So the meaning aspects associated with any specific natural language have something to do with drawing certain inferences such that these inferences make sense to native speakers of that language. This notion of language understanding is called competence by most linguists and philosophers of language since Chomsky. As we will see, this is a pragmatic issue.

However, the question what exactly this competence is, is answered in very different ways. Still most influential is the competence theory of Chomsky. According to this theory competence and so the question whether or not a language utterance makes sense, is restricted to the explicit knowledge of grammar rules only. Understanding language depends on building sentences correctly, i.e. in accordance with Chomsky's rewrite systems' to natural language. These rewrite systems are in fact an application of a kind of grammar developed by the American logician Post to describe the structure of formal languages. In [1] Allwood et al point out that "many structuralists have actually chosen to disregard the content of language, even to the point of denying that semantics is a part of linguistics". Less extreme but still structuralistic are theories and models in which meaning is regarded to be closely connected to the linguistic structures themselves. Montague grammars and Kamp's Discourse Representation Theory belong for instance to these theories and models. These theories are based on the idea that meaning is in one-to-one-relationship to the structure of the utterance and so it can be derived from this structure.

1.1 THE USE OF LOGIC IN LINGUISTICS

Although part of the meaning can be derived out of the utterances, a greater part of meaning remains. This has led to the conviction that meaning has to be found in, that is, has to be derived from the world. This approach is in strong correspondence to model theoretic semantics in logic. Even the very motivation is the same: the need for a semantics of more complex expressions. According to the Fregean definition semantic meaning is to be defined in terms of truth-values or truth-conditions of the components of the (logic or linguistic) expression. The origins in logic can still be discovered in this model-theoretic approach; most applications of models to semantic representations within natural language demand a translation of
natural language utterances to first order logic formulae. Indeed within this approach there is a competence theory of meaning, but the question arises whether or not natural language utterances are isomorphic with first order logic formulae. Apart form the ultimate answer to this question, the translation of language utterances into logical formulae seems to be very problematic. Within this approach more problems have arisen than have been solved.

So far we have distinguished the structuralistic approach of most linguists using logic notions within a competence theory of well-formed and thereby meaningful sentences and the model theoretic approach of mostly logicians using the model-theoretic semantics of first order logic within another competence theory of true and, consequently meaningful, sentences. This distinction between the two approaches proceeds within the field of pragmatics. The structural approach uses its grammatical theories for developing discourse grammars which in this opinion will be the pragmatic theory of language. The model theoretic approach is attracted by modal logic and the corresponding possible world semantics. Within this approach a mutual influence appears of general logic theories and theories dealing with the semantics and pragmatics of language. In this way the logical treatment of natural language has a kind of feedback effect to logic in general.

1.2 DISTINCT LOGIC REPRESENTATIONS

Given the division in approaches it will be clear pragmatists criticize this distinction into two competence theories. This criticism is mainly concerned with the absence of any integration between the two representation models. In [4] Wouter von Hahn points out that our knowledge of natural languages is highly insular without bridges in between. Formal linguists seem to classify all linguistic phenomena into a model consisting of a growing number of levels on which a specific set of phenomena is described and will be formalized. Von Hahn points out that this will not be the successful way. In language technology we have to deal with the relationship of the different levels and phenomena. Not the structures of the phenomena themselves or the relationship between their components is relevant, but the interaction of these phenomena through all these levels. Pragmatics needs a kind of integration. As opposed to syntax there can not exist an autonomous pragmatic theory. Syntax has nothing to presuppose at all and most current model semantic theories do not either. They are more or less self contained. But pragmatics has to have its roots in at least one of the other linguistic subdivisions. In my opinion even in both. There can not be a pragmatic theory independent of syntax or semantics. Pragmatics has to deal with structural aspects of language utterances and with representational aspects of the world represented. Even more, as we will see in the next section, pragmatics is the study of this relationship.

As already noted in the previous section the translation of natural language utterances into first order logic formulae seems to be problematical. Not only in a practical sense but also in a theoretic one. Assumptions involving the compositionality of natural language for instance have become controversial after a real thorough formal and computational treatment of languages utterance in accordance to these assumptions. The one-to-one-correspondence of components in language utterances and their references presuming that there exists a relationship of that kind between logic formulae and components in the model is untenable. This rejection is taken into account by Jon Barwise and John Perry ([2]). Instead of the Principle of Compositionality they introduce the Principle of Efficiency. That is to say the set of terms in natural language is much smaller than the set of objects to refer to. According to this principle the reference of terms is context- or situation-dependent. To be only dependent on these terms themselves would be an impossibility according to situation semantics.

Barwise and Perry introduce the concept of situation as the basis of the other meaning giving component. Within this theory a situation is defined as a partial world, abstract or real, consisting of individuals, relations over these individuals, a truth-value, and a time-space index. This definition makes it possible to define meaning in terms of relations between different situations: one indicated situation and situations that are cognitively related to the first one. This concept of meaning has a wider scope than linguistic meaning. It covers the meaning of meaning in expressions like "Smoke means fire" as well as in the corresponding situations, viz. the situation in which smoke appears as cognitively related to a situation containing the presence of fire. In the same way the situation of receiving a natural language utterance is related to
a situation containing the reference of this utterance if the receiver is as competent as a language user as the source of the utterance. This relationship has to be seen as the meaning of the utterance.

Unfortunately, after defining meaning in this very plausible and even useful way, Barwise and Perry focus on the representation of situations and on the distinction between their theory and the theory of possible world semantics. Many logicians and philosophers of language already do admit that situation semantics has a lot of advantages in comparison to possible world semantics. Still these accepted advantages do concern only the representational aspects of situation semantics. Not the computational aspects. One might even say these computational aspects are a disadvantage of the theory of situation semantics; but this holds for possible worlds semantics as well. Only the structural, syntactic approach seems to be computationally satisfactory. So we have returned to our previous statement that one should take into account both aspects of linguistics: the syntactic-computational and the semantic-representational. As Fenstad points out: one needs a general theory of signs for the interconnection and integration of both aspects.

### 1.3 Semiotics and Language

The general theory of signs is called semiotics. This term is derived from Locke. When studying syntax, semantics, and their relationship which is called pragmatics, the best use is still to take the semiotics of Charles S. Peirce (1839-1914). It was Peirce who introduced the term pragmatics and gave it the meaning of the study of the relationship between syntactic and semantic aspects of signs. Pragmatics as a guiding principle is characteristic and essential to his semiotics as is made clear in his philosophy, which is called pragmatism. Pragmatism has to be distinguished from pragmatism because of a difference in the conception of pragmatics. As we will see Peirce's conception of pragmatics as a logical study of the functions of signs exceeds the very empirical and behavioural aspects which tend to be the beginning and the end in the conception of pragmatics to much pragmatists like William James and Charles Morris.

The syntactic aspects of signs are the aspects of the sign itself as related to the sign system in question. A sign, according to Peirce, is more or less self containing. It is an idea, a feeling, a sensation, the subjective, the possible, a quality, in short everything which is present. The semantic aspects of signs are the aspects of the objects referred to. A reference is the object or actuality referred to by the sign. There can be no reference independent of signs; in Peircean semiotics there is no place for a "Ding an sich". The reference presupposes a sign. But in the meantime what is referred to is something that has the character of independent reality; our assumptions and knowledge concerning the world of objects are formed by the brute reality of the objects referred to. Finally the pragmatic aspects of signs are the aspects of interpretants. An interpretant is the guiding principle, e.g. the context of goals relating signs to references. It is of the character of a general order, regularity, or explicit knowledge. There can be no meaning without sign and reference. Both are presupposed by the meaning which is in turn an interpretant. Thus, interpretants are constituted by as well as constitutive of references and signs.

In the previous paragraph we have introduced the different entities in the semiotic theory. Now, we will distinguish the different kinds of relationships between these entities. First there are three ways a sign can appear. There is the possibility of being a sign: the quality itself. This aspect of signs Peirce calls qualisign. Then there is the actuality of being a sign. The discontinuity, the here-and-now functioning of a sign. This was called sinsign by Peirce (from singular sign). It is cognate to the notion of a token. The last way of being a sign is to be indicated explicitly as a sign. This is called legisign (from legal sign). Second there are three ways a sign can be related to a reference. There is the possibility of being related. Such a sign we call icon. Logical formulae are icons; they do not have a reference but have the possibility to get one. After this there is an actual relationship. This we call an index. Indices correspond to causality, or physical law. The way smoke means fire is indexical. Finally the relationship between sign and reference may be conventional. A sign with conventional reference is called symbol. All social signs like road signs, clocks, and language are symbols. Third and last there are also three ways in which an interpretant relates a sign to a reference. First this relationship is possible. In that case the sign is called a term. Terms are like concepts, a kind of general meaning. Second the relationship is actual. In this case the sign is called a proposition. Assertions and positive descriptions are propositions. Finally the relationship is regular.
This sign is called an argument. Arguments are for instance rules of inference, modes of reasoning, and the function of a complete discourse.

Applying this general theory of signs to those signs constituted by natural language utterances we may distinguish three classes of threefold distinction of natural language functions. The terminology is borrowed from Nauta [8]. The first class of natural language functions is expressive. This corresponds to the notion of the sign in itself. Within this function it is possible to distinguish:

- the emotional function: the utterance serves the expression of the feelings, experiences, moods, etc.
- the evocative function: the utterance induces certain states in the mind of the recipient; it evokes certain pictures, associations, feelings, etc.
- the rapportive function: the utterance is exchanged in accordance with a certain social habit and is meant to do this.

The second class of natural language functions is descriptive. This corresponds to the relation of sign and reference. We distinguish:

- the formative function: the utterance serves as indicator of certain distinct components and their relationship.
- the denotational function: the utterance indicates references to the described world.
- the designative function: the utterance contains a certain description of the world, not by pointing but by abstraction.

Finally, we have the third class of functions which is regulative. This corresponds to the interpretant. We distinguish:

- the incitative function: the utterance promotes a certain action or incites a specific behaviour.
- the valuative function: the utterance indicates valuations in the environment.
- the performative function: the utterance prescribes performance or directs the action in order to reach a proposed goal.

Like signs these functions do never appear in a pure form. The appearance of functions is in most cases a combination of one feature from every class. However, some features can not be combined into an appearing function. A function corresponding to a quasign for instance cannot function as something like an argument as well. The 10 possible appearances of language functions are presented as combinations of different entities out of the three classes of functions in the decagram below:

1.4 A Functional Representation

In this decagram all possible natural language functions are described. So, when we intend to develop a complete and formal theory on natural language we can base it on this decagram. Within the PARLEVINK project, in which among other things, we intend to construct a technological system in which syntax, semantics, and pragmatics are integrated, an architecture based on the decagram is being developed for a computational system answering language utterance in a restricted dialogue context, e.g. concerning time-schedules of trains and flights, (the Responding Dialogue Model (RDM)). Within this system the semiotic relationship between every sign, reference and interpretant is put into operation according to the following mechanism interrelating three modules presentation, application, and control, which are the three cybernetic functions corresponding respectively to sign, object referred to and interpretant:

In the left-corner module (presentation) a sign is received which causes some action of the module in the top (control). This action is mainly the presentation of a relevant selection of what is presented via feedforward, feedback, or feed-from-file (select). In return the right-corner module (application) will present the information asked for
feedback). In accordance with the 10 language functions distinguished in section 1.3, our RDM-system contains 10 modules, interconnected in the way shown below:

![Diagram of RDM-system](image)

The left-corner module corresponds to the expressive function: all phrases, including phrases without any relevance to (a part of) the dialogue system, such as "hello" and "my aunt is ill" (which do not have any relevance to a system answering questions about trains and flights), are presented. The latter are filtered by the sentence module, and what is left is formatted by it, resulting in relevant expressions. The right corner module corresponds to the combination of the evocative, denotational and valutative functions. It is about an indicated state, referring to something in the world (which is in this case a database) and making it possible to evaluate the content of the utterance. The model illustrates very well that there is not one single semantic representation. Interpreting language utterances has to take into account several levels of meaning representation. In our system these levels are a more or less formal representation of the relevant parts of the utterance at the level of the expression-module, a representation in terms of the actual database terms at the level of the indexical-module, and a representation of the executed database-query at the level of the information-module.

The modules at the second level contain rules relating the content of their left-corner module to a content of their right-corner module. This process is described in the first part of this section. The sentence-module contains the rules relating constituents of the utterance to primitive constituent functions. In this module features out of related sentences in one dialogue turn are combined as if they were belonging to one complex sentence. Sentences having nothing in common are separated into different expressions. The proposition-module can be compared to the frame-concept of Minsky [7] and, in some respect, to Fillmore's semantics [4]. In this module the more or less general language functions represented in the expression are related to domain-dependent database-terms or indexicals. The last module at this level is the domain-module. Here the database-query is constructed out of the indexicals and some defaults resulting from the initialisation from the most recent dialogue-history. Because these modules at the second level are not fixed but are governed by the three modules at the two top-levels, the RDM-system has the ability to act really context-dependent. By this I mean that the behaviour of the system is not fixed by general rules or, even worse, by specific rules which are always to be executed, but the module existing of specific rules has to be selected and can be changed by the module at higher level selecting another module. Only the module in the top position is fixed for the time being: as long as the interpretation, the conclusion, decision, or belief holds. In its restricted content the whole function of the system is represented.

In the three modules at the left a more or less syntactic analysis is executed. Constituents of the utterances are analysed and related to elements of a general set of primitive functions, resulting in the presentation of relevant expressions. The semantic analysis, i.e. the process of the three modules at the right, is simply the construction and execution of a database-query. The relation between the syntactic and the semantic analysis is represented in the proposition-module and executed by the three modules at the top. The last process we shall call the pragmatic analysis. As our model points out this pragmatic analysis consists of three distinct functions:

- analysing discourses and relating subdialogues to different states of information or situations;
- storing and retrieving parts of the dialogue-history (also called situations);
- containing and selecting the different functions of the system (called the context (of goals)).

It must be said that most existing dialogue systems provide only one of these functions and try to process a whole dialogue only from the point of view of that specific function. The last few years however we can see a development toward an integration of these different functions. In our
RDM-system the functions are integrated in a logical way. A more detailed description of the RDM-system is presented in [9].

2. THE EXISTENTIAL GRAPHS

Although the RDM-system is implementing the requirement of being a formal representation of utterances, meaning, and reasoning, the system does not make explicit and present insights. In other words, the result of the process of interpretation can not be derived from the input utterances by means of logical expressions. The disadvantage of the RDM-implementation comes down to the impossibility of comparing the behaviour of this system with other dialogue systems or even with human behaviour in dialogue situations. By this I do not intend to say the RDM-project is worthless. On the contrary, RDM will result in a working dialogue system with many advantages over and above other, existing systems. However, the generalization of the RDM-concepts by means of a comprehensive logical theory of reasoning enables us to develop more general versions of RDM. Systems, not only responding to, but also modelling the discourse situation and intervening in the dialogue.

2.1 MATHEMATICAL FOUNDATIONS

With this goal in mind we return to the ideas of Charles Peirce. More specifically to the branch of his philosophy and semiotics he himself calls mathematics. According to his father, Benjamin Peirce, "mathematics is the study which draws necessary conclusions". The Greek word μαθηματική means something like "the result of learning". According to Charles Peirce it has the same root as "mind". In Peirce's division of sciences mathematics has got the most fundamental position. Peirce motivates this positioning saying:

> It does not seem to me that mathematics depends in any way upon logic ... On the contrary, I am persuaded that logic cannot possibly attain the solution of its problems without great use of mathematics. Indeed all formal logic is merely mathematics applied to logic.

(quoted by Carolyn Eisele in [3], p. xxii)

Logic conversely is the normative study of drawing conclusions. In this respect logic is the normative study of reasoning too. Logic has nothing to do with actual reasoning of people, but its subject is normative: to prescribe how people should argue.

In accordance with the position mathematics has got into the classification of sciences, it has to be more general than the reasoning processes to be represented by it. If there exists a way of drawing conclusions which can not be expressed by mathematics, then there is a more general study which draws conclusions. The most general branch within mathematics is, according to Peirce, topology. Not algebra. Topology contains the most fundamental notions of thought: continuity, identity, and space (possibility, actuality, and patterning). Our first observation is that of the whole. After that, we can distinguish some parts of a whole, and, finally, we can bring the observation back into a certain proportion. Involved in these very basic notions of observation, recognition, and thought, the branch of topology will be the most general representation of reasoning processes.

Choosing topological notions as the basic terms in which reasoning processes are to be described, the following consequences have to be made:

- the truth of expressions always depends on the whole that is observed: during the observation it seems to be the truth and the truth for ever, but it is related to that specific observation;
- within Peirce's mathematics continuity is presupposed as possibility contrary to most common opinion among the mathematicians of his time it is not something that has to be derived from discontinuous things;
- similarly for the concept of identity: in accordance to Ockam's razor things are to be identified as long as the contrary is not necessitated by the hard facts of the objective world (including conclusive proofs).

2.2 THE STRUCTURE OF REASONING

Topological notions are represented by geometric figures. Using two-dimensional figures the continuum is represented by a plane, the distinguishable elements by points, parts of lines, or spots, and the proportionality by something that functions as a border to the continuum. When reasoning can be expressed in topological notions it can be represented by these figures. Representing reasoning processes by geometric figures is not such a strange idea as it seems to be. Everyone once has used spots, lines and circles to sketch a
reasoning process. Most very first drafts of even scientific articles consist of geometric figures. And even in published articles some parts are still represented geometrically; see for instance the decagram in section 1.3 in this article.

Most logical notations developed in Peirce's days were geometric. Fregé's Begriffschrift, Venn's diagrams (at that time called Euler diagrams), etc. These notations were not informal supporters of memory any more, but whole systems in which every point, every line, and every circle has a fixed meaning. This meaning is not determined by the figures. There is a great variety of the meaning associated to the same figure in different systems. These differences in geometric representations represent the differences in ontological or metaphysical opinions of the founders of the different systems. Peirce and Venn both are using a kind of circle to represent inclusion. But in Venn's logic this circle represents a set of elements where in Peirce's logic the same figure represents an abstract type or class. And so the inclusion represented in Venn's logic notation is an extensional one, where Peirce's inclusion points out to be intensional although it is written in precise the same diagram.

This difference in logical systems has important consequences. The only thing the diagrams of Venn are able to represent is strict deductive reasoning. Because of Venn's strong influence on Boole and Boole's influence on Russell, deductive reasoning became the main area within logic. Even set theory still underlies the semantics of most logical systems as we have seen in section 1.2. Deduction however is only one kind of reasoning, and maybe even the most simple one. Deduction is drawing consequences from what is already known. One can say the results of deductive reasoning is implicitly present in the information given. In addition to deduction we have inductive and abductive reasoning. The former, by which a general rule is constructed out of several cases, is wellknown and is incorporated in some logic systems. The latter, by which a premise is constructed as a working hypothesis out of a rule and a consequence, is neglected. Most logicians even oppose to the existence of abduction as a legal mode of reasoning.

In Peirce's approach to reasoning all modes of reasoning are taken into account. Abduction is even introduced within the scope of logic by Peirce. Dealing with abduction presupposes a stronger notion of relationship among propositions (in Peirce's logical system) than in most other systems mainly dealing with deduction. Not every proposition can be abduced. The intensionality of the system however provides in this stronger relationship. Propositions are not related to each other because they appear in the same situation, but the are related because of a certain definition which expresses this relationship. Only in this way abduction can be controlled, but, moreover, even deduction is controlled by these intensional definitions. Because propositions not only have an extensional, set theoretic relationship, but also an intensional relationship, as defined by concepts, definitions, and rules, in Peircean logic the expression "if the moon is made of green cheese, I am an unicorn" is not a logical expression, because there is no intensional relation between the terms in the antecedent and the terms in the consequent. Finally the transformation of extensional relations (relationship because of appearance in the same situation) into intensional relations (relationship because of concepts and rules) is characteristic of the third mode of reasoning: induction.

2.3 CONVENTIONS

After this, somewhat long introduction into Peirce's system of notations, it will become more easy to understand his system of Existential Graphs, as defined in A Syllabus of Certain Topics of Logic (1903; also published in [6], 4394-413). Without the introduction given, some definitions or Conventions, as they are called by Peirce, would make no sense at all or, in the best case, would be translated in terms of first order logic immediately (see a.o. Sowa [10]). The definition of the Existential Graphs consists of 10 Conventions, the last 9 three to three taken together in three Parts, called Alpha, Beta, and Gamma. Within this section I present the Conventions and add a little explanation to it.

Convention No. Zero.

Any feature of these diagrams that is not expressly or by previous Conventions of languages required by the conventions to have a given character may be varied at will.

As student in semiotics Peirce was aware that only by way of conventions any intersubjective meaning (i.e. meaning valid or effective in a given language community) may be associated to any character of any diagram.
ALPHA PART

Convention No. I.
These Conventions are supposed to be mutual understandings between two persons: a Graphist, who expresses propositions according to the system of expression called that of Existential Graphs, and an Interpreter, who interprets those propositions and accepts them without dispute. A graph is the propositional expression in the System of Existential Graphs of any possible state of the universe (...) It is agreed that a certain sheet, or blackboard, shall, under the name of The Sheet of Assertion, be considered as representing the universe of discourse, and as asserting whatever is taken for granted between the graphist and the interpreter to be true of that universe. The sheet of assertion is, therefore, a graph. Certain parts of the sheet, which may be severed from the rest, will not be regarded as any part of it. (...)

This is the founding convention: a reasoning process is founded in the agreement of two persons: one could say speaker and hearer. In another paper the interpreter is called graphicus: the person who draws graphs representing the expressions of the graphist. The agreement between graphist and interpreter is the basis of the conversation and is represented in the sheet of assertion.

Convention No. II.
A graph (...) on the sheet of assertion having no scribed connection with any other graph (...) that may be scribed on the sheet shall, as long as it is on the sheet of assertion in any way, make the same assertion, regardless of what other replicas may be upon the sheet. (...)

The propositional expressions are represented in a graph on the sheet. Every propositional expression represented by a graph upon the same sheet has the same value. In Sowa's description this convention corresponds to the conjunctive operator in propositional logic.

Convention No. III.
By a Cut shall be understood to mean a self returning linear separation (...) which severs all that is enclosed from the sheet of assertion on which it stands itself, or from any other area on which it stands itself. (...) Though the area of the cut is not part of the sheet of assertion, yet the cut together with its area and all that is on it, conceived as so severed from the sheet, shall, under the name of the enclosure of the cut, be considered as on the sheet of assertion or as on such other area as the cut may stand upon. Two cuts cannot intersect on another, but a cut may exist on any area whatever.

The intuitive notion connected with a cut is that of putting something apart from the rest, using another sheet, the back of the current sheet, or separate it by drawing a circle-like figure around the representation of the expression to be taken apart. According to Sowa this operation has to be the negation. In this representation the alpha part is isomorphic to the system of propositional logic. Peirce himself asserts negation is the most simple interpretation of the cut. There are more possible interpretations as we shall see in the explanation of convention no. VIII.

BETA PART

Convention No. IV.
The expression of a rheme (a concept; JS) in the system of existential graphs, as simple, that is without any expression, according to these conventions, of the analysis of its signification, and such as to occupy a superficial portion of the sheet or of any area shall be termed a spot. (...) On the periphery of every spot, a certain place shall be appropriated to each blank of the rheme; and such a place shall be called a hook of the spot. By this convention the intensionality, put forward in the previous section, is implemented within the system.

Convention No. V.
Every heavily marked point, whether isolated, the extremity of a heavy line, or at a juncture of a heavy line, shall denote a single individual, without in itself indicating what individual it is. A heavily marked line without any sort of interruption (...) shall, under the name of a line of identity, be a graph, subject to all the conventions relating to graphs, and asserting precisely the identity of the individuals denoted by its extremities. (...) And the extensionality too. Sowa identifies spots and heavy lines with predicates and subjects respectively. According to this identification and the isomorphism of the alpha part to the propositional logic, the conventions no I up to V
together define a system of first order logic. A heavy line may pass a cut.

Convention No. VI.
A symbol for a single individual, which individual is more than once referred to, but is not identified as the object of a proper name, shall be termed a Selective. (…)

This convention is more comprehensible when we are supposing that the first, second, and third conventions express corresponding functions within the different parts. As the third convention in the alpha part is about the production of new sheets by abstraction, this third convention in the beta part is about the production of new spots by abstraction.

GAMMA PART

This last part of the Existential Graphs is the most difficult one. It is defined by Peirce in very different ways. The following definition is one of the most early ones.

Convention No. VII.
The following spot-symbols shall be used, as if they were ordinary spot-symbols (…).

Monadic character, dyadic relation, triadic relation, facts, possession of characters, and standing in some dyadic or triadic relation to something else are represented with certain symbols. So these spot-symbols are connectionally associated with a specific more or less fixed meaning.

Convention No. VIII.
A cut with many little interruptions aggregating about half its length shall cause its enclosure to be a graph, expressing that the entire graph on its area is logically contingent (non-necessary).

The same happens to the cuts. By convention no. III a cut has the meaning of taking something apart. Convention no. VIII adds a specification to it. Sowa puts forward this convention has to be seen as introducing the notion of modality within the logic of existential graphs.

Convention No. IX.
By a rim shall be understood an oval line making it, with its contents, the expression either of a rheme or a proper name of an ens rationis. (…)

This convention is a very difficult one to understand. It seems that this convention is about the construction of a new image of the world as a result of the reasoning process. An image not only consisting of new concepts (as by convention no. VI) but also involving the state of affairs in reality. The content of the enclosure is stated to apply to the social reconstruction of reality as a conclusion, an interjunction in the conversation between Graphist and Interpreter (usually a dialogue interieure).

3. APPLICATION

Up to now we have presented the definition of the Existential Graphs. We have tried to clarify some ideas underlying this definition, emphasizing that the logic of the Existential Graphs is a rather plausible reconstruction of human reasoning. In this final section we shall sketch some consequences of the logic of Existential Graphs with respect to language technology and the formal theory of communication. In the first sub-section we deal with some philosophical presuppositions concerning the things we can talk about and their relationship, in the second with the logical rules, and in the last one with the general representation of communicative processes.

3.1 Three Modes of Existence

As pointed out in section 1.2 most logical systems are dealing with so called objective entities. That is, the ontology established by the universe of discourse in question is presumably fixed and objective in character; moreover, this representation can be characterized as an one to one relationship (comprehending all four kinds of mapping: token-token, token-type, type-token, and type-type). Every presented symbol is corresponding to one and only one entity in the real world. This opinion about the character of representations causes still some more problems than we have mentioned already. The main one is expressed in the question how we can be sure that our representation of the world fits the real state of affairs. In the philosophical tradition of Rationality this was really a problem, because of the opinion in vigor among rationalists that the human senses are not wholly reliable. According to the Cartesian systematic doubt there is nothing to be sure of. The only thing we know and where our knowledge has to be founded in is that we exist as doubting subjects. Peirce just starts at the other side. We can only found our (common) knowledge in the belief that constitutes (and is constituted by) our perception of
the world, reliable or not. This belief is not purely subjective; its confrontation to the hard facts in the world and the social environment causes a continuous process of attunement. Our knowledge does not change, more precisely: does not become more conformable to Truth and Reality, because of the addition of representation of entities never seen before or the creation of new relations, but because of new information undermining our previous perceptions, our beliefs and our doubts. This is also expressed in Convention no. IX of the Existential Graphs.

So, according to Peirce our representation of the world does not consist of a one to one relationship to that world. This statement involves that there is no sense in searching for primitive entities of the world, or for a fixed kind of format consisting of building blocks according to which the whole world can be represented, underlying the formal notation of reasoning. Peirce's representation of building blocks does not primarily correspond to entities in the real world, but to shared beliefs, i.e. to a social reconstruction of reality based on the scientific method as elaborated in pragmatism. These building block (re)presentations are the possibilities, defined as spots by convention no. IV. These spots are not to be conceived as points without dimension. On the contrary, they occupy a certain part of the sheet and it is possible during the reasoning process - as expressed by drawing graphs - to zoom in on the spot. By convention no VIII it is even possible to build new spots out of (parts of) given spots. By these conventions it is possible to represent rather easily reasoning at different levels of abstraction about the things of the socially reconstructed world.

But the spots are only one kind of representation. According to Peirce there has to be at least one other kind too: the representation of first perception. The notion of being somewhere, seeing something. In short: the common sense notion of being situated. The reality represented within Existential Graphs by a blank sheet or a blank enclosure consists of unspecified events. The content of one perception without further details. The notion of a whole. This whole may support some more specified events which are said to belong to this whole. In that case we have an enclosure with as many spots as events that are specified. In this way the whole expressed by a sheet or enclosure strongly corresponds to the situation of Barwise and Perry. But, contrary to their situation, our whole is not constructed out of the entities it supports. Its occurrence (representing a possibility) is independent of the existence of the entities.

Peirce calls himself a realist, because next to the reality of presentations and of objects, accepted as different modes of existence, he accepts the reality of rules and social concepts as a third mode. The existence of this mode is not determined by, though dependent on, the existence of the other ones. Human beings are not forced to formulate specific rules. The activity of formulating these rules is more of less arbitrary. Different social communities have developed different systems of rules to describe and predict the same events. Peirce fails to present the existence of these rules in his system of Existential Graphs. But the notion of situation types introduced by Barwise and Perry will help to provide in this omission. Situation types relate different situations to each other. As pointed out earlier these relationships over situations are called meaning. A situation we observed, means something because of its relationship to other situations expressed by a situation type. In the theory of Barwise and Perry the situation type even relates specific entities to situations. This relationship fits the idea, according to which we only can identify some entities after we have recognized the situation we are involved in.

So, three modes of existence relevant to whatever reasoning process might be (re)presented by the Existential Graphs:

- wholistic frames, represented by sheets or enclosures;
- objects relevant to a given frame but existing independently of that frame; they are constitutive of a specific situation represented by spots in an enclosure;
- rules relating situations to other situations and to entities, having no specific representation in Existential Graphs.

When situations are not defined any more in terms of entities supported by them, situation semantics fits very well as a complement to the representational aspects of Existential Graphs.

### 3.2 LOGICAL RULES

Another difference between situation semantics and Existential Graphs is that the former does not provide for logical rules relating situations to each other. Situations are isolated entities, only related
by situation types. The system of Existential Graphs provides for a set of more general Rules of Transformation. These Rules are comparable to the rules of transformation in first order logic; they are formal in the sense that they have nothing to do with the actual content of the situation.

The Rules of Transformation given by Peirce are listed below. Again I add a little explanation to each Rule or Permission as it is called by Peirce.

**Permission No. 1.**

*In each special problem such graphs may be scribed on the sheet of assertion as the conditions of the special problem may warrant.*

Apparently in Peirce's opinion a discourse only deserves a representation in Existential Graphs if it is concerned with a problem, a guiding principle for ongoing research. Indeed it makes no sense to represent a straightforward narrative by this system. Only in the case the relationship of different parts of the discourse may be validated by public norms, a representation in Existential Graphs would be useful. Of course the problem is defined by the Graphist. The Graphist determines the way the problem is described. There are no rules by which a problem has to be translated to a Graph.

**Permission No. 2.**

*Any graph on the sheet of assertion may be erased, except an enclosure with its area entirely blank.*

This Permission also rules out the unconditional addition of graphs on the sheet of assertion. Anything Graphist and Interpretant agree about, i.e. is scribed on the sheet of assertion, may be erased because it is not that relevant anymore. But adding things to the sheet at least is ruled by the condition Graphist and Interpretant have to agree.

**Permission No. 3.**

*Whatever graph it is permitted to scribe on the sheet of assertion, it is permitted to scribe on any unoccupied part of the sheet of assertion, regardless of what is already on the sheet of assertion.*

The addition of things to the sheet of assertion only depends on the agreement of Graphist and Interpretant. Not on the things already scribed on the sheet. So, no statement in the history of the discourse may rule out the addition of another statement by itself. It is up to the participants of the discourse to preserve the consistency of the discourse.

**Permission No. 4.**

*Any graph which is scribed on the inner area of a double cut on the sheet of assertion may be scribed on the sheet of assertion.*

In case the cut is interpreted as a negation a double cut means a double negation and so this Permission is equivalent to the double negation rule in most logical systems: $\neg \neg p \rightarrow p$.

**Permission No. 5.**

*A double cut may be drawn on the sheet of assertion; and any graph that is scribed on the sheet of assertion may be scribed on the inner area of any double cut on the sheet of assertion.*

In addition to the former (and its interpretation), this Permission determines $p \iff \neg \neg p$.

**Permission No. 6.**

*The reverse of any transformation that would be permissible on the sheet of assertion is permissible on the area of any cut that is upon the sheet of assertion.*

In combination to Permission No. 2 it means we can add every graph we want to the area of a certain cut but we are not allowed to erase such graphs. This rule is in accordance with the notion that the enclosures represent the beliefs of a specific discourse participant not belonging to the set of common beliefs.

**Permission No. 7**

*Whenever we are permitted to scribe any graph we like upon the sheet of assertion, we are authorised to declare that the conditions of the special problem are absurd.*

This "Permission" seems to be clear. In other papers different Rules can be found. Peirce did not succeed in developing an entire system of permissions ruling the operations to be executed on his system of Existential Graphs. Problems arise when trying to formulate rules about the existence of the same object within situations represented by different sheets. However, the start made by Peirce certainly deserves a continuation.

### 3.3 Towards a Formal Theory of Discourses

In the previous sub-sections the building blocks of discourses and the rules of manipulation have been presented. By these building blocks and rules the structure of discourse can be represented. But a
representation of discourse is still not a discourse theory. There has to be a guiding principle governing the progress of discourse.

As stated in some explanations added to the Permissions in section 3.2, the sheet of assertion contains the beliefs shared by all discourse participants while the enclosures are containing the beliefs that one or more specific discourse participants do not share with the other participants. The beliefs represented by graphs that may initially be presented on the sheet of assertion refer for instance to the commitment that there is a discourse, to the presence of the participants, and maybe to some objects existing in what is called by Barwise and Perry the discourse situation or the situation of utterance. The initial convictions of the discourse participants are represented by the graphs scribbled upon different enclosures. A guiding principle governing the progress of a discourse, could consist in the aim that the result of the discourse is represented by a sheet of assertion only containing blank enclosures. The representation of a complete agreement. But of course other guiding principles are possible too.

By these guiding principles the progress of discourse could be prescribed and analysed. We do not have a formal theory of these guiding principles yet, but as soon as we are able to develop them, it will be possible to build a dialogue system not expressively restricted to discourse grammars or to communication according to plan recognition, but 'destined to' make explicit in their interrelations: the beliefs of the participants, the uttered agreements and the intentions defined by the discourse situation itself.

REFERENCES


Belief contexts in human-computer dialogue

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1 INTRODUCTION

When contributing to a dialogue, one does not react just to the last contribution from the partner, but one takes much if not all of the preceding dialogue into account. The following dialogue fragment illustrates this:

1. A: Schiphol information
2. B: Good afternoon. This is Van L. in Eindhoven. I would like to have some information about flights to Munich. When can I fly there between now and ... next Sunday?
3. A: Let me have a look. Just a moment
4. B: Yes
5. A: O.K., there are ... three flights every day, one at nine fifty,
6. B: Yes,
7. A: one at one-forty ... and one at six twenty-five
8. B: Six twenty-five ... These all go to Munich
9. A: These all go to Munich
10. B: Right ... Do you also have information about the connections to Schiphol by train?
11. A: Yes, I do
12. B: Do you know how long the train ride takes to Schiphol?
13. A: You're travelling from Eindhoven?
14. B: That's right
15. A: It's nearly one and a half hour to Amsterdam ... You change there and then it's another twenty minutes, so you should count on some two hours.

In this fragment, A's contribution 5 is the first one that clearly reacts to a larger part of the preceding dialogue than just the previous contribution. It can be said to react primarily to part of B's contribution 2. (This can be checked by examining the effect of deleting the contributions 3 and 4.) The second part of B's contribution 8, "These all go to Munich", obviously reacts to the combination of A's contributions 5 and 7. An especially interesting case is A's contribution 13, "You're travelling from Eindhoven?" which reacts to B's question 12 combined with an element from 2, where B mentions that he is calling from Eindhoven.

The fact that dialogue continuations depend on more of the preceding dialogue context than just the last contribution, means that any attempt to build a dialogue machine with the ability to continue a dialogue in a rule-based manner, should work with context-dependent rules.

The context-dependence of the rules in any system of rules, able to adequately generate communicative linguistic behaviour in dialogue, is more dramatic than that, however. For one does not react to what was said, but to one's understanding of what was said. A theory of dialogue must therefore be closely related to a theory of understanding in dialogue. And the understanding of what is said in a dialogue is not a matter of 'local' interpretation of utterances, but crucially depends on context in two ways, as it must take into account:

- the dialogue context, i.e. on what was said in the preceding dialogue and how that was understood;
- the nonlinguistic context, i.e. on properties of the communication situation and its participants.

In what follows, we will outline a theory of dialogue which subsumes a context-based theory of utterance meaning; for reasons that will

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1I use the term 'contribution' here to refer to everything said by one and the same speaker during one turn.
become apparent below, we refer to this theory as Dynamic Interpretation Theory (Bunt, 1989; 1990a), or "DIT" for short.

At this point we may conclude from the above considerations that:

1. The generation (and, by the same token, the interpretation) of natural language dialogue cannot be accomplished by means of devices similar to those used to describe the generation and interpretation of isolated sentences. The analog of a sentence grammar, a 'dialogue grammar', is an illusion if conceived in the form of statements about sequences of sentences or other linguistic objects. (See also Good, 1987; Bunt, 1988.)

2. The language technology needed for handling dialogue is in no way some more or less straightforward extension of the technology for parsing, interpretation and generation of sentences. Instead, a dialogue system is inherently working in a context-dependent fashion not just in that it needs to take linguistic as well as nonlinguistic context into account, but in that it needs to describe how dialogue elements interact with the context.

2 DIALOGUE AND INTERACTION WITH CONTEXT

The utterances in a dialogue can be said to interact with the context in three ways:

1. they constitute the linguistic context;
2. their interpretation and further processing updates the nonlinguistic context;
3. they are motivated by certain properties of the context.

The first of these points is trivial. The third point is obvious, for what else than something in the context could possibly motivate communicative activity? The goals of the speaker? Yes, but these are part of the nonlinguistic context, as are the speaker's knowledge, beliefs, expectations, and other mental properties - in fact, these are central to the notion of context, relevant for dialogue management. Before saying something about point 2, let us briefly look at some potentially relevant aspects of context.

Aspects of context:

- the informational and further attitudinal states of the speakers and hearers involved;
- aspects of the communication situation such as place, time, weather conditions, etc.;
- interactive situational characteristics, such as whether both participants are native speakers of the same language;
- characteristics of the kind of communication, e.g. is it an exchange of factual information, or a television interview, or a chat with the neighbour, or a scientific debate, etc.;
- the relations between the participants, their role and status, e.g., do they have an employer-employee relation, or a husband-wife relation, or a judge-accused relation, etc.;
- who is speaking, and what role does the speaker play in the nonlinguistic activity motivating the dialogue (e.g. teacher and pupil in an educational setting);
- the turn-taking situation ('whose turn is it to speak?');
- the interactive situation: is there visual contact; can each participant hear the other well, etc.;
- expected, conventional type of reaction ('reactive pressures'), e.g. responding to a welcome greeting with another greeting.

This list is not exhaustive; for more extensive discussions of the notion of context see e.g. Allwood, 1976; Lewis, 1972; Lyons, 1977. One may well wonder whether any exhaustive listing of potentially relevant context aspects is at all possible. In fact, we have added the weather conditions as part of the situational context aspects somewhat tongue-in-cheek; indeed, it may be argued that, when the sun shines after weeks of dreary, rainy weather, this affects the way people behave in general and in dialogue in particular. On the other hand, if we allow factors like this, we may as well allow for such factors as whether it's Monday or Friday (and on Monday, whether his favourite football club has won or lost), how well the speaker has slept last night, and how his sex life has been lately.

Looking at the above list of context aspects, and recognizing that it is certainly not exhaustive, one may well wonder whether there is any hope that we can describe the interaction between dialogue utterances and the context effectively. There is hope, however, for three reasons:
1. By far most nonlinguistic context aspects are static during a dialogue, or to the extent that they change, they do so independently of the dialogue. (Such as time, and place when the dialogue takes place during a travel, or when the speaker makes a phone call from an airplane.)

2. In many (types of) communication situations, many of the conceivably relevant context features are in fact hardly relevant at all, or can be assumed to have a standard default value. (Such as the default assumptions that the addressee in a spoken dialogue is not deaf or mute, and speaks the same language.) We will concentrate on human-computer communication and in particular on 'information dialogues': between a user and a system, i.e. dialogues purely concerned with the exchange of factual information.

3. Static aspects of context have an overall effect on global characteristics of the dialogue, rather than on local properties. For instance, a participant will express himself more briefly when he is under great time pressure and will avoid going into issues of secondary importance. The best way to capture this would seem to be that static context features set certain global constraints which are applied separate from the rules for dialogue generation.

The most significant interaction is thus between dialogue utterances and those aspects of the context that they can influence; we will refer to these as dynamic context aspects.

This brings us back to the second of the above points: the interpretation of an utterance tells the hearer something about the speaker's communicative goals and information. This being part of the nonlinguistic dynamic context, we thus see that the interpretation of an utterance updates the context. Further processing of the new information becoming available through the interpretation may lead to further updates, e.g. of the hearer's factual information about the discourse domain.

3 Dynamic aspects of context

Of central importance among those aspects of context that change in, and in particular, through a dialogue, are the knowledge, beliefs, and other attitudes (goals, hopes, fears,...) of the dialogue partner. For information dialogues the most relevant attitudes are:

- to know that P, in the sense of having the information that P (where P is not necessarily actually true, i.e. one may have incorrect information);
- to intend that P, in the sense of having the goal that P;
- to believe that P, in the sense of having the information that P but having doubts about its correctness ('to suspect that P');
- to know X, where X is non-propositional in nature, e.g. to know Eve's phone number. This is especially relevant in combination with the 'intend' attitude: typical for information dialogues is that one of the partners has the goal to know something like a phone number, an address, a departure time.

In earlier versions of DIT, dynamic context has been construed as simply the totality of the participants' knowledge, beliefs and intentions concerning the discourse domain (Bunt, 1987). This is too simple to account for everything that goes on in a dialogue, however, even in a relatively straightforward information dialogue. It does, for example, not account for the greeting rituals common in human-human dialogues, of which we tend to find primitive versions in human-computer dialogues. Such 'rituals' are perhaps best captured in terms of 'reactive pressures', built up by certain communicative acts and released by others. For instance, when entering a lecturing room and saying "Good morning!" to the audience, I have the experience that some people, especially among those in front rows, respond either verbally or nonverbally; moreover, those not too far in the back seem to feel uneasy about not responding. This can be understood by assuming that an initiating greeting puts some pressure on those greeted to respond with a response greeting; such a response greeting relieves that pressure from those responding, while those not responding are stuck with the unresolved pressure.

Another dynamic aspect of the context concerns the allocation of turns. In informal multi-party conversations it is quite common that more than one participant is speaking at a time, but in dialogues, with only two participants, there is usually one 'main' speaker at a time, the other speaker being restricted to (simultaneously) volunteering marginal contributions, like "Mmm",...
for giving feedback about attention, understanding, etc. Intonation, nonverbal means, and punctuation in the case of typed interaction, are among the instruments used for keeping the turn (the right to act as main speaker), giving the turn to the partner, and other turn management actions.

Other dynamic aspects that are relevant to distinguish, because natural language has specific devices for addressing them, concern specific beliefs, knowledge and intentions not relating to the domain of discourse (in other words, not relating to the main goal of the dialogue), but relating to aspects of the dialogue, of the interactive situation, and of the processing of each other's contributions. To the latter type of information we refer as feedback information, and to the communicative acts addressing them as feedback acts, whereas all the other information not related to the domain of discourse we refer to as interaction management information. We will return to these distinctions after we have considered the communicative instruments for addressing these context aspects in dialogue.

In summary, we identify the dynamic context in an information dialogue as having the following main components:

- knowledge, beliefs, and intentions relating to:
  - the domain of discourse (the task motivating the dialogue);
  - the processing of each other's contributions (feedback information);
  - the dialogue history (and planned future);
  - attentional and perceptual aspects of the interaction;
  - other interaction management information.
- reactive pressures;
- turn assignment situations.

Clearly, the various kinds of knowledge and beliefs of the participants in the dialogue forms the heart of the dynamic context. Moreover, the intentions in an information dialogue are also related to knowledge, since in such a dialogue, the speaker's intentions are always either to obtain or to provide certain information.\footnote{Except for intentions concerning turn assignment. Dealing with reactive pressures is perhaps best viewed as not being governed by intention.}

4 Dialogue Acts

In DIT, we view dialogues in an action perspective, and language as an instrument for performing communicative actions. These actions influence the state of the addressee in that they make new information available to the addressee about what the speaker wants, knows, suspects, fears, hopes, has understood, etc. They also influence the addressee's state in putting pressure on him to perform certain actions, such as respond to a initiating greeting with a response greeting, or answer a question. They may also influence the addressee's state indirectly, e.g. in getting him to believe what he has come to know that the speaker believes ('convincing him').

Language has special devices for addressing particular aspects of the dynamic context, and influencing these in specific ways. However, natural language utterances are in general multifunctional in the sense that they simultaneously address different dimensions of the context and do so in different ways. For example, an answer to a question relating to the discourse domain not only provides factual information,\footnote{More precisely, it provides information about the speaker's information about the domain of discourse.} but also offers feedback information since it implicitly indicates that the original question was understood, and it also has a function in the assignment of turns. We introduce the 'dialogue act' concept for referring to the functional units used by the speaker to modify the dynamic context (notably, aspects of the partner's state).

The action view on language obviously owes much to speech act theory. We use the term 'dialogue acts' (Bunt & Van Katwijk, 1979) rather than 'speech acts', first of all to avoid the unfortunate association with the use of speech; second in order to restrict ourselves to those types of speech act relevant in dialogue; third to avoid the frequent confusion between the use of the term as referring to a linguistic token and as referring to an abstract action denoted by the linguistic token ('illocutionary acts'), and finally in order to avoid some of the theoretical difficulties with speech act theory. The dialogue act concept is not situated at the linguistic level of words and phrases, but at the level of formal operations changing dynamic aspects of the context.

Dialogue acts do not have a straightforward correspondence with contributions. A contribution may consist of a sequence of several sentences or other expressions that each express dialogue
acts. So dialogue acts relate in general to smaller units than contributions. Moreover, the linguistic expressions that do carry functional meaning in terms of dialogue acts, typically carry more than one functional meaning simultaneously (see below on multifunctionality).

Two of the most important aspects of a dialogue act that can be distinguished are its communicative function and its semantic content. These aspects can be used together to describe the effect that a given dialogue act has on the state of information of the addressee. For instance, a dialogue act with the communicative function ‘yes/no question’ and the semantic content consisting of the proposition ‘It is raining’, has the effect that the addressee learns (among other things) that the speaker wants to know whether that proposition is true. By contrast, a dialogue act with the same semantic content but now with the communicative function ‘inform’ tells the addressee that the speaker wants the addressee to know that the proposition is true. A dialogue act thus tells the addressee various things about the speaker’s beliefs, desires, etc.; the generic term ‘attitudes’ is used to refer to such properties of the speaker’s mental state.

In the following section, we define the notion of ‘communicative function’ a little more precisely and present a taxonomy of communicative functions.

4.1 Communicative functions

Communicative functions are related to, but most be distinguished from, grammatical moods. Grammatical mood signifies the combination of a particular syntactic or morphological structure with a stereotypical function. Some common moods are:

- declarative
- interrogative
- imperative
- exclamative

Linguistic expressions classified as having one of these moods can, however, be used to convey one or more communicative functions differing from the one they stereotypically carry as a mood related function. For example, a declarative sentence can be used as a statement but also as a question (see Beun, 1989).

As already noted, contributions in general do not correspond to functional units in a one-to-one fashion, but are most of the time multifunctional, i.e., they are associated with more than one communicative function. The multifunctionality of contributions is caused by four factors:

1. Sequential complexity. A contribution may consist of parts that each have their own function(s). A simple example is an utterance like “OK, thanks.”

2. Indirectness. A question like “Do you have a light?” may function indirectly as a request to give a light.

3. Functional subsumption. Some dialogue unit types are more specific than others. An inform may at the same time be a promise or a warning. An expression of agreement at the same time signals understanding.

4. Functional multidimensionality. Aspects of the dimension of performing the task which motivates the dialogue (such as factual information seeking) are very often combined in one utterance with aspects of dialogue management. For instance, answering a question concerning the domain of discourse at the same time signals correct understanding of the question (positive feedback).

Generalizing slightly, we can say that the first case represents sequential multifunctionality, whereas the three latter cases are instances of simultaneous multifunctionality.

4.2 A taxonomy of communicative functions

Linguistic communication usually serves some noncommunicative purpose, such as learning something, or making an appointment, or planning a travel. The noncommunicative activity, motivating a dialogue, we will for the sake of clarity call the ‘task’ at hand. Relating the user’s utterances to aspects of that task is evidently an essential part of the system’s understanding of the user’s utterances.

The relevant dynamic aspects of context can be divided into those relating to the task that motivates or embeds the dialogue, and those relating to the dialogue itself. The distinction between ‘task-oriented’ and ‘dialogue-oriented’ information corresponds to a similar distinction among dialogue acts, where those acts concerned with
the dialogue as such are called ‘dialogue control’ acts. These acts serve a purpose in monitoring the dialogue. Important aspects of monitoring a dialogue are:

1. The signalling of misunderstandings (misperceptions, misinterpretations) or other problems in the dialogue, e.g. concerning whose turn it is to say something, or uncertainty concerning communication channels being open. (Negative feedback)

2. The repair of misunderstandings or other problems in the dialogue.

3. The prevention of misunderstandings etc., by providing positive feedback information about the processing of the preceding or ongoing discourse.

4. The evaluation of information offered in a dialogue, e.g. the signalling of agreement, doubt or disbelief, or of accepting information that was offered.


6. The structuring of the dialogue, e.g. by explicitly opening or closing a subdialogue, or introducing a new topic.

7. The management of temporal aspects, in particular the handling of pauses (“Just a moment”, “Here I am again”, etc.)

8. The management of turn-taking, including the handling of interruptions, turn-giving, turn-keeping, etc.

The first four of those aspects constitute aspects of feedback (cf. Allwood, Nivre & Ahlsen, 1991). The other four are concerned with various aspects of ‘interaction management’.

The schema on the next page provides a taxonomy of the most important categories of dialogue acts we think must be distinguished in information dialogues.

Some important instances of these dialogue act types in human-computer information dialogues are the following.

1. Task-oriented:
   Factual Whquestion, Ynquestion, Check, Request, Inform, Whanswer, Ynanswer, Confirm, Corrections

2. Dialogue Control:
   (a) Feedback:
      Explicit overall positive feedback (“OK”, “Yes”).
      (Negative feedback only through explicit sc informs with the relevant semantic content).
   (b) Turn Management:
      User: turn giving through use of RETURN key.
      System: explicit turn-giving to encourage the user to continue (“Yes”); only through use of cursor prompts on screen.
   (c) Time Management:
      Requests for more time before continuing the turn: (“Just a moment, please”).
   (d) Structuring:
      Explicit topic shift indications and their acknowledgements.
   (e) Own Communication Management:
      User: “eh”; pause.
   (f) Channel Management:
      Checking contact: “Hello?”
   (g) Social:
      Greeting, thanking.

Note that dialogue acts of the kind mentioned under ‘task-oriented’ act, may also occur for performing functions w.r.t. feedback or interaction management. For example, “Wait a minute, please” is an explicit REQUEST for more time, and “May I finish?” is a QUESTION concerned with turn management.
Dialogue act categories:

```
|--task-oriented          |--perception
|                         |--positive--|--
|                         |--feedback--|--|--understanding
|                         |--negative--|--
|--dialogue control--|--evaluation
|
| discourse               |--opening/closing
|--structuring--|--
|                         |--topic management
|                         |--turn management
|                         |--time management
| interaction               |--channel management
|--management--|--
|                          |--own comm. management
|                          |--self-introduction
| social                   |--greeting
|--obligations--|--
|                         |--thanking
```
5 Conclusion: What drives a dialogue forward?

In DIT, dialogue acts are key instruments both in the interpretation of the utterances in a dialogue and in their generation. They are also the key to understanding why dialogues may develop the way they do, assuming that the participants are motivated, rational, social agents (see Allwood, 1976 on motivated rational agenthood). Being motivated means using language as instrumental for achieving some purpose (performing some task, often noncommunicative in nature); being rational means here, primarily, using dialogue acts as instruments to achieve the goal in a way that serves the overall goal best. Being social here means being susceptible to reactive pressures, and feeling these as something one should try to be free from.

It then follows that every dialogue act should be licensed by one of the following requirements being satisfied, together forming the 'Dialogue Act Use Principle':

Every dialogue act should either:

- be a step towards achieving the overall dialogue goal;
- relieve the speaker from a reactive pressure;
- perform a useful dialogue control function, to ensure successful communication.

The essential task of understanding an utterance in dialogue then comes down to the recognition of its communicative functions and semantic contents, together determining how the utterance updates the dynamic context; the generation of a continuing utterance is a matter of deciding, according to the above considerations, which dialogue acts are licensed by the current context, and expressing these linguistically (or nonverbally).

Another way of expressing this is that the idea of a 'dialogue grammar' as a kind of production rule system, mentioned in the introduction, is replaced by that of a 'constraint-based' one, which views a dialogue as the expression of a sequence of combinations of dialogue acts, satisfying the constraint that each act is licensed by the current context, according to the above Dialogue Act Use Principle.

Of course, this is only the beginning of a full-fledged dialogue theory. The Dialogue Act Use Principle formulates a necessary, not a sufficient condition. In realistic, complex contexts, this principle allows many dialogue acts. We therefore need, in addition, at least the following elements:

- Rules, assigning priorities among alternative admissible dialogue acts;
- Logical constraints on the possibilities to combine dialogue acts, i.e., what combinations of dialogue acts are logically possible;
- Linguistic constraints on the possibilities to combine dialogue acts, i.e., what (logically possible) combinations of dialogue acts can be expressed in a single utterance.

Prioritization rules would say, for example, that negative feedback acts (such as signals of non-understanding) have top priority; that positive feedback concerning evaluation ('agreement') has higher priority than positive feedback concerning the perception and understanding of the corresponding utterance; and that task-oriented acts by default have higher priority than positive feedback. Prioritization rules depend on the kind of communication situation and can only be established by empirical study.

Logical constraints on the possibilities to combine dialogue acts follow from the logical properties of contexts. Assuming that it is logically impossible to both know that P and want to know whether P, it would be logically impossible to update a context to the effect that the speaker would want to know whether P but would also know that P. Similarly, it is logically impossible to both want to keep the turn and want give the turn to the partner.

Linguistic constraints obviously embody empirical observations on the possible usage of natural language. An empirical observation is, for example, that natural language utterances by default provide positive feedback about the speaker's perception and understanding of the previous contribution; negative feedback, by contrast, must be given explicitly.

The further development of a dialogue theory along the lines indicated here thus requires a combination of logical analysis and empirical study of natural language use.

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